Prevalence of Intestinal Helminthes Infection among Primary School Children in Urban and Semi-Urban Areas in Rivers State, Nigeria

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ABSTRACT: The prevalence and intensities of intestinal helminthes among school children were determined in urban and semi-urban communities in Rivers state, Nigeria. Stool samples were collected from 300 hundred consented children attending University Demonstration Nursery & Primary School (UDNPS), Choba and Community Primary School (CPS), Rumuolumeni. The stool samples were analyzed for helminthes eggs and larvae using standard methods. Other information was collected using a Performa specifically designed for this study. Results showed that *Ascaris lumbricoides* 27(57.4%) was the most predominant, followed by *Trichuris trichuria* [12(25.5%)] and hookworm [8(17.0%)] was the least prevalent. Location-specific prevalence showed a significant difference ($p<0.05$) in the acquisition of helminthes. Children from the semi-urban area (21.8%) had higher prevalence than their counterparts in the urban area (10.1%). Children who had stream (24.5%) and well (19.4%) as their sources of water had higher prevalence than their counterparts with bore-hole water (11.9%). Children who had pit (26.7%) as their type of toilet had higher prevalence than their counterparts with water closet (12.9%). Children whose parents were traders (20.9%) and farmers (18.0%) had a higher prevalence than their counterparts whose parents were civil servants (10.7%). However, ages and sexes of subjects showed no significant difference ($p>0.05$) in the acquisition of helminthes in this study. This study has shown that intestinal helminthes are still highly prevalent among school-aged children in Nigeria. This information however will be very useful in the control strategy. Based on the result obtained, we would like to recommend routine examination of stool of all school children. However, further studies are therefore advocated.

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1. INTRODUCTION

Parasitic diseases are common in the developing counties and are of major health hazard because of their high prevalent rate, and their effect on both nutritional and immune status of the population (Alli et al., 2011a). Parasitic diseases of blood and gastro-intestine of human are rampant in the tropics because there are favourable climatic, environmental and sociocultural factors which permit transmission of these parasitic diseases for greater part of the year (Obiamiwe and Nmorsi, 1990; Mordi and Ngwodo, 2007; Alli et al., 2011a). These parasitic diseases, whether waterborne, vector-borne, soil transmitted or those that result from some poor sanitary or social habits provide some of the many public health problems in the tropics (Mordi and Ngwodo, 2007; Alli et al., 2011a).

The most prevalent neglected tropical diseases (NTDs) are due to helminthes, lymphatic filariasis, soil –transmitted helminthiasis (including Ascariasis, trichuriasis and hook worm infections) schistosomiasis and food – borne trematodeinfections (Sachs et al., 2006; Odu et al., 2011a). These NTDs are commonly caused by helminthes. Helminthes are worms classified as parasites. More than 72 species of protozoa and helminthes can lodge in humans; most are considered food and water-borne zoonoses (Jimenez-Gonzalez et al., 2009; Odu et al., 2011a). The parasites frequently encountered include *Ascaris lumbricoides*, hookworms, *Trichuris trichiura*, *Strongyloides stercoralis*, *Giardia lamblia*, *Enterobius vermicularis, Ancyclostoma duodenale, Necator americanus,* and some species of *Schistosoma* as well as *Entamoeba histolytica* (Awolaju and Morenikeji, 2009; Odu et al., 2011a).

Gastro-intestinal parasites are identified as a cause of morbidity and mortality throughout the world particularly in the under developed countries (Odu et al., 2011a). They are one of the most common infections in humans especially in tropical and sub-tropical countries (Awolaju and Morenikeji, 2009; Odu et al., 2011a). Intestinal parasitic diseases remain a serious public health problem in many developing countries especially due to fecal contamination of water and food (Jimenez-Gonzalez et al., 2009; Odu et al., 2011a).

Soil transmitted helminthes (STHs) infections are important factor contributing to malnutrition in this age group (Stephenso et al., 2000; Odu et al., 2011a). Soil transmitted helminthiasis (STHs) are *Ancylostoma duodenable*, *Necator americanus (hook worms)* and *Trichuris Trichuria* (Whipworm). STHs infections are widespread globally. In some species and regions, people with multiple infections are more common than those with either an infection or a single infection (Okolie et al., 2008; Okonko et al., 2009; Odu et al., 2011a).

