Prevalence and risk factors of urinary schistosomiasis among school-aged children in Devego Sub-municipal, Ketu North Municipality, Volta Region, Ghana

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ABSTRACT

Background

Schistosomiasis affects an estimated 250 million people worldwide, with 200,000 people dying each year. Despite success in managing the disease, data on its prevalence in non-endemic areas is rare. This study assessed the prevalence and risk factors of urogenital schistosomiasis among people in the Devego sub-municipality of the Ketu North Municipal Volta region, Ghana.

Methods

A cross-sectional study design was conducted among 335 respondents. Data was collected using a semi-structured questionnaire. Urine samples were examined microscopically to identify *S. haematobium* ova. Categorical data was analyzed and presented as percentages or frequencies. Means, medians and standard deviations were used to summarize the continuous variables. Chi-square/Fishers Exact test was used to determine the associations between the independent and dependent variables and considered significant if P-value was less than 0.05.

Results

The study found 34.6% (116/335) prevalence rate of urinary schistosomiasis among the 335 participants studied. The prevalence rate was 58.6% (68/116) in male respondents and 41.4% (48/116) among female respondents. Respondents aged 11-15 years recorded the highest (41.4%) prevalence. Major risk factors associated with urinary schistosomiasis were; swimming, fetching of water, bathing and washing of cloths ((χ^2=21.207, *P*-value < .02); frequency of exposure to fresh water (χ^2 = 14.684, *P* = .005, CL = 95%).

Conclusion

Urinary schistosomiasis is common in remote communities with fresh water sources. Chemoprevention should be extended to schistosomiasis non-endemic communities with fresh water sources.

Key words: Urinary schistosomiasis, prevalence, risk factors, Devego, Ghana

1.0 INTRODUCTION

Schistosomiasis is still a major public health concern, particularly in developing countries. The disease is endemic in many places of the world, including Sub-Saharan Africa, according to available data (1). Human schistosomiasis according to Bradley as cited by Thompson and Cairncross is a water-based parasitic disease caused by worms called trematodes (2). People are infected during routine agricultural, domestic, occupational and recreational activities which expose them to infested water. These worms grow within the blood vessels of the human body producing eggs which migrates to the bladder in the case of urogenital schistosomiasis, causing damages to tissues of the bladder and urethra (3).

Schistosomiasis accounts for about 250 million infections across 78 countries worldwide. It is estimated that about 85% of these cases are in the Sub-Saharan African region (4). Chronic and repeated schistosomiasis infection can result in major health and economic consequences including, growth failure, disability and death with children and young adults being the most vulnerable (5). According to the WHO, schistosomiasis kills over 200,000 people worldwide each year. The good news is that the disease can be prevented through Mass Drug Administration (MDA) using Praziquantel as recommended by WHO (4).

Ghana is one of these endemic countries, however, treatment is restricted to only selected districts due to limited data on the prevalence of the disease in the country. For instance, Anim-Baidoo *et al.*, 2017 in their study among children in a community along the Volta River in the Eastern region reported a high prevalence of 76% of the disease among the inhabitants of these communities (6). A similar study by Kulinkina et al, 2018 revealed an estimated schistosomiasis prevalence rate of 23.3%, in Ghana (7). In the Volta region, regular community-based praziquantel preventive treatment is limited to only few districts recognized as schistosomiasis endemic areas. This is so because of limited data on the prevalence of the disease in many areas in the country most especially among school-age children (8).

In 2018, a schistosomiasis outbreak among basic school pupils in the study settings resulted in 138 confirmed cases. This is an indication that disease transmission may be going on in many additional areas unobserved places (9).

Travel, both domestic and international, is a major factor in the spread of schistosomiasis from endemic to non-endemic places around the world. According to the Centers for Disease Control and Prevention (CDC), many travelers frequent fresh water locations such as rivers and dams for recreational and other tourist purposes (10). The WHO proposes an integrated approach based on infection prevalence rates for efficient schistosomiasis control. Furthermore, the recommended treatment technique is determined by whether the infection prevalence is low, moderate, or high (11), which can only be determined through research on the disease among the affected age groups. Although some studies have been conducted in the Volta region little attention was paid to the community-based contributory factors to the schistosomiasis burden. This study aimed to assess the prevalence of urogenital schistosomiasis and the associated risk factors among people in the Devego sub-municipality of the Ketu North Municipal Volta region, Ghana.

