Prevalence and Risk Factors of Intestinal Helminthinthiasis among Primary School Children in Obio-Akpor Local Government Area of River State, Nigeria.

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ABSTRACT

Background: *Intestinal helminthic infections continue to pose a significant global health burden, particularly in tropical and sub-tropical regions. Thus, the prevalence and the risk factors intestinal helminth infections was investigated among primary schools children in Obio-Akpor, Rivers State, Nigeria.*

Methods: *This was a descriptive cross sectional study of three hundred and sixty children, selected using a multistage sampling method. Their stool samples were collected and examined for helminth eggs using Kato- Katz technique and analyzed at the Department of the Medical Microbiology laboratory, University of Port Harcourt Teaching Hospital. Data was analyzed using Statistical Software for Social Sciences version 17.0 (Chicago IL, USA).and a p- value of 0.05 was regarded as statistically significant.*

Results: *Their ages ranged from 5-12 years (mean age of 8.95±1.96 years)and most 229 (62.4%) were female. Twenty of the 367 (5.4%) children were infested with helminths. Three of the 161(1.9%) children resident in an urban community compared to 17 of 206 (8.3%) living in a rural community were infested with intestinal helminths and this was statistically significant($\chi2$= 7.159; p= 0.007). Multivariate analysis showed that children drinking from wells and streams were ten times at risk of being infected with intestinal helminths.(β=2.320, 95% C I=2.02 to 51.20, p=0.005).*

***Conclusion**: Children who drank from wells and streams were at ten times greater risk of intestinal helminths. Therefore, access to improved water sources and improved personal hygiene should be the main goal in reducing the burden of helminthic infestation.*

KEYWORDS: Helminthic infestation, prevalence, risk factor and primary school children

INTRODUCTION

Intestinal helminthic infections continue to pose a significant global health burden, particularly in tropical and sub-tropical region.[1] Globally, about 4.5 billion individuals are at risk and more than 1.5 billion people become infected. Of these, about 568 million suffer from the infection, most of whom are school-age children.[2] In 2010, it was estimated that 438.9 million people worldwide had hookworm infections, 819.0 million had Ascaris lumbricoides infections, and 464.6 million had Trichuris trichiura[3] These infections affect the poorest and most deprived communities with poor access to clean water, sanitation and hygiene in tropical and subtropical areas, with the highest prevalence reported from sub-Saharan Africa, China, South America and Asia.[4]

Over 260 million preschool-age children, 654 million school-age children and 108 million adolescent girls live in areas where these parasites are intensively transmitted.[4] Transmission could be by ingestion of eggs present in human faeces that contaminate vegetables and water or when children put soil contaminated hands into their mouth.[4] Walking on contaminated soil bare footed also, could get children infected by the macroparasite of hookworm.[4]

Intestinal helminths have been linked with significantly reduced growth and increased risk of protein- energy malnutrition, including growth stunting, iron deficiency anaemia and reduced cognitive/ psychomotor development.[5] They impaired children through direct feeding of the worms on host tissue and blood causing iron deficiency anaemia; increased malabsorption of nutrients causing growth stunting; chronic intestinal blood loss that can result in anaemia, and loss of appetite and reduction of nutritional intake and physical fitness.[4]

Studies [6,7] in Nigeria have identified a common triad of transmitted helminth infection: Ascaris lumbricoid, Trichuris trichiuria, and hookworm species.In a study of intestinal helminthiasis, Idowu, et al.[8] in Lagos State, examined 413 stool samples of children and reported that 132 (32%) were positive for soil transmitted helminths (STHs). The three STHs recorded were: Ascaris lumbricoides (50%), Trichuris trichiura (23%) and hookworm (3%). In another study [9] done in Uganda among 432 primary school children aged 6-10 years, the prevalence was 10.9%, 3.1%, 1.95 and 0.3% for hookworm, T. trichiuria, Schistosoma mansoni, and Ascaris lumbricoides respectively.

Scio-economic factors, including low income, poor sanitation, overcrowding, and limited access to clean water, have been linked to increased prevalence of these infections.[10] Reduced prevalence has been associated with improved economic status and access to proper toilet facilities, but hand washing and clean drinking water are equally important for preventing transmission.[11] The high burden of intestinal helminths in Nigeria is due to poor socioeconomic status, which will necessitates the estimation of its prevalence and risk factors.

