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EPIDEMIOLOGY OF INTESTINAL HELMINTH INFESTATIONS AMONG SCHOOLCHILDREN IN SOUTHERN UGANDA
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ABSTRACT

Objective: **To determine the prevalence and intensity of intestinal helminth species among school children in southern Uganda.**
Design: **A cross-sectional survey using a randomly selected sample.**
Setting**: Eighteen districts of southern Uganda.**
Subject: **Two thousand and four school children aged two to twenty years (93.3%, aged 5-10 years) selected from classes 1 and 2 in 26 randomly selected primary schools.**
Results: **Overall, 55.9% of children were infected with either hookworm, *Ascaris lumbricoides* or *Trichuris trichiura*. The prevalence of *A. lumbricoides* was 17.5% (range 0-66.7% by school), *T. trichiura* was 7.3% (0 - 45.0%) and hookworm 44.5% (15.6-86.0%). The prevalence of *A. lumbricoides* and *T. trichiura* was greatest in western districts while hookworm infection was more evenly distributed across the country.**
Conclusion: **Mass antihelminthic treatment of school children was warranted in 13 of the 18 districts as more than 50% of the children were infected with an intestinal nematode. It is likely that pre-school children are similarly infected.**

INTRODUCTION

Intestinal helminths are amongst the most common infections of humans in the world today(1). There is increasing recognition that these parasites can impair the growth and development of children of all ages(2-4) and this, coupled with advances in helminth epidemiology, has led to renewed interest in parasite control(5,6). Despite this, the success of control efforts is likely to be hampered by lack of up-to-date information on the distribution of helminth infections in the countries like Uganda where worms occur(7). Much of the published information is based on hospital records(8) or on surveys involving few villages(9-14) with only one survey that covered several districts(15). Most of the available information is also more than 30 years old.

One way of obtaining useful epidemiological information quickly and at low cost is by carrying out surveys in school children. School-age children are most likely to be infected with helminths(16) and, if the prevalence is high, then the prevalence of worms is likely to be similar or a little lower, in younger and older age groups(17).

The Uganda National Early Childhood Development Project is proposing to assess the impact of periodic deworming on the growth and cognitive development of pre-school children. The aim of this study was to determine the prevalence and intensity of intestinal helminth infections among school children living in districts of southern Uganda to assess whether intestinal helminths could be a public health problem among pre-school children.

MATERIALS AND METHODS

The study was conducted between July and October 1998 in 18 districts south of the river Nile and Lake Kyoga in Uganda. The districts were divided into three clusters: an eastern cluster of Kumi, Mbale, Tororo, Busia, Bugiri, Iganga and Kamuli districts; a central cluster of Nakasongola, Luwero, Kiboga and Mubende districts; and a western cluster of Sembabule, Masaka, Rakai, Mbarara, Bushenyi, Ntungamo and Rukungiri districts. These clusters were selected to represent different ecological zones within the country based on differences in altitude, rainfall and temperature. The number of schools to be visited in each cluster was calculated as a proportion of the total population in the cluster using data given in the Uganda Districts Information Handbook(18). In all, 26 schools were visited.

A target of 40 boys and 40 girls in class 1 were selected randomly. If there were insufficient pupils in Class 1 additional pupils were sampled from Class 2. Participation was voluntary and had been approved by the school committee. A faecal sample was collected from each child and examined in duplicate within

30 minutes using the Kato-Katz method(19). The concentration of eggs of *Ascaris lumbricoides*, *T. trichiura* and the hookworms were estimated in eggs per gram (epg) faeces. Other worm species were recorded as present or absent. In accordance with WHO recommendations that mass treatment be provided when prevalence exceeds 50%(20), in schools where the prevalence of infection exceeded this threshold, all children studied were treated with albendazole 500 mg; where the prevalence of infection was less than 50% only children found infected were treated. Individual children found infected with *Schistosoma mansoni* were given a single dose of praziquantel at a dosage of 40mg/kg.

Observed prevalences with single and multiple-species infections were calculated and compared to expected prevalences, as predicted from a simple probabilistic model based on the assumption that infections of different species are transmitted independently of one another(21). Spearman's rank correlation analysis was used to assess the association between the prevalence of different infections in the 26 schools. The relationship between infection and the age and sex of children was examined using logistic regression in which school was included as a random factor to allow for variation in the prevalence of infection between schools.

RESULTS

A total of 2004 children in 26 schools participated in the study with a mean of seventy seven/school (range 57-93). Over 90% of children were aged five to ten years old.

