International Journal of Science and Research (IJSR)
ISSN: 2319-7064
Index Copernicus Value (2016): 79.57 | Impact Factor (2017): 7.296

Schistosomiasis among School Children Living in Endemic Communities Around Kwanar Areh Dam, Rimi Local Government Area, Katsina State, Nigeria

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Abstract: ***Schistosomiasis remains a major threat to public health and it's mostly prevalent in poor communities that have no access to safe drinking water and adequate sanitation. This study was aimed at determining the prevalence and co-infection of intestinal and urinary schistosomiasis among schoolchildren living in communities around KwanarAreh Dam, Rimi L.G.A. of Katsina State, Nigeria. A cross-sectional study was conducted among 288 schoolchildren, aged 4 – 15 years. Stool samples were collected and examined for the presence of Schistosomamansoni eggs using modified Kato Katz technique while the urine samples were examined using the filtration technique for the presence of S. haematobium eggs. Demographic and socioeconomic information of the participants was collected using questionnaires. The overall prevalence of schistosomiasis was 54.5%; with 16.7% and 37.8% infected with S. mansoni and S. haematobium, respectively, and 6.6% presenting co-infection with both species. Statistical analysis revealed that male gender (OR = 1.83; 95% CI; 1.06-3.14) and surface water contact (OR = 1.94; 95% CI= 1.16–3.27), were the significant risk factors associated with urinary schistosomiasis in the area (P<0.05). For intestinal schistosomiasis, only surface water contact (OR= 2.79; 95% CI= 1.29–6.02) was significant (P<0.05). Conclusively, this study revealed the prevalence of schistosomiasis in the study area. Access to safe water, appropriate personal hygiene and sanitation, snail control and health education on the possible transmission of the infection is therefore recommended. Timely reporting should also be encouraged at all levels to aid in planning and implementing preventive and control measures against the disease.***

Keywords: *Schistosomahaematobium, Schistosomamansoni*, KwanarAreh, Kato-Katz, Filtration

1. Introduction

Schistosomiasis is one of the identified neglected tropical diseases (NTDs) of human public health concern. It is an acute and chronic parasitic disease caused by blood flukes (trematode worms) of the genus *Schistosoma*. Six different species infect humans, among which *Schistosomahaematobium and S. mansoni* are the predominant causes of the disease and both are prevalent in Nigeria [1]. It is the most prevalent water-borne disease with a very great risk on the health of rural populations [2]. According to a recent estimate by WHO [3], Schistosomiasis affects about 258 million people globally, of which about 236 million (97%) among the affected individuals live in Africa. The disease is most common in rural areas among the underprivileged people. It was earlier estimated that more than 600 million people are at risk of infection by the disease [4], [5], which is most prevalent in the tropical and sub-tropical regions of the world.

Intestinal schistosomiasis caused by *S. mansoni* in Nigeria often result in abdominal pain, diarrhoea and blood in the stool. Higher complications include hepatomegaly associated with periportal liver fibrosis, portal hypertension, and hematemesis [6], [7]. Urinary schistosomiasis on the other hand which is caused by *S. haematobium* presents with haematuria (blood in urine), dysuria, bladder polyps and ulcer, as well as suprapubic discomfort. Other complications have been explained previously [6], [8] - [10]. Nigeria is one of the highly endemic countries with an estimated 101.3 million people at risk of infection and 29 million of the people being already infected with the disease [11] – [13]. Cases of schistosomiasis have been reported from various parts of Katsina state [14] – [17]. According to the data obtained from a recent epidemiological survey conducted by the Federal Ministry of Health among nineteen states that are endemic for Schistosomiasis in Nigeria, Katsina state is ranked 10th in terms of morbidity due to the disease [18]. However, published data on the status of Schistosomal infections in many communities within the state are still scanty. The World Health Organization stressed the need to strengthen monitoring and evaluation of schistosomiasis, as well as timely reporting at all levels [3]. Hence, there is the need for updated information on the extent and severity of the disease in communities at risk, as well as the factors associated with the transmission of the disease within the communities. This study is therefore designed to assess the status of schistosomiasis among schoolchildren in communities near Areh Dam, RimiLGA, Katsina State Nigeria, to serve as a guide in the planning and implementation of preventive and control measures against the disease in the area.

