

GEOHELMINTHIC INFECTIONS AND ASSOCIATED RISK FACTORS AMONG CHILDREN LIVING IN SELECTED SHANTY/BATCHER SETTLEMENTS IN PORT HARCOURT METROPOLIS, RIVERS STATE, NIGERIA

Abstract

Aim: To determine the prevalence of intestinal parasites and their associated risk factors among children living in some selected batcher/shanty settlements in Port Harcourt Metropolis, Rivers State, Nigeria

Study Design: A cross sectional study (Descriptive study).

Place and Duration: The study was carried out in Port Harcourt Metropolis Rivers State Nigeria, between March to September 2015

Methodology: Concentration Method (Sedimentation) was used to examine the stool samples according to Cheesbrough (2005). Questionnaire was also used to assess the associated risk factors

Results: The results showed an overall prevalence of 27.1% of helminths and four soil transmitted helminths were reported, namely *Ascaris lumbricoides* (15.0%), Hookworm (10.9%), *Trichuris trichiura* (1.0%) and *Strongyloides stercoralis* (0.2 %). Multiple parasitic infections were not recorded and result also showed a significant difference in the occurrence of species of geohelminths ($p=0.000$). Children from Diobu II were most infected than those from the other locations and location prevalence showed a significant difference among the seven locations surveyed ($p<0.05$). Males were more infected than females in this study, though there was no significant difference. Children 9 – 10years had the highest number of geohelminths than other groups. However, statistically significant difference occurred among age groups and geohelminthic infections ($p<0.05$). WHO categorization for STH showed that four locations Diobu II, Rukpukwu, Bundu and Diobu III fell in the low-risk category, while Elioizu, Mgbuoba and Rumukalagbor areas were clinic based and thus be treated case by case (individually). Demographic factors such as location, toilet type contributed as risk factors in the acquisition and distribution of geohelminth infections among these children.

Conclusion

Moderate infection was observed with *A. lumbricoides* having the highest occurrence and children living in shanties/batcher in Diobu II had the highest parasitic infections while 9-10 age range recorded the highest prevalence. Sex related prevalence varied greatly in terms of percentage infection within and across the sexes. However, gastrointestinal parasitism was significantly different ($p>0.05$) within the age groups but was not significantly different ($p<0.05$) between the sexes. The study recorded infection with, Investigation showed that the batcher/shanty population was at risk to helminth infections because of poor infrastructure, and poor sanitary habits, among others..

38 **Keywords:** Geohelminths, prevalence, multiple parasitic infections; associated risk factors

39

40 **Introduction**

41 Soil transmitted infections are known to cause great morbidity in endemic areas. Effects of
 42 soil transmitted infections usually result in malnutrition, iron deficiency anaemia,
 43 malabsorption syndrome, intestinal obstruction, chronic dysentery, rectal prolapse,
 44 respiratory complications, poor weight gain, impaired cognition in children (effect on school
 45 performance) and also hinder economic development (Bethony *et al.*, 2006; Godkar and
 46 Godkar 2003). Infections with geohelminths affect virtually all members of a population, but
 47 the most vulnerable groups are the pre-school and school age children (WHO 2004).
 48 According to Ogbe *et al.*, (2002), geohelminth infections remain the second leading cause of
 49 morbidity among children less than 6 years of age in Africa. Infections caused by
 50 geohelminths are associated with poor hygienic habits. These include the indiscriminate
 51 disposal of human and animal faeces. In Nigeria for instance a considerable amount of human
 52 and animal wastes are discharged into water bodies and soil untreated, leading to the
 53 infestation or contamination of water and soil with eggs and larvae of these helminthes. This
 54 therefore increases the probability of contact with faeces laden with geohelminth eggs and
 55 exposes individuals to possible risk of infections which is known to be acquired via the oral
 56 faecal route. Other possible risk factors include lack of safe water source, overcrowding,
 57 poverty, poor residential infrastructure, food prepared under unhygienic conditions, failure to
 58 put on foot wears, presence of ditches that retain water/sewage around the house, lack of
 59 sanitation, improper sanitary habits (not washing the hands after using the toilets), geophagia
 60 (eating of sand) and poor socio-economic status (Bethony *et al.*, 2006). Prevalence of
 61 intestinal helminthes have been studied in different areas of the tropics. With increase in
 62 migration and massive movements of people into Rivers State and their exponential growth,
 63 there is need for more epidemiological information on the prevalence of parasitic infections
 64 including that of the shantie (batcher) where most settle. Similar works have been done by
 65 many researchers, but the batcher and shanty settlements as a study population is still a virgin
 66 area and no study on geohelminths has been done particularly on these area. Also, the need
 67 for documentation of the epidemiological studies of parasitic infections and associated risk
 68 factors of geohelminthic infections among children living in selected shanties (batcher) in
 69 Port Harcourt has become imperative because of paucity of information. This study therefore
 70 was undertaken to provide baseline data for future research and control program in this
 71 direction.

