Original Research Article

Enteroparasitism among school children in a coastal community of Chorkor, Accra-Ghana: an urgent need for improved sanitation and public health education.

Abstract

Background: Intestinal parasitic infections (IPIs) among school children are important public health problem, especially in developing countries like Ghana, but information on prevalence in coastal communities remains scanty. Monitoring of IPIs and associated risk factors especially in areas of poor sanitary conditions are necessary for intervention strategies.
Aim: The present study aimed to determine the prevalence of IPIs and associated risk factors among school children in the coastal town of Chorkor, Accra Ghana.

Methods: A cross-sectional study was carried out from May to September 2022 on 262 schoolchildren selected at Lantemeame-Chorkor. Faecal specimens were examined using saline and iodine wet mount and formal-ether concentration techniques. Sociodemographic data were collected using pre-designed, structured questionnaires. The results were analyzed using SPSS for Windows version 23 (SPSS Inc., Chicago, IL, USA).

Results: Out of 262 participants, the overall prevalence of IPIs was 19.5% (51/262). The most common intestinal parasite was *G. lamblia* (5.7%), followed by *E. histolytica* (3.4%), *Taenia solium* (3.1%), Ascaris lumbricoides (3.1%), and *S. mansoni* (1.1%). Dual infection of G. lamblia and *E. histolytica* occurred in 3 children (1.1%). Prevalence in males (38.7%) was significantly higher than in females (11.8%) *(P* =0.0001). Children, 5-6 years had highest prevalence (31.3%) followed by 7-8 years (28.2%) and the lowest (8.6%) was in 13 years and above.
Children who practiced open defecation, eat food from both street and home, with illiterate mothers, large family size, and rainwater as drinking source all had comparatively high prevalence rates. Also, there were highly significant differences between infected and non-infected children regarding all behavioral and hygienic variables.

Conclusion: The present study revealed that IPIs remain a public health problem in the coastal community of Chorkor where sanitation is generally poor. Effective prevention and control strategies are needed to reduce the incidence of IPIs in this area of Accra.

Keywords: Chorkor coastal community, sanitation, intestinal parasitic infections, school children, Accra-Ghana

1. Introduction

Intestinal parasitic infections (IPIs) present a significant public health challenge globally especially in developing countries where they are important cause of high morbidity and mortality [1]. The World Health Organization estimates that approximately 3.5 billion people are exposed to IPIs, and 450 million suffer various illnesses of which more than half are children [2, 3].

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Overcrowding, lack of environmental sanitation and safe water, poor hygienic living conditions, severe malnutrition, low educational background, poverty, and lack of personal hygiene are the most potential risk factors for IPIs [4, 1]. Though IPIs affect people of all ages, children suffer most infections due to poor hygienic practices and their weak immune status [5, 6, 7].

The effect of IPIs could be very grave as they can impair digestion, limit nutrient absorption, cause diarrhoea, reduce appetite, and suppress the immune system [8, 9], though there are also asymptomatic infections [10]. IPIs are associated with intestinal bleeding, nutritional deficiency, cell and tissue damage, anemia, and delayed physical and mental development [11, 12]. This leads to high rates of school absenteeism and poor academic performance [13, 14, 15]. The most common intestinal parasite infections are caused by *Giardia lamblia*, *Entamoeba histolytica*, *Cryptosporidium* sp., *Ancylostoma duodenale*, *Ascaris lumbricoides*, *Trichuris trichiura*, Hookworm, *Strongyloides stercoralis*, and *Enterobius vermicularis* [6, 16, 17]. Their prevalence rates vary from one region to the other which may be attributed to many factors such as prevailing climatic conditions, geographic area, socioeconomic aspects, personal hygiene and population density [18, 19,]. Recently, an overall prevalence of 32.9% was reported among Egyptian school children, with the most prevalent parasitic species being *E. histolytica* (12.3%), *G. lamblia* (8.5%), *H. nana* (7.7%), and *A. lumbricoides* (5.7%) [7]. Similarly, epidemiological studies among school children in Kathmandu, Nepal recorded a prevalence of 40.6% with 9 pathogenic species of parasites identified [20]. In Ghana, an overall prevalence of 15% has been recorded among school children in Accra, and *Giardia lamblia* (10%), and *Schistosoma mansoni* (1.7%) were the common parasites found [21]. The majority of IPIs are transmitted through consumption of contaminated food or eating with contaminated hands whilst nematodes such as *S. stercoralis* and Hookworm are transmitted by penetration of their larvae through the skin [22, 23].

