BRIEF COMMUNICATION

HOOKWORM SPECIES DISTRIBUTION AMONG SCHOOL CHILDREN IN ASENDABO TOWN, JIMMA ZONE, SOUTH WEST ETHIOPIA

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ABSTRACT

BACKGROUND: ***Hookworm is one of the most wide spread soil transmitted helminth in Africa. It is an acknowledged cause of anemia as a result of intestinal blood loss. The aim of this study was to identify hookworm species infecting school children in and around Asendabo Town.***
METHODS: ***A cross-sectional study design was established during the month of January 2007. A total of 100 elementary school children were chosen using stratified sampling technique. Each student was instructed to submit fresh stool specimen. Harada-Mori hookworm culture was done at Jimma University School of Medical Laboratory Technology.***
RESULTS: ***Among the total study children, 93 submitted fresh stool samples giving a response rate of 93%. The overall helminth infection was 70.9%; of which hookworm was found in 38(40.8%), Ascaris lumbricoides 13(14%) and Trichuris trichiura 8(8.6%). Further morphological examination revealed that 34(92%) of the hookworm infections were due to N. americanus and 3(8%) were due to A. duodenale. None of the culture showed mixed infection (infection by the two species at a time).***
CONCLUSION: ***The presence of both hookworm species in the study area is indicative of the consequences one would face if infection with A. duodenale left unnoticed especially among young girls. Therefore due attention should be given with regard to treating hookworm positive individuals together with intense environmental sanitation to curb the high burden of helminth infection.***
KEY WORDS: ***Hookworm species, anemia, helminth, Asendabo, Jimma, Ethiopia.***

INTRODUCTION

Hookworm infection in humans is caused by helminth nematode parasites *Necator americanus* and *Ancylostoma duodenale* and is transmitted through contact with contaminated soil. It is one of the most common chronic infections with an estimated 1.3 billion cases globally and directly accountable for 65,000 deaths annually (1). Disability adjusted life years as a quantitative measure of a disease burden reveals that hookworm infection outranks African trypanosomiasis, Dengue, Chagas' disease, Schistosomiasis, and Leprosy (2).

The two species (*Ancylostoma duodenale* and *Necator americanus*) of hookworm that infect human exhibit differences in their pathogenicity, mode of transmission, geographic distribution, and these differences may influence the morbidity of hookworm disease (3). *A. duodenale* is geographically more restricted in distribution and is found at higher elevation, and in more extreme climates, whereas *N. americanus* is the most common hookworm worldwide. It is responsible for 90% of human hookworm infection that occur in tropical and subtropical regions of the world (4). In some localities, the distribution of the species overlaps. Furthermore, it has been suggested that *A. duodenale* can be vertically transmitted from mother to infant (5, 6), however, the larvae have not yet been demonstrated in human milk or colostrums. *A. duodenale* undergoes developmental arrest in human host which lasts for about eight months. This survival adaptation enables *A. duodenale,* the species with shorter adult life span, to survive the dry season in the host avoiding release of eggs into hostile environment (5).

Earlier studies (7, 8) conducted in various parts of Ethiopia showed the existence of both species with *N. americanus* accounting for the larger share. Studies reported 92.5% and 7.5% prevalence for *N .americanus* and *A. duodenale*, respectively in Gojam (7) whereas the same group demonstrated *N. americanus* as a sole agent of hookworm infection in Gondar. Another study showed a species distribution of 78% for *N. americanus* and 22% for *A. duodenale* at three different localities in the country (8).

A study done to determine regional distribution of hookworm species showed that out of 95 communities surveyed in 10 administrative regions, 82 of them had hookworm infection and in 20 of those communities the two species were found concurrently. But, when mixed infections were found, the occurrence was rare, and only one person in each of those 6 communities harbored both species (9).

Clinical manifestations of hookworm disease are the consequences of chronic intestinal blood loss. Iron-deficiency anemia occurs and hypoalbuminemia develops when blood loss exceeds the intake and reserves of host iron and protein (3, 10) depending on the status of host

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iron, a hookworm burden (the intensity of infection, or number of worms per person) and species of hookworm involved.