Estimates of these parasitic diseases thus become a matter of necessity for the surveillance of public health, proper health-care delivery and people's welfare (Mordi and Ngwodo, 2007). Estimating the amount of morbidity or disease due to human helminthiasis is even more contentious than trying to calculate the number of infections. Odu *et al*. (2010) carried out a similar research on helminthiasis among school children in rural communities in Rivers State Nigeria. The schools were chosen at random sampling while the pupils were chosen through a multi-stage sampling technique. About 185 stools were investigated using cellophane thick smear method in Ogba and Ekpeye Kingdoms. The prevalence of hookworm was the highest in both kingdoms (72.6%), followed by *Ascaris lumbricoides* (33.9%) and *Trichuiris trichuria* (29%) while the least was *Fasciolopsis buski* (1.6%).

Few studies have examined the impact of infection on younger children, partly because of burden of worms and, it has been assumed that disease is light at the early age and perhaps because of the practical difficulty in reaching the pre-school population (Odu et al., 2011a). Two recent studies from Africa, however, suggest different conclusion. A study of de-worming children in Port Harcourt, Nigeria, showed there was a significantly high level of reduction in worm infestation and worm load (Odu et al., 2011b). While a study of de-worming pre–school children during "health days" in Uganda increased growth rate and was cost – effectively (Alderma et al., 2006). PSAC (pre – School Aged Children comprise between 10% and 20% of the 3.5 billion people living in soil transmitted helminthes (STHs) endemic areas (WHO, 2006), and although these infections are not among the big killers, they endanger children's health in a subtle and debilitating way, chronic infections compromise healthy growth, cognitive development, physical fitness, and iron status and affect immune response of infected children (Albonico et al., 2008; Odu et al., 2011a).

Previous studies elsewhere in Nigeria have been along these lines. Among such studies are those of Mordi and Ngwodo (2007), Ajero et al. (2008), Okolie et al. (2008), Tohon et al. (2008), Chukwuma et al. (2009), Awolaju and Morenikeji (2009), Alli et al. (2011a,b,c) and Odu et al. (2010, 2011a,b). This study currently focused on evaluating the demographic feature and intestinal helminthes infection among nursery and primary school children in urban and semi-urban areas in Rivers State, Nigeria. It also investigates into the hygienic conditions of schools in some parts of the state and to identify factors that are essential for the development of sustainable school health programme.

2. MATERIALS AND METHODS

2.1. Study Area

The study areas were from both urban and semi-urban nursery and primary schools in Rivers State. The schools include University Demonstration Nursery & Primary School (UDNPS), Choba and a semi urban Community Primary School (CPS), Rumuolumeni both in Obio/Akpor Local Government Areas of Rivers State, Nigeria. The area has warm humid climate condition with high temperature and heavy rains distributed almost all the year round. The inhabitants of Choba and Rumuolumeni comprise of people from all part of Nigeria and even foreigners. Majority of people here are civil servants, traders and only very few are agricultural workers. Generally, there is provision of some basic amenities like pipe-borne water and also hygienic toilet system (water closet system). Most houses lack toilet facilities and as such, defecation is done in the bush though some of them have pit toilets. The farms are often situated near their houses and subsequently contaminated water may run into farms. Occasionally, the town becomes flooded after heavy rain fall as a result of poor drainage system, the condition of environmental pollution is still very poor as some streets still contain some excreta deposits.

2.2. Study population

A total of three hundred consented school children (134 males and 166 females) from private and public nursery & primary schools were recruited for this study. Their age ranges from 4-12 years. One hundred and fifty-eight (158) of them were from the urban locality and one hundred and forty-two (142) of them were from the semi-urban area (Table 1). All children sampled were going about with their normal activities and were apparently in healthy conditions.

2.3. Sample Collection

A total of 300 stool samples were collected from children attending the semi-urban and urban nursery & primary schools in Rivers State, South-southern, Nigeria. The samples were collected in sterile containers and transported to the laboratory for processing and to be analyzed. The samples were obtained by informed consent of the patients used for this study and the permission to that effect was obtained from the ethical committee. Other information such as sex, age, occupation of parents/guardians and the type of toilet in use at homes, environmental conditions of where they reside were collected using a Performa specifically designed for this study. A survey form was also used to collect information on the schools' sanitation condition specifically: type of water supply conditions/ availability, the kind of toilet in use, availability of hand washing soap in class rooms, presence of cabbage cans in schools, presence of toilet lid, conditions of class rooms/playing ground (Ekpo et al., 2008). The stool samples were then fixed immediately in 10% formalin before taken to the laboratory for analysis.