Past studies conducted in Ghana have revealed that IPIs are common in school children because of their vulnerability together with poor environmental conditions, which also vary from region to region [16, 10, 21]. Almost a decade ago, a prevalence rate of 19.1% was reported among school children in some coastal communities of Cape coast, Ghana, and the use of pit latrines together with lack of environmental sanitation were identified as contributing risk factors to the high prevalence [16]. Although Ghana has many coastal towns, most of which have poor environmental sanitation much focus has not been placed on studies to determine the effect of poor sanitary conditions on prevalence of intestinal parasitic infection among the inhabitants of these areas. Periodical assessment of local IPIs is needed to formulate an appropriate control and prevention strategies, for such high-risk communities. This study was aimed to estimate the current prevalence and associated risk factors of IPIs among school children most of whom are in frequent contact with poor sanitary conditions in the coastal town of Chorkor, Accra Ghana.

2. Materials and methods

2.1 Study design and setting

This was a school-based cross-sectional study that was conducted on nursery, primary, and junior secondary school children in selected schools at Lantemeame-Chorkor, a coastal town and suburb of Accra-Ghana, between May 2022 and September 2022 to assess the prevalence of IPIs among school children. Chorkor is a poorly planned and overpopulated community which overlooks the Atlantic Ocean. It is located 612 km north of the equator, 27 km west of the prime meridian and has geographical coordinates of latitude 5°31'36.9"N (5.5269100°), longitude 0°14'31.7"W (-0.2421500°) with a population number 314,627 in 2010 with an

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average growth rate of 0.6% per annum [24]. The climate is tropical with wet rainy and dry harmattan seasons. It is regarded as one of the major slums in Accra, and the main occupation of the residents is fishing and fish mongering. Illiteracy rate among most parents is generally high with low socio-economic status and they live in poor environmental conditions.

The community is densely populated and lacks basic social amenities such as toilets, drains and bath houses. Proper sewage systems and drains are not available, and wastewater from homes run through other homes with children defecating along these drains. The high overcrowding due to the unplanned nature of the town has led to the exposure to variety of communicable diseases. Most of the children play around the seashore where they also defecate and urinate. It was noted that public and private hygiene was lacking in the community.

2.2 Study Population

The study involved children of age four (4) to sixteen (16) years who were clinically healthy from selected daycare and basic schools in the Chorkor community. The schools were selected by random sampling and school pupils enrolled in the study were also sampled randomly using their class registers.

Children who had serious diseases, and treated last 1 month before the survey for any illness were excluded from the study.

2.3 Sampling techniques and sample size

The study populations were determined by a single population proportion statistical formula used for sample size determination: $N= (Z^2 (P)(1-P)) / e^2$ where N= Minimum sample size, Z= Critical value of two-tailed distribution (1.96 at 95% confidence interval), P= estimated prevalence of the infection and e= allowable error of 5% (0.05). In this study *P*= 15% (0.15) according to a study, 'Intestinal parasitic infections and risk factors: a cross-sectional survey of some school children in a suburb in Accra, Ghana' by Forson *et al.*, (2017). A 10% compensation for non-response rate was considered. Thus, the final calculated sample size was 260.

2.4 Study questionnaire

Data were collected using a structured questionnaire which was designed based on the research objectives. It was prepared first in the English language and then translated to the Ga language which is locally spoken in the community. The questionnaire includes data on the socio-demographic characteristics (age, gender, educational stage, residence, and father and mother education and occupation) of the participants, environmental and behavioral risk factors (school environment, finger hygiene, handwash habit, washing vegetables and fruits well before consumption, domestic animal and water source, and walking bare footed), and GIT symptoms (anorexia, nausea or vomiting, abdominal pain, bloating, constipation or diarrhoea and bloody stool).

