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Prevalence of Intestinal Parasitic Infection and Associated Risk Factors Among Primary School-Aged Children (5 - 15 years) in Southern Nigeria

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Abstract

Background: In Nigeria, intestinal parasitic infection (IPI) is one of the neglected tropical diseases of public health importance.
Objectives: This study investigated intestinal parasitic infection and associated risk factors among primary school-aged children in Sagbama Local Government Area, Bayelsa State, Nigeria.
Methods: A total of 622 stool samples (335 males and 287 females) were collected from 13 primary schools in nine communities and analyzed using parasitological techniques (direct wet mount and formal ether concentration method). The Tukey Honest Significance Difference test (HSD) was used to determine the association and variation between prevalence and socioeconomic variables.
Results: Nine parasite species were encountered with a total prevalence of 23.95%, including *Ascaris lumbricoides* (7.32%), *Entamoeba histolytica* (4.98%), *Strongyloides stercorals* (2.09%), *Giardia lamblia* (1.93%), Hookworm (1.77%), *Trichuris trichiura* (1.61%), *Schistosoma mansoni* (1.45%), *Diphyllobotium latium* (0.64%) and *Fasciola hepatica* (0.32%). A total of 4.50% of infections were mixed. With 30.26%, the age group 5 - 7 years had the highest infection rate. The second most prevalent age group was 8 - 10 years old (26.53%), while the least prevalent age group was 14 - 16 years old (12.60%). Males were more infected with the disease, 25.07%, than females, 22.65%. *Ascaris lumbricoides* were the most predominant parasites encountered across the nine communities. There was a significant difference between the infected population in the nine communities at $P < 0.05$ ($P = 0.001$).
Conclusions: There was a relatively high prevalence of intestinal parasitic infection among primary school children in Sagbama local government area. Improved sanitation, safe drinking water, and a step-up in health education in the communities will reduce the exacerbation of the infection in the area.

Keywords: Intestinal Parasites, Infections, Prevalence, School Children, Nigeria

1. Background

Intestinal parasitic infections (IPIs) are among groups of parasitic infectious diseases that constitute a major public health problem globally, belonging to the class nematodes and protozoans (1). It is a condition in which parasites predominantly infect the gastrointestinal tract of humans, residing particularly in the intestinal wall (2). In 2012, the World Health Organization (WHO) estimated that 270 million preschool-aged children and over 600 million school-aged children lived in areas where helminths and intestinal protozoa are intensively transmitted and thus warrant interventions (3).

Intestinal parasitic infections are chronic infections that can have detrimental effects, particularly in children, such as trauma, nutrition-robbing and poisoning, changes in resistance, and immune suppression (1, 4). Multiple and interactive mechanisms can cause or aggravate anemia caused by intestinal parasites (5, 6). Hookworms, schistosomiasis, and *Trichuris trichiura* lead to intestinal blood loss and inflammation-induced restriction of iron absorption (5, 6). Many intestinal parasites reduce appetite and compromise nutrient absorption. Further helminthiasis-induced intestinal inflammation may limit nutrient absorption. By causing intestinal mucosal damage, impairing digestion, or causing diarrhea, intestinal parasites may cause indigenous nutrient loss. Additionally, *Giardia lamblia* and *Entamoeba histolytica* can also cause blood loss.

Intestinal parasitic infections adversely affect the nutritional status of children under five years (7). The most common intestinal parasite infections are caused

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by *Ancylostoma lumbricoides*, *Trichuris trichiura*, Hookworm, *Strongyloides stercoralis*, *Enterobius vermicularis*, and Toxocara species. S.stercoralis and Hookworm are transmitted directly through the skin, while the rest are transmitted through the mouth (8, 9).

Using contaminated household items, eating contaminated food, or eating with contaminated hands facilitates oral-route transmission. It has also been suggested that houseflies (*Musca domestica*) contribute to household items and food contamination (10).

Due to their vulnerability, intestinal parasites are more prevalent among primary school children in Nigeria and are the leading cause of morbidity and mortality among primary school children. Intestinal parasitic infections have been reported to have a high prevalence among children in Nigeria because of their vulnerability (11-14). Nevertheless, information regarding their current status is limited, particularly in BAYELSA, a region of the Niger Delta in Nigeria.

