Asian Journal of Medical Sciences 6(4): 34-39, 2014
ISSN: 2040-8765; e-ISSN: 2040-8773

Submitted: November 06, 2013 Accepted: November 18, 2013 Published: August 25, 2014

Prevalence of Intestinal Parasites among Children in Day Care Centres in Esan West Local Government Area, Edo State, Nigeria

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Abstract: Intestinal parasites are globally endemic, affecting the health, growth and development of children world-wide. The child day care centres are said to be one of the environments where children are potentially exposed to infections. This study aimed to determine the prevalence of intestinal parasites among children in day care centres in Esan West Local Government Area in Edo State, Nigeria and thus confirm whether child day care centres expose children to intestinal parasite infections in the local government area. Stool samples were collected from 80 children (36 males and 44 females), age range 4 months to 5 years from 7 day care centres, after parents or guardians gave their informed consent and filled a structured questionnaire on their wards. The samples were examined macroscopically and then microscopically for parasitic infections using wet preparation and formol-ether concentration technique. Overall prevalence of intestinal parasites in the study was 13.8%. The only protozoon identified was *Entamoeba coli* (2.5%), while the helminthes identified were *Ascaris lumbricoides* (8.8%) and *Trichuris trichiura* (2.5%). Multiple infections (1.3.0%) also occurred in the children. The intestinal parasite infections was highest in age group 2-3 years, 8 (15.7%) and in males, 5 (13.9%). *Ascaris lumbricoides* had the highest prevalence in age group 2-3 years, 6 (11.8%) and in females, 6 (13.6%). The differences in age and sex related intestinal parasites infections were statistically significant ($p<0.05$). Thus, this study indicated that intestinal parasites are prevalent among children in day care centres in Esan West Local Government Area, Edo State, Nigeria.

Keywords: Child health, day care centre, environmental sanitation, hygiene, intestinal parasites

INTRODUCTION

Intestinal parasitic infections caused by protozoa and helminths are globally endemic and have been described as constituting the greatest single worldwide cause of illness and disease (Chan, 1997; Pillai and Kain, 2003). The most common infections in humans are caused by intestinal parasites, which may give rise to intestinal obstruction, malnutrition, iron deficiency anaemia, diarrhoea, malabsorption and other damages to the hosts (Buchini *et al*., 2007). Intestinal parasitic infections have a worldwide distribution with high prevalence found in people with low socio-economic status and poor living conditions as well as people in over-crowded areas with poor environmental sanitation, improper garbage disposal, unsafe water supply and unhygienic personal habits (Adamu *et al*., 2006; Noor-Azian *et al*., 2007). These factors are the causes of a major proportion of the burden of diseases and deaths in developing countries (Adamu *et al*., 2006).

The pathogenic effects of some intestinal parasites are well established, while others may or may not cause symptoms, depending on the host immune status and other factors. Among the protozoa, *Giardia intestinalis* and *Entamoeba histolytica* have been associated with persistent and acute diarrhoea (Utzinger *et al*., 1999; Newman *et al*., 2001). *Giardia intestinalis* is considered to be one of the leading causative agents of diarrhoea in both children (Addy *et al*., 2004; Noor-Azian *et al*., 2007; Dib *et al*., 2008) and adults (Nyarango *et al*., 2008; Ayeh-Kumi *et al*., 2009). It is one of the most common causes of waterborne disease outbreaks associated with drinking water (Bertrand *et al*., 2004; Yoder *et al*., 2007). Pathogenic amoeba, *Entamoeba histolytica* can also be found in young children (Kappus *et al*., 1994; Phiri *et al*., 2000; Okyay *et al*., 2004). This is the most important amoeba of man. This amoeba invades the colonic mucosa, producing characteristic ulcerative lesions and a profuse bloody diarrhoea (amoebic dysentery) (Greenwood *et al*., 2007). In developing countries, diarrhoea causes more than 2.2

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million deaths of children under the age of 5 years (WHO, 2003; Rayan *et al*., 2010).

