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Ajayi EO
Elechi HA
Alhaji MA
Adeniyi OF

Prevalence and pattern of intestinal parasites among pupils of private and public primary schools in an urban centre, Nigeria

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Elechi HA (✉)
Alhaji MA
Department of Paediatrics,
University of Maiduguri,
Maiduguri, Nigeria.
Email: h2elechi@gmail.com

Ajayi EO
Adeniyi OF
Department of Paediatrics,
Lagos University Teaching
Hospital, Lagos, Nigeria.

Abstract*:* *Background*: Intestinal parasitic infection is highly prevalent among children in the tropics. Identifying the most at risk group and subsequent targeted intervention will lead to cost effective and easy to implement control programme. We thus aim to determine the prevalence and pattern of intestinal parasite among pupils from public and private schools.
Material and Method: This was a cross-sectional survey. Participants were recruited through multistage stratified random sampling. Information were collected using a questionnaire and early morning freshly passed stool sample was collected and processed from each participating pupil. Stool microscopy was done using saline and iodine preparations. Eggs were counted using Stoll's method. Data obtained was analyzed using EPI INFO version 3.5.1.
Results: Four hundred and twenty pupils were studied, 210 pupils from each school type. Prevalence of 78.1% and 17.1% were recorded for the public and private schools respectively. The pupils from the public schools were 17.23 times more likely to have intestinal parasitic infestation compared to those from private schools (OR =17.23, 95% CI = 10.6-28.01, p = <0.0001). *Ascaris lumbricoides* was the most frequent isolate in both the public (62.8%) and private (66.7%) schools. The prevalence of multiple parasitic infestation was 14.8% in the public schools and none in the private schools. Socioeconomic status and source of water were the main factors with significant effect on the prevalence of intestinal parasite (p<0.0001).
Conclusion: Intestinal parasitic infestation remains a very common health issue among the children particularly in the public schools. Distribution of free antiparasitic drugs to pupils at the beginning of every term should be incorporated into the school health program.

Key words: Intestinal Parasites, *Ascaris lumbricoides,* public school, private school, socioeconomic status.

Introduction

Intestinal parasitic infestations are highly prevalent in developing countries, particularly in the tropics, and pose serious medical and public health problems.[1]The World Health Organization (WHO) estimates that over two billion people are infected with one or more types of soil-transmitted intestinal parasites.[2] Infection in man is by parasites belonging to either the nematodes (round worm) or platyhelminthes (flat worm) phylum.[3] The basis of aggregation of soil-transmitted parasites in population is unknown. It may be related to the heterogeneity of the parasites, differences in susceptibility of human population, social behavioral or nutritional factors.[4]

The prevalence and intensity have been found to be highest in communities in which poverty, poor environmental and personal hygiene are endemic.[5] In such communities, faecal disposal is indiscriminate, resulting in contamination of the soil, water, food and vegetables[5,6] and the prevalent habit of walking bare footed and eating unwashed fruits further enhance high transmission rates.[7] The frequency of intestinal parasitisation can be regarded as a general indicator of the level of development, as high prevalence rates are almost invariably associated with poor living conditions.[5]

Children are particularly vulnerable to intestinal helminthic infections, which may affect their mental and physical developments through several mechanisms including malabsorption, blood and protein loss, anorexia and chronic dyspeptic syndromes, all of which compromise nutrition in these children.[5]

Several studies in Nigeria have shown that the prevalence of intestinal parasitic infestation is high, especially among children: Saka *et al*[8] reported a prevalence of 47.4% among primary school pupils from Ilorin, North-central Nigeria, Salawu *et al*[9], on the other hand, found a higher prevalence of 59.2% among pupils from Ife, Southwest Nigeria, while Odinaka *et al*[10] reported a prevalence of 30.3% from Imo State, Southeast Nigeria. Low socioeconomic status was a common factor found among these children with helminthic infestation in the various studies.[8-10] This reported high prevalence underscores the need for appropriate public health intervention aimed at controlling the infestation in children. In Nigeria, particularly in the urban centres like Lagos, dichotomisation of school system into private and public schools naturally selects the children along socioeconomic lines, with the low socioeconomic ones concentrated in the public schools.[11] This may provide a good opportunity in reaching the most vulnerable population with any interventional programme. We thus undertook a survey to determine the prevalence and pattern of parasitic infestation among pupils in private and public school in Ikeja- Lagos which is an urban centre in Nigeria.

