



## Prevalence of intestinal helminth infections among primary school children in Alimosho Local Government Area, Lagos, Nigeria.

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### KEYWORDS

Prevalence,  
Helminths,  
School Children,  
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### ABSTRACT

#### Background:

Intestinal parasites are among the most common infection of school age-children worldwide and remain a major cause of morbidity and mortality among children in developing countries. Thus the prevalence and risk factors of intestinal helminth infections was investigated among children in four primary schools in Alimosho Local Government Area of Lagos, Nigeria.

#### Methodology:

A descriptive cross sectional study of one hundred and twenty children, selected using a multistage sampling method. Fecal samples were collected from the pupils and examined microscopically using direct smear and Formol- ether concentration technique. Each child was interviewed using a structured questionnaire. Data was analysed with Epi Info 6.

#### Results:

Their ages ranged from 5-19 years and most 63 (52.5%) were female. Thirteen (11%) of the samples were found positive. The two major intestinal helminths identified were *Ascaris lumbricoides* (76.9%) and Hookworm (15.4%) with a mixed infection of both accounting for 7.7% of the samples. Females (69.2%) were more infected. The socioeconomic status (lower education and having a skilled job)of the parents, female gender, being in a higher class, use of pit latrines and use of well water were found to contribute to the prevalence of intestinal helminth infection, although showed no statistical significant association with the presence of parasites in their stool samples ( $P > 0.05$ ).

#### Conclusion:

There is need to improve sanitation and peoples' living conditions, provide clean water, health education, chemotherapy and encourage good hygiene and healthy habits.

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### Introduction

Intestinal parasites are among the most common infections of school age-children worldwide and remains a major cause of morbidity and mortality.<sup>1-3</sup> Soil-transmitted helminths (STH) infections are widely distributed in tropical and subtropical areas and are linked to a lack of sanitation, therefore occur wherever there is poverty.<sup>4</sup> Helminths, such as *Ascaris*, *Trichuris* and Hookworms infest approximately 1 - 3.5 billion individuals worldwide and they are of immense public health concern.<sup>5-7</sup>

Over the years, intestinal parasitic infections have been transmitted, distributed and sustained by inadequate living conditions of people, overcrowding or unhealthy situations, lack of adequate by hygienic personal habits and inadequate health education or lack of maintaining simple health promoting activities.<sup>8-11</sup> It has also been facilitated by the socio-cultural and agricultural practices of the people combined with factors such as ecosystem degradation in creating conditions favorable for the high transmission and sustenance of many parasitic and communicable diseases.<sup>12-14</sup> These

intestinal parasitic agents thrive mostly in polluted environments such as refuse heaps, gutters and sewage units in and around human dwelling,<sup>15</sup> and its transmission initiated by the faecal contamination of soil, water and food.<sup>16,17</sup> All these factors should be explored as a whole, when evaluating the prevalence of intestinal parasites in a given population, taking into account the parasite-host-environment relationship.<sup>18</sup>

Intestinal helminths infection in children is transmitted faeco- orally by direct ingestion of the mature egg via contaminated food or hands (*Ascaris lumbricoides*) or by larva penetration of skin (Hookworm).<sup>5</sup> Transmission in most communities are due to improper disposal of faecal wastes, poor environmental sanitation, pollution with agricultural wastes which can result in contamination of surface and underground water.<sup>9</sup> A lot of studies have been carried out over the years on helminths infection in children with varying prevalence reported in different parts of the country. A few have reported urban-rural prevalence or behavioral factors related to helminthiasis. Poorly planned housing and human habitation patterns in terms of inadequate and poor sanitary facilities have been reported to contribute to environmental decay, as urbanization in developing countries usually results in unplanned, uncontrolled and constant migration of people from the rural area to the urban centers in search of employment opportunities. A cross-sectional study of children in Ilesha, southwest, Nigeria microscopically examined fresh stool samples for intestinal parasites and found 33.1% had various parasites.<sup>19</sup> Another study

