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Full Length Research Paper

Prevalence and speciation of hookworm in Plateau State, Nigeria

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This study was designed to estimate the prevalence and speciation of hookworm in Plateau State. 592 faecal samples were collected from patients with abdominal discomfort from six health facilities in the state and examined for presence of parasitic eggs or cysts. Among them, 147 (24.8%) were positive for at least one parasitic egg or cyst, whereas 39 (6.6%) had hookworm eggs alone. Hookworm was found in all the localities. Langtang South had the highest prevalence (1.5%), while Shendam had the lowest (0.7%). Females were more infected with hookworm (3.9%) than males (2.7%). Age group 1 to 10 showed more positive rate (33.3%), whereas subjects <1year had the least (2.6%). However, there is no statistical difference (P > 0.05) in the prevalence rate observed with respect to gender, age and location. Among the 39 samples positive for hookworm eggs, it was determined that 23 (59.0%) were *Necator americanus* and 9 (23.1%) were *Ancylostoma duodenale*, whereas 7 (17.9%) samples contained both species when Harada-Mori larvae recovery was used. The findings showed that Plateau State has a prevalence rate of 6.6% for hookworm infections with *N. americanus* as the dominant specie.

Key words: Plateau State, *Necator americanus*, *Ancylostoma duodenale*, Harada Mori.

INTRODUCTION

Hookworm is a leading cause of maternal and child morbidity in the developing countries of the tropics and subtropics. In susceptible children, hookworms cause cognitive and growth retardation, intrauterine growth retardation, prematurity and low birth weight among newborns born to infected mothers. In developed countries, hookworm infection is rarely fatal, but anemia can be significant in a heavily infected individual (Stephenson et al., 1989; Brooker and Micheal, 2000). Despite considerable advances in chemotherapy and control, hookworms rank amongst the most widespread of soil-transmitted intestinal helminth parasites and affect a significant proportion of the world population (approximately 900 million people) mainly in the tropics and sub-tropics (Bundy et al., and sub-tropics (Bundy et al., 1991). Adult hookworms attach to the mucosa of the small intestine, feed on blood and are an important cause of anaemia in school-aged and adult populations in the tropics (Olsen et al., 1998). *Ancylostoma duodenale* predominates in the Middle East, North Africa, India and (formerly) in southern Europe, while *Necator americanus* predominates in the Americas, Sub-Saharan Africa, Southeast Asia, China, and Indonesia.

Hookworms are thought to infect more than 600 million people worldwide (Crompton, 2000). *N. americanus* and *A. duodenale*, the 2 major species of human hookworms are sympatric over much of their distribution and people are often simultaneously infected with both species in endemic areas. Despite significant differences in their life histories, the 2 species have traditionally been considered to be identical for treatment and control strategies (Hoagland and Schad, 1978). Failure to consider these differences is probably responsible for reports of failed drug

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treatments and rapid reinfection rates following antihelmintic treatments. Report of different antihelmintic susceptibilities between the species indicates that administration of only one anthelmintic may not be sufficient to kill both species (Rossignol, 1990).

Most studies do not attempt to speciate hookworm infections and rely on past epidemiological data, which indicate the predominance of one species over the other (Brooker et al., 1999). This is because the eggs of the 2 species are similar and not readily distinguishable from one another by classical parasitological methods (Hawdon, 1996). Although there are established morphological differences between the adult worms (Yoshida et al., 1974a; b; Pawlowski et al., 1991), the adult stages are rarely available for routine parasitological examination. Species identification has traditionally been done by using subtle morphological characteristics to differentiate the infective, third-stage filariform (L_3) larvae, reared from eggs in coprocultures (WHO, 1981; Pawloski et al., 1991). The larvae of the two hookworm species can be distinguished microscopically, although this would not be done routinely but usually for research purposes. Adult worms are rarely seen (except via endoscopy, surgery or autopsy), but if found, would allow definitive identification of the species. Speciation can be performed based on the length of the buccal cavity, the space between the oral opening and the esophagus: hookworm rhabditoform larvae have long buccal cavities, whereas *Strongyloides rhabditoform* larvae have short buccal cavities (Markell et al., 2006). Moreover, the larvae of *A. duodenale* had a blunt head and tail, there is no gap between the oesophagus and the intestine, and the oesophagus did not end in a thistle funnel shape. Larvae of *N. americanus* also had a blunt head and tail. There is also no gap between the oesophagus and the intestine. However, the oesophagus ended in a thistle shape funnel (Okolie, 2007).

