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Re-infection patterns of ascariasis among school children in Ogun State, Nigeria

Sam-Wobo, S. O*., Mafiana, C.F., and Idowu, A. B.
Department of Biological Sciences
University of Agriculture
PMB 2240, Abeokuta, Ogun State, Nigeria
Email: sam_wobo@yahoo.com

Abstract

A study was conducted to determine the direct prevalence, intensity and re-infection pattern of ascariasis among school pupils aged 6-17 years in Ogun State, Nigeria; 2,837 primary school pupils randomly selected from twenty schools in five Local Government Areas (LGAs) namely: Odeda, Obafemi/Owode, Ewekoro, Ado-Odo/Otta, and Ogun Waterside were enlisted for the study. Drug (Levamisole) administration was used to determine the direct prevalence, intensity and the re-infection patterns of infection. The overall direct prevalence for A. lumbricoides was 48.5%. Obafemi/Owode had the highest mean infection rate of 62.6%, followed by Ogun Waterside (59.18%), Odeda (44.8%), Ewekoro (34.2%) and Ado-Odo/Otta (25.6%). Male pupils were slightly more infected (51.9%) than females (48.1%) and also had higher mean intensity (((2.2) than females (((1.7). Statistical analysis showed no significant difference between the infection rates in both sexes (t= 2.60, p=0.234). The cumulative numbers of worms expelled by pupils in the LGAs were Ogun Waterside 778 (39.5%), Obafemi/Owode 768 (39%), Odeda 216 (11%), Ewekoro 152 (7.7%) and Ado-Odo/Otta 55 (2.8%). The morphometric studies revealed that of the 1969 worms voided, adult worms accounted for 92.7% while young worms formed only 7.3%. Re-infection of pupils with ascariasis from different LGAs varied. The calculated monthly re-infection rates (X) were: Ewekoro (1.6%), Odeda (2.3 %), Ado-Odo/Otta (2.3%), Ogun Waterside (3.8%), and Obafemi/Owode (4.2%); with a mean value of 2.84% for Ogun State. The re-infection time (N months) are Ado-Odo/Otta (12.7), Ogun Waterside (21.8), Obafemi/Owode (22.92), Odeda (25.45), and Ewekoro (25.9). The mean value for N in Ogun State was 21.75, which implies that it would require 22 months for initial equilibrium of *A. lumbricoides* infection to be attained in school pupils in Ogun State, Nigeria.

Key words: *Ascaris lumbricoides*, reinfection, primary school pupils, Ogun State.

*Corresponding author.

Introduction

Intestinal parasitic infections are highly prevalent in developing countries, mainly due to deficiency in sanitary facilities, unsafe human waste disposal systems, inadequacy and lack of safe water supply, and low socio-economic status (Savioli *et al* 1992). The burden of disease associated with worm infection is enormous. It is estimated that schistosomiasis and soil-transmitted helminthiasis represent more than 55% of the disease burden due to all tropical diseases, excluding malaria. Most morbidity are seen in pre-school children, school-age children and women of child-bearing age, with symptoms ranging from malnutrition, anaemia, growth retardation, cognitive impairment, increased susceptibility to other infections and even acute intestinal obstruction due to roundworms (WHO 1999).

In Nigeria, intestinal parasites have continued to prevail because of low level of living standards, poor environmental sanitation, and ignorance of simple health-promoting factors. Although the prevalence rates of individual parasites vary considerably in different parts of the country, several studies show that *Ascaris lumbricoides* is the most prevalent intestinal parasite, followed by hookworms, *Trichuris trichiura* and *Strongyloides stercoralis* (Asaolu *et al* 1992, Mafiana, 1995; Mafiana *et al* 1998, Sam-Wobo, 1999; Mafiana *et al* 2000; Ogbe *et al*, 2002).

The dynamics of re-infection are thought to vary according to local factors such as initial prevalence and intensity of infection, environmental and seasonal conditions, and the extent and type of control administered. Quantitative data concerning the patterns of worm re-acquisition from a variety of regions would facilitate the design of large-scale control strategies (Seo, 1983). Information obtained from the studies of Mafiana *et al* (2000) in two small communities explained that theoretically, it would take about 11-12 months to achieve pre-treatment prevalence. An earlier study carried out by Jong-Yil (1983) in Korean villages, a lower equilibrium value of 7-8 months was obtained; in which it was also speculated that the period of 7-8 months may be related to the average life span of the worm, but Chandler and Read (1981), reported the life-span of ascaris to be somewhere between 9-12 months, but Brown and Neva (1983) reported that it could be up to 18 months.