Materials and Method

Study area

The study was carried out in public and private primary schools in Ikeja Local Government Area (LGA) of Lagos State, Nigeria. Ikeja is the capital city of Lagos state, the most populated and urbanized state in Nigeria with over 10 million residents.[12] There are 114 registered private primary schools and 32 public primary schools in Ikeja LGA as of the time of the survey.

Study design

This was a cross-sectional survey.

Study population

They consisted of pupils in public and private primary schools in Ikeja LGA.

Sample size determination

Minimum sample size for each type of school was determined using the formula:[13]

$$N = \frac{(za + zb)^2 (p1q1 + p2q2)}{(P1 - P2)^2}$$

Where N = Minimum sample size

Za = Standard deviate (1.96)

Zb = Critical value depending on power usually 1.28 at 90% power.

P1 &P2 = Proportion of pupils estimated to be infected in each group

q = 1-p

The values for P1 and P2 (20.9% & 53.5%) were taken from a previous study.[14] The calculated minimum sample size was 41 from each study group. However, two hundred and ten (210) pupils were studied from each type of school to increase the power of the observation as resources allowed.

Sampling method

Multistage stratified random sampling was used. There were 114 registered private primary schools and 32 public primary schools in Ikeja Local Government Area as at the time of the study. The schools were stratified into private and public schools. Two schools were selected by simple random sampling from the list of public schools and three from the list of private schools. Seventy and 105 pupils were studied from each of the participating private and public schools respectively. In each participating school the total number was proportionally distributed across all levels based on the number of pupil in each level. Participants were selected by simple random sampling method using the class register as a template in each of the classes of the selected schools.

Ethical consideration

Written permission was sought and obtained from the Ikeja LGA Education Authority. The head teachers of the selected schools also gave well-informed expressive approval after receiving appropriate information. All the selected pupils were given consent form and introductory note to the study to their parents for their signature or thumbprint. There was no consequence for the pupil if he or she refused to participate or parents refused consent. Data obtained were treated with confidentiality and only for the purpose of this research. All children whose stool sample tested positive were given appropriate prescription.

Data collection method

Information for the study was obtained via an author administered structured questionnaire. All the participating pupils were interviewed at school and sent home with the section of the questionnaire to be completed by their parents and were returned the following day. Information obtained included sociodemographic data such as age, gender, parents' occupation, average monthly income, and educational attainment. Information on type of housing, mode of sewage and refuse disposal and source of water were sought as indicators of sanitary condition of the family. Socioeconomic status was assessed using the model of Ogunlesi et al.[15] Weight was measured in kilogram to one decimal place using a bathroom weighing scale with sensitivity of 0.5 kg. Height was measured in meters to two decimal places using a stadiometer. Nutritional status was determined using body mass index (BMI) percentile in accordance with the National Centre for Health Statistics/Center for Disease Control and Prevention.[16] Children with BMI below the 5th percentile were classified as underweight, 5th

to less than 85th percentile as normal, 85th to less 95th percentile as overweight and 95th and above as obesity.

The children were given specimen bottles to collect fresh stool with the help of their parents and bring the same to school the same morning. The samples were received and transported in ice pack to the laboratory where it was subsequently store in a refrigerator at -4°C until analysis. Stool examination was done by an experienced Laboratory scientist in the parasitology laboratory of Lagos University Teaching Hospital within four hours of sample collection. Saline preparations were used to detect vegetative forms, eggs and larval, while iodine preparations detected cyst. Eggs were counted using Stoll's method. Identification of any of egg, larva, cysts and active forms on microscope were considered positive.