2.0 METHODS

2.1 Study site description

The study was conducted in Devego sub-municipality in the Ketu North municipal of the Volta region. Devego sub-municipal is located in the southeastern part of the municipal capital, Dzodze. Devego which is the sub-municipal centre is about 16.5 kilometers away from Dzodze the municipal capital. The sub-municipal has a total estimated population of 17,705 with an annual estimated growth rate of 2.5% per annum based on the 2010 population and housing census. This represents 14.4% of the total population of the Municipality. There are three health facilities (Zones) in the sub-municipality, namely; Devego health center, Dekpor CHPS compound and Klenormadi CHPS compound. The sub-municipal also has thirteen (13) basic schools comprising of ten (10) public and three (3) private schools with a total enrollment of 2,739 pupils in the 2019/2020 academic year. The major occupation of the people is agriculture with a couple of them engaging in petty trading, kente weaving and the formal sector. The main sources of water supply include pipe-borne, dam, stream, bore-hole, well and rain waters (12).

The following communities were selected in the Devego sub-municipality for the study; Doekope, Lave, Dekpor-horme and Dekpor-Yia. The maps below are illustration of the study location in the country.

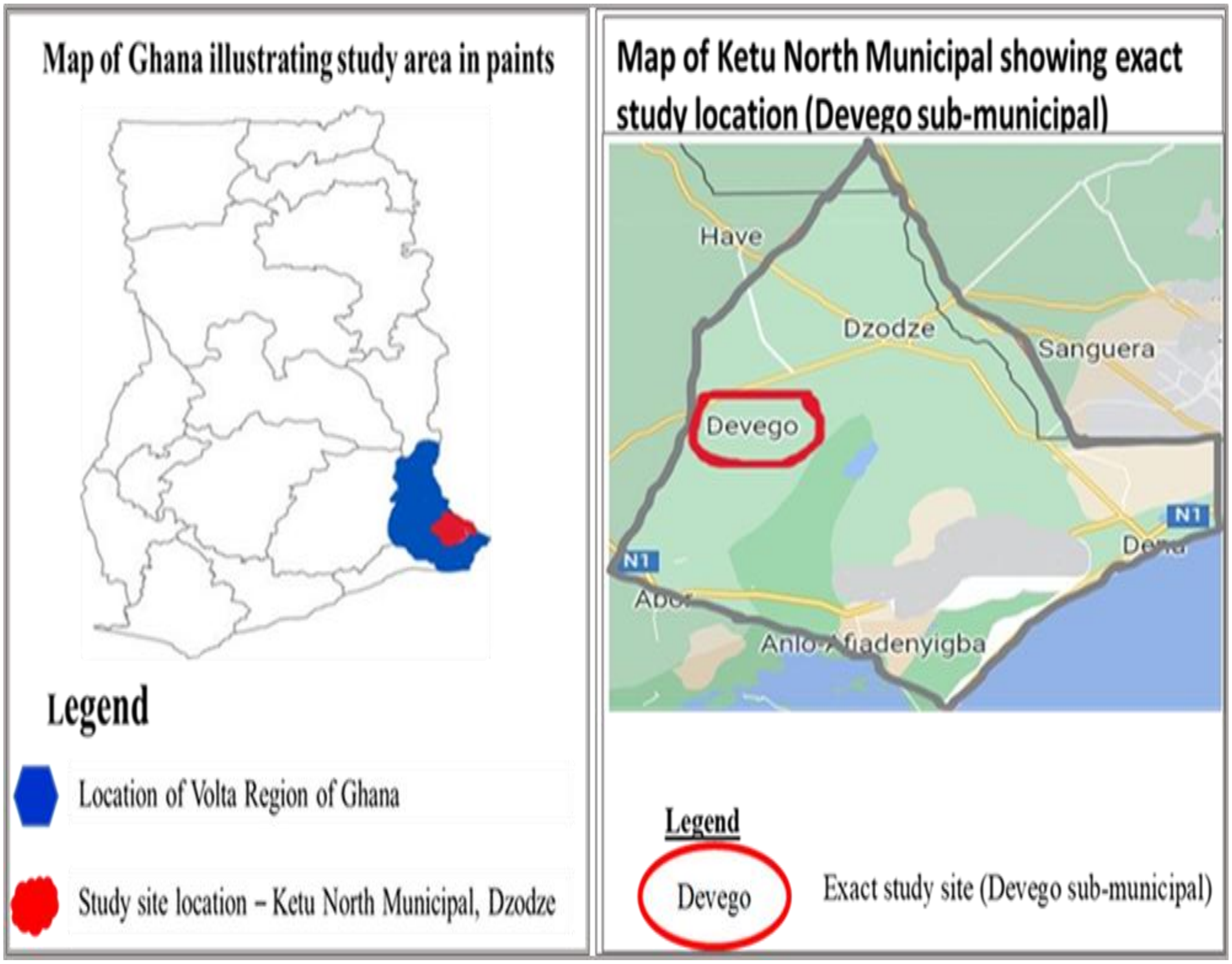

Figure 1 : Map showing study location

2.2 Study population

The study population was composed of persons of school going age (6-25 years old) who were either in basic school or out of school.

2.3 Study design

A descriptive cross-sectional study design was employed for the study in 2020. A semi-structured questionnaire was administered through face-to-face interview to the participants. Parents/guardians of very young participants were granted the interview on behalf of their children who were unable to appropriately respond to the questionnaire. Data captured from participants included demographic variables of the respondents, activities that predispose the respondents to schistosomiasis and prevalence of schistosomiasis among the respondents.

2.4 Sample Size Determination

