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Original Article

Anthropogenic Indices of Soil-Transmitted Helminthiasis among Children in Delta State, Southern Nigeria

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Abstract

Background: The prevalence and intensity of soil-transmitted helminth infections and the anthropogenic risk factors of 978 randomly selected primary school children from Igbede community in Isoko South Local Government Area of Delta State Southern Nigeria were evaluated.

Methods: Subjects were screened for the presence of STH using direct smear method and kato-katz techniques. This study was conducted between April and December, 2007 and comprised of 516 (52.76%) males and 462 (47.24%) females between the age of 5 and 13 years.

Results: Nine hundred and seven (92.74%) of the subjects were infected by soil-transmitted helminthes (STH). The overall prevalence by species was *Ascaris lumbricoides* (76.89%), Hookworm (54.60%) and *Trichuris Trichiura* (29.24%). Three hundred and eight two (39.40%) were infected with two or more STH. The prevalence and intensity of all species of STH significantly varied with age ($P< 0.05$), with highest prevalence in age group 5-7 years. The sex related prevalence showed that males were more infected for all species of STH than females, but this was only statistically significant for hookworm ($P< 0.05$). Multiple logistic regression analysis for the epidemiological variable showed that walking barefoot was the only risk factor for hookworm infection while licking of fingers as well as drinking from well and surface tank was risk factors for *A. lumbricoides* and *T. trichiura* infections.

Conclusion: Considering the high prevalence of STH observed from this study, establishment of sustainable and regular deworming programme in the community coupled with health education messages on good hygienic practices are highly essential.

Keywords: *Soil transmitted helminthiasis, School Children, Nigeria*

Introduction

One of the principal factors contributing to children morbidity and mortality in the tropical countries is the high prevalence of intestinal infections. These infections have been associated with low standard of sanitation as well as poverty, and approximately 480-500 million children are infected and mortality ranges from 40,000 to 130,000 persons per year (1). School age children are one of the groups at high-risk for intestinal infections. The adverse effects of intestinal parasitic infections among children are diverse and alarming. Intestinal parasitic infections have detrimental effects on survival, appetite, growth, school attendance and cognitive performance of school age children (2). There are several reports from various parts of Nigeria on intestinal helminthes (3-5).

However, sufficient attention has not been given to Igbede community; a remote, rural community where health and environmental facilities and structure are poor, inadequate or altogether lacking. This community reflects the situation of most remote communities in developing countries where the absence of regular and sustained intervention could be detrimental to the well being of growing children. With these prime factors in mind and with the recommendation of the World Health Organization (WHO) that baseline survey is carried out among school children to determine the prevalence and intensity of infections (6). In addition, baseline sur-

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veys provide basis for development of control programmes at national, state and local levels.
In Nigeria, various baseline surveys have been carried out to estimate the status of soil transmitted infections (3, 5, 7). This study was undertaken to add to the growing pool of essential baseline data on the prevalence and intensity of soil transmitted helminth infection in Nigeria. The relationship between intensity of infections and the anthropogenic indices of subjects in the study area is also examined.

Materials and Methods

The Study Area and subjects

Igbede is a tropical rural community in Isoko South Local government area of Delta State Southern Nigeria. It is located within latitude 6'10 - 6'18 and longitude $6'10^0$ - $6'\ 15^0$E of the Greenwich meridian. It is found within the tropical rainforest belt in Nigeria. The area has a relatively high temperature ranging from 25 ˚C to 27 ˚C in the wet season but rises a little to between 27 ˚C to 30 ˚C during the dry season. The community is characterized by a plain landscape with pockets of hills and slope. It experiences heavy flooding during the rainy season resulting in gully erosion in some areas. The major drainage system is the Owodokpokpo River.
The inhabitants of this metropolis are a mixture of people from various ethnic groups in Nigeria, although the majority is the Isoko speaking people of Delta State. They are mainly civil servants, traders, farmers, artisan workers, transport workers anglers and sand dredgers. The sources of water supply in the community are; pond water, wells, stream, pipe borne (tap water), which runs occasionally and borehole water. Latrine facilities include; water closets, pit latrines, while others defecate in the nearby bush sometimes in well dug out open trenches. The heavy flooding during the rainy season occasionally increases sanitation problems. This can be attributed to the inadequate sewage and refuse disposal facilities.
The subjects were 978(516 males and 462 females) primary school children between the age of 5 and 13 yr randomly selected with the lottery method described by (8) from the primary schools within the community. Data such as age, sex, parents' occupation, type of toilet facility and source of drinking water among others were obtained from each child using a well-structured questionnaire.

