Advance Research in Agriculture and Veterinary Science
Adv. Res. Agri. Vet. Sci. Vol. 1, No. 1, 2014: 24-30
Academy for Environment and Life Sciences, India
Available at www.aravs.org

ORIGINAL ARTICLE

HETEROGENEITY IN MORPHOMETRIC PARAMETERS STUDIES OF *ASCARIS LUMBRICOIDES* IN RELATION TO ITS EFFECTS IN INFECTED PRIMARY SCHOOL CHILDREN IN THREE LOCAL GOVERNMENT AREAS OF OGUN STATE, SOUTH-WESTERN NIGERIA

Agbeyangi OA*[1], Sam-Wobo SO[1], Mafiana CF[2], Ajayi JB[3], Agbeyangi AO[4]
1- Department of Biological Sciences, University of Agriculture, Abeokuta Nigeria
2- Executive Secretary Office, National University Commission, Abuja, Nigeria
3- Department of Science Laboratory Technology, ICT Polytechnic Igbesa, Nigeria
4- Department of Computer Science and Engineering, Obafemi Awolowo University Ile-Ife, Nigeria

KEYWORDS
Ascaris,
Morphometric,
Length,
Weight,
School Children,
Nigeria.

Article History:
Received on
13 Jan 2014

Accepted on
27 Jan 2014

Published on
10 Feb 2014

ABSTRACT: Morphometric studies were carried out on Ascaris lumbricoides recovered after Antihelminthic Levamex (400 mg Levamisole) treatment of 960 school children in Ewekoro, Ado-odo-Ota and Ogun- Waterside Local Government of Ogun State, Nigeria. 986 worms were expelled, of which 613 (62.17%) were female worms and 373 (37.83%) were male worms. An overall average maximum length of 39.70 cm and weight of about 10.37 g and an average minimum length of 8.50 cm and weight of about 0.16 g were obtained. Total mean length and weight were obtained as 8.8 ± 3.14 and 10.13 ± 5.52 for female worms, and 5.33 ± 2.98 and 6.38 ±4.56 for male worms, respectively in all the three local governments. Analysis of variance ($P < 0.05$) revealed a significant difference in the measurement by length and weight of female and male Ascaris across the three local governments. The pattern of frequency distribution of length and weight showed a high length and weight measurement class between 12.00 and 23.99 cm and 1.10 and 11.09 g, respectively. This may be responsible for physical effects, such as diarrhoea, abdominal pains, nausea and loss of appetites. However, high frequency of measurement observed across the local government areas of Ogun State may be due to health status, low level of hygiene, socio-cultural activities and occupation of people in these local government areas.

INTRODUCTION

Gastrointestinal heliminthasis constitute a major health problem in developing countries, including Nigeria, and remain among the most prevalent of human infection being responsible for much morbidity and some mortality (Ogbe and Adu, 1990; Agi, 1995; Adefioye *et al.*, 2011; Odu *et al.*, 2011a; Odu *et al.*, 2013). *Ascaris* is even at present one of the important helminthiasis all over the world (WHO, 2006).

Two primary factors in maintaining endemicity of intestinal helminthes infections are favourable quantities of the soil and frequent contamination of the environment by human faeces (Sam-Wobo *et al.*, 2005; Jimenez-Gonzalez *et al.*, 2009; Odu *et al.*, 2011b; Emmy-Egbe *et al.*, 2012). Transmission within the community is predominantly related to human habits with regards to eating, defecation, personal hygiene, cleanliness and level of education (Ibidapo and Okwa, 2008; Chijioke *et al.*, 2011).

Ascariasis has been known to be responsible for physical effects which may include diarrheoa, abdominal pains, nausea, loss of appetites and even migratory larvae that causes hemorrhage (Edungbola and Obi, 1992). Previous studies on association of *Ascaris* infection in relation to diarrheoa, abdominal pains, nausea, loss of appetites and other physical effects among school children in Nigeria have been reported by Mordi and Ngwodo, (2007); Ajero *et al.*, (2008); Okolie *et al.*, (2008); Chukwuma *et al.*, (2009); Awolaju and Morenikeji, (2009); Alli *et al.*, (2011a); Alli *et al.*, (2011b); Odu *et al.*, (2011a); Odu *et al.*, (2011b); Odu *et al.*, (2013).

