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Low Prevalence of Helminth Infections among Primary School Children in the Volta Region of Ghana

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Authors' contributions

This work was carried out in collaboration among all authors. Author VNO conceived and designed the study, performed the statistical analyses, wrote the protocol and the first draft of the manuscript. Authors JOA and KHAA assisted in the design of the protocol, conducted the literature searches, and revised the drafted manuscript. Authors LMA, IJ and IA managed the laboratory work as well as reviewing the protocol and manuscript; while author FKA supervised the whole work. All authors read and approved the final manuscript.

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ABSTRACT

Soil transmitted helminths (STH), as well as *Schistosoma haematobium* and *mansoni,* are very common helminth infections among children in Sub-Saharan Africa (SSA). This study aimed at evaluating the prevalence of helminth infection among children in the Volta Region of Ghana. This was a cross sectional study involving primary school children from 5 primary schools in 3 districts in

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the region. A total of 550 primary school children were enrolled in this study. Questionnaires were administered to each child, together with collection of stool and urine samples. Samples were then examined using the microscope to detect the presence of larvae and eggs of intestinal helminths as well as *Schistosoma* parasites. Pearson chi square test was used to evaluate the association between *Schistosoma sp.* and other variables in the study. Only 1.27% (7/550) of children in this study were infected with *Ascaris lumbricoides* and 0.91% (5/550) with hookworm. A single child was infected with *Schistosoma mansoni*, and 57(10.36%) children were infected with *Schistosoma haematobium.* Highest prevalence of *Schistosoma haematobium* infections were seen in primary school children at the Afegame Evangelical Presbyterian primary school (34, 27.64%) and Davanu primary school (14, 17.72%). The low prevalence of helminth infection among the school children in this study might suggest a positive impact of the periodic deworming program for the children. This effort should be intensified, especially among the poor and vulnerable groups in the region.

Keywords: Intestinal helminthes; Schistosoma haematobium and mansoni; periodic deworming; primary school children.

1. INTRODUCTION

Helminths are worms classified as metazoan parasites because of the macroscopic morphology of their adult forms [1]. Intestinal nematodes or roundworms, also known as soil transmitted helminths (STH), and *Schistosoma* organisms, platyhelminth trematodes, are helminths of public health importance [1,2]. They significantly contribute to the neglected tropical disease burden prevalent among the poor in rural areas and in impoverished urban populations, especially in sub-Saharan Africa (SSA) [3,4].

Common STH like *Ascaris lumbricoides*, *Trichuris trichiura* and Hookworms, all have their adult forms living in the intestines of infected humans [5]. They are all transmitted via the faeco-oral route, except for hookworms that are transmitted via infective larval penetration of the skin [5]. *Schistosoma* species, such as *S. haematobium* and *S. mansoni,* are transmitted when an infective cercaria penetrates the skin of a person who comes in contact with water body contaminated with the infective stage of *Schistosoma* parasite [6]. The adult worms live in venous plexuses while their eggs migrate to the bladder in case of *S. haematobium* or to the intestines as in the case of *S. mansoni* [1].

Over two billion STH infections have been recorded globally with the highest infection rate seen among the world's poorest in SSA and Asia [7,8]. Over 150 million cases of schistosomias is also known to be reported globally with close to about 120 million cases caused by *Schistosoma haematobium* infections alone in SSA [7]. These Helminth infections are more prominent in school-aged children, adolescents and pre-school children with severe consequences on their physical and mental growth [9]. The increased risk of helminth infection seen in children is not only due to their less developed immunity, but also behavioral habits like poor toilet habit, walking bare footed, poor personal hygiene and poor hand washing practices [10]. Behavioral risks in children are also responsible for *S. heamatobium* infection. It is the wont of school-aged children to visit streams and rivers for swimming and other activities, thereby exposing them to infective cercariae of *S. heamatobium* [11]. These behavioral risks for infection are higher in poor socio-economic environment where sanitation and water supply are poor [8,12].

Ghana was one of the countries that heeded to the call by WHO global assembly calling on developing countries to begin the control of helminth infections among school going children [13]. With a population of over 40% consisting of children from 0-14years, many of them live in rural areas where socio-economic and biological factors favour the spread of helminth infection [14,15,16]. The deworming exercise is incorporated into the School Health and Education Programme (SHEP) of the Ghana Education Service and the Neglected Tropical Disease Control Programme (NTDCP) of the Ghana Health Service, with support from Non-Governmental Organizations (NGOs) [17]. Hence, periodic mass preventive chemotherapy was rolled out to target STH and *Schistosoma* organisms [18,19]. It is important to periodically assess the progress of the deworming exercise by evaluating the prevalence of helminth infections among the school going children. Thus, this study tends to evaluate the prevalence of helminth infections among primary school children in 3 districts in the Volta region.