2.4. Macroscopic Examination of Stool Samples

This describes the appearance of the stool i.e. the physical appearance such as colour, to know whether the stool is formed, semi-formed, unformed or watery, presence of blood/mucus, or pus. When a stool is unformed, containing pus and mucus the possible cause is shigella (shigellosis). When a stool sample is semi-formed and black hookworm disease is suspected. Unformed with blood and mucus stool possible cause is schistosomiasis. There are many appearance of faecal sample: Bloody diarrhea, watering stools, Rice water stools with mucous flakes etc. Blood can also be found in the stools of an individual suffering from haemorrhoids, ulcerative colitis, or tumours of the intestinal tract. A normal stool sample appears brown and formed or semi-formed. While for infants are yellowish – green and semi-formed. In this work the sample analyzed were without mucous or blood. But there are samples that are black and semi-formed, watery stool, and some appeared brown, formed or semi-formed.

2.5. Parasitological Analysis

Among the different parasitological techniques for stool analysis, formol - ether concentration technique as described by Cheesbrough (2006) was employed in this study. The procedure involved emulsifying about one gram (1g) of faeces with an applicator stick in a test tube containing 7ml of formalin solution it was well mixed, 3ml of ether was then added and mixed properly the tube was corked with cotton wool and shook vigorously in an inverted position and the stopper is removed with care. Each sample was made in this same way and the test tubes were balanced in the centrifuge (Model: MINOR 35 from MST Ltd) and centrifuged at 1500 r.p.m for 5 minutes. At the end of centrifugation, the following layer were observed in the test tube: ether at the top (colourless clear liquid); a plug of debris (dark coloured thick); formal solution (a colourful liquid with suspended debris) and a sediment (solid deposit at the bottom of tubes). The plug of debris was then removed from sides of the tube with an applicator stick. The first three layers were decanted down the sediment with a few drops allowed to drain back from the sides of the tube. A cotton swab was used to remove any debris adhering to the sides of the tube. The remaining sediments and the fluid that drained back were mixed properly by flicking the test tube. After which a smear preparation was made using a drop of iodine solution on a slide and the sediment was added and properly emulsified also on the left side of the slide a smear was made using normal saline covered with a over slip for microscopic examination. The X 10 and X 40 objective was used to examine the whole area under the cover slip for parasite ova, cyst and larvae. Slowly to the other end of the slide, iodine solution decolorized the parasite and making it more visible. In cases were debris were still found in the sample during examination the samples were subjected to the same procedure (formol – ether technique) describe above until it becomes much clearer.

2.6. Identification of Worm (Ova, Larvae and Adult)

Positive specimens were identified on the basis of microscopy. Using standard methods (CDC, 2007), a trained laboratory scientist at Department of Microbiology, University of Port Harcourt, Port Harcourt, Nigeria interpreted the microscopic slides of stool specimens. Several criteria were employed in recognizing the worms: *Ascaris lumbricoides* eggs were recognized on the basis of being round, ova or elliptical with rough membrane (fertilized) or they were a bit elongated and also has rough membrane (unfertilized). *Trichuris trichiura* were recognized by their barrel – shaped egg with transparent, mucoid polar plug at either ends. The hookworm (*Necator americaricanus* and *Ancylostoma duodenale*) has similar egg structure. The eggs were oval or elliptical with the larvae coiled within, thus, showing a clear zone between the embryo and the eggs shell.

2.7. Enumeration of helminthes eggs

The procedure for counting helminthes eggs in stool sample involves making a wet preparation of the sediment on a clean slide and covering the drop with a cover slip. Starting at one corner of the cover slip, the preparation was systematically examined under a light microscope, using X40 lens moving it back and forth across and noting the number of egg found.

2.8. Data analysis

The prevalence (P), defined as the percentage of infected individuals (NP) among the total number of individuals examined (N) (P= (NP/N) x 100). The helminthes density is the mean number of eggs per gram of stool of each subject. The incidence rate (IN) which is defined as the ratio of the number of new positive samples detected one year after treatment to the number of negative samples obtained before treatment and during the control phases expressed as a percentage (Nkengazong et al., 2009).