2. Materials and Methods

2.1 Study area

The study was conducted among schoolchildren living in communities around KwanarAreh dam in RimiLGA of Katsina State, Nigeria. It is located on Latitude 12^{o}46'N and

Longitude 7°41'E, covering an area of 452 km² (175sq miles) with a total population of 212,819 inhabitants based on the 2006 National Population Census figures. The vegetation of the area is Sudan savannah type which combines the features and species of both the Guinea and Sahel Savannah [19], [20]. The settlements covered in this research are: Tudun-Kadir, Faduma, Ci-ka-koshi, and Areh villages. The inhabitants of these villages are engaged in different socio-cultural activities involving the dam such as fishing, boating, dry season farming and other domestic uses. The open plain around the dam is fertile and is extensively tilled to produce food and cash crops. Situated around the villages mentioned earlier are public and private schools. Five schools were selected for the purpose of this study namely; Bardayya primary school, Community Day Secondary School, Kaura Primary School, Areh Primary School and Ci-ka-koshi primary school.

2.2 Ethical consideration

Prior to the commencement of this research, introduction letters were obtained from the Department of Biology, Umaru Musa Yar'adua University, Katsina, to the state Honourable Commissioner of Health, Director of Primary Healthcare Department RimiLGA and the Education Secretary of RimiLGEA respectively, in order to seek for their consent and permission to conduct the research. Ethical approval for the conduct of the research was obtained from the Medical Research ethics review committee of the state Ministry of Health. Written permission letters were obtained from RimiLGEA and introduction letters were given to the Head Teachers of the various schools enrolled for the study. The purpose of the study was clearly explained to the head teachers, other staff, the parents and the pupils for more clarification. Similarly, all the selected pupils were given orientation about the survey to enhance maximum cooperation. An informed written consent was also obtained from the parents of the selected children before embarking on the research.

2.3 Study Population

The minimum number of schoolchildren required for the study was calculated using the sampling procedure recommended by WHO [21]. A total of 288 schoolchildren (69.4% males and 30.6% females) were enrolled for this study. Schoolchildren aged 5-15 years were considered eligible for enrolment into the study. The subjects were selected randomly from the five (5) schools mentioned earlier. The children were notified that participation is optional and that anybody who wishes to withdraw from participation, could do so without giving any prior information.

2.4 Samples Collection and Analyses

Prior to the samples collection, a pre-tested questionnaire was used to collect information on the Biodata of the children and their parents. All participants were given appropriate serial numbers for easy identification. Moreover, each pupil was provided with two (2) appropriately labeled, 30ml sterilized screw-capped universal bottles to provide in one, the urine sample and in the other, the stool sample. The children were appropriately trained on how to collect the samples so as to avoid any undue contamination in the process.

A total of 288 each of urine and stool samples were collected from the participants from the five (5) sampled schools in the study area. The collection was made on a weekly basis, between the hours of 10.00am and 12.00noon, one school at a time.

The urine samples were initially analyzed in the field (before preservation) for microhaematuria, Proteinuria and pH using Combi-9 Medi-test reagent strips [22]. The samples were then transported to the Department of Biology, Umaru Musa Yar'adua University for further analysis to detect the possible presence of *S. haematobium* eggs using standard filtration technique as described previously [23]. This method employs the use of filtration devices; plastic filter that contain nylon filter (pore size 12 - 20), WhatmanNo.1 filter paper, and a pressure pumping machine (Charles Austen Pumps). The intensity of Infection was recorded as previously described [24] viz: 0 egg/10ml of urine was reported as negative; 1 - 49 eggs/10ml of urine as light intensity of infection and ≥ 50 eggs/10ml of urine as heavy intensity of infection [24].

