Original Research Article

Prevalence and associated factors of urinary schistosomiasis among basic school children in the Akyemansa District, Ghana

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ABSTRACT

Background: Globally, urinary schistosomiasis has devastating implications on school children. It predisposes them to dysuria, haematuria among others which can negatively influence their academic performance. This study determined the prevalence and associated risk factors of urinary schistosomiasis among basic school children in the Akyemansa district.

Materials and Methods: A cross-sectional study design using multi-stage sampling was used to enroll 504 basic school children from six communities of the Akyemansa District into study. Structured questionnaires were used to gather information on risk factors. Urine samples were collected and microscopically examined for the presence of *Schistosoma haematobium* (SH) ova. The observed ova were then quantified as light or heavy.

Results: Prevalence of SH infection among school children in Akyemansa District was 10.32% [95% CI: 7.80 -13.31%]. Out of 52 participants who were infected, 69.2% had light infection whilst the rest had heavy infection. Female participants were less likely to be infected with SH than males [OR=0.47; 95% CI: 0.23-0.97], children who do not stay by the river/stream were also less likely to be infected with SH compared to those who lived near waterbodies [OR=0.35; 95% CI: 0.17-0.72]. Additionally, participants who did not play around water bodies were also less likely to be infected with SH compared to those who did [OR=0.17; 95% CI= 0.04-0.71; p=0.015]. However, inhabitants of Kotokuom were more likely to be infected compared to those in Pawuda [OR=8.54; 95% CI: 1.91-38.27; p=0.005]

Conclusion: The prevalence of urinary schistosomiasis among basic school children in the Akyemansa district was found to be 10.32% [95% CI: 7.80 -13.31%]. Gender, staying around river/ stream, playing at river/ stream and habitation of participants were significantly associated with the prevalence of *Schistosoma haematobium* infection. The study therefore recommends that periodic drug administration and a comprehensive intervention strategy should be designed and implemented to reduce schistosomiasis prevalence.

Keywords: Urinary Schistosomiasis, School Children, Akyemansa District.

1. INTRODUCTION

Schistosomiasis has been shortlisted among the world's major public health challenges with marked incidence in about 77 developing countries in the tropics and subtropics (Bruun & Aagaard-Hansen, 2008; Thétiot-Laurent, J., Robert, & Meunier, 2013). It has been put on record that about 249 million people are infected globally with an alarming 779 million people at risk (Thétiot-Laurent, J., Robert, & Meunier, 2013).

Human schistosomiasis is a parasitic infection caused by various species of *Schistosoma*, namely, *Schistosoma haematobium* (*S. haematobium*), *S. mansoni*, *S. japonicum*, *S. mekongi*, and *S. intercalatum* (Gryseels, Polman, Clerinx, & Kestens, 2006). In 2015, a report by the Centre for disease Control (CDC) revealed that about 224 million malignant effects of schistosomiasis are seen annually in sub-Saharan Africa with an estimated 280,000 deaths, largely among rural inhabitants. A study by van der Werf, et al., (2003) depicted *S. haematobium* infection as the cause of 70 million cases of hematuria, 32 million cases of dysuria, 18 million cases of bladder-wall pathology and 10 million cases of major hydronephrosis in sub-Saharan Africa of which Ghana is no exception. The infection which is crucial among children has been linked with complications such as nutritional deficiencies, growth retardation, cognitive function impairment, decreasing physical activity, school performance, and work capacity and productivity (Stephenson, 1993).

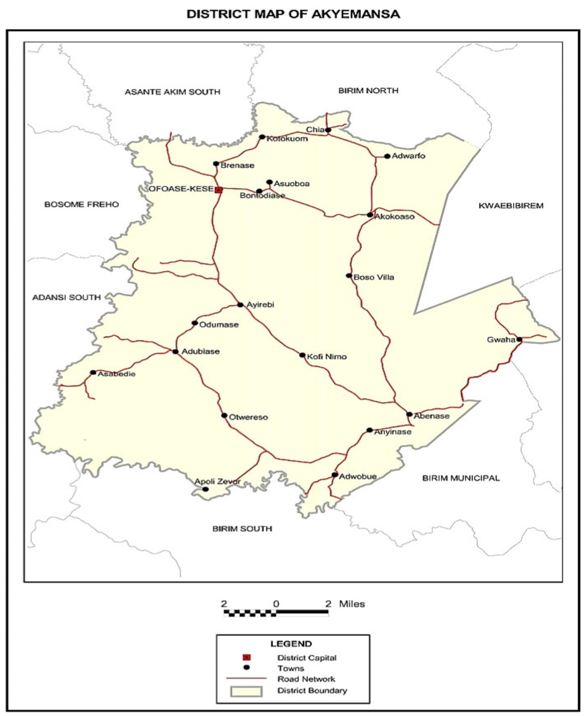
Urinary schistosomiasis is endemic in Ghana with widespread distribution across the country causing considerable morbidities. Its transmission is by fresh water snail (host) that belongs to the genus *Bulinus* and water contacts through human activities. Children are at greater risk of the infection and this is attributed to their love to play with water most of the time. Reports from studies conducted by Aryeetey et al., (2000), have depicted a range between 54.8 and 60.0% urinary schistosomiasis prevalence in southern Ghana, with increasing infection rates with age and a peak in the 10-19year category, and decreasing rate with increasing age. These figures reflect the need to monitor and control the rate at which children get infected with urinary schistosomiasis.