2. Objectives

This study examined intestinal parasitic infections (IPIs) and associated risk factors in primary school-aged children (5 - 15 years old) in various communities in Sagbama Local Government Area, Bayelsa State, Nigeria.

3. Methods

3.1. Study Areas

The study was carried out in nine riverine communities:

- Adagbabiri (5°12'6.246" N, 6°12'26.928"E),
- Angalabiri (5°5'30.209" N, 6°2'18.420"E),
- Bulou-Orua (5°8'20.850" N, 6°4'54.228"E),
- Ebedebiri (5°8'20.850" N, 6°4'54.228"E),
- Ofoni (5°6'40.124" N, 6°3'21.237"E),
- Sagbama (5°9'11.422" N, 6°11'45.744"E),
- Toru-Angiama (5°8'23.166" N, 6°6'27.558"E),
- Toru-Orua (5°6'5.346" N, 6°3'51.588"E),
- Trofani (5°18'6.565" N, 6°19'40.632"E).

All in Sagbama Local Government Area, Bayelsa State, Nigeria. Communities in this area are generally rural. Homes are built in block houses, clustered homesteads of mainly mud houses enclosed by bamboo sticks. Sagbama's climate and vegetation are consistent with that of a typical rainforest region in Southern Nigeria. The basic occupation of the inhabitants includes farming, fishing, and hunting. Some are self-employed, traders, commercial boat and vehicle drivers/transporters, and a few are public servants, civil servants, and retired civil servants. The villages are located on a coastal plain with many ponds, streams, and rivers. The state of Bayelsa experiences heavy rainfall from May to October, with the peak occurring in August. Most of these communities are affected by flooding due to the rainforest's vegetative cover. The dry season begins in November and ends in April. The average temperature in the area ranges from 25 to 34 degrees Celsius. The crops grown in these communities include sugarcane, banana, plantain, cassava, yam, beans, garden egg, fresh tomatoes, fresh pepper, cucumber, groundnut, Okro, banana, cocoyam, water yam, and vegetables which are planted and cultivated in large quantity basically for consumption and commercial purposes. Most of the inhabitants in these communities use water from the Forcados River as a local source of drinking water for waste disposal, fecal disposal, and other domestic activities. Inhabitants also use the community taps and individual boreholes as drinking water sources, which only flow at a certain period of the day. There are toilet facilities, but most people use the surrounding bushes, ponds, and streams as toilets.

3.2. Consent and Approval

The Department of Public Health, the State Ministry of Health, and the State Primary Schools Board provided ethical approval. Written informed consent was obtained from the Community Development Committee (CDC), and informed consent was obtained from the community chiefs and elders before the study. The parents, teachers, and participants were properly enlightened on the study's aims, objectives, benefits, and protocols, the need for voluntary participation, and the right to stop participation at any time.

3.3. Sample Collection

A total of 622 stool samples were collected from primary school children between the ages of 5 - 15 years using clean 50 cm^3 wide-mouthed, screw-capped universal specimen bottles. All samples were collected using structured questionnaires that asked for basic epidemiological information. This information included their ages, sexes, classes, parents' occupations, children's hygiene, histories of their contact patterns, and activities with water bodies. The specimens were labeled appropriately on the submission of stool samples and properly corked. On-the-spot macroscopic analysis of motile trophozoites was conducted using a direct technique. For examination and further analysis, the samples were placed in a cooling container and taken to the Parasitology Research Laboratory of the Department of Animal and Environmental Biology, University of Port Harcourt.

3.4. Stool Sample Analysis

The samples were analyzed by direct wet mount and formal ether concentration method as described by Cheesbrough (15).

3.5. Statistical Analysis

All data collected were analyzed using frequency tables and graphic representations of bar charts using the SPSS version 9.3 (SAS Institute, Inc., Cary, NC, USA). To test whether the infection was statistically significant at 0.05 alpha levels across the population, analysis of variance (ANOVA) was employed. A post hoc test using Tukey's HSD (honest significant difference) demonstrated prevalence across communities.

