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SOIL- TRANSMITTED NEMATODE INFECTIONS IN SCHOOL CHILDREN IN A PERI-URBAN AREA, NORTH CENTRAL NIGERIA

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Abstract

Parasitic infections caused by Soil Transmitted Nematodes (STN) are a common occurrence in developing countries with unfavourable environmental conditions that favour the development of eggs and larvae of STN. This was a cross sectional study carried out from January to April, 2018 to determine the prevalence and intensity of STN infections in six randomly selected primary schools in the Ilorin South Local Government Area, Kwara State, Nigeria. Stool specimens were collected from 508 pupils (259 males; 249 females), which were prepared and examined using the Kato-Katz technique. Of 508 stool specimens examined, 206 (40.6%) were infected with at least one of the STN. Eggs of *Ascaris lumbricoides*, *Trichuris trichiura, Enterobius vermicularis* and hookworms were identified with prevalences of 37.9%, 4.9%, 2.4% and 30.1% respectively. In all six schools examined, 115 males (44.4%) and 91 females(36.5%) were found to be infected (P<0.01). Pupils in the age group 5-7 years were found to be the most infected (52.2%), while the least occurred in the age group 14-16 years (28.2%). Of the 206 (40.6%) infected pupils; light, moderate and heavy infections were noted in 12.2%,20.7% and 7.5% respectively. The egg-count of *Ascaris lumbricoides*, *Trichuris trichiura*, hookworms and *Enterobius vermicularis* were 277.8±168.4, 160±118.1, 199.7±131.4 and 33.6±13.1 eggs per gram of faeces respectively. The intensity of STN infections was higher among males (231.3±159.8) than among females (230.8±154.8). Pupils in the age group 11-13 had the highest intensity of infection (267.0±158.1). Prevalence of single and double infections was 75.3% and 24.7% respectively. STN infections are prevalent in the study area which calls for regular deworming, health education and provision of basic sanitary and social amenities to reduce the disease burden.

Keywords: Soil-transmitted nematodes, prevalence, school children, Ilorin, Nigeria

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1. Introduction

Soil-transmitted nematode (STN) infections are a serious public health and medical problem especially in tropical and subtropical countries (Pullan *et al.,* 2014; WHO, 2017) and is the second largest leading cause of mortality in children above six years in Africa.STN infections may account for up to 12% of the total disease burden among children in resource-poor-countries (WHO, 2009).The World Health Organization estimates that over 270 million preschool children and over 600 million school-age children are living in areas where these parasites are intensively transmitted (WHO, 2012). In sub Saharan Africa, more than one quarter has one or more intestinal nematode infections occurring simultaneously (Montressor *et al.,* 2002). Studies have shown that infection with soil transmitted nematodes affect mostly children of school going age with significant effects on morbidity and mortality resulting in more than 10,000-135,000 deaths annually (Lustigman *et al.,* 2012). Symptoms associated with STN infections in school age children include anaemia, growth retardation, cognitive impairment, malnutrition, dysentery, fever, dehydration and vomiting amongst other severe symptoms that may also occur. In Nigeria, STN infections mainly *Ascaris lumbricoides*, *Trichuris trichiura*, and hookworms are a major health concern especially in rural and urban slums (Amali *et al.,* 2013; Amaechi *et al.,* 2014; Ohiolei *et al.,* 2017). Here too, it is common that individuals are infected with more than one nematode species .Therefore a continuous assessment of the prevalence status of these infections is required to assist in reducing the disease burden. The present study investigated the status of soil transmitted nematode infections among primary school children in an urban slum, north central Nigeria, where the disease is endemic with a view to implementing control initiatives to manage these nematode infections.