Corresponding Author: Agbeyangi OA, Department of Biological Sciences, University of Agriculture, Abeokuta Nigeria. **E-mail:** oagbeyangi@yahoo.com

Many effective control measures have provided substantial benefits in reducing the abundance with an affordable chemotherapy (Albendazole, Membendazole and Levamisole) (Sam-Wobo and Mafiana, 2005; WHO, 2006; Odu *et al.*, 2011a; Usip *et al.*, 2013).

The prevalence and incidence of *Ascaris* is much higher than other intestinal helminthes, *Trichuris trichuria*, hook worms which are more common in mixed infection (Mafiana *et al.*, 1998; Okonko *et al.*, 2009; Alli *et al.*, 2011a; Sam-Wobo, *et al.*, 2012; Alo *et al.*, 2013; Atting *et al.*, 2013; Banjo *et al.*, 2013; Lorina, 2013; Usip *et al.*, 2013). Observations from field data in the range of geographically distinct human communities showed that variability depends on the level of infection in the community and geographical differences in the host or parasite population, which suggest that there is no statistical significant difference between males and females to intestinal helminthes infection (Mafiana, 1995; Agbolade *et al.*, 2004; Sam-Wobo and Mafiana, 2005).

The homogeneity of the size of individual worms found in heavy *Ascaris* infections in humans has led to the hypothesis that newly acquired worms cannot mature while there is an established worm burden present in the gut that interfere with further recruitment of juveniles.

Reports have shown that length and weight of *Ascaris* depend on the rate of infection, re-infection, number of treatment time and type of chemotherapy such children are exposed to (Forrester and Scott, 1990; Fashuyi, 1992).

Studies have revealed that morphometric parameters have an adverse effect on nutritional status, physical, cognitive, educational and societal development of the school children (Forrester and Scott, 1990; Sam-Wobo *et al.*, 2005; Sam-Wobo *et al.*, 2007, Sam-Wobo *et al.*, 2008; Prosper *et al.*, 2014). Therefore, there is a necessity for provision of antihelminthic drugs, preventive measures and control against helminthiasis among school children since they are at risk of *Ascaris* infection.

The main objective of this study was to compare the relationship between morphormetric features among sexes in relation to their effect on the pupils

MATERIALS AND METHODS

2.1. Study Area

The study areas are three local government areas of Ogun State, Nigeria, which are selected based on their soil physio-chemical properties (Mafiana *et al.*, 1998; Sam-Wobo and Mafiana, 2005) (Ewekoro, Ado-odo-Ota and Ogun-Waterside); a tropical rain forest zone lies approximately between longitude 2 30'W and 4 30'E, latitude 6 30'S and 8 N. It is bounded in the south partly by the Atlantic Ocean and sharing common boundaries with Oyo and Ondo States. It has an area of 16,369 square/km with population of about 7.5 million (2003 census estimation) and are predominantly Yoruba speaking tribe of Nigeria whose traditional occupations are farming and commerce. The study areas were mapped using the soil-geographical map of Ogun State (Mafiana *et al.*, 1998) (Figures 1 and 2).

Figure 1: Map showing Ogun State (in red), Nigeria.

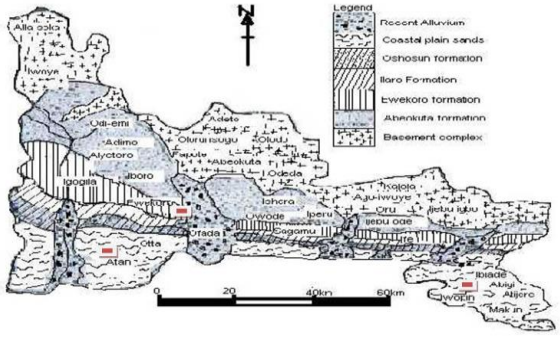

Figure 2: Soil-geographical map of Ogun State showing the selected three local government areas of Ogun State, Nigeria.

2.2. Ethical Consent and Approval

Ethical consideration for the study were also observed, consent and approval were obtained from the State Primary School Education Board. Letters were thereafter issued to officials of the Local Government Education Authority in the local government areas, and the head teachers of the selected primary schools for cooperation and assistance during the course of the research study. Parental consents were obtained through the school from Parents/Teachers Association, and the school children consents through interactive sessions facilitated by the head teacher of each school.