This study was carried out to determine the prevalence, intensity and re-infection rate of *Ascaris lumbricoides* among school children in different parts of Ogun State, in view of the burden of emerging and re-emerging parasitic diseases.

Materials and methods

Ogun State lies approximately between longitude 2°30' and 4°30' E and between latitudes 6°30' and 8°N. It is predominately populated by the Yoruba-speaking tribes of Nigeria whose traditional occupations are agriculture and commerce.

From the soil-geological map of Ogun State, a Local Government Area representing each demarcation was selected, and these are: Coastal Plains Sands I (Alfisols)- Ado-Odo/Otta Local Government; Coastal Plains Sands II (Utisols) - Ogun Waterside Local Government; Upper Coal Measure (Ewekoro formation) - Ewekoro Local Government; Sandstone (Abeokuta formation)- Obafemi-Owode Local Government; and Undifferentiated Basement Complex - Odeda Local Government. Four primary schools were selected from each of the Local Government Areas:

Ado-Odo/Otta Local Government Area: St. Michael's African Primary School, Otta; St. James Primary School, Otta; A.U.D. Primary School, Ado-Odo; All Saints Anglican Primary School, Ado-Odo.

Ewekoro Local Government Area: Baptist Day Primary School, Ewekoro; All Saints School Primary School, Itori; St. Michael's School Primary School, Wasimi; Baptist Central School Primary School, Wasimi.

Odeda Local Government Area: O.L.G Primary School, Itesi -Ajegunle; Methodist Primary School, Odeda; African Church Primary School, Rogun Rogun; O.L.G. Primary School, Obantoko.

Obafemi/Owode Local Government Area: Anglican Primary School, Obafemi; All Saints Primary School I, Owode; All Saints Primary School II, Owode; Nawaruddeen Primary School, Owode.

Ogun Waterside Local Government Area: St. Thomas Anglican Primary School, Abigi; Moslem Pri-

mary School, Abigi; St. Michael's Anglican Primary School, Ibiade; L.G. Primary School, Makunomi.

Prevalence and intensity by direct method

Levamex (containing 40 mg of Levamisole and manufactured by UNIBIOS Laboratories Ltd. India) a broad-spectrum antihelminthic was administered to all participants in the study according to manufacturer's instructions. The pupils who took the drugs in our presence, were each given a labelled screw cap plastic container, about 1.5 litres with an instruction to pass all stools for the next 24 hours into the container. Stool passed within 48 hours of treatment was collected, preserved with 10% formalin and taken to the Parasitology Laboratory in the Department of Biological Sciences, University of Agriculture, Abeokuta. Examination of ascaris was by flushing the stool with running water through a sieve. The worms present were then sorted into sexes and counted. Before fixing the worms in 10% formalin, the length (cm) and weight (gm) were obtained for characterization into young and adult worms. The length measurement was done by tracing a flexible wire through the anterior to posterior ends and the weight was measured on weighing balance.

Statistical analysis

SPSS version 10 employing simple percentiles, paired and sample *t*-tests techniques were used in analysing the prevalence and intensity of infections, in addition to comparing infections and the frequency distribution probability factor (k) of the worms in the study areas.

Re-infection studies

The method used for the prevalence and intensity studies was adopted. Each pupil previously treated was re-treated 6 or 7 months after the initial treatment with levamex. Thereafter, the pupils were requested to void all stools into the 1.5 litre container and bring to the school for two consecutive days. The stools were examined for young worms, which are indicative of fresh infection since the initial treatment.

Using the theoretical equation of Hayashi (1977) for time-prevalence:

$Y = G[1-(1-X)N-R]$ as applied by Jong-Yil (1983)

Where

Y = Prevalence.

X = Monthly re-infection rate.

N = Time elapsed in months.

R = Incubation period for worm maturation.

G = Maximum prevalence to be reached in the area.

The above equation was modified under the consideration that G should be 1(100%) and R be 0 when X and Y values were expressed by worm positive rates as follows: $Y = 1 - (1-X)^N$

The monthly re-infection rate therefore was obtained using the known values of 'Yr' (Young worm positive rate) and 'N' (no in months) according to the equation

$$Y = 1\ (1-X)^2$$

Results

Direct prevalence and intensity of infection

One thousand and six hundred pupils (51% males: 49% females) within the age classes 6-17 years were examined for direct prevalence in the different Local Government Areas (LGAs). The level of compliance of the pupils in the study revealed that Odeda LG School and Obantoko had the least compliance (19%), while the highest was in Anglican School, Obafemi (96.3%). On the whole, there was 62% compliance.