This study would help determine the prevalence of intestinal helminth infestation and risk factors for helminth infestation among primary school in Obio/Akpor local government of Rivers State. The outcome of this study will raise awareness of the impact of helminthic infestation as a significant aspect of school health, and the significance of effective programs designed to improve the health and hygiene of school-aged children.

Subjects and Methods

Study population

All pupils aged 5-12 years in the selected private and public primary schools in Obio/ Akpor Local Government were recruited into the study. Data obtained from Rivers State Ministry of Education show that as at 2009/2010, the estimated number of pupils in primary 1-6 in Obio/Akpor Local Government Area were 106,920. Of these, 23,200 were from private schools and 83,720 from public schools.

This was a cross-sectional study which was carried out among children attending private and publicprimary schools in Obio/ Akpor Local Government Area of Rivers, South-south of Nigeria between September and November 2016.

All children aged 5-12 years in the selected schools and those whose parents/ guardians gave written consent and those who gave assent were included in the study. However, children who had received anthelminthics within three months preceding the date of data collection were excluded.

Sample size determination

The sample size for this study was calculated based on previously documented prevalence rate of 32.1% among primary school children in a study[12] done in Enugu, South East Nigeria, using the formular.;

Minimum sample size (n) = $\underline{Z^2Pq/d^2}$

WithZ being 1.96 (corresponding to 95% confidence interval)and with a prevalence rate of 0.321 and anacceptable error of 0.05, the minimum sample size plusattrition of 10% calculated was 367.

The schools and the pupils for this study were selected by stratified multistage sampling technique. This selection involved four stages.

One hundred and sixty six schools were stratified into rural and urban schools with assistance of the officials of Ministry of Education. The total number of schools in urban and rural areas was 142 and 24 respectively.

Fifteen out of 142 and 4 out of 24 government-approved schools in the urban and rural areas of the community respectively were randomly selected. The schools in both the urban and rural areas were further stratified into public and private schools through the assistance of the officials of the Ministry of Education.

The total number of schools in the urban area= (33 public schools+ 109 private schools) = 1: 3 .Total number of schools in rural area = (13 public schools + 11 private schools) = 1: 1. Based on the ratio above, five public and fifteen private schools were randomly selected by simple random sampling from the urban schools. For rural schools, two public schools and two private were selected by simple random sampling. The pupils in the selected schools who met the inclusion criteria for the study were sampled based on proportion to size allocation. This was done by selecting the appropriate number from the schools. They were selected via simple random sampling by balloting using school attendance as the sampling frame.

The body weight and height of the pupils were determined using a weighing scale and height pole respectively. Weight was measured using Health scale (Ocean

Medical, England) and read off to the nearest 100g (0.1kg). Scale was adjusted to zero prior to each measurement and calibrated using known weight monthly. Pupils were weighed in their schools with minimal clothing (underpants used for physical training). All the selected pupils were given consent forms to be filled by their parents; those whose parents/ caregivers signed the consent form were given questionnaires and well labeled sample bottles. The number on the questionnaire was the same on the sample bottles. They were to come with the stool samples the next day for submission and measurement of weight and height.

For measurement of height, the subject had to stand straight on a level floor, with their buttocks, shoulders and back of the head touching the wall, with the heels flat and together, shoulder relaxed and arms hanging down, the head erect with eyes looking straight forward and the lower border of the orbit in line with the external auditory meatus (Frankfurt plane). The headpiece, a metal bar was lowered gently, pressing down the hair and height was measured. The pupils were stratified into socio-economic classes (I-V) based on the Oyedeji classification.[13] Socio-economic index scores (one to five) were awarded to each subject, based on the occupational and educational levels of parents. The mean of four scores (two for the father and two for the mother) to the nearest whole number, was the social class assigned to the child. For the study, classes I and II were grouped together as upper social stratum, class III was taken as the middle stratum and classes IV and V as lower social stratum.

The approval of the Ethics Committee of the University of Port Harcourt Teaching Hospital was obtained before the commencement of the study. Notification and permission to carry out the study was obtained from the Rivers State Ministry of Education. Written consent was also obtained from the parents

Specimen collection and handling

The stool was collected by the child's parent into a container (universal bottle) provided by the investigator which had already been washed and air-dried. Only stool specimens passed on the collection day were accepted for examination by the investigator under the supervision of the laboratory scientists. This because hookworms' eggs are seen in fresh samples due to their thin wall. The stool samples were properly labelled and carried in cold boxes filled with ice packs to enhance detection of macroparasite of hookworm. They were transported to the Department of Medical Microbiology at University of Port Harcourt Teaching Hospital for analysis within 10 hours of collection. The samples were analyzed by investigators under the supervision of experienced, certified laboratory technicians. The samples that could not be analyzed immediately were preserved using 100% formalin examination on the latter day.