Using Krejcie and Morgan (1970*)* statistical sample size calculation table (13), a sample size for the study was determined. The table was propounded with the formula below at a confidence level of 95% (z = 1.96) for easy sample size determination.

$s = X^2NP(1-P) \div d^2(N-1) + X^2P(1-P).$

Where; N = Population size, P = population proportion, d = degree of accuracy expressed as a proportion (0.05). Therefore, with a total population of 2,739 school-aged children within the Devego Sub-municipal, the corresponding sample size for the study was **335** on the statistical table. Thus, a total of **335** sample size of persons aged 6-25 years who were either in basic school or out of school were recruited for the study.

2.5 Sampling Technique

Devego sub-municipality was purposively selected out of the five sub-districts because of the reported outbreak of schistosomiasis in the area in 2018 (9). A list of the 22 communities was made and three (Devego zone, Dekpor Zone and Klenormadi Zone) randomly selected by ballot.

A proportionate to population size of the community was used to determine the number of participants to be interviewed per community. From the list of households obtained in each of the communities, a systematic sampling techniques was used to select the household. A sampling interval of two was used in the selection of the household to sample, starting from the last house on the list and followed in the straight line until the desire sample size was obtained for each of the communities. Participants aged 6-25 years with blood in urine in the selected households and attends basic school were considered admitted to the study. In a situation where there was more than one eligible participant, only one was selected by a ballot. A 100% response rate was recorded by the study.

2.6 Data collection

Data from the study was captured using a pretested semi-structured questionnaire. The questionnaire was administered to respondents in households of the selected communities by trained Research Assistants. The questionnaire was designed to collect information on the study variables which included demographic information of respondents, prevalence of urinary schistosomiasis and risk factors associated with urinary schistosomiasis. The instrument was administered in the dialect of the respondents and in English to respondents who did not understand the local dialect.