Collection and Examination of Samples

Verbal consent was obtained from headmasters of the schools before stool containers were distributed to subjects. The class teacher assisted in the filling of the questionnaire as well as educating the subjects on method of collection the stool. The stool samples were collected in the morning and examined in the afternoon by direct smear method and Kato-Katz method to quantify the number of eggs per gram of faeces (9). The examination of stool samples was carried out in the research laboratory of the Department of Zoology, Delta State University Abraka. To ensure consistency of the readings, second readings were performed in 20% of the slides randomly selected (6).
All statistical analyses were performed using SPSS for windows version 11.0 (SPSS inc, Chicago, IL, USA). Differences in the prevalence and intensity were tested using Chi square and one- way ANOVA test respectively. Multiple logistic regression analysis was used to determine independent effects of variables on the prevalence of geohelminths infections.

Results

A total of 978 pupils were examined for soil transmitted helminthes (STH) infections, consisting of 516 (52.76%) males and 462 (47.24%) females. The study indicated that 907 of the 978 children were positive for one or more helminths infection therefore revealing a general prevalence of 92.74%. In all only three helminthes were observed in the infected stool samples; these includes *A. lumbricoides*, hookworm and *T. trichiura.*
Data on table 1a shows that the prevalence of the observed STH parasites was significantly dif-

ferent ($P< 0.05$) with age of subject. *A. lumbricoides* infection was the most prevalent parasite among the pupils, its prevalence though, decreases with age, and pupils within the age 5-7 yr had the highest prevalence (90.26%) while those in age group 11-13 yr recorded the least (68.97%). With respect to hookworm infection, the trend is contrary as the prevalence increases with age, with the highest prevalence of 78.45% in age group 11-13 yr while subjects in age group 5-7 yr had the least prevalence of hookworm (44.16%). Similarly, the prevalence of *T. trichiura* followed similar trend of increasing prevalence with age. Considering the mean egg count for all infected subjects in the various age groups, the prevalence trend, was maintained apart from that of *T. trichiura,* which revealed a significant difference ($P< 0.05$) egg load with age group.

Table 1b further reveals that multiple infection among the subjects is not uncommon as 36.36% of subjects positive for *A. lumbricoides* also had hookworm while co-infection of *A. lumbricoides* and *T. trichiura* (10.22%), hookworm and *T. trichiura* (6.13%) while 3.48% of the subjects have the three parasites.

Table 2a indicates the prevalence and intensity of STH with respect to sex. The figures reveals that the mean prevalence and intensity of STH infections was relatively higher among males subjects than in females for all STH infection, though, no significant difference was observed except for the prevalence of hookworm ($P< 0.05$) as well as the intensity of *T. trichiura*. The gender related multiple infections showed no significant difference (Table 2b).

Table 3 shows the results of multiple logistic regression analysis. The data shows that the risk of infection with the helminth parasite was high for subjects who regularly eat soil (geophagy) and those without toilet facilities in their homes ($P< 0.001$). There was marginal risk of hookworm infection in pupils who are occasionally geophagic (OR 2.09, 95% CL 1.17-2.81, p-0.038) and regularly lick or bite their fingernails (OR 1.58, CL 1.04-3.78, *P*-0.046). Walking barefoot was identified as the only significant predictor for hookworm infection at regular (OR 4.39, 95%CL 2.59-7.45, p-0.001) and occasional (OR 2.24, 95%CL 1.16-4.30, *P*-0.016) levels. There was no association between infection of the three species of geohelminths and the use of river or stream as sources of drinking water. However, children who used hand-dug wells and tanks as source of drinking water were at significant increased risk of *A. lumbricoides* (OR 0.02, 95%CL 0.007-0.08, *P*-0.001) and *T. trichiura* (OR 0.06, 95%CL 0.02-0.20, *P*-0.004). Children whose parental occupation is farming were at significantly higher risk of hookworm (OR 0.19, 95%CL 0.11-0.32, *P*-0.001) and *A. lumbricoides* (OR 0.06, 95%CL 0.30-0.12, *P*-0.001) than *T. trichiura* (OR 3.17, 95%CL 1.09-2.58, *P*-0.006).

