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Full Length Research Paper

Geohelminthiasis among Nigerian preschool age children

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A study of the prevalence, intensity and risk factors of geohelminth infections was investigated among preschool children aged 1-5 years old in Ibilo, Akoko-Edo Local Government Area of Edo State, Nigeria. Two hundred and ninety eight children (94.30%) out of 316 volunteers examined were infected with one or more geohelminth parasites. The predominant geohelminth was *Ascaris lumbricoides* (85.7%, 104.4 epg), followed by hookworm (65.7%, 172.2 epg) and *Trichuiris trichuira* (2.9%, 305 epg). The difference in the prevalence of infection of the geohelminths among the preschool children was statistically significant (F=6.708, p <0.05). Infection rate of *A. lumbricoides* and hookworm (35.6%) was more than for either *Ascaris and Trichuris* (2.7%) or Hookworm and *Trichuris* (6.0%). The infection rate of multiple parasites of *A. lumbricoides*, hookworm and *Trichuris* was 3.4%. The difference in the mean pre treatment parasite load (369.8 epg) and post treatment parasite load (17 epg) was statistically significant (χ^2 =13.92, p < 0.05). The mean difference between children who were anaemic pre treatment (7.9 g/dL) and the improvement of the haemoglobin profile post treatment (10.5 g/dL) was not statistically significant (t=2.65, p > 0.05). Of the three anthelmintic drugs administered, namely, Albendazole, Mebendazole and *Pyrantel pamoate,* children treated with Pyrantel pamoate had the lowest parasitic load post treatment and highest cure rate. Places of defecation such as pit latrines, bushes and water closets as well as mothers'/caregivers' occupation have been identified as potential risk factors contributing to the high infection rates of helminth parasites among preschool age children studied.

Key words: Geohelminthiasis, preschool age, children, albendazole, mebendazole, *Pyrantel pamoate*, haemoglobin, risk factors, Nigeria.

INTRODUCTION

Intestinal helminth infections constitute significant public health problem in many developing countries. More than 3.5 billion people worldwide are currently infected with one or more species of intestinal helminthes (Crompton, 1999). Children are at greatest risk of helminthiasis infection which are often associated with poor growth, reduced physical activity and impaired learning ability (Stephenson, 1993). Preschool age children have been reported to harbour the greatest number of intestinal worms (Crompton and Nesheim, 2002).

An increasing number of studies of helminth epidemiology have shown that it is common for individuals to be infected with more than one species of helminth (Booth et al*.,* 1998; Fleming et al., 2006). Co-infection of geohelminth has been reported to be associated with higher levels of anaemia compared to an independent infection of helminth parasites (Ezeamama et al., 2008). A number of epidemiological studies have indicated that individuals infected with multiple species of helminth often harbour heavier infection than individuals infected with a single helminth species (Booth et al*.,* 1998; Needham et al*.,* 1998).

Factors enhancing exposure to helminthiasis have been implicated in previous field studies to include defecation practices (Haswell-Elkins et al*.,* 1989), cultural differences relating to personal and food hygiene (Haswell-Elkins et al*.,* 1989; Kan et al*.,* 1989), occupational necessities (Gesielski et al., 1992), housing conditions (Holland et al*.,* 1988) and geophagy (Geissler et al*.,* 1998). Each of the above factors can be exaggerated by socio-economic status, with the poorest having the most worm burden (Henry, 1988; Holland et al*.,* 1988).

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Table 1. The prevalence and intensity of geohelminth infections

Age group in years	No examined	No infected with Helminth	*Ascaris lumbricoides*		Hookworm		*Trichuris trichuira*	
			Infected volunteers no (%)	Intensity of infection egg/g/feaces	Infected volunteers no (%)	Intensity of infection no (%)	Intensity of infection no (%)	Intensity of infection
1	108	100 (92.6)	70(70)	148	48(68.6)	153.8	4(5.71)	300
2	50	42(84.0)	26(61.9)	170	16(38.1)	162.5	12(28.57)	65
3	38	36(94.7)	18(50)	136.7	28(77.77)	130.7	4(11.11)	135
4	40	35(87.5)	32(80)	139.4	16(40)	217.5	4(10)	260
5	80	75(85.7)	60(85.71)	104.4	46(65.7)	172.2	2(2.85)	305
Total	316	288(91.1)	206(65.2)		154(48.7)		26(8.2)	

In spite of the health risks associated with helminthiasis infections, data on the level of infection among preschool age children have not been investigated in our locality. This study is therefore aimed at establishing geohelminthiasis in preschool age children and their associated risk factors in our locality.

