EPIDEMIOLOGY OF GASTROINTESTINAL PARASITES AMONG SCHOOL CHILDREN IN MINNA, NIGER STATE, NIGERIA

Article · February 2017

CITATION
1

READS
87

12 authors, including:

Innocent Chukwuemeka Omalu
Federal University of Technology Minna
39 PUBLICATIONS **208** CITATIONS
SEE PROFILE

Pam Dung
University of Jos
29 PUBLICATIONS **109** CITATIONS
SEE PROFILE

Adeniyi Kamoru
Federal University of Technology Minna
43 PUBLICATIONS **52** CITATIONS
SEE PROFILE

Samuel Sunday Eke
Federal University of Technology Minna
22 PUBLICATIONS **16** CITATIONS
SEE PROFILE

EPIDEMIOLOGY OF GASTROINTESTINAL PARASITES AMONG SCHOOL CHILDREN IN MINNA, NIGER STATE, NIGERIA

[*1] I. C. J Omalu, [1] N.Agu, [1] I. A. A Ejima, [2] D. D Pam, [1] K. A Adeniyi , [1] S. S Eke [1] C. A., Otuu, [3] C. I Nnaji, [4] Y Garba, [1] V. G Zhiri, [1] H. A Makinde, and [1] F. A. Osodi,

1 Department of Animal Biology, Federal University of Technology, Minna, Niger State
2 Department of Zoology, University of Jos, Nigeria
3 National Biotechnology Development Agency, Abuja
4 Department of Biology, Federal College of Education, Kontagora

*Corresponding author
email address: omaluicj@futminna.edu.ng

ABSTRACT

Gastrointestinal parasites usually inhabit the intestines of man and various animals. Consequently a total of 300 faecal, 300 Hand wash and 18 Soil samples from school children were analyzed using formal concentration method, while 20 flies were analysed using Soul technique, all from three different schools; Tudun Fulani Model, Chanchaga Model and Shango Primary Schools. A prevalence of 175(58.33%) was recorded from the Stool sample analyzed, in which four (4) parasites were isolated: Ascaris lumbricoides 91(30.33%), Schistosoma mansoni 19(6.33%), Entamoeba histolytica 11(3.67%) and Hookworms 54(18%). There was a significant ($P<0.05$) difference in the prevalence of gastrointestinal parasites encountered, also with age groups with respect to location. Stool analysis with respect to gender showed no significant ($P>0.05$) difference. A prevalence of 51(17%) was recorded from the hand analysis, in which three (3) parasites were isolated: Ascaris lumbricoides 31(10.33%), Entamoeba histolytica 5(1.67%) and Hookworm 14(4.67%). There was no significant ($P>0.05$) difference in the prevalence of gastrointestinal parasite encountered from hand-wash analysis with respect to location. Hand-wash analysis with respect to age group and gender also showed no significant ($P>0.05$) difference. A prevalence of 10 (55.56%) was detected from the soil sample analysis where 2 parasites were isolated; A. lumbricoides 6(33.33%) and Hookworms 4(22.227%). There was also no significant ($P<0.05$) difference in the prevalence of gastrointestinal parasite encountered from soil analysis. This study has shown that various sources are responsible for the transmission of gastrointestinal parasites; hence there is every need to maintain a high level of hygiene combined with mass public enlightenment to check the spread of this infection in Minna.

Keywords: Gastrointestinal, Hookworm, Epidemiology, Entamoeba histolytica

INTRODUCTION

Gastro-intestinal parasitic infections remain one of the major public health disease in Sub-Saharan Africa[1,2]. Globally, about 3.5 Billion people are affected, and 450 million are ill as a result of these infections, the majority being children[3]. Epidemiological studies have attributed this prevalence to several environmental, genetical and socio-economic factors such as poor sanitary conditions, unhygienic practices, absence of portable water, poor housing and poverty [4,5,6,7]. According to Oyeniran et al[2], these factors include: the strain and number of the parasites, age and level of immunity at the time of infestation, immune response to the infestation, presence of co-existing disease

or condition which reduces immune response, malnutritional undertone due to iron deficiency folic acid and protein deficiency.