Although, previous reports from some parts of Nigeria have shown that *N*. *americanus* is the ubiquitous and dominant hookworm species (Fisk, 1939; Cowper and Woodward, 1961; Oyerinde, 1978; Adenusi, 1997) and that infections with *A. duodenale* represent only a small proportion of the local hookworm infections, over the years however, the epidemiological situation may not be the same as previously reported. Moreover, the relative distribution of the 2 species may vary from one endemic locality to the other. Thus, similar studies need to be carried out in other parts of the country.

MATERIALS AND METHODS

Study site

This study was conducted in Plateau State, Nigeria. The state is divided into three senatorial districts for political convenience. Each senatorial district consists of either 5 or 6 Local Government Areas. Either a General or a Cottage Hospital is cited by the State Government in each of the Local Government Areas.

Samples and sampling method

Two Local Government Areas from each senatorial district were randomly selected by balloting for the purpose of the study. Samples were collected from the General or Cottage Hospital sited in the area between October 2011 and February 2012. Samples were collected from patients with complains of abdominal discomfort. A total of 592 faecal samples were collected in sterile universal sample bottles. Key information such as name, age and sex were retrieved from each patient upon receipt of sample, after which an identification code was assigned to every sample. Samples were processed immediately in the laboratory.

Sample processing

Samples were first screened for the presence of hookworm using the direct smear. This involved the placing and emulsifying of two pin size stool samples, one on a drop of physiological saline and the other on a drop of iodine on the other end of the glass slide. The preparations were covered with cover slips and examined under the microscope using x10 and x40 objective lenses with closed condensers to give a good contrast for the identification of hookworm ova (Cheesbrough, 1992). Samples that were negative were discarded, while those that were positive were immediately cultured using Harada-Mori technique (Stoltzfuz et al., 1996; Rai et al., 1997) as follows: 0.1 g of feaces containing hookworm was placed on the middle portion of a strip of filter paper. The filter paper was inserted into 15 ml test tube and then about 7 ml of distilled water was carefully added into the test tube, ensuring that the faeces was not soaked or washed into the bottom of the test tube. Test tubes were labeled accordingly using an indelible marker and stood vertically on a test tube rack. The test tubes were sealed using cello tape and rubber band and incubated at room temperature (25 to 28°C) for a maximum of ten days. At the end of the incubation, the tubes were submerged to three quarters of their length into a beaker of water heated at 50°C for 15 min to kill the infective larvae as a precautionary measure against infection during harvesting. The rubber band and cello tapes were discarded by means of forceps into disinfectant jar. Contents of the test tubes were transferred into a conical centrifuge tubes and centrifuged at 1000 rpm for 5 min to sediment the larvae. The supernatant was discarded and sediments examined for sheathed filariform larvae using ×10 objective lens with condenser sufficiently closed for good contrast. Other possible parasitic eggs and cysts were also screened for in addition to hookworm eggs.

The filariform (infective larvae) of the two species were identified using the following distinct morphological characteristics which allowed for their differentiation: the larvae of *A. duodenale* had a blunt head and tail, and there was no gap between the oesophagus and the intestine. Moreover, the oesophagus did not end in a thistle funnel shape. On the other hand, the larvae of *N. americanus* also had a blunt head and tail. Also, there was no gap between the oesophagus and the intestine. However, the oesophagus ended in a thistle shape funnel.

RESULTS

From the 592 samples collected, 331 were from females and 261 were from male subjects. Out of these, 147 (24.8%) had parasites. Hookworm alone was found in 39(6.6%) of the total samples (Table 1). Hookworm was found in all the sites surveyed (Figure 1). The highest prevalence was recorded in Langtang South (1.5%), followed by Barkin-Ladi (1.4%), Pankshin (1.2%), Bokkos

Table 1. Distribution of parasites in Plateau State according to gender (n = 592).