among school children in an urban and rural communities of Ogun State, Southwest Nigeria reported prevalence as 66.2%.<sup>20</sup> *Ascaris lumbricoides* (53.4%) and Hookworms (17.8%) have repeatedly been identified in stool samples of school age children in Nigeria.<sup>20,21</sup> Intestinal parasitic infections in children have been shown to contribute to anaemia, stunted growth, underweight and poor school performances.<sup>23-25</sup> Behavioural and environmental factors have been reported as predisposing factors to helminthiasis in Nigeria and other developing countries.<sup>26,27</sup> A study done in Enugu, southeastern Nigeria reported poor hand washing habits after defecation, and not washing fruits before eating in children as a contributor to helminthic infection. Other factors found to significantly affect infestation were the source of drinking water, water boiling habits, use of footwear after school and defecation sites. The rate of helminthic infection was higher in the children who used pit latrines compared to water closets.<sup>26</sup> Reduced risk of STH has been associated with access to sanitation (OR 0.66) and hand washing after defecating (OR 0.45), piped water access with lower risk *Ascaris lumbricoides* infection (OR 0.40).<sup>28</sup>

Humid climate provides favourable environmental conditions for the development of oval and larval stages of the parasite and their transmission to man as revealed in the study conducted in south western Nigeria in April-June (during the rainy season), where streams close to the subjects (primary school children) were used as sources of drinking water and other domestic activities and also as refuse dump.<sup>29</sup> Warm, moist conditions are said to be required for some parasites to develop, Austrian Aboriginals in Northern Australia,

where it is warm and moist, suffer more parasitic infections more than those in drier, Southern areas, even with the same sanitation and hygiene patterns.<sup>30</sup> It was observed that the prevalence of *Ascaris* is generally low in dry countries of Africa while it is high in humid regions.<sup>2</sup> A study carried out in rural and urban areas of North Central Nigeria, the prevalence of Hookworm was very low (4.5% and 5.4%) in spite of the fact that the study was been carried out during a humid season.<sup>27</sup>

The distribution of intestinal parasites in host community is such heavy infestation occurs in a small proportion of people, whereas majority harbour few or no worms.<sup>31</sup> This aggregated distribution is probably due to a complex combination of factors related to environmental and host exposure to infection and genetic constitution and immune responsiveness of hosts.<sup>32</sup> The purpose of this study was therefore to determine the prevalence of, risk factors to and the parasites formula of intestinal parasites among school children in Alimosho Local Government Area of Lagos State.

## Material and Methods

Alimosho Local Government Area of Lagos State comprises of six Local Council Development Areas namely: Agbado/Oke-Odo, Ikotun/Igando, Isheri/Idimu, Egbeda/Akowonjo, Mosan/Okunola and Ayobo/Ipaja. It shares boundaries with Ogun State (North), Ojo LGA (West), Oshodi-Isolo and Agege (LGAs) to the East. The 58 primary schools in Alimosho LGA are grouped into 4 zones and controlled by Local Government Education Authority.

A descriptive cross-sectional study was carried out to determine the prevalence of intestinal parasitic worms among children in four primary schools in Alimosho LGA of Lagos State. The study was conducted during the dry season from January -March 2008. A sample size (n) of 206 was calculated using the formula  $z^2pq/d^2$ , where the prevalence of intestinal parasite based from a previous study (p) was 16.9%,<sup>33</sup> standard normal deviate (z) was 1.96 and the margin of error (d) was 5%. However, because of cost constraints a total of 120 school children whose parents gave consent where enrolled in the study and had their stools samples taken.

A multi-stage sampling method was used for the study. In the first stage a school was randomly selected from each of the four zones in the LGA by simple random sampling (balloting). The schools selected were in Ipaja, Oke-Odo, Egbeda and Ikotun. Secondly, 30 pupils were selected from each school by simple random sampling (balloting). Thirdly, 5 pupils were selected from pooled arms of classes one-six. Informed parental consent was obtained and questionnaires used to collect information on socio-demographic and environmental details were sent to home to the parents. Instructions on stool collection and a Universal plastic container was labeled with a sample number; their age and sex and then given to the pupils to take home for stool sample collection. The stool samples were examined microscopically for the presence of ova, cysts or trophozoite, of intestinal parasitic worms, using a thin smear of the stool in saline solution for trophozoites and in Lugol's iodine solution for identification of cysts.