Data analysis

The data obtained were entered and analysed using EPI INFO version 3.5.1 (developed by Centres for Disease Control and Prevention (CDC), Atlanta, Georgia (USA)). Tables were used in data presentation. Chi-square and Fisher's exact test were used in comparing frequencies

Results

A total of 420 children were studied, 210 pupils from each school type. The children from the private schools were younger with a mean age of 7.7 ± 1.9 years compared to 10.3 ± 2.6 years for those in public school ($P \leq 0.001$). The female pupils (113 & 111 in public and private schools respectively) were slightly more than the male (97 & 99 in public and private schools respectively) with M: F ratio ≈ 1:1.1 in both groups. Majority 176 (83.3%) of the pupils from the private schools were of high socioeconomic class whereas those from public schools were predominantly of the middle socioeconomic class ($P \leq 0.001$). Table 1 shows the sociodemographic features of the study population.

Table 1: Sociodemographic features of the study population

Variable	Public School *n* (%)	Private School *n* (%)	X^2	*P-value*
Age				
5–6	14 (6.7)	63 (30.0)	97.81	<0.0001*
7–8	46 (21.9)	59 (28.1)		
9–10	50 (23.8)	81 (38.6)		
11–12	59 (28.1)	7 (3.3)		
>13	41 (19.5)	0 (0)		
Sex				
Male	97 (46.2)	99 (47.1)	0.0382	0.844
Female	113 (53.8)	111 (52.9)		
Socioeconomic status				
Low	49 (23.3)	6 (2.9)	233.7	<0.0001*
Middle	157 (74.8)	28 (13.3)		
High	4 (1.9)	176 (83.8)		

*, Chi-square for trend

Looking at the sanitary indicators of the household of the pupils, more than half, 121 (57.6%) of those from public schools lived in a single room apartments– toilet detached and shared with several other households - as compared to 207 (98.6%) from the private schools who lived in block of flats or bungalow. There was statistically significant difference between the housing type of the pupils from the two groups ($p < 0.0001$). Mode of sewage and refuse disposal was similar among the two groups: Majority of the pupils 195(92.9%) and 208 (99.0%) from public and private school respectively, used water closet as mode of sewage disposal (P = 0.0743), while 168 (80%) and 160 (76.2%) from public and private schools used refuse trucks (P=0.3710). In contrast however, source of drinking water differed significantly between the two groups (P=0.0005) table 2.

Table 2: Sanitary indicators of the respondent's family

Sanitary Indicators	Public Schools n (%)	Private Schools n (%)	X^{2*}	P-value
Type of house				
Single room	121 (57.6)	3 (1.4)	174.0	<0.0001
Block of flats	85 (40.4)	140 (66.7)		
Bungalow/ Duplex	4 (2.0)	67 (31.9)		
Type of toilet				
Open defecation	4 (1.9)	1 (0.5)	3.186	0.0743
Pit latrine	8 (3.8)	1 (0.5)		
Water closet	195 (92.9)	208 (99.0)		
Others	3 (1.4)	0 (0.0)		
Refuse disposal				
Burning/ dumping	32 (3.3)	12 (1.9)	0.8002	0.3710
Cart pushers	10 (4.8)	38 (18.1)		
Refuse trucks	168 (80.0)	160 (76.2)		
Source of drinking water				
Bore hole	56 (26.7)	153 (72.9)	12.10	0.0005
Pipe borne water	138 (65.7)	25 (11.9)		
Well water	3 (1.4)	3 (1.4)		
Others	13 (6.2)	29 (13.8)		

*, Chi-square test for trend

A total of 123 (58.6%) pupils from the public schools were dewormed at least once in a year which is not significantly different from 119 (56.7%) pupils from private school (P=0.6929). Further categorization of the deworming practice into three monthly, six monthly and yearly also showed no statistically significant difference between the two groups (p – 0.5565).

Table 3: Use of anthelminthic among the respondents

De-worming Frequency	Public School n (%)	Private School n (%)	X^{2*}	P
Every 3 months	72 (34.3)	62 (29.5)	0.3459	0.5565
Every 6 months	25 (11.9)	32 (15.2)		
Once in a year	24 (11.4)	23 (11.0)		
Others	2 (1.0)	2 (1.0)		
Total	123 (58.6)	119 (56.7)		

*, Chi-square test for trend

Underweight was three times more frequent in the public schools, 33 (15.7%), when compared to the private schools, 10 (4.8%). On the other hand, overweight/obesity was three and half times more frequent in the private school, 57 (27.1%), when compared to the public school, 16 (7.7%). This nutritional pattern was significantly different (P = <0.0001).

