Soil Transmitted Helminth Infections in Indigenous Communities of Anambra State: The Role of Sanitation, Human behaviour and Socio-Economic Factors

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Abstract: ***Soil transmitted helminths (STHs) are known to be endemic in developing tropical countries. A study to determine the relationship between sanitation, human behaviour, socio-economic factors and soil transmitted helminth infections in indigenous communities of Anambra State, Nigeria was undertaken between a two-year interval (February 2016to July, 2018). The stool samples were collected from 2,787residents aged 1 – 60 years in the nine communities of Ihiala L.G.A. and analyzed using direct normal saline and formal-ether concentration technique for the presence of STHs while Kato-Katz technique was used to determine the intensity of infections. Structured questionnaires and direct observations were used for collection of data on sanitation, human behaviour and socio-economic factors associated with STHs. Four different soil transmitted helminths were observed with overall prevalence of (54.1%). These included hookworm 614(22.0%), Ascaris lumbricoides611(21.9%),Trichuris trichiura 207 (7.4%) and Strongyloides stercoralis 75(2.7%). Multiple infections were however observed in473(31.4 %) individuals. Thehigher prevalence of (76.0%, 65.4%, 70.6%, 81.1%, 67.7%, 55.4%, 63.7%) were found among farmers, those who drinks water from underground tanks, defecates in bushes, eats with unwashed hands, do not wash hand after defecation, do not wash vegetables and fruits before consumption and walks bare-footed respectively. The individual sanitation and social behaviour had important role in helminth infection. STHs infections could be reduced by improved sanitation facilities and the utilization of safe water sources as well as change in human behaviour. In addition, health education programs aimed at indigenous farmers is likely to play a significant role in the reduction of roundworm infection in the community.***

Keywords: Soil transmitted helminths, Sanitation, Human Behaviour, Socio-economic factors, Infections

1. Introduction

Soil transmitted helminths (STHs) infections also known as geohelminths are among the mostprevalent of chronic human infections worldwide. The four most common nematode worms that infect humans are: the roundworm, *Ascaris lumbricoides*; the whipworm, *Trichuris trichiura*; and, the hookworms, *Ancylostomaduodenale* and *Necatoramericanus* [Bethony *et al*., 2006; Hotez*et al*., 2006]. These intestinal parasites infect humans through exposure to eggs or larvae that develop in the environment after being deposited in faeces [Brooker et al., 2006]. Eggs and larvae thrive in warm, moist soils of the tropics and subtropics, particularly in poorer areas with inadequate access to sanitation [Hotez *et al*., 2006; Brooker *et al*., 2006]. Recent estimates suggest that among 800 million people in sub-Saharan Africa, 130 million are infected with hookworm, 50 million with *A. lumbricoides*, and 37 million people with *T. trichiura* [Feachem, 1983]. Socio-economic conditionsinfluence the socio- behaviour of individual with respect to primary health, improve sanitation and safe water, an important contributor to helminthiasis (*Karagiannis*, 2006). Geohelminths infections rate increases in individuals with lack of health education, poor sanitation, lack of safe water supply, primary health, household hygiene and personal behaviour (WHO, 2012).

Human behaviour plays an important role in the transmission of geohelminths infections. The behavioural aspects of the people have been recognized to be of significance in the epidemiology of most parasitic diseases in tropical Africa (Ikoh&Useh, 1999; WHO, 2008). Such human behaviour as defaecating in nearby bushes tends to increase the prevalence of geo-helminths infections. For instance, Nock *et al.*, (2003) observed that open-air defecation is a common practice among the residents of Samaru, Zaria, Nigeria. Adequate sanitation together with good hygiene and safe water, are fundamental to good health and to social and economic development.

The cycle that leads to faecal-oral disease transmission begins with poor sanitation. Failure to dispose of human excreta safely can contaminate the environment and new victims through a variety of routes. Poor personal and household practices can spread disease in many ways. Even when acceptable sanitation facilities are installed the risks are not eliminated as poor hygiene practices can spread the disease through a variety of faecal-oral routes (Cairn cross *et al.*, 1996). Poor sanitary habit like eating with unwashed hands also increases the chances of contacting geohelminths infections (Atu*et al.*, 2006).

