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Research Article

Intestinal Parasitic Infection and Associated Risk Factors Among Pre-school Children in a Deprived Community in Amasaman, Accra-Ghana

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Abstract

Intestinal parasites (IPs) affect health, growth and development of children worldwide. At child daycare centres, children are potentially exposed to infections due to close interpersonal contact and contact with environment including soil they play with. In the city of Accra, Ghana, daycare centres are very common and many parents leave their children in these centres for a considerable period each day for work. These children could be prone to intestinal parasitic infections (IPIs) in these institutions. The present study was carried out to determine the prevalence and risk factors associated with IPIs among children in selected daycare centres at Amasaman, a suburb of Accra, Ghana. A cross-sectional study was conducted among a total of 143 children of age 5 years and below randomly selected from three daycare centres at Amasaman, Accra. Stool samples were collected from each child for parasitological laboratory investigation. Additionally, a structured questionnaire was used to gather socio-demographic characteristics, and the information correlated with laboratory findings. The entire results were analyzed using SPSS for Windows version 23 (SPSS Inc., Chicago, IL, USA). The overall prevalence of IPIs among the children was 18.9% (27/143). Infection in females (20.0%) was higher than in males (17.5%) though difference was not significant (P=0.669). Infection was highest in children of age 3 years, with no infection in those of age 1 year. The most common parasite identified was *Giardia lamblia* (7.0%), followed by *Cryptosporidium* sp. (4.9%), and then *Entamoeba coli* (3.5%). Others included *Ascaris lumbricoides* (0.7%), Hookworm (0.7%), *Schistosoma intercalatum* (0.7%) and *E. histolytica* (0.7%). There was a low rate of mixed infection (0.7%) which occurred for *G. lamblia* and *Entamoeba coli.* There was significant association between IPIs and family size. Families with 6-10 children at home had highest prevalence (42.1%). Children with mothers who had primary education had highest prevalence (24.4%). No significant association was found for source of drinking water, breastfeeding habits, presence of domestic animals or deworming status (p> 0.05). The present study revealed that IPIs is a public health problem in daycare centres at Amasaman. Health education on personal hygiene, environmental sanitation, potable water supply and deworming should be considered to control the prevalence of intestinal parasites among children in daycare centres.

Keywords

Amasaman Community, Daycare Centres, Intestinal Parasites, Children, Accra-Ghana

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1. Introduction

Intestinal parasitic diseases remain an important health challenge in many developing countries throughout the world, and particularly common in socio-economically depressed communities [1-4]. The World Health Organization (WHO) has reported that, about three billion of world population is infected with intestinal parasites and 450 million people, including children suffer from the adverse effects of these infections [5]. Children are more susceptible, constituting the greatest risk population and many studies suggest that children in day care centers and orphanages can suffer malnutrition as a result [6-9]. The high infection rate among children is largely attributed to ignorance, poor hygiene, direct contacts and sharing toys with other children [10, 11, 2]. Soil-transmitted helminth infections, which form significant proportion of these IPIs especially hookworm infection causes childhood and maternal anaemia resulting in great disability [12]. Some infections can cause iron-deficiency anaemia, growth retardation in children, intestinal obstruction and other physical and mental health problems [13]. Notable among these intestinal parasites are protozoans namely *Entamoeba histolytica*, *Giardia lamblia* and *Cryptosporidium* sp. which are common and frequent cause of diarrhoea in children [14, 15].

The transmission of intestinal parasites is high among children in crowded social institutions such as daycare centres, dormitories, and orphanages [16-18]. The mode of transmission is primarily through ingestion of the cysts or oocysts of parasites usually by hands or through contaminated tools or objects. The (oo) cysts can be also transmitted through contaminated water or by consumption of contaminated fruits or water [19, 20]. Reports indicate that the prevalence varies in countries around the globe [21-23], and from one social institution to another [16, 24] based on prevailing risk factors [21, 25, 26]. A prevalence of 23.6% was recently reported in the Nigerian state of Kwara, and the authors identified factors such as unclean water sources, poor hygiene, and economic conditions as main causes of infection [27]. Among preschool children in Sekota town, Ethiopia, Kassaw et al. observed 29.9% prevalence and also reported irregular deworming, animals in close human habitation and economic conditions as associated risk factors [24]. In Triple Border Brazil, Argentina and Paraguay, prevalence of 26.9% was recorded, and low maternal education was identified as a risk factor [23]. Also, in Iranian daycare centres, prevalence range of 10.6- 26.6% has been reported with associated risk factors including parental education and habit of handwashing playing a significant role in infection rates [28, 29]. Other risk factors such as poor sanitation, domestic hygiene and bad eating habits were identified in a study conducted in Nigerian orphanage and daycare centres in which 9.2% prevalence was recorded [17].