2.3. Sample population

A total population of 960 pupils which comprised children of four years of age and above (primary 1 to 5 pupils) in the three local government areas were used. Four schools were selected from each local government with a total population of 80 pupils sampled in each school to make a total of 320 pupils from each local government. The study was conducted between 2003 and 2005.

The selected schools sampled in each local government are as follow:

- *Ewekoro Local Government*:
- Baptist Central Primary School, Wasimi, Ogun State
- All Saint Anglican Primary School, Itori, Ogun State
- Saint Michael Anglican Primary School, Wasimi, Ogun State
- Baptist Day Primary School, Egbesi, Ogun State
- *Ado-Odo-Ota Local Government:*
- Saint Michael Anglican Primary School, Ota, Ogun State
- Saint James Primary School, Ota, Ogun State
- All Saint Anglican Primary School, Ado-Odo, Ogun State
- Ansar Ur Deen Primary School Ado-Odo Ogun State
- *Ogun Water-Side Local Government*:
- Saint Michael Anglican Primary School, Ibiade, Ogun State
- Saint Thomas Anglican Primary School, Abigi, Ogun State
- Muslim Primary School, Abigi, Ogun State
- Local Government Primary School, Makun-Omi, Ogun State

2.4. Treatment and worm examination

A broad-spectrum Antihelminthic Levamex (containing 40 mg of Levamisole, manufactured by UNIBIOS Laboratories Ltd, India) was administered to all respondents in the study in accordance with manufacturer's instructions (dosage based on age). The pupils were made to take the drug in our present and they were each given a labelled screw cap plastic container of about 1.5 L with an instruction to pass all stools for the next 24 to 48 h. The stools passed within 24 to 48 h of treatment were collected, preserved with 10% formalin and transported to the University of Agriculture, Abeokuta, Ogun State, Nigeria. Examination of worm was by flushing the stool with running water through sieve. The worms present were sorted into sexes, young and adult, and were counted and recorded. Before fixing the worms in 10% formalin, the length (cm) and weight (g)

were taken and characterized into young and adult worms using the measurement criteria of (Sam-Wobo *et al.*, 2008).

2.5. Data analysis

Data recorded were analyzed using SPSS Version 16. The worms were classified into sexes, young and adult, and the measurement of length and weight of worms were taken. Analysis of variance (ANOVA) was used to compare the measurement by length and weight of female and male worms in all the three local government areas.

RESULTS

Morphometric studies of *Ascaris lumbricoides* expelled by the pupils showed that out of the 986 worms expelled, 613 (62.17%) were female worms, 373 (37.83%) were male worms (Table 1). Of the 613 female worms expelled, 60 (59.41%) were young and 553 (62.49%) were adult female worms, and of the 373 male worms expelled, 41 (40.59%) were young and 332 (37.51%) were adult male.

Table 1: Percentage of female and male worms, young and adult male and female worm expelled.

Local government	Total worm		Young worm		Adults worm	
	Female (%)	Male (%)	Female (%)	Male (%)	Female (%)	Male (%)
Ewekoro	88 (57.89)	64 (42.11)	4 (44.40)	5 (55.60)	84 (58.70)	59 (41.30)
Ado-odo-Ota	35 (63.64)	20 (36.36)	21 (0.00)	0 (0.00)	33 (62.30)	20 (37.30)
Ogun-Waterside	490 (62.90)	289 (37.10)	54 (60.00)	36 (40.00)	436(63.30)	253 (36.70)
Total	613 (62.17)	373 (37.83)	60 (59.41)	41 (40.59)	553 (62.49)	332 (37.51)

The weight and length profile of the worms are presented in Tables 2 and 3. An overall average maximum length (cm) and weight (g) of about 39.70 cm and 10.37 g, respectively were obtained from the length and weight measurement profile from the study with highest maximum length (cm) and weight (g) of about 46.00 cm and 13.60 g obtained in Ogun-Waterside, others are, 37.00 cm and 8.20 g in Ewekoro, and 36.00cm and 9.30 g in Ado-odo-Ota. Also, an overall average minimum length (cm) and weight (g) of about 8.50 cm and 0.16 g, with lowest minimum length (cm) and weight (g) of about 4.00 cm and 0.01 g in Ogun-Waterside, others are 10.30 cm and 0.09 g in Ewekoro and 12.10 cm and 0.38 g in Ado-odo-Ota.