2.5 Data collection

The objectives of the study were well explained to the children and their parents and teachers by research assistants who were trained for data collection. Parents, teachers, and guardians who gave their consent on behalf of the children were given the pretested structured questionnaire to fill. The research assistants and teachers assisted parents who could not read to understand the questionnaire.

For students who could provide samples on the same day, stool samples were deposited onto a piece of paper and with the help of a spoon applicator was transferred into a dry, clean, wide neck, leak-proof container with a well fitted screw cup based on WHO standard of stool sample

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collection as previously described [25]. During the interview, the school environment and fingernails hygiene of children were observed by the research assistants.
For children who could provide the sample another day, the research assistants explained how the sample should be taken and precautions needed to avoid sample contamination to the participants and parents. Stool samples were labelled with the name, age, gender, identification number and the time of collection. Questionnaires were labelled with the same identification number for the participant on the stool container.
Upon receipt of the samples, 10% formalin was added and immediately transported in an ice-chest to the Microbiology laboratory of the Medical Laboratory Sciences, SBAHS, University of Ghana.

2.6 Stool examination

All stool specimens were examined macroscopically for colour, consistency, blood, mucous, pus, and parasite stages such as adult helminths, larvae, and segments of cestodes, which are visible to unaided eyes. They were then examined by the direct smear using a light microscope and the formol-ether concentration method as previously described [26].
For the direct smear method, an applicator stick was used to mix about 50 mg of stool with one or two drops of normal saline placed on a clean slide. A cover slip was used to create a thin, uniform suspension. The entire film was screened systematically for the presence of parasites. The remaining samples were then processed using a modified acid-fast technique and 10% formalin for formol-ether concentration. Using an applicator stick, about 1 g of stool was placed in a clean 15-mL conical centrifuge tube containing 7 mL of formalin-saline for the formol-ether concentration technique. The resulting suspension was filtered through a sieve into another conical centrifuge tube. The debris trapped in the sieve was discarded. After adding 3 mL of diethyl ether to the formalin solution, the contents were centrifuged at 3200 rpm for 3 min. The supernatant was discarded, and a smear of the sediment was made on a clean glass slide and covered with a cover slip. The entire area under the coverslip was then systematically examined using ×10 and ×40 objective lenses to detect ova, cysts, trophozoites and larvae of enteric parasites. Also, in the case of modified acid-fast staining, the faecal smear was methanol-fixed (2-3 min) and stained with carbol fuchsin for 5 min. Then it was rinsed with 50% ethanol followed by tap water. It was then decolorized with 1% sulfuric acid for 2 min, washed with tap water, and counter-stained with alkaline methylene blue for 1 min. Finally, the preparation was examined for the oocyst of intestinal coccidian parasites under a light microscope using a 100-fold magnification.

2.7 Ethical approval

Ethical clearance (ethical identification SBAHS/AA/MLAB 10741778/2021-2022) was obtained from the Ethical Review and Protocol Committee of the School of Biomedical and Allied Health Sciences of the University of Ghana. Permission was obtained from the heads of schools from which the children were recruited for study. The aim of the study was explained to the study participants and their parents or guardians. Written informed consent was obtained from the parents or guardians of the children. The confidentiality of the data was maintained. Children who were infected with the intestinal parasite(s) were referred to the Korle bu Polyclinic, Accra for further investigation.

2.8 Statistical analysis

Data collected were coded and analysed using the Statistical Package for Social Sciences (SPSS) version 23.0. The association of possible risk factors and presence of intestinal parasite infection were evaluated using bivariate logistic regression analysis model. Two tailed

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Pearson's rank correlation was used to test for the association between various factors and prevalence of intestinal parasites. The results of the association were considered as statistically significant when the P-value was below 0.05.