The stool samples were examined for the presence of *S. mansoni* eggs using modified Kato-Katz technique [25], [26]. The prepared slides were examined microscopically using x 10 and x 40 objectives. Egg counts were performed and recorded as eggs per gram of faeces (epg) for positive samples and the intensity of infections was then graded as heavy (≥ 400 epg), moderate (100-399 epg) or light (1-99 epg) according to the criteria provided by the World Health Organization [24], [27].

2.5 Statistical Analysis

The data obtained from this research was analyzed using the SPSS statistical software (Version 16.0). The Pearson chi-square (χ^2) test was used to assess the possible association between infection and some demographic and socioeconomic factors. Student t-test was used to compare the difference between intensities of the *S. haematobium* infections, while one-way analysis of variance (ANOVA) was used to compare the differences between intensities of *S. mansoni* eggs. *P*-value ≤0.05 is considered significant.

3. Results

3.1 General Characteristics of the Participants

The demographic and socioeconomic characteristics of the participants are shown in Table 1. Two hundred and eighty-eight (288) subjects comprising 69.4% males and 30.6% females, aged between 4 and 15 years old, were enrolled in this study. The distribution of the participants per school was based on the total number of enrolled students in each school and includes, 100 (34.7%) from Kaura Primary School, 80 (27.8%) from Bardayya Primary School, 50 (17.4%) from Areh Primary School, 38 (13.2%) from Ci-ka-koshi Primary School and 20 (6.9%) from Community Day Secondary School. About 90% of the sampled schoolchildren had no access to treated/pipe-borne water. Moreover, 64.2% of the participants claimed that they had regular contact with surface waters for different purposes. On another note, 43.4% of the fathers of the children are farmers. All the participants in this survey indicated that they had pit latrines in their homes.

3.2Prevalence of schistosomiasis

The current study presented a prevalence rate of 37.8% and 16.7% for urinary and intestinal schistosomiasis respectively. Similarly, 6.3% of the participants had co-infections with both species. A mean egg count of 20.0 eggs/10ml of urine was recorded among the individuals infected with *S. haematobium* while a mean egg count of 60.5 eggs per gram of stool was recorded among the subjects infected with *S. mansoni* (Table 2). The prevalence of schistosomiasis according to school indicated that Ci-ka-koshi Primary School had the highest prevalence (47.4%) for *S. haematobium*, while Bardayya Primary School had the least (32.5%). On the other hand, Areh Primary School presented the highest prevalence (30.0%) for *S. mansoni*, with Kaura Primary School showing the least (6.0%). No infection with *S. mansoni* was recorded in Community Day Secondary School. Moreover, the result of age specific prevalence showed that schoolchildren aged 10-16 years had the highest prevalence of *S. haematobium* and *S. mansoni* (39.0% and 17.9%) respectively, as compared to their counterparts aged 3–9 years (37.0% and 15.8%) respectively. Gender specific prevalence of *Schistosomaspp* infections among the schoolchildren under study indicated that males had higher prevalence of both *S. haematobium*, *S. mansoni* as well as their co-infection than their female counterparts (Table 2).

Table 1: Socio-demographic characteristics of the participants (n=288)

Variables	N	%
Age group (years)		
4-9	165	57.3
10-15	123	42.7
Gender		
Males	200	69.4
Females	88	30.6
Schools		
Bardayya Primary School	80	27.8
Areh Primary School	50	17.4
Kaura Primary School	100	34.7
Ci-ka-koshi Primary School	38	13.2
Community Day Secondary Sch.	20	6.9
Water source		
Untreated	256	88.9
Treated (piped)	32	11.1
Contact with surface water		
Yes	185	64.2
No	103	35.8
Purpose of water contact		
Fetching	155	83.8
Playing	14	7.6
Bathing (Swimming)	02	1.1
Multiple purpose	14	7.6
Father's occupation		
Farmers	125	43.4
Non-farmers	163	56.6
Type of toilet in the household		
Pit latrine (ground dug)	288	100
Pour flush system	0	0.0