Local Government Area	No. infected		No. of uninfected	% Prevalence	
	H	H+		H	H+
Bassa (n = 100)					
Male (42)	2	8	34	4.8	19.0
Female (58)	3	13	45	5.2	22.4
Barkin Ladi (n = 102)					
Male (n = 40)	3	11	29	7.5	27.5
Female (n = 62)	5	19	43	8.1	30.6
Pankshin (n = 105)					
Male (n = 50)	4	15	35	8.0	30.0
Female (n = 55)	3	12	43	5.5	21.8
Bokkos (n = 95)					
Male (n = 50)	2	10	40	4.0	20.0
Female (n = 45)	4	11	34	8.9	24.4
Shendam (n = 90)					
Male (n = 31)	1	5	26	3.2	16.1
Female (n = 59)	3	13	46	5.1	22.0
Langtang South (n = 100)					
Male (n = 48)	4	11	37	8.3	22.9
Female (52)	5	19	33	9.6	36.5
Total	39	147	445	6.6	24.8

H, Hookworm; H+= Hookworm and other parasites.

(1.0%), Bassa (0.8%), while Shendam had the least (0.7%) (Table 2 and Figure 1). According to age, the breakdown of hookworm prevalence from the total infected population shows that infants less than 1 year of age accounted for 2.6%, while age group 1 to 10 accounted for 33.3%. Age groups 11 to 20 and 21 to 30 accounted for 23.1% each, just as 17.9% prevalence was obtained from subjects above 30 years of age (Figure 2). Additionally, based on gender, female subjects accounted for 23 (3.9%), while their male counterparts accounted for 16 (2.7%) prevalence rate among the hookworm-positive population.

Aside hookworm, other parasites were encountered (Table 2). In general, hookworm and roundworm were the most prevalent intestinal parasites. Hookworm culture however revealed that the 23 (3.9%) of the hookworm-positive samples hatched out into larvae of *N. americanus*. The larvae of *A. duodenale* hatched out from 9 (1.5%) of the hookworm-positive samples, while 7 (1.2%) gave a mixture of both larvae (Table 3). However, there is no statistical difference ($P > 0.05$) in the prevalence rates obtained with respect to age, location or gender.

DISCUSSION

The findings confirm the presence of hookworm in Plateau State. This implies that despite considerable advances in chemotherapy and control, hookworms rank amongst the most widespread of soil-transmitted intestinal helminth parasites and affect a significant proportion of the world population (approximately 900 million people) mainly in the tropics and sub-tropics (Bundy et al., 1991). The prevalence rate of 6.6% recorded for hookworm infections in the state is considerably lower than 68.2% obtained by Adenusi and Ogunyomi (2003) in the urban city of Ibadan, Nigeria. It is also lower than the reported findings of Okolie (2007) who recorded 23.3% prevalence rate in Owerri and 13.3% prevalence rate in Port Harcourt, all in Nigeria. With respect to other African countries, it is lower compared to the 40.8% prevalence reported by Fekadu et al., (2008) from school children in Asendabo Town, Jimma zone, South West Ethiopia. Also, it is lower than 32.1% prevalence rate obtained in Uganda (Adrienne et al., 2005). The reason for this may not be unconnected with the increased awareness on the

Table 2. Prevalence of hookworm and other parasites as obtained.

Parasite	BS	BL	PN	BK	SD	LS	Total	Prevalence (%)
Hookworm	5	8	7	6	4	9	39	6.6
Ascaris lumbricoides	6	11	4	5	4	9	39	6.6
Enterobius vermicularis	-	3	-	-	-	3	6	1.0
Trichuris trichiura	2	2	3	-	-	2	9	1.5
Entamoeba histolytica	5	4	10	5	7	4	35	5.9
Hymenolepis nana	-	2	-	1	2	1	6	1.0
Strongyloides stercoralis	1	-	3	-	-	1	5	0.8
Schistosoma mansoni	2	-	-	4	1	1	8	1.4
Total	21	30	27	21	18	30	147	24.8

BS= Bassa; BL= Barkin-Ladi; PN= Pankshin; BK= Bokkos; SD= Shendam; LS= Langtang South.

Table 3. Prevalence of hookworm species in Plateau State.

Hookworm species	No.	Prevalence (%)
Ancylostoma duodenale	9	23.1
Necator americanus	23	58.9
Ancylostoma duodenale and *Necator americanus*	7	17.9