More than one dozen different species of soil-transmitted helminths infect humans, especially in the tropical and subtropical parts of the developing world. However, four nematodes in particular stand out because of their widespread prevalence and distribution that result in hundreds of millions of human infections It is estimated that globally *A. lumbricoides* infects 1.221 billion people, *T. trichiura* 795 million and hookworms 740 million (De Silva *et al*., 2003). *Strongyloides stercoralis* is also a common soil transmitted helminth in some of these regions, although less common, infecting 10 million people (De Silva *et al*., 2003; Brooker *et al*., 2006). Intestinal obstruction, anaemia, malnutrition, dysentery syndrome, fever, dehydration, vomiting and colitis are the major complications associated with soil transmitted helminths infections (Cooper, 1991). Soil transmitted helminths infections affect most frequently children in developing countries and are associated with poor growth, reduced physical activity and impaired learning ability (Stephenson *et al*., 1990; Nokes *et al*., 1992; Adams *et al*., 1994; Koroma *et al*., 1996; Stoltzfus *et al*., 1996).

MATERIALS AND METHODS

Study area: This study was carried out in selected day care centres in Esan West Local Government Area including Ekpoma, the administrative headquarter of the Local Government Area in Edo State, Nigeria. The area lies between latitudes 6°43' and 6°45' North of the Equator and longitudes 6°6' and 6°8' East of the Greenwich Meridian (Aziegbe, 2006) with a population of 127,718 at 2006 population census (NPCN, 2012). The occupation of the inhabitants includes civil service, trading, transportation, farming and studentship. Eguare, Ujuoelen, Ihumudumu, Uhiele Emaudo and Iruekpen were considered in this study. The samples were examined in the Research and Diagnostic Laboratory, of the Department of Medical Laboratory Science, College of Medicine, Ambrose Alli University, Ekpoma.

Subjects: The participants consisted of 80 children (36 males and 44 females) age ranged 4 months to 5 years from seven day-care centres. Informed consent was obtained from the parents or legal guardians of each child prior to enrolment after a clear explanation. The study was approved by the Department of Medical Laboratory Science of Ambrose Alli University, Ekpoma. Ethical approval was obtained from the university ethics committee and Day care centres authorities.

Sample collection: Clean specimen containers-universal bottles, were given to day care centre workers or parents and instructed on how, when and quantity of early morning stool to be collected from their wards. For each subject, a structured questionnaire was filled by a parent or guardian to ascertain the level of child hygiene and health. Demographics gathered included name, age, sex and day care centres. Samples collected were immediately taken to the laboratory and examined within 1 h of collection.

Examination of the samples: The samples were observed macroscopically for macrosiopc parasites before being mixed with 10% formol-saline (1 g of stool to 7 mL. of formol saline and 3 mL of diethyl ether), centrifuged, upper three layers discarded and the deposit examined for microscopic parasites-cysts, eggs and larvae of the parasites, examining two smears per sample (Cheesbrough, 2006). This method was preferred because it allowed diagnosing both protozoa and helminthes. Logistic limitations prevented the collection of more than one stool sample from each subject.

Statistical analysis: The percentage prevalence (%) was calculated in each case. Comparative analysis of the results was done using two-tailed Chi-square (X^2). A p-value less than 0.05 ($p<0.05$) was considered statistically significant.

RESULTS

Out of the 80 children (36 males and 44 females), age range 4 months-5 years examined, 11 of them were infected by intestinal parasites giving an overall prevalence of 13.8%. Three parasites were identified-*Entamoeba coli* (2.5%), *Ascaris lumbricoides* (8.8%) and *Trichuris trichiura* (1.3%) and infection with more than one parasite (1.3%) (Table 1). The age group 2-3 years had the highest prevalence (15.7%), followed by the age group 4-5 years (12.5%), with the age group ≤1 year having the lowest prevalence (9.5%). The differences in prevalence between the age groups were statistically significant (X^2 = 7.818; df = 2; $p<0.05$) (Table 2). The males were more infected (13.9%) than females (13.6%), though not statistically significant (X^2 = 0.09; df =; $p>0.05$) (Table 3).