2. METHODOLOGY

2.1 Study Area

This study was carried out in three districts of the Volta region of Ghana. The Volta region is one of the ten regions in Ghana located between latitudes 50º 45‟N and 80º 45‟N in the Southeastern part of the country, bounded by Togo on the east and Lake Volta on the west. The districts studied include Ho municipal area (which is the administrative capital of the region), Adaklu, and Agotime-Ziope districts. These districts are close to each other and share boundaries. The rainfall pattern is characterized by two rainy seasons referred to as major (from March to June) and the minor (from July to November).

2.2 Study Population

School children from the ages of 6 to 14 years were selected from primary schools in the three districts. Primary schools in rural or densely populated areas were particularly selected for this study. A total of five primary schools were selected for this study: Freetown primary school in Ho municipality, Dave and Davanu Primary schools in Adaklu district, and Evangelical Presbyterian (EP) Primary schools in Afegame and Kpetoe both in Agotime-Ziope district. Children (from primary one to six) who signed the assent form and whose parent signed the informed consent form were recruited into the study.

2.3 Ethical Clearance

This study was carried out after due ethical clearance and approval was obtained from the Ghana Health Service Ethical Committee (ID NO: GHS-ERC: 29/11/15). Written informed consent was also obtained from the parents of children who participated in the study and assent forms were signed by the children before they were enrolled onto the study.

2.4 Data Collection

This study was cross sectional, involving administration of questionnaires, as well as collection of stool and urine samples. These took place from March 14th to April 14th, 2016, between 9:30am and 3pm each day.

2.5 Questionnaire Administration

Children enrolled in this study were asked about their demographic and socioeconomic status vis-á-vis: occupation of both parents, the type of housing, toilet type, family size, and the person who child stays with.

2.6 Sample Collection

Fresh stool and urine samples were collected from the children in clean, appropriately labeled plastic containers. Samples were transported in ice chest to the designated laboratory for storage and same-day analysis of parasitic organisms.

2.7 Microscopic Detection of Intestinal Parasites

Microscopic examination of the stool was done using the wet mount method. Briefly, small amounts of faeces from each sample were placed directly on separate microscopy slides; drops of normal saline were then added and mixed to form homogenous solutions. Cover slips were then placed over the stool smears, and examined under the microscope. This method was used to detect the presence of protozoa, and the eggs of intestinal helminths and *S. mansoni* in the stool samples.

2.8 Microscopic Detection of *Schistosoma haematobium*

Microscopic examination of the urine sample was done using the sedimentation method. Urine samples collected were put in centrifuge tubes, and centrifuged for about 2 minutes at 2000Xg. The sediments were examined under the microscope in low magnification to detect the presence of the ova of *S. haematobium.*

2.9 Statistical Analyses

A frequency distribution was performed for all the socioeconomic and demographic characteristics of the primary school children in the study (i.e. age, occupation of parents, education of parents, etc), together with other characteristics like intestinal helminths and *Schistosoma* parasites infections. These characteristics of the children were further analyzed using Pearson χ^2 tests and ANOVA for the comparison of mean. Analyses were done with 95% confidence interval (CI), and p-value of 0.05 and below ($p \leq 0.05$) was considered statistically significant. All analyses were performed using IBM SPSS Statistics version 21.0 (IBM Corporation, Armonk, NY, USA).

3. RESULTS

A total of 550 children were enrolled in this study. Table 1 shows the frequency distributions of the characteristics of the study population. There were more females (301, 54.73%) than males (249, 45.27%) in the study population. The predominant occupation of the parents was trading (mothers, 334, 60.73%; fathers, 254, 46.18%), followed by farming (mothers, 156, 28.36%; fathers, 170, 30.91%), while few are civil servants (mothers, 34, 6.18%; fathers, 103, 18.73%). The children either lived in compound houses (196, 35.64%), semi-detached houses (189, 34.36%) or single rooms (165, 30%). Few practice open defecation (49, 8.91%), while majority have toilet facilities within their houses (341, 62%); but, some still use the community toilet (169, 29.09%). A minimum family size of two probably consisting of a single parent or guardian and a child was seen among 69 (12.55%) of the children. Majority of the children belong to a family size of three (120, 21.82%), followed by a family size of four (106, 19.27%) and five (96, 17.45%) respectively. Some children lived in a large family size of 6 (65, 11.82%) and above (94, 17.09%). Children in this study lived with either their fathers (25, 4.55%), mothers (80, 14.55%), both parents (318, 57.82%), grandparents (70, 12.73%) or with persons other than their parents or grandparents (57, 10.36%).