72 **Materials and Methods**

73 **Study area and Populations**

74 The area covered during the study is Port Harcourt, Nigeria. Port Harcourt city is the capital
 75 of Rivers State, Nigeria. It lies between latitudes 4°4' and 7°10'N to longitude 7°55'E of
 76 Greenwich meridians. The metropolitan area covers two large Local Government Areas (Port
 77 Harcourt City Local Government and Obio/Akpor Local Government Area). Total mean
 78 temperature in Port Harcourt is 30°C, with a relative humidity between 80% and 100% and a
 79 mean annual rainfall of 2300mm. Children aged between <1 – 10years residing in batcher or
 80 shanties in selected communities/towns were used for this investigation. This study was
 81 approved by the Ethical Committee of the University of Port Harcourt.

82 **Sample size and sampling technique**

83 The sample size (n) was estimated using the single population proportion formula (Cochran,
84 1963).
85

$$86 \quad n = \frac{Z^2 \times P(1 - P)}{d^2}$$

87

88 Where P = prevalence of intestinal parasites from previous study,
89 d = margin of error and Z = standard score corresponds to 1.96. This gave a sample size of
90 452. The prevalence rate (p) of intestinal parasites from previous study in the area was 73.3%
91 (Foghi *et al.*, (2014). For the calculation, a 95% confidence interval and a 5% margin of error
92 were used. To minimize errors arising from the likelihood of non-compliance, five percent of
93 the sample size was added giving a final sample size of 452. To select the children, the
94 students were stratified according to their educational level (grade 1 to grade 8).
95

96 **Sampling technique:** A cluster sampling technique was used in selecting the study subjects.
97 A simple random technique by means of balloting was used to select six (6) towns out of the
98 forty (40) major towns making up urban Port Harcourt City. Rumuibekwe and Old GRA
99 were among the towns selected from the first balloting but because the areas do not have
100 enough batcher and shanty settlements to support this study, they were dropped and a second
101 balloting was conducted. The final six towns selected through balloting were Rumukalagbor,
102 Diobu, Elioza, Mgbuoba, Rukpokwu and Bundu Water Front. Batchers and shanties were
103 then sourced for among the towns selected in the study area. A total of 452 stool samples
104 were to be collected for this survey, but not all the children returned their bottles for analysis.

105 **Specimen collection:** Four hundred and fourteen stool samples were collected randomly
106 from pre-school and school aged children between the ages of <1 and 10 years from different
107 locations in Port Harcourt city between March 2015 to September 2015. The procedure for
108 introducing stool into the bottle was thoroughly explained. Questionnaire was used to assess
109 the associated risk factors while stool samples were collected into a clear, transparent, wide
110 mouthed bottle. The name, age and sex of the patients were properly labeled on the universal
111 bottles containing the samples. Each of the stool specimens was examined both
112 macroscopically and microscopically using saline preparation, Logo's Iodine and Formal
113 ether concentration techniques as described by Cheesbrough, 2005. The samples were
114 examined in batches in order of their collection and the parasite species were identified based
115 on the characteristics of their egg shape, larvae and other morphological features using the
116 identification key of Cheesebrough 2005.

