INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY
ISSN Print: 1560–8530; ISSN Online: 1814–9596
07-242/SAE/2008/10–1–89–92
http://www.fspublishers.org

***Full Length Article***

# The Prevalence and Intensity of Soil Transmitted Helminths in a Rural Community, Lagos Suburb, South West Nigeria

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## ABSTRACT

A study was conducted to determine the prevalence and intensity of soil transmitted helminth parasites among residents of Era-Awori village located in a Lagos suburb, South West Nigeria. The results showed an overall prevalence of 83.3% of helminths, from 300 participants (149 males & 151 females). A total of 134 males (44.7%) and 126 females (42.0%) were positive as parasites. Four soil transmitted helminths were reported, namely *Ascaris lumbricoides* (67.7%), Hookworm (45.0%), *Trichuris trichiura* (31.3%) and *Strongyloides stercoralis* (18.0%). Children (1-10 years) showed higher positive rates with *T. trichiura* 40 (38.1%) than adults 06 (17.6%). Multiple parasitic infections was least in the 51-60, 09 (36.0%) and 61-80 years, 08 (47.1%) age groups; while it reached a peak in the 1-10 years, 66 (62.9%) and 11-20 years, 33 (66.0%) age groups. Multiple infections were recorded in 170 (56.7%) of participants, while 08 (27.0%) had single infection and 49 (16.3%) no infection at all. The egg load per gram of faeces (EPG) among males ranged between 202.0 and 2369.79, while that for females was 325.0 and 3184.8. Differences in the levels of infection between the sexes were not significant. Educational standard did not reduce positive rates of infection. Data suggested that soil transmitted helminths are important public health problems hence actions is imperative against deficiencies in sanitary facilities, improper disposal of human faeces, insufficient supplies of potable water, poor personal hygiene and substandard housing.

**Key Words:** Soil-transmitted helminthes; Prevalence; Egg load; Rural-community

## INTRODUCTION

Infection by soil transmitted helminths has been increasingly recognized as an important public health concern, particularly in developing countries. Due to this significance, there have been regular endeavours to determine and present figures for soil transmitted helminth (STH) infections in various places such as China, Southern Malawi, Ecuador, Uganda, and Nigeria (Chan, 1994; Xu, 1995; De Silva, 1997; Phiri *et al.*, 2000; Andrade *et al.*, 2001; Guayatt, 2002; Nock *et al.*, 2003; Brooker, 2003; Kabatereine *et al.*, 2005). Typically the helminths involved include *Ascaris lumbricoides*, *Trichuris trichiura*, hookworm and *Strongyloides stercoralis*. Worm transmission is enhanced by poor socio economic conditions, deficiencies in sanitary facilities, improper disposal of human faeces, insufficient supplies of potable water, poor personal hygiene, substandard housing and lack of education (WHO, 1996). In Nigeria, studies on the evaluation of STH infections in different localities include those of Mafiana (1995), Ibidapo (1997), Mafiana *et al.* (1998), Adeyeba and Akinlabi (2002), Etim *et al.* (2002), Ogbe *et al*. (2002), Nock *et al.* (2003), Ukpai and Ugwu (2003). Nwosu and Anya (1980) noted that 88% of hookworm infestations in Southern Nigeria are due to *Necator americanus*, while about 12% are due to *Ancylostoma duodenale*. Sam – Wobo *et al.* (2004) reported prevalence levels of 17.8 to 87% in various communities in Ogun State, South - west Nigeria, which was due to high biotic potential of the worm as well as the ability of eggs to withstand adverse conditions. This study was undertaken to identify, assess, evaluate the prevalence and epidemiologic factors relating to intestinal helminthiasis and suggest ways by which the level of infection can be reduced in Era – Awori community, Southern Nigeria.

## MATERIALS AND METHODS

**The study area.** The study was carried out in Era - Awori village, 50 km off Lagos - Badagry expressway, South – west Nigeria. It lies in latitude 6º 25´ North and longitude 2º 53´ East. It is located in the rain forest zone with distinct rainy and dry season. It is predominantly a rural setting with clustered houses, haphazardly built without any social amenities. The immediate environment of the houses consisted of grassy areas and sandy soil seeded with human excreta.

**Subjects.** These were rural dwellers aged between 1- 80 years. This study involved a total of 70 households. Although most households comprised of 10-11 persons, it was not every member in each household who volunteered to participate in the exercise. In all, 300 persons volunteered to participate in the exercise.

