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Preliminary Investigation of Intestinal Parasites Infection amongst School Children in Bendi, Cross River State of Nigeria

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Authors' contributions

This work was carried out in collaboration between both authors. Author UIG designed the study, performed the statistical analysis, wrote the protocol, managed the literature search and wrote the first draft of the manuscript. Author ADI wrote the protocol, managed the analyses of the study and managed the literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

Background: Human intestinal parasites steadily constitute a source of impaired growth and development, and among the leading causes of death of children in developing countries. Consistent epidemiological studies are imperative to identify high-risk populations.
Aim: This study sought to ascertain the occurrence of intestinal parasites among primary school children in St. Peter Primary School, Bendi 1, a rural community in Cross River State of Nigeria, as a preliminary step towards evidence-based intervention.
Methodology: Stool specimen was collected from 132 pupils who were available to enroll in the study. Samples were analysed macroscopically and microscopically using direct saline wet mount method and Formaline-ethyl acetate concentration technique. Socio-demographic data of pupils were collected through a pretested questionnaire.
Results: Overall prevalence of 56.1% of intestinal helminths and protozoans was recorded; including *Entamoeba histolytica* as the most common, (43.7%), Hookworm, (31.1%), *Ascaris lumbricoides,* (14.6%), *Giardia lamblia* (5.8%), *Schistosoma mansoni,* (2.9%), and *Enterobius*

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vermicularis, (1.9%). Prevalence was higher in males (54.1%). The age group 1-5 years was the least infected, but infection reduced with age from the highest prevalence of 67% among 6-10 years age range to 31.1% among pupils 11-15 years old. Age-related infection was statistically significant (P = 0.05). The prevalence of polyparasitism was 36.5%.

Conclusion: A high prevalence of intestinal parasite infection was identified among pupils. School children could be a focus of infection in the community. This finding presents an alarming need for intervention in Bendi community.

Keywords: Intestinal parasites; prevalence; helminths; protozoans; polyparasitism.

1. INTRODUCTION

Public health concerns on intestinal parasite infections have been heightened over the past two decades [1]. Contextually, the term "Intestinal parasites" is obviously a loose nomenclature for parasitic organisms that inhabit the intestines of vertebrates; and these include mostly helminths and protozoans, which are noted among the most prevalent infections in humans in developing countries. Prevalence of these infections is related with the lack of adequate water and sanitation facilities [2,3,4].

Human Intestinal infection with helminthic parasites can be caused by cestodes, such as *Taenia* species, trematodes, such as *Fasciolopsis* species or a wide range of nematode species [5]. However, reference of human intestinal helminths is rather prominently made to intestinal nematodes, and largely so, to the group of mostly faeco-orally transmitted worms generally called soil-transmitted helminths (STH). Of these, *Ascaris lumbricoides*, *Trichuris trichiura* and the hookworms (*Necator americanus* and *Ancylostoma duodenale* are the major species posing a huge public health concern, with worldwide distribution and affecting the poorest and most deprived communities. Current statistics show that over 1.5 billion people (24% of world's population) are affected by STH, with widely distributed infection in tropical and sub-tropical areas, but mostly in sub-Saharan Africa, the Americas, China and East Asia; while more than 267 million preschool-age and over 568 million school-age children are at risk in highly endemic areas [6].

While intestinal helminth infections rarely cause death, they induce diverse forms and levels of morbidity on victims, with far-reaching adverse effects on health and nutritional status of hosts [7,8,4]. They especially impair growth and development of infected children; studies have linked stunting of linear growth, weakness and cognitive impairment in school children, as well as a hindrance to economic development, with intestinal helminth infections [9,10,11,12,13].

Intestinal protozoan parasites are largely associated with diarrheal diseases, which are among the ten leading cause of death, worldwide; leading cause of malnutrition in children and the second leading cause of under-five mortality, killing 525,000 children annually [14,15]. The most common of such parasites are *Giardia intestinalis* (causing giardiasis), *Entamoeba histolytica* (causing amoebiasis), *Cyclospora cayetanenensis* (cyclosporiasis) and *Cryptosporidium* species [16]. They are mostly transmitted through faecal contamination of food and water, and thus are preventable through the provision of safe drinking-water and adequate sanitation and hygiene [15].

In Nigeria, the high prevalence of various intestinal parasites has been reported, especially among school-age children [17,18,19,20, 21,22,13,23]. While the WHO recommends large-scale de-worming of children, health education and improved sanitation as potent control measures, prevalence profiles are significant for case identification even in endemic areas for effective intervention. This study sought to ascertain the occurrence of intestinal parasites among children in a remote rural community with evidently poor sanitation level, as a preliminary step towards evidence-based intervention in the area. Its significance derived from the fact that there has not been any such study in the area, hence preliminary information on intestinal parasites infection was lacking; a situation which could hamper prospective intervention programmes.