3. RESULT ANALYSIS

Table 1 shows the frequency of occurrence of Helminthes detected in stool samples of nursery and primary school children in urban and semi-urban areas of Port Harcourt, Nigeria. It showed that *Ascaris lumbricoides* 27(57.4%) was the most predominant, followed by *Trichuris trichuria* [12(25.5%)]. Hookworm [8(17.0%)] was the least prevalent.

Table 1: Frequency of occurrence of Helminthes detected in stool samples of school children

Helminthes	**No. (%)**	**UDNPS (%)**	**CPS (%)**
Ascaris lumbricoides	27(57.4)	8(29.6)	19(70.4)
Trichuris trichuria	12(25.5)	4(33.3)	8(66.7)
Hookworm	8(17.0)	4(50.0)	4(50.0)
Total	**47(100.0)**	**16(34.0)**	**31(65.9)**

Table 2 shows the prevalence of helminthes in relation to locations. Children from the semi-urban area had higher prevalence rate of helminthes (21.8%) than their counterparts in the urban area with 10.1% prevalence of helminthes. There was a significant difference ($p<0.05$) between locations of the subjects and the acquisition of helminthes.

Table 2: Prevalence of Helminthes in relation to locations

Locations	**No. Tested (%)**	**No. Positive (%)**	***Ascaris lumbricoides***	**Hookworm**	***Trichuris trichuria***
University Demonstration Nursery & Primary School, Choba	158(52.7)	16(10.1)	8(50.0)	4(25.0)	4(25.0)
Community Primary School, Rumuolumeni	142(47.3)	31(21.8)	19(61.3)	4(12.9)	8(25.8)
Total	**300(100.0)**	**47(15.7)**	**27(57.4)**	**8(17.0)**	**12(25.5)**

Table 3 shows the prevalence of helminthes in relation to the demographic characteristics. There was a significant difference ($p<0.05$) between sources of water, type of toilet facilities used by the subjects and the acquisition of helminthes. Children who had stream (24.5%) and well (19.4%) as their sources of water had higher prevalence rate than their counterparts with bore-holes (11.9%) as their source of water. In the same vein, children who had pit (26.7%) as their type of toilet had higher prevalence than their counterparts with water closet (12.9%) as their type of toilet facility used at school and at home. However, ages and sexes of subjects showed no significant difference ($p>0.05$) in the acquisition of helminthes in this study as shown in Table 3.

Table 4 shows the prevalence of helminthes in relation to the occupation of parents. There was a significant difference ($p<0.05$) between occupation of parents of the subjects and the acquisition of helminthes in this study. Children whose parents were traders (20.9%) and farmers (18.0%) showed a higher prevalence than their counterparts whose parents were civil servants with prevalence rate of 10.7% (Table 4).

Table 3: Prevalence of Helminthes in relation to the demographic characteristics

Demographic Characteristics	School children		University Demonstration Nursery & Primary School (UDNPS), Choba		Community Primary School (CPS), Rumuolumeni	
	No. tested (%)	No. positive (%)	No. (%)	Positive (%)	No (%)	Positive (%)
Sex						
Males	134(44.7)	24 (17.9)	71(53.0)	14(19.7)	63(47.0)	10(15.9)
Females	166(55.3)	23(13.9)	87(52.4)	2(2.3)	79(47.6)	21(26.6)
Age groups (years)						
5-10	225(75.0)	34(15.1)	118(52.4)	11(9.3)	107(47.6)	23(21.5)
11 & above	75(25.0)	13(17.3)	40(53.3)	5(12.5)	35(46.7)	8(22.9)
Sources of water						
Bore-hole	185(61.7)	22(11.9)	148(80.0)	15(10.1)	37(25.0)	8(21.6)
Well	62(20.6)	12(19.4)	10(20.0)	1(10.0)	52(83.9)	10(19.2)
Stream	53(17.7)	13(24.5)	0(0.0)	0(0.0)	53(100.0)	13(24.5)
Type of toilet						
Pit	60(20.0)	16(26.7)	0(0.0)	0(0.0)	60(100.0)	16(26.7)
Water closet	240(80.0)	31(12.9)	158(65.8)	16(10.1)	82(34.2)	15(18.3)
Total	**300(100.0)**	**47(15.7)**	**158(52.7)**	**16(10.1)**	**142(47.3)**	**31(21.8)**