Table 2: Mean values of length measurement of both female and male worms.

Local government	Maximum length (cm)	Minimum length (cm)	Mean length measurement			
			Female	SEM	Male	SEM
Ewekoro	37.00	10.30	3.70 (4.48)	1.62	2.60 (4.04)	1.68
Ado-odo-Ota	36.00	12.10	1.30 (3.13)	1.08	1.00 (2.77)	1.12
Ogun-Waterside	46.00	4.00	20.20 (16.49)	6.73	12.40 (63.30)	6.15
Average Mean	39.70	8.80	8.4 (8.03)	3.14	5.33 (7.30)	2.98
			F = 9.52, P = 0.0002		**F = 7.16, P = 0.0015**	

SEM: Standard error of mean.

The result shows an average total mean length measurement of 8.4 (8.03) ± 3.14 for female worms, 5.33 (7.30) ± 2.98 for male worms for the three local government areas. With respect to each local government, mean length of 3.70 (4.48) ± 1.62 (female) and 2.10 (4.04) ± 1.68 (male) in Ewekoro, 1.30 (3.13) ± 1.08 (female), 1.00 (2.77) ± 1.22 (male) in Ado-odo-Ota and 20.20 (16.49) ± 6.73 (female) and 12.40 (15.08) ± 6.15 (male) in Ogun-Waterside.

Analysis of variance at $P < 0.05$ showed a significant difference in the measurement of length of both female and male worms across the three local government areas as a result of high rate of *Ascaris* infection ($F = 9.52$, $P = 0.0002$ (female worms) and $F = 7.16$, $P = 0.0015$ (male worms).

In Table 3, the values for total mean weight measurement of 10.13 (12.00) ± 5.52 for female worms and 6.38 (10.83) ± 4.56 for male worms across the three local governments are presented. The mean weight obtained in each local government are 4.50 (6.34) ± 2.84 for female worms and 3.20 (6.35) ± 2.84 for male worms in Ewekoro, 1.70 (2.71) ± 1.33 for female worms and 1.00 (2.09) ± 0.94 for male worms in Ado-odo-Ota and 14.94 (24.06) ± 10.79 for male worms and 24.20 (26.96) ± 12.39 for female worms in Ogun- Waterside. Analysis of variance ($P < 0.05$) showed a significant difference in the weight measurement of both female and male worms across the three local governments due to high rate of *Ascaris* infection ($F = 5.03$, $P = 0.01$ (female worms) and $F = 3.79$, $P = 0.03$ (male worms).

Table 3: Mean values of weight (g) measurement of both female and male worms

Local government	Maximum weight (g)	Minimum weight (g)	Mean weight (g) measurement			
			Female	SEM	Male	SEM
Ewekoro	8.20	0.09	4.50 (6.34)	1.62	3.20 (6.35)	2.84
Ado-odo-Ota	9.30	0.38	1.30 (2.71)	1.08	1.00 (2.09)	0.94
Ogun-Waterside	13.60	0.01	24.20 (26.96)	6.73	14.94 (24.06)	10.79
Average Mean	10.37	0.16	10.13 (12.00)	3.14	6.33 (10.83)	4.86
			F = 5.03, P = 0.001		**F = 3.79, P = 0.003**	

SEM, Standard error of mean.

From the data obtained, the pattern of frequency distribution of length (cm) showed that a higher frequency was observed in length measurement (cm) class between 12.00 and 23.99 cm (female = 212 and male = 311) followed by > 24.00 cm (female = 372 and male = 63) and 1.00 to 11.99 cm (female 19 and male =12) as presented in Table 4. Also, pattern of frequency distribution of weight (cm) revealed a high frequency of weight (g) measurement class between 1.10 and 11.09 g (female = 524 and male = 302) followed by 0.01 and 1.09 g (female = 75, male = 81) and > 11.10 g (female = 6, male = 0).