Within this context, a cross-sectional study was conducted to provide a comprehensive data of the current status on sanitation, human behaviour and socio-economic factors associated with the high prevalence of STHs among indigenous communities in Ihiala L.G.A. Anambra State, Nigeria. The establishment of such data will be beneficial for the public health authorities to reassess the effectiveness of the current control programme (i.e., deworming programme every six months and the usage of a broad spectrum anti-helminthics such as albendazole and mebendazole) and planning of more specific control strategies and policies in combating the infections among these indigenous communities.

2. Materials and Methods

Ethics Statement: Ethical clearance was obtained from the Ministry of Health, Anambra State, Nigeria and the Local Government Public Health Unit before the commencement of the study. Written informed consents were obtained from study participants while those of minors were gotten from their parents. The participants wereproperly enlightened on the aims, objectives,benefits and protocols of study, and the need for voluntary participation and the right to stop participation at any time.

Study Area and Population: The study was conducted in nine communities of Ihiala Local Government Area of Anambra State, South Eastern Nigeria. The various communities in Ihiala LGA include Ihiala, Okija, Uli, Amorka, Azia, Mbosi, Lilu, Ubuluisiuzo, Isseke and Osmorghu. Theheadquarters is at Ihiala. Ihiala is a heavy rainforest region and is located between latitude $6^{0}45^{1}$N and longitude $7^{0}05^{1}$E. Ihiala L.G.A is pre-dominated by the Ibos and it covers an estimated area of 92 square kilometres. It is made up of both semi urban and rural settlements of about 302,277 persons comprising of 152, 200 males and 150, 077 females. (Federal Republic of Nigeria, official gazette, 2009). The rainy season which is between March – October and the dry season which is betweenNovember – February. The average humidity is 90%.The study area consists of low-lying land with ultisol-type soils of the coastal plains. Thesegeographical features together with economic and socio cultural factors favour the survival, transmission as well as spread of STHs in thearea. Inhabitants of the area are mostly farmers and petty traders.

There are ten Health government health centres and health posts located in each of the towns. However, Our Lady of Lourdes Hospital, Ihiala (A mission hospital) is the largest, and it serves all the towns in the L.G.A. There are also many private hospitals as well as many homeopathic hospitals.Tertiary institutions like Chukwuemeka Odumegwu Ojukwu University, Uli, School of Nursing and midwifery Ihiala and Madonna University, Okija are all located in the Local Government Area. There are 17 Government owned secondary schools and 21 private secondary schools in the L.G.A and over 50 primary schools in the Local Government Area.

The major sources of drinking water are streams, rivers, borehole and underground and surface tanks. The excreta disposal system is inadequate in the L.G.A as most households have pit latrines detached from the living places while others lack proper toilet facilities and defaecate in nearby farmlands and bushes. About 85% of the people are Christians and few traditionalists but all enjoy equal citizenship.

Population structure

The study population comprised of 152, 200 males and 150, 077 females aged 1 to 60 years residing in the ten communities of Ihiala LGA.

Sample selection

Sample selection was done using a combination of stratified and systematic random samplings. Villages in the communities were randomly selected using stratified random sampling technique whereas households in the villages were selected using systematic random technique where one household was selected out of every ten households. Male and female were randomly selected from the selected households.

Data Collection

The study data were obtained using structural questionnaire with open and closed ended questions and laboratory analysis of stool samples.

Survey Questionnaire

A structured questionnaires and direct observation were used to obtain information on factors associated with soil transmitted helminthiasis such as sanitary facilities, hygiene, sources of drinking water and demographics of the household.