The prevalence and mean intensities of the pupils by direct infection in the different LGAs are shown in Table 1. The mean infection rate in the Obafemi/Owode LGA was 62.6%. Male pupils had 64% and 61.2% for female pupils. There was no statistical significant difference between male and female infection rates (t=-0.60, p=0.656). The mean intensities for the worms voided revealed that male pupils had higher intensity (x=3.3) than females (x=2.7). However, for the Odeda LGA, the mean infection rate was 44.8%. Females had higher infection rate (46.7%) than males (42.8%) with no statistical significant difference between male and female (t=-0.50, p=0.705). The mean intensities for

Table 2: Prevalence and intensity of *Ascaris lumbricoides* by sex in the study areas.

Local Government Area	School	Number examined		Number (%) infected		No of worms voided/mean		Total means no.. of worms Voided/ mean
		Male	Female	Male	Female	Male	Female	
OBAFEMI/ OWODE	NUD SCHOOL, OWODE	24	38	15 (62.5)	23(60.5)	79.(3.3)	97(2.5)	176(2.8)
	ALL SAINTS ANG SCH I, OWODE	29	26	18(62.1)	13(50)	106(3.6)	43(1.6)	149(2.7)
	ALL SAINTS ANG SCH II, OWODE	42	35	19(45.2)	20(57.1)	85(2.0)	105(3.0)	190(2.4)
	ANGLICAN SCHOOL, OBAFEMI	30	30	28(93.3)	23(76.7)	146(4.8)	107(3.6)	253(4.2)
	TOTAL	**125**	**129**	**80(64)**	**79(61.2)**	**416(3.3)**	**352(2.7)**	**768(3.0)**
ODEDA	ODEDA LG SCHOOL, OBANTOKO	7	8	2 (28.6)	3(37.5)	17(2.4)	12(1.5)	29(1.9)
	ODEDA LG SCHOOL, ITESI-AJEGUNLE	29	37	6(20.7)	6(16.2)	13(0.4)	12(0.3)	25(0.3)
	AFRICAN CHURCH SCHOOL, ROGUNROGUN	27	14	9(33.3)	(35.7)	34(1.2)	7(0.5)	41(1.0)
	METHODIST SCHOOL, ODEDA	28	31	22(78.6)	28(90.3)	49(1.7)	72(2.3)	121(2.0)
	TOTAL	**91**	**90**	**39(42.8)**	**42(46.7)**	**113(1.2)**	**103(1.1)**	**216(2.7)**
EWEKORO	ST. MICHAEL ANG SCHOOL, WASIMI	33	31	14(42.4)	4(12.9)	28(0.8)	4(0.1)	32(0.5)
	BAPTIST CENTRAL SCHOOL, WASIMI	29	30	8(27.6)	9(30)	17(0.5)	10(0.3)	27(0.4)
	ALL SAINTS ANG SCHOOL, ITORI	20	16	8(40)	5(31.3)	38(1.9)	16(1.0)	54(1.5)
	BAPTIST DAY SCHOOL, EWEKORO	17	20	9(52.9)	10(50)	22(1.3)	17(0.8)	39(1.1)
	TOTAL	**99**	**97**	**39(39.4)**	**28(28.9)**	**105(1.0)**	**47(0.4)**	**152(0.7)**
ADO-ODO/ OTTA	ST. MICHAELS AFRICAN SCHOOL, OTTA	9	15	4(44.4)	4(26.7)	5(0.5)	8(0.5)	13(0.5)
	ST. JAMES ANG SCHOOL, OTTA	12	15	4(33.3)	5(33.3)	15(1.2)	7(0.4)	22(0.8)
	ALL SAINTS ANG SCHOOL, ADO-ODO	23	22	4(17.4)	4(18.2)	5(0.2)	7(0.3)	12(1.3)
	AUD SCHOOL, ADO-ODO	11	10	3(27.3)	2(20)	4/(0.3)	4/(0.4)	8(0.4)
	TOTAL	**55**	**62**	**15(27.3)**	**15(24.2)**	**29(0.5)**	**26(0.4)**	**55(0.4)**
OGUN WATERSIDE	ST. MICHAEL ANG SCHL, IBIADE	37	32	18(48.6)	13(40.6)	78(2.1)	52(1.6)	130(1.8)
	ST. THOMAS ANG SCHL, ABIGI	27	23	15(55.6)	8(34.7)	41(1.5)	22(0.9)	63(1.2)
	MOSLEM SCHL, ABIGI	28	33	17(60.7)	18(54.5)	41(1.4)	58(1.7)	99(1.6)
	LG SCHOOL, MAKUN-OMI	32	30	28(87.5)	26(86.7)	267(8.3)	219(7.3)	486(7.8)
	TOTAL	**124**	**118**	**78(62.9)**	**65(55.1)**	**427(3.4)**	**351/(2.9)**	**778(3.2)**