The prevalence of intestinal nematode infections and mean egg counts are summarised by district and cluster in Table 1. Overall, 55.9% of the children were infected with *A. lumbricoides*, *T. trichiura* or hookworm, and the combined prevalence of these species exceeded 50% in 13 of 18 districts. The prevalence of *A. lumbricoides* was 17.5% (range 0 - 66.7% by school), *T. trichiura* was 7.3% (0 - 45.0%) and hookworm was 44.5% (15.6-86.0%). *Ascaris lumbricoides* and *T. trichiura* were most common in schools in the west of the country while hookworm was more homogeneously distributed (Figure 1). Only eighteen (0.9%) children were infected with *Schistosoma mansoni*, two children had *Strongyloides stercoralis*, 35 children (1.7%) had *Enterobius vermicularis*, *ten* children (0.5%) had *Hymenolepis nana* and one child had *Taenia* spp.

Table 1

Prevalence of intestinal nematode worms and the mean egg counts in 2004 school children

Cluster/ District	No. examined	*Ascaris lumbricoides* % infected	*Ascaris lumbricoides* Mean epg	*Trichuris trichiura* % infected	*Trichuris trichiura* Mean epg	Any hookworm nematode % infected	Any hookworm nematode Mean epg	% infected	*S. mansoni* % infected
Eastern									
Bugiri	71	0.0	0	2.8	9	31.0	185	31.0	1.4
Busia	80	10.0	66	0.0	6	66.3	467	70.0	3.8
Iganga	209	0.0	0	1.0	1	56.9	531	56.9	1.9
Kamuli	57	1.8	1	1.8	1	59.6	284	64.9	0.0
Kumi	75	8.0	13	2.7	2	52.0	237	54.7	0.0
Mbale	146	6.8	444	2.1	127	49.3	277	55.5	1.4
Tororo	70	0.0	0	0.0	0	72.9	501	72.9	14.3
Average	708	3.5	101	1.4	28	55.1	378	57.5	0.03
Central									
Luwero	71	0.0	0	0.0	0	33.8	69	33.8	1.4
Kabarole	159	54.7	7146	36.9	47	21.9	84	73.6	0.0
Mubende	166	10.8	289	6.6	10	56.6	968	61.4	0.0
Nakasongola	78	0.0	0	0.0	0	57.7	697	57.7	0.0
Average	474	22.1	2498	14.7	19	41.7	492	60.7	0.01
Western									
Bushenyi	167	43.1	4334	6.0	6	41.6	181	57.5	0.0
Masaka	91	1.1	2	1.1	1	31.9	135	33.0	0.0
Mbarara	247	13.8	559	3.6	4	23.4	82	32.8	0.0
Ntungamo	65	32.3	731	9.2	19	18.5	281	47.7	0.0
Rakai	73	28.8	2289	9.6	9	30.1	467	56.2	0.0
Rukungiri	93	66.7	6032	24.7	48	44.1	489	78.5	0.0
Sembabule	86	10.5	137	11.6	7	86.0	1005	86.0	0.0
Average	822	26.8	2007	8.0	11	37.1	297	51.8	0.0
Total	2004	17.5	1449	7.3	19	44.5	372	55.9	1.0

Figure 1

Prevalence of intestinal helminth infection in 26 schools in 18 districts of southern Uganda