**To cite this paper:** Ibidapo, C.A. and O. Okwa, 2008. The prevalence and intensity of soil transmitted helminths in a rural community, lagos suburb, south west Nigeria. *Int. J. Agri. Biol.*, 10: 89–92

**Sample collection.** Samples were collected over a six - month period (July – December). Consent was obtained after briefing the village head and chiefs, who in turn informed their people on the purpose of the study. The consent of the individuals was also sought for maximum cooperation before the commencement of the exercise. Personal data of each participant such as age, sex, education and occupation were obtained using the questionnaire. The specimens were collected in tight fitting sterile bottles in the mornings. These were immediately taken to the laboratory for examination.

**Examination.** Three hundred stool samples were examined in the Zoology laboratory of Lagos State University, using the simple test tube floatation method (Hanson & Perry, 1990). Approximately 3 g of faecal sample was put into a beaker containing 50 mL floatation × fluid (NaCl 400 g, water 100 mL, sugar 500 g) and stirred thoroughly. The resulting faecal suspension was strained in another beaker and then poured into labelled test tubes (10 × 12 mm) arranged in a rack, ensuring that it was filled to the brim. A cover slip was placed over each tube for about 20 min, then lifted and immediately placed on a glass slide, after which it was examined under the microscope for helminth ova.

**Egg count.** Kato – Katz method was used to quantitate the number of eggs per gramme of faeces (WHO, 1994).

**Statistical analysis.** The analysis of data collected was done with Epinfo-6 software. This was presented at 0.05% level of confidence using Chi-square test with Microsoft Excel 2000 and SPSS 9.0 software packages.

## RESULTS

The study revealed an overall prevalence of soil transmitted helminth infections of 83.3% (Table I). Of the population sampled (N = 300; 149 males & 151 females) *A. lumbricoides* accounted for 67.7%, *T. trichiura*, 31.3%, hookworm 45.0% and *S. stercoralis* 18.0% (Table I). A total of 124 males and 126 females were positive for parasites. The percentage of infections was high all through the age groups with a range of 76.0 – 90.0% (Table I). With the exception of the 51 – 60 years age group where *S. stercoralis* was the most common parasitic infection (52.0%), *A. lumbricoides* recorded the highest positive rates in all other groups. Infection with *T. trichiura* and hookworm were most common among children (1-10 years) with positive rates of 38.1% and 51.4%, respectively (Table I). The mean egg count (EPG) recorded for the age group (11 – 20 years), 2841.12 was the highest in all the groups followed by the value recorded for the 1 – 10 years age group, 1893.1 (Table II). There was a drop in the mean EPG value from age group 21 – 30 years, 860.66 down to the 51 – 60 years age group, 392.64. For males, there were no significant differences in egg counts among all the age groups except for the 51 – 60 years group, which was significantly different ($P < 0.05$).

The egg load for females in the 1 -10 years group was not significantly ($P > 0.05$) different from that of the 11 – 20 years group, but different ($P < 0.05$) from those of other groups. Statistical analysis showed no significant difference between the infection rates in both sexes ($P > 0.05$). Of the population sampled, 170 (56.7%) had multiple helminth infections, single infections occurred in 08 (27.0%), while 49 (16.3%) had no infection at all. Multiple helminth infections was least in the 51 – 60 and 61 – 80 years age groups, with values of 36.0% and 47.1%, respectively; while it was highest in the 11 - 20 and 1 - 10 years age groups with values of 66.0% and 62.9%, respectively (Table II). Students, toddlers, post primary/primary school pupils and children below school age recorded high positive rates for *A. lumbricoides*, 78.0%, 71.9%, 71.3% and 70.6% respectively. According to the educational background, illiterates and semi illiterates recorded positive rates of 49.6%, 32.7%, 38.9% and 19.5% for *A. lumbricoides, T. trichiura*, hookworm and *S. stercoralis* respectively. The literate counterparts (civil servants) recorded positive rates of 60.0, 24.0, 44.0 and 20.0% for the same parasites in that order (Table III). The difference in infection rate between the two groups was statistically non-significant ($P > 0.05$).