2.7 Urine Sample Collection and Examination

Urine specimens were collected from each of the respondents in the study for laboratory examination to determine the prevalence of schistosomiasis among the participants in the study area. A clean wide mouth container with a tight lid was given to each participants and instructed to collect about 60 ml of urine after a brisk exercise. All collected specimen were closed tightly, packaged in plastic zip-lock bags and placed in a box with an absorbent to prevent spillage. The specimens were labelled with the identity number of the each of the participants. The specimens were then stored in a shaded place away from direct sunlight and transported to the laboratory daily within four hours after collection. The microscopic detection of *S. haematobium* terminal-spine eggs was carried out based on a sedimentation concentration technique. It involved the centrifugation of 10 millilitre of urine at 3000 rpm for 5 minutes to concentrate the eggs. After draining the supernatant, a drop of sediment was transferred to a microscope slide and a cover slip applied. The prepared slides were examined under a microscope by focussing and scanning the entire field using X100 and X400 magnification to confirm the presence of *S. haematobium* eggs, recorded as eggs/10 mL of urine. The presence of *S. haematobium* eggs was considered positive, whereas their absence was considered negative. An experienced laboratory technician double-checked the samples.

2.8 Data analysis

Data from the study respondents was double entered into a Statistical Package for Social Sciences (SPSS) version 20 database. The data was validated and analyzed with the SPSS version 20. Demographic characteristics of the respondents such as sex, level of education, religion and other categorical variables were summarized and presented as percentages or frequencies. The continuous variables such as age was also summarized in means, medians and standard deviations. The prevalence of urinary schistosomiasis was also presented as proportions. A Chi-square (χ^2)/Fishers Exact test was used to establish the associations between urinary schistosomiasis and demographic characteristics or exposure status of respondents. A p-value of 0.05 was considered as statistically significant.

3.0 RESULTS

3.1 Background characteristics of study respondents

A total of 335 respondents were recruited for the studied. Out which 54.6% were males and 45.4% females). The age of the respondents ranged between 6 to 25 years with mean age of 11.7 ± 4.0 years. Majority 150 (44.8%) of the respondents were between the ages of 6 to10 years. Three-quarters (87.5%, 293) of the respondents were Christians. Three hundred and eighteen (94.9%, 318) of the respondents were in school where as 17 (5.1%) were out of school.

Table 1: Demographic characteristics of primary respondents

	Basic educational Status		Total
	In school	Not in school	
	n = 318 (%)	n =17 (%)	N = 335(%)
6-10years	145 (45.6)	5 (29.4)	150 (44.8)
11-15years	129 (40.6)	3 (17.6)	132 (39.4)
16-20years	39 (12.2)	4 (23.6)	43 (12.8)
21-25years	5 (1.6)	5 (29.4)	10 (3.0)
Sex of Respondents			
Male	174 (54.7)	9 (52.9)	183 (54.6)
Female	144 (45.3)	8 (47.1)	152 (45.4)
Religion of respondents			
Christianity	281 (88.4)	12 (70.6)	293 (87.5)
Traditional	37 (11.6)	5 (29.4)	42 (12.5)
Islamic	0 (0.0)	0 (0.0)	0 (0.0)
Community of respondents			

Dekpor Horme	144 (45.3)	9 (52.9)	153 (45.7)
Lave	35 (11.0)	1 (5.9)	36 (10.7)
Doekope	38 (11.9)	0 (0.0%)	38 (11.3)
Dekpor Yia	101 (31.8)	7 (41.2)	108 (32.2)

3.2 Prevalence of urinary schistosomiasis among respondents (6-25 years)

The results in table 2, shows the prevalence of schistosomiasis to be 34.6% (166/335) among respondents. Among those who reported with past history of blood in the urine 37.1% (43/116) had urinary schistosomiasis. Also, 67.2% (78/116) of respondents who presented with clinical signs and symptoms had urinary schistosomiasis. The age group mostly affected 41.4 % (48/116) were 11 to 15 years. With respect to sex, more males 58.6% (68/116) were affected than female 41.4 % (48/116) counterparts. In the four communities studied; Dekpor-Yia was reported more schistosomiasis cases (43.1%, 50), with the least in Doekope (6.9%, 8). A significant association was found between urinary schistosomiasis and past history of blood in urine (χ^2=17.573, p-value < .01) or presence of signs and symptoms (χ^2 = 49.697, *P*-value < 0.01) or age of respondent (χ^2 =12.177, *P*-value = .007) or community of respondents (χ^2 = 10.886, p-value = .012). Sex of respondent was however, not statistically associated with urinary schistosomiasis (χ^2 =1.142, p-value = .285).