2. Material and Methods

2.1 Study Area and population

The study was conducted in three districts (Akanbi, Balogun Fulani, Okaka/Oke-Ogun) in the Ilorin South Local Government Area of Kwara State. The headquarters (Fufu) is 30Km from Ilorin the State Capital. The dominant ethnic group is Yoruba with other minority groups such as the Hausas, Fulanis, Nupes, Barubas and Igbos.The vegetation is guinea savannah, comprising of tall grasses with scattered trees, dominated by Shea butter trees (*Vitellaria paradoxa*) and Locust bean trees (*Parkia biglobosa*). The environment is seasonal with dry and wet seasons and an intervening harmattan from December to January. The annual rainfall ranges from 1000 and 1500mm while the mean temperature is between 20° C and 37°C.The major occupations in the study area include subsistence agriculture, livestock farming, petty trading, craft making and government jobs. Their main food crops include; yam, cassava, guinea corn, maize and rice. The area is provided with basic amenities such as health centers, pharmacies, hospitals, and schools while electricity, bore-holes and pipe-borne water is also available. Most of the inhabitants still make use of pit latrines and bushes for defecation. The hygiene conditions of the area are unfavourable.

2.2 Sample collection and laboratory procedures

Random sampling technique was used in the study. Six primary schools were randomly selected among the three selected districts by balloting. The Fisher formula was used to determine the desired sample size.

$$n = \frac{Z^2_{1-\alpha/2} P(1-P)}{d^2}$$ (Daniel,1995)

Where: n = Minimum sample size required

$Z^2_{1-\alpha/2}$ = Standard normal deviate at 95% confidence interval (1.96)

P = Assumed prevalence of STH among school going children in Ilorin south Local Government Areas **(50%)** **1 – P =** 1-0.5 = 0.5 and **d =** degree of accuracy desired which is set at **0.05**

$$\text{Thus, } n = \frac{1.96^2 \times 0.50\,(1-0.50)}{0.05^2}$$

n = 384

The minimum sample size (n) was calculated to be 384 .Given this the inclusion of 508 children for the study satisfied the minimum requirement.

A registration list of pupils (aged 5-16years) from the selected schools was obtained and using a simple random sampling method, pupils were selected from each school and class. When a selected pupil was absent, a student before or after this student was selected as a replacement. Before the collection of the stool specimen, the research including the benefits was explained to the teachers and school children. Collection of specimens was thoroughly explained in local dialect after which they were given a clean, dry, leak-free wide-mouthed universal bottle with a screw cap, a clean sheet of paper, a spatula. A consent form was also distributed**.** Stool specimens were collected the following morning between 0900-2200hrs and preserved in 10% formalin and immediately transported to the laboratory of the Department of Medical Microbiology, University of Ilorin immediately for processing and examination. Each stool specimen was examined macroscopically for colour, consistency (whether formed, semi-formed or watery) and constituents (presence or absence of blood or mucus). The Kato-Katz technique was used to prepare stool specimens for microscopy for qualitative and quantitative diagnosis of STNs (based on eggs or larvae).

The intensity of infection of *A. lumbricoides* was graded as light(+) ranging from 1-299eggs/g, moderate (++) ranging from 300-499eggs/g and heavy (+++) ≥500 eggs/g. Hookworm was graded as light(+) ranging from 1-199eggs/g, moderate(++) ranging from 200-399eggs/g and heavy(+++) was ≥ 400 while *T. trichiura* was graded as light(+) ranging from 1-99eggs/g, moderate(++) ranging from 100-299eggs/g and heavy(+++) ≥ 300 eggs/g (Montresor *et al.,* 2016).

2.3 Ethical consideration

The protocol used in this study was approved by the Ethical Review Committee of the University of Ilorin, Nigeria (UERC/ASN/2017/1088), Ministry of Education and Human Capital Development and Local Government Education Board (E/MISC/170/1/128). Prior to the study, informed consent of parents and guardians of the school children was obtained after a detailed explanation of the study protocol. Following the ethical review regulation, patients who were found to be positive for the tested infections were given treatment.

2.4 Data analysis

Data obtained from parasitological analyses were analyzed using SPSS (Statistical Package for Social Sciences, version 20.0 California, USA) to interpret the levels of soil- transmitted nematode infections among school children in Ilorin South Local Government Area of Kwara State. The Chi square test was used to discern differences when the values ($P<0.05$) were considered to be statistically significant.