Stool Collection and Examination

A total of 2, 787 stool samples were collected from the community members recruited for the study. The stool samples were collected in wide mouthed screwed containers and transported to the laboratory for processing and analysis. The participants were properly educated on how to collect the stool specimen to avoid contamination by urine, water and free living organisms. The returned completed form and stool samples were assigned a code number for identification. The containers were distributed in the evening while the stool samples were collected in the early morning hours. The stool samples were then fixed immediately in 10% formalin before taken to the laboratory for analysis. All samples collected were analysed within 2-6 hours of collection or put in the refrigerator.

The stool samples were first examined macroscopically to show consistency of the stool. Then examined microscopically using wet preparation method and where it reveals no organism, the more sensitive formol ether concentration technique was applied to determine the presence or not of these geohelminths parasite. The parasites ova and larvae were identified as described by Jeffrey & Leach, 1975. The intensity of infections was determined using kato-katz technique according to WHO, (1991).

Data Analysis

Data collected from the study were analyzed using percentages. Differences in the STH prevalence between sexes were tested using the t-test and among ages and communities using one way analysis of variance(ANOVA). Responses from the questionnaires were tested using Chi square (ℵ2). All theanalyses were done using the Statistical Package for Social Sciences (SPSS) version 16.

3. Results

Table 1shows the distribution and prevalence of different species of Geohelminth parasites in 10 communities of Ihiala L.G.A. From the diversity Index calculated it was discovered that the prevalence of the different species depends on the community.

Table 1: Prevalence of different species of geohelminths parasites in 10 Communities of Ihiala L.G.A

Community	No. Examined	Al No.+ve (%)	Hk No. +ve (%)	Ss No. +ve (%)	Tt No.+ve (%)	Total No.+ve (%)
Okija	494	100(20.2)	140(28.3)	11(2.3)	22(4.5)	273(55.3)
Ihiala	486	134(27.6)	106(21.8)	14(2.9)	32(6.6)	286(58.9)
Uli	402	98(24.4)	102(25.4)	9 (2.2)	28 (7.0)	237(59.0)
Amorka	200	36(18.0)	52(26.0)	4(2.0)	4(2.0)	96(48.0)
Azia	300	41(13.7)	62(20.7)	13(4.3)	35 (11.7)	151(50.3)
Isseke	234	59(25.2)	48(20.5)	10(4.3)	30(12.8)	147(62.8)
Mbosi	246	66(26.8)	34(13.8)	4(1.6)	18(7.3)	122(49.6)
Osmorghu	144	32(22.2)	19(13.2)	4(2.8)	10(6.9)	65(45.1)
Lilu	158	28(17.7)	18(11.4)	4(2.5)	19(12.0)	69(43.7)
Ubuluisiuzo	123	17(13.8)	33(26.8)	2(1.6)	9(7.3)	61(49.6)
TOTAL	2,787	611(21.9)	614(22.0)	75(2.7)	207(7.4)	1,507(54.1)

Key to the Table
AL = *Ascaris lumbricoides* SS = *Strongyloides stercoralis*
HK = Hookworm Tt = *Trichuris trichiura*

Table 2shows the sex-specific prevalence of Geohelminth parasites in the study Area. Geohelminth parasites were recorded more in males (59.8%) than in females (49.4%) and this was observed to be statistical significant at 0.05% significant levels.

Table 2: Sex-specific prevalence of Geohelminths parasites in the study area

Parasite	Hookworm No. +ve (%)	*Ascaris* No. +ve (%)	*Trichuris* No. +ve (%)	*Strongyloides* No. +ve (%)	Total No. +ve (%)
Males n=1,256	368(29.3)	260(20.7)	73(5.8)	50(4.0)	751(59.8)
Females n=1,531	246(16.1)	351(22.9)	134(8.8)	25(1.6)	756(49.3)
Total n=2,787	614(22.0)	611(21.9)	207(7.4)	75(2.7)	1,507(54.1)

Table 3shows the Age-specific prevalence of geohelminths infections in Ihiala L.G.A. The prevalence of each of the four species of geohelminths varied significantly (P<0.05) with age. Highest prevalence of 69.5% occurred in Age group 1-10 years while the least prevalence of 26.4% occurred in those above 40 years. The observed differences which existed between Geohelminth and age were statistically significant (P<0.05).