The age and sex related prevalence of various types of intestinal parasites shows that infection with the protozoon, *Entamoeba coli*, a commensal was seen in the age group ≤1 year (4.8%) and 2-3 year (2.0%) and also in males (5.6%). Among the helminths, *Ascaris lumbriciodes* has the highest prevalence in the age group 2-3 years (11.8%) and in females (13.6%). Mixed infection (*Ascaris lumbricoides* and *Trichuris trichiura*) occurred only in age group 2-3 year (2.8%) and in males (2.8%). However, the difference in prevalence of various types of parasitic infections according to age was statistically significant (X^2 = 12.67; df = 6;

Table 1: Prevalence of intestinal parasites in stool samples

Intestinal parasites	Number examined	Number infected	Prevalence (%)	X^2	p-value
Protozoa					
G. lamblia	80	0	0.0		
E. histolytica	80	0	0.0		
E. coli	80	2	2.5		
Helminths					
A. lumbricoides	80	7	8.8		
Hookworm	80	0	0.0		
T. trichiura	80	1	1.3		
S. stercoralis	80	0	0.0		
Mixed infection					
A. lumbricoides and *T. trichiura*	80	1	1.3		
Total	80	11	13.8	29.00	0.00

X^2 tab = 24.32; α = 0.05; p<0.05; df = 7

Table 2: Age related prevalence of intestinal parasites in day care centers

Age (years)	Number examined	Number infected	Prevalence (%)	X^2	p-value
≤1	21	2	9.5		
2-3	51	8	15.7		
4-5	8	1	12.5		
Total	80	11	13.8	7.818	0.02

X^2 tab = 7.824; α = 0.05; p<0.05; df = 2

Table 3: Sex related prevalence of intestinal parasites in day care centers

Sex	Number examined	Number infected	Prevalence (%)	X^2	p-value
Males	36	5	13.9		
Females	44	6	13.6		
Total	80	11	13.8	0.09	0.76

X^2 tab = 0.148; α = 0.05; p>0.05; df = 1

Table 4: Age and sex related prevalence of various intestinal parasites

Parameter	Number examined N	Number infected N	*Entamoeba coli* N (%)	*Ascaris lumbricoides* N (%)	*Trichuris trichiura* N (%)	Mixed infection N (%)
Age (years)						
<1	21	2	1 (4.8)	1 (4.8)	0 (0.0)	0 (0.0)
2-3	51	8	1 (2.0)	6 (11.8)	0 (0.0)	1 (2.0)
4-5	8	1	0 (0.0)	0 (0.0)	1 (12.5)	0 (0.0)
Sex						
Males	36	5	2 (5.6)	1 (2.8)	1 (2.8)	1 (2.8)
Females	44	6	0 (0.0)	6 (13.6)	0 (0.0)	0 (0.0)

Age: x^2 cal = 12.67, x^2 tab = 12.59, p = 0.04, Q = 0.05, p<0.05, df = 6; Sex: x^2 cal = 7.543, x^2 tab. = 7.815, p = 0.05, Q = 0.05, p>0.05, df = 3

p<0.05), while that for sex was not statistically significant (X^2 = 7.543; *df* = 3; p>0.05) (Table 4).

Some child day care characteristics were relatively homogeneous in the study area; most daycares had electricity (99.9%) and a Water Closet system (71.4%). Private bore-holes were the main source of water (71.4%); garbage was usually burnt (99.9%). However, the level of hygiene and sanitation among the day care centres corresponded to level of prevalence of intestinal parasites. Child day care centres with the lowest level of hygiene showed the highest rate of prevalence, while day care centres with the highest level of hygiene and sanitation showed zero prevalence.

DISCUSSION

In this study, the overall prevalence of intestinal parasites was 13.8%. This finding is lower when compared with Chirdan *et al*. (2010) who reported a prevalence of 57.8% in Jos, central Nigeria. However, it is in agreement to some extent with Ribeiro (2011), who reported a prevalence of 29.3% in the region of Uberlândia, State of Minas Gerais, Brazil and also with the findings of Boonchai *et al*. (2007) who reported a prevalence of 27.9% of asymptomatic controls (66/236) and 17.4% of symptomatic cases (41/236) in Sangkhlaburi, Thailand, among day care (preschool) children. The low prevalence of intestinal parasitism in this study could be attributed to the level of hygiene and clean environment among the day care centres. High prevalence of intestinal parasitic infection is apt to occur in low socioeconomic conditions, characterised by inadequate water supply and poor sanitary disposal of faeces (Meremikwu *et al*., 1995; Rajeswari *et al*., 1994; Al-Agha and Teodorescu, 2000). The discriminate disposal of human wastes and hygienic way of life might have been predisposing factors, as the children play on a clean ground. The day care centres in this study were located in semi-urban areas with portable water, proper system of refuse and human waste disposal. However, few day care centres lack these factors leading to infection among these day care centres, as the children come in contact with contaminated playing ground. The lower prevalence