3. Results

Sociodemographic characteristics

From a total of 262 school children studied, 75 (28.6%) were males and 187 (71.4%) were females (Table 1). The minimum age recorded was 4 years whilst the maximum was 17 years. The age group 9-10, formed the highest proportion of children in the study.

Prevalence of Intestinal Parasites

In all, 51 of the children were infected with intestinal parasites giving an overall prevalence of 19.5%. The infection rate in males (38.7%) was significantly higher than females (11.8%) (*P*=0.0001). With respect to age, children 5-6 years had the highest infection (31.3%) followed by 7-8 years (28.2%) and the lowest was in 13 years and above where 8.6% prevalence was recorded. Although no particular trend was observed, infection was generally lower in ages 11 and above, and the difference was not significant ($P > .05$) (Table 1).

Types of parasites identified

The most common parasite detected was *G. lamblia* (5.7%), followed by *E. histolytica* (3.4%) (Table 2). Others were *Taenia solium* (3.1%), *Ascaris lumbricoides* (3.1%), and *S. mansoni* (1.1%). Dual infection of *G. lamblia* and E. histolytica occurred in only 3 children (1.1%).

Socioeconomic conditions and associated risk factors

With respect to the type of toilet facility used, there was no significant difference in the rate of infection of intestinal parasites ($P > .05$). However, children who practiced open defecation recorded the highest infection (21.1%) followed by children who used latrine (19.1%). Those who used water closet had the least infection (18%). Children who obtained their food from both the street and home were most infected (23.1%) compared with others who had their food from home alone (11.4%) or from street alone (21.3%) (Table 3). Children whose mothers had no formal education (illiterates) recorded a significantly high rate of infection (20%) compared with those with educational level up to secondary (6.2%) or higher (4.8%) ($P = .035$). A similar trend was observed between fathers and their children. With occupation, a significantly high proportion of children whose mothers were involved in fish mongering (24.1%) ($P= .019$) were infected, and a similar trend was observed for father's occupation (Table 3). Children whose family size was four or more had a higher infection rate (22.6%) than those with family size of three or less (16%), though the difference was not significant ($P> 0.05$). Again, children whose source of drinking water was rainwater recorded the highest infection (50%) compared with those who drank well water (37.5%) or pipe water from vendors (31.4%), pipe water from home (9.1%), borehole water (10%) and sachet water (10.2%) (Table 3).

Behavioral and hygienic practices

A comparatively low infection rate was obtained for children who practiced regular handwashing before and after meals (16.4%), compared with infection in those who did not (22.7%) and those who sometimes washed their hands (22.0%) (Table 4). A significantly

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higher infection occurred in children who played in moist sand at the seashore (23.7%) than those who did not (5.1%) (P < 0.05). Also, a significantly higher infection rate was observed in children without clean fingernails (25%), compared with children with clean fingernails (13.9%) (P= 0.01). With regards to deworming status, children who had dewormed less than 3 months before the study had the lowest infection rate (10%), whilst the highest infection occurred in children who had been dewormed 1-2 years ago.

4. Discussion

Intestinal parasitic infection is a common public health challenge among the majority of school children in many developing countries particularly as a result of their frequent interaction with unclean environments and poor personal hygiene. IPIs have severe impact on health and cognitive performance of school children. It is therefore necessary that an investigation is conducted regularly to determine rate of infection among the children and treatment offered where needed. In the present study, school children in a coastal community where the children are constantly exposed to poor sanitary and environmental conditions were tested for intestinal parasites. An overall prevalence of 19.5% was recorded which agrees with a similar study in another coastal community of Ghana in which 19.1% was reported [16]. The prevalence rates from these coastal communities represent a higher infection rate over several other studies done in Ghana [21, 10]. The higher infection rate recorded from the coastal communities may be due to poor environmental sanitary conditions and personal hygiene. These observations call for an urgent attention of health authorities to focus on children living in coastal communities.