Table 2: Prevalence and distribution of urinary and intestinal schistosomiasis among the study subjects (n=288)

Category	Number Examined	*S. haematobium*		*S. mansoni*		Co-Infection	
		Number Infected	%	Number Infected	%	Number Co-infected	%
Overall	**288**	**109**	**37.8**	**48**	**16.7**	**18**	**6.3**
Schools							
BardayyaPri. Sch.	80	26	32.5	20	25.0	7	8.8
ArehPri. Sch.	50	20	40.0	15	30.0	5	10.0
KauraPri. Sch.	100	37	37.0	06	6.0	3	3.0
Community Day Sec. Sch.	20	8	40.0	0	_	_	_
Ci-ka-koshiPri. Sch.	38	18	47.4	07	18.4	3	7.9
Age group							
4-9	165	61	37.0	26	15.8	10	6.06
10-15	123	48	39.0	22	17.9	8	6.5
Gender group							
Males	200	84	42.0	34	17.0	14	7.0
Females	88	25	28.4	14	15.9	4	4.5

3.3 Risk factors of schistosomiasis

Table 3 shows the prevalence of schistosomiasis in relation to some associated risk factors. The result showed that surface water contact activities among the schoolchildren that participated in the research was a significant risk factor for both *S. haematobium* and *S. mansoni* infection (P = 0.011 and 0.007 respectively). Our findings also showed that male gender is a significant risk factor for *S. haematobium* infection in the study area. Furthermore, according to our findings, although the older children aged 10-15 years, were more infected compared to the younger ones aged 4-9 years, the difference between them was not statistically significant (P>0.05). Similarly, the subjects that mostly consume untreated water were more infected with both *S. haematobium* and *S. mansoni* but the difference was not statistically significant (P>0.05).

3.4 Intensity of *S. haematobium* and *S. mansoni* eggs among the infected subjects

The result for Schistosoma infection intensity among the schoolchildren was shown on Table 4. The findings revealed that out of the 109 infected schoolchildren, 94 (86.2%) had light infection intensity, while the remaining15 (13.8%) had heavy intensity for *S. haematobium*. Light intensity of infection (1-49 eggs/ 10 ml of urine) was found to be significantly higher among the schoolchildren as compared with heavy intensity (≥50 eggs/10ml of urine) (t=3.746; *P*< 0.05). Furthermore, for *S. mansoni*, the findings revealed that 85.4% of the infected schoolchildren had light egg intensity, while the remaining 14.6% had moderate intensity (Table 4). No case of severe intensity of *S. mansoni* was recorded in this survey. However, a significant difference (*P*<0.05) existed between the levels of *S. mansoni* infection intensity for one-way analysis of variance (ANOVA).

Table 3: Association of some socio-demographic factors with Schistosomiasis among the participants (n = 288)

Variables	N.E.	*S. haematobium*			*S. mansoni*		
		N.I. (%)	OR (95% CI)	*P*-value	N.I. (%)	OR (95% CI)	*P*-value
Age group (Years)							
10-15	123	48 (39.0)	**0.92 (0.57–1.48)**	**0.722^{ns}**	22 (17.9)	**0.86 (0.46 – 1.60)**	0.632^{ns}
4-9	165	61(37.0)			26 (15.8)		
Gender							
Male	200	84 (42.0)	**1.83 (1.06–3.14)**	**0.028***	34 (17.0)	**1.08 (0.55 – 2.14)**	0.819^{ns}
Female	88	25 (28.4)			14 (15.9)		
Drinking Water source							
Untreated	256	100 (39.1)	**1.64 (0.73–3.68)**	**0.229^{ns}**	44 (17.1)	**1.45 (0.49 – 4.35)**	0.502^{ns}
Treated	32	9 (28.1)			4 (12.5)		
Surface Water Contact							
Yes	185	80 (43.2)	**1.94 (1.16–3.27)**	**0.011***	39(21.1)	**2.79 (1.29 – 6.02)**	0.007*
No	103	29 (28.2)			9(8.7)		