obtained could also be attributed to the timing and the geographical differences in the area, as this work was conducted between the months of November-January (dry season, when the soil is usually dry).

Children of the age group 2-3 years were significantly ($p<0.05$) most infected, while the age group ≤1 year were least infected. This is due to the fact that children ≤1 year have less contact with the playing ground. This is in agreement with De Souza *et al*. (2007) who says that "Intestinal parasitism tends to be less prevalent among children under 1 year of age, thereafter reaching a prevalence plateau around 50%, but these age-related differences did not reach statistical significance". This direct relationship between the age and intestinal parasites might be due to decreased exposure of children to soil environment/interaction coupled with the level of cleanness and good hygienic practice in day care centres, as they spend most of their playing time on very clean floors and are well cared for by day care workers and parents. The males were more infected than the females (13.6%), though the difference is not significant ($p>0.05$).

Furthermore, analysis on the type of parasites/infection in relation to age and sex revealed that only (3) organisms were implicated. Among the protozoa, *Entamoeba coli* was significantly ($p<0.05$) highest in the age group ≤1 years. This finding is however in disagreement with the findings of Boonchai *et al*. (2007) who found the proportion of *G. lamblia* to be highest in 2-3 year olds pre-school children in Sangkhlaburi, Thailand and that of Ribeiro (2011) who reported *Gardia lamblia* to be highest in day care centres in preschool children in the region of Uberlândia, State of Minas Gerais, Brazil. It is however important to say that, prevalence estimates derived from the examination of a single stool sample have been considered accurate for most intestinal parasites (Gyorkos *et al*., 1989). However, our estimates for *Giardia lamblia* should be interpreted with caution, since due to the intermittent elimination of cysts, examination of a single sample may underestimate the prevalence of this species. The analysis of three serial stool specimens collected on alternate days has been reported (Garcia, 1999) to increase the detection rate of *Giardia* cysts by about 11%. Therefore, *Giardia* prevalence could be even higher than reported here and can be a serious health problem in children, leading to protein-energy malnutrition (Muniz-Junqueira and Queiroz, 2002).

Helminths were detected more often than protozoa, with only *Ascaris lumbricoides* and *Trichuris trichiura* identified. Infection with *Ascaris lumbricoides* was significantly ($p<0.05$) highest in this study and in the age group 2-3 years, but lowest in the age group ≤1 year. This is in agreement with Chukwuma *et al*. (2009) which say that, "The prevalence of *Ascaris lumbricoides* was significantly increased as the age of the pupils increased". Dada-Adegbola *et al*. (2005) also supported this finding and reported a prevalence of 52.4% for children aged 0-5 years. *Ascaris lumbricoides* infection was also higher in females than in males. The high prevalence of Ascaris infection could be attributed to the fact that *Ascaris lumbricoides* were much higher in their water or food via contamination by Child's parents/guardians, as eggs of *Ascaris lumbricoides* are highly persistent and ubiquitous. This is in line with Bundy *et al*. (1995) and Stephenson *et al*. (1993) who said, *Ascaris lumbricoides* was much common with ingestion of water and food contaminated with *Ascaris lumbricoides* eggs and occasionally via inhalation of contaminated dust. Also similar with Naish *et al*. (2004) who said, ova of *Ascaris lumbricoides* can survive a prolonged period of 10 years under a warm, shady and moist environmental condition which could be a reason for their long constant infection. The danger with ascariasis is that it is intimately related with intestinal obstruction and malnutrition in children. *Trichuris trichiura* infection only occurred in the age group 4-5 year and in males. The prevalence of *Trichuris trichiura* among the age group is however in accordance with that of Adikankwu *et al*. (2012) who reported a prevalence of 2.0% for male with overall prevalence of 1.3%. Hookworm and *Strongyliodes stercorali* infections were not detected, which is suspected to be due to decreased exposure of day care children to the environment. This is in agreement with Boonchai *et al*. (2007) who reported that they did not identify hookworm in any of the 472 stool samples analyzed among pre-school children.