Kattula et al[8] reported that the risk of acquiring these infections and their higher prevalence cannot be attributed to just one factor, but is due to the coexistence and amalgamation of various biological, social behavioral and environmental factors like poverty, substandard living conditions and lack of personal hygiene, both at the individual and the community level. Studies in other tropical countries have postulated that the environment and behavior of local residents influence the rates of infection[8,9]. Despite the fact that gastrointestinal parasites have been found endemic in must rural communities of the tropical Africa[2,10] due to the aforementioned factors, their problems are also increasing in the urban areas due to similar deficiencies.

Children are mostly at risk especially when they make regular contacts with sandboxes and school playgrounds in their surrounding which may harbor some of these parasites and are not carefully cleaned thereafter. The morbidity experienced in school children and women during their child bearing years has made gastrointestinal parasites to assume public health importance. The helplessness of children with respects to nutritional inadequacies and weighty infections they acquire make them most vulnerable infections[11].

Although several studies have been conducted on the distribution and prevalence of gastrointestinal parasites in Nigeria, many localities are still heavily infected particularly children and most importantly there is lack of adequate epidemiological information. The lack of epidemiological state of gastrointestinal parasites in the study area informed this study to elucidate the epidemiology of gastrointestinal parasites among school children from three selected schools in Minna, Niger State, Nigeria.

MATERIALS AND METHOD

Study Area and Population

The study was carried out by examining Three Hundred School Children (300) from three (3) selected schools, Tudun Fulani Primary School, Chanchaga Model School and Shango Primary school all in Minna, the Niger State. Minna is located within longitude 6^0 33'E and latitude 9^0 37'N covering a land area of 88km^2 with population of 1.2 Million, having a tropical climate with mean annual temperatures relative humidity and rainfall of $30:20^0$ 61.00% and 1334.00cm respective. The climate presents two district seasons; rainy season (April – October) and dry season (November – March).The study was conducted within four months from May to August 2014.The study populations were three hundred school children from three selected schools in Minna, Niger State, Nigeria.

Sample collection

Two sample bottles were provided for each subject. The first sterile bottle was given to each subject to take home and provide early morning faeces between 7.00am and 8.00am, while the second sample container was used to collect the samples of the handwash of each student upon submission of the faecal sample bottle. Txhese sample bottles were appropriately labeled to correspond to the number on each subject's questionnaire (prepared for demographic information of each subject). Each questionnaire contained the subject's name, sex and age. A total of three hundred (300) faecal samples and three hundred (300) water samples (handwash) was collected. The samples (both faecal and water) were then transported to the Department of Biological Sciences Laboratory, Federal University of Technology Minna, and analyzed for Ova;

Cyst and/or larvae of gastro-intestinal tract parasites using the direct wet mount microscopic examination and the formal ether concentration technique [12,7].

A total of eighteen (18) soil samples were equally collected from the three schools involved in this study. Six soil samples were collected from various locations within each of the school's compound. The collection was done using 30ml sterile plastic screw capped sample bottle. The soil samples were equally taken to the Department of Biological Sciences Laboratory, Federal University of Technology Minna, for analysis (Cheesbrough[13]). Isolation of eggs, oocytes and other parasitic forms was as described previously (with slight modifications (Tavalla et al[14]).

Data Analysis

The data collected in this study was presented using descriptive statistics. The prevalence data was presented in percentages. The overall and individual prevalence rates was calculated and compared between the different age groups, gender and among the tested schools. P value less than 0.05 (5%) was considered statistically significant. All the analysis was performed using Microsoft Excel version 2010 and statistical packages for social sciences.

Ethical Clearance and Considerations

The study was carried out according to the guideline for human experimentation in clinical research by Federal Ministry of Health of Nigeria (F.M.H), sorted from Niger State University Basic Education Board (NSUBEB) and Niger State Ministry of Health and Hospital Services (NSMHHS). Parents of the children gave informed oral consent.