117 **Data Analysis**

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119 Statistical analysis was carried out by ANOVA and Chi-square test using SPSS software
120 version 20, and P value of <0.05 was considered significant at $p < 0.05$.
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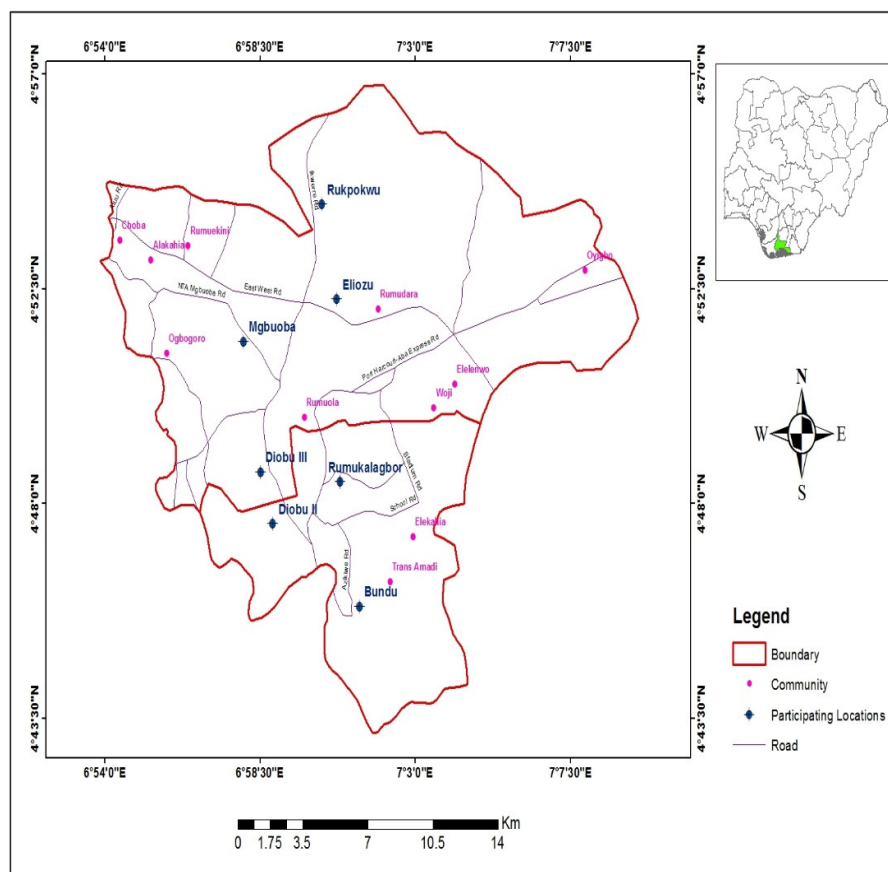


Fig.1.1 Port Harcourt Metropolis showing study area

Data Analysis.

Data on stool specimens were stratified according to age and sex and was analysed using standard statistical tests, including Chi-squared tests. Values were considered statistically significant at $p < 0.05$

RESULTS

A total of 452 children were surveyed, out of which 414 returned stool samples for analysis giving the response rate as 91.6%, comprising 206 (49.8%) males and 208 (50.2%) females. Out of a total of 414 students examined, 112 (27.1%) were infected with one or more of the intestinal parasites. A total of four geohelminth infections were encountered. These parasites include *Ascaris lumbricoides*, Hookworms, *Trichuris trichiura* and *Strongyloides stercoralis*. Table 1 showed that *A. lumbricoides* had the highest occurrence 62(15.0%), followed by Hookworm 45(10.9%) with *S. stercoralis* 1(0.2%) as the least. Table 2 revealed the prevalence of intestinal helminth parasites by gender shows that 60(29.1%) males were more infected while 52(25.0%) females were infected. This observed difference in prevalence by gender was not statistical significant $\chi^2 = 0.893$, $df = 1$, $p = 0.345$ ($p > 0.05$). The males also had a higher prevalence of Ascariasis 34(16.5%) against 28(13.5%) of the females, and 23(11.2%) of hookworm infection against 22(10.6%) recorded among the females. Infection with *Trichuris* was 2(0.97%) for males, and 2(0.96%) for the female, while the single