CONCLUSION

Despite the fact that the prevalence rates of intestinal parasites in this study were considerably lower than prevalence rates observed in similar studies conducted in other regions, the rates of the infections are however of public health significance. The occurrence of intestinal parasites among children in day care centres (preschool) can cause chronic infections which can negatively affect all aspects of childrens' health, nutrition, cognitive development, learning and educational access and achievement.

This prevalence although low is directly related to the sanitary conditions, socioeconomic status, education level, the age and hygienic habits among the day care centres in relation to the children. Thus, necessary sanitary policies, awareness, screening and de-worming exercises and occasional check of intestinal parasites among children in child day care centres are recommended.

ACKNOWLEDGMENT

Our gratitude goes to the Almighty God for His care during the study, the children, parents and workers at the child day care centres for their cooperation. We also appreciate Mr. Akhile, A. and staff of the Medical Research and Diagnostic Laboratory, Department of Medical Laboratory Science, College of Medicine, Ambrose Alli University, Ekpoma for their assistance.

REFERENCES

Adams, E.J., L.S. Stephenson, M.C. Latham and S.N. Kinoti, 1994. Physical activity and growth of Kenyan school children with hookworm, *Trichuris trichiura* and *Ascaris lumbricoides* infections are improved after treatment with albendazole. J. Nutr., 124: 1199-1206.

Adamu, H., T. Endeshaw, T. Teka, A. Kife and B. Petros, 2006. Prevalence of intestinal parasites. Ethiop J. Health Div., 20(1): 39-47.

Addy, P., G. Antepim and E.H. Frimpong, 2004. Prevalence of pathogenic Escherichia coli and parasites in infants with diarrhoea in Kumasi, Ghana. E. Afr. Med. J., 81(7): 353-357.

Adikankwu, O.R., O.O. Odikamnoro, A.C. Uhuo and A.C. Nwuzo, 2012. The prevalence of intestinal nematode in school children in ebonyi local government area, Ebonyi state, Nigeria. Cont. J. Biomed. Sci., 6(1): 13-17.

Al-Agha, R. and I. Teodorescu, 2000. Intestinal parasites infections and anaemia in primary schools children in G29 Gonernorates Palestine. Roum. Arch. Microbiol. Immunol., 59(1-2): 131-143.

Ayeh-Kumi, P.F., S. Quarcoo, G. Kwakye-Nuako, J.P. Kretchy, A. Osafo-Kantanka and S. Mortu, 2009. Prevalence of intestinal parasitic infections among food vendors in Accra, Ghana. J. Trop. Med. Parasitol., 32(1):1.

Aziegbe, F.I., 2006. Sediment sources, redistribution and management in Ekpoma, Nigeria. J. Hum. Ecol., 20(4): 259-268.

Bertrand, I., C. Gantzer, T. Chesnot and J. Schwartzbrod, 2004. Improved specificity for Giardia lamblia cyst quantification in wastewater by development of a real-time PCR method. J. Microbiol. Meth., 57(1): 41-53.

Boonchai, W., S. Apichai, S. Oralak, D.F. Caroline, M. Philip, B. Ladaporn and J.M. Carl, 2007. Intestinal parasitic infections among pre-school children in Sangkhlaburi, Thailand. Am. J. Trop. Med. Hyg., 76(2): 345-350.

Brooker, S., A. Clement and D.A.P. Bundy, 2006. Global epidemiology, ecology and control of soil-transmitted helminth infections. Adv. Parasitol., 62: 223-265.

Buchini, M.L.T., E. Pittner, T. Czervinski, I.M. Moraes, M.M. Moreira, H.F. Sanches and M.C. Monteiro, 2007. Spatial distribution of enteroparasites among school children from Guarapuava, State of Paraná, Brazil. Rev. Bras. Epidemiol., 10: 568-578.