Table 4: Prevalence of Helminthes in relation to the occupation of parents

Parents' Occupation	No. Tested (%)	No. Positive (%)	No. Males (%)	No. Positive (%)	No. Females (%)	No. Positive (%)
Farmers	50(16.7)	9(18.0)	22(44.0)	4(18.2)	28(56.0)	5(17.9)
Traders	110(36.7)	23(20.9)	35(31.8)	10(28.6)	75(68.2)	13(17.3)
Civil servants	140(46.7)	15(10.7)	77(55.0)	10(12.9)	63(45.0)	5(7.9)
Total	**300(100.0)**	**47(15.7)**	**134(44.7)**	**24(17.9)**	**166(55.3)**	**23(13.9)**

4. DISCUSSION

In this study, the most prevalent parasite was *Ascaris lumbricoides* 27(57.4%). This was followed by *Trichuris trichuria* [12(25.5%)]. Hookworm [8(17.0%)] was the least prevalent. These intestinal helminthes have been reported in various parts of Nigeria (Mordi and Ngwodo, 2007; Ajero et al., 2008; Okolie et al., 2008; Tohon et al., 2008; Chukwuma et al., 2009; Awolaju and Morenikeji, 2009; Okonko et al., 2009; Odu et al., 2010, 2011a,b, Alli et al., 2011a,b). This is in agreement with the finding of Odu et al. (2010, 2011a) that these three species are cosmopolitan. The higher prevalence reported for *Ascaris lumbricoides* in this study agreed with some previous report by Adeyeba and Akinlabi (2002), Agbolade et al. (2004) and Alli et al. (2011a). Okolie et al. (2008); Okonko et al. (2009) and Alli et al. (2011a) also reported *A. lumbricoides* to be most predominant in their studies. This however disagrees with the previous study by Odu et al. (2011a) who reported the predominance of *Trichuris trichuria* over *Ascaris lumbricoides* and hookworm.

The 57.4% prevalence value reported *Ascaris lumbricoides* in our study was however, high when compared with what has been previously reported in other areas. Mordi and Ngwodo (2007) reported a value of 30.0% in all the eighteen local government areas of Edo State, Nigeria. Eguwunyenga et al. (2004) reported a prevalence of 55.0% in Eku, Delta State of Nigeria. Nwosu et al. (2004) reported a prevalence of 52.0% in school children in Abia and Imo States of Nigeria. Odikamnoro and Ikeh (2004) reported a prevalence of 51.5% among the Kpiri-kpiri community of Abakiliki of Ebonyi State, Nigeria. Human ascariasis is spread through faecal pollution of soil, and so the intensity of infection depends on the degree of soil pollution (Mordi and Ngwodo, 2007). Infection is spread through eggs, which are swallowed as a result of ingestion of contaminated soil or contact between the mouth and the various objects carrying the adherent eggs. Contamination of food or drink by dust or handling is another source of infection. Ascaris ova are spread through the agents of flood and coprophagous animals, and can thus be transported to locations far from the defecation sites (Obiamiwe and Nmorsi, 1990; Mordi and Ngwodo, 2007). The eggs are passed unaltered through the intestine of coprophagous animals. The well-protected eggs can withstand drying and can survive for very lengthy periods. Soil pollution is thus a major factor in the epidemiology of human ascariasis (Mordi and Ngwodo, 2007).

T. trichuria popularly known as whipworm because of the whip like form of the adult worm has a cosmopolitan distribution. It is however, prevalent in the warm humid tropics (Mordi and Ngwodo, 2007). *T. trichiura* could be traced to the fact that moisture which is available all year round is essential for the development of embryo in the soil (Odu et al., 2011a). Therefore, soil pollution is a major factor in the transmission of the infection in a community (Mordi and Ngwodo, 2007). Transmission occurs through poor sanitary habits of indiscriminate defecation. Infections usually occur through ingestion of infective ova from contaminated hands, food or drinks. Flood and copraphagous animals play some part in the transportation of the ova to locations other than the defecation site (Mordi and Ngwodo, 2007). In this study *T. trichiura* had a prevalence rate of 25.5%. This is lower than the 39.4% reported in our previous study (Odu et al., 2011a); the 75.8% reported by Ejezie (1981) and the 77.6% reported by Obiamiwe and Nmorsi (1990). The value reported for *T. trichiura* in this study is high when compared with the reports of both past and current studies in other parts of the country and in the world. Anosike et al. (2002) reported a value of 14.0% amongst post primary school children in Owerri, Imo State, Nigeria. Onyindo et al. (2002) reported a value of 5.3% among the inhabitant of Amaechi-Idodo community in Nkanu East local government area of Enugu State. Egwunyenga et al. (2004) reported a value of 20.8% in Eku, Delta State of Nigeria while Nwosu et al. (2004) reported a prevalence value of 19.4% among children in Aba, Abia State.