infection with *Strongyloides* was recorded among the males 1(0.5%) (Table 2). Distribution of geohelminth infections based on location varied significantly ($\chi^2= 18.940$, $df= 6$, $p= 0.004$). Children from Diobu II had the highest prevalence rate of infection 28(39.4%) when compared with children from other locations, followed by those in Bundu 22(32.4%), Rukpukwu 21(34.4%), Diobu III 17(28.8%), Mgbuoba 8(17.8%), Eliozu 7(14.6%) while Rumukalagbor showed the least prevalence 9(14.5%) of infection with intestinal parasites. Children from Diobu II were infected more with *Ascaris* 15(21.1%) than others, whereas those in Rukpukwu had more of hookworm infections 11(18.0%) than other locations. Strongyloidiasis was recorded in Diobu II 1(1.4%) and was seen as the least occurred helminthes among the children in all the locations (Table 3). Table 4 depicts the age specific prevalence of parasitic infections amongst school children in the study area. Age group 9-10 years had the highest prevalence of 36 (48.0%) followed by those of 7 – 8years of age with 39 (42.9%) and least among the subjects aged 3 – 4years 9 (11.4%). This was also statistical significant difference ($p < 0.05$). Comparing the distribution of parasites within the age groupings, *A. lumbricoides* was most frequent among children aged 7–8years 21(23.1%) followed by age group 9-10 16(21.1%) while Hookworm was highest among age group 9–10 years 18(24.0%). *Strongyloides* infection was observed only in children above 7-8 years as shown in Table 4. Distribution of geohelminthic infections based on the major risk factors associated with the infection showed that children who defaecated on the ground recorded the highest level of prevalence (42.3%) than those with pit latrine (27.1%), water closet (11.9%). *A. lumbricoides*, hookworm and *T. trichiura* were equally most occurring among children with pit latrine while the ground users had *S. stercoralis*. The difference was statistically significant between ($p<0.05$). More so, children who often wash their hands after toilet usage were less infected with geohelminths (6.2%) than those that don't wash hands after toilet use (50.9%) and those who washed occasionally (27.7%). Also, ascariasis, hookworm infections and trichiuriasis were recorded highest among children who don't wash their hands. Statistical analysis also showed a significant difference between hand washing and infections ($p=0.000$). Children who bite fingers regularly had higher infection (62.3%) than the children who bite occasionally (27.0%) and those who don't (13.3%) ($p<0.05$). Finally, children who don't put on footwear were infected more (43.4%) than those who wear occasionally (32.0%) and regularly (18.0%). Also, hookworm infection was highest among children who don't put on foot wears ($p<0.05$) Table 5.

Table 1. Types and occurrence of geohelminth infections amongst children living in selected shanties (batcher) in Port Harcourt

Helminths	No. infected students	Percent of occurrence (n=414)
<i>A. lumbricoides</i>	62	15.0
Hookworms	45	10.9
<i>T. trichiura</i>	4	1.0
<i>S. stercoralis</i>	1	0.2
Total	112	27.1

Table 2. Distribution of geohelminths in relation to sex.

Sex	No. examined	No. infected (%)	Al (%)	Hkw (%)	Tt (%)	Ss (%)	χ^2	p
Males	206	60 (29.1)	34(16.5)	23(11.2)	2(0.97)	1(0.5)	0.893	0.345
Females	208	52 (25.0)	28(13.5)	22(10.6)	2(0.96)	0(0)		
Total	414	112(27.1)	62(15.0)	45(10.9)	4(1.0)	1(0.2)		

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Table 3. Prevalence of Geohelminths among children in the various locations of study.

Locations	No. Examined (%)	No. Infected (%)	Al (%)	Hkw(%)	Tt (%)	s (%)	χ^2	<i>p</i>
Diobu II	71(17.1)	28(39.4)	15(21.1)	10(14.1)	2(2.8)	1(1.4)		
Diobu III	59(14.3)	17(28.8)	9(15.3)	8(13.6)	0	0		
Rukpukwu	61(14.7)	21(34.4)	8(13.1)	11(18.0)	2(3.3)	0		
Bundu	68(16.4)	22(32.4)	13(19.1)	9(13.2)	0	0		
Eliozu	48(11.6)	7(14.6)	6(12.5)	1(2.1)	0	0		
Mgbuoba	45(10.9)	8(17.8)	5(11.1)	3(6.7)	0	0		
Rumukalagbor	62(15.0)	9(14.5)	6(9.7)	3(4.8)		0	18.940	0.004
Total	414(100)	112(27.1)	62(15.0)	45(10.9)	4(1.0)	1(0.2)		

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Table 4. Age prevalence in relation to occurrence of species of geohelminthes

Age group(yrs)	No.examined	No.positive(%)	Al(%)	Hkw(%)	Tt(%)	Ss(%)	χ^2	<i>P</i>
<1 – 2	77	9(11.6)	9(11.7)	0	0	0		
3 – 4	79	9(11.4)	6(7.6)	3(3.8)	0	0		
5 – 6	92	19(20.6)	10(10.9)	9(9.8)	0	0		
7 – 8	91	39(42.9)	21(23.1)	15(16.5)	2(2.2)	1(1.1)		
9 – 10	75	36(48.0)	16(21.1)	18(24.0)	2(2.7)	0	49.132	0.000
Total	414	112(27.1)	62(15.0)	45(10.9)	4(1.0)	1(0.2)		