Epi-Info 6 statistical software was used to

analyze the data. Categorical variables presented as frequencies and percentages. Chi-square and Fisher's exact tests were used to compare categories. Odd's ratio and confidence intervals were also used to test association between variables. Level of significance was set at 5%. Permission for the study was obtained from the Alimosho Local Government Education Authority, Medical Officer of Health and Education officer of Alimosho LGA. Ethical approval was granted by the Health Research and Ethics committee of Lagos University Teaching Hospital.

## Results

### *Socio-demographic characteristics of children*

A total of 120 pupils participated in the study and their age ranged from 5 - 19 years (Table I). Majority 67 (55.8%) of the children were in the age group 10-14 years. There were more females 63(52.5%) than males, with a female to male ratio of 1: 0.9. Most 50 (41.7%) of the children lived in one rooms accommodation with family (Table II), while the main source of drinking water for most of them was borehole 46 (38.3%). Others drank water from a public tap 36 (30%), well 22 (27.5%), tanker with unknown source of water 4 (3.3) and only 1 a river. The type of toilet facility used by majority 77(64.2%) of the children at home was a pit latrine, while most 99(82.5%) of them disposed of their home refuse at a dumpsite by means of cart pushers. Majority of the children 94 (78.3%) washed their hands always after going to the toilet.

Presence and distribution of helminths among the children  
Thirteen (10.8%) of the children had

intestinal helminthic infection, of which the most predominant parasite (76.9%) identified was *Ascaris* (Table III). The remaining samples contained mainly Hookworm 2 (15.4%) and 7.7% a mixed helminths infection. Seventy percent of children with Ascariasis were females, while the two cases of hookworm were evenly distributed between the sexes. A higher proportion of females 9 (69.2%) had helminth infestations compared to the males (30.8%) but the difference was not statistically significant ( $p=0.832$ ).

### *Social status (education and occupation) of parents and its association with the presence of helminths.*

A higher proportion of children whose father 7 (15.2%) or mother 6 (11.5%) had no formal education or at most primary school education had intestinal helminthes compared to those whose parents had post primary education. However, the differences were not statistically significant ( $p<0.05$ ). In terms of the parental occupation, children whose father or mother was in a skilled occupation had a higher proportion of infestation but was also not statistically significant ( $p=0.152$  and  $p=0.130$  respectively). Therefore, parental education and occupation in this group of children were not associated with the presence of intestinal helminthes (Table IV)

### *Risk factors for intestinal helminths infection among the children*

Helminths were found to be commoner among older children aged 10-14 years (11.8%) and those in higher classes 4-6 (14.8%) compared to the younger age group (OR 1.25,  $X^2=0.14$ ,  $p=0.704$ ) and lower classes (OR 2.38, Fisher's exact  $p=0.160$ ) respectively. Females (14.3%) had a higher proportion with helminthes compared to males (OR 2.21, Fisher's  $p=0.248$ ). A slightly higher proportion (11.5%) of pupils

who did not or occasionally washed their hands after defecating had helminthes compared to those who reported always practicing hand hygiene OR 1.10, p=0.896). The presence of helminths was higher among children who used pit latrine (12.9%; OR 1.99, p-0.374) instead of water closet toilets and well water rather than borehole/public

tap (15.2%; OR 2.75, X<sup>2</sup>=2.43, p-0.119).

The factors age, sex, class, hand washing practices, type of toilet, drinking water source and types of house were however found not to have a statistically significant association with the presence of helminths in this children (p<0.05)

**Table I: Socio-demographic characteristics of the school children**

<b>Variables</b>	<b>Frequency n=120</b>	<b>Percent (%)</b>
<b>Age (Years)</b>		
5-9	52	43.3
10-14	67	55.8
15-19	1	0.8
<b>Sex</b>		
Female	63	52.5
Male	57	47.5
<b>Religion</b>		
Christian	79	65.8
Muslim	41	34.2
<b>School</b>		
St. Andrew	29	24.2
Oke-Odo	31	25.8
Ebenezer	31	25.8
Ategbo	29	24.2
<b>Class</b>		
Primary 1	19	15.8
Primary 2	21	17.5
Primary 3	19	15.8
Primary 4	20	16.7
Primary 5	21	17.5
Primary 6	20	16.7
Others	4	3.3