Bundy, D.A., E.S. Cooper and D.E. Thompson, 1995. Epidemiology and population dynamics of ascaris lumbricoides and trichuris infection in the some community. T. Roy Soc. Trop. Med. H., 18: 987.

Chan, M.S., 1997. The global burden of intestinal nematode infections-fifty years on. Parasitol. Today, 13: 438-443.

Cheesbrough, M., 2006. Parasitological Test. In: Low Price (Ed.), District Laboratory Practice in Tropical Countries. 2nd Edn., Cambridge University Press, Cambridge, pp: 183-215.

Chirdan, O.O., J.T. Akosu and S.O. Adah, 2010. Intestinal parasites in children attending day care centres in Jos, Central Nigeria. Niger. J. Med., 19(2): 219-22.

Chukwuma, M.C., I.M. Ekejindu, N.R. Agbakoba, D.A. Ezeagwuna, I.C. Anaghalu and D.C. Nwosu, 2009. The prevalence and risk factors of geohelminth infections among primary school children in Ebenebe town, Anambra state, Nigeria. Middle-East J. Sci. Res., 4(3): 211-215.

Cooper, E., 1991. Intestinal parasitoses and the modern description of diseases of poverty. T. Roy Soc. Trop. Med. H., 85: 168-170.

Dada-Adegbola, H.O., A.O. Oluwatoba and C.O. Falade, 2005. Prevalence of multiple intestinal helminths among children in a rural community. Afr. J. Med. Sci., 34(3): 263-367.

De Silva, N.R., S. Brooker and P.J. Hotez, 2003. Soil-transmitted helminth infections: Updating the global picture. Trends Parasitol., 19: 547-551.

De Souza, E.A., D.S. Mônica, D.M. Rosely, T.M. Pascoal, A.C. Marly and U.F. Marcelo, 2007. Prevalence and spatial distribution of intestinal parasitic infections in a rural Amazonian settlement, Acre State, Brazil. Cad. Saúde Pública, Rio de Janeiro; 23(2): 427-434.

Dib, H.H., S.O. Lu and S.F. Wen, 2008. Prevalence of *Giardia lamblia* with or without diarrhea in South East, South East Asia and the Far East. Parasitol. Res., 103(2): 239-251.

Garcia, L.S, 1999. Practical guide to diagnostic parasitology. ASM Press, Washington, DC, pp: 12-19.

Greenwood, D., R. Slack, J. Peutherer and M. Barer, 2007. Protozoa: Fungi Pathogens, Parasitic Infections and Medical Entomology. In: Medical Microbiology, a Guide to Microbial Infections: Pathogenesis, Immunity, Laboratory Diagnosis and Control. 17th Edn., Churchill Livingstone Elsevier, Edinburgh, pp: 621-628.

Gyorkos, T.W., J.D. McLean and C.G. Law, 1989. Absence of significant differences in intestinal parasite estimates after examination of either one or two stool specimens. Am. J. Epidemiol., 130: 976-980.

Kappus, K.D., R.G.J. Lundgren, D.D. Juranek, J.M. Roberts and H.C. Spencer, 1994. Intestinal parasitism in the United States: Update on a continuing problem. Am. J. Trop. Med. Hyg., 50: 705-713.

Koroma, M.M., A.M. Williams, R.R. DeLa-Haye and M. Hodges, 1996. Effects of Albendazole on growth of pri-mary school children and the prevalence and inten-sity of soil-transmitted helminths in Sierra Leone. J. Trop. Pediatrics, 42: 371-372.

Meremikwu, M.M., O.E. Antia-Obong, A.A. Asindi and G.C. Ejezie, 1995. Prevalence and intensity of intestinal helminthiasis in pre-school children of peasant farmers in Calabar, Nigeria. Nig. J. Med. Lab. Sci., 2: 40-44.

Muniz-Junqueira, M.I. and E.F.O. Queiroz, 2002. Relationship protein-energy malnutrition, vitamin A and parasitoses in children living in Brasília. Rev. Soc. Bras. Med. Tro., 35: 133-41.

Naish, S., J. McCarthy and G.M. Williams, 2004. Prevalence, Intensity and risk factor for soil transmitted helminthes infection in South India fishing village. Acta Trop., 9: 177-187.