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Table 5. Risks Factor Assessment of geohelminthes

Variables	Frequency	Al	Hkw	Tt	Ss	Prevalence (%)	χ^2	<i>p</i>
Toilet type								
Pit latrine	288	43	32	3	0	78 (27.1)		
Water closet	42	3	2	0	0	5 (11.9)		
Ground	54	12	9	0	1	22 (42.3)		
Others	30	4	2	1	0	7 (23.3)	10.221	0.017
Hand washing								
Regularly	178	6	5	0	0	11 (6.2)		
I don't	153	41	33	4	0	78 (50.9)		
Occasionally	83	15	7	0	1	23 (27.7)	79.762	0.000
Finger biting								
Regularly	53	20	12	1	0	33 (62.3)		
I don't	135	11	7	0	0	18 (13.3)		
Occasionally	226	31	26	3	1	61 (27.0)	46.174	0.000
Footwear								
Regularly	189	25	7	2	0	34 (18.0)		
I don't	53	8	13	1	1	23 (43.4)		
Occasionally	172	29	25	1	0	55 (32.0)	17.154	0.000

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196 **DISCUSSION**

197 It is evident from the results that geohelminth infections are still prevalent and continue to
 198 constitute a major public health problem in Port Harcourt especially those residing in
 199 “batchers”. The overall prevalence of geohelminths among children living in some selected
 200 batcher settlements in seven localities in Port Harcourt Metropolis was 27.1%, this is a
 201 pointer to the fact that the urban area still harbours these parasites. This is higher compare to
 202 the work of Odu *et al.*, (2013), who observed 15.7% prevalence in Port Harcourt among
 203 primary school children in Urban and semi urban areas. Findings showed that children living
 204 in batcher houses usually have poor hygienic conditions and low socio-economic status. In
 205 this study, geohelminths detected included: *A. lumbricoides*, Hookworms, *T. trichiura* and *S.*
 206 *stercoralis*. These helminths have been reported and their deleterious effects known in
 207 various parts of Nigeria, It confirms the triad pattern of Ascaris – Hookworm – Trichuris
 208 infections common in most rural communities in Africa (Obiamiwe *et al.*, 1990). This can be
 209 compared favourably with the work done by Nduka *et al.*, 2006, Ajero *et al.*, 2008,
 210 Chukwuma *et al.*, 2009, Odu *et al.*, 2010, 2011, Eze and Onoja 2016. This is expected
 211 considering the differences in the study age groups, environmental contamination and degree
 212 of over-crowding seen among the batcher settlers. According to Pullan *et al.*, (2010) global
 213 estimation of geohelminthic infections are: *A. lumbricoides* > *T. trichiura* > Hookworm in
 214 this order. The high prevalence of *A. lumbricoides* in this study agreed with most findings
 215 done within and outside Rivers State. It established previous reports of Okonko *et al.*, (2009),
 216 Alli *et al.*, (2011), Odu *et al.*, (2013), Gimba and Dawam (2015). Nigerian Report on
 217 Epidemiological Mapping of Schistosomiasis and Soil Transmitted Helminthiasis (WHO,
 218 2015) put ascaris prevalence to be 42.0%. This could be as a result of the longevity of ascaris
 219 eggs which can survive up to 15 years under favourable conditions (O’Lorcain and Holland,
 220 2000). Eggs of Ascaris could also spread through agents of flood and thereafter be distributed
 221 to other areas devoid of infection (Obiamiwe and Nmorsi 1990; Mordi and Ngwodo 2007).
 222 However, the prevalence of hookworm infection in this study was significantly higher than
 223 that of trichuris infection. This could be as a result of the practice and the habit of children in
 224 the study area moving about barefooted on soil that could have been possibly contaminated
 225 with deposits of faeces containing hookworm eggs; as children were observed defecating in
 226 the open on their play ground during the survey. Indiscriminate disposal of sewage and poor
 227 sanitary habits are key factors to acquiring hookworm infection. Hookworm prevalence in
 228 this study was recorded as 10.9%. This was expected, particularly in highly overcrowded,
 229 polluted and low housing settings in the batcher environment where chances of infection with
 230 the helminths are unavoidable. The relatively low prevalence of hookworm observed here
 231 agrees with previous findings of Odu *et al.*, (2013), Alli *et al.*, (2011a), and Tengku *et al.*,
 232 (2014). However, this finding was very low when compared to the 46.9% prevalence
 233 recorded by Tilahun *et al.*, (2015), 42.7% and 73.6% hookworm prevalence reported by
 234 Chukwuma *et al.*, (2009), Eze and Onoja (2016) respectively. In this study, the males
 235 showed higher prevalence (29.1%) compared to the females (25.0%), this finding is in line
 236 with work done by Awolaju and Morenikeji (2009), Nkengazong *et al.*, (2009), Ihesiulor *et al.*,
 237 (2013). Children from Diobu II had higher prevalence rate followed by Bundu Water
 238 Front, the high prevalence rate in some locations could be indicative of a low sanitary habits
 239 and lack of good personal hygiene among residents in those locations, and of course the
 240 habit/illiteracy level of most parents on de-worming their children/wards as at when due
 241 (impact of de-worming) Odu *et al.*, (2011). Children who defaecate on the ground, had higher
 242 prevalence (42.3%) than those with other toilet types. According to Adebote *et al.*, (2005)
 243 that poor personal hygiene, environmental sanitation and indiscriminate defaecation are
 244 responsible for the spread of geohelminthic infections. It should also be known that the