In children, chronic hookworm disease retards physical growth (11) which is sometimes most apparent at puberty. More recent evidence suggests that hookworm infection also has subtle yet profound adverse effects on memory, reasoning ability, and reading comprehension in childhood (11). Most of these effects are probably attributable to the presence of iron-deficiency anemia. Infants and preschool children are particularly vulnerable to the developmental and behavioral deficits caused by iron-deficiency anemia and two analyses indicate that hookworm infection remains an important contributor to anemia in this age group (12)

Identification of the species of hookworm is achieved either by checking the morphology of the buccal apparatus of adult worms obtained by expulsion chemotherapy or by studying the morphology of larval stage cultured from eggs. In all cases correct identification is important to ensure control measures are applied most effectively (13).

As indicated above the degree of iron-deficiency anemia induced by hookworms depends on the species (3). Infection with *A. duodenale* causes greater blood loss than infection with *N. americanus*, (*Necator* 0.03 ml/day, *Ancylostoma* 0.15 ml/day).

Therefore this study was intended to visualize hookworm species distribution pattern which is basically important in control of anemia as the consequences infection with a species with greater blood shade. Further more; from the point of view of studying biology of infection agent it is very much important to study every detail of an infectious organism as some information are helpful in the process of control and prevention of the infectious agent.

MATERIALS AND METHODS

The study was conducted in Ethiopia, Asendabo town, Omo Nada Woreda, Jimma Zone, Oromiya regional state between the months of January and February 2007.

Five years average annual rainfall was 1131.08 mm with bimodal rainy seasons. The monthly average maximum and minimum temperatures were 27.6 ^{o}C and 13 ^{o}C for five consecutive years (2000-2004). Although relative humidity data for the town is not available, it is expected to share similar humidity situation with that of Jimma town (45 Km away) for which three times a day monthly average humidity for five consecutive years (2000-2004) was 71% (Source National Metrological Service Agency Addis Ababa Ethiopia and Health center's documentation).

Cross sectional study design was employed. Study subjects were selected on the basis of stratified sampling. Strata were made based on classes (grade 1 to 4) the students were attending. Twenty-five children were taken from each class category by lottery method using the name list as sampling frame. Strata were made in order to avoid effects of age on parasite infection distribution. A sample size of 100 children was taken considering the intense handling difficulty with hookworm culture technique with much larger samples and associated cost of running study.

Socio-demographic statuses of the study subjects were collected using pre-tested structured questionnaire. A single fresh stool was collected with labeled and clean cup from each study subject. Immediately, the specimens were placed on ice bag in order to slow/protect ova hatching while transporting to Jimma University laboratory.

Test tube culture (Harada-Mori technique) was set up and thin film of feces was spread on one side of the middle third of a 13 by 120 mm strip of filter paper and placed in a 15 ml conical tip centrifuge tube containing about 3 ml distilled water. The culture was kept for 7 to 10 days at 28^{o}C, adding water daily as needed to keep the water level well above the bottom end of the filter paper. For identification, the larvae were transferred to slide and mounted under a cover glass. Morphological key differences such as esophagointestinal junction, esophageal bulb, buccal spears and striations on sheath in tail region were used to identify the species (14).

Ethical clearance was obtained from the ethical committee of Biology Department, Addis Ababa University. The school administrative head was submitted official permission letter further consultation was held on the study plan and out come. Written consent was obtained from the study subject. Positive individuals were treated according to standard guideline for helminth infection.

Data was pre-cheeked by hand and processed by hand calculator and simple frequency and averages were calculated using Microsoft Excel program. Considering the relative small size study subjects involved in the study statistical significance tests were not done for any the study variables.

RESULTS

A total of 100 school children with mean age 12.9 years were included in the study. The majority of the students were Oromo (63%) and Muslims (84.1%). Most (48%) use streams or rivers as their water source. And 87% of them had latrines and 65% of the participants wore shoes always (Table 1).