2. METHODOLOGY

2.1 Study Area

Bendi is a rural community in Obanliku local government area of Cross River State, a south-east Nigerian State lying between Latitude 4°28[1] and 6° 55[1] north of the Equator and Longitude 7° 50[1] and 9° 28[1] east of the Greenwich Meridian. Obanliku is both interstate and international boundary local government area; bounded in the north by Kwanda local government area of Benue State, in the south and west by Boki and Obudu local government areas of Cross River State, respectively; and in the east by the Republic of Cameroon. The area lies within the tropical rainforest ecozone climate with temperature ranges of 4°C to 10°C from June to September and 26°C to 32°C between November and January. There are two distinct seasons, the wet (rainy) season (May to October) and the dry season (November to April). The area receives a heavy amount of rainfall, as much as 4,200 millimetres [24]. The population of Bendi comprises predominantly farmers, who cultivate rice, cassava, yam, oil palm, local beans, banana, cocoa, fruits and vegetables; others engage in fishing. These activities are wont to promote transmission and hence the prevalence of intestinal parasite infections. Only a few of the people are civil servants or in various other business concerns [25].

2.2 Study Population and Sample Collection

The study employed cross-sectional and stratified sampling methods on the study population, which comprised school children age 4 -15 years in St. Peter Primary School, Bendi 1, Obanliku Local Government Area of Cross River State, Nigeria. The school was selected for the study because it was the best available cluster of the target population (children) of the research, which was primarily a preliminary investigation. The school has a total population of 264 pupils. The study sample was 132; 50% of total pupil population, selected randomly. The low sample size was informed by the actual number of pupils available to participate in the study. Availability depended on parents' willingness to allow their children to enroll in the study and a child's willingness to participate. It also depended on the required age range for the study. Following this limitation, 50% of the study population was however purposively enrolled in the study.

2.2.1 Data collection

Prior to sample collection, permission was sought and obtained from the school authorities through a letter, which explained the purpose of the study. The pupils were also informed of the study. Informed consent of parents of the enrolled pupils was obtained to facilitate the collection of stool specimens. Socio-demographic data of pupils including age, gender, sanitation habits, sanitary facilities, water supply, etc. were collected through a pretested questionnaire.

2.2.2 Collection of faecal sample

Standard procedures of faecal sample collection were explained to the children and parents. Appropriately-labeled, clean wide-mouthed, crew-capped, transparent, dry and disinfectant-free universal containers were distributed to pupils to produce stool specimen. About 4-5gm of faecal samples was collected by each participating pupil the following morning. A total of 132 stool samples were collected. Each sample was preserved in 10% formol saline, a time-honoured fixative in the ratio of three (3) parts of fixative to one part of the faecal material, to preserve protozoan cysts, helminth eggs and larvae [26].

The preserved samples were transported to the Biology Laboratory, Department of Biological Sciences, Cross River University of Technology, Calabar.

2.3 Analysis of Fecal Samples

Faecal samples were examined macroscopically for the presence of bloodstains and mucus; and processed and examined microscopically using direct saline wet mount method and Formaline-ethyl acetate concentration technique [27,28].

2.4 Statistical Analysis

Data obtained were analyzed using descriptive (simple percentage) and non-parametric (chi-square) statistics.

2.5 Ethical Consideration

Ethical clearance was obtained from the Cross River State ministry of health. Permission was obtained from the authorities of St Peter primary School, Bendi 1 to engage in the study. Informed consent of parents of pupils was obtained before children were enrolled in the study. Participation in the study was kept optional, and participants' data were kept under close confidentiality.

2.6 Limitation of the Study

The study relied on the available number of pupils who were permitted by parents and were willing to participate in the investigation. This limited the sample size of the study remarkably. However, it was ensured that the sample size was not below 50% of study population. This was expected to provide data for this preliminary investigation.

3. RESULTS

A total of 132 stool samples examined in the study were obtained from 132 pupils aged 4 to 15 years, comprising 70 (53%) males and 62 (47%) females. Of these, 74 were positive for various intestinal parasites comprising helminths (50.5%) and protozoans (49.5%); with an overall prevalence of 56.1%. *Entamoeba histolytica* was the most common parasite species isolated, (43.7%), followed by Hookworm, (31.1%), *Ascaris lumbricoides,* (14.6%), *Giardia lamblia* (5.8%), *Schistosoma mansoni,* (2.9%), and *Enterobius vermicularis,* (1.9%); (Table 1).