Microscopic examination

The cellophane thick faecal smear technique described by Kato and modified by Katz *et al*[14] was used to examine for the parasites. A test kit comprising nylon meshes/ filters, cover-slips of pre-stained cellophane, spatulas, perforated plates and conversion tables for the determination of the number of the eggs per gram of faeces was utilize in the procedure.

To prepare the thick smear, stool was taken with a spatula and placed on a piece of absorbent paper. A nylon mesh was placed over the stool and compressed with the spatula so that part of the stool passed through the mesh. The side of the spatula was used to scrape off the stool that passed through the mesh and deposited into the orifice of the perforated plate already placed on a microscope slide. The stool was smeared into orifice of the plate until it was full. The spatula was then passed over the perforated plate to remove excess faeces. The spatula and meshes were discarded. The perforated plate was carefully lifted from the slide from one end so that a cylinder of faecal material is left on the microscope slide. A pre-stained cover-slip was then placed on the cylinder of faeces. The preparation was turned upside down on a smooth surface and pressed gently with the thumb over the cylinder of faeces to spread it evenly without spilling. The preparation was allowed to stand for 60 minutes in room temperature before a microscopic examination and counting of ova under x 10 objective lenses magnification of a light microscope was done. All the parasite ova in each slide were identified and counted. To obtain semi-qualitative estimation of the eggs-load, the total number of eggs counted was multiplied by twenty-four to obtain the number of eggs per gram of faeces. Based on eggs per gram of faeces and their association with morbidity, individuals were classified into light, moderate and heavy infestation by World Health Organization.[15] For ascariasis, light infestation is less than 5,000 epg, heavy infestation is greater than 50,000 epg while moderate infestation lies between these figures.[5] For trichuriasis, light infestation is less than 1,000 epg, heavy infestation is greater than 10,000 epg and moderate infestation lies between these figure.[15] For hookworm, light infestation is less than 2,000epg, heavy infestation is greater than 4,000epg and moderate infestation lies between these figures.

Data analysis

Data entry was using the Microsoft Excel software and analyzed using version 17.0 of the Statistical Package for Social Scientific software package (SPSS Inc, Chicago, IL). Proportions and ratios were compared using Fisher's exact test and Chi square test. To analyse the intensity of infestation for intestinal helminths, the number of eggs per slide was converted to number of eggs per gram. Student t- test was used to compare the means.

The potential influence of place of residence and other socio-demographic variables on worm infestations was tested using multivariate logistic regression. A p-value of < 0.05 was considered to be statistically significant.

Results

General characteristics

Three hundred and eighty-four pupils (384) were selected to participate in this study. The study was performed on 367subjects, a total of 17 subjects were excluded due to missing data. Of these, 206 (56.1%) were from rural public school and 161 (43.9%) were from urban schools.

Out of 367 children studied, 138 (37.6%) were males and 229 (62.4%) were females giving a male: female ratio of 1: 1.6. The subjects were between 5 and 12 years old, with a mean age of 8.95±1.96 years .Of these, 184(50.1%) were in 8-10 years age group and 92 (25.1%) were in 11-12 years age group. Of these, 281 (76.6%) were from the lower social class, 73 (19.9%) from the middle class and 13 (3.5%) from the upper class. Two hundred and six (56.1%) pupils lived with their parents in the rural area and 161 (43.9%) in the urban area.

Tab I: Socio-demographic characteristics of the study population

Variables (N=367)	Frequency	Percentage (%)
Age category		
5-7 years	91	24.8
8-10 years	184	50.1
11-12 years	92	25.1
Mean age +SD (years)	**8.95±1.96**	
Mean weight +SD (Kg)	**25.0±7.13**	
Gender		
Male	138	37.6
Female	229	62.4
Social class		
Upper (I-II)	13	3.5
Middle(III)	73	19.9
Lower(IV-V)	281	76.6
Place of residence		
Rural	206	56.1
Urban	161	43.9

Prevalence of helminths. A total of 20 out of 367 pupils had ova of parasite helminth in their stools. An overall prevalence of 5.4% was recorded.