Table 3: Age –specific prevalence of Geohelminths infections in Ihiala L.G.A

Age in yrs/ Parasite Species	*Ascaris* No. +ve (%)	Hookworm No. +ve (%)	*Trichuris* No. +ve (%)	*Strongyloides* No. +ve (%)	Total No. +ve (%)
1-10 (n=878)	265(30.2)	253(28.8)	84(9.6)	8(0.9)	610(69.5)
11-20(n=890)	224(25.2)	251(28.2)	56(6.3)	18(2.0)	549(61.7)
21-30(n=466)	71(15.2)	61(13.1)	35(7.5)	12(2.8)	179(38.4)
31-40(n=356)	41(11.5)	35(9.8)	24(6.7)	17(4.8)	117(32.9)
>40(n=197)	10(5.1)	14(7.1)	8(4.1)	20(10.2)	52(26.4)
Total(n=2,787)	611(21.9)	614(22.0)	207(7.4)	75(2.7)	1,507(54.1)

Ascaris (x^2= 9.3), Hookworm (x^2=13.3), *Trichuris* (x^2=24.5), *Strongyloides* (x^2 = 156.4)

Table 4 shows the prevalence of Geohelminth parasites in relation to occupation in the study areas. The highest prevalence rate of 76.0% was observed among farmers while the least occurred in civil servants as shown below. The difference in prevalence among the different occupation was found to be significant (P<0.05).

Table 4: Prevalence of Geohelminths parasites in relation to occupation in the study area

Occupation	Total number Examined	Number infected	% infected
Civil servants	420	180	42.9
Farmers	700	532	76.0
Students/pupils	987	511	51.8
Business men	480	278	58.1
Unemployed	200	105	52.5
Total	2,787	1507	54.1

Table 5 shows mixed infections of geohelminths in the different age groups in the study area. It shows that the highest occurrence of mixed infections were those of *Ascaris* /Hookworm (58.1%) followed by *Ascaris/ Trichuris.* Triple infection of Al/Hk/Ss and Al/Tt/Ss were recorded 1.9% and 1.7% respectively.

Table 5: Mixed infections of Geohelminths Parasites in the different age groups in Study Area.

Age groups	Multip AL/Tt	le AL/Ss	infectio AL/HK	n HK/Ss	HK/Tt	Tt/Ss	AL/HK/Ss	AL/Tt/ Ss	Total
1-10	40(45.5)	2(18.2)	103(37.5)	1(11.1)	31(43.7)	0(0.0)	0(0.0)	2(25.0)	179(37.8)
11-20	28(31.8)	2(18.2)	136(49.5)	3(33.3)	22(31.0)	0(0.0)	0(0.0)	3(37.5)	194(41.0)
21-30	20(22.7)	3(27.3)	28(10.2)	2(22.2)	8(11.3)	0(0.0)	2(22.2)	0(0.0)	63(13.3)
31-40	0(0.0)	2(18.2)	5(1.8)	2(22.2)	7(9.9)	0(0.0)	3(33.3)	3(37.5)	22(4.7)
>40	0(0.0)	2(18.2)	3(1.1)	1(11.1)	3(4.2)	2(100.0)	4(44.4)	0(0.0)	15(3.2)
Total	88(18.6)	11(2.3)	275(58.1)	9(1.9)	71(15.0)	2(0.4)	9(1.9)	8(1.7)	473(31.4)

Key to Table
Al/Tt: *Ascaris/ Trichuris* Al/Ss: *Ascaris /Strongyloides* Al/Hk: *Ascaris* /Hookworm
Hk/Ss: Hookworm/*Strongyloides* Hk/Tt: Hookworm/*Trichuris*
Al/Hk/Ss: *Ascaris/*Hookworm/ *Strongyloides*
Al/Tt/Ss: *Ascaris /Trichuris /Strongyloides*

Intensity of geohelminths parasites infections in the ten communities of Ihiala L.G.A

Table 6shows the intensity of geohelminths among the different sexes in the study area. It shows that the intensity of *Ascaris* and *Trichuris* infections were higher in females than males 21,200 and 6,400 respectively whereas the intensity of Hookworm is higher in males 23,600. From the chi-square it was found to be statistically significant P< 0.05.

