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Research Article
Water Contact Activities Affecting Prevalence and Distribution of Intestinal Schistosomiasis in Two Endemic Communities Gwanje and Mada Hills, Akwanga, Nigeria

E.U. Amuta, A. Onekutu, I.O. Ogbonna and J.I. Chikwendu

Federal University of Agriculture Makurdi, Nigeria

Abstract

Background and Objective: Schistosomiasis is a disease of medical importance. It is responsible for morbidities such as blood and protein deficiency in those infected. A study was carried out to determine prevalence and distribution of the *Schistosoma mansoni* and to determine effects of water contact activities on the prevalence and distribution of the disease. **Materials and Methods:** To determine *Schistosoma mansoni* prevalence in humans, 400 urine samples were tested for *S. mansoni* antigen using point of care circulating cathode antigen (POC-CCA) test kit. Questionnaires were also used to obtain information on water contact activities of residents of both Gwanje and Mada hills community. **Results:** In both Gwanje and Mada hills, males had higher relative prevalence of 73 and 69%, respectively. Children aged 11-20 years had significantly higher ($p<0.05$) prevalence than other age groups in both Gwanje (24.79%) and Mada hills (17.76%). Males had higher prevalence of *S. mansoni* in Gwanje than in Mada hill and males had significantly higher prevalence ($p<0.05$) than females in both Gwanje (33.70%) and Mada hills (19.04%). Fetching water for domestic use was the most done water contact activity and defecating was the least done water contact activity in both communities. Males preformed more water contact activities than females in both communities. **Conclusion:** Schistosomiasis is prevalent in both Gwanje and Mada hills and water contact activities of residents of the areas affect the prevalence and distribution of the disease.

Key words: Intestinal schistosomiasis, prevalence, distribution, water contact activities, Gwanje, Mada

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Corresponding Author: J.I. Chikwendu, Federal University of Agriculture Makurdi, Nigeria

Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Schistosomiasis is a neglected tropical disease of medical and veterinary importance. It is one of the most prevalent neglected tropical diseases and among parasitic diseases. It ranks second only to malaria in terms of disease morbidity[1], world estimates revealed that 206.4 million people in 78 countries require preventive treatment for schistosomiasis and 91% of people requiring treatment reside in Africa[2]. In Africa, there are 2 major forms of schistosomiasis in humans: Intestinal schistosomiasis caused by *Schistosoma mansoni and* urogenital schistosomiasis caused by *Schistosoma haematobium*[3], both of which are endemic in Nigeria, however, *S. mansoni* has lower distribution than *S. haematobium*[4]. Mass drug administration is currently the main strategy being implemented for control of schistosomiasis in Nigeria[5]. High re-infection rates however may reduce the impact of MDA as a strategy for schistosomiasis control. The life cycle of the disease involves two hosts, a vertebrate (definitive) host and a snail (intermediate) host. People get infected when they come in contact with cercariae released by infected freshwater snails while carrying out routine water contact activities.

Schistosomiasis affects people in the tropics with limited access to safe water and adequate sanitation. The life cycle of schistosomiasis in itself reveals the importance of proper Water Sanitation and Hygiene (WASH) as an important tool for transmission interruption and control of the disease[6]. Laundry, bathing and recreational swimming are activities that cause people to spend prolonged periods of time in water and are high risk activities for schistosomiasis infection. Fetching of water for domestic use may lower the risk[7]. People who as a result of their poor economic status have to visit natural water bodies to wash clothes and fetch water for domestic use have been shown to have high prevalence of the disease. Farmers, fishermen and their children have been shown to have high prevalence and high infection intensities as a result of spending prolonged time in water. This study was aimed at determining the prevalence and distribution of intestinal schistosomiasis in Gwanje and Mada hills and determining the impact of water contact activities on prevalence and distribution of schistosomiasis in Gwanje and Mada hills.