Table 1a: Prevalence and Intensity of Soil Transmitted Helminthes (STH) by age of Pupils in Igbede Community, Delta State, Southern Nigeria

Age (yr)	n	Parasite					
		A. lumbricoides		**Hookworm**		***T. trichiura***	
		No infected (%)	**Epg±SE**	**No infected (%)**	**Epg±SE**	**No infected (%)**	**Epg±SE**
5-7	308	278(90.26)	275.60±131.00	136(44.16)	66.80±19.40	36(11.69)	75.80±6.02
8-10	438	314(71.69)	389.70±197.80	216(49.32)	120.20±33.60	94(21.46)	92.40±12.06
11-13	232	160(68.97)	384.30±192.40	182(78.45)	83.80±39.61	156(67.24)	88.12±717.80
Total	978	752(76.89)	322.80±133.60	534(54.60)	93.86±21.02	286(29.24)	85.20±9.21
P value		<0.05	NS	<0.05	NS	<0.05	NS

NS= not significant; Epg= Eggs/grams; *A. lumbricoides* (x^2=22.9), Hookworm (x^2 = 35.9), *T. trichiura* (x^2 = 110.3)

Table 1b: Multiple Infection Prevalence and Intensity of Soil Transmitted Helminthes (STH) by age of Pupils in Igbede Community, Delta State, Southern Nigeria.

Age (yr)	n	Parasite			
		***A. lumbricoides* + Hookworm**	***A. lumbricoides* + *T. trichiura***	**Hookworm + *T. trichiura***	***A. lumbricoides* + *T. trichiura* + Hookworm**
		No infected (%)	**No infected (%)**	**No infected (%)**	**No infected (%)**
5-7	308	112(36.36)	28(9.09)	22(7.14)	12(3.90)
8-10	438	174(39.73)	48(10.96)	28(6.39)	18(4.11)
11-13	232	96(41.38)	14(6.03)	10(4.31)	4(1.72)
Total	978	382(39.90)	100(10.22)	60(6.13)	34(3.48)
P value		NS	NS	NS	NS

NS= not significant; Epg= Eggs/grams; *A. lumbricoides* (x^2=22.9), Hookworm (x^2 = 35.9), *T. trichiura* (x^2 = 110.3)

Table 2a: Prevalence and Intensity of Soil Transmitted Helminthes (STH) with regard to Sex among Pupils in Igbede Community, Delta State, Southern Nigeria.

Parasite	Sex				Total (n=978)		*P* value
	Male (n=516)		Female (n=462)				
	Number infected (%)	Epg±SE	Number infected (%)	Epg±SE	Number Infected (%)	Epg±SE	
A. lumbricoides	396 (76.74)	337.8±129.20	356(77.06)	302.10±112.30	752(76.89)	321.2±116.40	NS
Hookworm	350(67.83)	99.80±29.02	184(39.83)	87.4±23.80	534(54.60)	93.8±25.50	<0.05
T. trichiura	164(31.78)	98.20±12.60	122(26.41)	71.10±9.60	286(29.24)	85.20±9.02	<0.05

NS = not significant, Hookworm (x^2 =38.6), *A. lumbricoides* + Hookworm (x^2 =5.6)

Table 2b: Multiple Infection Prevalence and Intensity of Soil Transmitted Helminthes (STH) with regard to Sex among Pupils in Igbede Community, Delta State, Southern Nigeria.

Parasite	Sex		Total	*P* value
	Male	Female		
	Number infected (%)	Number infected (%)	Number infected (%)	
A. lumbricoides + Hookworm	176(34.11)	206(44.59)	382(39.06)	NS
A. lumbricoides + *T. trichiura*	56(10.85)	44(9.52)	100(10.22)	NS
Hookworm + *T. trichiura*	28(5.43)	32(6.92)	60(6.13)	NS
A. lumbricoides + *T. trichiura* + Hookworm	16(3.10)	18(3.90)	34(3.48)	NS

NS = not significant, Hookworm (x^2 =38.6), *A. lumbricoides* + Hookworm (x^2 =5.6)

Table 3: Multiple Logistic Regression Analysis for the Association between the Epidemiological Variables and Soil Transmitted Helminthes (STH) among Pupils in Igbede Community, Delta State, Southern Nigeria.