RESULTS

The prevalence of gastrointestinal parasites in stool samples of children from three selected schools in Minna, Niger State is as detailed in Table 1. A total of 300 school children (183 males and 117 females) subjects participated in the survey with the ages ranging from 8 years to 16 years. The three schools were located in three different areas of Minna, Niger States namely. Tudun Fulani and Shango with 120, 120, and 60 participantd\s respectively. From the 300 stool samples collected, 175(58.33%) were found to be positive for eggs of geohelminthes. The eggs include A. lumbricoides with 91(30.33%), Hookworm 54(18.00%), Schitosoma mansonia 19 (6.33%) and Entamoeba histolitica 11(3.67%). The highest prevalence of the parasites was recorded in school situated in both Tudun Fulani 86(71.60) followed by the school situated in Chanchaga 64(53.33%), while the least prevalence was recorded in the school situated in Shango. Chi square analysis showed insignificant difference in the prevalence from the three schools at P>0.05.

The age prevalence and characteristics of the gastrointestinal parasites in stool samples of the studies school in children is presented in Table 11. The prevalence among the age groups showed highest prevalence in age group between 11 years and 13 years (75.83%), while the least prevalence 37(49.33%) was recoded for age group between 14 and 16 years. Among the parasite encountered, based on age groups, A. lumbricoide showed highest prevalence 45(37.50%) and for age group between 11 and 13 years.

The result of the prevalence of gastrointestinal parasites with respect to gender revealed that out of 183 male pupils examined, 111(60.66%) were positive for geohelminths; while out of 117 female pupils examined, 64(54.70%) were infected with the parasites. Male therefore seemed to have higher prevalence. However, statistical analysis showed no significant difference in the gender prevalence at P>0.05 level of significant. Additionally, all the parasites encountered were insignificantly higher in male than in female (Table 111).

The prevalence of gastrointestinal parasites in water samples of children from three schools in three different communities in Minna metropolis is as detailed in Table 1V. Highest prevalence 26(21.67%) of the gastrointestinal parasite in the analyzed water sample, was found in Tudun Fulani School, followed by Chanchaga and the least was recorded for Shango School. The parasites encountered in the water sample and then total prevalence are A. lumbricoide 31(10.33%), Hookworm 14(4.67%) and 5(1.67%).

The soil sample analysis recorded on overall prevalence of 55.5% with the isolation of two parasites namely A. lumbricoide for 33.33% than for Hookworm 22.22%. This implies that for all sources of infection, two parasites namely Hookworm and A. lumbricoide were consistent (Table V).

Table I: Prevalence of gastrointestinal parasites in stool samples of Children from three Schools in Minna, Niger State

Schools	No of sample examined	No of positive samples (%)	A. lumbricoides No of positive samples (%)	Hookworm No of positive samples (%)	S. mensonia No of positive samples (%)	E. histolitical No of positive samples (%)
Tudun Fulani	120	86 (71.60)	42 (35.00)	26 (21.67)	11 (9.16)	7 (5.83)
Chanchaga	120	64 (53.33)	35 (29.17)	20 (16.67)	6 (5.00)	3 (2.50)
Shango	60	25 (41.67)	14 (23.33)	8 (13.33)	2 (3.33)	1 (1.67)
Total	300	175 (58.33)	91 (30.33)	54 (18.00)	19 (6.33)	11 (3.67)

$\chi^2_{cal} = 1.88$ $\chi^2_{tab} = 12.59$ df = 6

Table II: Prevalence of gastrointestinal parasites in stool samples of Children from three Schools in Minna, Niger State with respect to age groups

Age groups	No of sample examined	No of positive samples (%)	A. lumbricoides No of positive samples (%)	Hookworm No of positive samples (%)	S. mensonia No of positive samples (%)	E. histolitical No of positive samples (%)
8 – 10	75	37 (49.33)	21 (28.00)	11 (14.67)	3 (4.00)	2 (2.67)
Chanchaga	120	64 (53.33)	35 (29.17)	20 (16.67)	6 (5.00)	3 (2.50)
Shango	60	25 (41.67)	14 (23.33)	8 (13.33)	2 (3.33)	1 (1.67)
Total	300	175 (58.33)	91 (30.33)	54 (18.00)	19 (6.33)	11 (3.67)