## DISCUSSION

The high prevalence of soil transmitted helminthiases in Era-Awori and the presence of the common triad *A. lumbricoides*, *T. trichiur*a and hookworm is comparable with previous reports in Southern Nigeria (Wariso & Ibe, 1994; Mafiana, 1995; Adeyeba & Akinlabi, 2002; Etim *et al.*, 2002; Nock *et al.*, 2003; Sam - Wobo *et al.*, 2004). The prevalence of ascariasis as the most common infection in this and other studies in Southern Nigeria has been observed (Ogbe & Odudu, 1990; Asaolu *et al.*, 1992; Mafiana *et al.*, 1998; Nworgu *et al.*, 1998; Ogbe *et al.*, 2002). *A. lumbricoides* eggs are very resistant to harsh environmental conditions and air-borne. They may account for the ubiquitous nature of egg distributions and hence very high prevalence in all the age groups. While infections with *T. trichiura* and hookworm were more common among children, no age dependence was observed for *A. lumbricoides.* Hookworm infection was the second most prevalent STH in this study with a value of 45.0%. In a related study, Ibidapo (1997) reported a prevalence of 33.3% in a cross section of Lagos population, while Otubanjo and Ebirikwe (1999) reported a prevalence of 24.5% among individuals in a rural community. Hookworm infections are prevalent in Nigeria especially among children, depriving them the much - needed nutrients required for development and growth (Udonsi, 1983; Udonsi & Amabibi, 1992). *S. stercoralis* was less prevalent compared to hookworm, with adults recording the bulk of the infection. High prevalence rates have been recorded for *T. trichiura* in Lagos and other southern Nigeria cities. Asaolu *et al.* (1992) observed egg positive rates of 65.7% for *T. trichiura* in some rural communities around Ile Ife. Ibidapo (1997) reported a prevalence of 52.5% for *T. trichiura* in Lagos metropolis while Mafiana (1995) in

**Table I. Age Stratified prevalence of infection with soil-transmitted helminths at Era-Awori village, Lagos**

| (Years) | No examined | No Infected (%) | *A. lumbricoides* (%) | *T. trichiura* (%) | Hookworm (%) | *S. stercoralis* (%) |
|---|---|---|---|---|---|---|
| 1-10 | 105 | 92(87.6) * | 82(78.1) | 40(38.1) | 54(51.4) | 10(9.5) |
| 11-20 | 50 | 45(90.0) | 41(82.0) | 15(30.0) | 24(48.0) | 10(20.0) |
| 21-30 | 50 | 38(76.0) | 32(64.0) | 13(26.0) | 18(36.0) | 08(16.0) |
| 31-40 | 34 | 26(76.5) | 17(50.0) | 06(17.6) | 15(44.1) | 07(20.6) |
| 41-50 | 19 | 15(78.9) | 12(63.2) | 07(36.8) | 06(31.6) | 02(10.5) |
| 51-60 | 25 | 21(88.0) | 09(36.0) | 08(32.0) | 11(44.0) | 13(52.0) |
| 61-80 | 17 | 13(76.5) | 10(58.8) | 05(29.4) | 07(41.2) | 04(23.5) |
| Total | 300 | 250(83.3) | 203(67.7) | 94(31.3) | 135(45.0) | 54(18.0) |

*Parenthesis represents percentage

**Table II. Mean egg load (Epg) and levels of infections with helminths at Era-Awori village, Lagos**

| | | AGE GROUPS (YEARS) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **SEX** | **1-10** | **11-20** | **21-30** | **31-40** | **41-50** | **51-60** | **61-80** |
| Mean egg Count | MALE | 55 | 22 | 13 | 07 | 12 | 08 | 07 |
| Egg Per Gram (EPG) | | 1641.22 ± 2205.48 | 2369.7± 2962.3 | 748.8 ± 905.3 | 616.0 ± 745.4 | 845.3 ± 1112.0 | 202.0 ± 260.95 | 692.0 ± 857.67 |
| Mean egg Count (EPG) | FEMALE | 37 | 23 | 25 | 19 | 03 | 13 | 06 |
| | | 2235.1 ± 2878.9 | 3184.8± 3651.2 | 916.6± 1170.6 | 844.8± 1108.8 | 325.0 ± 403.11 | 419.5 ± 608.2 | 942.8 ± 1122.5 |
| | Total Number | 92 | 45 | 38 | 26 | 15 | 21 | 13 |
| | Cumulative Mean EPG | 1893.1 ± 2514.13 | 2841.1 ± 336.4 | 860.6 ± 1089.6 | 764.1 ± 1025.2 | 803.3 ± 1053.9 | 392.6 ± 561.2 | 797.9 ± 997.1 |
| Multiple Infections (%) | 170(56.7) * | 66(62.9) | 33(66.0) | 27(54.0) | 17(50.0) | 10(52.6) | 09(36.0) | 08(47.1) |
| Single Infection (%) | 08(27.0) | 26(24.8) | 12(24.0) | 11(22.0) | 09(26.5) | 05(26.3) | 13(52.0) | 05(29.4) |
| No Infection at all (%) | 49(16.3) | 13(12.4) | 05(10.0) | 12(24.0) | 08(23.5) | 04(21.1) | 03(12.0) | 04(23.5) |