In ensuring appropriate interventions against schistosomiasis, information on the distribution and associated risk factors of the disease in different transmission settings remains a prerequisite. Furthermore, extensive mapping programme is required to facilitate scaling-up of the much needed preventive chemotherapy intervention in rural communities. This study therefore determined the prevalence and associated risk factors of *S. haematobium* infection among basic school children in the Akyemansa district, Eastern region, Ghana.

2. MATERIAL AND METHODS

2.1 Study Area

This study was conducted in six communities in the Akyemansa district. The district is located in the Eastern Region of Ghana and consists of 96 communities with a total population of 97,374. It covers a surface area of 613 kilometers square (Population and Housing Census, 2010). The District is predominantly rural with few urban settlements. Preliminary surveillance showed that the district has two (2) senior high schools, fifty nine (59) Junior High Schools and eighty six (86) primary schools. Most of the inhabitants in this district are farmers who cultivate cash crops like cocoa, cola, oil palm among other. The district is drained by several rivers and streams and among them are the two great historical rivers, the Birim and Pra tributaries. Access to safe drinking water is a major challenge, with the exception of Ayirebi Township that has pipe borne water as source of drinking water and some few communities that have boreholes. Majority of the population therefore depend mainly on wells, streams and rivers for their source of water for drinking and household activities. As illustrated in Figure 1 is a map of Akyemansa district.



Source: Ghana Statistical Service, GIS

Figure 1: District Map of Akyemansa

2.2 Sample size calculation

Cochran's sample size formulae was used in calculating for the total participants to be enrolled into the study. Using a urinary schistosomiasis prevalence of 51.7% reported in a similar study among children in Mozambique by Augusto et al., (2009), bearing in mind a 5% margin error, 95% confidence interval and 30% attrition, a sum of 499 sample size was attained. The sample size for the study was calculated as shown below;

$$N = \frac{Z^2 P(1-P)}{D^2}$$

Where;
N represents estimated sample size
Z represents constant for 95% confidence interval given as 1.96
P represents prevalence of urinary schistosomiasis of 51.7%
D represents the percentage margin of error taken as 5%

$$N = \frac{1.96^2 * 0.517 * 0.483}{0.05^2}$$

$$N = 384$$

$$N = \frac{30}{100} * 384$$

$$N = 499$$

However, extra 5 participants were still interested in the study, this made an overall of 504 basic children to be recruited into the study.

2.3 Study Design/ Eligibility Criteria

A cross-sectional study was conducted in the Akyemansa district in January, 2014. The study began by grouping the communities into six strata based on their geographical location with one community randomly selected from each stratum. These communities were Pawudu, Adubiase, Adjobue, Abenase, Nyamebekyere and Kotokuom. A total of five hundred and four (504) basic school children were recruited from the six communities within the Akyemansa district. The study included all children who attended the local basic school of the selected communities and within the age range of seven (7) to eighteen (18) years. Basic school children on any anti-parasitic agents for at most one week prior to the day of sampling were however excluded from the study. All children who satisfied the above inclusion criteria were recruited into the study. Structured questionnaire was then administered to obtain information on participants' socio-demographic characteristics, predisposing factors and knowledge on urinary schistosomiasis.

2.4 Sample collection and processing

2.4.1 Urine specimen collection

Each participant was given a labeled sterile urine container to collect random urine sample. The participants were directed to empty their bladder completely into the container after some minimal exercise. The samples were received the same day between 10:00 am and 2:00 pm. The urine samples were then assembled, kept in cold boxes with ice packs and transported to the laboratory attached to the Ayirebi Health Centre for immediate parasitological investigation.