**Table II: Home environment and hand washing practice of the school children**

<b>Variables</b>	<b>Frequency</b>	<b>Percent (%)</b>
	<b>n=120</b>	
<b>Type of house</b>		
One room	50	41.7
Two rooms	49	40.8
Flat	18	15.0
Others	3	2.5
<b>Source of drinking water</b>		
Public tap	36	30.0
Bore hole	46	38.3
Well	22	27.5
River	1	0.8
Tanker	4	3.3
<b>Type of toilet facility</b>		
Pit latrine	77	64.2
Water closet	43	35.8
<b>Refuse disposal method</b>		
Burning	8	6.7
Burying/ Pit	9	7.5
Dumpsite	99	82.5
Others	4	3.3
<b>Hand washing practice after defaecation</b>		
Always	94	78.3
No	3	2.5
Occasionally	23	19.2

**Table III: Presence and distribution of intestinal helminthes.**

<b>Helminths Identification in childrens' faecal samples (n =120)</b>			
	<b>Positive (%)</b>	<b>Negative (%)</b>	
<b>Presence of helminths</b>	13 (10.8)	107 (89.2)	
<b>Main type of intestinal helminths (n=13)</b>			
Ascaris	10 (76.9)		
Hookworm	2 (15.4)		
Mixed infection (Ascaris/ Hookworm)	1 (7.7)		
<b>Distribution of helminthes infection by gender (n=13)</b>			
	<b>Male</b>	<b>Female</b>	
Ascariasis	3 (30.0)	7 (70.0)	
Hookworm	1 (50.0)	1 (50.0)	<b>Fisher's exact p- value = 0.832</b>
Mixed infection (Ascariasis/ Hookworm)	0 (0)	1 (100)	
Total	4 (30.8)	9 (69.2)	

**Table IV: Association between the social status of parents and presence of intestinal helminthes in children.**

Variables	Intestinal Helminths			X <sup>2</sup>	p - value	OR (95% CI)
	Total n	Positive (%)	Negative (%)			
<b>Fathers education</b>						
No/Primary	46	7 (15.2)	39 (84.8)	1.48	0.223	1
Post primary	74	6 (8.1)	68 (91.9)			0.49 (0.13-1.86)
<b>Mother's education</b>						
No/Primary	61	7 (11.5)	54 (88.5)	0.05	0.818	1
Post primary	59	6 (10.2)	53 (89.8)			0.87 (0.23-3.26)
<b>Father's occupation</b>						
Professional	16	0 (0)	16 (100)		0.152*	Undefined
Skilled	63	10 (15.9)	53(84.1)			2.39 (0.56-14.31)
Non skilled/ Unemployed	41	3 (7.3)	38 (92.7)			1
<b>Mother's occupation</b>						
Professional	12	0 (0)	12 (100)		0.130*	Undefined
Skilled	52	9 (17.3)	43 (82.7)			2.72 (0.69-12.83)
Non-skilled/ Unemployed	56	4 (7.1)	52 (92.9)			1



**Table V: Association between socio-demographic characteristics, hand washing practices, housing factors and the presence of helminthes in the children.**

Variable	Total n	Intestinal helminths		X <sup>2</sup>	p-value	OR (95% CI)
		Positive (%)	Negative (%)			
<b>Age (years)</b>						
5-9	52	5 (9.6)	47 (90.4)	0.14	0.707	1
10-14	68	8(11.8)	60 (88.2)			1.25(0.34-5.19)
<b>Sex</b>						
Male	57	4 (7.0)	53 (93.0)		0.248*	1
Female	63	9 (14.3)	54 (85.7)			2.21 (0.57-10.36)
<b>Class</b>						
1-3	59	4 (6.8)	55 (93.2)		0.160*	1
4-6	61	9 (14.8)	52 (85.2)			2.38 (0.61-11.16)
<b>Hand washing</b>						
Always	94	10 (10.6)	84 (89.4)		0.896*	1
No/occasionally	26	3 (11.5)	23 (85.5)			1.10 (0.18-4.74)
<b>Type of toilet</b>						
Pit latrine	77	10 (12.9)	67(87.1)		0.374*	1.99 (0.47-11.85)
Water closet	43	3 (7.0)	40 (93.0)			1
<b>Drinking water source n=115</b>						
Bore hole/ public tap	82	5 (6.1)	77 (93.9)	2.43	0.119	1
Well water	33	5 (15.2)	28 (84.8)			2.75 (0.58-12.82)
<b>Type of house (n=117)</b>						
Flat	18	2 (11.1)	16 (88.9)		0.897*	1
1-room/ room and parlour	99	10 (10.1)	89 (89.9)			0.90 (0.17-9.20)