In Ghana, several studies have been conducted to ascertain prevalence of intestinal parasites among children of school going age [30-32] but little is known on preschool children. The children in Ghanaian preschools or daycare centres and other social institutions spend very long hours together and must therefore be given the needed attention regarding their public health safety. In Ho, Volta region of Ghana a prevalence of 14% intestinal parasitic infections (IPIs) was recorded among preschool children with maternal education identified as an associated risk factor for infection [18]. Also, bowl water used for communal handwashing represented a risk factor of intestinal parasite infection in a preschool at Accra, Ghana [33]. The increasing demand of work in the city of Accra has compelled majority of parents to leave their children at daycare centres during the day. Children in these facilities are more vulnerable to IPIs due to inadequate sanitary conditions and many other factors. So far, no study has been conducted to investigate prevalence of these infections in the daycare centres situated in new settlements at the suburb of Accra including Amasaman. Like many other new settlements, a major part of Amasaman lack many basic infrastructures including potable water, and the community depends on water from many sources including wells, bore-holes, open ponds and sachet water. Given the rapid establishment of new daycare centres, preschool children in such communities could be at public health risk including IPIs. This situation underscores the urgent need to undertake a study to determine prevalence and risk factors of IPIs among children in daycare centres in the Amasaman community. Results of our study will address this gap and provide vital information for health authorities and owners of daycare centres in similarly deprived communities in Accra, Ghana. In so doing, the public health safety against spread of intestinal parasites in these facilities will be guaranteed.

2. Methods

2.1. Study Design and Setting

This was a preschool-based cross-sectional study that was conducted on nursery school children in selected daycare centres located at Amasaman, a suburb of Accra-Ghana, between May 2022 and September 2022 to assess the prevalence of IPIs among these children. Amasaman is situated about 20 km North-West of Accra, the capital of Ghana, and occupies a land area of approximately 284 sq km with about 412 communities. The area lies within latitudes 5 °42 N, 5 °43 N and longitude 0 °17 W, 0 °19 W with a population number 314,299 according to 2021 population and housing census with 155,543 being males and 158,756 females [34]. The climate is tropical with wet rainy and dry harmattan seasons. A major infrastructural challenge in the area is the lack of access to potable water. A large number of the population rely heavily on open ponds and streams as sources of water for domestic

use. Currently, many people are migrating from the city to this municipality for various economic reasons. As a result of this, more daycare centres (pre-schools) are being established to the demand of parents for them to be able to carry out their daily work in the city. Illiteracy rate among most parents is generally high with low socio-economic status and they live in poor environmental conditions.

2.2. Study Population

The study involved children of age one (1) year to five (5) years who were clinically healthy from selected daycare in the Amasaman community. The daycare centres were selected by random sampling and the children 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 population was 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= 9.2% (0.092) according to a study, '*Prevalence of Intestinal Parasites Among Children Attending Daycare and Orphanage Centers in Kaduna Metropolis, Kaduna' by Hadiza et al., 2019* [17]. A 10% compensation for non-response rate was considered. Thus, the final calculated sample size was approximately 140.

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 and Akan languages which are widely spoken in the community. The questionnaire includes data on the socio-demographic characters (age, gender, father and mother education and occupation, source of water, breastfeeding habits) 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 parents of the children and their classroom attendants by research assistants who were trained for data collection. Parents and guardians who gave their consent on behalf of the children were given the pretested structured questionnaire to fill. The research assistants and attendants assisted parents who could not read to understand the questionnaire.

For children 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 collection as previously described [35].

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 [35].

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 10% formalin for formol-ether concentration, and also the modified acid-fast technique for oocyst of intestinal coccidian parasites [35].