MATERIALS AND METHODS

Study area: The study was conducted from August, 2018-May 2019 in Mada hills and Gwanje communities of Akwanga Local Government Area, Nasarawa state, Nigeria. Map of the study area is shown in Fig. 1.

Sample size: Four hundred urine samples were collected, 200 samples from school children in Gwanje community and 200 samples from school children in Mada hills community. The sample size of 400 was arrived at using Raosoft sample size calculator (which gave sample size of 382 and was approximated to 400).

Ethical clearance: Prior to the commencement of this study, written consent and accent was obtained from parents of research participants and research participants, respectively. Permission was also obtained from school authority where the research was carried out.

Health education/awareness: School children in study sites were briefly informed on how to protect themselves from schistosomiasis infections by avoiding freshwater bodies containing the snail intermediate host where possible. They were also enlightened on the need to stop the practice of open defecation and urination in water in order to stop the transmission of intestinal and urinary schistosomiasis.

Questionnaire forms: Questionnaires were administered in English language and orally translated to local dialect where necessary. Questionnaires were used to obtain information on participant's age, sex and location and to obtain supplementary information on water contact activities carried out by residents of an area.

Specimen collection

Time of specimen collection and collection method: Urine was collected during recess which started at 10-11 am in schools for convenience and because it falls within schistosomiasis egg shedding peak period (10 am-2 pm). Each research subject was given 20 mL plastic universal bottle bearing a unique number for identification. This number tallied with the subject's questionnaire and consent/assent form number. Each subject was required to fill the universal bottle with 20 mL of clean catch terminal urine, fasten the lid of the universal bottles tightly and return/submit for analysis. Upon submission, the collector while wearing hand gloves checked to ensure the specimen bottles were properly fastened. The samples where then transported to College of Education, Akwanga Clinic Laboratory, for analysis.

Administration of praziquantel drug treatment: After laboratory analysis of urine samples, the research subjects who tested positive were treated with praziquantel by a clinician. Drug dosage was administered based on body weight 40 mg kg^{-1}.