2.4.2 Sample analysis

2.4.2.1 Microscopy

10ml of each urine sample was measured with a graduated measuring cylinder into a test tube and centrifuged at 3000rpm for 5 minutes to obtain the sediment and the supernatant. The supernatant was poured away and the sediment was re-suspended. A drop of the re-suspended sediment was then placed on a clean glass slide, cover slipped and examined using x10 and later x40 objective lenses of light microscope (Olympus American Clinical/Education CX® light microscope) to detect the presence or absence of *Schistosoma haematobium* egg.

2.4.2.2 Egg counting

Egg count was performed on each urine sample containing *Schistosoma haematobium* ova to rank the intensity of infection. Urinary schistosomiasis infection was categorized as light or heavy depending on the number of *Schistosoma haematobium* ova per 10ml of urine. Light infection represented less than fifty (50) *Schistosoma haematobium* ova per 10ml of urine whilst heavy infection meant more than fifty (50) *Schistosoma haematobium* ova per 10ml of urine.

2.5 Statistical analysis

Data collected was cleaned and entered into Microsoft excel 2010 and analyzed using SPSS version 22.0. Descriptive statistics was then used to calculate the frequencies and proportions of study participants with respect to various characteristics. The magnitude of association between urinary schistosomiasis and potential risk factors was then assessed using logistic regression and described in terms of odds ratio (OR) at 95% confidence interval with p-value <0.05 considered as statistically significant.

3. RESULTS AND DISCUSSION

3.1 RESULTS

Table 1 below shows the general characteristics of the study population. A total of 504 participants comprising 343 (68.1%) males and 161 (31.9%) females were included in the study. Majority, 264 (52.4%) of the respondents were aged 11-14 years. Among the respondents, 321 (63.7%) indicated that borehole was their source of drinking water. Most 311 (61.7%) of the respondents stayed by a river/stream. Out of the 504 respondents interviewed, 416 (82.5%) played with a water body where they lived and 495 (98.2%) swam in the waterbody (river/stream). Majority 476 (94.4%) indicated that they do not urinate in the river/stream. Also, 343 (68.1%) indicated that they were knowledgeable on SH infection. Out of the 504 respondents, 141 (28%) had ever suffered from SH infection.

Table 1: General Characteristics of Study Population

Variable	Male (n = 343)	Female (n = 161)	Total (n = 504)
Age range			
7-10	117(60.9)	75(39.1)	192(38.1)
11-14	197(74.6)	67(25.4)	264(52.4)
15-18	29(60.4)	19(39.6)	48(9.5)
Source of Drinking Water			
Pipe Borne Water	1(33.3)	2(66.7)	3(0.6)
Well	48(55.8)	38(44.2)	86(17.1)
River/Stream	64(68.1)	30(31.9)	94(18.7)
Borehole	230(71.7)	91(28.3)	321(63.7)
Staying around River/Stream			
Yes	208(66.9))	103(33.1)	311(61.7)
No	135(70.0)	58(30.0)	193(38.3)
Playing at River/Stream Bank			
Yes	297(71.4)	119(28.6)	416(82.5)
No	46(52.3)	42(47.7)	88(17.5)
Swimming in River/Stream			
Yes	339(68.5)	156(31.5)	495(98.2)
No	4(44.4)	5(55.6)	9(1.8)

Urinating in River/Stream			
Yes	19(67.9)	9(32.1)	28(5.6)
No	324(68.1)	152(31.9)	476(94.4)
Knowledge of Schistosomiasis			
Yes	253(73.8)	90(26.2)	343(68.1)
No	90(55.9)	71(44.1)	161(31.9)
Ever Suffered Schistosomiasis			
Yes	126(89.4)	15(10.6)	141(28.0)
No	217(59.8)	146(40.2)	363(72.0)