Hookworm infections occur by skin penetration of the L3 stage infective larvae. Poor sanitary disposal of human faeces and indiscriminate defecation are the principal factors in the aetiology of hookworm infections (Mordi and Ngwodo, 2007). Hookworm was relatively the least most common helminthes reported in the study. The prevalence rate of hookworm in this present study was 17.0%. This compared favourably with the 17.7% reported by Alli et al. (2011a). This value is however low when compared with the value from other studies in various parts of the country both now and in the past. Gilles (1964) reported a prevalence value of 71.0%. Nwosu et al (2004) reported 25.8% in Aba, Abia State, Nigeria. Egwunyega et al. (2004) reported infection rate of 22.5% at Eku in Delta State of Nigeria. Odu et al. (2011a) reported 27.3% among school children in rural and urban communities in Rivers State, Nigeria. However, the 17.0% prevalence rate reported in this study indicates high level of unhygienic practices among some group of children which enhanced transmission in the communities.

Furthermore, the overall prevalence of intestinal helminthes in this study was 15.7%. Contrary to our findings, some workers in Nigeria and overseas had earlier on reported higher prevalence rates. Odu et al. (2011a) reported an overall prevalence of 30.7% among school children in rural and urban communities in Rivers State, Nigeria. Alli et al. (2011a) reported 49.4% in Ibadan, Oyo State, Nigeria. Jimenez-Gonzalez et al. (2009) reported a value of 34.0% among inhabitants of a rural community in Mexico. Awolaju and Morenikeji (2009) reported a value of 48.4% among primary and post-primary schools children Ilesa West, Osun State and 50.80% among school children in Ilaje, Osun State. Chukwuma et al. (2009) in their study on the prevalence of parasitic geohelminth infection of primary school children in Ebenebe Town, Anambra State, reported a prevalence value of 53.6% in soil and 87.7% in stool. Chukwuma et al. (2009) also reported prevalence of geohelminth eggs/larvae in soil with respect to schools to be Umuji primary school 52.5%, Umuogbuefi primary school 83.3% and Obuno primary school 32.5% and overall prevalence in stool samples in the three schools to be 87.7% with distribution as follows; Umuji primary school, 87.5%, Umuogbuefi primary school, 97.5% and Obuno primary school, 75%. Okolie et al. (2008) reported a prevalence value of 75% among patients with appendicitis in Oguta, Imo State, Nigeria. Mordi and Ngwodo (2007) reported a value of 0.7% in all the eighteen local government areas of Edo State, Nigeria. Alison et al. (2004) reported 17.0% in Uganda. Egwunyenga *et al.* (2001) reported 33.3% in Nigeria. Warison and Ibe (1994) reported 46.0% prevalence rate of intestinal parasite within some parts of Port Harcourt, Nigeria.

This study showed significant difference ($p<0.05$) between sources of water, type of toilet facilities used by the subjects and the acquisition of helminthes. Children who had stream (24.5%) and well (19.4%) as their sources of water had higher prevalence rate than their counterparts with bore-holes (11.9%) as their source of water. In the same vein, children who had pit (26.7%) as their type of toilet had higher prevalence rate than their counterparts with water closet (12.9%) as their type of toilet facility used at school and at home. Studies in many parts of Nigeria (Obiamiwe and Nmorsi, 1990; Egwunyenga *et al.,* 2001; Arinola *et al.*, 2003) have highlighted the hyperendemicity of soil transmitted helminthes, especially among children. Maternal women are at high risk of infection because of their close relationship with children. The differences in the percentages reported in these studies may be due to environmental factor, life style and occupation of the subjects, as seen in this project, which may truly expose them to infection also personal habits like ingesting food and water, contaminated with infective larvae or ova of these parasites. Moreover, the occurrence of helminths infection at high rates among children is indicative of faecal pollution of soil and domestic water supply around homes due to poor sanitation, ignorance of the mode of transmission of these worms and improper sewage disposal has been found to be a predisposing factor to infection.