Table 4: Frequency distribution of length and weight class of both female and male worms

Local government	Worm length class (cm)						Worm weight class (g)					
	1.0 1.99		12.00-23.99		>24.00		0.01-1.09		1.10-11.09		>11.10	
	F	M	F	M	F	M	F	M	F	M	F	M
Ewekoro	0	0	29	61	59	3	6	6	83	58	0	0
Ado-odo-Ota	0	0	7	21	24	3	1	4	32	16	0	0
Ogun-Waterside	19	12	176	229	289	57	68	71	409	228	6	0
Total	19	12	212	311	372	62	75	81	524	302	6	0

DISCUSSION

Morphometric studies showed a high degree of heterogeneity in the body size of *Ascaris* within the population recovered following the antihelminthic treatment of the pupils in the study areas. The result reveals highest percentage of female adult worms than male worms as well as young female and male worms, the high number of female adult worm observed across the three local governments' inferred high rate of re-infection of *Ascaris* (Sam-Wobo and Mafiana, 2005). Sam-Wobo *et al.*, (2008) observed in some studies that the high worm burden may not be related to the gender of the individual host, but their weight profile.

Some worms recovered measured up to 46 cm and weighed up to 13.60 g with highest distribution of worm population observed within length range of 12.00 to 23.99 cm and weight range of 1.10 to 11.09g which may be due to one or multiple of the following factors: lack of antihelminthic treatment or de-worming, low availability of sanitary facilities and health education, and development rate of embryonic stage in soil based on the supportive soil physio-chemical properties (Mafiana *et al.*, 1998; Sam-Wobo and Mafiana, 2005; Sam-Wobo *et al.*, 2008).

The frequency distribution revealed a heavier and longer range of female worms than male worms which showed that length and weight range of female worms were significantly heavier and longer than that of male worms and it is related to findings by Fatiregun and Oluwatoba, (2008).

The bulky, heavier and longer worms obtained from the data inferred prevention of juvenile worms, absorption of intestinal wall (haemorrhage) by adult worms, re-infection rate and mal-absorption of nutrient (Sam-Wobo *et al.*, 2005; Stephenson *et al.*, 2000). This may result into an adverse effect on the pupils' intestinal wall as reviewed by Edungbola and Obi, (1992) and Prosper *et al.*, (2014), and can impair physical and mental growth, poor cognitive development as well as nutritional status of children (Hotez *et al.*, 2008).

The length and weight profile, high percentage of female adult worms as well as young female and male worms observed from the study may also have resulted to high frequency distribution of the worm population as observed by Sam-Wobo *et al.*, (2005); Sam-Wobo *et al.*, (2007), Sam-Wobo *et al.*, (2008); Sam-Wobo *et al.*, (2012) and this has increase worm burden which may eventually has effect on their intellectual capability.

In conclusion, the morphometric index could be useful in inferring the nutritional status, physiological and abdominal conditions of the children and could also lend support at interpreting the re-infection pattern of helminthes infection which plays key role in disease epidemiology.

ACKNOWLEDGEMENTS

The authors appreciate the support of the head teachers, parents and pupils of the schools during the study.

REFERENCES

Adefioye OA, Efunshile AM, Ojurongbe O, Akindele A.A., Adewuyi IK, Bolaji OS, Adedokun SA, Adeyeba AO. Intestinal Helminthiasis among School Children in Ilie, Osun State, Southwest, Nigeria. Sierra Leone Journal of Biomedical Research 2011; 3: 36-42.

Agbolade OM, Akinboye DO, Awolaja A. Intestinal helminthiasis and urinary schistosomiasis in some villages of Ijebu North, Ogun State, Nigeria. *Afr J Biotechnol* 2004; 3(3): 206-209.

Agi PI. Pattern of infection of intestinal parasites in Sagbama community of the Niger Delta, Nigeria. West Afri J Med 1995; 14: 39-42.

Ajero CM, Nwoko BEB, Nwoke EA, Ukaga CN. Human Amoebiasis: Distribution and Burden; and the Nigerian Environment. International Science Research Journal, 2008; 1(2): 130–134

Alli JA, Kolade AF, Okonko IO, Nwanze JC, Dada VK, Ogundele M, Oyewo AJ. Prevalence of intestinal nematode infection among pregnant women attending antenatal clinic at the University College Hospital, Ibadan, Nigeria. Advances in Applied Science Research 2011a; 2(4): 1-13.