Table 6: Intensity of Infection of Geohelminths parasites in relation to sex

Sex	*Ascaris* No infected (%) Egg/gram +S.E Range	Hookworm No infected (%) Eggs/gram +S.E Range	*Trichuris trichiura* No infected (%) Eggs/gram +S.E Range
Males	260(20.7) 160.0 + 66.9 1,200-22,200	368 (29.3) 181.5 + 77.2 1,800-25,400	73(5.8) 189.0 + 111.1 300-4,800
Females	351 (22.9) 172. +82.2 7,200-28,400	246(16.1) 156.3 + 68.8 600-1,600	134(8.8) 173.9 +88.0 1,400-7,800
Total	611(21.9) 167.4 + 3.1 1,200-28,400	614(22.0) 171.5 +3.2 600-25,400	207(7.4) 183.6 + 6.8 300-7,800

Hookworm (x^2=25.1) *Ascaris* (x^2= 12.9) *Trichuris* (x^2=17.6)

Table 7: Classification of intensity for geohelminths infections in Ihiala L.G.A

Class of Intensity	*Ascaris* (n=611)	Hookworm (n=614)	*Trichuris* (n=207)
Light	122(19.9)	499(8.0)	32 (15.5)
Moderate	509 (80.1)	61(9.9)	175(84.5)
Heavy	0(0.0)	504(82.2)	0(0.0)

* Numbers in bracket represent percentage

Relationship between sanitation/human behaviour and prevalence of geohelminths parasites infections

Table 8 shows the relationship between sanitation/human behaviour and prevalence of geo helminths infections. 81.1% of infections occur among people that eat with unwashed hands while 36.5% infection occur in those that eat with washed hands. On the source of drinking water, the highest prevalence was found among people that drink stream water 69.6% while the least prevalence was found in those who drink sachet water (23.1%).It was also observed that the highest prevalence of geohelminths infections was seen in people lacking toilet facilities thereby using nearby bushes and farmlands for defecation (70.6%) while the least infections occurred in people using water closet system (18.2%).67.7% of infections occurred in those that do not wash hands after defecation.Only 29.6% infections with geohelminths occurred among those that washes hand after defecation and only 7.4% were *Ascaris* while 68.9% which is the highest prevalence rate were Hookworm infections.

There is only a slight difference in prevalence rate among people who consumes unwashed vegetables and fruits and washed vegetables and fruits 55.4% and 51.6% respectively.

Finally it was observed that walking bare-footed affects the prevalence rate of Hookworm as 63.7% infection occurred in those that regularly walk bare-footed and 55.3% in those occasionally while the least prevalence of 35.1% was found in those that rarely walks bare-footed.

Table 11: Relationship between sanitation/human behaviour and prevalence of Geohelminth parasites infections

Risk factor	No. examined	No.+ve (%)	Al +ve (%)	Hk +ve (%)	Tt +ve (%)	Ss +ve (%)
Sanitation facilities **Source of drinking water**						
Stream	880	612(69.6)	341(52.7)	78(12.7)	151(24.7)	42(6.9)
Borehole	600	230(38.3)	34(14.8)	186(80.9)	10(4.4)	0(0.0)
Underground tank	610	399(65.4)	148(37.1)	119(29.8)	4(10.3)	11(2.8)
Sachet water	294	68(23.1)	11(16.2)	39(57.4)	5(7.4)	13(1.9)
Surface containers	374	198(53.0)	77(389)	112(56.6)	0(0.0)	19(4.5)
Toilet facilities						
Bush	1,151	813(70.6)	267(32.8)	386(47.5)	111(13.7)	49(6.0)
Pit latrine	1,241	622(50.1)	308(49.5)	206(33.1)	88(14.2)	20(3.2)
Water closet	395	72(18.2)	36(50.0)	22(30.6)	8(11.1)	6(8.3)
Human behaviour						