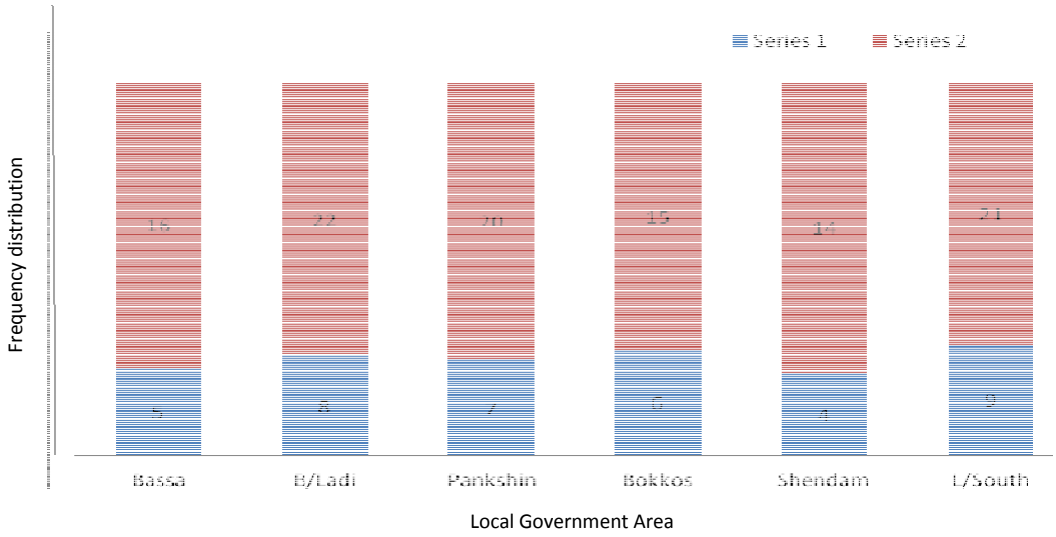

Figure 1. Distribution of hookworm and other parasites within Plateau State.
Series 1= Hookworm alone; Series 2= other parasites.

on the disease and improved personal hygiene.

Both species of hookworm were found to be present in the state. However, *N. americanus* was the dominant species obtained (3.9%). Previous studies had reported the presence of both *N. americanus* and *A. duodenale* (Jemaneh and Tedla, 1984; Armstrong and Chane, 1975). This result is in agreement with previous ones from different parts of Nigeria (Fisk, 1939; Cowper and Woodward, 1961; Oyerinde, 1978; Adenusi, 1997). The authors all concluded that *N. americanus* is the ubiquitous and dominant hookworm specie in the country. In Lagos, Nigeria, Oyerinde (1978) showed that apparently all infections with *A. duodenale* occurred always in association with *N. americanus*, with the latter occurring independent of the former. He concluded that perhaps, less than 1% of hookworm infections from the Lagos population, were solely due to *A. duodenale*. This report (Oyerinde, 1978) suggests that *A. duodenale* seldom occurs solely in human hosts. A more recent study in Lagos (Adenusi, 1997) however, found *A. duodenale* solely accounting for 4.5% of hookworm infections.

On the whole, 147 samples were confirmed positive for

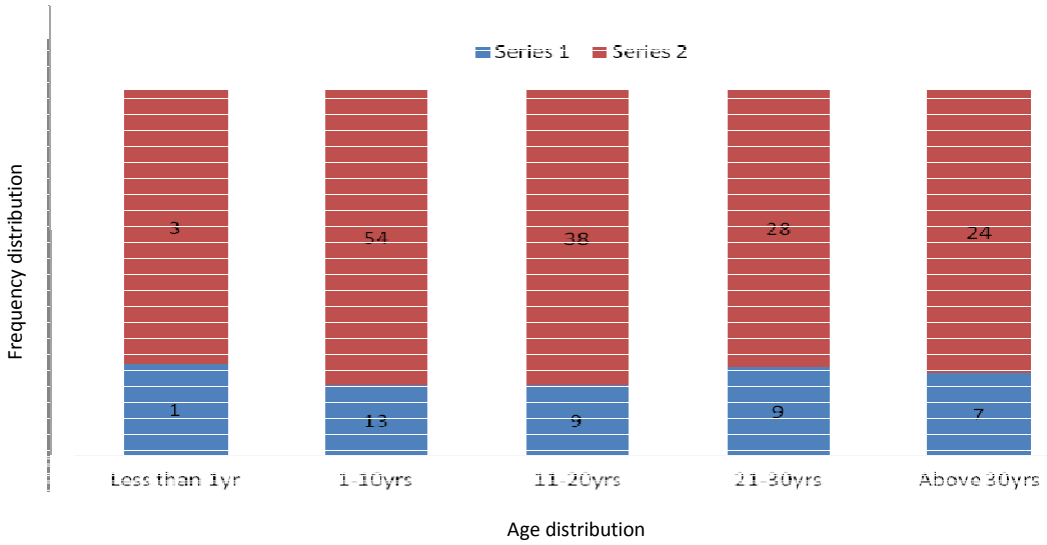

Figure 2. Distribution of hookworm and other parasites among age groups in Plateau State. Series 1= Hookworm alone; Series 2= hookworm and other parasites.