Table 2 shows the prevalence of urinary schistosomiasis stratified by demographic data. Out of the 504 participants, 52 representing 10.3% tested positive for urinary schistosomiasis. A higher prevalence (12.2%) of SH was found among males. Those who used river/stream as their major source of drinking water had a highest prevalence (11.7%) whiles those who drank pipe borne water had no prevalence. A higher prevalence, (13.5), (12.0%), (10.5%) and (10.7%) of SH was found among those stayed in river/stream, played in river/stream, swam in river/stream and did not urinate in river/stream respectively. The highest prevalence (26.3%) of SH was recorded in Kotokoum whiles no prevalence was found among inhabitants of Adubiase. A greater prevalence, (11.4%) was also found among participants who had knowledge of schistosomiasis. Gender, staying around river/ stream, playing at river/stream and inhabitant of school children were significantly associated with the prevalence of *Schistosoma haematobium* infection. Females had 53% reduced odds of SH infections compared to their male counterparts [OR=0.47; 95% CI= 0.23-0.97; p=0.042]. Those who did not stay around water bodies had 65% reduced odds of SH infections compared to those who did [OR=0.35; 95% CI= 0.17-0.72; p=0.004]. Furthermore, those who did not play around water bodies had 83% reduced odds of SH infections compared to those who did [OR=0.17; 95% CI= 0.04-0.71; p=0.015]. Participants who lived in Kotokuom had 8.54 times increased odds of SH infections compared to those in Pawudu [OR=8.54; 95% CI= 1.91-38.27; p=0.005].

Table 2: Prevalence of SH Infection Stratified by Demographic Data

Variable	Positive (n = 52)	Total (n = 504)	OR (95% CI)	p-value
Age range				
7-10	17(8.9)	192(38.1)	1	
11-14	32(12.1)	264(52.4)	1.42 (0.76 – 2.64)	0.268
15-18	3(6.2)	48(9.5)	0.68 (0.19 – 2.44)	0.561
Gender				
Male	42(12.2)	343(68.1)	1	

Female	10(6.2)	161(31.9)	0.47 (0.23 – 0.97)	**0.042**
Source of Drinking Water				
Pipe Borne Water	0(0.0)	3(0.6)	1	
Well	8(9.3)	86(17.1)	0.31 (0.03 – 3.32)	0.331
River/Stream	11(11.7)	94(18.7)	0.40 (0.04 – 4.16)	0.442
Borehole	33(10.3)	321(63.7)	0.34 (0.03 – 3.40)	0.361
Staying around River/Stream				
Yes	42(13.5)	311(61.7)	1	
No	10(5.2)	193(38.3)	0.35 (0.17 – 0.72)	**0.004**
Playing at River/Stream Bank				
Yes	50(12.0)	416(82.5)	1	
No	2(2.3)	88(17.5)	0.17 (0.04 – 0.71)	**0.015**
Swimming in River/Stream				
Yes	52(10.5)	495(98.2)	1	
No	0(0.0)	9(1.8)	0.94 (0.12 – 7.62)	0.959
Urinating in River/Stream				
Yes	1(3.6)	28(5.6)	1	
No	51(10.7)	476(94.4)	3.24 (0.43 – 24.35)	0.253
Knowledge of Schistosomiasis				
Yes	39(11.4)	343(68.1)	1	
No	13(8.1)	161(31.9)	0.68 (0.35 – 1.32)	0.259
Communities				
Pawudu	2 (4.0)	50 (9.92)	1	
Adubiase	0 (0.0)	50 (9.9)	0.48 (0.04 – 5.47)	0.554
Adjobue	7 (5.6)	126 (25.0)	1.41 (0.28 – 7.04)	0.674
Abenase	13 (9.8)	133 (25.0)	2.60 (0.57 – 11.96)	0.220
Nyamebekyere	9 (13.9)	65 (12.90)	3.86 (0.79 – 18.72)	0.094
Kotokuom	21 (26.3)	80 (15.87)	8.54 (1.91 – 38.27)	**0.005**

Table 3 shows the intensity of SH infection stratified by Demographic data. In relation to the 52 (10.3%) participants who tested positive for SH, 36 (69.2%) had light infection and 16 (30.8%) had heavy infection. A higher prevalence, (33.3%) and (37.5%) of heavy infection was found among males and 11-14 year old participants respectively whilst there was no prevalence of heavy infection among 15-18 year olds. A greater prevalence, (33.3%), (35.7%), (32,0%), (30.8%) and (31.4%) of heavy intensity SH was found among used borehole as source of drinking water, stayed around river/stream, played in river/stream, swam in river/stream and did not urinate in river/stream respectively. The topmost prevalence (42.9%) of heavy intensity SH was recorded in Adjobue whiles no prevalence was found among inhabitants of Pawuda. A greater prevalence, (38.5%) of heavy intensity SH was found among participants who had knowledge of schistosomiasis whiles a higher prevalence (43.3%) was also found among those had suffered from the infection before.