Alli JA, Okonko IO, Oyewo AJ, Kolade AF, Nwanze JC, Ogunjobi PN, Tonade OO, Dada VK. Prevalence of Intestinal Parasites among Palm Wine Drinkers in Ibadan Metropolis. Researcher 2011b; 3(11): 11-16

Alo M, Ugah U, Elom M. Prevalence of Intestinal Parasites from the Fingers of School Children in Ohaozara, Ebonyi State, Nigeria American Journal of Biological, Chemical and Pharmaceutical Sciences 2013; 1(5): 22 -27

Atting IA, Ukpe IO, Usip LP. The prevalence of excreta-related soil-transmitted helminthiasisand the role of sanitation in its control in primary school children in Uyo Metropolis, Akwa-Ibom State – Nigeria. Research Journal of Agriculture and Environmental Management 2013; 2(11): 341-346

Awolaju BA, Morenikeji OA. Prevalence and intensity of intestinal parasites in five communities in south-west Nigeria. African Journal of Biotechnology 2009; 8(18): 4542-4546.

Banjo TA, Amoo AOJ, Busari A, Kama AC, Lawal IA, Ogundahunsi OA, Olooto WE, Familoni OB, Onilude AA, Mutiu WB, Oyelere KA, Kama G. Intestinal parasites among abattoir workers in Abeokuta. American Journal of Research Communication 2013; 1(10): 84-96.

Chijioke IR, Ilechukwu GC, Ilechukwu G, Okafor CI, Ekejindu IM, Sridhar M. A community based survey of the burden of *Ascaris lumbricoides* in Enugu. Ann Med Health Sci Res 2011; 1: 165-71

Chukwuma MC, Ekejindu IM, Agbakoba NR, Ezeagwuna DA, Anaghalu IC, Nwosu DC. The Prevalence and Risk Factors of Geohelminth Infections among Primary School Children in Ebenebe Town, Anambra State, Nigeria. Middle- East J Scientific Research 2009; 4(3): 211-215

Edungbola LD, Obi AA. A review of human intestinal parasites in Nigeria: Challenges and prospect for integrated control. Nigeria J Parasitol 1992; 13: 27-37.

Emmy-Egbe IO, Ekwesianya EO, Ukaga CN, Eneanya CI, Ajaero CMU. Prevalence of Intestinal Helminthes in Students of Ihiala Local Government Area of Anambra State. Journal of Applied Technology in Environmental Sanitation 2012; 2: 23-30.

Fashuyi SA. The pattern of human intestinal helminth infections in farming communities in different parts of Ondo State, Nigeria. West Afri J Medi 1992; 11(1): 13-17.

Fatiregun AA, Oluwatoba OA. Pattern of intestinal helminth infections among school children in an urban community in Ibadan, Nigeria. Asian Pac J Trop Med 2008; 1: 42-47.

Forrester JE, Scott ME. Measurement of *Ascaris lumbricoides* infection intensity and dynamic of expulsion following treatment. Parasitol 1990; 100: 303-309.

Hotez PJ, Brindley PJ, Bethany JM, King C, Pearce EJ, Jacobson J. Helminth Infections: the great neglected Tropical Diseases. J Clin Invest 2008; 118(4): 1311-1321.

Ibidapo CA, Okwa O. The prevalence and Intensity of Soil Transmitted Helminths in a Rural Community, Lagos suburb, South West Nigeria. International Journal of Agriculture & Biology 2008; 1: 89-92.

Jimenez-Gonzalez DE, Marquez-Rodriguez K, Rodriguez JM, Gonzales X, Oxford J, Sanchez R, Kawa-Karasik S, Flisser A, Maravilla P. Prevalence and risk factors associated with intestinal parasites in a rural community of central Mexico. Journal of Parasitology and Vector Biology 2009; 1(2): 009-012

Lorina IE. Prevalence of Intestinal Helminthic Infection among School Children in Rural and Semi Urban Communities in Nigeria. Journal of Dental and Medical Sciences 2013; 6(5): 61-66

Mafiana CF, Sodipe MB, Koleoso BI. Soil transmitted helminth parasites of humans in a city in South-Western Nigeria, Heiminthlogia 1998; 35(4): 203-208.