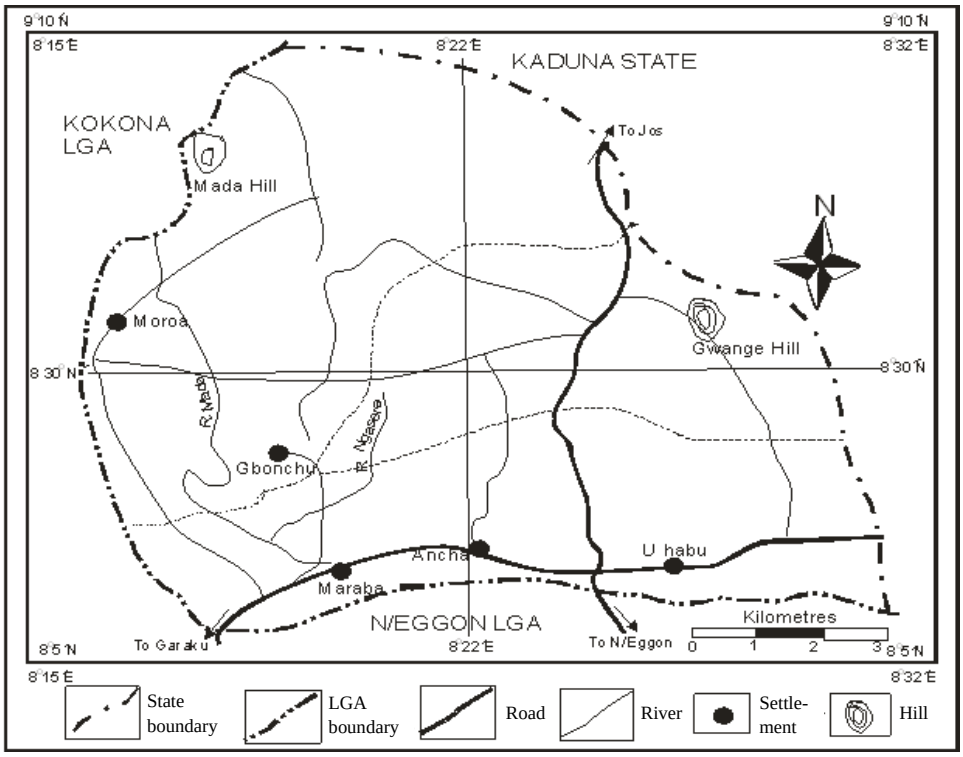

Fig. 1: Map of Akwanga local government area showing Gwanje and Mada hills
Source: Ministry of lands and survey, Lafia, Nasarawa state, 2016

Diagnosis of *S. mansoni* in humans: Diagnosis for intestinal schistosomiasis was done using point of care circulating cathode antigen (POC CCA) test kit (Manufactured by: Second-generation POC-CCA Schistosoma AG Test, ICT International). A straw pipette was used to suction and place two drops of urine into a shallow well on the POC-CCA cassette and the results were read after 20 min. The appearance of 2 lines (the control line and another red line) was interpreted as positive while the appearance of a single line (only the control line) was interpreted as negative.

Statistical analysis: Data obtained was analyzed for statistical significance. Chi-square test was used to verify the homogeneity of the disease in the different schools.

RESULTS

As shown in Table 1, out of the 200 subjects examined in Gwanje, a total of 43 were infected giving an infection rate of 33.70%. Out of the 200 subjects examined in Mada hills, a total of 28 were infected giving an infection rate of 14%. Infection rate in participants aged 11-20 years was 24.79% in Gwanje and 17.76% in Mada hills and was significantly higher ($p<0.05$) than in other age groups. Among those $\leq$10 years old, infection rates were significantly higher ($p<0.05$) in Gwanje (16.42%) than in Mada hills (9.68%). Among participants in Gwanje, there was a 16.67% infection rate in age group 21-30 years. While in Mada hills, there was 0% prevalence rate in age group 21-30 years.

Prevalence of *S. mansoni* among males and females in Gwanje and Mada hills, Akwanga shown in Table 2. The prevalence was significantly higher ($p<0.05$) in males than females. In Gwanje, prevalence in males was 33.70 and 11.11% in females. In Mada hills, prevalence was 19.04% in males and 8.42% in females. Relative prevalence of *S. mansoni* according to sex in Gwanje and Mada hills shown in Fig. 2. In Gwanje, prevalence in males was almost three times higher (73%), than in females (27%). In Mada hills, prevalence in males (69%) was more than twice as high as prevalence in females (31%).

Four most common water contact activities done by residents of Gwanje and Mada hills presented in Fig. 3. The most done water contact activity carried out by residents of Gwanje and Mada hills is fetching water (for drinking and domestic use) and the least done water contact activity is defecating in the fresh water bodies. All four water contact activities: Bathing, washing clothes, defecating and fetching

Table 1: Age related prevalence of *S. mansoni* in Akwanga (Gwanje and Mada hills)

	Gwanje		Mada hills	
Age	No examined	No infected (%)	No examined	No infected (%)
≤10	67	11 (16.42)	93	9 (9.68)
11-20	121	30 (24.79)	107	19 (17.76)
21-30	12	2 (16.67)	0	0 (0.00)
Total	200	43 (21.50)	200	28 (14.00)

p<0.05

Table 2: Sex related prevalence of *S. mansoni* in Akwanga (Gwanje and Mada hills)