$\chi^2_{cal} = 0.673$ $\chi^2_{tab} = 9.488$ df = 4

Table III: Prevalence of gastrointestinal parasites in stool samples of Children from three Schools in Minna, Niger State with respect to gender (sex)

Gender	No of sample examined	No of positive samples (%)	A. lumbricoides No of positive samples (%)	Hookworm No of positive samples (%)	Schistosoma mensonia No of positive samples (%)	Entamoeba Histolitical No of positive samples (%)
Male	183	111 (60.66)	57 (31.15)	33 (18.03)	13 (7.11)	8 (4.37)
Female	117	64 (54.70)	34 (29.06)	21 (17.95)	6 (5.13)	3 (2.56)
Total	300	175 (58.33)	91 (30.33)	54 (18.00)	19 (6.33)	11 (3.67)

$\chi^2_{cal}=0.804$ $\chi^2_{tab}= 7.815$ df=3 $P<0.05$

Table IV: Prevalence of gastrointestinal parasites in water samples of Children from three Schools in Minna, Niger State

Schools	No of sample examined	No of positive samples (%)	A. lumbricoides No of positive samples (%)	Hookworm No of positive samples (%)	Entamoeba Histolitical No of positive samples (%)
Tudun Fulani	120	26 (21.67)	17 (14.17)	7 (5.83)	2 (1.67)
Chanchaga	120	19 (15.83)	12 (10.00)	5 (4.17)	2 (1.67)
Shango	60	6 (10.00)	3 (5.00)	2 (3.33)	1 (1.67)
Total	300	51 (17.00)	31 (10.33)	14 (4.67)	5 (1.67)

$\chi^2_{cal} = 0.673$ $\chi^2_{tab} = 9.488$ df = 4

Table V: Prevalence of gastrointestinal parasites in soil samples of Children from three Schools in Minna, Niger State

Schools	No of sample examined	No of positive samile	A.lumbricoides	Hookworm
Tudun Fulani	6	5(83.33)	3 (50.00)	2 (33.33)
Chanchaga	6	3 (50.00)	2 (33.33)	1 (16.67)
Shango	6	2 (33.33)	1 (16.67)	1 (16.67)

$\chi^2_{cal} = 0.13$ $\chi^2_{tab} = 5.99$ df=2

DISCUSSION

Epidemiological studies carried out in different communities around the globe assert that gastrointestinal parasite infection still presents a great health predicament in both rural and urban settlement. In line with this view, the present investigation attempted to assess the epidemiology of gastrointestinal parasite among school children from selected schools in Minna, Niger State, Nigeria. In the present study, the observed overall prevalence rate of gastrointestinal parasite was found to be 58.33%, which is relatively higher than the previously reported prevalence by Aribodor et al[15] who reported a prevalence of 46% among 5-14 years old subject. Our prevalence is also higher compared to the findings of Chukwuma et al[16] who recorded a prevalence of 5.9% among primary school children in Ebenebe Town, Anambra State. This high prevalence could be due to a reflection of the local endemicity and geographic condition of the study area. On the contrary, our findings is in agreement with the prevalence of 58.5% reported by Chan et al[17] among primary school pupils in Makurdi, Benue State and approximately same range (60.0%) with the report of Gujarat (Crompton and Savioli[18]). The high prevalence, if no intervention occurred, may lead to cognitive deficits, learning disabilities and high school absenteeism. It may also lead to high morbidity, mortality and economic loss to the country [19].

The highest prevalence of gastrointestinal infection from stool analysis with respect to location was recorded in children attending Tudun Fulani Model School Minna. The reason for this high prevalence can be deduced to the location of the school and its unkempt environment. This agrees with the report of Khan[20] who stated that defecation habits, reduced use of footwear, and the presence of dirty nails have been reported as significant factors in parasite infestation rates. The manner with which these children defecate within the school premises could lead to a vicious cycle of parasites re-infestation as these children come in contact with such wastes in their communities and on the school's playing ground. Thus, subjects who used open fields for defecation had markedly higher parasite infestation rates than those who used some type of latrine. Most of the children are often made to engage in farming especially when it rains, which

majority do without wearing scandals, shoes, slippers or any protective covering for their feet. The difference in prevalence in the schools involved in this study is due to the fact that the level of hygiene in Tudun Fulani is the poorest compared to other schools which are equally poor though to a lesser degree, hence the lesser prevalence. This is in agreement with the submission of Onwuliri et al[21] that variations in prevalence rate of intestinal helminthiasis from different rural communities could be related to several factors including people's level of education, standard of personal/environmental hygiene and perhaps social habits. In addition, some ecological factors such as temperature, relative humidity, rainfall, different diagnostic techniques used by various workers could be the reason for notable differences in prevalence between communities.