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 proprietors of daycare facilities 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 advised to attend health care facilities 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 IPI were evaluated using bivariate logistic regression analysis model. Two tailed 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

3.1. Sociodemographic Characteristics of the Study Participants

In this study, a total of 143 children comprising of 63 (44.1%) males and 80 (55.9%) females were selected from three randomly selected daycare centres. The minimum age recorded was 1 year and the maximum was 5 years, with the mean age of 3.5±1.1 years. The age 3 years recorded the highest count of 49 out of 143 (34.3%), and the age 1 year recorded the lowest count of 3 (2.1%). Most of the participants were from mothers who attended only primary school (62.9%). Similarly, most of the participants (84.6%) came from family sizes of 1 to 5, and most had their main drinking source as the sachet (bagged) water (90.9%) with the others (9.1%) depending on water from several other sources (Table 1).

3.2. Prevalence of Intestinal Parasitic Infections Among the Study Participants

The stool sample analysis indicates that 27 out of a total of 143 children were infected with intestinal parasites, giving an overall prevalence of 18.9%. The infection rate within females (20.0%) of the school was higher than the males (17.5%), although the difference was not significant (P=0.669) (Table 1). With regards to age, the results revealed that no infection was detected among children of age 1 year. The highest prevalence (26.5%) occurred among children of age 3 years, followed by children of age 4 years old, and there was no significant difference in infection rate among the various ages (P= 0.329) (Table 1). The intestinal parasites detected in this study were both protozoans and helminths. The most common parasite identified was *Giardia lamblia* (7.0%), followed by *Cryptosporidium* sp. (4.9%), and then *Entamoeba coli* (3.5%). There was a low rate of mixed infection (0.7%) composed of *G. lamblia* and *Entamoeba coli* (Table 2).

Table 1. *Prevalence and socio-demographic characteristics of intestinal parasites among children at selected daycare centres, Amasaman, Accra-Ghana (n= 143).*

Parameter	No. examined	No. infected	Prevalence (%)	P-value
Sex				
Male	63	11	17.5	0.669
Female	80	16	20.0	
Age (years)				
1	3	0	0.0	
2	30	4	13.3	
3	49	13	26.5	0.329
4	39	8	20.5	
5	22	2	9.1	
Maternal education				
Illiterate	15	2	13.3	
Primary	90	22	24.4	0.137
Secondary	30	3	10.0	
Tertiary	8	0	0.0	
Source of water				
Pipe-borne & sachet	7	3	42.9	0.108
Borehole/well & sachet	4	1	25.0	

Parameter	No. examined	No. infected	Prevalence (%)	P-value
Rainwater & Sachet	1	1	100.0	
Pipe-borne, rainwater & sachet	1	0	0.0	
Sachet alone	130	22	16.9	
Breastfeeding				
Exclusive	72	13	18.1	0.834
Non-exclusive	71	14	19.7	
Domestic animals				
Yes	108	23	21.3	0.225
No	35	4	11.4	
Family size				
1-5	121	18	14.9	
6-10	19	8	42.1	0.015
>10	3	1	33.3	
Deworming status				
Yes	112	23	20.5	0.441
No	31	4	12.9	

Table 2. *Prevalence of intestinal parasites identified among children at selected daycare centres, Amasaman, Accra-Ghana (n= 143).*

Name of intestinal parasites	No. examined	No. infected	Prevalence (%)
Ascaris lumbricoides	143	1	0.7
Cryptosporidium sp	143	7	4.9
Giardia lamblia	143	10	7.0
Entamoeba coli	143	5	3.5
Hookworm	143	1	0.7
Schistosoma intercalatum	143	1	0.7
Entamoeba histolytica	143	1	0.7
G. lamblia + *Entamoeba coli*	143	1	0.7
Total	143	27	18.9

Table 3. *Age and sex related prevalence of various intestinal parasites among children at selected daycare centres, Amasaman, Accra-Ghana (n= 143).*

Parameter	No. examined	No. infected	AL (%)	C (%)	GL (%)	EC (%)	H (%)	SI (%)	EH (%)	GL + EC (%)
Age (years)										
1	3	0	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
2	30	4	0(0.0)	0(0.0)	1(3.3)	1(3.3)	1(3.3)	0(0.0)	1(3.3)	0(0.0)
3	49	13	1(2.0)	4(8.2)	6(12.2)	1(2.0)	0(0.0)	1(2.0)	0(0.0)	0(0.0)