Intensity of intestinal helminth infestation among school children

The intensity of infestation was of light intensity in 14 (70%) and moderate in 6 (30%). No heavy intensity was observed in the study.

Table II shows the prevalence of helminth infestation was 7.6%, 5.4%, and 3.3% in children aged 11- 12 years, 8-10 years, and 5-7 years respectively. There was no statistically significant difference in the prevalence of helminth infestation among age groups ($\chi2$ =1.651; p = 0.438). The prevalence of helminth infestations was 5.1% in females and 5.7% in males. The two groups were similar ($\chi2$= 0.061, p=0.805). The prevalence of helminth infestations was 8.3% in children living in a rural areas compared to 1.9% of those living in urban areas. There was a statistically significant difference in the prevalence of helminth infestation between children in rural and urban schools ($\chi2$= 7.159; p= 0.007).

Table II: Socio-demographic characteristics and intestinal helminths infestation among school children

Variables	Intestinal helminths infestation				
	Infested n (%)	Not infested n (%)	Total n (%)	*Chi* Square/Fisher's exact	*p-value*
Age category					
5 – 7 years	3 (3.3)	88 (96.7)	91 (100.0)	*1.651*	*0.438*
8– 10 years	10 (5.4)	174 (94.6)	184 (100.0)		
11 – 12 years	7 (7.6)	85 (92.4)	92 (100.0)		
Gender					
Male	7 (5.1)	131 (94.9)	138 (100.0)	*0.061*	*0.805*
Female	13 (5.7)	216 (94.3)	229 (100.0)		
Type of school					
Public	16 (6.8)	219 (93.2)	235 (100.0)	*2.342*	*0.126*
Private	4 (3.0)	128 (97.0)	132 (100.0)		
Social class					
Upper	2 (15.4)	11 (84.6)	13 (100.0)	**	*0.127*
Middle	2 (2.7)	71 (97.3)	73 (100.0)		
Lower	16 (5.7)	265 (94.3)	281 (100.0)		
Place of residence					
Rural	17 (8.3)	189 (91.7)	206 (100.0)	*7.159*	*0.007**
Urban	3 (1.9)	158 (98.1)	161 (100.0)		

**Statistically significant p<0.05* ***Fisher'*

Household Characteristics and Intestinal Helminths Infestation among School Children

Table III shows the household characteristics and intestinal helminthic infestation among school children. The prevalence of intestinal helminthic infestation was 33.0%, 25.0%, 4.9%, and 4.1% in children who drank from wells, streams, taps (pipe-borne water), and boreholes. There was a statistically significant difference in the prevalence of helminth infestation in children who drank from various sources of water ($\chi2 = 9.266$, p=0.023). The prevalence of helminth infestation in children who use pit latrines, open defecation and water cisterns was 8.9%, 7.1%, and 5.0% respectively. There was no statistically significant difference in the prevalence of helminth infestation and the type of toilet ($\chi2 = 1.844$, p=0.555). The prevalence of intestinal helminth was 15.2%, 12.5%, 5.6%, and 3.3% in children whose floors were made of rug, earth, cement, and tiles respectively. There was a statistically significant difference in the prevalence of helminth infestation and home floor material ($\chi2$ = 8.179; p = 0.030). The prevalence of helminthic infestation was 5.9% among children who did not wear shoes outside the house compared to 4.7% among children that wore shoes. There was statistically significant difference in the prevalence of helminthic infestation in those that wore and those that did not wear shoes outside the house (χ^2=0.222, p = 0.638).

Table III: Household characteristics and intestinal helminths infestation among school children

Variables	Intestinal helminths infestation Infested n (%)	Not infested n (%)	Total n (%)	Chi-square /fisher's exact test	p-value
Source of water in household					
Tap	14 (4.9)	269 (95.1)	283 (100.0)	*9.266***	*0.023**
Borehole	3 (4.1)	71 (95.9)	74 (100.0)		
Well	2 (33.3)	4 (66.7)	6 (100.0)		
River	1 (25.0)	3 (75.0)	4 (100.0)		
Treatment of water in household					
Yes	11 (6.4)	162 (93.6)	173 (100.0)	*0.525*	*0.469*
No	9 (4.6)	185 (95.4)	194 (100.0)		
Type of toilet in household					
Water cistern	15 (5.0)	285 (95.0)	300 (100.0)	*1.844***	*0.555*
Pit latrine	4 (8.9)	41 (91.1)	45 (100.0)		
Public toilet	0 (0.0)	8 (100.0)	8 (100.0)		
No toilet (open air defecation)	1 (7.1)	13 (92.9)	14 (100.0)		
Use of soap for hand was hing after toilet					
Yes	15 (5.0)	283 (95.0)	298 (100.0)	**	*0.554*
No	5 (7.2)	64 (92.8)	69 (100.0)		