\*Fisher's p-value

## Discussion

Childhood intestinal parasitic infections is endemic in the tropics and subtropics for reasons attributable mainly to environmental conditions and poor hygiene, causing significant morbidity such as anaemia, diarrhea and dysentery, malnutrition, mental deficits, poor growth and in severe cases intestinal obstruction.

In this study, one hundred and twenty primary school children were recruited into the study from four primary schools in Alimosho Local Government Area of Lagos state. They were between the ages of 5-19 years. Out of 120 stool samples examined, <sup>13</sup> had one or more intestinal parasites giving the prevalence of intestinal helminthes infection as 11%. This is comparable to the soil transmitted helminthes infection prevalence rate of 16.9% obtained among school children in south eastern, Nigeria<sup>33</sup> but was considerable lower than the prevalence rates obtained in other states within the same southwestern part of Nigeria 72.0%.

Studies done in other developing countries like Liberia 33.4%,<sup>34</sup> India 71.5%,<sup>35</sup> Turkey 31.8%,<sup>36</sup> Palestine 19.07% showed a higher prevalence.<sup>29</sup> These varied rates in prevalence may be a reflection of the differences in the local communities environmental and sanitary standards, personal hygiene, or timing and geographical differences as at when the study was done.<sup>37</sup> Seasonal variations could be a reason for the low prevalence found in this children as stool samples were collected within the dry season (January-March) and it has been reported that parasites are more

prevalent in humid region than dry region.<sup>2,30, 39</sup>

Another reason for low prevalence could be ascribed to the fact that the various public health programmes/ campaigns via health facilities routinely administer anti-helminths drugs to the children in Lagos State. This is based on WHO's recommendation for annual treatment in areas where prevalence rate of soil-transmitted helminths is between 20% and 50%, and, a bi-annual treatment in areas with prevalence rates of over 50%.<sup>26</sup> However, it was not inquired if the children had ever or when last they received anti-helminths. In addition, majority (78.3%) of the children had good hand washing practices.

The main intestinal parasites identified in this study, were *Ascaris lumbricoides* having the highest proportion and Hookworm as reported in a number of previous studies.<sup>26,33,35,40</sup>

This study revealed that a higher proportion of females (69.2%) were infested with helminthes compared to the males (30.8%), but the difference was not significant. This observation was similar to previous studies.<sup>20, 22</sup> Presence of intestinal helminthes in the children was not associated with the child's gender, parental education and occupation ( $p > 0.05$ ).

The study shows that children in higher classes 4-6 (14.8%) were more infected than children in lower classes 1-3 (6.8%). One would have expected the children in lower classes to be more infected. This may be attributed to the fact that children in the lower classes are tender and younger in age and probably their teachers restrict them from being play around like the children in higher classes. There was however no statistical significant association between class and presence of intestinal parasites as revealed by the study ( $P > 0.05$ ).

Majority of the children reported always washing their hands after using the toilet, however, there was no statistically significant difference in the proportion of children with intestinal helminthes who reported washing their hands always and those who occasionally or do not wash their hands after defaecation. It therefore showed no significant association between washing of hands and the presence of parasites in these children. The high prevalence among those who claimed to have washed their hands always may suggest that the children did not wash their hand properly with soap after using the toilet or did not maintain adequate hand hygiene at other times such as before eating as reported in a study done in Enugu.<sup>26</sup> About two-thirds of the children used pit latrines and the prevalence of infestation was higher among these children compared to those who used water closet as found in previous studies but in contrast found no statistically significant association between defaecation site and helminthes infestation.<sup>26</sup> The use of water closet toilet facility tends to exhibit a better hygiene than use of pit latrine. Children who used either borehole/public tap had lower prevalence of intestinal parasites compared to those who used well water as expected. Ascariasis and hookworm are transmitted as a result of poor faecal/sewage disposal; if source of water was contaminated with faecal matter it is likely to affect the children. This may be attributed to the improper way in which their faecal matter and refuse in being dispose. However, there was no statistical significant association between source of drinking water and the presence of parasite ( $P>0.05$ ).