Infection rates in male children (38.7%) was significantly higher than females (11.8%), an observation that was also reported previously by Forson et al. (2017) in Ghana, and similarly among Ethiopian school children [28] and children in Nigeria [27]. The present report however contradicts others in which prevalence was rather higher in females [29, 30] and those with no difference in prevalence among gender [31, 4].
In Ghana, male children usually play outdoors and engage in outdoor activities like playing football, which predispose them to higher risks of infection. This may explain the higher rate of infection in males than females observed in the present study.

The percentage of monoparasitism was higher than multiparasitism in this study which was in agreement with other studies [7, 22, 4]. However, the recovery of different species of parasite suggests that the children are exposed to unsanitary environmental conditions and unhygienic practices. The parasite species recorded include *Ascaris lumbricoides*, *Giardia lamblia, Entamoeba histolytica*, Hookworm, *Taenia solium* and *Schistosoma mansoni*.
G. lamblia was the predominant parasite with a prevalence rate of 5.7% followed by E. histolytica (3.4%) and *A. lumbricoides* (3.1%). Similarly, *G. lamblia* was by far the most prevalent parasite recorded among children in Mozambique [1], Nigeria [4], and Eswatini [30]. *Giardia lamblia* cyst may persist in water, even after conventional water treatment procedures [32], contributing to higher prevalence. *Ascaris lumbricoides* and Hookworm are soil-transmitted helminths with infections associated with poor environmental conditions and unhygienic practices and have been reported among school children in many other studies [9, 31, 11, 33]. The children in the present study may have been infected as a result of playing in contaminated soil. *Schistosoma mansoni* with prevalence of 1.1% was recorded as the least infection among the children in this study. Children usually get infected by this parasite through swimming as a recreation in a water body infested with the parasite. The cercariae form of the parasite penetrate their skin to give infection. The children infected are suspected to have visited a schistosomiasis endemic community during which infection might have occurred. An

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equally low prevalence of this parasite was reported in an earlier study in a coastal community of Ghana [16].

Age related prevalence was observed with the highest parasitic infection rates seen among children of age range 5-6 years. Infection was generally low among older children of age 13 years and above. Apart from high levels of physical activity, younger children are usually geophagic and also tend to walk bare footed which could be source of infections. Similar observations have been made in other studies [7, 4 and 34].

Table 1. Sex and age distribution of intestinal parasites among 262 school-aged children of Chorkor community

Characteristic		No. examined	No. infected	Percentage (%)	P-value
Sex	Male	75	29	38.7	0.0001*
	Female	187	**22**	11.76	
Age (years)	< 5	39	8	20.51	0.43
	5 - 6	32	10	31.25	
	7 - 8	39	11	28.21	0.76
	9 -10	49	12	24.49	
	11-12	35	4	11.43	0.72
	13 - 14	35	3	8.57	
	≥ 15	33	3	9.09	

Table 2. Prevalence of Intestinal Parasites identified in 262 school-aged children of the Chorkor community

Parasites	No. examined	No. infected	Prevalence (%)	P-value
Ascaris lumbricoides	262	8	3.05	
Giardia lamblia	262	15	5.73	0.38
Entamoeba histolytica	262	9	3.44	
Hookworm	262	5	1.91	0.41
Taenia solium	262	8	3.05	
Schistosoma mansoni	262	3	1.12	0.5
G. lamblia + E. histolytica	262	3	1.12	

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Table 3. Demographic and socioeconomic conditions of school-aged children of Chorkor community

Categories	No. examined	No. infected	Percentage infected (%)	P-value
Type of toilet				
Latrine	89	17	19.1	0.37
Open Defecation	95	20	21.05	
Water Closet	78	14	17.95	0.25
Feeding				
From home	70	8	11.43	
From the street	75	16	21.33	0.05
Both home & street	117	27	23.08	0.39
Educational level				
MOTHER				
None	80	16	20	0.035*
<Secondary	65	4	6.15	
>Secondary	42	2	4.76	0.38
FATHER				
None	38	18	47.37	0.13
<Secondary	22	8	36.36	
>Secondary	15	3	20	0.14
Occupation				
MOTHER				
Fishing	31	2	6.45	
Fish mongering	58	14	24.14	0.019*
Professional	28	1	3.6	
Trader	43	4	9.3	
Other	27	1	3.7	0.18
FATHER				
Fishing	34	17	50	
Fish mongering	7	5	71.43	0.15
Professional	16	3	18.75	
Trader	14	3	21.43	
Other	4	1	25	0.43
No. of Family members				
≤ 3	125	20	16	0.09
≥ 4	137	31	22.63	
Drinking Water				
Borehole	10	1	10	0.49
Sachet Water	118	12	10.17	
Rainwater	2	1	50	0.036*
Well	8	3	37.5	