Table 2: Prevalence of schistosomiasis among persons of school going age

	Test results		Total	χ^2	P-value (P)
	Positive	**Negative**			

	n = 116 (%)	n = 219 (%)	N = 335 (%)		
Past history of blood in urine					
Blood in urine	43 (37.1)	37 (16.9)	80 (23.9)		
No blood in urine	69 (59.5)	176 (80.4)	245 (73.1)	17.573	<0.01
Don't know	4* (3.4)	6 (2.7)	10 (3.0)		
Presence of signs/symptoms					
Symptomatic	78 (67.2)	60 (27.4)	138 (41.2)	49.697	<0.01
Asymptomatic	38 (32.8)	159 (72.6)	197 (58.8)		
Age of respondents					
6-10years	40 (34.5)	110 (50.2)	150 (44.8)		
11-15years	48 (41.4)	84 (38.4)	132 (39.4)	12.177	0.007
16-20years	23 (19.8)	20 (9.1)	43 (12.8)		
21-25years	5 (4.3)	5 (2.3)	10 (3.0)		
Sex of respondents					
Male	68 (58.6)	115 (52.5)	183 (54.6)		
Female	48 (41.4)	104 (47.5)	152 (45.4)	1.142	0.285
Community of respondents					
Dekpor-Horme	47 (40.5)	106 (48.4)	153 (45.7)		
Lave	11 (9.5)	25 (11.4)	36 (10.7)	10.886	0.012
Doekope	8 (6.9)	30 (13.7)	38 (11.3)		
Dekpor-Yia	50 (43.1)	58 (26.5)	108 (32.2)		

*χ^2 = Pearson Chi-square test, *Fishers Exact Test, p-value is significant if $p < 0.05$*

3.3 Risk factors associated with schistosomiasis among primary respondents (6-25years)

The study as indicated in table 3, observed that 325 (97.0%) of the 335 respondents studied were exposed to risk factors (fresh water bodies) of schistosomiasis with 35.7% of those exposed testing positive for urinary schistosomiasis. Most (44.0%) of the respondents were exposed to water from the dam than the other water sources. The difference between exposure status of respondents and positive urinary schistosomiasis was statistically significant (χ^2 = 5.460, *P*-value = .019). On frequency of exposure, it was observed that majority 51 (43.9%) of the respondents who tested positive were exposed on daily basis. There was a statistically significant association between frequency of exposure to fresh water and test results of respondents. (χ^2 = 14.684, *P*-value = .005).

Table 3: Risk factors associated with schistosomiasis

	Status of exposure		**Total**	χ^2	**P-value (P)**
	Exposed n = 325 (%)	**Not exposed n = 10 (%)**	**N = 335 (%)**		
Sex of respondents					
Male	177 (54.5)	6 (60.0)	183 (54.6)	0.120	0.729
Female	148 (45.5)	4*(40.0)	152 (45.4)		
Age of respondents					
6-10years	142 (43.7)	8(80.0)	150 (44.8)		
11-15years	131 (40.3)	1*(10.0)	132 (39.4)	5.490	

16-20years	42 (12.9)	1*(10.0)	43 (12.8)		0.139
21-25years	10 (3.1)	0* (0.0)	10 (3.0)		
Test results					
Positive	116 (35.7)	0* (0.0)	116 (34.6)		
Negative	209 (64.3)	10 (100.0)	219 (65.4)	5.460	0.019