3. Results

3.1 *Overall prevalence of soil-transmitted nematode infections*

A total of 508 school children, 259 boys and 249 girls in six randomly selected primary schools in Ilorin South Local Government Areas of Kwara State were examined. In all, characteristic eggs of four nematodes (*A. lumbricoides*, *T. trichuria*, Hookworms and *E. vermicularis*) were identified. Of the 508 pupils examined 206 (40.6%) were infected with at least one of the four STNs (Table 1).

3.1.2 Prevalence of Soil Transmitted Nematode Infections by Age

The age range of pupils examined was 5-16 years. Pupils in the age group 5-7 years (52.2%) were the most infected while the least infected were those in the age-group 14-16 years 28.2% (Table 2). There was a significant difference among the age groups in relation to STN infections ($p<0.01$).

Table 1: Overall Prevalence of STN Infections in 6 Selected Primary Schools (N = 508)

S/N	LGEA PRIMARY SCHOOL	NO EXAMINED	NO (%) INFECTED
1	KILANKO	79	32(40.5)
2	ERO-OMO	81	22(27.2)
3	MODEL	83	35(42.2)
4	UNITED	92	38(41.3)
5	ISALE-ASA	78	38(48.7)
6	CENTRE-IGBORO	95	41(43.2)
	TOTAL	508	206 (40.6)

3.1.1 Prevalence of Soil Transmitted Nematode Infections by Gender

Of the 259 boys and 249 girls examined, 115 boys (44.4%) and 91 girls (36.5%) were infected with STNs. However, the boys were significantly more infected than the girls ($p<0.01$). The prevalence of STN infections by gender reveals that the STNs were more prevalent among the boys than girls except in the case for *T. trichiura* and *E. vermicularis* infections.

3.1.3 Prevalence of Soil Transmitted Nematodes by STN Species

The prevalence of Soil Transmitted Nematodes found were; *A. lumbricoides* (37.9%), *T. trichiura* (4.9%), hookworms (30.1%) and *E.vermicularis* (2.4%). Prevalence of single infections was 75.3% while double infections was 24.7% **.** The highest prevalence of *A. lumbricoides* infections were seen in United LGEA (8.7%) while the highest prevalence of hookworm infections were in Centre-Igboro LGEA (6.8%).

Double infections of *A. lumbricoides* and hookworms were seen in all the six schools with a prevalence of 20.8% while double infections of *A. lumbricoides* and *T. trichiura* were seen in four schools; United, Model, Centre-Igboro and Isale-Asa LGEA Primary Schools with prevalence of 3.9% (Table 3).

3.2 Overall Intensity of Soil Transmitted Nematode Infections among School Children

The intensity of STN infections among the school children shows that majority of the pupils were infected with light (12.2%) and moderate (20.7%) infections, while 7.5% of the pupils were infected with heavy infection of STNs (Table 5).

Table 2: Prevalence of STN infections among pupils in relation to age (N= 508)

AGE-GROUP	NO EXAMINED	NO (%) INFECTED
5-7	92	48 (52.2)
8-10	182	79 (43.4)
11-13	195	68 (34.9)
14-16	39	11 (28.2)
TOTAL	508	206 (40.5)

Table 3: Prevalence of Soil Transmitted Nematodes by species and schools (N= 508)