4. Results

A total of 149 (23.95%) school children tested positive for intestinal parasitic infections. Nine species of intestinal parasites were encountered, namely; *Ascaris lumbricoides* 49 (7.88%), *Entamoeba histolytica* 31 (4.98%), *Strongyloides stercoralis* 13 (2.09%), *Giardia lamblia* 12 (1.93%), Hookworm 11 (1.77%), *Trichuris trichiura* 11 (1.61%), *Schistosoma mansoni* (1.45%), *Diphyllobothrium latum* 4 (0.64%) and *Fasciola hepatica* 2 (0.32%) in this order (Table 1). In terms of communities, Adagbabiri was observed to have the highest prevalence in the study, recording 11 (47.83). Afterwards, Sagbama recorded 48 (37.5%), Trofani recorded 12 (32.43%), Toru-Orua recorded 14 (27.50%), Angalabiri recorded 21 (19.81%), Ebedebiri recorded 14 (18.92%), Toru-Angiama recorded 6 (16.22%), Bulou-Orua recorded 20 (15.04%), and Ofoni recorded 3 (9.09%) in this order. There was a significant difference in prevalence between the nine communities studied at $P < 0.05$ ($P = 0.001$). The prevalence in the Adagbabiri community was not significantly different from that in the other communities at $P > 0.05$, except for Sagbama ($P = 0.014$). The Angalabiri and Buluo-Orua communities did not show any significant differences from other communities. Edebebiri showed no significant difference from other communities except Sagbama ($P = 0.018$). Additionally, the prevalence in the Ofoni community was significantly different from the Sagbama community ($P = 0.000$), but it did not differ significantly from other communities. The study found that the highest prevalence of intestinal parasitic infections occurred in ages 5 - 7 years 59 (30.26%). After this, ages 8 - 10 had 43 (26.53%), and ages 11 - 13 had 31 (22.92%). The lowest rate was recorded for age brackets 14 - 16, with 16 (12.60%) (Table 2). In these nine communities, intestinal parasitice infections were significantly different at $P < 0.05$ ($P = 0.049$) among the sampled population. Furthermore, there was a significant difference between the infected populations in each of the nine communities. Table 3 shows the sex-related infections among the nine communities. Out of the population examined, 84 (25.07%) males tested positive against 65 (22.65%) females. The population of infected males showed no significant difference from those of infected females at $P < 0.05$ ($P = 0.647$).

The source of drinking water, toilet facilities, washing of hands after using the restroom, washing of hands before meals, waste disposal pattern, and washing of hands following waste disposal were also found to be associated with intestinal parasitic infections (Table 4).

5. Discussion

The prevalence of 23.95% recorded in this study is relatively high. The rate is higher than the 21.0% recorded among primary school children in Gokana and Kana Local Government Areas (LGAs) of Rivers State (16). It is, however, slightly lower than the 27.66% reported in Port Harcourt (17) and 52.0% reported in Ilie, Osun State (8). Location, sanitation, and level of awareness may contribute to this variation. All the communities sampled in Sagbama Local Government are rural, which agrees with the settings (8, 16) above, except when compared to Port Harcourt (17), an urban setting. The level of health awareness and sanitation in an urban setting is usually superior to that of a rural setting. Nevertheless, periodic dewormings, mass screenings, and awareness creation programs may be responsible for the variation observed because the provision of adequate sanitation is not always possible in resource-poor settings, particularly in rural areas.

It was established that *Ascaris lumbricoides*, *Entamoeba histolytica*, *Strongyloides stercoralis*, *Giardia lamblia*, Hookworm, *Trichuris trichiura*, *Schistosoma mansoni*, *Diphyllobothrium latum*, and *Fasciola hepatica* were the intestinal parasites identified. At 7.88%, *A. lumbricoides* was the most prevalent parasite. The findings of this study are consistent with those of earlier researchers (4, 8, 18, 19), who identified *A. lumbricoides* as the most prevalent and important helminth.