	Test results		**Total**		
	Positive	**Negative**			
	n = 116 (%)	**n = 209 (%)**	**N = 325 (%)**		
Reasons of exposure					
Swimming	40 (34.5)	42 (20.1)	82 (25.2)		
Washing	21 (18.1)	36 (17.2)	57 (17.5)		
Fishing	2* (1.7)	9 (4.3)	11 (3.4)		
Agriculture	1* (0.9)	3* (1.4)	4* (1.2)	21.207	<0.02
Bathing	26 (22.4)	83 (39.7)	109 (33.5)		
Fetching	26 (22.4)	36 (17.2)	62 (19.1)		
Frequency of exposure					
Daily	51 (43.9)	124 (59.3)	175 (53.8)		
Weekly	32 (27.6)	46 (22.0)	78 (24.0)		
Monthly	6 (5.2)	12 (5.7)	18 (5.5)	14.684	0.005
Occasionally	27 (23.3)	27 (12.9)	54 (16.6)		

	Positive	**Negative**	**Total**
Source of fresh water	**n = 116 (%)**	**n = 219 (%)**	**N= 335 (%)**

River	37 (31.9)	79 (36.1)	116 (34.6)		
Stream	28 (24.1)	36 (16.4)	64 (19.1)	2.939	0.230
Dam	51 (44.0)	104 (47.5)	155 (46.3)		

*χ^2 = Pearson Chi-square test, *Fisher Exact Test, p-value is significant if P < .05*

4.0 DISCUSSION

Despite various national and international programs aimed at preventing and controlling schistosomiasis, it continues to be a major public health problem in many rural communities. This is due to the lack of data on its transmission in some locations, which is needed to scale up control actions as suggested by the World Health Organization. This study was therefore conducted to provide data on prevalence and risk factors associated with the urinary schistosomiasis among persons from 6-25 years.

The study findings reveal the urinary schistosomiasis prevalence to be 34.6% among the respondents. Findings from a study by Kabuyaya *et al*., 2017 were not different from the above findings as they observed *S. haematobium* infection prevalence of 37.5% in a base line study among 320 primary school children aged 10-15 years (14). Our findings can also be compared to that reported by Anim-Baidoo *et al*., 2017 in a study of 100 children in a community along the Volta River in the Eastern region of Ghana which found a prevalence rate of urinary schistosomiasis of up to 76.0% among the study participants of communities within these environs. In their study they associated age of respondents to infection with urinary schistosomiasis (6). A similar study conducted by Kulinkina *et al*., 2018 in the southern part of Ghana observed a *Schistosoma haematobium* prevalence rate to be 23.3% (7) whereas Orish *et* *al*., 2019 reported 10.4% prevalence among 383 participants in three districts of the Volta region of Ghana (15). Tetteh *et al*., 2016 also found an overall prevalence rate of 20.9% (16). These findings justify our assertion that schistosomiasis is very endemic in many remote communities and transmission goes on unreported hence no intervention to mitigate the plight of those afflicted by the disease.

The age range of 11 to 15 years old had the highest prevalence of urinary schistosomisis, according to our findings. This is consistent with Tetteh *et al*., 2016, who found a higher prevalence rate of 14.0% in children aged 10-15 years, stressing the age at which most infections occur (16). This could be explained by the level of activities they are engaging in, which could include water exposure.

This study findings also indicated males to have a higher prevalence of urinary schistosomiasis than females. This is in consonance with previous studies by Akinneye *et al*., 2018, in Nigeria who found 22.7% prevalence rate in male and 14.4% in female (17). A similar study by Angora *et al*., 2019 in Cote d'Ivoire also observed a 14.2% and 13.7% prevalence rates in male and female (18). In contrast, a 2017 study by Banhela *et al*. revealed a prevalence of schistosomiasis infection of 53.0% in males and 56.0% in females in the uThungulu health district. In the ILembe health district, they also found 37.0% and 39.0% prevalence in male and female sexes, respectively. There was no significant link between sex and urinary schistosomiasis in any of the cases (17). The differences and similarities in prevalence between our study and others can be attributed to sample sizes, study sites, and study participant age groups. Studies in places with several fresh water bodies and a smaller sample size, for example, are more likely to find a higher prevalence than those in areas with a large sample size and limited fresh water sources. Regardless, the findings showed that schistosomiasis is common in the study community, as may be the case in several unknown geographic areas. More research in communities with water bodies is needed to enable the scaling-up of control measures in the study region to prevent transmission.