NEMATODES	NO (%) INFECTED PRIMARY SCHOOLS						TOTAL (%) INFECTED
	UNITED	MODEL	ERO-OMO	KILANKO	CENTRE-IGBORO	ISALE-ASA	
Ascaris lumbricoides	18(8.7)	13(6.3)	8(3.9)	12(5.8)	12(5.8)	15(7.2)	78(37.9)
Trichuris trichiura	1(0.5)	4(1.9)	2(0.9)	2(0.9)	-	1(0.5)	10(4.9)
Hookworms	8(3.9)	10(4.9)	6(2.9)	13(6.3)	14(6.8)	11(5.3)	62(30.1)
Enterobius vermicularis	-	1(0.5)	-	2(0.9)	1(0.5)	1(0.5)	5(2.4)
Ascaris lumbricoides + Hookworms	9(4.4)	6(2.9)	6(2.9)	3(1.5)	11(5.3)	8(3.9)	43(20.8)
Ascaris lumbricoides + *Trichuris trichiura*	2(0.9)	1(0.5)	-	-	3(1.5)	2(0.9)	8(3.9)
TOTAL	38(41.3)	35(42.2)	22(27.2)	32(40.5)	41(43.2)	38(48.7)	206(100)

Table 4: Prevalence of transmitted nematode infections in relation to other predisposing factors (N= 508)

Prevalence of STN Infections by;	Responses	NO Examined	NO (%) Infected	P- value
Parental Occupation	Farming	24	10(41.7)	0.195
	Trading	115	46(40.0)	
	Self-employed	299	126(42.1)	
	Formal employment	26	6(23.1)	
	Unemployed	44	18(40.9)	
Parents' level of education	No formal education	103	81(78.6)	0.038
	Primary school completed	187	58(31.1)	
	Secondary school completed	167	55(32.9)	
	Tertiary	51	12(23.5)	
Ethnicity	Yoruba	443	180(40.6)	0.336
	Hausa	35	14(40.0)	
	Igbo	14	9(64.2)	
	Fulani	10	2(20.0)	
	Others (Nupe, Tiv, Calabari & baruba)	6	1(16.7)	
Religion	Christianity	193	80(41.5)	0.360
	Islam	315	126(40.0)	
Shoe-wearing	Yes	450	184(40.8)	0.002
	N0	58	22(37.9)	
Common-habits	Finger sucking/nail biting	56	25(44.6)	0.002
	Walking bare-footed	73	30(41.1)	
	Geophaghy	22	13(59.1)	
	Eating unwashed fruits	181	75(41.4)	
	None	176	63(35.8)	

3.2.1 Mean Intensity (Egg-Count) of Soil Transmitted Nematodes by Gender

The eggs counts per gram ranged from a minimum of 24 to a maximum of 528eggs/g. The overall intensity of infections of *A. lumbricoides*, *T. trichiura*, hookworms and *E. vermicularis* were 277.8±168.4,160±118.1, 199.7±131.4 and 33.6±13.1 eggs/g respectively. There was a higher intensity of infection among males (231.3±159.8) than among females (230.8±154.8) but this difference was near similar statistically.However, a higher intensity of *E. vermicularis* was seen among the girls (36.0±16.9) while higher intensity of hookworms and *A. lumbricoides* was seen among the males (207.4±129.5 and 289±157.9 respectively) (Table 6).

3.1.2 Mean Intensity (Egg-Count) of Soil Transmitted Nematodes by Age

The intensity of infection was highest among age group 11-13 years (267.0±158.1),while the lowest intensity was recorded among age group 14-16 years (172.3±173.6),with a significant difference between the various age groups ($p<0.05$) (Table 7).

4. Discussion

The results of this study revealed that STN infections are common among the pupils of the selected primary schools in Ilorin South LGA, Kwara State, Nigeria. Of 508 school children examined, 206 (40.6%) were infected with at least one of the STNs which is attributable to ignorance, poverty, poor environmental sanitation, poor personal hygiene practices and the lack of basic amenities.