Table 2 highlights the socio-demographic characteristics of the children in the five schools from the three districts in this study. There was a significant difference in the mean age of the primary school children ($p<0.001$) in the various schools, with Afegame EP primary school having the least mean age of 10.08±2.32, whereas Kpetoe EP primary school recorded the highest (11.46±2.14). There was no significant difference

Table 1. General baseline characteristics of children in five primary schools in the Volta Region of Ghana

Parameter	Characteristics	Frequency (n = 550)	Percentage (%)
Sex	Male	249	45.27
	Female	301	54.73
Occupation of father	Trader	254	46.18
	Farmer	170	30.91
	Civil servant	103	18.73
	Unemployed	23	4.18
Occupation of mother	Trader	334	60.73
	Farmer	156	28.36
	Civil servant	34	6.18
	Unemployed	26	4.73
House Type	Family compound	196	35.64
	Single Room	165	30
	Semidetached house	189	34.36
Family size	2	69	12.55
	3	120	21.82
	4	106	19.27
	5	96	17.45
	6	65	11.82
	>6	94	17.09
Who child stays with	Father	25	4.55
	Mother	80	14.55
	Both parents	318	57.82
	Grant parents	70	12.73
	Others	57	10.36
Toilet facility	Within the building	341	62
	Community toilet	160	29.09
	Open /bush toilet	49	8.9
Name of school	Dave	84	15.27
	Freetown	125	22.74
	Davanu	79	14.36
	Afegame	123	22.36
	Kpetoe	139	25.27

Data is presented as frequency and proportions

in the distribution of sex of the children among the five primary schools (p=0.357). There was a statistically significant difference with the various occupations of the pupils' parents (Father, p<0.001; Mother, p<0.001). Primary school children in Freetown in Ho municipality had the highest proportion of parents that are civil servants (Father, 38, 36.89%; Mother, 13, 38.24%), followed by children from Kpetoe EP primary school (Father, 29, 28.16%; Mother, 11, 32.35%). Children in Davanu primary school had the highest proportion of fathers who are farmers (56, 32.94%), whilst children in Afegame EP primary school had most of their mothers as farmers (55, 35.26%). A significant number of children from Freetown primary school have toilet facilities within their homes (101, 29.62%, p<0.001), while most children from Afegame EP primary school use community toilet facilities (46, 24.34%, p<0.001). Open defecation was also mostly practised by children in Afegame EP primary school (17, 34.69%, p<0.001).

Fig. 1 highlights the different helminths observed in this study. Only 1.27% (7/550) of children in this study were infected with *Ascaris lumbricoides* and 0.91% (5/550) with hookworm. A single child was identified to be infected with *Schistosoma mansoni*, and 57(10.36%) children were observed to be infected with *Schistosoma haematobium.*

Table 3 stratified the primary school children according to their *Schistosoma haematobium* status. Boys were significantly more infected with *Schistosoma haematobium* (32, 12.85%) than girls 25(8.31%) in this study (p=0.053). There was significant heterogeneity in the prevalence of *Schistosoma haematobium* among the primary school children in the five schools in the study (p<0.001). There were no infections of *Schistosoma haematobium* seen among children in Kpetoe EP primary school. The highest prevalence of *Schistosoma haematobium* infection was seen among children attending the Afegame EP primary school (34, 27.64%); followed by Davanu primary school (14, 17.72%), Dave primary school (5, 5.95%) and Freetown primary school children in the Ho municipality (4, 3.20%) respectively. Children whose parents were farmers were proportionally more infected with *Schistosoma haematobium* infection (fathers 22, 12.94%; mothers, 22, 14.10%), but this finding was not significant (fathers, p=0.355 and mothers, p=0.268). Children who defecate in the open/bush were also noticed to be proportionally more infected with *Schistosoma haematobium* (7, 14.29%); but again this finding was not

Table 2. Socio-demographic characteristics of children in five primary schools in the Volta Region of Ghana