Table 1. Socio-demographic characteristic of the study participants, Asendabo, South West Ethiopia, Jan 2007 (*Page 8 under the subheading of description of the study subjects)*

Socio-demographic variables	Male (n=63)	Female (n=37)	Total
Ethnicity			
Oromo	36	27	63
Amhara	16	9	25
Dawuro	6	1	7
Yem	2	0	2
Keffa	1	0	1
Others	2	0	2
Religion			
Muslim	52	32	84
Christian	11	5	16
Water source			
Pipe	10	10	20
Well	20	12	32
Stream	33	15	48
Latrine availability			
Yes	57	30	87
No	6	7	13
Shoe- wearing			
Always	38	27	65
Some times	18	8	26
Not at all	7	2	9

Among the 100 students, 93 properly submitted fresh stool samples (93% response rate) and the rest failed to produce samples and hence excluded from the study. Direct microscopy was done before Harada Mori culture. The overall intestinal parasitosis among the study participants was 70.9% (66/93). Thirty eight (40.8%) specimens were positive for hookworm, 15(16%) were positive *Ascaris lumbricoides* and *7*(7.5%) were positive for *Trichuris trichiura* (Table 2).

Table 2. Helminth species prevalence in the study participants by age group, Asendabo, southwest Ethiopia Jan 2007. (Page 9 under the subheading of helminth infection)

Age category	Total examined	Parasites species						
		Hw*	Al†	Tt‡	Hn§	Ev ¶	Tae. ¶	Ss**
5-9	32	14	5	4	2	1	0	0
10-14	43	17	8	2	0	0	1	0
15-19	18	7	2	1	0	0	1	1
Total	93	38	15	7	2	1	2	1

†*Ascaris lumbricoides*, *Hookworm, ‡*Trichuris trichiura*, ¶*Enterobius vermicularis*,
¶Taenia species, ***Strongyloides stercolaris* , § *Hymenolepis nana*

After 10 days of well-established Harada Mori culture almost all 97% (37 out of 38), hookworm positive stool samples were hatched into third stage filariform larva. Detail morphological examination revealed that 34/37(92%) of the larvae were *N. americanus* and 3/37(8%) was *A. duodenale*. None of the culture showed mixed infection.

DISCUSSION

The overall prevalence of intestinal helminth infections (70.9%) in this study was relatively lower than previous report on school children from the same study area, and Wondo-Genet area of SNNP region (15,16). This difference could be explained by the different laboratory techniques used; the present study utilized direct microscopy where as the mentioned other studies utilized formalin-ether concentration technique.

Helminth species prevalence pattern in the study population was similar to that reported from Uganda (17) whereby hookworm was the most prevalent (32.1%) followed by *Ascaris lumbricoides* (17.4%) and *Trichuris trichiura* (8.1%). On the other hand, a number of other studies (16, 18, 19) have shown a different species

prevalence pattern where A. *lumbricoides* and *Trichuris trichiura* were the predominant species in Wondo-Genet and south west Ethiopia, respectively (18,19). This difference in helminth parasite species prevalence might be explained by altitude and soil type differences, which are known to influence species distribution of geo-helminth parasites (20).

The fact that both hookworm species are present in the study area is in agreement with previous studies conducted elsewhere in the country. With regard to the prevalence of both hookworm species, our finding was in line with other study reports from Gonder area (7, 8, 9). Unlike some other studies (8,9) which reported mixed infection by both hookworm species in a single individual, no concurrent infection by the two hookworm species was detected. This could possibly be explained by the fact that mixed infection is a rare incidence as indicated in other studies where only one person was identified in each of the six communities assessed harboring both species (9).

In conclusion, the study identified the existence both hookworm species in the area with *N. americanus* being the dominant one. Furthermore relatively higher burden of helminth infection was seen in the study population. Therefore, the authors recommend immediate treatment of hookworm positive children and improve environmental and personal hygiene to curb the observed high burden of helminth infection among the study participants.

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