	Gwanje		Mada hills	
Age	No examined	No infected (%)	No examined	No infected (%)
Male	92	31 (33.70)	105	20 (19.04)
Female	108	12 (11.11)	95	8 (8.42)
Total	200	43 (21.50)	200	28 (14.00)

p<0.05

Fig. 2: Relative prevalence of *S. mansoni* according to sex in Akwanga

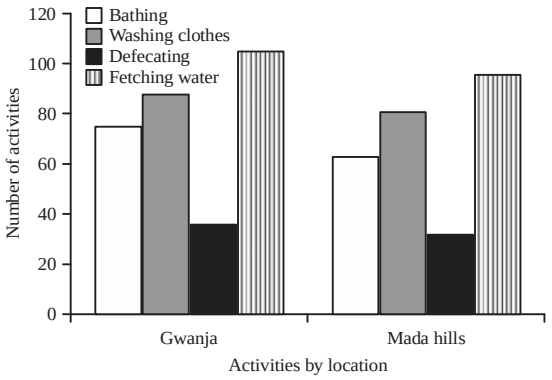

Fig. 3: Four water contact activities done by residents of Akwanga

water for domestic use were more commonly practiced in Gwanje than in Mada hills. In Gwanje, males perform more water contact activities than females as presented in Fig. 4. From the first column, more females (78 %) than males (22%) performed only 1 water contact activity. From the second

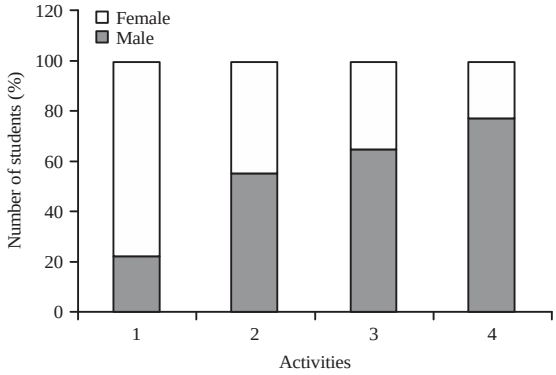

Fig. 4: Number of water contact activities performed by males, females in Gwanje, Akwanga
Four activities were bathing, washing clothes, defecating in water, Fetching water for domestic use

column, the proportion of females and males that performed 2 water contact activities are almost the same (48 and 52%), respectively. From the third column less females (38%) than males (62%) performed 3 water contact activities. From the forth column less females (28%) than males (72%) performed four water contact activities. Figure 5 shows water contact activities done by males and females in Mada hills. In Mada hills, males performed more water contact activities than females. From the first column, more females (59%) than males (41%) performed only one water contact activity. From the second column less females (36%) than males (64%) performed 2 water contact activity. From the third column, the proportion of females and males that performed 3 water contact activities are almost the same (51 and 49%), respectively and from the forth column, less females (35%) than males (65%) performed up to four water contact activities.

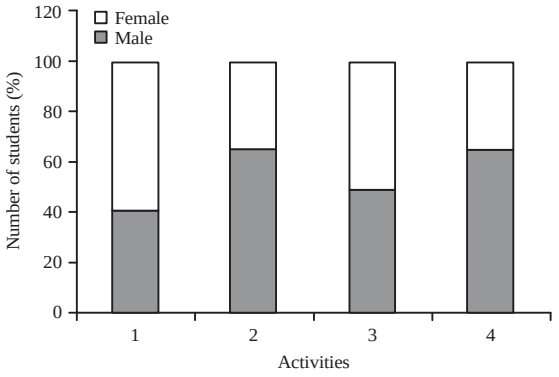

Fig. 5: Number of water contact activities performed by males, females in Mada hills, Akwanga
Four activities were bathing, washing clothes, defecating in water and fetching water for domestic use

DISCUSSION

In both Gwanje and Mada hills, *Schistosoma mansoni* prevalence was significantly higher in males than in females. This could be due to the fact that males perform more number of water contact activities in Gwanje and in Mada hills than females. Spending of protracted period of time in water could allow ample time for cercariae to locate and penetrate the host's skin infecting the individual. It does not matter whether a person defecates in rivers or not; all it takes is a few infected people to infect "most" of the population when they visit the water bodies for routine domestic or agricultural activities. Significant difference in prevalence between males and females with males having higher prevalence than males have been reported by Dawaki *et al.*[1] and Bekana *et al.*[8], high prevalence in males was linked to the fact that they participate in small-scale irrigated agriculture which their female counterparts do not participate in[8]. No significant difference in prevalence was found between males and females in a study in Ethiopia[9].