However, Amaechi *et al.,* (2013) reported a higher prevalence (75.7%) among school children in rural communities of Abia State, Nigeria. Several factors could have contributed to the variation in prevalence of soil transmitted nematode infections in different areas of the country. These include ecological factors such as relative humidity, temperature, rainfall, vegetation and other climatic factors, socio-cultural habits, religious practices and geographical locations (Anosike *et al.,* 2006). Differences in the targeted age groups and populations, timing of examinations and diagnostic techniques could also be responsible for variations in the prevalence of STN. Males had higher infection rates (44.4%) than females (36.5%). This result was consistent with the findings of Babatunde *et al.(*2013) and Amaechi *et al*., (2013) in Kwara State and Abia State respectively. The significant difference between males

Table 5: Intensity of STNs among school children (N=206)

	NO (%) INTENSITY OF STN INFECTIONS			
NEMATODE	LIGHT (+)	MODERATE (++)	HEAVY (+++)	TOTAL
Ascaris lumbricoides	27(5.3)	55(10.8)	20(3.9)	102(20.1)
Trichuris trichiura	7(1.3)	5(1.0)	3(0.6)	15(2.9)
Hookworms	24(4.7)	45(8.9)	15(2.9)	84(16.5)
Enterobius vermicularis	5(0.9)	-	-	5(0.9)
TOTAL POSITIVE	61 (12.2)	105 (20.7)	38 (7.5)	206 (40.4)

The overall prevalence recorded in this study is similar to a study carried out in the Moro Local Government Areas of Kwara State (Babatunde *et al.,* 2013) where an overall prevalence of 41.6% was reported.

outdoor activities and adventurous nature of males in comparison to the females. This is in agreement with the report of Obiukwu *et al.,* 2008.

Table 6: Mean Intensity (Egg-Count) of soil transmitted Nematodes among pupil by Gender (N= 206)

GENDER	NO INFECTED	EGG COUNT (Mean egg/g)				
		Ascaris lumbricoides	*Trichuris trichiura*	Hookworms	*Enterobius Vermicularis*	TOTAL
BOYS	115	15616 (269.2±176.8)	1464 (146.4±121.5)	9336 (207.4±129.5)	72 (36.0±16.9)	26488 (230.8±154.8)
GIRLS	91	12720 (289±157.9)	936 (187.2±119.2)	7440 (190.7±134.6)	196 (32.0±13.8)	21192 (231.3±159.8)
TOTAL	206	28336 (277.8±168.4)	2400 (160.0±118.1)	16776 (199.7±131.4)	168 (33.6±13.1)	47680 (231.4±157.2)

Table 7: Mean Intensity (Egg-Count) of Soil Transmitted Nematodes among Pupil by age (N= 206)

AGE GROUP	NO INFECTED	EGG COUNT (Mean egg/g)				
		Ascaris lumbricoides	*Trichuris trichiura*	Hookworms	*Enterobius Vermicularis*	TOTAL
5-7	92	4152 (173±152.4)	888 (222±104.3)	3960 (232.9±143.4)	96 (32.0.0±13.8)	9096 (189.5±146.8)
8-10	182	9960 (321.2±157.4)	744 (93.0±96.3)	7536 (193.2±124.0)	24 (24.0±0.0)	18264 (231.1±155.9)
11-13	195	13600 (340±142.2)	456 (228±118.7)	4056 (162.2±117.8)	48 (48.0±0.0)	18160 (267±158.1)
14-16	39	624 (89.1±108.8)	312 (312±0.0)	1224 (480±0.0)	-	2160 (172.3±173.6)
TOTAL	206	28336 (277.8±168.4)	2400 (160.0±118.1)	16776 (199.7±131.4)	168 (33.6±13.1)	47680 (231.4±157.2)

The highest prevalence (52.2%) of STN infections occurred among the age-group of 5-7 years,which declined towards 11 to 16 years. As the children grow older, they become more selective in their choice of food and activities thereby reducing infection risks through proper health habits (Amaechi *et al.,* 2013). The higher prevalence in the pupils of the ages 5-7 years might be due to the level of exposure to indiscriminate eating of foods, fruits and snacks purchased from vendors, vulnerability to infections, lower level of immunity and the lack of attention to personal hygiene (Asinobi *et al.,* 2004). The higher prevalence recorded in this study among pupils under the age of 10 years is in agreement with the finding of Ekpeyong and Eyo (2008), Akingbade *et al.,* (2013) and Amaechi *et al.,* (2013). This implies that pupils in the first years of their life are likely to suffer from nutritional deficits, growth retardation, cognitive impairment, serious illness and occasionally death and even surgical emergencies such as intestinal obstruction (de Silva *et al.,* 1997).