Personal hygiene Eats with unwashed hands	1,098	891(81.1)	573(64.3)	102(11.4)	187(21.0)	29(3.3)
Eats with washed hands	1,689	616(36.5)	38(6.2)	512(83.1)	20(3.3)	46(7.5)
Hand washing after defecation	999	296(29.6)	22(7.4)	204(68.9)	28(9.5)	42(14.2)
Do not wash hand after defecation	1,788	1,211(67.7)	589(48.6)	410(33.9)	179(14.8)	33(2.7)
Wash vegetables/fruits before consumption	969	500(51.6)	107(21.4)	354(70.8)	28(5.6)	11(2.2)
Do not wash vegetables/fruits before consumption	1,818	1007(55.4)	504(50.1)	206(2.58)	179(17.8)	64(6.4)
Walk bare-footed						
I don't	621	218(35.1)	167(76.6)	02(0.9)	48(22.0)	01(0.5)
Regularly	1,081	689(63.7)	171(24.8)	456(66.2)	37(5.4)	25(3.6)
Occasionally	1,085	600(55.3)	273(45.5)	156(26.0)	122(2.3)	49(8.2)

4. Discussion

The present study showed a high prevalence of geohelminths parasites (54.1%). Previous reports showed similar trend of prevalence in other parts of the country (Etim *et al*., 2002; Nock *et al*., 2003; Alli *et al*., 2011; Okonko *et al*., 2009; Ukpai & Ugwu, 2003; Awolaju & Morenikeji, 2009). This was expected as these locations have similar climatic, environmental and socio-cultural factors. Generally, parasitic infections abound in Nigeria not only because our population still live in high unsanitary surroundings with constant faecal pollution of soil by cultural habits of the inhabitants but also as a consequence of tropical environment for easy parasite growth, spread and transmission. The occurrence and high endemicity of these parasites observed in the different communities sampled can be attributed to the low level of sanitation and aspect of human behaviour in these communities. The indiscriminate deposition of faeces around homes which was observed as a common practice aids the spread of these geohelminths parasites. This is because the faeces deposited around dwelling houses contain a lot of geohelminths eggs and parasite cyst which under the hot humid climates and soft sandy warm soils develop into infections traps around human inhabitations (Amadi & Uttah, 2010; Ajero*et al*., 2008). It is observed that the villagers used dry leaves from the contaminated sites to clean their anus after defecation. The eggs and larvae of geohelminths may stick on their fingers which are later ingested while eating with unwashed hands or drinking of water or exposed food contaminated by houseflies or other animals. These factors, accounted for the persistence of geohelminths in the study area.

Males had higher prevalence's of Hookworm and *Strongyloides* while female had more infections of *Ascaris* and *Trichuris*. Although geohelminths parasites are not sex-related parasites but the difference is significant in this study and can be attributed to human behaviour and associated sex-dependent differences in exposure to infection. Males often play, work and walk more bare-footed than females. That explains why they had more prevalence of Hookworm and *Strongyloides* whose infections occur more through the penetration of the filariform larva. The females had more infections with *Ascaris* and *Trichuris* due to their habits such as their involvement in preparations and cooking of foods (licking of fingers during cooking) as well as taking care of infants (changing napkins, cleaning up children anus after defecation) and eating with unwashed hands. These habits mentioned above predispose them more to *Ascaris* and *Trichuris* infections. This work is in line with earlier findings by Odu*et al*., (2011) in Port Harcourt which showed a higher prevalence rate in males than in females also Fekadu *et al*., (2008) reported a higher prevalence of hookworm in males than females in a study conducted in Southwest, Ethiopia. However Basista*et al*., (2001) and Girum, (2005) reported a significantly higher prevalence of hookworm in females than males. Previously Tohon*et al*., (2008) in Nigeria claimed that parasitic infections were not sex dependent while Nkengazong *et al*., (2009) also showed that differences in prevalence values of parasites between the sexes in KoltoBarombi and Manumba II were not statistically significant. These are all in contrast to the present findings.