*Parenthesis represents percentages

**Table III. Prevalence of intestinal parasites in relation to education and occupation at Era-Awori village, Lagos**

| A | Educational Background | No. Examined | | | *A. lumbricoides* (%) | *T. trichiura* (%) | Hookworm (%) | *S. stercoralis* (%) |
|---|---|---|---|---|---|---|---|---|
| | | M | F | Total | | | | |
| 1 | Illiterate/ Semi- illiterate | 65 | 48 | 113 | 56(49.6)* | 37(32.7) | 44(38.9) | 22(19.5) |
| 2 | Post Primary/ Primary | 80 | 56 | 136 | 97(71.3) | 42(30.9) | 72(52.9) | 25(18.4) |
| 3 | Below School Age | 26 | 25 | 51 | 36(70.6) | 16(31.4) | 18(35.3) | 06(11.8) |
| 4 | Toddlers | 22 | 35 | 57 | 41(71.9) | 18(31.6) | 21(36.8) | 06(10.5) |
| **B** | **Occupation** | | | | | | | |
| 1 | Farming | 55 | 45 | 100 | 62(62.0) | 29(29.0 | 36(36.0) | 23(23.0) |
| 2 | Civil Servant | 17 | 08 | 25 | 15(60.0) | 06(24.0) | 11(44.0) | 05(20.0) |
| 3 | Petty Trading | 02 | 04 | 06 | 04(66.7) | 0(0.0) | 03(50.0) | 0(0.0) |
| 4 | House wife | 0 | 08 | 08 | 03(37.5) | 02(25.0) | 04(50.0) | 03(37.5) |
| 5 | Fishing | 09 | 04 | 13 | 09(69.2) | 06(46.2) | 07(53.8) | 05(38.5) |
| 6 | Students | 46 | 45 | 91 | 71(78.0) | 32(35.2) | 53(58.2) | 12(13.2) |

*Parenthesis represents Percentage

Abeokuta reported very low prevalence of 14.7% and 13.9% for *T. trichiura* and hookworm, respectively. Adeyeba and Akinlabi (2002) reported high prevalence and intensity of STHs among rural school age children. A prevalence of 31.3% for *T. trichiura* was reported in this study. The age group 11-20 years recorded the highest prevalences of parasites and egg load. This trend was similarly observed previously (Nwosu, 1983; Elkins *et al.*, 1986; Asaolu *et al*., 1991; Wariso & Ibe, 1994).

This study showed that the nature of the occupation of individuals influenced the infection rate. Farmers recorded high positive rates for all the STH parasites and this was similarly observed by Phiri *et al.* (2000). The high prevalence of the faeco – orally transmitted intestinal helminthes (*A. lumbricoides* & *T. trichiura*) reported among the 1-10 and 11-20 years age group in this study is closely related to their habits. This is generally the school age. Lollies, food and snacks are freely purchased from hawkers and frequently shared among friends. Cabrera *et al.* (1994), Etim *et al.* (2002) and Olsen (2003) noted that un-clean hands played a vital role in the transmission of ascariasis among school children. Toddlers also recorded high positive rates for STHs, because of the dirty environment in which they played and because contaminated hands were dipped into the mouth quite often. The decrease in the prevalence of some parasites e.g. *T. trichiura* and *S. stercoralis* among the older age group (61-80 years) in this study may reflect a positive change in the hygiene behavior. Poor sanitation, under-nutrition, inadequate personal and domestic hygiene contributed immensely to the none effectiveness of educational standard in reducing positive rates of STHs infections in this study. Dry environmental conditions encountered during the survey period (July – December) might have contributed to low positive rates for *T. trichiura* and *S. stercoralis*, since the ova of these parasites are shown to be liable to destruction due to their fragility (Ukoli, 1984). Guayatt (2000) noted that anaemia arising from STH infection is often associated with reduced work output and also impaired cognitive ability, with effects on school attendance among children. Globally, a lot of efforts are made to reduce STH infections (Toan, 1998; Gwatkin & Guillot, 2000; Montressor *et al*., 2002; WHO, 2002;

Kabatereine *et al.*, 2005). For Nigeria, it is suggested that regular treatment of school age children and others at risk groups such as pre-school children, pregnant women and special occupation groups may help avoiding the worst effects of infection, even if there is no improvement in safe water supply or sanitation.