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Pipe from vendors	102	32	31.37	0.002*
Pipe from home	22	2	9.09	

Table 4. Behavioural and hygienic practices among school-aged children in Chorkor community

Categories	No. examined	No. infected	Percentage infected (%)	P-value
Handwashing				
Yes	128	21	16.4	0.13
No	75	17	22.67	
Sometimes	59	13	22.03	0.47
Play in moist sand/at seashore.				
Yes	203	48	23.65	0.000*
No	59	3	5.08	
Fingernail neatness				
Unclean	132	33	25	0.011*
Clean	130	18	13.85	
Deworming status				
No	136	23	16.91	0.12
Less than 3 months	50	5	10	
3-12 months	12	3	25	0.005*
1-2 years	21	8	38.1	
>2 years	43	12	27.91	0.20

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The present study was conducted in a coastal community with environmental conditions similar to other coastal communities in Ghana. A prevalence of 19.5% of intestinal parasites infection recorded in this study is comparable to that which was reported (19.1%) in another coastal community in Ghana [16]. In other non-coastal communities, lower prevalence rates were reported [21, 10]. The disparity in prevalence may be due to peculiar factors in coastal settings including poor sanitary conditions.

Regarding type of toilet facility used by children, even though children who practiced open defecation recorded highest infection rate, the difference between the other types is not significant. In the process of open defecation, the children walk on contaminated soil which may harbour parasitic agents thereby placing them at a high risk of infection. Some studies have however reported that the use of latrines is an associated risk factor for intestinal parasitic infection [16, 35].

The study has also revealed that behavioral and personal hygienic practices of children play a significant role in the spread of intestinal parasites. In the present study, children who do not always wash their hands before meals, those without clean finger nails, as well as those who usually play in the sand at the seashore all had high rates of infection. Children with untrimmed finger nails may harbor parasitic agents underneath their nails, which could cause infection if hands are not washed before meals. The association of these risk factors with prevalence of intestinal parasites has also been reported elsewhere [18, 7, 31, 22].

Other risk factors identified in our study include source of drinking water, family size of more than four, and educational status of parents. Children whose source of drinking water was rain water and pipe water from vendors recorded the highest infection. These sources can easily be contaminated by parasitic agents such as cysts of *G. lamblia* and oocysts of *Cryptosporidium* sp. In Eswatini, rain or well water showed a considerable risk factor for intestinal parasite infection in children [30]. Similar reports were obtained from children in Yemen [34], Central Mozambique [36], Kapan VDC, Kathmandu [20], and Ethiopia [6]. A large family size usually reduces the quality of life making it difficult for some parents to take good care of their children and also increases the possibility of intestinal parasite transmission. In our study children belonging to small family sizes had low infection rates, and this agrees with other studies [29, 33].

With regards to parent's educational status, children of illiterate parents had high infections which may be due to parents' lack of basic knowledge of sources of parasitic infection and means to prevent or control them. Many studies support these observations [7, 29, 6].
A study among Egyptian children however disagrees that low educational level of parents leads to high infection rates in children [31].

5. Conclusion

In conclusion, the study showed that intestinal parasites were prevalent in children of age 4 – 16 years selected from daycare and basic schools in the Chorkor community of Accra. Children, 5-6 years had highest prevalence, and the most common parasites were *G. lamblia* and *E. histolytica*. The provision of hygienic toilet facilities, treated water for drinking, and public health education about risks and prevention of IPIs especially personal hygiene will help in controlling the transmission of these parasites in the various schools.

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