Parameter		Dave N=84(%)	Davanu N=79(%)	Freetown N=125(%)	Afegame N=123(%)	Kpetoe N= 139(%)	P value
Age (yrs.) Mean ± SD		10.76±2.85	11.32±3.35	10.93±2.68	10.08±2.32	11.46±2.14	<0.001
Sex of child	Male	37(14.86)	38(15.26)	51(20.48)	64(25.70)	59(23.70)	0.357
	Female	47(15.61)	41(13.62	74(24.59)	59(19.60)	80(26.58)	
Occupation of father	Trader	43(16.93)	20(7.87)	61(24.02)	56(22.05)	74(29.13)	<0.001
	Farmer	22(12.94)	56(32.94)	19(11.18)	45(26.47)	28(16.47)	
	Civil servant	19(18.45)	1(0.97)	38(36.89)	16(15.53)	29(28.16)	
	Unemployed	0(0.00)	2(8.70)	7(30.43)	6(26.09)	8(34.78)	
Occupation of mother	Trader	60(17.96)	26(7.78)	92(27.55)	57(17.07)	99(29.64)	<0.001
	Farmer	18(11.54)	47(30.13)	14(8.97)	55(35.26)	22(14.10)	
	Civil servant	3(8.83)	1(2.94)	13(38.24)	6(17.65)	11(32.35)	
	Unemployed	3(11.54)	5(19.23)	6(23.08)	5(19.23)	7(26.92)	
House types	Family house	41(20.92)	17(8.67)	39(19.90)	56(28.57)	43(21.94)	<0.001
	Single room	15(9.09)	23(13.94)	40(24.24)	37(22.42)	50(30.31)	
	Semi detached	28(14.82)	39(20.63)	46(24.34)	30(15.87)	46(24.34)	
Toilet facility	Within the building	52(15.25)	37(10.85)	101(29.62)	60(17.60)	91(26.68)	<0.001
	Community toilet	26(16.25)	34(21.25)	18(11.25)	46(28.75)	36(22.50)	
	Open bush toilet	6(12.25)	8(16.33)	6(12.25)	17(34.69)	12(24.48)	
Who child stays with	Father	5(20.00)	2(8.00)	6(24.00)	7(28.00)	5(20.00)	<0.001
	Mother	11(13.75)	6(7.50)	18(22.50)	24(30.00)	21(26.25)	
	Both parents	60(18.87)	62(19.50)	70(22.01)	57(17.93)	69(21.69)	
	Grant parents	3(4.29)	6(8.57)	16(22.86)	26(37.14)	19(27.14)	
	Others	5(8.77)	3(5.26)	15(26.32)	9(15.79)	25(43.86)	

Note: SD= standard deviation. P values derived from Pearson chi-square test for categorical variables and ANOVA for the mean of continuous variable

Table 3. Characteristics of primary school children stratified by *Schistosoma haematobium* infection status in the Volta Region of Ghana

Variables		*Schistosoma haematobium* Positive N= 57 (%)	*Schistosoma haematobium* Negative N= 493(%)	P value
Age (yrs.) Mean ± SD		10.75± 2.82	10.9±12.64	0.67
Gender	Male	32(12.85)	217(87.15)	0.053
	Female	25(8.31)	276(91.69)	
Name of school	Dave	5(5.95)	79(94.05)	<0.001
	Freetown	4(3.20)	121(96.80)	
	Davanu	14(17.72)	65(82.28)	
	Afegame	34(27.64)	89(72.36)	
	Kpetoe	0(0.00)	139(100)	
Occupation of Father	Trader	27(10.63)	227(89.37)	0.355
	Farmer	22(12.94)	148(87.06)	
	Civil servant	7(6.80)	96(93.20)	
	Unemployed	1(4.35)	22(95.65)	
Occupation of Mother	Trader	31(9.28)	303(90.72)	0.268
	Farmer	22(14.10)	134(85.90)	
	Civil servant	3(8.82)	31(91.18)	
	Unemployed	1(3.85)	25(96.15)	
Toilet facility	Within the building	34(9.97)	307(90.03)	0.177
	Community toilet	16(10.00)	144(90.00)	
	Open bush toilet	7(14.29)	42(85.71)	
Who child stays with	Father	4(16.00)	21(84.00)	0.636
	Mother	5 (6.25)	75(93.75)	
	Both parents	34(10.69)	284(89.31)	
	Grant parents	8(11.43)	62(88.57)	
	Others	6(10.53)	51(89.47)	

Note: SD= standard deviation. P values derived from Pearson chi-square test for categorical variables and ANOVA for the mean of continuous variable

significant (p=0.177). Children who live with their fathers were again observed to be proportionally more infected (4, 16%), (p=0.636).