Table 3: Intensity of SH Infection Stratified by Demographic Data

Variable	Light (n = 36)	Heavy (n = 16)	Total (n = 52)
Age range			
7-10	13(76.5)	4(23.5)	17(32.7)
11-14	20(62.5)	12(37.5)	32(61.5)
15-18	3(100.0)	0(0.0)	3(5.8)
Gender			
Male	28(66.7)	14(33.3)	42(80.8)
Female	8(80.0)	2(20.0)	10(19.2)
Source of Drinking Water			
Well	6(75.0)	2(25.0)	8(15.4)
River/Stream	8(72.7)	3(27.3)	11(21.2)
Borehole	22(66.7)	11(33.3)	33(63.5)
Staying around River/Stream			
Yes	27(64.3)	15(35.7)	42(80.8)
No	9(90.0)	1(10.0)	10(19.2)
Playing at River/Stream Bank			
Yes	34(68.0)	16(32.0)	50(96.2)
No	2(100.0)	0(0.0)	2(3.8)
Swimming in River/Stream			
Yes	36(69.2)	16(30.8)	52(100.0)
No	0(0.0)	0(0.0)	0(0.0)

Urinating in River/Stream			
Yes	1(100.0)	0(0.0)	1(1.9)
No	35(68.6)	16(31.4)	51(52.6)
Knowledge of Schistosomiasis			
Yes	24(61.5)	15(38.5)	39(75.0)
No	12(92.3)	1(7.7)	13(25.0)
Ever Suffered Schistosomiasis			
Yes	17(56.7)	13(43.3)	30(57.7)
No	19(86.4)	3(13.6)	22(42.3)
Communities			
Pawudu	2 (100.0)	0 (0.0)	2 (3.8)
Adubiase	0 (0.0)	0 (0.0)	0 (0.0)
Adjobue	4 (57.1)	3 (42.9)	7(13.5)
Abenase	10 (76.9)	3 (23.1)	13 (25.0)
Nyamebekyere	7 (77.8)	2 (22.2)	9 (17.3)
Kotokuom	13 (61.9)	8 (38.1)	21 (40.4)

3.2 DISCUSSION

The overall prevalence of urinary schistosomiasis was found to be 10.32% [95% CI: 7.80 - 13.31%]. This result is similar to a prevalence of 10.5% reported in Nigeria (Bishop, & Akoh, 2018) and 8.6% reported in Central Sudan (Ahmed, Abbas, Mansour, Gasim, & Adam, 2012). On the contrary, our finding was lower than a prevalence of 95% reported in Bunuso in rural Ghana (Ayeh-Kumi et al., 2013) and 51.7% reported in Mozambique (Augusto et al., 2009). The inconsistency in the above prevalence rates can be attributed to differences in study periods, sample sizes, participants recruited for the study and geographical location.

Additionally, the present study found a statistically significant association between gender and the prevalence of *Schistosoma haematobium* infection (p=0.042). Further, the prevalence of SH infection and the intensity of heavy SH infection were higher in males than in females. This observation is consistent with that of Banwat et al., (2012) in Langai plateau, Nigeria. Similarly, the high prevalence of heavy SH infection common among males than females in our study is similar to the observation made by Nkengazong, Nijioku, & Asonganyi, (2013), in South-West Cameroon. Water contact activities such as swimming and playing in water bodies could be a possible cause of the variation in the prevalence of SH infection and the intensity of SH infection among males and females. In the transmission of urinary schistosomiasis, the risk of infection varies directly with frequency of contact with contaminated water (Jordan & Webbe, 1999). Secondary to the frequency of contact, the time of the day, duration of exposure and the area of the skin exposed also account for the risk of infection (Jordan and Webbe, 1999). Generally, more males often engage in swimming than females which leads to the higher prevalence of SH infection in males. Females mostly fetch water from the rivers and streams for washing and cooking at home. Hence, the females have less contact to water than males and this accounted for the low prevalence of SH infection in females. As proposed by Remoue *et al*., (2001), females have stronger immune response to schistosomiasis infection than males because the females are known to produce more specific IgA, TGF-β and Interleukin-10 (1L-10) to the infection. Hence, there is higher intensity of heavy infection in males than in females.

In relation to the 52 positive SH ova cases, 16 (30.8%) were heavy SH infections and 36 (69.2%) were light infections. Hence, light infection was more prevalent than heavy infection. The higher prevalence of light infection is in conformity with an earlier study conducted which investigated the prevalence of urinary schistosomiasis among Nigerien school children (Tohon, et al., 2008). The low prevalence of heavy infection is important because the severity of morbidity caused by urinary schistosomiasis is directly related to the intensity of infection. Therefore, the heavy infection causes more severe morbidity and the light infection causes less severe morbidity (King and Dangerfield-Cha, 2008).