Results from this study showed that majority

of the children lived in one room apartment (42.7%) and 15.4% in flat apartment. Prevalence of intestinal parasites was higher in those children who lived in one room or room and palour accommodation than those who lived in flat type of accommodation. Poor housing conditions which are usually associated with overcrowding and lack of essential amenities may be attributed to the high prevalence.<sup>8</sup> There was no statistical significant association between types of house and the presence of intestinal parasites ( $P>0.05$ ).

Socioeconomic and cultural factors are other factors that affect the prevalence of intestinal parasites in this study. Majority of the children father and mother occupation are either skilled or non-skilled, all the children infected with parasites falls within this group considered to be low income class,<sup>41-43</sup> this may be attributed to poverty which is association with intestinal parasitic infection. Previous studies have revealed that illiteracy is associated with intestinal parasitic infections.<sup>42</sup> Intestinal parasitic infections still remain a public health concern and a major cause of morbidity and mortality in children in developing countries. This study also revealed the parasites formula of the species of intestinal parasites identified in the stool samples of the infected children in the study area. Parasite formula is the ratio of the different intestinal parasites identified in the sample. Parasite formula for *Ascaris* was 79%, while Hookworm was 21%.

The main limitation of this study was the small sample of children recruited; this was due to some parents not giving consent and the high cost of carrying out stool examination. Because of these issues findings from this study may not be generalizable. Further studies should take

into consideration the season, recruiting an adequate population and funding for stool analysis.

## Conclusion

The prevalence of intestinal helminthes infection in the children in Alimosho LGA was 11%. *Ascaris lumbricoides* (76.9%) and Hookworm (15.4%) were the two intestinal helminths identified in both sexes and cut across all age groups. The prevalence rate of infection was higher among the female children (69.2%) than in male children. Primary school children should receive health education on personal hygiene and proper hand washing with soap and water. There should be regular de-worming of school children, improved sanitation and provision of clean water as this will go a long way in reducing morbidity and mortality associated with intestinal parasitic infections in school aged children.

## REFERENCES

1. Oyewole, F., Ariyo, F., Oyibo, W.A., Sanyaolu A., Faweya, T, Monye, P., Ukpong, M., Soremekun B, Okoro C, Fagbenro-Beyioku A.F, Olufunlayo T.F. Heminthic reduction with albendazole among school children in riverine communities of Nigeria. *Journal of rural and tropical public health.* (2007) 6:6-10.
2. World Health organization. Prevention and Control of Intestinal Helminthes Infections. Report of WHO Expert committee. Technical Rep. 1987, series 749, R.A. WHO Geneva.
3. Poggensee, G., Krantz, I., Nordin P, Mtweve. S., Alhberg, B., Mosha, G., Freudenthal, S.A. six year follow up to school children for urinary and intestinal schistosomiasis and soil-transmitted helminthiasis in Northern Tanzania. *Act. Trop.* 2005. 93:131-140.
4. World Health Organization. Intestinal worms epidemiology . [http://www.who.int/intestinal\\_worms/epidemiology/en/](http://www.who.int/intestinal_worms/epidemiology/en/) Accessed 29/04/2014
5. Bethony J, Brooker S, Albonico M, Geiger SM, Loukas A, et al. Soil-transmitted helminth infections: ascariasis, trichuriasis, and hookworm. *Lancet* 2006; 367:1521–1532.
6. World Health Organization. The world health report 1996, 173. Ort, Geneva. WHO.
7. Savilei, L, Bunddy DAP, Tomkins A.M, Intestinal parasite infections: a soluble Public Health Problem. *Transaction of the Royal society of tropical medicine and health.* 1992.86.353-354.
8. Udonsi, J.K; Amebibi, M.I. The human environment, occupation and possible water-borne transmission of the human hookworm (*Necator Americanus*) in endemic costal community of the Niger Delta, Nigeria *Journal Soc, Public Health* 1992, 106:63-71.
9. Fagbenro - Beyioku, A.F; Oyerinde, J.P.O. parasitic intestinal infection of the children in Lagos. *Nig. Journ. Paediatric* 1987:89-95.
10. Ejezie, G.C., Onyezili, N.N., Okeke, G.C.