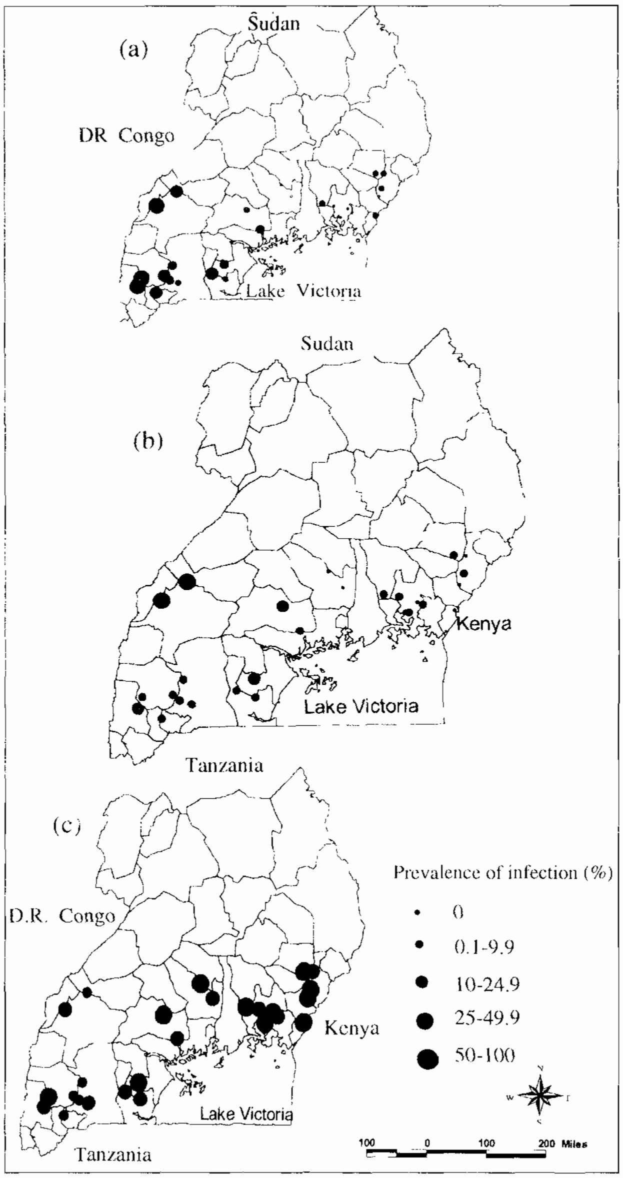


Table 2

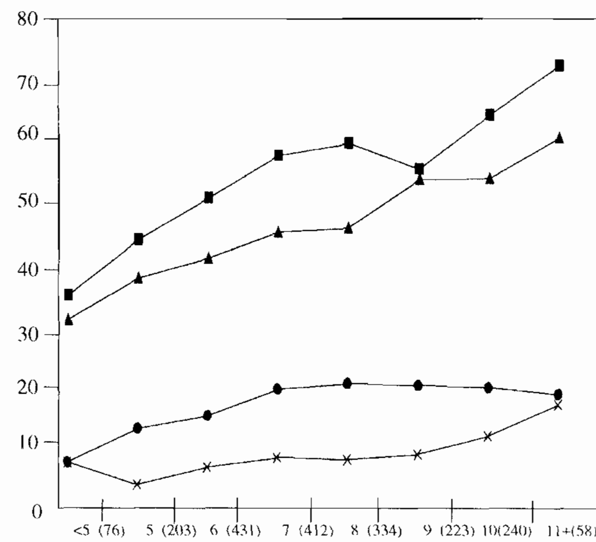
Observed prevalence of single and multiple infections compared with expected prevalence as calculated on the basis of no interaction using observed overall prevalence of infection.

	Observed % infected (range in schools)	Expected % infected
Single infection		
Ascaris lumbricoides only	7.9 (0 - 35.4)	8.9
Trichuris trichiura only	1.6 (0-16.3)	3.5
Hookworm only	34.0 (2.5 -66.3)	34.2
Double infection		
A. lumbricoides/T. trichiura only	1.8 (0 -17.5)	0.7
A. lumbricoides/ hookworm only	5.8 (0 - 38.9)	7.3
T. trichiura / hookworm only	2.4 (0 - 13.6)	2.8
Triple infection		
A. lumbricoides / T. trichiura / hookworm only	2.0 (0 -15.1)	0.6

Table 2 shows the prevalence of single and multiple species infections. Infections with *A. lumbricoides* and *T. trichiura* occurred in children more frequently than would be expected by chance based on a simple probabilistic model(21). Infection with all three species also occurred more frequently than would be expected by chance. By contrast, infection with either *A. lumbricoides* or *T. trichiura* and hookworm occurred at a frequency less than would be expected by chance. There was also a significant association between the prevalence of *A. lumbricoides* and *T. trichiura* in schools (Spearman's rho = 0.699, $p < 0.001$).

Figure 2

Age dependent infection patterns for prevalence of infection



■, *Any nematode species;* ▲, *Hookworm;* ●, *A. lumbricoides; X, T. trichiura*

The logistic regression revealed that there was a significant relationship between host age and being infected with hookworm ($p>0.000$ 1), and *T. trichiura* ($p=0.0001$) but not with *A. lumbricoides* ($p=0.121$) (Figure 2). There was no significant difference between the sexes in the prevalence of any species or egg counts.

DISCUSSION

The present study found that intestinal helminth infections are common among young school children in southern Uganda, and that mass treatment would be warranted according to WHO recommendations in schools in 13 out of the 18 districts(20). The fact that the logistic regression indicated that prevalence of infection was higher in older children suggests that the prevalence of infection in the schools studied may actually be higher than recorded because of the selection of the youngest children in each school for study. The data also suggests that these worms are likely to occur in pre-school children as well and could contribute to undernutrition(22,23) and poor childhood development, although most infections are likely to be light.

Only 18 infections with *Schistosoma mansoni* were detected because the schools chosen for study were not near the lakes. The transmission of *S. mansoni* in Uganda tends to be confined to narrow zones along the shores of large water bodies because this governs the distribution of the intermediate snail host(24,25).

A comparison of the current data with earlier reports shows a remarkable similarity, which from a public health perspective is disappointing. A study in seven districts 30 years ago also found that *A. lumbricoides* and *T. trichiura* were most common in western Uganda while hookworm was more evenly distributed(8,15). It is likely that the climate influences the geographical distribution of *A. lumbricoides* and *T. trichiura* because of the role of environmental conditions in the embryonation and survival of infective stages(26-28). West of the country receives greater rainfall than eastern Uganda where the transmission of *A. lumbricoides* and *T.trichiura* does not seem to be favoured because none of the schools had a prevalence in excess of ten per cent. The influence of environmental factors on the distribution of intestinal nematodes within Uganda needs to be examined.

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