topography, ecology, environmental sanitation and life style may vary among locations. As a result, risk factors for geohelminthic infection in one location may not be the same or may not be determinant in other locations.

CONCLUSION

The findings of this study showed that the following geohelminths: *A. lumbricoides*, Hookworms, *T. trichiura* and *S. stercoralis*, are still prevalent among children living in Port Harcourt Metropolis. The prevalence of these helminths among children living in this study area supports earlier observations that soil transmitted helminths constitute a major health problem in Nigeria. Investigation showed that the batcher/shanty population was at risk to helminth infections because of poor infrastructure, and poor sanitary habits, among others. Hence, their knowledge about geohelminths should be adequately improved. Interventions such as clean water supply, sanitation exercise, health education, good sewage management, and improved living conditions have been proven to effectively reduce infections due to geohelminths and must be adopted. The periodic mass de-worming exercise of children as recommended by WHO, was therefore recommended.

CONSENT AND ETHICAL APPROVAL

The study protocol was approved by the Research and Ethical Committee of the University of Port Harcourt. Informed written consent was obtained from the parents/caregivers of each child investigated, before the subjects were enrolled in the study.

REFERENCES

- Ajero C.M, Nwoko B.E.B, Nwoke E.A, Ukaga C.N (2008). Human Amaebiasis: Distribution and burden and the Nigeria Environment. *International Science Research Journal*; 1(2):130-134.
- Alli J.A, Kolade A.F, Okonko I.O, Nwanze J.C, Dada V.K, Ogundele M, Oyewo A.J (2011). Prevalence of intestinal nematode infections among pregnant women attending antenatal clinic at the University College Hospital Ibadan, Nigeria. *Advances in Applied Science Research*. 2(4):1-13.
- Awolaju B.A, Morenikeji O.A (2009). Prevalence and intensity of intestinal parasites in five communities of Southwest Nigeria. *African Journal of Biotechnology* 8(18): 4542-4546.
- Bethony J; Brooker S; Albonico M; Geiger SM; Loukas A; Diemert D; Hotez PJ (2006). Soil-transmitted helminth infections: Ascariasis, Trichiuriasis and hookworm. *Lancet* 367:1521-1532.
- Cheesbrough M. (2005). *District Laboratory Practice in Tropical Countries*. Second Edition Updated. Cambridge University Press ISBN: 9780511581304.
- Chukwuma M.C, Ekejindu I.M, Agbakoba N.R, Ezeagwuna D.A, Anaghalu I.C, Nwosu D.C (2009). The Prevalence and Risk Factors of Geohelminth Infections among Primary School Children in Ebenebe Town, Anambra State Nigeria. *Middle-East Journal of Scientific Research* 4(3): 211-215.