Table 4: Nutritional status of the respondents

BMI percentile	Public School n (%)	Private School n (%)	X^{2*}	P-value
Underweight (< 5th)	33 (15.7)	10 (4.8)	41.38	<0.0001
Normal (5th to < 85th)	161 (76.7)	143 (68.1)		
Overweight (85th to <95th)	14 (6.7)	28 (13.3)		
Obese (≥ 95th)	2 (1.0)	29 (13.8)		
Total	210 (100)	210 (100)		

*, Chi-square test for trend

One hundred and sixty-four (78.1%) pupils from the public schools had intestinal parasites compared to 36 (17.1%) from the private schools. Pupils from the public schools were 17.23 times more likely to have intestinal parasitic infestation compared to those from private schools (OR =17.23, 95% CI = 10.6-28.01, p = <0.0001).The prevalence of multiple parasitic infestation was 14.8% in the public schools and none in the private schools. The commonest parasites seen in both the public and private schools was *Ascaris lumbricoides* accounting for 62.8%and 66.7%of infestation in the public and private schools respectively. The overall pattern of infestation was statistically different between the public and private school (X^2=13.52, p = 0.0002). At individual parasite level, only *Trichuris trichura* showed statistically significant different pattern between the two groups (P = <0.0001).

Table 5: Frequency and Pattern of intestinal parasites isolated among the respondents

Type of parasite	Public Schools (n=164) n (%)*	Private Schools (n = 36) n (%)	P-value**
Ascaris Lumbricoides	103 (62.8)	24 (66.7)	0.7066
Trichuris Trichura	11 (6.7)	12 (33.3)	<0.0001
Entamoeba coli	15 (9.1)	0 (0.0)	0.0778
Hymanolepsi Nana	5 (3.0)	0 (0.0)	0.5875
Hookworm	10 (6.1)	0 (0.0)	0.2136
Entameba Histolytica	21 (12.8)	0 (0.0)	0.0165
Fasciola Hepatica	5 (3.0)	0 (0.0)	0.5875
Schistosoma Mansoni	5 (3.0)	0 (0.0)	0.5875
Gardia Lamblia	5 (3.0)	0 (0.0)	0.5875
Strongiloides stercorales	5 (3.0)	0 (0.0)	0.5875
Enterobius vermicularis	10 (6.1)	0 (0.0)	0.2136

*Some of the pupils had more than one parasites identified; ** Fisher's exact test
X^2=13.52, p = 0.0002

The proportion of infection was highest among pupils from low socioeconomic family 90.9% while the least proportion (14.4%) was among those from high socioeconomic class. Low socioeconomic status was significantly associated with higher prevalence of parasitosis (X^2= 148.7. P = <0.0001). In contrast, use of anthelminthic in the last one year was associated with statistically significant lower prevalence of parasitosis (X^2 = 119.3, P = <0.0001). Age and nutritional status had no statistically significant effect on the prevalence (P= > 0.05).

Table 6: Prevalence of Intestinal parasitosis by various factors among the study population

Variables	Parasitosis Positive n (%)	Negative n(%)	X^2	P-value
Age (Years)				
5-6	37 (48.1)	40 (51.9)	3.971	0.4100
7-8	45 (42.9)	60 (57.1)		
9-10	70 (53.4)	61 (46.6)		
11-12	32 (48.5)	34 (51.5)		
≥ 13	16 (39.0)	25 (61.0)		
Socio-economic status				
Low	50 (90.9)	5 (9.1)	148.7	<0.0001
Middle	124 (67.0)	61 (33.0)		
High	26 (14.4)	154 (85.6)		
Types of Toilet				
Open defaecation	3 (60.0)	2 (40.0)	3.918	0.2704
Pit latrine	7 (77.8)	2 (12.2)		
Water closet	189 (46.9)	214 (53.1)		
Others	1 (33.3)	2 (66.7)		
Nutritional Status				
Underweight	22 (51.2)	21 (48.8)	0.2605	0.8779
Normal	143 (47.0)	161 (53.0)		
Overweight/ obese	35 (47.9)	38 (52.1)		
Dewormed				
Yes	60 (24.8)	182 (75.2)	119.3	<0.0001
NO	140 (78.7)	38 (21.3)		
Source of water				
Bore hole	120 (57.4)	89 (42.6)	21.95	<0.0001
Pipe borne	57 (35.0)	106 (65.0)		
Well	5 (83.3)	1 (16.7)		
Others	18 (42.9)	24 (57.1)		