The age group 11-14 years had the highest prevalence of SH infection followed by 7-10 years and 15-18 years. The intensity of heavy infection was highest among the age group 11-14 years whilst the intensity of light SH infection was predominantly high among the age group 15-18. The findings in our study in relation to the prevalence and intensity of SH infection among the age groups of the participants is in keeping with studies conducted among basic school children in Kigogo administrative ward of the Kinondoni district of Dare-es-Salam (Ndyomygyenyi *et al*., 2001) and two peri-urban villages in the South- Western state of Osun, Nigeria (Ugbomoiko *et al*., 2010) where the participants aged 10-14 years had the highest prevalence and intensities of infection than those in the younger or older age groups studied. These findings, may be attributed to the swimming or playing behavior of participants aged 11-14 years in infested river or stream, resulting in the high urinary schistosomiasis infections recorded among these subjects. Also, lower immunity at age 11-14 years may be another contributing factor to their susceptibility. The prevalence of infection among the age group 15-18 years could have resulted from prolong exposure to infested water bodies.

The study also found a significant statistical association between staying around river or stream, playing at river or stream bank and SH ova with the communities in which the study was carried out. The prevalence of SH ova or urinary schistosomiasis was 26.3% in Kotokuom,13.8% in Nyamebekyere, 9.8% in Abenase, 5.6% in Adjobue and 4% in Pawudu. No participant from Adubiase tested positive to SH ova. It was also observed that all the communities with SH infections had water bodies in or closer to them. These findings are in conformity with another study conducted in the Ga district of the Greater Accra region of Ghana by Aboagye and Edoh (2009), which revealed a high prevalence rate of SH infection in two communities in the district; Mahem (58%) which is closer to the Weija dam than Galilea (49%). Additionally, the present study is in agreement with a study carried out in Kumasi in the Ashanti region of Ghana. The prevalence of urinary schistosomiasis in Kumasi South hospital (surrounded by Atonsu, Gyinyase and Ahinsan communities) and Animwa Medical Centre (surrounded by Boadi, Ayeduase, Emena, Appiadu and Kokoben communities) revealed prevalence of 40.2% and 4.5% respectively (Tay, Amankwa, & Gbedema, 2011). The variations in the prevalence rates within the communities could be due to differences in the number of freshwater bodies infested with the snail intermediate host (*Bulinus* species) of the parasite as well as the behavioural patterns of the communities

(Tay, Amankwa, & Gbedema, 2011). The high prevalence of urinary schistosomiasis in Kotokuom and Nyamebekyere may be due to unsanitary conditions, unavailability of clean household water, proximity of the town to infested water bodies, ignorance of the knowledge of schistosomiasis and anthropological activities such as swimming, fishing, fetching and washing in water infested with the snail intermediate hosts of the parasite. Further, the zero prevalence in Adubiase may be attributed to the non-availability of the intermediate water snail of the parasite secondary to good sanitary conditions in the community. Although the Adjobue community is traversed by a river suspected to be infested with the intermediate water snail of the parasite, the annual initiative community outreach programme undertaken by the University of Cape Coast School of Medical Sciences (UCCSMS) to educate inhabitants about diseases of public health interest in rural areas including Adjobue community may have contributed to the low prevalence (5.6%) of urinary schistosomiasis recorded in Adjobue.

CONCLUSION AND RECOMMENDATIONS

The prevalence of urinary schistosomiasis among basic school children in the Akyemansa district was found to be 10.32% [95% CI: 7.80 -13.31%]. Gender, staying around river/ stream, playing at river/ stream and inhabitant of participants were significantly associated with the prevalence of *Schistosoma haematobium* infection. Periodic drug administration as well as a comprehensive intervention strategy should be designed and implemented to reduce schistosomiasis prevalence.

LIMITATION

Real-time PCR assay approach would have been more sensitive in detecting *Schistosoma haematobium* ova compared to the light microscopy which was the diagnostic technique employed in the study.

COMPETING INTERESTS

The authors hereby declare that there are no competing interests regarding the publication of this article.

CONSENT (WHERE EVER APPLICABLE)

Written informed consent was obtained from participants before the study took place and these documents are preserved by the authors.

ETHICAL APPROVAL (WHERE EVER APPLICABLE)

Ethical clearance was sought from the management of Ayirebi Health Centre before the study was commenced. In addition, study participants gave informed consent after thorough explanation of the rationale of the study has been given.

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