The prevalence of infection from stool analysis varies among the three age categories represented in this study. Thus, a prevalence of 75.83% was recorded in the 11 – 13 age group; prevalence of 49.33% recorded for the 8 – 10 age group while the least prevalence of 44.76% was recorded in children within the 14 – 16 age category. Thus it can be observed that younger children (below 14 years) recorded higher prevalence of infection than older ones. This is consistent with the findings observed by (Smith[22]; Luka et al[23]) in their separate studies among primary school children in Kaduna and Abia states both in Nigeria. The highest prevalence recorded among children between age group 11 – 13 showed that they usually behave in common and this more likely leads to their high infection rate, also they have not equally taken their personal hygiene very seriously. Being at the start of their adolescence, they demonstrate possession of enormous energy, thus they want to put it to use. They are very active and there body systems are strong enough to move around every place. Pupils in these age groups often spend more of their leisure time outdoors, playing and or foraging in garbage dumps Also they are given to adventures, involving a lot of touching.

The age group 8-10, on the average had prevalence between the highest and lowest. The reason behind this is that they still enjoy much parental attention, however certain times they are far from parental watch and are quick to indulge in some of their desired activities which they have been restrained from. Usually making contact with sand and eat indiscriminately with unwashed hands. They are yet to understand the reason why they are being restrained from certain activities. Thus the presence of parental care to helps to keep infection rate in theses category to a manageable level.

Also in agreement with the findings of Luka et al[23] and Smith[22] that in the direct opposite/sharp contrast, the lowest prevalence of infection observed in the 15-17 years age group. The reason for the lowest prevalence/occurrence in the 14 – 16 age groups could be deduced to their maturity level. Due to their level of maturity and reasonable minimal exposure, they are beginning to imbibe good personal hygiene, become more hygiene-conscious about their looks as compared to the lower age group and hence are able to avoid as much as possible what would lead to one being infected though more still to be done, to bring down the prevalence level to a lesser degree.

The prevalence of gastrointestinal parasite by sex showed that from the stool analysis, the prevalence of males was 60.66 % compared to prevalence of 54.7% obtained in females. Thus the prevalence in males was higher than that of females though the difference was statistically non significant ($P > 0.05$). This agrees with the findings of Ikon and Useh[24] during an epidemiological study of gastrointestinal helminthes among pupils in urban and sub-urban

communities in Nigeria. This high prevalence associated with males may be due to the fact that they are more often engaged in predisposing activities such as football, and also playing in streams or ponds. This finding also agrees with (Meinhardt[25] that females are more immune to parasitic infection although it can be broken down under certain circumstances. Nevertheless, both sexes had the same probability of contracting the disease as both sexes live in the community and engage in similar activities e.g. farming, fishing etc, thus are prone to same hazards.

Water sample analysis isolated three (3) parasites; A. lumbricoides, Entamoeba spp and Hookworm. The average prevalence from water analysis in this study is 17% which is approximately same range of 7.5 – 15% and 16.8 % reported in Chandigarh and Delhi respectively[26] .This may due to the fact that the prevailing conditions and the subjects employed were approximately the same.

The highest prevalence of gastrointestinal infection from water analysis in this study with respect to location was equally recorded in children attending Tudun Fulani Model School Minna. This can be attributed to the little attention paid to hygiene in this area in comparison to other schools involved in this study, Other schools involved in this study equally do not pay adequate attention to hygiene but not as bad as in Tudun Fulani where children hardly wash their hands as the school has no identified supply of water or even a container for water in its premises. This agrees with the submission of Boot and Cairncross[27] that; variation in hand-washing practices can also impact the risk of disease transmission, and rigorous hand-washing habits are effective in reducing the risk of contracting disease.