In addition, the current investigation assessed risk factors for schistosomiasis infection among the participants. The findings revealed that those participants with exposure to fresh water sources had a higher rate of schistosomiasis infection. This is consistent with Mupakeleni *et al.*, 2016 findings, which found that 96.8% of schistosomiasis patients were exposed to water from canals and ponds for both domestic and recreational purposes (18). Swimming, washing, bathing, fishing, agriculture, and water fetching were all used to explain respondents' exposure to fresh water sources. The presence of *S. haematobium* eggs in the individuals' urine was strongly linked to these risk exposures.

Also, daily, weekly, and monthly contact with contaminated fresh water sources was highly associated with schistosomiasis, corroborating the findings of Anim-Baidoo *et al.*, 2017 that 95.0% of infected individuals had contact with fresh water through washing, bathing, fetching, swimming, and other domestic activities (6). Our findings are comparable to those of Hajisa *et al.*, 2018, who discovered that the participants' schistosomiasis infection was primarily caused by their proximity to significant fresh water sources that harbor the parasites (19). Socolo *et al.*, 2018 describe how activities such as taking water from streams/rivers, fishing, open-space defecation, gathering hippo grass from fresh water sources, washing clothes, cleaning utensils, bathing, and other risky practices, among others, leave one very vulnerable to disease (20). These are well-known risk factors for schistosomiasis infection in those who have been exposed to it, according to the study. As a result, if people in the study area continue to engage in these hazardous behaviours without intervention, the area could become a schistosomiasis hyperendemic zone. Apart from that, the disease will continue to affect people, especially those who have been infected, causing a variety of life-threatening complications, including death. Aside from the disease's incapacitating effects, the financial consequences for individuals, families, and the community at large are severe.

In addition, people with schistosomiasis will act as infection reservoirs not only in their communities, but also in other places they may visit, because they may discharge urine and feces directly into rivers, dams, streams, and other fresh water sources. To lessen the burden, it is critical to raise public awareness about the risk factors for the transmission of urinary schistosomiasis.

5.0 CONCLUSION AND RECOMMENDATION

The study confirms a 34.6% prevalence of urinary schistosomiasis in the Devego sub-municipality of the Ketu North Municipality, which is not a schistosomiasis endemic community. The prevalence was higher in adolescent and older children. Males were more affected than females.

Urinary schistosomiasis could be acquired through swimming, fetching of water, bathing, and washing clothes in a fresh water source.

We recommend that the Ghana Health Service Neglected Tropical Disease (NTD) Control Program reevaluate the country's schistosomiasis endemic zones and expand community-based mass drug administration programs to other non-endemic schistosomiasis communities with fresh water sources.

In addition, the NTD control program should include community education regarding the risk factors for contracting urinary schistosomiasis in communities living near fresh water sources.

Further research could be conducted to map the schistosomiasis endemic communities around the country.

ETHICAL APPROVAL

Ethical clearance for the study was obtained from the Ethical Review Board of the Ghana Institute of Management and Public Administration (GIMPA) before the study with the following identification number; 25667395710. Also, permission was sought from the Ketu North Municipal Health Directorate and community leaders of the various communities.

Consent

Written informed consent was obtained from study participants. For participants who were children, the parents or legal guardians consented for them after oral assent was obtained.

LIMITATIONS OF THE STUDY

1. Laboratory investigation was limited to *Schistosoma haematobium* species as such other species that cause schistosomiasis could not be investigated.
2. Water samples could not be obtained from the various fresh water bodies for laboratory testing to determine the presence of larvae of the organism.
3. The study was limited to only one sub-municipality in the Ketu North Municipal hence the findings do not reflect the prevalence of schistosomiasis in the entire municipality**.**

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COMPETING INTERESTS

The authors declare no conflict of competing interest

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AUTHORS' CONTRIBUTIONS

This piece of work was collaboratively executed by all the authors. Authors CK, AF and SO conceived the study. Authors CK, AF, SO, AD and DT prepared the study methodology. Authors CK, AF and SO analyzed the data. Authors CK, SO, AF, AD and DT drafted the initial manuscript. All Authors were responsible for reviewed the final manuscript.

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