Discussion

The findings from this survey show that there is wide disparity in the prevalence of intestinal parasitic infestation between the pupils from private schools (17.1%) and those from public schools (78.1%). This finding agrees with the findings from previous studies; Ogwurike *et al*[17] reported prevalence of 16.6% and 46.6% from Jos in Nigeria, while Debalke *et al*[14] from Ethiopia found prevalence of 20.9% and 53.5%, both in pupils from private and public primary schools respectively. However, the disparity observed in this study is much wider than was documented by the two previous studies.[14,17] This is most likely due to the difference in spectrum of parasites considered. While the previous studies focused on helminths alone, this work, in addition, also identified other forms of intestinal parasites other than helminths. This assertion is further supported by the prevalence of 17.1% found in the private schools where only helminths were isolated which is comparable to 16.6% and 20.9% in the previous studies.

This wide disparity in prevalence between the schools might be due to variation in the various factors associated with the transmission of the parasites including factors like age, socioeconomic status, type of housing, source of water, mode of sewage disposal and nutritional status.

Similar to the findings in previous studies[10,18,19] age had no significant association with intestinal parasite infection. Odinaka *et al*[10] found the highest prevalence among children aged 8-10years and least among those 14 -16years but in the overall this variation by age was not statistically significant. Similarly, Obikwu *et al*[18] and Ukpai *et al*[19] observed slightly higher prevalence among children between the ages of 9-12years but again were not significantly different from other age groups. In this study, the highest prevalence of 53.4% was found among those aged 9-10years. The reason for this consistent finding of higher prevalence among children between 8-12 years of age is not clear but may be due to the adventurous nature of the early adolescent.

The high prevalence of 90.9% among pupils of low socioeconomic class compared to 14.4% among those of high socioeconomic status highlights the cardinal role of low socioeconomic status in the prevalence of intestinal parasite. The pupils from public school were significantly of lower socioeconomic class compared to those of private school and hence the high prevalence recorded in the public schools. Several other studies have equally highlighted similar relationship between low socioeconomic status and prevalence of intestinal parasitosis.[8-10,20] It is a known fact that low socioeconomic status is an important determinant of slum dwelling in urban centres which provides conducive environment for parasite transmission. The search of the literature yielded no contrary finding.

In our study, mode of sewage disposal had no significant effect on the prevalence of intestinal parasites. Other studies[9,10] have equally documented similar results. In contrast, several other studies[8,18-12] have found mode of sewage disposal to be an important factor in the prevalence of intestinal parasites. The finding in this study and that of Salawu *et al*[9] and Odinaka *et al*[10] however is not surprising as majority of the participants, 403(96%) in our study, used similar mode of sewage disposal and hence eliminating its supposed effect in the study population.

Source of water supply had statistically significant association with the prevalence of intestinal parasite. The importance of source of water supply in the local epidemiology of intestinal parasites have been documented by several authors[6,21,22]. Of concern however, is the high rate of infection 120 (57.4%) among children from families using bore hole as source of water which is expected to be contamination free. The reason for this observation is not clear but might have to do with siting and depth of the bore hole as well as surface storage facility.

Nutritional status had no significant effect on the prevalence of intestinal parasitic infection among the study population. This is contrary to the findings in several earlier studies,[23-25] where malnutrition has consistently been found to be associated with higher prevalence of intestinal parasites. Intestinal parasitic infections have been said to exert a very heavy toll on the nutritional status of children through increased metabolic rate, anorexia and diarrhoea among other things hence contributing to undernutrition[26]. The reason why we could not demonstrate similar relationship between malnutrition and intestinal parasitic infection in this work is not clear.