The prevalence of infections of the four species of geohelminths showed a considerable variation ($P < 0.05$) with age of inhabitants. Age-specific prevalence of geohelminths decreased with age so that the younger age groups were more infected than the older ones (Adeyeba & Akinlabi, 2002; Ugbomoiko *et al*., 2006). The age-group 1-10 years had higher prevalence of *Ascaris*, Hookworm and *Trichuris* than other age groups. This is a reflection of the exposure pattern in view of the fact that they are usually active, adventurous and mindless of hygiene habits. They often eat indiscriminately with unwashed hands. Etim*et al*., (2002); Olsen, (2003); Ibidapo & Okwa, (2008) noted that un-clean hands played a vital role in the transmission of *Ascaris* among school children. Some of them still indulge in finger nibbling and play a lot in the sand. The second highest prevalence was observed in the 11-20 years age group. These observations could be attributed to higher exposure to sources of infection through their farming and school activities. The results are in conformity with those of earlier studies which established that young children are more vulnerable to many enteric infections than are adults and are more responsible for contaminating the environment and transmitting infections (Albonico *et al*., 2002; Agbolade *et al*., 2007; Adeyeba & Akinlabi, 2002; Auta*et al*., 2013). Again these school children play important role in maintaining transmission as this group of infected individuals are gathered together in small space under unhygienic conditions: no adequate toilet facilities, no water for washing hands after defecation or playing in soil along with poor defecation habits of the community. The older age groups had the least infection rate of *Ascaris*, Hookworm and *Trichuris* but highest for *Strongyloides*. This can be attributed to the fact that this age group might have acquired some immunity to these geohelminths as a result of repeated infections. Also their sanitary habits are more improved than the younger age groups. However age >40 years had the highest prevalence of *S. stercoralis* also observed by Ibidapo & Okwa, (2008) and this might be as a result of the parasite ability to remain as a low grade infection in a human host for a long period coupled with its auto-infection pattern. The decrease in the prevalence rate in the older age group > 40 than the younger age groups (1-10 and 11-20) for the other geohelminths (except for *Strongyloides*) is an indication that people in these age group are the less productive age and so have less contact with the factors that would predispose them to frequent infection as well as a positive change in their hygiene behaviour. The prevalence rates when compared in the age groups showed a significant difference ($P< 0.05$) not because geohelminths are age dependent but due to above mentioned factors.

Hookworm and *Ascaris* were the most common occurring geohelminths encountered in this present study and this result is comparable to those of (Adeyeba & Akinlabi, 2002; Okolie*et al*., 2008; Okonko*et al*., 2009; Alli *et al*., 2011; Mafiana *et al*., 1998; Nworgu*et al*., 1998; Ogbe *et al*., 2002; Egwunyenga & Atakwu, 2005). In most of these studies, Hookworm and *A. lumbricoides* were the highest intestinal geohelminths, while *S. Stercoralis* was usually rare while *T. trichiura* showed moderate prevalence but however Odu*et al*., (2011) reported *T. trichiura* as the predominant helminth recovered from school children in Port Harcourt, Rivers State Nigeria. In the present survey, hookworm was found to be the dominant STHs consistent with previous studies in different places in Nigeria (Pukuma& Sale, 2006; Amadi & Uttah, 2010) and the preponderance of hookworm infection could be attributed mainly to the sustainability of microclimate, soil type and humid environment favourable for parasite development as the study area is a typical tropical rainforest zone. It has been reported that under favourable ecological conditions larvae of hookworm can survive a period of three weeks (21 days). More so the penetrative infective pattern of Hookworm larva makes it to be more common in this survey as majority of the individuals in the study area move about bare-footed and even children play naked or half-naked in the heavily infested soil. Again most children do not wear protective shoes to school which is very common among rural children (Odu*et al*., 2010). The larvae of hookworm are capable of vertical migration up and down in contaminated soil, depending on moisture suction and temperature (Udonsi, 1983). Since the villagers are constantly having contact with these contaminated sites, this accounts to the more occurrence of hookworm than other geohelminths.