In this study, four characteristic eggs of STN; *A.lumbricoides*, *T. trichiura*, hookworm species and *E. vermicularis* were identified from the stool specimens. This agrees with the study of Babatunde *et al.,* (2013). The transmission of these STNs is related to congenial condition for transmission of the parasites such as high relative humidity, optimal temperatures and shade (Brooker and Michael, 2000). Equally, important factors that favour the transmission of the parasites as revealed through the present study are ignorance, poverty, lack of portable water, poor personal hygiene, environmental sanitation and the lack of basic amenities such as pipe-borne water and good health care facilities.

The prevalence of the infection of *A. lumbricodes* (37.9%) was the highest among all the STNs encountered which is in agreement with findings of others for areas within Nigeria (e.g Asaolu *et al.,* 1992; Amaechi *et al.,* 2013; Babatunde *et al.,* 2013 Ojurongbe *et al.,* 2014).The relatively high prevalence of the infections of *A. lumbriocodes* indicates poor sanitation and unhygienic practices among the pupils (Crompton & Savioli, 1993) ignorance on the part of the parents and pupils, poverty, lack of basic amenities and good health facilities.

More than one infection (multiple infections) was also reported in the study as it was common for a pupil to be infected with two or more STNs (Amaechi *et al.,* 2013; Salawu *et al.,* 2014). In this study, double infections were recorded; *A. lumbricoides* and Hookworm (20.8%) and *A. lumbricoides* and *T. trichiura* (3.9%). These possibly indicate that the environmental conditions in the study are conducive to the development and successful transmission of the Ubiquitous triad of *A. lumbricoides*, *T. trichiura* and Hookworms (Suswam *et al.,* 1992).

Pupils whose parents were self-employed showed highest prevalence of 42.1%. Some studies associated parents' occupation with STN infections (Chukwuma *et al.,* 2009; Nmorsi *et al.,* 2009). It is expected that parents engaged in occupations which involves contact with soil (farmers and bricklayers) and sewage are either reservoirs or sources of nematodes, and they once infected, would have a higher chance of transmitting the parasites to their children.

The highest prevalence of STN infections was recorded among pupils whose parents are without formal education (78.6%). This finding is in agreement with the studies carried out by Halpenny *et al.* (2013) and Wang *et al.* (2012) who report that care-givers education levels were significantly associated with STNs infections among pre-school and school going children. It is commonly known that caregivers, particularly mothers, are often responsible for both food preparation and health education of children in the family and, they significantly influence the health of their children. If a child's mother is educated, she is more likely to know about the dangers of STNs and how to

prevent it, and thus will be more likely to incorporate safe health habits into the home practices, for instance, boiling water. The Yorubas showed highest prevalence (87.4%) of STNs, which may be connected to the large proportion of the Yoruba ethnic group that formed the examined population as compared to the relatively smaller proportion of other ethnic groups. The STN infections recorded among the Christian pupils (41.4%) and the Muslim pupils (40.0%) were near similar. Habits related to STN infections practiced by the pupils in the study include; Finger sucking/Nail biting, walking barefoot, geophagy and eating unwashed fruits. These common habits promote the ingestion of most of the viable and infective embryonated nematode ova and infective larvae present in contaminated foods, fruits and drinks. This is in agreement with the view of WHO (1964), Cheesebrough (1981) and Chiodini *et al.* (2001).Walking barefoot promotes the entry of infective filariform larvae of hookworm species, hence, increasing chances of infection . Health education programmes in schools could enhance awareness on the transmission modes and control mechanism of STNs. Intensity of infection is the main epidemiological index used to describe STN infections; this intensity is measured by the number of eggs per gram of faeces (WHO, 2002a). The distribution of these eggs/larvae showed that the majority of the pupils had moderate infections (20.7%) while few had light (12.2%) and heavy (7.5%) infections. Generally, only STN infections of moderate and heavy levels produce clinical manifestations (Chan *et al.,* 1994). This finding agrees with those of Babatunde *et al.,* (2013).