Deworming was significantly associated with lower prevalence of intestinal parasites among the study population affirming the fact that intermittent use of anthelminthic remains an important and effective control measure. Palatty *et al*[27] in 2015 also demonstrated a significant reduction in prevalence of intestinal parasites among Indian school children following Government sponsored 6 monthly deworming programme but however, noted that anthelminthic chemoprophylaxis alone is unlikely to control the scourge due to its multifactorial nature.

Ascaris lumbricoides was the most frequently isolated helminths in both the public (62.8%) and private (66.7%) schools. While several authors have documented similar parttern[8.9], others have found Hookworms to be the most frequently isolated helminths[10,18,19]. This study similar to the earlier studies[8,9] were carried out in the urban centre as opposed to the others [10,18,19] which were studies from rural communities. The reason for the variation in pattern of helminthic isolates in studies from urban centres and those from rural area is not clear but might be due to differences in occupation and behaviour. While majority of inhabitants of rural communities in Nigeria are usually peasant farmers and are more likely to walk bare footed, urban dwellers are predominantly civil servants and traders. Some authors however, have not find any difference in pattern between rural and urban populations.[28]

Conclusion

In conclusion, Intestinal parasitic infestation remains a very common problem among children in urban centres in Nigeria with the highest burden among pupil in the public schools. We recommend incorporation and provision of free anthelminthic to all pupil in public school at the beginning of every term into the school health programme, while addressing the major risk factors in the wider society.