parasites, giving a prevalence rate of 24.8%. Other parasites were also found (Table 2). Helminth species prevalence pattern in the study population was similar to that reported in Uganda (Adrienne et al., 2005) where hookworm was the most prevalent (32.1%) followed by *Ascaris lumbricoides* (17.4%) and *Trichuris trichiura* (8.1%). Also, the pattern is not different from the findings of Emmy-Egbe (2007) on intestinal helminthes in Anambra State, Nigeria. Previous studies (Roma and Worku, 1997; Haileamlak, 2005; Erko and Edhin, 2003) have also shown that A*. lumbricoides* and *Trichuris trichiura* were the predominant species in Wondo-Genet and South West Ethiopia, respectively.

Furthermore, the age bracket of 1 to 10 years was the most infected with a total of 22 helminthes out of the 35 obtained from the study. The reason is not far-fetched as the group consists of children that play a lot with sand without the consciousness of personal hygiene. This is a predisposing factor to the infection giving that it is amongst the most widespread of soil-transmitted intestinal helminthes and affect a significant proportion of the world population (approximately 900 million people) mainly in the tropics and sub-tropics (Bundy et al., 1991). Fekadu et al. (2008) have earlier reported in Ethiopia that age groups 10 to 13 years and 5 to 9 years have the highest prevalence rates for parasitic infections. However, that there was no significant difference in the rate of infection among age bracket, location and gender is a straight warning for everyone to guard against the scorch. Previous findings have earlier highlighted this precaution (Emmy-Egbe, 2007; Fekadu et al., 2008).

In conclusion, this study identified the existence of both hookworm species in the area (6.6%) with *N. americanus* being the dominant one. Furthermore, relatively higher burden of parasitic infection was seen in the state (24.8%). Therefore, we recommend immediate treatment of positive cases and improved environmental and personal hygiene to curb the observed high burden of parasitic infection in the state.

REFERENCES

Adenusi AA (1997). The distribution of *Necator americanus* and *Ancylostoma duodenale* among school children in Lagos, Nigeria. Trans. Roy. Soc. Trop. Med. Hyg. 91(3):270.

Adenusi AA, Ogunyomi EOA (2003). Relative prevalence of the human Hookworm species, *Necator americanus* and *Ancylostoma duodenale* in an urban community in Ogun State, Nigeria. Afr. J. Biotechnol. 2(11):470-473

Adrienne E, Edridah M, Jennifer K, Clarkea K, Pascal M, Annette O, Narcis B, Kabatereineb R, Simon B (2005). Epidemiology of helminth infections and their relationship to clinical malaria in southwest Uganda. Trans. Roy. Soc. Trop. Med. Hyg. 99:18-24.

Armstrong J, Chane T (1975). Identification of Hookworm species in Ethiopia. Ethiop. Med. J. 13:13-18.

Brooker S, Peshu N, Warn PA, Mosobo M, Guyatt HL, Marsh K, Snow RW (1999). The epidemiology of hookworm infection and its contribution to anaemia among pre-school children on the Kenyan Coast. Trans. Roy. Soc. Trop. Med. Hyg. 93:240-246.

Brooker S, Michael E (2000). The potential of geographical information system and remote sensing in the epidemiology and control of human helminth infections. Adv. Parasitol. 47:245-288.

Bundy DAP, Chandiwana SK, Homeida MMA, Yoon S, Mott KE (1991). The epidemiological implications of a multiple-infection approach to the control of human helminth infections. Trans. Roy. Soc. Trop. Med. Hyg. 85:274-276.

Cheesbrough M (1992). Medical Laboratory Manual for Tropical Health Technology Butter-Heiman Ltd.

Cowper SG, Woodward SF (1961). Parasitic infections recorded at University College Hospital, Ibadan, Nigeria, over a three-year period (1957-1960). W . Afr. Med. J. 10:366-383.

Crompton W (2000). The public health importance of Hookworm disease. Parasitol. 121:S39-S50.