- Enwonwu C.O. Ijanikin: A study of environmental health in a rural Nigeria community. *Epidemiol. Microbiol. Immunol.* 1987. 31:163-172.
11. Kasprzak, W., Mazur, T., Karlewiczowa, R. Prevalence of *Entamoeba histolytica* and other intestinal protozoa among the inhabitants of Poznan province over a period of 30 years. *Wiad. Parazytol.* 1989. 35:535-545.
  12. Hutty, R.S. The impact of inadequate sanitary conditions on health in developing countries, *World Health Statist. Quart* 1990; 43
  13. Agi. P.I. Pattern of Niger-Delta, Nigeria. *West Afr. Journ. Med.* 1995; 14(1):39-42
  14. Oyerinde, J.P.O Adegbite-Hoolist, A.F.: Ogunbi, O. The prevalence of intestinal parasite of man in the metropolitan Lagos. *Nig. J Nat Sci* 1980;3::147-155
  15. Nwosu, A.B.C; Anya, A.O. Seasonality in human hookworm infection in an endemic area of Nigeria and relationship to rainfall. *Tropen Med. Parasite* 1980;31(2); 29-208.
  16. Schulz, S.A. Kroeeger. Soil contamination with *Ascaris lumbricoides* eggs as an indicator of environmental hygiene in urban area of north east Brazil. *J.Trop. Med. Hyg.* 1992.95; 95-103.
  17. Torres, P, Otth, L, Montefusco,A.,Wilson, G. Ramirez, C., Acuna,M. Infection by intestinal protozoa and helminthes in school children from river-side sectors, with different faecal contamination levels in Valdivia River Chile. *Bol. Chil. Parasitol.* 1997. 52:3-11.
  18. Gamboa, M.I., Basualdo, J.A., Kozubsky, L., Costas, E., Cueto Rua, E. Prevalence of intestinal parasitosis within three population groups in La Plata, Argentine. *Eur. J. Epidemiol.* 1998. 14:55-6121.
  19. Okeniyi, JAO., Ogunbi, TA., Oyelami, OA., Oyedeji, GA. :Asymptomatic intestinal parasitosis among Semi –urban Nigeria children. *The internet journal Epidemiology.* 2005; 2[2].
  20. Agbolade, O.M., Agu, N.C., Adesanya, O.O., Odejayi, A.O. Adigun, A.A., Adesanlu, E.B., Ogunleye, FG., Sodimu, A.O. Adeshina, S.A. Bisiriyu ,G.O., Omotoso, O.I.,Udia K.M: Intestinal helminthiasis and Schistosomiasis among school children in an urban centre and some rural communities in Southwest ,Nigeria. *Korean Journal of Parasitology.* 2007.45(3)233-238.
  21. Ihesiulor GU, Emokpae M, Adeeke SI, Samalia AB. Soil transmitted Helminths among apparently healthy children in Kano municipality. *Afr. J. of Clin. Exper. Microbiol.* 2006; 8(1): 81-87.
  22. Adefemi SA, Musa O.J. Intestinal helminths infestation among pupils in rural and urban communities of Kwara state, Nigeria. *Afr. J. of Clin. Exper.*

Microbiol. 2006; 7(3):208-211.