The highest intensity (egg-count) of infection was of *A. lumbricoides* (277.8±168.4 eggs/g). However, this could be attributed to the fact that female *A. lumbricodes* produces the highest number of eggs which are extremely resistant to harsh environmental conditions (Roberts *et al.,* 2009). The intensity of STN infections in relation to gender was similar among males and females probably because both sexes have the same level of exposure to STN infections in the study area. The intensity of STN infections was lower among the ages 14-16 years compared to pupils under the age of 13 years which could be attributed to the fact that at mid adolescence, the pupils in this age-group are more conscious of their personal hygiene and are more likely to walk bare-foot.

5. Conclusions

Soil-transmitted nematode infections are common in peri-urban communities of Nigeria considered in the present study with considerable morbidity and mortality being recorded especially amongst primary school children. We have established that in least developed and low income communities, the lack of parental education, walking bare foot and other common habits such as finger sucking and biting, geophagy and eating of unwashed fruits are possible risk factors that are significantly associated with STN infections among school children. Health education targeted at enlightening school children on personal hygiene, provision of basic, social amenities and large scale de-worming campaigns should be frequently carried out in schools as a means of managing these STN infections.

References

Amaechi, E.C., Ohaeri, C.C., Ukpai, O.M. (2013) Prevalence of Helminthiasis among School Children in some Rural Communities of Abia State, Nigeria. *Animal Research International* **10 (3):** 1817-25.

Amali, O., Anyam, R.W., Jeje, P.N., Olusi, T.A.(2013) Soil-transmitted Nematodes and hygiene practices in a rural community of Benue State, Nigeria,

Nigerian Journal of Parasitology **34 (2**): 147-152.

Anosike, J.C., Adeiyongo, C.M., Abanobi, O.C., Amajuoyi, O.U., Dada, E.O., Oku, E.E. Keke, I.R., Uwaezuoke, J.C., Obiukwu, C.E., Nwosu, D.C., Ogbusu, F.I., Zaccheaus, V.O. (2006) Studies on the intestinal worm infestation in a Central Nigeria rural community, *Journal of Applied Science and Environmental Management* **10 (2):** 61-66.

Akingbade, O.A., Akinjimi, A.A., Ezechukwu, U.S., Okerntugba, P.O., Okonko, I.O. (2013) Prevalence of intestinal parasite among children with diarrhea in Abeokuta, Ogun State, Nigeria, *Researcher* **5(9)**: 66-73.

Babatunde, S.K., Adedayo M.R., Ajiboye, A.E., Sunday, O., Ameen, N. (2013) Soil Transmitted Helminth Infections among School Children in rural communities of Moro Local Government Area, Kwara State, Nigeria. *African Journal of Microbiology Research* **7 (45**): 5143-5148

Brooker, S., Michael, E. (2000) The potential of geographical information systems and remote sensing in the epidemiology and control of human helminth infections, *Advances in Parasitology* **47**: 245–288.

Cheesebrough, M. (1981*). Medical Laboratory Manual for Tropical Countries*. Vol. 1, Stephen Austin & Sons LTD.

Chukwuma, M.C., Ekejindu, I.M., Agbakoba, N.R., Ezeaguwuna, D.A., Anaghalu, C., Nwosu, D.C. (2009) Prevalence and risk factors of geohelminth infections, *Middle-east journal of Scientific Research* **4 (3)**: 211-215.

Daniel, W. W. (1995). *Biostatistics of Foundation for analysis in the health Science*. In: Statistical analysis. 6th Edition, J. Willey and Sons.pp.155.