*Statistically significant ** Fisher's ex

Table III: Household characteristics and intestinal helminths infestation among school Children continued

Variables	Intestinal helminths infestation		Total n (%)	Chi-square / fisher's exact test	p-value
	Infested n (%)	Not infested n (%)			
Home floor material					
Tiles	6 (3.3)	178 (96.7)	184 (100.0)	*8.179* **	*0.030**
Earth	1 (12.5)	7 (87.5)	8 (100.0)		
Cement	8 (5.6)	134 (94.4)	142 (100.0)		
Rug	5 (15.2)	28 (84.8)	33 (100.0)		
Going outside without shoe					
Yes	6 (4.7)	122 (95.3)	128 (100.0)	*0.222*	*0.638*
No	14 (5.9)	225 (94.1)	239 (100.0)		
Footwear used at home					
Shoe	0 (0.0)	44 (100.0)	44 (100.0)	*7.332*	*0.026**
Sandal	17 (8.2)	191 (91.8)	208 (100.0)		
Neither	3 (2.6)	112 (97.4)	115 (100.0)		

*Statistically significant ** Fisher's exact

Predictive Factors for Helminth Infection among School Children.

Parameters with probability values less than 0.05 (place of residence, source of water in household, household floor material, and footwear used at home) were selected into our logistic regression models accordingly to predict relationships with helminth infections (Table IV). Drinking from the well water and stream was the main predictor of intestinal helminth infestation among these children (β=2.320, 95% C I=2.02 to 51.20, p=0.005).

Table: IV Logistic regression analysis for predictors of intestinal helminths infestation in schoolchildren

Independent variables	Coefficient (B)	Odds ratio	95% Confidence Interval		P-value
			Lower	Upper	
Place of residence					
Rural	1.215	3.370	0.91	12.54	0.070
Urban R		1			
Source of water in household					
Well/Stream	2.320	10.176	2.02	51.20	0.005*
Tap/Borehole R		1			
Househo ld floor material					
Earth/Rug	0.981	2.668	0.89	8.02	0.081
Tiles/Cement R		1			
Footwear used at home					
Non-sandal use	1.284	3.612	0.96	13.57	0.057
Sandal use R		1			

*Statistically significant R – Reference catego

Discussion

In this study, the prevalence of intestinal helminths among the primary school children in Rivers State was 5.4%. This was compared to a prevalence of 4.9% found in a study conducted in Enugu, Nigeria[16], but it was lower than that of a similar study in the same local government with a prevalence of 30.7%.[17] This difference in prevalence of intestinal helminths may be due to the use of different methods in analyzing stool samples. The formol-ether concentration technique was employed by Odu et al[17]. Formol - ether concentration technique is believed to have a sensitivity that is 15 to 50 times greater than the direct method.[18] These variable rates in prevalence between this index study and Odu et al may be a reflection of the timing and geographical differences when the studies were carried out. The index study was carried out between September and November, while the study by Odu et al covered the entire year.

In this study, Trichuris trichiura was the aetiological agent that was most prevalent. This was similar to the findings of the study[17] done in the same local government, but in contradiction to other previous studies in Nigeria.[19,20] While in past decades, both species of Trichuris trichiura and Ascaris lumbricoide were thought to be distributed somewhat similarly, more recent estimates indicate an increasing predominance of Trichuris trichiura.[21]

De Silva et al,[21] in their important update on the global prevalence of soil-transmitted helminth, estimated 100 million cases of trichuriasis and 84 million cases of ascariasis in the Latin American and Caribbean (LAC) region. The reasons behind the current preponderance of Trichuris trichiura infestations remain unclear. One plausible explanation is that the widespread use of single-dose albendazole for de-worming campaigns in endemic countries has been less effective in reducing trichuriasis as this parasite is less susceptible to this drug.[22]