Schistosoma mansoni infection rate varied by location with Gwanje having significantly higher infection rates than Mada hills. The distribution of fresh water *B. pfeifferi* snails and their infection rates are important "factors" directly affecting the distribution of *S. mansoni* infections in humans[10]. In addition, the difference in prevalence between both study locations could be as a result of the fact that the residents of Gwanje carried out more water contact activities than the residents of Mada hills as revealed by the questionnaires administered. Contact with infected waters is necessary for infection with schistosomiasis to occur. As a result, frequent water contact is an important risk factor and may be responsible for the documented significantly higher prevalence of schistosomiasis in Gwanje than in Mada hills. The more time a person spends in water the more likely they are to get infected. Although all it takes to get infected is a single contact with infected waters, nevertheless more frequent contact with infected water would increase the risk of infection with the disease. As a result, the provision of alternative safe water such as pipe born water or boreholes in endemic communities could go a long way in reducing disease prevalence and bring about control of *Schistosoma mansoni* infection. It would take the commitment of the government and well-meaning individuals and WASH organizations to provide safe water to improve the health and welfare of people of endemic communities like these.

Varying *S. mansoni* prevalences among children based on location of the school was reported in southwest Ethiopia[11], siting proximity of schools to water bodies as an important risk factor. Significant difference in schistosomiasis prevalence by location was reported in Kano, Nigeria, where non-access to safe water was identified as an important risk factor for the disease[1].

Questionnaires revealed that among the four water contact activities performed by residents of Gwanje and Mada hills: Bathing, washing clothes, defecating and fetching water, defecating in water was the least done activity. Questionnaires also showed that defecating in water is a practice carried out by more residents of Gwanje than Mada hills. This means that even though most of the residents in Gwanje and Mada hills may not be in the habit of defecating in the open waters, nevertheless the unsanitary practices of those who do negatively impacts the health of the rest of the population. This implies that a cooperative change in WASH practices by the members of the community and not just a change in habits by a few or a group of people is needed in order to interrupt the life cycle of this disease and truly bring about control of this disease. Health education (social behavior change communication) could help residents appreciate the fact that the unhygienic practices of few people could adversely affect the health of others and this could persuade people to improve their WASH habits and insist on improved WASH habits of other members of their community. Open defecation is a risk factor impacting the prevalence of *S. mansoni* in communities across Uganda[12]. Proper waster sanitation and hygiene practices in endemic communities could interrupt the parasite life cycle and bring about the control of schistosomiasis in endemic areas[6].

CONCLUSION

Males tend to perform more water contact activities and have higher prevalence of intestinal schistosomiasis. Residents of endemic communities should be educated on the proper use of toilets and on the role of open defecation in perpetuating the high prevalence of schistosomiasis in their community. The Government, WASH organizations and ministries of health and other stakeholders must work together to improve the health of their community members by providing them alternative safe sources of water for endemic communities like Gwanje and Mada hills. In addition, researchers should investigate and implement strategies that could break the transmission cycle and lead to sustained control of schistosomiasis in Nigeria.

SIGNIFICANCE STATEMENT

This study discovers the prevalence and distribution of intestinal schistosomiasis in Gwanje and Mada Hills, Akwanga, Nigeria. The study will help the researcher to uncover the critical area of water contact activities as important risk factors affecting disease prevalence and distribution in the area and which could hinder control efforts if not taken into account. These aspects have not been investigated in the area before now and could prove critical in designing and implementing strategies for the control of the disease in the study areas and in other endemic communities.

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