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Soil transmitted parasitic infection among school-aged children in some parts of Nasarawa State, Nigeria

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Abstract
Soil-transmitted helminths (STH) disease burden is rapidly being identified as a crucial public health problem, especially in developing countries in which children are the most helpless group. Therefore, soil-transmitted parasitic infection in school-aged children in six selected primary schools from two selected Local Government Areas (LGAs) of Nasarawa State, Nigeria was conducted between January and March, 2018. Fecal samples were gotten from 360 school-aged children, 180 from each LGA between ages 5-18. Also, soil samples were gotten from three different areas in each of the school surveyed. The samples were subjected to analysis using standard parasitological techniques of direct smear and concentration. Overall prevalence of STH recorded was 17.5%; age group 9-12 years had the highest prevalence of 18.2% but there was no significant difference in STH prevalence in relation to the six schools sampled ($\chi^2 = 0.38957$, DF = 2, P = 0.823). The level of occurrence of STH in relation to sex was not significant ($\chi^2 = 1.3759$, DF = 1, P = 0.2408) but more females were infected. *Ascaris lumbricoides* was the predominant parasites encountered. Geohelminths were more dominant in soil examined from defecation site than those from refuse and playground or sit out sites. The observed hygiene conditions in the schools that predisposes the children to infection includes absence of water in toilets, poor sanitary conditions and bare foot walk. Hence, there is an urgent need for improved modern toilet facilities and good sanitation practice. Also, school health programs like quarterly deworming and health education are hereby recommended.

Keywords: *Ascaris lumbricoides,* Hygiene conditions**,** School-aged children, Soil-transmitted helminths

Introduction
At least 2 billion people worldwide are plagued by the sickness caused by helminths that are transmitted through the soil [1]. This is becoming more and more acknowledged as a serious public health issues especially in developing nations. Although these helminths can infect all members of population, the most vulnerable is pre-school, school-aged children, adolescent females and women of child bearing age. Children between the age of 5 and 15 frequently have the highest infection rates [1]. The disease's etiological agent is known to have a negative impact on children's health because they deplete their nutritional stores and harm their physical and mental growth, leading to symptoms like abdominal pain, anemia, bladder and liver disease, and other health issues that stunt growth and lead to poor academic performance [2]. There is no single biological, social behavioral or environmental element accounts for school-aged children susceptibility; rather, it results from the coexistence of a number of factors, including poverty, poor living conditions and poor personal cleanliness, both on an individual and communal level [3, 4].
Each year, 155000 people die from parasitic infections, 300 0f them have clinical manifestations [1]. *Ascaris lumbricoides, Trichuris trichiura,* the hookworms *Necator americanus* and *Ancylostoma duodenale,* and *Schistosoma* species are the most common human parasites and these have been connected with significant levels of morbidity and mortality among the hundreds of helminths that infect humans [5].

Infection is spread through the regular discharge of human and animal waste into the soil in Nigeria, which contains the eggs and larvae of this helminths. These have caused the helminth's eggs and larvae to be sown in the soil, serving as a source of infection. Food, water, fruits and vegetables are additional secondary source of infection [6-12]. It is impossible to overstate the issue of human and animal waste being dumped onto the soil very day in Nigeria.

The assessment of disease prevalence and the geographic distribution of STH are the first steps in planning effective intervention measures. Hence, the study on the assessment of the prevalence of STH was carried in order to map its distribution in the selected six schools located in two LGAs of Nasarawa State, North Central Nigeria so as to contribute to the available baseline data that would help guide informed decisions in formulation and implementation of effective control strategies.

2. Materials and Methods

2.1 Study Areas: The research was conducted in Doma and Obi Local Government Areas of Nasarawa State. Nasarawa State is located around North Central Nigeria and is bounded by Kaduna State in the North, Abuja in the West, Kogi and Benue in the South and Taraba and Plateau States in the East. The Local Government Areas have an area of 2714 km^2 and 967 km^2 with a population of 139,607 and 148,874 respectively according to the 2006 census.

2.2 Selection of Schools: The selection of schools was carried out in accordance to the procedure by Hesse [13]. A sketched map of the study areas was obtained. The corner of the map was selected and two baselines were drawn at right angles to each other. The interval width was then determined and a point was selected from the interval width leading to the random selection of six schools for the survey, three in each Local Government Area were chosen for the study.

2.3 Ethical clearance: The ethical clearance for the survey was obtained from the ethical committee of Department of Zoology, Faculty of Science, and Federal University Lafia with the Project Identification Code (PIC) – FUL/FS/ZLY/2017/001. Also, consent from the school authorities (NS/UBEB/S/Edu-9/V. I/104) of the 3 schools in each LGA and guardians of the school children were obtained.