In this study, the intensity of helminthic infestations was primarily of light infestations. This is similar to that of previous workers [23] in Enugu, but contrast to a study done in Osun, Nigeria.[19] The differences are probably due to variations in study sites and methodologies applied. In this study, stool analysis was done using the Kato-Katz method, which is different from the Stoll's dilution egg-count technique employed in the Oninla et al.study.[19] The Stoll dilution technique is associated with higher intensity.[24]

The prevalence of helminth infestation in this study is significantly influenced by the types of household floors. Improved household floor was associated with a lower prevalence of helminth infestation. Improved household floors like cement and tiled surfaces are easy to clean and may not be damp, which makes them a hard surface for parasite ova to survive and proliferate. This finding suggests that improved household floors such as cement and tiled surfaces hold promise as an environmental intervention to reduce helminth infestation transmission among children in low-resource settings.[25] A random-effects meta-analysis suggested that households with improved floors had 0.75 times the odds of infection with any type of enteric or parasitic infection compared with households with unimproved floors.[25]

In this study, children who reside in urban communities were less than three times as likely to be infested with intestinal helminths as those who reside in rural communities. This is consistent with a study done in Ibadan, Nigeria.[19] Rural communities have been known to be associated with potential risk factors that favour the transmission of helminth infestations. For instance, the proportion of the Nigerian population with access to an improved water source is higher in urban than in rural areas.[26] However, these findings disagree with a study done in southern Malawi, where pupils from urban areas were more than four times infected with intestinal helminths than their rural counterparts.[27]This disparity is due to potential risk factors for intestinal helminthic infestations that is present in the communities. These include having pools of waters and sewage around the houses, not wearing shoes and low socioeconomic status.[27]

The findings from multivariate analysis demonstrated that children who drank from wells and streams had ten times the risk of being infected with intestinal helminths. This agrees with another study [28] in Port Harcourt, Nigeria. This disparity may be due to contaminated soil particles that are washed into open wells and streams. When water is drawn from these wells and streams and used by households without boiling or treating it, households are infected by ingestion of helminth eggs.[29]

Conclusions

This study found a low prevalence of intestinal helminths, with a light intensity of intestinal helminths. The risk of intestinal helminth infection was ten times greater for children who drank from wells and stream.

Recommendations

Provision of pipe-born water should be available made in the communities and schools. A single dose of Albendazole should not be used for routine deworming where there is a high prevalence of Trichuris trichuris.

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Conflict of Interests
The authors declare that there is no conflict of interests regarding the publication of this paper.

References

1. Norhayati M, Fatmah MS, Yusof S, Edariah AB. Intestinal parasitic infections in man: review. Med Malaysia 2003; 58:296-305.
2. WHO. "Soil-transmitted helminth infections Fact sheet". Who.int. March 2019,Retrieved 15 Aug. 2024. Available online: https://www.who.int/news-room/fact-sheets/detail/soil-transmitted-helminth-infections.
3. Pullan RL, Smith JL, Jasrasaria R, BrookeSJ. Global numbers of infection and disease burden of soil transmitted helminth infections in 2010 Parasite Vectors2014; 7: 37.
4. WHO Fact Sheets; Soil-Transmitted Helminthes Infections. 2022. https://www.who.int/news-room/fact sheets/detail/soil-transmitted-helminth-infections
5. Hotez PJ, Brooker S, Bethony JM, et al. Hookworm infection. The New England Journal of Medicine 2014; 351:799 – 807.
6. Muhammad AB, Kumurya A1, Ahmed J, Abdussalam UA, Alhassan A.Epidemiology and control of soil transmitted helminthiasis and giardiasis in Nigeria- a review.BJMLS, 2016; 1:47 – 55.
7. Wokem GN, Onosakpondme EO. Soil transmitted helminthiasis in Sapele local government, Delta state. Nig J Parasitol. 2014; 3:143–48.
8. Idowu ET, Fagbolun IK, Sanyaolu OC, Oguntuyi KO, Otubanjo OA. Soil-Transmitted Helminths Infections among School Aged Children in Lagos State, Nigeria. Animal Research International 2019; 16: 3508-518.
9. Lwanga F, Kirunda BE, Orach CG. Intestinal helminth infections and nutritionalstatus of children attending primary schools in Wakiso is District, Central Uganda. Int J EnvironRes Public Health 2012; 9: 2910-21.
10. Aschalew G, Belay A1, Bethel N, Betrearon S, Atnad Y, Meseret A, Mengistu E, Baye G. Prevalence of intestinal parasitic infections and risk factors among school children at the University of Gondar Community School, Northwest Ethiopia: a cross-sectional study. BMC Public Health 2013; 13:304.
11. Kan SP. Environmental, socioeconomic and cultural-behaviouralfactors affecting endemicity of soil-transmitted helminthiasis and nutritional status of urban slum dwellers. The Asian Parasite Control Organization (APCO) 1993; 44-63.
12. GC, Ilechukwu CGA, Ubesie AC, Onyire NB, Emechebe G, EzeJC. Relationship between nutritional status and intensity of common intestinal helminths among children in Enugu, South-East Nigeria. Ann Med Health Sci Res 2014; 119: 2-4.
13. Oyedeji G. A Socio–economic and cultural background of hospitalized children in Ilesha. Nig J Paediatr 1985; 12:111–17.
14. Katz N, Chaves A, Pellegrino J. A simple device for quantitative stool thick smear technique in