The isolation of three parasites from hand wash analysis in this study agrees with the submission of Han et al[28] that hands readily become contaminated after defecation even with the use of toilet paper. Since no source of water exists, hand washing is almost nonexistent, coupled with their unkempt and dirty fingers, thus making this area and consequently the inhabitants available hosts/carriers for certain parasitic diseases.

The prevalence rate recorded from water analysis is lower than that obtained from stool analysis. This agrees with the submission of Andrews[29] that the ability of parasite ova/cysts to survive on environmental surfaces varies greatly among different groups of parasites.

Infection rates recorded in both primary and post-primary schools may be due to their non-compliance with certain rules of hygiene. Most of these school children were seen eating food and snacks wrapped with papers and nylons got from doubtful sources and which might be contaminated.

The highest prevalence of gastrointestinal infection from soil analysis in this study with respect to location was equally recorded in Tudun Fulani Model School premises. This is no surprise with the almost total absence of any basic toilet facility even pit latrines, thus; the school children there have no alternate but to defecate in open places, fields, farms etc which are allowed to serve as local manure. Thus, infection of the soil becomes unavoidable. This agrees with the submission of Sterritt[30] who reported that, an epidemic of roundworm in Germany was directly traced to the use of raw sewage to fertilize gardens.

Soil sample analysis isolated two (2) parasites; A. lumbricoides and Hookworm, with Ascaris having a higher rate than Hookworm. The prevalence rate recorded from this analysis (55.56%) is lower than that obtained from stool analysis but higher than that observed in water analysis. This further confirms the report of Andrews[29] that the ability of parasite ova/cysts to survive on environmental surfaces varies greatly among different groups of parasites. While Ascaris eggs are known to survive for a long time in the environment, eggs of other parasites (such

as Enterobius) are relatively less resistant to environmental stresses. E. histolytica cysts contaminating fingers rarely survive air drying of more than five minutes.

The isolation of two parasites from soil analysis namely A. lumbricoides and Hookworm agrees with the submission of Sopper et al[31] and Shuval[32] who reported that the viability of Ascaris eggs was almost unaffected even when stored for three months under anaerobic conditions as the parasite eggs that require an environmental incubation period are the most resistant. A. lumbricoides infection occurred consistently with the highest frequency. The possible reason for this is understandable. It is well established that the infective stages of A. lumbricoides, the embryonated eggs have a huge capacity for tolerating the environmental limit of urban environments. Furthermore, Ascaris eggs are coated with a mucopolysaccharide that makes them glue to a wide variety of environmental surfaces; this characteristic is the reason why they are able to adhere to most things from door handles, dust, fruits and vegetables, paper money and coins. The eggs of Hook worms and Strongyloides hatch into the larval stages which become infective at L3. These larvae penetrate the skin and are carried by blood circulation until they develop into full adult forms in the small intestine [33,34,35,36].

The study observed that inadequate or total absence of sanitary facilities was of epidemiological significance considering the number of hours pupils spend in school.

Generally, the differences recorded in the prevalence of intestinal parasites in the study locations are attributable to the level of sanitation prevailing in these areas.

The result of this study was corroborated by Amuta et al[6], who reported a positive correlation between contamination of school compounds with faecal pathogens and the availability of sanitary facilities in schools in Makurdi, Nigeria.

Ejima and Ajogun[37] reported that high level of indiscriminate defecation out of toilets on to the soil around human habitations serves as a determinant of human gastro-intestinal parasitic infections and transmission among the community. These children constitute an immense reservoir and source of infection to other healthy children with no intestinal parasites. Other health consequence in children includes, growth retardation and reduction, mental deficit, malnutrition, which limit school achievement[38]. The infected child is predisposed to secondary infection or other super infection. Vital organs of the body can also be affected when parasites wander to ectopic areas.