**Acknowledgement.** Our sincere gratitude goes to the village head, chiefs and residents of Era-Awori for their cooperation during the study.

## REFERENCES

Adeyeba, O.A. and A.M. Akinlabi, 2002. Intestinal parasitic infections among school children in a rural community, South west Nigeria. *Nigerian J. Parasitol.*, 23: 11–8

Andrade, C., T.D.E. Alava, I.A. Palacio, P. Del Poggio, C. Jamoletti, M. Gulleta and A. Montressor, 2001. Prevalence and intensity of soil-transmitted helminthiasis in the city of Porto Viejo (Ecuador). *Mem. Inst. Oswaldo Cruz*., 96: 1075–9

Asaolu, S.O., C.V. Holland and D.W.T. Crompton, 1991. Community control of *Ascaris lumbricoides* in rural Oyo State, Nigeria. Mass targeted and selective treatment with levamisole. *Parasitol.*, 103: 291–8

Asaolu, S.O., C.V. Holland, J.O. Jegede, N.R. Fraser, R.C. Stoddard and D.W.T. Crompton, 1992. The prevalence and intensity of soil transmitted helminthiases in rural communities in Southern Nigeria. *Ann. Trop. Med. Parasit*., 86: 279–89

Brooker, S., 2003. Soil - transmitted helminth infections and parasite control in South east Asia. *South East Asian J. Trop. Med. Public Health*, 34: 24–36

Cabrera, B.D., F.F. Balagtas and U.P. Manila, 1994. The role of unclean hands in the transmission of ascariasis among school children. Presented at the 15th and 16th APCO Parasitologists' Meeting, Tokyo, 1993 and 1994. *Collected Papers on the Control of STH, by the APCO Group*, 2: 20–37

Chan, M.S., 1994. The evaluation of potential global morbidity attributable to intestinal nematode infections. *Parasitol.*, 109: 373–87

De Silva, N.R., 1997. Morbidity and mortality due to ascariasis: re-estimation and sensitivity analysis of global numbers at risk. *Trop. Med. Int. Health*, 2: 519–28

Elkins, B.D., M. Haswell - Elkins and R.M. Anderson, 1986. The epidemiology and control of intestinal helminthes in the publican region of Southern India. Study design and pre - and post - treatment of observations on *Ascaris lumbricoides. Trans. Royal. Soc. Trop. Med. Hyg.*, 80: 774–92

Etim, S.E., P.A. Akpan, S.E. Abeshi and O.E. Offiom, 2002. Intestinal helminth infections in children: Implications for helminth control using school based mass chemotherapy. *Nigerian J. Parasitol.*, 23: 53–60

Guayatt, H., 2000. Do intestinal nematodes affect productivity in adulthood? *Parasitol. Today*, 16: 153–8

Guayatt, H., 2002. *In*: Holland, C.V. and M.W. Kennedy (eds.), *The Geohelminths: Ascaris, Trichuris and Hookworm*, pp: 75–87. Kluwer Academic Publishers, Dordrecht, Netherlands

Gwatkin, D.R. and M. Guillot, 2000. *The Burden of Disease Among the Global Poor*. Current Situation, Future Trends and Implications for Strategy, World Bank

Hanson, J. and B.D. Perry, 1990. *The Epidemiology Diagnosis and Control of Gastro- intestinal Parasites of Ruminants in Africa*, p: 121. A hand-book, ILRAD. English Press Ltd., Kenya

Ibidapo, C.A., 1997. Incidence of Intestinal parasites in a cross section of Lagos population. *J. Prosp. Sci.*, 1: 80–5

Kabatereine, N.B., E.M. Tukahebwa, F. Kazibwe, J.M. Twa-Twa, J.F.Z. Barenzi and S. Zaramba, 2005. Short communication: Soil-transmitted helminthiasis in Uganda. Epidemiology and cost of control. *Tropical Med. Int. Health*, 10: 1187–9

Mafiana, C.F., 1995. Intestinal helminthiasis (with particular reference to Ascariasis) among school children in Ilewo- Orile, Ogun state, Nigeria. *Nigerian J. Parasitol.*, 16: 47–53

Mafiana, C.F., M.B. Sodipe and B.I. Koleoso, 1998. Soil transmitted helminth parasites of humans in a city in south western Nigeria. *Helminthologia*, 35: 203–8