2.4 Sampling size: Three hundred and sixty (360) school-aged children were recruited into the study; 60 pupils per school. Pupils between ages 5 and 18 were randomly selected according to the guideline by World Health Organization for survey of soil-transmitted helminths.

2.5 Collection and examination of fecal samples: Labeled plastic bottles were used for the collection of fecal samples. The stool samples were observed macroscopically using the naked eye for large parasites, proglottid, blood and mucous. It was also observed for color and consistency. Samples were analyzed using direct smear and sedimentation technique as describe by Cheesbrough [14]. The glass slide was labeled; a drop of normal saline was placed centrally on the slide. With the aid of an applicator stick, a portion of the stool sample was picked and emulsified in the normal saline. A cover slip was placed over the specimen and examined microscopically with x10 objective.

2.6 Concentration technique: With the help of an applicator stick, 1 gram of fecal sample was emulsified in 7 ml of 10% normal saline contained in a centrifuge tube. Additional 3 ml of normal saline was added and homogenized accordingly. The emulsified stool was sieved into a centrifuge tube and centrifuged at 1500 revolutions per minute (rpm) for 2 minutes. The supernatant was discarded, deposit mixed and 7 ml of 10% formal saline and 3 ml ether was added. It was well mixed and centrifuged. The deposit, supernatant dissolved debris was separated. The supernatant dissolved debris was decanted and sediment placed on a clean microscope slide and examined microscopically using x10 and x40 objectives [14].

2.7 Soil sampling and analysis: 20 grams of top soil that is 2 cm deep was collected with the aid of a hand trowel, a total of approximately 60 grams of soil samples was collected from three different locations in each school (refuse sites, area close to defecation sites and playing grounds or common sitting grounds) into three labeled polythene bags by throwing a quadrant at random on the identified site. Each polythene bag was labeled A, B, and C. The soil samples obtained from each site was properly mixed; 20 grams of each sample was weighed and analyzed using saturated sodium nitrate floatation method as described by Tavalla *et al.* [15] The weighed 20 g soil sample was poured into a 250 ml broad flask; 50 ml of 5% sodium hydroxide (NaOH) was added and left for one hour to separate the eggs from the soil. The sample was shaken manually for 20 minutes afterwards; the whole content of the flask was strained through cloth sieve placed over funnel to remove coarse sand particles into a 50 ml tube. The tube containing the sample was centrifuged for three minutes at 1500 rpm in order to settle the eggs and oocysts at the bottom. The supernatant was discarded and the sediment washed three times with distilled water. After washing, the sediment was re-suspended in saturated sodium nitrate (NaNO3) with specific gravity 1.30 and centrifuged for the second time for three minutes at 1500 rpm. The tube was transferred into the test tube stand, and the flotation fluid (saturated sodium nitrate (NaNO3) was added using a pipette until the fluid is raised up to the brim of tube. A clean grease free cover slip was placed on the surface of the fluid and left for 30 minutes where parasitic eggs and oocysts would stick to the cover slip, after which it was viewed microscopically.

2.8 Statistical analysis: The Data gotten was analyzed using R Console software (Version 3.2.2). Soil transmitted helminths infection rate in relation to age groups, locations as well as sex was compared using Pearson's Chi-square test. Also, Chi-square test was used to compare presence of parasites in relation to three soils from defecation point, refuse/dumpsite and playground/sit out points as well as in water between the two LGAs. Level of statistical significance was set at $p<0.05$.

3. Results and Discussions

From the 360 sampled faeces for soil-transmitted helminths in the six schools, 17.5% (63/360) were infected while those not infected were 82.5% (297/360) (Table 1). School-aged children from Doma Central Pilot Primary School had the highest infection rate of 28.3% while those from Obi South Primary School had the least prevalence rate of 3.3%. Therefore, prevalence of parasites in faeces of school-aged children between the six schools showed a very high significant difference (χ^2 = 38.635, DF = 5, $p<0.0001$).

Prevalence of soil transmitted helminths in the faeces of the subjects in relation to the two LGAs significantly varied (χ^2 = 15.982, DF = 1, P = 0.00006395) in favours of Doma LGA 47 (26.1%) over Obi LGA 16 (8.9%).

Table 2 shows the prevalence of geohelminths with respect to age group and gender. Age group 9 -12 years had the highest prevalence rate 36 (18.2%) followed by 5-8 years 18 (17.8%) while age group 13-18 years was the least infected 9 (14.8%). However, there was no significant difference (χ^2 = 0.38957, DF = 2, P = 0.823) in the prevalence rate of soil transmitted helminths in relation to age groups from the six schools sampled. Prevalence of soil helminthes in relation to sex showed no significant difference (χ^2 = 1.3759, DF = 1, P = 0.2408) although female school-aged children were more infected 35 (20.2%) than males 28 (15.0%) as shown in Table 2. Soil samples examined from defecation site had the highest prevalence of geohelminths 5 (83.3%) followed by soil from playground/sit out soil 4 (66.7%) whereas the lowest was refuse site soil samples 3 (50%) as shown in Table 3. Nonetheless, occurrence of geohelminths in relation to soil collected across different sites showed no significant difference (χ^2 = 1.5, DF = 2, P = 0.4724).