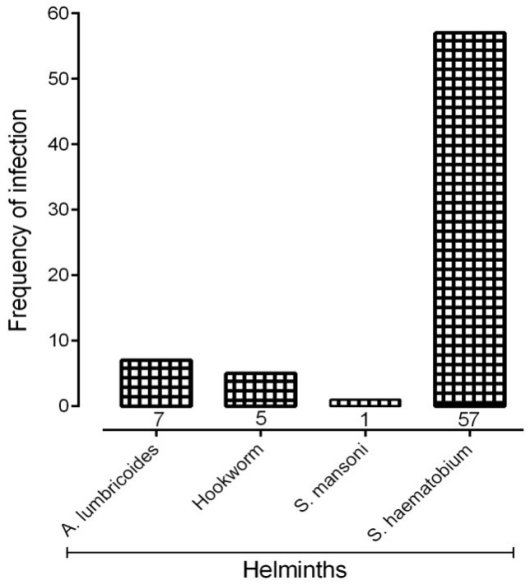

Fig. 1. Prevalence of helminths infections in primary school children in the Volta Region of Ghana

4. DISCUSSION

This study was a cross-sectional study aimed at evaluating the prevalence of helminths infections among five hundred and fifty primary school children from five separate primary schools in three districts in the Volta region infection.

There was a low prevalence of intestinal parasites infections among the primary school children in this study, with 2% or less prevalence seen for *Ascaris lumbricoides* and Hookworm. This result is similar to the low levels of intestinal parasites in a study conducted in South-Tongu district of the Volta region [20]. These low levels could be due to the periodic deworming exercise carried out by the regional School Health and Education Programme (SHEP) of the Ghana Education Service/Ministry of Education and the NTDCP of the Ghana Health Service [17,20]. Another possible reason that might be responsible for the low levels of intestinal parasite infections in the study, which also might be a probable limitation of this study, is the method used for the parasitological examination of the stool samples. The present study used Wet Mount method which is less sensitive compared with Formol-Ether concentration and

Kato-Katz methods [21]. However, it is important to note that similar work by Ayeh-Kumi et al. in 2016 [20] used the Formol-Ether concentration in addition to the Wet Mount methods in analyzing stool samples of school children in the South-Tongu district of the Volta Region, and still recorded no intestinal helminths infection in the children [20]. Another limitation which is common to both the present study and the South-Tongu study is the single stool sample collection from each primary school child. This might have contributed to the low level of infections, as multiple stool sample collection would have increased the chances of picking intestinal parasite in the stool of an infected person [22].

There was a 10% prevalence of *Schistosoma haematobium* infection in primary school children in this study. This prevalence is higher than that obtained from the study conducted in primary school children of the South-Tongu district of the Volta region, which reported a prevalence of 2.5% [20]. However, the prevalence of this study is within the range of a study done by Nkegbe in 2010 [23] among primary school children in five communities in the lower River Volta Basin of Southeastern Ghana with a prevalence ranging between 2-21% [23]. Notwithstanding, it must be stated that the prevalence recorded in this present study is quite lower compared to other studies conducted in other parts of Ghana [24,25,26]. These low levels of helminths infections can be attributed to the periodic deworming exercise rolled out in the region, as the drugs used like mebendazole and praziquantel might have destroyed the intestinal and *Schistosoma* parasites [17,27].

In this study, males were observed to be significantly more infected than females; a finding which is consistent with several other studies [24,26,28,29,30,31]. This male preponderance seen with *Schistosoma haematobium* infection is probably due to males being involved in activities that increase their exposure to infested water bodies, such as swimming, fishing and other recreational activities [24,28]. Some studies however have reported higher prevalence in females than males; clearly suggesting that if females are exposed to high-risk activities like their male counterparts their infection rate would also increase [25,32]. This suggests that the gender preference is probably behavioral rather than immunologic [33]. Children from Afegame EP primary school had the highest prevalence (28%) of *Schistosoma haematobium* infection. Afegame is a rural, farming and riparian community, a combination that contributes a great deal to higher prevalence of *Schistosoma haematobium* infection [20,34,28]. This same reason could explain why children whose parents are farmers, (though not statistically significant), had proportionally higher prevalence of *Schistosoma haematobium* infection [28]. More so, children who admitted to open defecation had proportionally higher prevalence of *Schistosoma haematobium* infection, even though this value was not statistically significant. Open defecation might be one of the drivers of helminths infections, particularly in areas of poor sanitation and inadequate water supply [35,36], as observed in these rural communities.

5. CONCLUSION

This study reported a relatively low level of soil transmitted helminths and *Schistosoma* infections, a finding which is consistent with other studies done in the region. This reassuring finding could be attributed to the periodic deworming exercise taking place among primary schools in the region. Despite these good results, the prevalence of *Schistosoma haematobium* in this study still needs attention. Deworming exercises, health education and improvement of sanitation should therefore be intensified, especially among primary school children in rural riparian areas whose risk for helminth infections might still be high in the region.

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CONSENT

As per international standard or university standard, patient's written consent has been collected and preserved by the authors.

ETHICAL APPROVAL

As per international standard or university standard, written approval of Ethics committee has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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