In conclusion, the findings of this study have shown that four gastrointestinal parasites; Ascaris lumbricoides, Hookworm, Schistosoma mansoni and Entamoeba histolytica were prevalent among children in Minna, Niger State particularly in the three study areas. The study has also showed that intestinal parasites are still highly prevalent among school children who are confronted with shortage of good water supply and still practice, indiscriminate defaecation and low level of hygiene generally. Infection by Ascaris lumbricoides and Entamoeba histolytica showed the highest and lowest rates respectively with significant difference observed with respect to location and age group, unlike in sex where there was no significant difference. This study also provides data for understanding the epidemiological status of the human gastrointestinal parasites in Minna, Niger State.

REFERENCES

1. Mengistu LN, Berhanu E. Prevalence of intestinal parasites among school children in a rural area close to the Southeast of Lake Langano, Ethiopia. Ethiopia Journal of Health Development, 2004.18(2), 116-120

2. Oyeniran OA, Ojurongbe O, Oladipo EK, Afolabi AY, Ajayi OO, Oloke A.A. Intestinal parasitic infection among primary school pupils in Osogbo Nigeria. Journal of Dental and Medical Science, 2014.7(4), 76-101.
3. World Health Organization. Intestinal Helminth parasites. http://www.who.int [database online]. 2009. (Accessed in January 2013).
4. World Health Organization. De – worming for health and development. Report of the third global meeting of the partners for parasite control. http://www.who.int [database online]. 2005. (Accessed in January 2013).
5. Nwoke BEB. The impact of changing human environment and climate change on emerging and re-emerging parasitic diseases. 28th Annual Conference o Nigerian Society for Parasitology, Owerri; Nigeria, 2004. pp 1-37.
6. Amuta EU, Omudu EA, Ahmed AS. Bacteriological and parasitological evidence of soil contamination in relation to sanitary facilities in selected schools in Makurdi, Nigeria. Journal of Pest, Diseases and Vector Management, 2003.5: 337-347
7. Banke ROK, Omudu EA, Ikenwa DA, Feese JJ. Prevalence of Gastrointestinal parasites in relation to availability of sanitary facilities among schooling children in Makurdi, Nigeria. 2006.3(2), 489-493.
8. Kattula D, Sarkar R, Ajjampur SSR, Minz S, Levecke B, Muyi J, Kang G. Prevalence and risk factors for soil transmitted helminth infection among school children in South India. Indian Journal of Medical Research, 2014.139, 76-82.
9. Tomono N. Anantaphruti MT, Jongsuksuntigul P, Thongthien P, Leerapan P, Silaphratsamee Y. Risk factors of helminthiases among school children in Southern Thailand Southeast Asian. Journal of Tropical Medicine and Public Health, 2003.34, 264-268.
10. Ogbe MG, Edet EE, Isichei M N. Intestinal helminthes infection in primary school children in areas of operation of Shell Petroleum Development Company in Delta State. Nigerian Journal of Parasitology, 2002. 23: 3 – 10.
11. Luka SA, Ajogi I, Umoh JU. Helminthosis among Primary school Children in Lere Local Government Area, Kaduna State, Nigeria. The Nigerian Journal of Parasitology, 2000.21, 109- 116.
12. Ukaga CN, Onyeka PIK, Nwoke BEB. Practical Medical Parasitology for Biological and Medical Sudents. Avan Global Publication. Owerri, Nigeria. 2002.341 pp.
13. Cheesbrough M. District Laboratory Practice for Tropical Countries, Part 2. Cambridge University Press, UK. 2005.Pp. 434.
14. Tavalla M. Oormazdi AE, Razmjou M, Moradi, Lakeh S, Shojaee, RA, Maemar. African Journal of Biotechnology, 11(20), 4575-4578.
15. Aribodor DN, Okechukwu PA, Eneanya OA, Etaga HO. Prevalence and Associated Risk factors of intestinal Helminth infections among 5-14 years olds in Akpo community, Anambra State, Nigerian Journal of Parasitology, 2013.34(2), 107-111
16. Chukwuma MC, Ekindu IM, Agbakoba NR, Ezeagwuna DA, Anaghaln IC, Nwosu DC. The prevalence and risk factors of

geohelminth infections among primary school children in Ebenebe Town, Anambra State, Nigeria. Middle-East Journal of Scientific Research, 2009.4(3), 211-215.