Parameter	No. examined	No. infected	AL (%)	C (%)	GL (%)	EC (%)	H (%)	SI (%)	EH (%)	GL + EC (%)
4	39	8	0(0.0)	1(2.6)	3(7.7)	3(7.7)	0(0.0)	0(0.0)	0(0.0)	1(2.6)
5	22	2	0(0.0)	2(9.1)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
Sex										
Males	63	11	0(0.0)	1(1.6)	5(7.9)	3(4.8)	1(1.6)	1(1.6)	0(0.0)	0(0.0)
Females	80	16	1(1.3)	6(7.5)	5(6.3)	2(2.5)	0(0.0)	0(0.0)	1(1.3)	1(1.3)

AL= Ascaris lumbricoides, C= Cryptosporidium sp., GL= Giardia lamblia, EC= Entamoeba coli, H= Hookworm, SI= Schistosoma intercalatum, EH= Entamoeba histolytica.

Regarding infection of individual parasites among each age and sex, only children of age 3 years recorded helminthic infections of *Ascaris lumbricoides* (Table 3). The same helminth was found in 1 female and none in the males. None of the ages or sex recorded occurrence of all parasites within an individual.

3.3. Association of the Different Risk Factors with Intestinal Parasitic Infections

The study results revealed a statistically significant association between IPIs and some other sociodemographic factors including family size (P= 0.015). Families with 6-10 children in their homes had highest prevalence (42.1%), whilst the lowest prevalence (14.9%) occurred among families with 1-5 children. With regards to effect of mother's educational level on infection, children whose mothers had primary education recorded the highest prevalence of 22 out of 90 (24.4%), whilst the lowest prevalence, 3 out of 30 (10.0%) occurred in children whose mothers had secondary education. None of the children whose parents had tertiary education was infected. However, the difference in infection rates was not significant (p= 0.137). Similarly, there was no significant association of IPI with the other sociodemographic factors studied (p> 0.05) (Table 1). These included sources of drinking water (pipe-borne, sachet, borehole/well, and rain water) for each child. Whilst there was no infection recorded for the only child whose sources of water were pipe-borne, rain water and sachet altogether, the other only child whose sources were both rain water and sachet had infection. All other children who drank water from other sources recorded various rates of infection. Regarding breastfeeding habits, although a higher infection rate (19.7%) was recorded for non-exclusively 6-month breast fed children than those exclusively breastfed (18.1%), the difference was not significant (p= 0.834). Also, children who had domestic animals (cat, dog, fowl, goat, rabbit and sheep) at their homes recorded a higher infection rate (21.3%) than children without domestic animals (11.4%). Surprisingly, the prevalence of IPIs in children de-wormed was higher than those who had not, though the difference was not significant (p> 0.05) (Table 1).

4. Discussion

Intestinal parasites infection (IPI) is an important public health problem. The identification of distribution, prevalence and risk factors of IPIs in a given community is a prerequisite for planning and evaluating intervention programmes. The present study assessed the prevalence of IPIs among children of the age five years and below. The overall prevalence of IPIs was 18.9%. This prevalence was higher than the prevalence recorded in similar studies conducted at Nigeria [36] in which 13.8% was observed, and also by Akimbo et al. [37] who recorded 3.9%. Others include a report by Hadiza et al. who observed a prevalence of 9.2% in a recent study at Kaduna state, Nigeria [17]. Also, In Northwestern Iran, a prevalence of 10.6% was recorded [29]. The discrepancy in results could be due to geographic variations as well as environmental and socio-economic factors in the study areas. The present study was conducted in a suburb of Accra city and is an area which is still undergoing infrastructural development and therefore lacks basic social amenities including provision of potable water for many households, good toilet facilities and health care services. However, other studies have also reported prevalence rates higher including 52.8% at Karachi [38], 71.0% at northern Madagascar [2] and 82% among children at Pakistan [3]. The differences could be as a result of several factors including differences in hygiene practices, parental socio-economic status and laboratory techniques for sample analysis.

In the present study, IPIs was higher in females than in males, but not significantly different. This observation agrees with studies in Ethiopia [4], northwestern Iran [29] and Slovakia [1]. In Ghana, both boys and girls at age 5 years and below are not given any gender related chores and therefore equally exposed to environmental conditions that promote infections. The observation was thus expected.