3.1 Sex-related Prevalence

The prevalence of intestinal parasites was higher in males (54.1%) than in females (45.9%); (Table 2). The distribution of parasites species among sex groups showed males recording high prevalence of *Entamoeba histolytica* (35.7%) and Hookworm (27.1%), followed by *Ascaris lumbricoides* (12.9%); *Giardia lamblia* (2.9%); and *Enterobius vermicularis* (1.4%); while females recorded high prevalence of *Entamoeba histolytica* (32.3%), followed by Hookworm (21.0%), *Ascaris lumbricoides* (9.7%), *Giardia lamblia* (6.5%), *Schistosomamansoni* (4.8%) and *Enterobius vermicularis* (1.6%).

3.2 Age-related Prevalence

The age group of 6-10 years had the highest prevalence (67%), followed by the 11-15 years age range (31.1%); while pupils aged 1-5 years had the least (1.9%); (Table 3).

3.3 Multiple Infections among Children

Multiple infections were encountered but none of the pupils harboured more than four parasite species at once. Prevalence of double infection was the highest (33.8%), while triple and quadruplet infections were as low as 1.35% each (Table 4). The common double infections encountered were those of Hookworm + *Entamoeba histolytica*, Hookworm + *Ascaris lumbricoides*, Hookworm + *Giardia lamblia*, *Ascaris* + *Entamoeba histolytica* and Hookworm + *Schistosoma mansoni*. The triplet infections encountered were those of Hookworm + *Ascaris lumbricoides* + *Entamoeba histolytica* and quadruplet infections encountered were those of Hookworm + *Ascaris lumbricoides* + *Entamoeba histolytica* + *Schistosoma mansoni*.

Table 1. Occurrence of parasites in stool samples of pupils (N=132)

Parasites	No. isolated	%
Hookworm	32	31.1
Ascaris lumbricoides	15	14.6
Entamoeba histolytica	45	43.7
Giardia lamblia	6	5.8
Schistosoma mansoni	3	2.9
Enterobius vermicularis	2	1.9
Total	103	100

Table 2. Prevalence of intestinal parasites amongst the sexes

Parasite species	Males (N=40)		Females (N=34)		Total isolated	%
	No. of parasites	%	No.of parasites	%		
Hookworm	19	27.1	13	21.0	32	31.1
Ascaris lumbricoides	9	12.9	6	9.7	15	14.6
Entamoeba histolytica	25	35.7	20	32.3	45	43.7
Giardia lamblia	2	2.9	4	6.5	6	5.8
Schistosoma mansoni	0	0	3	4.8	3	2.9
Enterobius vermicularis	1	1.4	1	1.6	2	1.9
Total	56		47		103	100

Table 3. Prevalence of intestinal parasites relative to the age of pupils

Parasite species	The age range of pupils			Total Isolated (%)
	1-5(N=2)	6-10(N=82)	11-15 (N=48)	
	No of parasites (%)	No of parasites (%)	No of parasites (%)	
Hookworm	0	21 (30.4)	11 (34.4)	32 (31.1)
Ascaris lumbricoides	0	6 (8.7)	9 (28.1)	15 (14.6)
Entamoeba histolytica	1 (50)	34 (49.3)	10 (31.3)	45 (43.7)
Giardia lamblia	1 (50)	5 (7.2)	0	6 (5.8)
Schistosoma mansoni	0	1 (1.5)	2 (6.2)	3 (2.9)
Enterobius vermicularis	0	2 (2.9)	0	2 (1.9)
Total	2 (1.9%)	69 (67%)	32 (31.1%)	103

Table 4. Single and polyparasitism

No. of parasite species	Number infected	% Infection
1	47	63.5
2	25	33.8
3	1	1.35
4	1	1.35
Total	74	

4. DISCUSSION

A high prevalence (56.1%) of intestinal parasites was recorded among school children in Bendi, Cross River State, south-south Nigeria. This prevalence level is consistent with results from Benue state, north-central Nigeria, 58.5% [29]; but higher than results of previous studies in Akwa Ibom State, south-south Nigeria (10.7%) [30]; and lower than findings of 67.4% and 80.0% from the north east and south southern zones of the country, respectively [31,32]. High prevalence of intestinal helminths and protozoans is related to poor sanitation and inadequate supply or the lack of safe drinking water [4,15]. Going by the epidemiology of these infections, this prevalence level, perhaps higher, should be expected in the area. The observed condition would thus be attributed to the poor hygiene practice and unsanitary environment of the people, such as open defecation, indiscriminate disposal of human wastes, eating of unwashed fruits, and lack of proper hand washing practice after defecation; attitudes and practices that would expose the school children to contact with wastes, contaminated water and parasite eggs in the environment while playing and eating.