Emmy-Egbe IO (2007). Prevalence of Intestinal Helminthes parasite in

relation to age and occupation in Ihiala, Anambra state, Nigeria. Nat. Appl. Sci. J. 11:2.

Erko B, Edhin G (2003). Human helminthiasis in Wondo genet, southwestern Ethiopia, with emphasis on geohelminthiasis. Ethiop. Med. J. 41:333-343.

Fekadu D, Beyne P, Amha K (2008). Hookworm species distribution among school children in Asendabo town, Jimma Zone, South West Ethiopia. Ethiop. J. Health Sci. Vol. 18: pp. 18: 53-56.

Fisk GH (1939). Helminthiasis in Lagos, Nigeria. Trans. Roy. Soc.Trop. Med. Hyg. 32:645-652.

Haileamlak A (2005). Intestinal parasites in asymptomatic children in south west Ethiopia. Ethiop. J. Health Sci. 15:107-117.

Hawdon JM (1996). Differentiation between the human hookworms *Ancylostoma duodenale* and *Necator americanus* using PCR-RFLP. J. Parasitol. 82(4):642-647.

Hoagland KE, Schad GA (1978). *Necator americanus* and *Ancylostoma duodenale*: Life history parameters and epidemiological implications of 2 sympatric hookworms of humans. Exp. Parasitol. 44:36-49.

Jemaneh L, Tedla S (1984). Distribution of *N. americanus* and *A. duodenale* in school populations, Gojam and Gonder Administrative Regions. Ethiop. Med. J. 22:87-93.

Markell EK, John DC, Petri WH (2006). Markell and Voge's Medical Parasitology (9th ed.). St. Louis, Mo: Elsevier Saunders.

Okolie NJC (2007). Application of Harada Mori's Culture Method for Differentiating Hookworm Species in Two Major Cities in South Eastern Nigeria. Res. J. Med. Sci. 1(1):16-20.

Olsen A, Magnussen P, Ouma JH, Andreassen J, Friis H (1998). The contribution of hookworm and other parasitic infection to haemoglobin and iron status among children and adults in western Kenya. Trans. Roy. Soc. Trop. Med. Hyg. 92:643-649.

Oyerinde JPO (1978). Human *Ancylostoma* infections in Nigeria. Ann. Trop. Med. Parasitol. 72(4):363-367.

Pawlowski ZS, Schad GA, Stott GJ (1991). Hookworm infection and anaemia. Approaches to prevention and control. World Health Organization, Geneva. p. 96.

Rai SK, Shrestha HG, Nakanishi M, Kubo T, Ono K, Uga S, Matsumura T (1997). Hookworm infection recorded at University Teaching Hospital in Kathmandu, Nepal over one decade period. Jpn. J. Trop. Med. Hyg. 25:81-84.

Roma B, Worku S (1997). Magnitude of *Schistosoma mansoni* and intestinal helminthic infection among school children in Wondo-Genet zuria, South west Ethiopia. Ethiop. J. Health Dev. 11(2):125-129.

Rossignol JF (1990). Chemotherapy: Present status. In: Hookworm disease: Current status and new directions, Schad GA, Warren KS (eds.). Taylor and Francis, London. pp. 281-290.

Stephenson L, Latham M, Kurz K, Kinoti S, Brigham H (1989). Treatment with a single dose of albendazole improves growth of Kenyan schoolchildren with Hookworm, *Trichuris trichiura*, and *Ascaris lumbricoides* infection. Am. J. Trop. Med. Hyg. 41:78-87.

Stoltzfuz RJ, Albonic M, Chwaya HM, Savioli L, Tielsh J, Schulze JK, Yip R (1996). Hemoquant determination of hookworm related blood loss and its role in iron deficiency in African children. Am. J. Trop. Med. Hyg. 55:399-404.

WHO (1981). Intestinal protozoan and helminthic infections. WHO Technical Report Series No. 666. World Health Organization. Geneva.

Yoshida Y, Matsuo K, Kondo K, Arizona N, Ogino K (1974a). Scanning electron microscopy of hookworms. Adults and infective stage larvae of *Necator americanus* (Stiles, 1902). South East Asian J. Trop. Med. Pub. Health 5:510-514.

Yoshida Y, Matsuo K, Kondo K, Arizona N, Ogino K (1974b). Scanning electron microscopy of hookworms. 2. Adults and infective stage larvae of *Ancylostoma duodenale* (Dubini, 1843). South East Asian J. Trop. Med. Pub. Health 5:515-519.