17. Chan MS, Medley GF, Jamison D. Bundy DAP. The evaluation of potential global morbidity due to intestinal nematode infections. Parasitology, 1994.109: 373 – 387.
18. Crompton DWT, Savioli L. Intestinal Parasitic Infection and Urbanization. Bulletin of the World Health Organization, 1993.71(1): 1 - 7.
19. Silva NR, Brooker S, Hotez PJ, Monstresor A, Engils D, Savioli L. Soil transmitted helminthes; infections: updating the global picture. Trends in Parasitology, 2003.19, 547-531.
20. Khan MY. An analytical study of factors related to infestation by intestinal parasites in rural school children (report of a pilot study) Public Health, 1979.93, 82-88
21. Onwuliri COE, Anosike JC, Nkem CN, Payne VK. The ecology of animal parasitic nematodes in endemic areas of Jos, Nigeria. Applied. Parasitology, 1993.15(4),53-56.
22. Smith JD. Introduction to Animal Parasi ology.3rd Edition. Cambridge University Press, 1999.549
23. Ejima IAA, Odaibo AB. Urinary Schistosomiasis in the Niger-Benue basin of Kogi State Nigeria. International Journal of Tropical Medicine, 2010.5, 73-80.
24. Ikon GM, Useh MF. Epidemiology of gastro-intestinal helminthosis among pupils in urban and Sub-urban communities in Nigeria. Journal of Medical. Laboratory Science, 1999.8, 1-6.
25. Meinhardt PL. Recognizing waterborne disease and the health effects of water contamination: A review of the challenges facing the medical community in the United States. Journal of Water Health 2006. 4.27-34.
26. Sethi, S., Sehgal, R., Malla, N., Dubey, M.L., & Mahajan, R.C (2000). Changing trends of intestinal parasitic infections in Chandigarh (Northern India): hospital based study. Indian Journal of Medical Microbiology. 18: 106-109.
27. Cairncross, S., & Boot, M. (1993). Actions speak. The study of hygiene behaviour in water and sanitation projects. The Hague, the Netherlands: LSHTM and IRC.
28. Han, A. M., Aye, T. A., & Hlaing, T. (1986). Personal toilet after defaecation and the degree of hand contamination according to different methods used. Journal of Tropical Medicine and Hygiene, 89, 237–241
29. Andrews J. The retention of Entamoeba histolytica cysts under finger-nails. America Journal of Tropical Medicine, 1934. 1-14, pp. 439–441
30. Sterritt RM. Microbiology for environmental and public health engineers. New York: E & FN Spon; 1988.252.
31. Sopper WE, Kardos LT. Recycling treated municipal wastewater and sludge through forest and cropland. University Park, PA: Pennsylvania State University; 1973.251–2.
32. Shuval HI. Appropriate technology for water supply and sanitation—night soil composting. Washington DC: The World Bank; 1981.4.
33. Okpala I. The incidence of intestinal parasites among school children in Lagos, Nigeria. West Africa Medical Journal, 1956.5,167–170.

34. Nwosu AB. The community ecology of soil transmitted helminthes infection of human in hyperendemic area of southern Nigeria. Annual Tropical Medicine Parasitology, 1981.75,75–203.
35. Oyerinde JPO, Adegbete-Hochist AF, Ogunbi O. Prevalence of Intestinal Parasite of man in themetropolitan
Lagos. Nigerian Journal of Natural Science, 1979.3, 147-155
36. Azikiwe AN. The prevalence of intestinal parasitic infections in an African University Community. Annals of Tropical Medicine and Parasitology, 1984.(3), 333-334.
37. Ejima IAA & Ajogun RT. The Prevalence and Health Implications of the Ova of Human Intestinal Helminths Parasites isolated from Faeces collected near students Hotels; Federal Polytechnic Idah, Kogi State, Nigeria. International Journal of Tropical medicine, 2001.6(1), 15-18.
38. Hendrickse RG. Parasitic Disease in: Hendrickse R.G., Barr D.G.D., & Mathews T.S., (eds) Paediatrics in the Tropics. 1st Ed., Blackwell Scientific Publicaitons, 1991.695-764.