Six soil transmitted helminths were recorded in the study (Table 4), *Ascaris lumbricoides* infection was the highest with 9.2% where Doma North Primary School and Doma South Srimary School infection rate was within 10-20% whereas Doma Central Pilot Science Primary School, Obi Central Pilot Primary School, Obi South Primary School and LGEA Gidinye South Primary School had an infection rate that fell within the range of 1-10%, infection rate.

Table 1: Prevalence of soil transmitted helminths of school-aged children in relation to schools

Site	School	Number Examined	Number Infected (%)
Doma LGA			
	Doma Central Pilot Science Primary School	60	17(28.3)
	Doma North Primary School	60	9(15.0)
	Doma South Primary School	60	5(35.0)
	Subtotal	180	47(26.1)
Obi LGA			
	Obi Central Pilot Primary School	60	5(8.3)
	Obi South Primary School	60	2(3.3)
	LGEA Gidinye South Primary School	60	9(15.0)
	Subtotal	180	16(8.9)
	Grand Total	360	63(17.5)

Table 2: Prevalence of soil transmitted helminths in relation to age groups and sex among school-aged children in the six schools from the two selected LGAS in Nasarawa State Surveyed

		Doma Central Pilot Science Primary School		Dom North prima Primary School		Doma South Primary School			Obi Central Pilot Primary School	Obi South Primary School		LGEA South School	Gidinye Primary	Total Examined	Total Infected (%)
		No. Examined	No. Infected (%)	No. Examined	No. Examined	No. Examined	No. Infected (%)	No. Examined	No. Infected (%)	No. Examined	No. Infected (%)	No. Examined	No. Infected (%)		
Age	5-8	15	4(26.7)	8	1(12.5)	19	9(49.4)	13	1(7.7)	28	1(3.6)	18	2(11.1)	101	18(17.8)
	9-12	36	11(30.6)	38	7(18.4)	30	9(30.0)	32	2(6.3)	24	1(4.2)	38	6(15.8)	198	36(18.2)
	13-18	9	2(22.2)	14	1(7.1)	11	2(18.2)	15	2(13.3)	8	1(12.5)	4	1(25.0)	61	9(14.8)
Sex	Male	27	7(25.9)	32	6(18.8)	35	8(22.9)	33	3(9.1)	28	1(3.6)	32	3(9.4)	187	28(15.0)
	Female	33	10(30.3)	28	3(10.7)	25	12(48.0)	27	2(7.4)	32	2(6.3)	28	6(21.4)	173	35(20.2)

Table 3: Prevalence of geohelminths in soil samples in relation to different sites from the six schools in the selected two LGA in Nasarawa state

Sites of Collection	Doma LGA		Obi LGA		Total Number of sites examined	Total Number Positive (%)
	Number of sites examined	Number Positive	Number of sites examined	No. Positive		
Refuse Site	3	1	3	2	6	3(50)
Defecation Site	3	2	3	3	6	5(83.3)
Playground/sit out	3	2	3	2	6	4(66.7)
Total	9	5	9	7	18	12(66.7)

Table 4: Checklist of soil transmitted helminths and the frequency of their occurrence among school-aged children of six scho

School	Number examined	Helminths and Number infected (%)						
		S. Stercoralis	Hookworm	T. Trichiura	A. lumbricoides	H. Nana	S. Mansoni	S. haematobium
Doma Central Pilot Science Primary School	60	0(0)	2(3.3)	3(5.0)	11(18.3)	0(0)	0(0)	0(0)
Doma North Primary School	60	1(1.7)	1(1.7)	1(1.7)	6(10.0)	0(0)	1(1.7)	7(11.7)
Doma South Primary School	60	0(0)	6(10)	1(1.7)	10(16.7)	0(0)	0(0)	5(8.3)
Obi Central Pilot Primary School	60	0(0)	3(5.0)	0(0)	1(1.7)	0(0)	0(0)	11(18.3)
Obi South Primary School	60	0(0)	0(0)	0(0)	3(5.0)	1(1.7)	0(0)	19(31.7)
LGEA Gidinye South Primary School	60	0(0)	7(11.7)	2(3.3)	2(3.3)	1(1.7)	0(0)	8(13.3)
Total	360	1(0.3)	19(5.3)	7(1.9)	33(9.2)	2(0.6)	1(0.3)	50(13.9)