De Silva, N. R., Brooker, S., Hotez, P. J., Montressor, A., Engels, D., Savioli, L. (2003) Soil transmitted helminth infections: updating the global picture, *Trends in Parasitology* **19**: 547-51.

Ekpenyong, E. A., Eyo, J. E. (2008). Prevalence of Intestinal Helminths Infections among schooling Children in Tropical Semi-urban Communities, *Animal Research International* **5 (1)**: 804-810.

Halpenny, C.M., Paller, C., Koski, K.G., Valdés, V.E., Scott, M.E. (2013). Regional, Household and Individual Factors that Influence Soil Transmitted Helminth Reinfection Dynamics in Preschool Children from Rural Indigenous Panamá, *PLoS Neglected Tropical Diseases* **7(2)**: e2070.

Lustigma, S., Prichard R.K., Gazzinelli, A., Grant, W.N., Boatin, B.A., McCarthy J.S., Basanez M.G. (2012). A research agenda for helminth diseases of humans: the problem of helminthiases, *PloS Neglected Tropical Diseases* **6 (4)**: 1582.

Montresor, A., Awashti, S., Crompton, D.W.T. (2003**)** Use of benzimidazoles in children younger than 24 months for the treatment of soil transmitted helminthiasis. *Acta Tropica* **86**: 223–232.

Montresor, A., Deol, A., Porta, N., Lethanh, N., Jankovic, D. (2016).Markov model predicts changes in STH prevalence during control activities even with a reduced amount of baseline information, *PLoS Neglected Tropical Diseases* **10(4)**: e0004371.

Nmorsi, O.P.G., Issac, C., Aashikipelokhai, I.S., Ukwandu, N.C.D. (2009) Geohelminthiasis among Nigerian preschool age Children, *International Journal of Medicine and Medical Sciences* **1(10**): 407-411.

Obiukwu, M.O., Umeanaeto, P.U., Eneanya, C.I., Nwaorgu, G.O. (2008) Prevalence of gastro intestinal helminths in school children in Mbaukwu, Anambra State,

Nigeria. ,*Nigerian Journal of Parasitology* **29 (1)**: 15-19.

Ohiolei, J.A., Isaac, C., Omorodion, O.A. (2017) A review of Soil-transmitted helminthiasis in Nigeria. *Asian Pacific Journal of Tropical Disease* **7(12)**: 841-848.

Ojurongbe, O., Oyesiji, K. F., Ojo, J. A., Odewale, G., Adefioye, O. A., Olowe, A. O., Opaleye, O. O., Bolaji, O. S., Ojurngbe, T. A. (2014). Soil Transmitted Helminth Infections among Primary School Children in Ile-Ife Southwest, Nigeria. *International Research Journal of Medicine and Medical Sciences* **2 (1)**: 6-10.

Pullan, R.L., Smith, J.L.,Jasrasaria, R., Brooker, S.J. (2014). Global numbers of infection and disease burden of soil transmitted helminth infections in 2010. *Parasites and Vectors* 7: 37.

Roberts L.S., Janovy,J, JR. (2009) Foundations of Parasitology, 8th Edition.US, McGraw Hill.

Salawu, S.A., Ughele, V.A. (2014) Prevalence of Soil transmitted helminthes among school age children in Children in Ife East Local Government Are, Osun State, Nigeria. *FUTA Journal of Research in Sciences* **1:** 139-151.

Wang, X., Zhang, L., Luo, R., Wang, G., Chen, Y. (2012) Soil-Transmitted Helminth Infections and Correlated Risk Factors in Preschool and School-Aged Children in Rural Southwest China. *PLoS ONE* **7 (9):** e45939.

World Health Organization (WHO) (2012) Helminth Control in School-age Children: A Guide for Managers of Control Programmes (2 ed.). *WHO Press,* World Health Organization, Geneva, Switzerland. pp.1–75. ISBN 978-92-4-154826-7.

World Health Organization(WHO) (2017) Guideline: Preventive chemotherapy to control soil-transmitted helminth infections in at-risk population groups. Geneva: World Health Organization.

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