Male children in the area tend to be more active than their female counterparts in their involvement in water-based activities and play, such as fishing, swimming, playing barefoot on sand; plucking and handling of fruits. This might have informed the higher prevalence of infection in this group (54.1%). This was however not statistically significant (x^2 = 7.33; *P* = .05). The pattern of infection showed children in the age group 6-10 years with the highest prevalence (67%). This is consistent with an earlier observation [31]. While the prevalence decreased with age (11-15 years had 31.1%), the very young children in the age range 1-5 years were least infected (1.99%). This trend was also statistically significant (x^2 = 42.4; *P* = .05). Children in the age group 6-10 are obviously very active and indiscriminate at play and with unrestrained adventurous attempts with materials and edibles; play barefoot under the rain, etc. These would represent the salient exposure sources for some children that would result in a relatively higher prevalence of infection; while older children might have been aware of dangers and risks of disease infections and might be a bit restrained in play and eating habits.

While results from different studies show inconsistencies in the relationship between prevalence of intestinal parasites in children and age or gender [33,34,35,30,29,31]; however, these findings would guide intervention and control strategies, especially with regards to health education, which may involve cautioning of children both at home by parents and at school by teachers; as well as de-worming activity.

The high prevalence of *Entamoeba histolytica* (43.7%) and hookworm (31.1%) in this study are consistent with earlier records for the protozoan [30,28] and the helminth, [32,29,36] respectively. This should be expected to judge from the prevalent epidemiological indices in the study area, which supports the life cycle, transmission and prevalence of these parasitic organisms, such as the tropical rainforest climate providing optimum temperature for egg development, and high rainfall enhancing high soil moisture and runoff that also washes parasite egg-contaminated soil into surface water [29]. The children are thus exposed to infection by the feaco-oral route through poor hygiene attitudes and play habits as well as through infective larval penetration as they play barefoot in the school playground and at home.

The overall prevalence of polyparasitism of 36.5% recorded in this study is lower than a previous record of 46% in south-east and 67.4% in south-south Nigerian communities [30,32]. Hookworm, *Entamoeba histolytica and Ascaris lumbricoides* dominated the multiple infection patterns. The double infection had the highest prevalence (33.8%); with these common combinations: Hookworm + *Entamoeba histolytica*, Hookworm + *Ascaris lumbricoides*, Hookworm + *Giardia lamblia*, *Ascaris* + *Entamoeba histolytica* and Hookworm + *Schistosoma mansoni,* while triple and quadruplet infections were low (1.35% each). Cases of polyparasitism with intestinal parasites in Nigeria and elsewhere dot the literature [37,38,39,34,40,32,41]; and it is obviously a concomitant condition in intestinal parasitic infection, which is supported by the common epidemiological factors as mentioned earlier in this paper.

5. CONCLUSION

This study has revealed a high prevalence of intestinal parasitic infection with protozoans and helminths in the rural community of Bendi. The study population in this study constitutes the at-risk population for intestinal worm infection and may be a focus of infection for the community. By the World Health Organisation's recommendation for mass treatment in areas with intestinal worm prevalence above 20%, our finding would present an alarming need for intervention in Bendi community. Intervention should include health education in the school and other schools and communities in the area, especially for attitudinal change on sanitation-related habits, provision of safe drinking water, provision of safe sanitation facilities and mass treatment.

Government at the state and federal levels may deploy health workers to schools regularly especially those in rural communities for routine de-worming; educate the people to improve their personal and environmental hygiene habits and enlighten them on methods of transmission and prevention of these diseases; including methods of household and human waste disposal. The villagers should also be educated on the practice of proper washing of hands before eating and after defecation, proper washing of fruits before eating, proper cooking of food and vegetables, and the health effect of open defecation. The villagers should form sanitation and environmental teams to check indiscriminate disposal of domestic/human wastes, open defecation and other environmental and sanitation issues. Teachers should educate and caution pupils to avoid contact with contaminated water bodies, playing barefoot around potentially or susceptibly contaminated areas, eating of soil and eating of unwashed fruits. Non-governmental organizations, parents and care-givers should all play a role in advocating for access and use of safe water, appropriate defecation options and mass treatment in the local communities.

ETHICAL APPROVAL

Ethical approval was obtained from the Ethical committee of the Cross River State ministry of health, Calabar, Nigeria.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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