MATERIALS AND METHODS

Our study area is Ibilo and its environs, which are rural human settlement located in Akoko-Edo Local Government Area of Edo State, Nigeria. It lies on latitude 6^0N and longitude 6^0E. The vegetation is Guinea Savanna. The inhabitants depend on streams and rivers for their sources of drinking water. Most of the volunteers use pit latrines while some defecate in their surrounding environment because of lack of appropriate toilet facilities. However, a few use water closet toilet facilities. The inhabitants are predominantly farmers while some of their literates are civil servants.

The investigation commenced with community mobilization campaign explaining the objectives, possible outcome and benefits of the research with the ultimate need for their participation on the research project. Informed consent was obtained from the mothers/ caregivers of the children who agreed to participate in the project. Ethical permissions were obtained from Ayunko Hospital, Ibilo where the samples were obtained and the State Ministry of Education, Benin City, Edo State, Nigeria.

Faecal samples were from the volunteers. The samples were immediately transported to our laboratory for procession. The samples were analysed and quantified for gastro-intestinal helminthes using Formol-ether concentration and Kato-Katz techniques. The capillary blood using finger prick was obtained from the infected volunteers for determination of the haemoglobin concentrations using standard laboratory technique. Ninety three volunteers infected with the geohelminths were treated with three antihelminthic drugs, namely, Albendazole, Mabendazole and *Pyrantel paomate*, after the random division of them into 3 groups of 31.

The data obtained from this study were subjected to statistical analysis using MicroSoft Excel and Instat statistical package.

RESULTS

Three hundred and sixteen preschool children of age 1-5 years old were examined for helminth parasites. Of the number investigated, 288(91.1%) was infected. The prevalence and intensity of *A. lumbricoides* infection for ages 1, 2, 3, 4 and 5 years old were: 70%, 148 epg; 50%, 170 epg; 61.9%, 136.7%; 80%, 139.4 epg and 85.71%, 104.4epg, respectively. The prevalence and intensity of infection of hookworm for ages 1, 2, 3, 4 and 5 years old were as follows: 68.6%, 153.8 epg; 38.1, 162.5 epg; 77.7%, 130.7 epg; 40%, 217.5 epg and 65.7%, 172.2 epg, respectively. The prevalence and intensity of *T. trichuira* infection for ages 1,2,3,4 and 5 were: 5.71%, 300 epg; 28.6%, 65 epg; 11.1%, 135 epg; 10%, 260 epg; 2.85%, 305 epg, respectively. The difference in the number of children infected with these geohelminths was statistically significant ($F=6.701$, $p < 0.05$) (Table 1).

Table 2. Polyparasitism of helminth parasites with infection rate

Helminths	Infection rate
Ascaris + Hookworm	106(35.57)
Ascaris + Trichuris	8(2.68)
Hookworm + Trichuris	18(6.04)
Ascaris + Hookworm + Trichuris	10(3.35)
Total	142(47.65)

Table 2 shows polyparasitism of the helminth parasites among preschool age children. The number and infection rate of children with *Ascaris* and hookworm was 106 (33.6%), *Ascaris* and *Trichuris* [8(2.7%)], hookworm and *Trichuris* [18(3.0%)]. The number of children infected with the three helminth parasites was 10 with infection rate of 3.37%.

Table 3 shows the pre and post treatment parasitic load and PCV levels of children with *A. lumbricoides* and hook worm infection. The pre treatment and post treatment status of parasite load and haemoglobin levels of children administered with different anthelmintic drugs were as follows: Pyrantel pamoate (317.08 epg, 8g/dL; 3.46 epg, 9.6g/dL, respectively), Mebendazole (472.5 epg, 8.2g/dL; 32.5epg, 10.4g/dL, respectively) and Albendazole (320 epg, 7.6g/dL; 15epg, 11.7g/dL, respectively). The mean difference in pre treatment parasite load (369.8 epg) and post treatment parasite load (17 epg) was statistically significant ($\chi^2 = 13.92$, $p < 0.05$). However, the difference in the pre treatment haemoglobin concentration and post

Table 3. The pre and post treatment parasitic load and PCV levels of the children with *A. lumbricoides* and hookworm infection

Drugs	No. of volunteers	Pre-treatment parasite load (epg)	haemoglobin (g/dL)	Post treatment parasite load (epg)	haemoglobin (g/dL)	Ratio of pre and post treatment parasite load
Pyrantel pamoate	31	317.1	8	3.5	9.6	91.6
Mebendazole	31	472.5	8.2	32.5	10.4	14.5
Albendazole	31	320.0	7.6	15	11.7	21.3
Mean		369.8	7.93	17	10.56s	91.6

Table 4. Risk factors of helminth infection with the rate of infection

Risk factors	Total number examined	Number infected with Helminths	*Ascaris lumbricoides*	Hookworm	*Trichuris trichuira*
Pit latrine	170	168(98.8)	112	94	14
Water closet	114	88(77.1)	68	40	8
Bush	32	32(100)	26	20	4
Mother/care giver occupation (peasant farming)	216	216	132	70	14
Mother/care giver occupation (civil servants)	100	72	54	34	12

treatment heamoglobin level was not statistically significant (t=1.756, p > 0.05). The ratio of pre and post treatment parasite load for *P. pamoate*, Mebendazole and Albendazole were 91.64, 14.54 and 21.33, respectively.