This present study showed that prevalence of helminthes were not age dependent. This might be due to habits as well as poor or lack of environmental sanitation especially where people eat or drink. Also, low body immune system especially as concerned children might be responsible for high infection rate reported in this study (Sorensen *et al*., 1996; Alli et al., 2011b).

Sex-related prevalence of helminthes in this study showed no significant difference ($p>0.05$) in the acquisition of helminthes. This disagrees with the findings of Anosike et al. (2004) who reported that parasitic infections were significantly higher in males than females. Adeyeba and Akinlabi (2002) and Baldo et al. (2004) showed that infection rates for intestinal parasites were higher in males than females. Chukwuma et al. (2009) reported prevalence of parasitic infection to be higher in females than in males. Our present finding is in consonance with some previous studies in Nigeria and overseas. It agrees favourably with Awolaju and Morenikeji (2009) who reported no significant among primary and post-primary schools children Ilesa West, Osun State. It also agrees with Nkengazong et al. (2009) who also reported that differences in prevalence values of parasites between the sexes in Kotto Barombi and in Marumba II were not statistically significant. Previously, Saathof et al. (2004) in KwaZulu-Natal/South Africa, and Tohon et al. (2008) in Nigeria also claimed that parasitic infections were not sex dependent. These are also in consonance with our present finding.

Location-specific prevalence of helminthes showed significant difference ($p<0.05$) between locations of the subjects and the acquisition of helminthes. Children from the semi-urban area had higher prevalence rate of helminthes (21.8%) than their counterparts in the urban area with 10.1% prevalence rate of helminthes. According to the occupational status of the parents from these locations, there was significant difference ($p<0.05$) in the acquisition of helminthes in this study. This is in agreement with the impact of mass de-worming (Odu et al., 2011a,b). Children whose parents were traders (20.9%) and farmers (18.0%) showed a higher prevalence rate than their counterparts whose parents were civil servants with prevalence rate of 10.7%. Urban parents were very much enlightened. They practicing good personal hygiene, they also de-worm their children some twice and other thrice yearly. This shows that the diseases burden can be greatly reduced if the children are de-wormed at least twice a year as recommended by World Health Organization (WHO). On the contrary, semi-urban parent are mainly farmers and traders. It is possible that their children may visit them at the farm bare footed, drink contaminated water and food. They also have no idea of de-worming their children. These might have been responsible for the high infection rate among the school children in semi-urban areas of Port Harcourt, Nigeria.

5. CONCLUSION

Intestinal helminthes are still highly prevalent among school-aged children in Nigeria and a major cause of morbidity in this age group. This study has successfully achieved the objective for which it was set. The findings of this study have shown that three helminthes (*Ascaris lumbricoides*, *Trichuris trichuria* and hookworm) were prevalent among nursery and primary school children in semi-urban and urban areas in Rivers State, Nigeria whose stool samples were used for this study. Our study shows that a good percentage of children were infested by helminthes and re-enforces the need for an urgent effort to check the unnecessary and avoidable heavy parasites load. The presence of these three parasitic helminthes among the nursery and primary school children in semi-urban and urban areas in Rivers State, Nigeria supports the earlier observations that parasitic infections constitute a major public health problem in the country. This observation is in accordance with the reports of previous workers who recovered different gastro-intestinal parasite species in different population. In contrast, the recovery of some of the intestinal parasites in this study indicates the level of hygienic practices exhibited by the school children since these do not require an intermediate host. The data obtained from this study provides information on the various parasitic diseases associated with blood and gastro-intestines of school children in semi-urban and urban areas of Rivers State, Nigeria. The study also provides data for understanding the epidemiological status of the human blood and gastrointestinal parasites in Port Harcourt, Nigeria. The information on the age, sex, locations, type of toilet facilities used, source of water supply and occupational status distribution of these parasites is very useful in the control strategy. Based on the result obtained from this study, we would like to recommend routine examination of stool of all school children. However, further studies are therefore advocated.

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