Schistosomiasis mansoni. Rev Inst Med Trop Sao Paulo 1972; 14:397-400.

15. WHO. Prevention and control of schistosomiasis and soil transmitted helminthiasis. Geneva: WHO; 2002.
16. Ekpenyong, EA, Eyo JE. Prevalence of intestinal helminths infections among schooling children in tropical semi urban communities. Animal ResearchInternational 2008; 5: 804 – 10
17. Odu NN, Okonko IO, Erhi O. Study of Neglected tropical diseases (NTDs):Gastro Intestinal Helminthes among school children in Port Harcourt, Rivers State, Nigeria. Report and Opinion 2011; 9:6-16.
18. Allen AV, Ridley DS. Further observations on the formol-ether concentration technique for faecal parasites. J Clin Pathol 1970; 23: 545-46.
19. Oninla SO, Onayade AA, Owa JA. lmpact of lntestinal helminthiasis on the nutritional status of primary school children in Osun State, South-Western Nigeria. Annal of Trop Med Parasitol 2010; 104: 583-54.
20. Saka MJ, Aremu AS, Saka AO. Soil-transmitted helminthiasis: prevalence rate andrisk factors among school children in Ilorin, Nigeria. J Appl Sci in Environ Sanitation 2014; 9:2, 139-45
21. de Silva NR, Brooker S, Hotez PJ, Montresor A, Engels D, Savioli L. Soil-transmittedhelminth infections: updating the global picture.Trends Parasitol 2003; 19: 547-51.
22. Vercruysse J, Behnke JM, Albonico M, Ame SM, Angebault C, Bethony JM, Engels D, et al. Assessment of the anthelminthic efficacy of albendazole in school children in seven countries where soil-transmitted helminths are endemic. PLoS Negl Trop Dis 2011; 5:948.
23. GC, Ilechukwu CGA, Ubesie AC, Onyire NB, Emechebe G, Eze JC. Relationship between nutritional status and intensity of common intestinal helminths among children in Enugu, South-East Nigeria. Ann Med Health Sci Res 2014; 119: 2-4.
24. Utzinger J, Marti H, Ame SM, Ali SM, Albonico M, Keiser J. Comparison of the Kato-Katz method and ether-concentration technique for the diagnosis of soil-transmitted helminth infections in the framework of a randomised controlled trial. Eur J Clin Microbiol Infect Dis 2014; 5:815-22.
25. Hugo Legge, Rachel L. Pullan, Benn Sartorius. Improved household flooring isassociated with lower odds of enteric and parasitic infections in low- and middle-income countries: A systematic review and meta-analysis. PLOS Glob Public Health. 2023; 3(12): e0002631.
26. National Population Commission (NPC) [Nigeria] and ICF International: Nigeria Demographic and Health Survey 2013. Abuja, Nigeria, and Rockville, Maryland, USA:NPC and ICF International; 2014.
27. Phiri K, Whirry CJ, Graham SM, Saembatyalule G. Urban/rural difference in prevalence and risk factors for intestinal helminthic infection in southern Malawi. Ann Trop Med Parasitol 2000; 94:381-7.
28. Odu NN, Elechi VI, Okonko IO. Prevalence of intestinal helminths infection among primary school children in urban and semi-urban areas in Port Harcourt, Rivers State, Nigeria. World Rural Observ 2013; 5:52-61.
29. Auta T, Kogi E, Oricha KA. Studies on the intestinal helminths infestation among primary school children in Gwagwada, Kaduna, North Western Nigeria. J Biol Agric Health Care 2013; 3: 48-53.