Variables	*A. lumbricoides*		Hookworm		*T. trichiura*	
	Odd ratio (95% Cl)	***P***	**Odd ratio (95% Cl)**	***P***	**Odd ratio (95% Cl)**	***P***
Eat Soil (Geophagy)						
I do not	1.00		1.00		1.00	
Regularly	5.77(2.92-11.41)	<0.001	4.18(1.43-12.24)	0.009	1674(6.04-46.35)	<0.001
Occasionally	9.98(4.61-21.61)	<0.001	2.09(1.17-2.81)	0.038	5.35(1.45-19.8)	0.012
Lick Finger/Bite Nails		0.000		0.046		0.035
I don't	1.00		1.00		1.00	
Regularly	1.10(0.62-3.38)	<0.001)	1.58(1.04-3.78)	0.046	2.65(1.45-4.83)	0.002
Occasionally	1.19(0.49-2.82)	Ns	0.62(0.37-1.04)	Ns	1.72(1.04-2.85)	0.035
Walk Barefooted						
I don't						
Regularly	1.66(1.34-3.96)	Ns	4.39(2.59-7.45)	<0.001	0.54(0.20-1.45)	NS
Occasionally	2.79(0.52-5.74)	Ns	2.24(1.16-4.30)	0.016	0.70(0.40-1.23)	NS
Site of Defaecation		0.041	0.000			0.004
Water Closet	1.00		1.00		1.00	
Pit Toilet	1.66(1.34-3.96)	0.041	1.90(0.19-6.59)	Ns	0.64(0-0.31)	NS
Bush/No Toilet	29.24(12.58-67.95)	<0.001	4.30(2.19-8.42	<0.001	0.19(0.06-0.59)	0.004
Source of Drinking Water		0.000				0.000
Bore-hole	1.00		1.00		1.00	
Wells/tanks	0.02(0.007-0.08)	<0.0010.	0.49(0.19-1.26)	Ns	0.06(0.02-0.20)	<0.001
River/Stream	0.085(0.53-1.36)	Ns	1.21(0.82-1.79)	Ns	0.78(0.51-1.21)	NS
Occupation of Parents		0.007		0.039		0.006
Wage earner	1.00		1.00		1.00	
Farming	0.06(0.30-0.12)	<0.001	0.19(0.11-0.32)	<0.001	3.17(1.09-2.58)	0.006
Trading/self-employed	0.13(0.69-0.26)	0.007	0.54(0.35-0.84)	<0.001	0.78(0.51-1.21)	NS

Discussion

Parasitic diseases are considered a major health problem causing great suffering in the tropical and subtropical countries (10). Infected School children are often physically and mentally compromised by malnutrition, leading to cognitive deficits, learning disabilities and high school absenteeism (11).

The high rate of positivity, for helminth infection among school children indicates that much attention is required and the implication of this with respect to school absenteeism and performance are enormous and this is a clear reflection of high rate of asymptomatic carriers in Igbede community. Consequently, the outcome adds to the store of baseline data on the occur-

rence of helminth infections among school children in Nigeria. The overall prevalence of 92.74% of helminthes among school children in Igbede community is in line with report of (5) who observed prevalence of 94.00% in Ondo state an area of same ecological zone. Contrary, the prevalence is higher than the findings elsewhere in the southern Nigeria (12, 4). This observation is expected because of the differences in study age groups, environmental contamination and degree of sanitation in the communities. More so, this prevalence has been attributed by several authors to improper hygiene, poverty, poor sanitary conditions and agricultural habits (13, 14).