Table 4 shows the risk factors of places of defecation and mothers' /care givers' occupation with the rate of infection. There was no significant difference in the prevalence of preschool age children infected with helminth parasites that made use of pit latrines (98.8%), water closets (77.1%) and bushes (100%) [F=1.802, p > 0.05]. The difference in number of helminth infection of *Ascaris* (132), hookworm (70) and *Trichuris* (14) whose mothers/caregivers are farmers and for children whose mothers/caregivers are non-farmers, with geohelminth infections of *Ascaris* (54), hookworm (34) and *Trichuris* (12) was not statistically significant (t=1.759, p > 0.05).

DISCUSSION

We observed that prevalence of helminth infection among preschool children was highest with *A. lumbricoides*, followed by hookworm and lowest with *T. trichuira*. This finding corroborates the study carried out in Edo State by Mordi et al. (2007). Also heaviest infections for *A. lumbricoides* and *T. trichuira* have been shown to be highest among children (Giles, 1996). This pattern of infection is related to the fact that human ascariasis and trichuriasis are spread through feacal pollution of soil, and so the intensity of infections depends on the degree of soil pollution (Giles, 1964). The high prevalence of infection among the volunteers who defecated in the surrounding bushes supports this assertion. Hookworm infection occurs by skin penetration of infective larvae. Poor sanitary disposal of human feaces and indiscriminate defecation are the principal factors in the aetiology of hookworm infections. In many tropical countries, it is an occupational disease of the farming community (Giles, 1964). This assertion is proved valid by our results where farming constitutes an important risk for geohelminthiasis, especially hookworm in our studied area.

The prevalence of the co-infection of *A. lumbricoides* and hookworm was highest among preschool children compared to other co-infections of *A. lumbricoides* and *T. trichuris*, hookworm and *T. trichuira*, and the multiple infections of *Ascaris*, hookworm and *Trichuris*. The positive association of hookworm and *Ascaris* shown with the relatively high prevalence rate supports previous studies in Brazil (Fleming et al., 2006). Protective effects might vary between different parasitic species, acting at different sites (skin, lung and gut) and different developmental stages such as third stage infective larvae (Yoshida et al., 1999) or adult worm (Curry et al., 1995). The relatively lower prevalence of co-infection compared to mono-infection may suggest possible synergistic effect on the immune response to these helminthic infections. This may tend to confer some levels of protective immunity as against individuals with single infection. This observation has been documented in some parasitic co-infections involving *Plasmodium* and schistosomiasis (Nmorsi et al., 2009).

We observed an improvement in the parasite load and haemoglobin concentrations in children with geohelminth infections after treatment with anthelmintic drugs (*P. pamoate*, Mebendazole and Albendazole). The increase in the heamoglobin levels after treatment in this investigation accords the report of Stoltzfus et al. (2001). Geohelminths can cause intestinal bleeding and protein loss proportional to worm burden (Diemert et al., 2008), which could result in iron deficiency and anaemia (van Ejik et al., 2009). It has been documented that iron deficiency and anaemia resulting from helminthiasis infection in pre-school children are associated with developmental delays and this has been attributed partially to low cure rate of anthelmintic drug (Stoltzfus et al., 2001). Our investigation identified Pyrantel pamoate as having the highest cure rate for helminthiasis and its administration should therefore be given priority in the control of geohelminthiasis using chemotherapy.

We reported that mother/caregivers' occupation and places of defecation can constitute risk factors in the transmission of helminth parasites. Infection was highest among children who made use of bushes as their place of defecation, followed by pit latrines and then water closets. This result is in line with the reports of Anosike et al. (2006), Nguyen et al. (2006). It has been reported that, individuals using closed latrine or river/pond for defecation had very low infection rate (Nguyen et al., 2006), which is an improved means of feacal disposal associated with improved environmental hygiene when compared with pit latrines and defecation in the surrounding bushes.

In conclusion, occupation of parents or caregivers (peasant farming) and poor environmental hygiene (defecation in bush) are major risk factors that we identified in the transmission of helminthiasis among pre-school age children. Since the use of anthelmintic drugs impacts positively on the health of the infected inhabitants such as improved haemoglobin, weight gain (Alderman et al., 2006; Chopra, 2006; Gulani et al., 2007; Micheal et al., 2000), we therefore recommend campaign on mass deworming of rural inhabitants at Ibilo, Nigeria using Pyrantel pamoate.

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