Key: N.E. = Number Examined; N.I. = Number Infected; OR= Odd Ratio; CI= Confidence Interval; ns= Not Significant; *= Significant

Table 4: Intensity Level of *S. haematobium* and *S. mansoni* eggs among the participants

School Name	*S. haematobium* Intensity			*S. mansoni* Intensity			
	Light (1-49 eggs) No. (%)	Heavy (≥50 eggs) No. (%)	*P*-value	Light (1-99epg) No. (%)	Moderate (100-399epg) No. (%)	High (≥400epg) No. (%)	*P*- value
BardayyaPri. Sch.	24 (22.0)	2 (1.8)		16 (33.3)	04 (8.3)	_	
ArehPri. Sch.	18 (16.5)	2 (1.8)		14 (29.2)	01 (2.1)	_	
KauraPri. Sch.	33 (30.3)	4 (3.7)		06 (12.5)	_	_	
Comm. Day Sec. Sch.	7 (6.4)	1 (0.9)		_	_	_	
Ci-ka-KoshiPri. Sch.	12(11.0)	6 (5.5)		05 (10.4)	02 (4.2)	_	
Total	94 (86.2)	15 (13.7)	0.0332	41 (85.4)	07 (14.6)	0 (0.0)	*P*<0.05

4. Discussion

The present study indicates that Schistosomiasis is still prevalent and a matter of concern in the study area. Our findings revealed an overall prevalence of 37.8% for urinary schistosomiasis and 16.7% for intestinal schistosomiasis. The burden of the two forms of schistosomiasis in this study falls within the WHO classification as hypo-endemic [28]. The current prevalence values recorded in the area are relatively lower as compared to some previous findings[15], [29-32] and higher than those reported in other findings[7, 33, 34]. The prevalence of schistosomiasis in the area could be best demonstrated in terms of closeness of the populace to contaminated water bodies, as well as engagement of the subjects in water contact activities such as fetching of water, playing, washing etc. This is in concordance with the findings from some previous similar studies [16,29,35].

Considering specific prevalence, urinary schistosomiasis showed a higher prevalence than intestinal schistosomiasis. This agreed with many previous findings, that urinary schistosomiasis is more prevalent than intestinal schistosomiasis in Nigeria [15,36, 37, 38, 39]. High prevalence of urinary schistosomiasis was also reported in Mali [40] and Sudan [41]. Our finding was however in contrast with the work of Dawaki*et al.* [7] carried out in Kano State Nigeria, which showed a slightly higher prevalence of intestinal schistosomiasis (8.9%), as compared with that of urinary schistosomiasis (8.3%) in the same area. It is also in contrast with the findings of Houmsou*et al.*, [42] in Taraba State, Nigeria, with 7.4% prevalence for *S. mansoni* and 2.8% for *S. haematobium*. The reduced prevalence of *S. mansoni* in the present study may be due to the absence of its specific intermediate host (Biomphalaria snail), as observed around the dam site during our preliminary survey. Therefore, the occurrence of intestinal schistosomiasis among the study subjects may be attributed to the presence of the snail intermediate host in other water bodies near the study area, which were not covered in our research or via the seasonal migrant movements which are common in the study area.

With reference to the world health organization classification in treatment guideline for schistosomiasis [18,24,43], the level of infection reported in this study presented a lower rate of infection in the study area. However, the current report illustrated that there is a fall in infection rate of the disease in the area, as compared with a previous research carried out by the Federal Ministry of Health, Nigeria [18], which placed RimiLGA among the local government areas requiring interventions for moderate infection of schistosomiasis. The reduced prevalence may be attributed to the Mass drug administration conducted in the area through administration of Praziquantel® drug to schoolchildren in the area by the government, as recommended by experts [44,45].