Children of age 3 years had highest infection rate in this study, followed by those of age 4 years. The results agree with studies at North-Eastern Iran [28] in which children, 3-4 years old recorded significantly higher infection rates than other age

groups. The age group 3-4 years therefore appears to be the most active group, and children in this group are likely to have more contact with their surroundings than the others, thereby increasing their risk of IPIs. A significant observation was the absence of infection among children of age 1 year. The restrictions in movement and special attention usually given to very young children by attendants or care givers at the daycare centre could be the reason for this result. The age of children has been identified as an important risk factor in the transmission of intestinal parasites in pre-school children [39, 40].

The most common intestinal parasite identified in the present study was *G. lamblia* followed by *Cryptosporidium* sp. This observation is in agreement with many studies worldwide including the Triple Border Brazil, Argentina, and Paraguay [23], Khodabandeh, Northwestern Iran [29], Jawi town, north-west Ethiopia [4], northern Madagascar [2], and Mozambique [41]. These parasites are important water-borne protozoan parasites which are largely associated with consumption of water or food contaminated by their cysts or oocysts [42, 43]. *G. lamblia* and *Cryptosporidium* sp. have both been detected in Ghanaian children hospitalized for acute diarrhoea at Accra [15, 44]. It will therefore be necessary to improve upon sanitary conditions and hygienic practices in the daycare centres. In addition, these results show the need for a close monitoring of companies that provide water for consumption in the community. Worm infection was generally low in the present study which could be due to the high proportion of children de-wormed, comprising 112 of 143 (78.3%) as indicated in Table 1.

Infection was higher for families with large number of children in the house. With large number of children at home, inter-personal contact with individuals increases, and the likelihood of contaminating the environment also increases. Moreover, the quality of care and attention required of parents for their children decreases as mothers become unable to provide such care. Reports elsewhere show that the more the number of children at home, the higher the risk of intestinal parasitic infection [45, 46].

In this study, children of mothers with low education and illiterate mothers had the highest infection, with none of the children of parents with Tertiary education infected. These data corroborate the findings of other studies [23, 28, 46], which also found a higher prevalence of parasitic infections in children whose mothers had low education. This appears to confirm the notion that, highly educated women practice better hygiene than illiterate women. Perhaps, the knowledge of parents about the ways parasites can be transmitted or their awareness of the prevention techniques can decrease the risk for intestinal parasite infection among children.

Pipe-borne water and sachet water are considered to be well treated water and wholesome for public consumption in Ghana. Observations from the present study indicate that children who depended on these sources of water were equally infected, just like the other sources. Thus, there is the need to conduct further studies to ascertain the public health safety of sachet water and pipe-borne water. In Southwest Ethiopia, children who drank water from river or well recorded higher IPIs compared with those who depended on pipe water [4].

Breast milk provides babies and infants with essential and nutritive elements for the body which are supposed to protect the child from infections. As a result of the immunological properties, the World Health Organization (WHO) has recommended a 6-month excusive breastfeeding period for all mothers. In support of this, Adamu et al. observed that only a few of the children breastfed more than six months had *Cryptosporidium* sp. and *Isospora belli* infection compared with others not breastfed [4]. However, in our study, there was no significant difference in infection regarding the proportion of children who were exclusively breastfed and those who were not. This observation was quite surprising, and needs further investigation.

5. Conclusion

Intestinal parasitic infections are common among children in daycare centres at Amasaman, Accra and may be associated with unclean water sources, family size, low maternal education and poor hygiene. It is recommended to implement effective control measures through general health education with special emphasis on cleanliness, personal hygiene and sanitation as well as transmission and prevention of infections.

Abbreviations

IPs	Intestinal Parasites
IPI	Intestinal Parasitic Infection
IPIs	Intestinal Parasitic Infections
SBAHS	School of Biomedical and Allied Health Sciences
WHO	World Health Organization

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Author Contributions

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Emmanuel Afutu: Writing – review & editing

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Data Availability Statement

The data supporting the outcome of this research work has been reported in this manuscript.

Nonetheless, the lead author is available to provide additional data upon request.

Conflicts of Interest

The authors declare no conflicts of interest.

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