4. Discussions

A group of NTDs known as soil-transmitted helminths affects almost a quarter of the global population [16]. In several areas of Nassarawa State, this study looked into the prevalence of soil-transmitted parasitic infections among school-aged-children. A low frequency of 17.5% was found for soil-transmitted helminths overall among school-aged children from the six schools examined. This is comparable to the prevalence of 17.1% as observed in the study of Echeta *et al*. [17]. This contrasts the findings of Mobolanle *et al.* [18] who recorded overall prevalence of 69.9%, Edema *et al*. [19] who recorded that the overall prevalence of soil-transmitted Helminthiasis (STH) (46.0%) falls within the stipulated range among Local Government Areas of Cross River State and Pukuma *et al*. [20] who observed 27.22% prevalence and Echeta *et al*. [17] (18:1%). This decrease in level of occurrence may be related to varying sanitary standards, environmental factors, timing, sociocultural habits, and level of knowledge on prevention and control of these helminths. Also, availability and utilization of toilet facilities in these communities could be a determining factor. It could also be related to the season of the research which does not favor hatching and longevity of helminth ova as a result of harsh environmental condition.

School-age children of Doma South Primary had the highest prevalence of 33.3% while school-age children of Obi South had the least prevalence of 5.0%. The main reason for this may be due to the sanitary condition of the school environment and its proximity to the refuse, wastes and garbage dumping sites, where some of the school pupils defecate.

The prevalence in relation to age group shows that age group 9-12 years had the highest prevalence of 18.2%, while the age group 13-15 had the least prevalence of 14.8% although there was no significant difference in the prevalence in relation to age group. This agrees with the findings of Olufunmilayo *et al.* [18] who observed a high proportion of the children between ages 19 and 24 months were positive to helminth infection compared with other age brackets. It is important to note that at that age, most children would have been walking actively, and studies have shown that children are more likely to walk barefooted, Abraar *et al*. [21] hereby exposing them to hook worm infections. The low prevalence in the later age group may be because older children practice good hygiene habits than younger ones.

The prevalence in relation to sex shows that females had high prevalence of 20.2% than males 15.0%. This observation is agreed with the Amarachukwu *et al.* [22] and Ratee *et al.* [23]. This contrasts the findings of Edema *et al*. [24] who observed a close prevalence among the two sexes. These variation in prevalence and intensity among sexes could be by chance as the difference was not statistically significant. For soil sampled for geohelminths in relation to site of collection, defecation site was the highest with prevalence of 83.3% while the refuse site was the lowest with 50.0% prevalence However, occurrence of geohelminths showed no significant difference. This contradict the records of Edema *et al.* [24] in his findings that (79%) were increasingly more contaminated with larvae of soil-transmitted helminths in dumpsite than farmland soils (52%). Oyebamiji *et al*. [25] stated that such phenomenon provides a continuous source of infection in communities where such dumpsites are located. Open defecation or sewage disposal in dumpsites increase the risk of soil transmitted helminth infections.

In this investigation, the helminths, *Ascaris lumbricoides*, hookworm, *Trichuris trichuiria*, *Hymenolepsis nana*, *Schistosoma mansonii* and *Strongyloides sterrcoralis* were identified as six soil transmitted helminths. With a percentage frequency of 9.2%, *Ascaris lumbricoides* had the highest prevalence of all the STHs seen, followed by hookworm at 5.3% and *T. trichuiria* at 1.9%. This result agrees with the report of Legese *et al.* [26] who recorded a higher prevalence of *Ascaris lumbricoides* and Echeta *et al.* [17] with percentage prevalence of 32.8% respectively. This was ascribed to the *A. lumbricoides* ova's capacity to endure adverse environmental circumstances in the soil until advantageous conditions for embryonation were available [19]. This may justify its ubiquitous nature and distribution in all age groups in this study. The transmission cycle must be broken in order to limit or stop the spread of STHs, however this study found that the population under investigation's poor hygiene habits and present living standards are actually making the cycle stronger rather than shorter.

5. Conclusions

The study indicates that STH is endemic in Doma and Obi local government area, Nigeria. The study revealed hookworm eggs, *Strongyloides stercoralis* larvae, *Ascaris lumbricoides*eggs, *Trichuris trichiura* eggs, *Hymenolepis nana* eggs, and *Schistosoma mansoni* egg as the soil-transmitted helminths isolated from school children as well as geohelminths from the soil samples obtained from the six schools sampled. This is a clear indication of poor hygienic practices, lack of sanitation as well as high rate of asymptomatic carriers in the study community. Intensified health and hygienic enlightenment campaigns, improved sanitation the provision of adequate modern toilet facilities in schools, and quarterly deworming of school-aged children will reduce infection.

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