Newman, R.D., S.R. Moore, A.A. Lima, J.P. Nataro, R.L. Guerrant and C.L. Sears, 2001. A longitudinal study of *Giardia lamblia* infection in north-east Brazilian children. Trop. Med. Int. Health, 6: 624-634.

Nokes, C., M.S.M. Grantham, A.W. Sawyer, E.S. Cooper and D.A.P. Bundy, 1992. Parasitic helminth infection and cognitive function in school children. P. Roy Soc. Lond. B Bio., 247: 77-81.

Noor-Azian, M.Y., Y.M. San, C.C. Gan, M.Y. Yusri, Y. Nurulsyamzawaty, A.H. Zuhaizam, M.N. Maslawaty, I. Norparina and I. Vythilingam, 2007. Prevalence of intestinal protozoa in an aborigine community in Pahang, Malaysia. Trop. Biomed., 24: 55-62.

NPCN (National Population Commission of Nigeria), 2012. Esan West (Local Government Area, Nigeria) Population. National Population Commission of Nigeria. Retrieved form: http://www.citypopulation.de (Accessed on: November 26, 2012).

Nyarango, R.M., A. Pa, E. Ew and N. Bo, 2008. The risk of pathogenic intestinal parasite infections in Kisii Municipality, Kenya. BMC Public Health, 8: 237.

Okyay, P., S. Ertug, B. Gultekin, O. Onen and E. Beser, 2004. Intestinal parasites prevalence and related factors in school children, a western city sample-Turkey. BMC Public Health, 4: 64-64.

Phiri, K.C., J.S. Whitty, M. Graham and G. Sembatya-lule, 2000. Urban/rural differences in prevalence and risk factors for intestinal helminthes infections in Southern Malawi. Ann. Trop. Med. Parasit., 94: 381-387.

Pillai, D.R. and K.C. Kain, 2003. Common intestinal parasites. Curr. Treat Opt. Infect Dis., 5: 207-217.

Rajeswari, B., B. Sinnaih and H. Husseini, 1994. Socioeconomic factors associated with intestinal parasites among children living in Gombak Malaysia. Asia Pac. J. Public Health, 7(1): 21-25.

Rayan, P., S.Verghese and P.A. McDonnell, 2010. Geographical location and age affects the incidence of parasitic infestations in school children. Indian J. Pathol. Micr., 53: 498-502.

Ribeiro, L.A., 2011. Prevalence of intestinal parasites in preschool children in the region of Uberlândia, State of Minas Gerais, Brazil. Rev. Soc. Bras. Med. Trop., 44(2): 191-193.

Stephenson, L.S., M.C. Latham, S.N. Kinoti, K.M. Kurz and H. Brigham, 1990. Improvement in physical fitness of Kenyan schoolboys infected with hookworm, *Trichuris trichiura* and *Ascaris lumbricoides* following a single dose of Albendazole. T. Roy Soc. Trop. Med. H., 84(2): 277-282.

Stephenson, L.S., M.C. Lathan, E.J. Adams, S.N. Kinoti and A. Pertet, 1993. Physical fitness growth and appetite of Kenyan school boys with hookworm, *Trichuris trichiura* and *Ascaris lumbricoides* infection. Am. J. Trop. Med. Hyg., 41: 78-87.

Stoltzfus, R.J., M. Albonico, H.M. Chwaya, L. Savioli, J. Tielsch, K. Schulze and R. Yip, 1996. Hemoquant de-termination of hookworm-related blood loss and its role in iron deficiency in African children. Am. J. Trop. Med. Hyg., 55: 399-404.

Utzinger, J., E.K. N'Goran, H.P. Marti, M. Tanner and C. Lengeler, 1999. Intestinal amoebiasis, giardiasis and geohelminthiases: Their association with other intestinal parasites and reported intestinal symptoms. T. Roy Soc. Trop. Med. H., 93: 137-141.

WHO (World Health Organisation), 2003. Diarrhoea remains a principal cause of illness and death. B. World Health Organ., 81: 197-204.

Yoder, J.S., M.J. Beach and Centers for Disease Control and Prevention, 2007. Giardiasis surveillance-United States, 2003-2005. MMWR Surveill. Summ., 56(7): 11-18.