According to age-related prevalence, infection was most prevalent in those between the ages of 5 - 7 years, followed by those between the ages of 8 - 10 years, and those between the ages of 14 - 16 years. In this study, the number of parasitic infections decreased as the children's age increased. The results of this study are consistent with findings from the study of intestinal parasite prevalence in school-age children in Lafia Nassarawa State (20). This study found that male children had a higher infection rate than female children in most communities. This finding

Table 1. Prevalence of Intestinal Parasites Among Primary School Children in Different Communities in Sagbama Local Government Area, Bayelsa State

Communities	No. Examined	No. Infected	Intestinal Parasites Species										Prevalence (%)
			A. lumbricoides	*E. Histolytica*	Hookworm	*G. lamblia*	*S. stercoralis*	*T. trichiura*	*D. latum*	*F. hepatica*	*S. mansoni*	Mixed infection	
Adagbabiri	23	11	3	3	0	0	3	1	0	0	1	3	47.83
Angalabiri	106	21	2	3	0	0	1	1	0	0	2	4	19.81
Bulou-Orua	133	20	7	3	2	5	1	1	0	0	1	6	15.04
Ebedebiri	74	14	3	3	3	0	1	2	1	1	0	2	18.92
Ofoni	33	3	2	1	1	1	0	0	0	0	0	0	9.09
Sagbama	128	48	16	12	5	6	2	3	3	0	1	6	37.50
Toru-Angiama	37	6	3	2	0	0	1	0	0	0	0	0	16.22
Toru-Orua	51	14	3	2	0	0	4	1	0	1	3	3	27.50
Trofani	37	12	6	2	2	0	0	1	0	0	1	3	32.43
Total	622	149	45	31	11	12	13	10	4	2	9	28	23.95

Table 2. Prevalence of Intestinal Parasites Among Primary School Children in Relation to Age in Sagbama Local Government Area, Bayelsa State, Nigeria

Age Groups in Years	Adagbabiri		Angalabiri		Bulou-Orua		Ebedebiri		Ofoni		Sagbama		Toru-Angiama		Toru-Orua		Ofoni		Total No. Examined	Total No. Infected	Prevalence (%)
	N.E	N.I	N.E	N.I	N.E	N.I	N.E	N.I	N.E	N.I	N.E	N.I	N.E	N.I	N.E	N.I	N.E	N.I			
5 - 7	8	4	34	10	45	9	19	4	11	2	44	16	9	3	13	5	12	6	195	59	30.26
8 - 10	5	3	29	6	35	5	24	7	8	1	28	12	11	1	19	5	3	3	162	43	26.53
11 - 13	3	2	17	3	23	3	17	3	9	0	32	14	13	2	10	3	11	1	135	31	22.92
14 - 16	7	2	26	2	30	3	14	0	5	0	24	6	4	0	9	1	8	2	127	16	12.6
Total	23	11	106	21	133	20	74	14	33	3	128	48	37	6	51	14	37	12	622	149	23.95

Abbrevitions: N.E, number examined; N.I, number infected.

Table 3. Prevalence of Intestinal Parasites Among Primary School Children in Relation to Gender in Sagbama Local Government Area, Bayelsa State, Nigeria

Communities	Gender							Prevalence (%)	
	Total No. Examined	Total No. Infected	Total Prevalence of Males and Females (%)	Total No. of Males Examined	Total No. of Males Infected	Total No. of Females Examined	Total No. of Females Infected	Males	Females
Adagbabiri	23	11	47.83	15	8	8	3	53.33	37.50
Angalabiri	106	21	19.81	55	9	51	12	16.36	23.53
Bulou-Orua	133	20	15.04	76	11	57	9	14.47	15.79
Ebedebiri	74	14	18.92	48	5	26	9	10.42	16.01
Ofoni	33	3	9.09	16	2	17	1	12.50	5.88
Sagbama	128	48	37.50	73	30	55	18	41.10	32.73
Toru-Angiama	37	6	16.22	20	4	17	2	11.76	11.76
Toru-Orua	51	14	53.85	14	9	37	5	75.00	13.15
Trofani	37	12	32.43	18	6	19	6	33.33	31.58
Total	622	149	24.96	335	84	287	65	25.07	22.65

agrees with those of other researchers (16, 17) but differs from those of Tongiura et al. (20), who found a higher infection rate in females than in males. It may be because male children engage in outdoor activities, whereas female children mostly do household chores indoors.