the worms voided are male pupils (x =1.2) and females (x=1.1). The mean infection rate in the Ewekoro LGA was 34.2%. Males had higher infection rate (39.4%) than females (28.9%) with no statistical significant difference between male and female (t=1.444, p=0.386). The mean intensities for the worms voided are male pupils (x=1.0) and females (x=0.4). The mean infection rate in the Ado-odo/Otta LGA was 25.6%. Males had higher infection rate (27.3%) than females (24.2%) with no statistical significant difference between male and female (t= -1.00, p= 0.500). The mean intensities for the worms voided are male pupils (x=0.5) and females (x =0.4). The mean infection rate for the Ogun Waterside LGA was 59.1%. Males had higher infection rate (62.9%) than females (55.1%) with no statistical significant difference between male and female (t=2.714, p=0.225). The mean intensities for the worms voided revealed that male pupils had higher intensity (x =3.4) than females (x =2.9).

The study observed that 480 pupils of the 990 pupils who complied with faecal collection passed out worms directly. The result showed that 51.9% male and 48.1% female pupils were infected with *A. lumbricoides*. Statistical analysis showed no significant difference between the infection rates in both sexes (t= 2.60, p=0.234). The study also observed that male pupils voided higher numbers of worms (1090, x = 2.2) than female pupils (879, $\bar{x}$=1.7) in all the study areas. The overall direct prevalence for *A. lumbricoides* was 48.5%; and 30% for the population enlisted for the study.

Pupils within the age bracket of 6-10 years had higher infection rates (66.04%) when compared with the 11-15 years (30.63%), while pupils above 15 years had a low infection rate (0.42%). On the weight distribution of the pupils, the study observed that pupils within the weight range of 31-40kg had 47.8% infection rate than 21-30 kg (45.5%), followed by >40 kg (31%) while 11-20 kg and 1-10 kg categories had infection rates of 27% and 25.6% respectively.

The frequency distribution of *A. lumbricoides* revealed a pattern that is highly over-dispersed and aggregated, with a negative binomial probability factor (k) of 0.45, a mean of 2.39, and a variance of 15.06 for Obafemi/Owode LGA; a k value of 0.37, a mean of 1.23, and a variance of 5.28 for Odeda LGA; a k value of 0.21, a mean of 0.77, and a variance of 3.58 for Ewekoro LGA; a k value of 0.23, a mean of 0.47, and a variance of 1.43 for Ado-Odo/Otta LGA; and a k value of 0.43, a mean of 3.25, and a variance of 27.95 for Ogun Waterside LGA.

Re-infection analysis

From the 1,237 pupils who participated in the study, a total of 102 young worms were voided by 70 young worm positive cases with a mean worm burden of 1.4 worms. The young worm positive rates in the study areas were in the range of 3.2 to 8.2%.

Table 2: Reinfection rate profile of *Ascaris lumbricoides* in the different Local Government Areas.

Local Government Area	Initial worm positive case (%) Y	Number treated after six and seven months	Number examined	Young worm positive case (%) Yr	Number of young worms voiced	Reinfection** rate (%) X	N***
OBAFEMI/OWODE	159 (62.6)	245	224	20 (8.2)	26	4.2	22.92
ODEDA	81 (44.7)	222	174	10 (4.5)	15	2.3	25.45
EWEKORO	67 (34.2)	217	196	7 (3.2)	10	1.6	25.9
ADO-ODO/OTTA	30 (25.6)	269	220	12 (4.5)	19	2.3	12.7
OGUN WATERSIDE	143 (59)	284	232	21 (7.4)	32	3.8	21.8
TOTAL	480	1237	1046	70	102	(=2.84	(=21.75

** Calculated from X = 1 -(1-Yr

*** Calculated from $N = \frac{\ln(1-Y)}{\ln(1-X)}$

Of the initial 480 worm positive cases, 70 cases were positive for young worms (Table 2). Using the theoretical equation of Hayashi (1977), as applied by Jong-Yil (1983) where $Y = G\,[1-(1-X)^{N-R}]$. The calculated monthly re-infection rates (X) for the LGAs are: Ewekoro (1.6%), Odeda (2.3%), Ado-Odo/Otta (2.3%), Ogun Waterside (3.8%) and Obafemi/Owode (4.2%). The mathematical mean of X values in the study areas for Ogun State was 2.84. The calculated re-infection time (N months) for the LGAs are Ado-odo/Otta (12.7), Ogun Waterside (21.8), Obafemi/Owode (22.92), Odeda (25.45), and Ewekoro (25.9). The mean value for N in Ogun State was 21.75. This reveals that following mass chemotherapy of school pupils with Levamisole antihelminthic, it would require an approximate 22 months for initial equilibrium of *A. lumbricoides* infection to be attained in school pupils in Ogun State, Nigeria.