Strongyloides infections were not observed, however this kind of infection has never been common in Delta State. The study further reconfirms the triad patterns of *Ascaris*-hookworm-*Trichuris* infections common in rural communities in Nigeria and Africa at large (15). Of all the intestinal helminthes observed, *A. lumbricoides* had the highest prevalence of 96.89%. Similar findings were made by *(*13, 15 16). They separately report that *A. lumbricoides* was the predominant parasite observed among school children. The low infection rate of hookworm in this study could be attributed to climatic conditions as (17) had earlier observed high prevalence rate for hookworm during rainy season. Infective hookworm larvae in the soil are much more dependent on soil composition and moisture content of the soil (18). The prevalence of 29.24% for *T. trichiura* is in contrast to findings made by (13, 19) among school children.

The occurrence of multiple infections is consistent with reports in other parts of the country (16, 17, 20). *A. lumbricoides* and hookworm had the highest prevalence (39.40%), followed by *A. lumbricoides* and *T. trichiura* (10.22%). This observation does not agree with reports of (5) who reported that *A. lumbricoides* and *T. trichiura* had the highest prevalence (33.10%). However, the triad of *Ascaris*-Hookworm-*Trichuris* infections was further confirmed by the report of (5). The observation of such pattern of infection is a clear indication that the physical and chemical composition of the soil promotes the transmission of helminth parasites, other possible contributory factors includes high human exposure to infective stage as well as environmental pollution resulting from indiscriminate defecation and dumping of refuse in the study area.

With respect to age of children, the prevalence of infections with the species of helminths showed significant variation with age of children ($P< 0.05$). Although the age group 5-7 yr had the highest prevalence of *A. lumbricoides* (90.26%), the prevalence gradually decreases with age of children while for other helminth (*T. trichiura* and hookworm) the prevalence gradually increases with age. The trend in the prevalence of helminthes parasite among this age group shows a common pattern of behavior and susceptibility for age group as children within these age groups probably spend more time playing where they often come in contact with infected soil. More so, they tend to eat indiscriminately sometimes with unwashed hands. However, the decrease of the prevalence with age particularly for *Ascaris* infection could be attributed to the fact that with increase in age the children are becoming more conscious of personal hygiene as well as development of resistance via increase of immunity. While the increase of prevalence of infection with age for hookworm and *Trichuris* gives an indication of the exposure patterns of the children considering that they are becoming more active and adventurous with age. The observation in the prevalence of helminth parasites with age is in conformity with the findings of (17) in Abia state as well as reports from Ogun state (21).

Although, the prevalence of the helminth infection by sex show higher prevalence among males than their female counterpart in all species of the helminth parasites no significant difference was observed ($P<0.05$) except in infection with hookworm ($P> 0.05$). This finding is in consonance with observations of (5, 16, 17) who separately reported higher preva-

lence of helminth parasites among males. This further confirm the special male activities such as playing football, sun bating on soil as well as molding of houses using moist soil, which predisposes them to infections. Sometimes these activities are carried out bare footed. This could account for the high and significant difference in the prevalence in males (67.83%) than in females (39.83%) for hookworm infection.

Investigation on the association of individual behavioral activities in relation to prevalence of infections confirms the existence of variable factors associated with different species of helminth parasites. The risk of eating soil (geophagy), licking of fingers and drinking well or tank water were significantly higher risks for *A. lumbricoides* and *T. trichiura* infections than hookworm, which only associated with walking barefoot. Other variables like drinking river or stream waters had no effect on the transmission of any of the helminth parasite in the study community. This observation is not in consonance with previous report (12) who observed an association between ascariasis and drinking tap and stream waters. The difference may be attributed to the location of water body with respect to human habitation as well as the level of human pollution in and around the water body.

Findings from this study reveal that intestinal helminthes such as *A. lumbricoides, T. trichiura* and hookworm are common worms found among primary school children in Igbede community. The transmission of intestinal helminthes infection is often associated with poverty, poor environmental sanitation and contamination of environment with human waste among others. The considerable high level of intestinal helminthes in pupils examined is a reflection of the poor state of hygiene in the community. Given that there is no association between prevalence and some of the factors examined is a disturbing indication that the eggs/infection has the potential to spread widely to different persons as well as locations. Therefore, improved sanitation, health education, and school based health programme as well as very deworming of the pupils will go a long way in reducing infection and consequently the associated morbidity.

It is therefore suggested that prospective studies be carried out to access the impact of intestinal worms in school children especially as regards school performance and growth.

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The authors declare that there is no conflict of interests.

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