The high *Ascaris* prevalence recorded could be attributed to their high survival strategy which is conferred on it by the outer chitinous layer of egg shell and the laying of numerous eggs of about 2000 per day by the female. Ascaris eggs are very resistant to harsh environmental conditions and also air-borne. This longevity of *Ascaris* ova contribute to the infections dynamics of the parasite species as it has been shown that egg kept for 10 years in the soil could still be infective (Brudator *et al.,* 1971). As a result of such longevity it is difficult to prevent infection and re-infection when hectares of farmland surrounding human habitation as found in the study area have been polluted with *Ascaris* ova. The high *Ascaris* prevalence can be attributed to indiscriminate defecation and poor personal hygiene in the study area. In this study *T. trichiura* had a prevalence rate lower than that reported by Odu*et al*., (2011); Odu*et al*., (2013) in Port Harcourt Rivers State; Ejezie (1981) in Lagos and Obiamiwe & Nmorsi (1991) in Benin City. These are all urban areas and are usually characterized by extensive hawking activities as well as indiscriminate eating with unwashed hands. The value reported for *T. trichiura* in this study is high when compared with those of Chukwuma*et al*., (2009) who reported a much lower value among the inhabitants of Ebenebe, Anambra State, Nigeria and Auta*et al*., (2013) in Gwagwada Kaduna, North-West, Nigeria and these are rural communities. *Strongyloides stercoralis* has the least prevalence yet it deserves greater attention due to the persistence nature of its infection as a result of its auto-infection nature.

The urban communities of Ihiala and Uli/Okija (university towns) have heaps of refuse dumps with human faeces scattered all over the place as well as high rate of hawking activities. Phiri*et al*., 2000 also recorded higher prevalence in urban communities in Southern Malawi than in rural communities. In Isseke and Okija the source of water (stream) is very far from living homes thereby making water not readily available and this affects their level of sanitation as water is needed for effective sanitation. Also, during direct observations, it was observed that these communities (Isseke, Ihiala, Uli and Okija) had a higher incidence of human faeces scattered near living houses than others.

Farming occupation was associated with increased risk of infection with geohelminths as engagement in agricultural pursuit remains a common denominator of Hookworm infection. Geohelminths infections was significantly higher among farmers ($P< 0.05$) than the other occupational groups probably due to the fact that farmers are more exposed to the source of infection which include soil (serving as reservoir of infection) as they usually walk and work barefooted in the soil using crude tools (hoes and matchet) that bring their hands in contact with the soil. The non- availability of water in the farmlands which are normally a distance from homes would play negatively on personal hygiene. Fruits and vegetables would remain unwashed before eating with unwashed hands during their stay in the farms. Civil servants have the least level of exposure to contaminated soil as they spend most time in their offices and coupled with their generally high level of awareness to the aetiology of STHs, infection is generally low among this group. Although the infection rates in the different occupations were also observed to be high as even the civil servants, businessman, unemployed are all involved in one form of farming practices such as small scale farming (cultivation of vegetables) around their homes.

A high prevalence of mixed infections were recorded, children below 10 years harboured a high prevalence of *Ascaris* and *Trichuris* whereas adolescents had more *Ascaris* and hookworm infections. These also followed the pattern of intensity among these age groups. This were also observed with earlier studies by Ugbomoiko*et al*., (2006); Obiukwu *et al*., (2008); Alli *et al*., (2011); Adeyeba & Akinlabi, (2002); Mordi & Ngwodo, (2007); Chukwuma*et al*., (2009); Tohon *et al*., (2008); Jawetz *et al*.,(2004); Okolie *et al*., (2008) and can be attributed to the mode of infections of these geohelminths. Children had more *Ascaris* and *Trichuris* infections which are acquired through contaminated foods, drinks and hands as a result of their unsanitary habits while adults had more *Ascaris* and hookworm mixed infections due to their exposure to farming activities.

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