23. WHO. Measuring change in nutritional status: Guidelines for assessing the nutritional impact of supplementary feeding programmes for vulnerable groups. WHO: Geneva: 1987.
24. Stephenson, L.S. Latham, M.C., Ottesen, E.A. Malnutrition and parasitic helminthes infections. *Parasitology* 2000; 121:523-38.
25. Stephenson, L.S, Lathan, M.C, Kinoti, S.N, Karz, K.M, Brigham, H. Improvement in physical fitness of Kenya schoolboys infected with Hookworm, Trichuris and Ascaris lumbricoides following a simple dose of Albendazole *Trans. R. Soc. Trop. Med. Hyg.* 1998, 84:277-282.
26. Ilechukwu GC, CGA Ilechukwu, AN Ozumba, NC Ojinnaka, BC Ibe, CN Onwasigwe. Some behavioural risk factors for intestinal helminthiasis. *Nigerian Journal of Clinical Practice.* 2010;13(3): 288-293.
27. Ikeh, E.I. Obadofin, M.O Brindeiro, B., Baugher, C., Frost F., Vandemrjago R. Glew, R.H. Intestinal parasitism in rural and urban area of North centre, Nigeria: An update. *The journal of microbiology*, 2006. 2:1
28. Strunz EC, Addiss DG, Stocks ME, Ogden S, Utzinger J, Freeman MC. Water, Sanitation, Hygiene, and Soil-Transmitted Helminth Infection: A Systematic Review and Meta-Analysis *PloS Med.* Mar 2014; 11(3): e 1 0 0 1 6 2 0 . D o i : 10.1371/journal.pmed.1001620
29. Ijagbone, I.F., Olagunju, T.F.; Intestinal parasites in school children in Iragbiji, Boripe Local Government Area, Osun State, Nigeria. *African Journal of biomedical research* 2006; 9: 63-66.
30. Anthony, R.; Parasites and diarrhea. *Dialogue on Diarrhea online.* 1986. Issue 27. Date accessed 4/1/2008.
31. Anderson, R.M. The population dynamics and epidemiology of intestinal nematode infections *Transaction of the Royal Society of Tropical Medical and Hygiene*, 1986, 80:686-696
32. Bundy D.A.P. Population ecology of intestinal helminthes infection in human communities. *Philosophical transaction of the Royal society, London* 1988. B321: 405-420
33. Chigozie, J.U., Kelvin, O.E., Patrick, G.O. Nelson. C.A., Emmanuel, A. Soil-transmitted Helminthes infection in school children in south-eastern, Nigeria: The Public Health implication. *The Internet Journal of Third World Medicine* 2007. Vol. 4:1
34. Sahr F, Jones J, Barh SB, Gbakima AA. Prevalence of Intestinal Helminthes among Children in Selected Communities in Monrovia, Liberia. *Sierra Leone Journal of Biomedical Research.* 2009; 1 (1): 28-32.
35. Wani, S.A., Ahmad, F., Zargar, S.A., Fomda, B.A., Ahmad. P. Helminthes infestation in children of Kupwara districts: A Prospective study. *Indian J. Med. Microbial* 2007; 25: 395-400.

36. Pinal O., Sema, E., Berna, G. Ozlen, O., Erdal, B. Intestinal parasites prevalence and related factors in school children, a western city sample. Turkey. *Biomed. Central Public Health*, 2004, 4; 64 doi. 10.1186/14712458-4-64.
37. Albinco, M., Crompton, D.W. Savioli, L., Control strategies for human intestinal nematode infections. *Adv. Parasitol* 1999; 42:277-341.
38. Obianmiwe, B.A., Nmorsi, P; Human Gastrointestinal Parasites in Bendel State, Nigeria. *Angew- Parasitol.* 1991.32 [3] 177-183.
39. Bethony J, Brooker S, Albonico M, Geiger SM, Loukas A, et al. (2006) Soil-transmitted helminth infections: ascariasis, trichuriasis, and hookworm. *Lancet* 367: 1521–1532.
40. Egwunyenga. O.A. Ataikiru, D.P. Soil-transmitted Helminthiasis among school age children in Ethiope-East Local Government Area, Delta State, Nigeria. *African Journal of Biotechnology*. 2005 4(9) 938-941.
41. Bundy, D.A.P. Epidemiology and transmission of intestinal helminthes. In: enteric infection 2, Intestinal helminthes, Farthing, M.J.G., Keusch, G.T. Wakelin D eds. Chapman and Hall Medical, 1995,5-24.
42. Wagbatsoma, U.A. Aisen, M.B: Helminthiasis in selected children seen at the University of Benin, Benin City, Nigeria. *Nig. J. parasitol.* 2000; 113:87-95.
43. Oyerinde, J.P.O *Essentials of Tropical Medical Parasitology*. University of Lagos Press, Akoka, Lagos, Nigeria. 1999; 211-234.