Montressor, A., D.W.T. Crompton, T.W. Gyorkos and L. Savioli, 2002. *Helminth Control in School - Age Children*. W.H.O Geneva

Nock, I.H., D. Duniya and M. Galadima, 2003. Geohelminth eggs in soil and stool of pupils of some primary schools in Samaru, Zaria, Nigeria. *Nigerian J. Parasitol.*, 24: 115–22

Nwosu, A.B.C., 1983. The human environment and helminth infections: A biochemical study of four Nigerian villages. *In*: Croll, N.A. and J.G. Cross (eds.), *Human Ecology and Infectious Diseases*. Academic Press London

Nwosu, A.B.C. and A.O. Anya, 1980. Seasonality in hookworm infection in an endemic area of Nigeria, and its relationship to rainfall. *Tropenmed Parasit*., 31: 201–8

Nworgu, O.C., J. Okeibunor, E. Madu, U.O. Amazigo and O. Evans, 1998. Helminthiasis Control Programme in Nigeria. Acceptability to community members. *Trop. Med. Int. Health*, 3: 841–9

Ogbe, M.G. and L.A. Odudu, 1990. Gastro - intestinal helminthiasis in primary schools in Epe Local Government Area, Lagos State, Nigeria. *Nigerian J. Parasitol*., 9 - 11: 95–106

Ogbe, M.G., E.E. Edet and M.N. Isichei, 2002. Intestinal helminth in primary school children in areas of operation of Shell Petroleum Development Company of Nigeria (SPDC), Western Division in Delta State. *Nigerian J. Parasitol*., 23: 3–10

Olsen, A., 2003. Experience with school - based interventions against soil-transmitted helminths and extension of coverage to non - enrolled children. *Acta Trop.*, 86: 255–66

Otubanjo, O.A. and S.O. Ebirikwe, 1999. Gastro - intestinal helminthiasis in a rural community, Umuoziri - Inyishi in Ikeredu LGA of Imo State, Nigeria. *Nigerian J. Sci*., 33: 319–26

Phiri, K., C.J. Whitty, S.M. Graham and G. Ssembatya - Lule, 2000. Urban/rural differences in prevalence and risk factors for intestinal helminth infection in Southern Malawi. *Annl. Trop. Med. Parasitol.*, 94: 381–7

Sam - Wobo, S.O., C.F. Mafiana and A.B. Idowu, 2004. Re-infection patterns of ascariasis among school children in Ogun State, Nigeria. *Nigerian J. Parasit.*, 25: 7–13

Toan, D.N., 1998. Contamination of soil with *Ascaris* and *Trichuris* eggs in a rural area of Vietnam. *In*: Yokogawa, M. (ed.), *Collected Paper on the Control of Soil Transmitted Helminthiases*, Vol. VI, pp: 87–91. APCO, Tokyo

Udonsi, J.K., 1983 *Necator americanus* infection: a longitudinal study of an urban area in Nigeria. *Annl. Trop. Med. Parasit.*, 77: 305–10

Udonsi, J.K. and M.I. Amabibi, 1992. The human environment occupation and possible water borne transmission of the human hook *Necator americanus* in endemic coastal communities of the Niger Delta, Nigeria. *Public Health*, 106: 63–71

Ukoli, F.M.A., 1984. *Introduction to Parasitology in Tropical Afric*a, p: 464. John Wiley and Sons Limited

Ukpai, O.M. and C.D. Ugwu, 2003. The prevalence of gastrointestinal tract parasites in primary school Children in Ikwuano Local Government Area of Abia State, Nigeria. *Nigerian J. Parasitol.*, 24: 129–36

Wariso, B.A. and S.N. Ibe, 1994. Prevalence of some intestinal helminths in Port Harcourt, University of Port Harcourt Teaching Hospital, Nigeria. *West African J. Med.*, 13: 218–22

WHO, 1994. *Bench Aids for the Diagnosis of Intestinal Parasites*, p: 114. Laboratory Manual, W.H.O, Geneva

WHO, 1996. *Fighting Disease, Fostering Development.* In The World Health Report, W.H.O, Geneva

WHO, 2002. *The Prevention and Control of Schistosomiasis and Soil-transmitted Helminthiasis*. Report of a W.H.O. Expert Committee. Geneva, World Health Organisation, W.H.O Technical Report Series 912

Xu, L.G., 1995. Soil - transmitted helminthiases: nationwide survey in China. *Bull. W.H.O.*, 73: 507–13

**(Received 21 July 2007; Accepted 20 September 2007)**