Risk factors associated with the distribution and spread of intestinal parasites infection among school-age children showed that source of drinking water, toilet facilities, washing of hands after using the toilets, washing of hands before meals, the pattern of waste disposal, and washing of hands after waste disposal were associated with Intestinal parasitic infections. This is based on the findings of Gizaw et al. (21) which reaffirms WHO's position safe and sufficient water, sanitation, and hygiene (WASH) play a key role in preventing numerous neglected tropical diseases NTDs such as intestinal parasitic infections, soil-transmitted helminths, and schistosomiasis (22). Most children in the Sagbama local government area with a river as their source of drinking water were infected with intestinal parasites. Also, a greater percentage of those that never treated their water at home were more infected than those that treated their water which further buttresses the crucial role of WASH in the reduction of transmission of intestinal parasitic infections and soil-transmitted

Table 4. Pattern and Practices of Primary School Children That Promote Transmission of Intestinal Parasitic Infections in Sampled Communities

Variables	No. Examined	No. Infected	Prevalence (%)
Source of drinking water			
Borehole	263	11	4.18
Community Tap	120	20	16.67
River	142	91	64.08
Hand-dug well	-	-	-
Stream	-	-	-
Rain	97	27	27.84
Treatment of water at home			
Yes	370	22	5.95
No	252	127	50.40
Method of treatment			
Chlorine	10	-	-
Boiling	30	2	6.67
Alum	330	21	6.36
Never	252	127	50.40
Toilet facilities			
Water cistern	35	3	8.57
Pit latrine	175	34	19.43
Riverside	412	112	27.18
The pattern of hand washing after using the toilet			
Soap and water	210	27	12.86
Ash and water	45	2	4.44
Water alone	339	95	28.02
Waste disposal pattern			
River/stream	413	92	22.28
Dust bin	28	11	39.29
Garbage pit	150	37	24.67
Burning	31	9	29.03
Washing hands after garbage/waste disposal			
Yes	168	15	8.92
No	454	134	29.52
Hand washing before eating meals			
Yes	477	14	2.94
No	145	135	93.10
The pattern of washing raw vegetables/fruits before eating			
Always	101	7	6.93
Sometimes	89	18	20.22
Rarely	-	-	-
Whenever l remember	432	124	28.70

helminths. In the same vein, people who used Riverside as their toilet facilities were more infected than those who used other facilities such as water cistern and even pit as their toilet. Furthermore, higher infection rates were observed among those who didn't wash their hands before meals compared to those who did; and among those who didn't wash their hands after waste/garbage disposal compared to those who did. These observations further lay credence to the fact that increased access to improved water, sanitation, and hygiene (WASH) infrastructure and services contributes greatly to the reduction in the STH disease burden by reducing exposure to Soil-Transmitted Helminths STH infective stages in the environment (23).

5.1. Conclusions

Intestinal parasitic infection is relatively prevalent in the Sagbama local government area of Bayelsa State. Provision of safe drinking water, improved sanitation, and a step-up in health education in the communities or local government will reduce the exacerbation of intestinal parasitic infection in the Local Government Area.

Footnotes

Authors' Contribution: The study was designed by AEA and GDBA. Data were acquired and analyzed by JG. AEA drafted the manuscript, and all the authors approved the manuscript.

Conflict of Interests: There was no research funding or support received from any employer or government. The authors declare that there is no conflict of interest.

Data Reproducibility: The data presented in this study are uploaded during submission as a supplementary file and are openly available for readers upon request.

Ethical Approval: Ethical approval was obtained from the Department of Public Health, State Ministry of Health and State Primary Schools Board, and Research Management Committee of the University of Port Harcourt (UPH/Ceremad/Rec/mm78/005) according to http://www.URL.com/IC-23456.

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Informed Consent: Written informed consents were obtained from the Community Development Committee (CDC), and informed consents were given by community chiefs and elders prior to the study. The parents, teachers, and participants were properly enlightened on the study's aims, objectives, benefits, and protocols, the need for voluntary participation, and the right to stop participation at any time.

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