Discussion

The study has shown the overall prevalence by direct intensity of *A. lumbricoides* in Ogun State through the school system to be 48.5%. However results from different communities in the study (Table 1) revealed prevalence levels from 17.8 to 87.1%, which also confirm earlier reports by Mafiana 1995; Mafiana *et al* 1998; Sam-Wobo 1999; and Ogbe *et al* 2002 that have investigated the prevalence of soil- transmitted helminths in areas of Ogun State and south-west Nigeria, and adduced the high prevalence to the high biotic potential of the worm as well as the ability of the eggs to withstand adverse conditions.

Some recent studies (Curtale *et al* 2003, Olsen 2003), had advocated the use of the school system approach to soil-helminth therapy. Results obtained from this study indicated an overall compliance of 62%. Olsen (2003) had reported between 29 and 39% level of absenteeism in school during helminth control programs. The study also observed that parents and guardians still nurse the fear of their children/wards faeces being used for fetish purposes. This same observation had been made by Sam-Wobo (1999); in a study on soil-transmitted helminths in some rural communities in Abeokuta North LGA of Ogun State. The fear by parents and community dwellers that faecal samples could be used for fetish purposes had also contributed to varying levels of compliance in faecal studies. Ukoli (1990) attributed it to level of ignorance on the part of parents and guardians.

The high infection rate recorded in Obafemi/Owode LGA and Ogun Waterside LGA may be attributed to the fact that the areas are semi-urban in nature, and the housing nature at the communal level are compact which may also predispose healthy individuals to level of infections with *A. lumbricoides* due to indiscriminate defaecation. Evidence that such infection with ascaris occurs around the home has been studied by some authors (Haswell-Elkins *et al* 1989; Forrester *et al* 1990; Asaolu *et al* 1992; Kightlinger *et al* 1998), which suggest that housing style in addition to the number of people sharing a house are important factors determining parasite distribution between families.

Generally, the intensity of ascaris infection was low in most of the schools studied which may be a reflection of the location or environment of such school. However, there were apparently heavier infections observed in some of the semi-urban schools. For instance, LG Primary School, Makun-Omi had 87.5% worm positive cases, with 486 voided worms and an arithmetic mean of 7.8 worms per pupil. This again may reflect greater contamination of the soil in the inner areas of the villages where they live.

The study revealed that the frequency of *A. lumbricoides* were over-dispersed or aggregated (negative binomial) within their host populations, where many pupils harbour few ascaris, and a few pupils harbour large numbers of ascaris. The causes of this heterogeneity are many and varied, but Anderson (1986), associated them with variability in host susceptibility. Such variability may be due to differences in host behaviour (Haswell-Elkins *et al* 1989), spatial aggregation of infective stages or differences in the ability of individual hosts to mount effective immunological responses to parasite invasion (Mcsharry *et al* 1999).

This study also revealed that 6-10 years old pupils had the highest prevalence rate of worm positive cases when compared with the other age groups. This observations confirmed reports by Asaolu *et al* (1992), Mafiana *et al* (1998), which attributed

the trend to changes in behaviour and hence exposure to infection. The study revealed no significant difference in the percentages of infected male and female pupils.

The re-infection rate *N* mean value of 21.75 months in the school system in Ogun State, is higher than the 11-12 months reported earlier by Mafiana *et al* (2000) of some rural communities in Ogun State. The implication of this result is that if all school pupils in the different LGAs were completely treated with levamisole, pre-treatment prevalence rates of *A. lumbricoides* would be attained after 22 months. Assuming the point prevalence represents roughly, the equilibrium state, the 22-month period would be considered the time required from one time mass treatment, for initial prevalence to return to equilibrium in Ogun State.

The determination of worm burden by chemotherapy-induced expulsion of helminths particularly ascaris by one dosage treatment with levamisole is indicative that chemotherapy is the best option for treatment (Haswell-Elkins *et al* 1989; Holland *et al* 1989; Guyatt *et al* 1995). Therefore, the repeated treatment of communities with antihelminths at less than 22 months interval in school pupils and communities would drastically reduce and eliminates the parasite. A possible problem of compliance arises since evidence from the study had revealed the influence of parents which could continue to increase the burden of re-emerging parasitic diseases.

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