Mafiana CF. Intestinal helminthiasis (with particular reference to Ascariasis) among school children in Ilewo-Orile, Ogun State, Nigeria. Nigeria J Parasitol 1995; 16: 47-53.

Mordi RM, Ngwodo POA. A study of bloodand gastro-intestinal parasites in Edo State. African Journal of Biotechnology 2007; 6(19): 2201-2207

Odu NN, Akujobi CO, Maxwell SN, Nte AR. Impact of Mass De-worming of School Children in Rural Communities in Rivers State, Nigeria: Option for Programme Sustainability. Acta Parasitologia 2011a; 2(2): 20-24

Odu NN, Okonko IO, Erhi O. Study of Neglected tropical diseases (NTDs): Gastro Intestinal Helminthes among school children in Port Harcourt, Rivers State, Nigeria. Report and Opinion 2011b; 3(9): 6-16.

Odu NN, Elechi VI, Okonko IO. Prevalence of Intestinal Helminthes Infection among Primary School Children in Urban and Semi-Urban Areas in Port Harcourt, Rivers State, Nigeria. World Rural Observations 2013; 5(1): 52-61

Ogbe MG, Adu OO. Intestinal helmithiasis in an orphanage in Nigeria. Bioscience Res communi 1990; 2(2): 1005-118.

Okolie BI, Okonko IO, Ogun AA, Adedeji AO, Donbraye E, Nkang AO, Iheakanwa CI, Onwuchekwa EC. Incidence and Detection of Parasite Ova in Appendix from Patients with Appendicitis in South-Eastern, Nigeria. World Journal of Agricultural Sciences 2008; 4(S): 795-802.

Okonko IO, Soleye FA, Amusan TA, Mejeha OK, Babalola ET, Adekolurejo OA. Detection and Prevalence Intestinal Parasites in Patients in Abeokuta, South-Western, Nigeria World Applied Science Journal 2009; 7(9): 1183-1187

Prosper O, Ibidapo CA, Okwa OO. Prevalence and Risk Factors of Geohelminthiasis in Umuebu Community, Ukwuani Local Government Area, Delta State, Southern Nigeria . British Journal of Medicine & Medical Research 2014; 4(5): 1175-1186,

Sam-Wobo SO, Asiwaju R, Idowu OA, Eromosele CO, Adeleke MA. Communal evaluation of Intestinal Helminthes in some Guineaworm-Controlled Communities in Ogun State, Nigeria. Journal of Entomology and Nematology 2012; 4(2): 7-11.

Sam-Wobo SO, Mafiana CF, Agwuegbo S, Adebanji AO, Agbeyangi OA, Idowu OA. Incidence of *Ascaris* infection among Primary school children in Ogun State, Nigeria: A generalized Linear Model Approach. Nigeria J Parasitol 2008; 29(1): 32-37.

Sam-Wobo SO, Mafiana CF, Amusan AA. Health-knowledge and hygiene behaviours in relation to Ascariasis among school children in Ogun State, Nigeria. Tanzania Health Res Bulle 2005; 7(2): 62- 66.

Sam-Wobo SO, Mafiana CF, Onashoga SA, Vincent OR. MONRATE: A descriptive tool for calculation and prediction of re-infection of *Ascaris lumbricoides* (Ascaridida: Ascarididae) Rev Biol Trop (Int J Trop Biol) 2007; 55(3-4): 755-760.

Sam-Wobo SO, Mafiana CF. The effects of surface soil physiochemical properties on the prevalence of helminthes in Ogun State, Nigeria. UNZA J Sci Technol 2005; 9(2): 13-20.

Stephenson LS, Latham MC, Ottesen EA. Malnutrition and parasitic helminth infection Parasitol 2000; 121: S23-S38.

Usip L, Patrick E, Nwosu CD. The prevelance of human intestinal helminthes and the efficacy of anthelmentic levamisole drug in Abak Local Government Area of Akwa Ibom State Nigeria Basic Research Journal of Medicine and Clinical Sciences 2013; 2(5): 52-58

WHO Expert Committee Report. Production and control of intestinal parasite infection. Technical report services 2006; pp:749-786.