- 287 Eze, Chinwe N. and Onoja Helen: (2016) High Intestinal Parasitic Diseases among Fulani
288 Pastoralists in Rivers State South South Nigeria. *International Journal of Current*
289 *Research Vol. 8, Issue, 08, pp.35507-3551,*
- 290 Foghi B.O, Eze N.C, Nzeako S.O (2014). Helminthiasis in School Aged Children In a
291 Selected Population in the Niger Delta. *International Journal of Tropical diseases and*
292 *health. 4(7): 793-801.*
- 293 Gimba U.N, Dawam N.N (2015). Epidemiological status of intestinal parasitic infection rates
294 in children attending Gwagwalada Township Clinic, FCT-Abuja, Nigeria. *American Journal*
295 *of research communication, 3(2): 97-110. www.usa-journals.com, ISSN: 2325-4076.*
- 296 Godkar P.B, Godkar D.P (2003). A Text Book of Medical Laboratory technology, 2nd edition,
297 India: Bhalani Publishing House. 921- 928.
- 298 Ihesiulor G.U., Kashibu E., Azeez-Akande O., Imoru M. (2013). Helminths of the
299 gastrointestinal tract among children in Kano, Northern Nigeria. *Asian Journal of*
300 *Biological and Life Sciences. 2(2):*
- 301 Mordi R.M, Ngwodo P.O.A (2007). A study of blood and gastrointestinal parasites in Edo
302 State. *African Journal of biotechnology, 6(19): 2201 - 2207*
- 303 Ndamukong K.J, Ayuk M.A, Dinga J.S, Akenji T.N, Ndiforchu V.A (2000). The pattern of
304 soil transmitted nematode infections in Primary School Children of Kumba Health
305 District, South-West Cameroon. *African Journal of Health Sciences, 7(3-4):103-106.*
- 306 Nduka F.O, Nwaugo V.O, Nwachukwu N.C (2006). Human intestinal parasite infections in
307 Ishiagu lead mining area of Abia State: *Animal Research International Journal, 3 93;*
308 *505-507.*
- 309 Nkengazong L, Njiokou F, Teukeng F, Enyong P, Wanji S. (2009). Reassessment of
310 endemicity level of urinary schistosomiasis in Kotto-Barombi Focus
- 311 O' Lorcaín P, Holland C.V, (2000). The public health importance of *Ascaris lumbricoides*
312 *Parasitology: 121:S51-S71.*
- 313 Obiamiwe B.A, Nmorsi P (1990). Human gastrointestinal parasites in Bendel State, Nigeria.
314 *Angew Parasitology: 32; 177 - 183.*
- 315 Odu N.N, Maxwell S.N, Nte A.R, Akujiobi C.O (2010). Helminthiasis among School
316 Children in Rural Communities of Rivers State Nigeria. *Nigeria Journal of*
317 *Microbiology; 24(1):2219-223.*
- 318 Odu N.N, Okonko I.O, Erhi O. (2011a). Study of neglected tropical diseases (NTDs):
319 Gastrointestinal Helminths among School Children in Port Harcourt, Rivers State,
320 Nigeria. *Report and opinion, 3(9): 6-16.*
- 321 Odu N.N, Elechi I.V, Okonko I.O (2013). Prevalence of intestinal helminthes infection
322 among Primary School children in urban and semi-urban areas in Port Harcourt, Rivers
323 State, Nigeria. *World Rural Observations. 5(1):52-61*
- 324 Ogbe M.N, Edet E.E, Isichel N.N (2002). Intestinal Helminth Infection in Primary School
325 Children in areas of operation of Shell Petroleum Development Company of Nigeria
326 (SPDC), Western Division in Delta State. *The Journal of Parasitology 23:3-10.*
- 327 Okonko I.O, Soleye F.A, Amusan T.A, Mejeha O.K, Babalola E.T, Adekulurejo O.A (2009).
328 Detection and Prevalence Intestinal Parasites in Patients in Abeokuta South Western
329 Nigeria. *World Applied Science Journal 7(9):1183-1187.*

- 330 Tengku, S.A, Fatmah M.S, Norhayati M. (2014). Soil Transmitted Helminth Infections and
 331 Associated Risk Factors in three Orang Asli Tribes in Peninsular Malaysia. Scientific
 332 Reports 4, Article number: 4101 doi:10.1038/srep04101.
- 333 Tilahun A, Abraham D, Berhanu E. (2015). Soil Transmitted Helminth Infections and
 334 Associated Risk Factors among school children in Durbete Town, North Western
 335 Ethiopia. *Journal of Parasitology Research* 2015, Article ID 641602, 5 pages.
 336 <http://dx.doi.org/10.1155/2015/641602>.
- 337 WHO (2004). Prevention and control of schistosomiasis and soil transmitted helminthiasis.
 338 CDS/CPE/PVC/2004.9