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References

1. WHO Soil-transmitted helminthes. (Updated) 2013. Available at http://www.who.int/intestinal_worms/en/. Accessed on January 2016.
2. Bethony J, Brooker S, Albonico M, Geiger SM, Loukas A, Diemart D, *et al*. Soil-transmitted helminth infections: ascariasis, trichuriasis, and hookworm. *The Lancet, 2006;367 (9521):1521–1532.*
3. Cromton DWT, Savioli L. Helminthiasis for Public Health. USA: CRC Press. 2006
4. Mofid LS, Bickle Q, Jiang J-Y, Du Z-W, Patrick E. Soil-Transmitted Helminthiasis in rural South-West China: Prevalence, intensity and risk factor analysis. Southeast Asia J Trop Med Public Health. 2011;42 (3): 513-526.
5. World Health Organization, "Prevention and control of schistosomiasis and soil transmitted helminthiasis," WHO Technical Report Series 912: i-vi, World Health Organization, Geneva, Switzerland,2002
6. Belyhun Y, Medhin G, Amberbir A. Prevalence and risk factors for soil-transmitted helminth infection in mothers and their infants in Butajira, Ethiopia: a population based study. BMC Public Health. 2010; 10:21
7. Monstresor A, Crompton DWT, Bundy A, Hall A, and Savioli L, Guidelines for the Evaluation of Soil-transmitted Helminthiasis and Schistosomiasis at Community Level, WHO/ CTD/SIP/98.1, World Health Organization, Geneva, Switzerland,1998.
8. Saka MI, Abdulraheem IS, Akanbi AA, Musa OI. Soil-transmitted helminthiasia in Children: Evidence from school based epidemiological study in an urban Nigerian community. *Niger Med pract 2006; 49: 148-153.*
9. Salawu SA, Ughele VA. Prevalence of soil transmitted helminths among school-age children in Ife East Local Govermnet Area, Osun State, Nigeria. *FUTA J Research Sci 2015;1:139-151.*
10. Odinaka KK, Nwolisa EC, Mbanefo F, Iheakaram AC, Okolo S. Prevalence and pattern of soil transmitted helminthic infection among primary school children in a rural community in Imo State, Nigeria. *J Trop Medicine, 2015; Article ID 349439, 4 pages*
11. Ajayi EO, Elechi HA, Alhaji MA. Prevalence of overweight/ obesity among primary school pupils in Urban Centre, Nigeria. *Saudi J Obesity 2015;3:59-65.*
12. National Population Commission of Nigeria. 2006 National Population Census. Maiduguri, Nigeria: National Population Commission of Nigeria; 2006.
13. Thomas H. Understanding Biostatistics. *Mosby Year Book* 1991; 167-181.
14. Debalke S, Worku A, Jahur N, Mekonnen Z. Soil transmitted helminths and associated factors among school children in Government and Private primary school in Jimma Town, Southwest Ethiopia. *Ethiop J Health Sci. 2013;23(3):237-244.*
15. Ogunlesi TA, Dedeke IO, Kuponiyi OT. Socio‑economic classification of children attending Specialist Paediatric Clinic in Ogun State, Nigeria. *Niger Med Pract 2008;54:21‑5.*
16. Centers for Disease Control and Prevention/National Center for Health Statistics. 2000 CDC Growth Chart for the United States: Methods and Development. Vital and Health Statistics, Series 11, No. 246; 2002.
17. Ogwurike BA. Ajayi JA, Ajayi OO. A Comparative Study of Helminthiasis among Pupils of Private and Public Primary Schools in Jos North local Government Area of Plateau State, Nigeria. *Niger Ann Natural Sci. 2010; 10 (1): 28 – 47.*
18. Obiukwu MO, Umeanaeto PU, Eneanya CI, waorgu GO. Prevalence of gastro-intestinal helminths in school children in Mbaukwu, Anambra State, Nigeria. *Niger JParasitol.2008;29(1):15–19.*
19. Ukpai OM, Ugwu CD. The prevalence of gastrointestinal-tractparasitesinprimaryschoolchildreninIkwuano LocalGovernmentAreaofAbiaState Nigeria. *Niger J Parasitol, 2003;24:129–136.*
20. Anuar TS, Salleh FM, Moktar N. Soil- transmitted helminth infections and associated risk factors in three Orang Asli tribes in Peninsular Malaysia. Scientific Reports,2014; doi:10.1038/srep04101.
21. Ilechikwu GC, Ilechukwu CGA, Ozumba AN, Ojinnaka NC, Ibe BC, Onwasigwe CN. Some behavioural risk factors for intestinal helminthiasis in nursery and primary school children in Enugu, south eastern Nigeria. *Niger J Clin Preactice, 2010;13(3):288-293.*
22. Magalhaes RJS, Barnett AG, Clements ACA. Geographical analysis of the role of water supply and sanitation in the risk of helminth infection of children in West Africa. *Porc Natl Acad Sci USA, 2011;108 (50):20084-89.*
23. Adeomi A, Adeoye O, Sabageh A, Adeomi O, Sabageh D. Prevalence of Helminthic Infection and its association with the Nutritional Status of Rural Primary School Children in Osun State, Nigeria. *J Biol Agric Healthcare, 2015;5 (14):122-127.*

24. Francis L, Kirunda BE, Orach CG. Intestinal Helminth Infections and Nutritional Status of Children Attending Primary Schools in Wakiso District, Central Uganda. *Int J Environ Res Public Health 2012; 9: 2910-2921*.
25. Sanchez AL, Gabrie JA, Usuanlele MT, Rueda MM, Canales M, Gyorkos TW. Soil-Transmitted helminth infections and nutritional status in school-age children from rural communities in Honduras. *PLOS Neglected Tropical Diseases, 2013; 7(8):e2378.*
26. Runsewe-Abiodun TI, Olowu AO. Study on Prevalence and Nutrional effect of Helminthic infection in rural children in Nigeria. *Niger Med Pract,2008; 54(1):16–20.*
27. Palatty PL, Peter AL, Rojin TS, Rekha B, Fredy IC. Quantitative assessmet of helminthiasis despite anthelminthic chemoprphylaxis and assessment of contributing factors in school children.*ARC J Pharm Science, 2015;1(3):1-8*.
28. Agbolade OM, Agu NC, Adesanya OO, Odejayi AO, Adigun AA, Adesanlu EB, *et al*. Intestinal helminthiases and schistosomiasis among school children in an urban center and some rural communities in southwest Nigeria. *Korean J. Parasitol. 2007;45 (3): 233-238.*