Gender related prevalence of schistosomiasis in the area indicated that females were less infected with both *S. haematobium* and *S. mansoni* compared to their male counterparts. This agrees with the findings from similar researches elsewhere [7,16,33,39,46,47]. However, this does not agree with the findings of Dabo*et al.* [48] in Mali and Ahmed *et al.* [49] in central Sudan, who found similar prevalence in males and females. Our finding is also in contrast with that of Okanla*et al.* [50] carried out in Cape Coast, Ghana, Gyuse*et al.* [51] in Osun State, Nigeria and Nwibari*et al.* [34] in Plateau State, Nigeria. The lower prevalence of infection among the females could be attributed to the fact that females in this part of the country are given much premium and care because the culture and religion prevent them from mingling with boys and participating in many menial jobs that could expose them to infection, unlike the male children that visit the water bodies more often and therefore had long exposure through swimming and other sorts of contacts, which in turn increases the chances of being infected.

The difference in prevalence of schistosomiasis among age groups appeared to be very little, even though the age group of 10-16 years presented higher prevalence in each case. However, considering the overall prevalence, the infection is much greater within the range of 6-15 years old children. This is in agreement with the findings of Adamu *et al.* [36], Sarkinfada*et al.* [52], Shinkafi*et al.* [15] and Houmsou*et al.* [42]. This may be explained by the fact that children of 6-15 years of age are fond of outdoor ebullience and tend to play so much outdoors which makes them more vulnerable to the infection than the younger ones below the age of 5 years, which mostly remained indoor under the care and control of their mothers. We also observed that some of the grown-up schoolchildren (mostly the boys) are sometimes engaged in farming practices during school free days which could also increase the chances of being infected. Despite the little variations in the prevalence of schistosomiasis among gender and age groups differences were not statistically significant except for urinary schistosomiasis where the males had a significantly higher prevalence of infection than the females. The implication is that irrespective of their gender, the school children may equally be exposed to infection by *Schistosomamansoni* through water contacts.

From the results obtained in this research, it is evident that children with the history of using water from untreated sources had higher prevalence of infection as compared with those using water from treated (piped) source. This agrees with the assertion that individuals using untreated water sources are more vulnerable and susceptible to *Schistosoma* infection than those using water from a treated source [53]. This also agreed with the findings of Damen*et al.* [54] carried out in Kaduna State, Nigeria. Grimes *et al.* [55] concluded that access to safe water and adequate sanitation are associated with significant lower odds of *Schistosoma* infection [55]. Thus, use of water from untreated sources will increase the chances of being infected.

Information on water contact activities as observed and recorded in the questionnaires showed that most of the children that participated in this research visit the dam regularly for the purpose of fetching the water, with a few expressing that they often swim or take bath in the dam. It is a common knowledge that contact with contaminated water increases the risk of *Schistosoma* infection. Many authors have shown the impact of exposure to snail infested water bodies on transmission of Schistosomiasis [55,56,57]. Nevertheless, the dam, being the major source of water for the neighbouring communities, is intensively utilized for domestic chores, farming and fishing which could increase the chances of the schoolchildren from acquiring the infection, as they often accompany their parents to the water site for different purposes.

5. Conclusion

From the data gathered in the course of this research, it is evident that Schistosomiasis is still prevalent and a matter of public health concern in the study area. Surface water contact and male gender are the major determinants of schistosomiasis in the study area. Awareness campaigns on matters of public health concern as well as access to portable drinking water could serve as important means of curbing the menace of the disease in the area.

6. Acknowledgement

The authors wish to acknowledge the support and cooperation of the pupils that participated in the survey, their parents, Head-teachers and teachers of the respective schools sampled, as well as the Directorate of Primary Health Care of RimiLGA.

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