DETECTION OF SCHISTOSMA HEAMATOBIUM AMONG ORPHANAGE CHILDREN ATTENDING JARMA UK ORPHANAGE HOME AND BAKIN GULBI PRIMARY SCHOOL SOKOTO.

ABSTRACT

Urinary schistosomiasis or Bilharzia caused by fluke worm *Schistosomahaematobium* (*S. haematobium*) is one of the seventeen (17) neglected tropical diseases associated with serious health problems and morbidities. It affects over 200 million people globally with an estimated death rate of more than 200, 000 annually and very common in Sub-Saharan African countries. The weight for the control of neglected tropical diseases has generated a renewed interest in the control of urinary Schistosomiasis, resulting in large-scale treatment and control in several countries. The aim of the study was to determine the prevalence and associated risk factors of *S. haematobium* and provide epidemiological data in part of Nigeria. This cross-sectional study was carried out on 202 consenting participants, using both male and female attending JarmaUk Orphanage home and BakinGulbi primary school. Detection and evaluation were done using Gold Standard Microscopy and commercially available RDT strips. Statistical analysis was carried out using astatistical package (SPSS version 26). A prevalence of 34(16.8%) among 202 from gold standard microscopy and 13(6.4%) circulating cathodic antigen (CCA) were obtained. High infection risk was observed among participant on swimming as a recreational activity 32(15.8%) at $p<0.046$ A gender prevalence of 26 (12.87%) and 8 (3.96%) at $p<0.067$ from male and female respectively were obtained. Female at the age group 11-15 had 27 (13.36%), and those with agriculture as recreational activity had the least infection risk 2(0.99%). This study showed that CCA has a less sensitivity and specificity than gold standard microscopy.

Keywords: *Schistosomahaematobium*,microscopy, circulating cathodic antigen.

1.0 Introduction

The public health and socioeconomic impact of schistosomiasis is such that, to date, over 230 million people have acquired the disease, including many children, mainly in the tropics and subtropics. Further, this chronic debilitating disease leads to around 11,500 deaths yearly and it is responsible for the loss of over 3.5 million dalys, with the majority (more than 80%) from sub-Saharan Africa (WHO 2002). The major schistosome species that cause infection in humans include *S. haematobium*, the agent of urinary schistosomiasis, and *S. mansoni, S. japonicum, S. mekongi, S. intercalatum and S. guineensis,* which cause intestinal schistosomiasis. These blood-feeding flukes are responsible for substantial long-term clinical complications with multiple organ involvement including the liver, intestine, and urinary bladder. Infective cercariae in fresh water sources penetrate the host skin and enter the blood circulation as schistosomulesand

inhabit mesenteric or vesical (intestinal and urinary schistosomiasis respectively) venous plexuses after pulmonary and hepatic migrations.

Mature female worms lay eggs in these sites, and eggs then penetrate the intestinal walls (in intestinal schistosomiasis) to be excreted in stool or penetrate the bladder wall (in urinary schistosomiasis) to be excreted in urine, while some of the eggs migrate towards ectopic sites, such as the liver and other organs, leading to chronic inflammation and fibrosis. The eggs released to the environment hatch in fresh water sources releasing miracidia that penetrate specific snail hosts within which they undergo asexual reproduction and become cercariae to continue the life cycle. Successful disease prevention and elimination programs for schistosomiasis involve the implementation of intensive intervention and efficient monitoring measures, with different countries having their own modified approaches tailored to the sociocultural and economic situations prevailing (Rosset al., 2013). For example, in China the number of human schistosomiasis cases was reduced by 90% over the decade from 2004 through human case detection and treatment, health education and snail control (Sun et al., 2017).Additionally, China has had a strong political will for many decades to eliminate schistosomiasis, since control options were first instigated by Chairman Mao in 1956, who made its elimination, a national health priority (Fan et al., 2008). In general, accurate community diagnosis of the infection and continued surveillance is helpful in the control for the transmission of schistosomiasis, while prompt treatment following early detection can minimize the associated morbidity and mortality (WHO, 2017). With continuing multiple prevention and control efforts, the prevalence and intensity of schistosomiasis in many endemic regions have gone down, as such in many infected individuals, the disease may go undetected with commonly used conventional diagnostic tools such as the Kato-Katz fecal smear (KK) test or urine egg filtration methods, due to their low sensitivity (Bergquist et al., 2017).

As a result, a schistosomiasis-endemic area may appear to be free of the disease infection whereas transmission continues and may even spread to other communities, thereby increasing the time for control and eventual elimination. A recent WHO expert committee report (WHO 2017) highlighted the significance of a One Health approach focusing on preventive chemotherapy, improvement of water, sanitation, and hygiene (WASH), health promotion, snail control, and detection and treatment of animal reservoirs for the sustained control and elimination of Asian schistosomiasis (WHO 2017). This further emphasizes the importance and essential need for accurate diagnosis if the target goals of transmission interruption by 2025 and elimination of transmission by 2030 are to be achieved. In this article, the prevalence,and individuals at risk of schistosomiasis among children attending Jerma UK orphanage School and BakinGulbi primary school in Sokoto were evaluated.

2.0 Materials and Methods

2.1 Study Design

This is a cross sectional study designed to determine and compare the sensitivity and specificity of both the gold standard and molecular technique. Also, the study will becomparative based studies using commercially available point- of-contact circulating cathodic antigen (CCA) against the gold standard microscopy in detecting *Schistosomahaematobium* in the urine sample.

2.2 Study Area

The study was carried out in Sokoto state which is located within the North- western geopolitical zone of Nigeria. According to the National Population Commission (2010), population figures stand at 3,702,676 persons with a land area of 33,776.89 square kilometers. The population mainly consists of the Hausa and Fulani ethnic groups; the major occupation of the people is farming and animal husbandry. Majority of its indigenes are Muslims. Sokoto state is located between latitude 9°N and 4°N and between 3°E and 8°E in the northern Nigeria. Most of the agriculturists here practice harshness of the sunlight (WHO, 2016). The study area would be JermaUk orphanage at Wamako local government area, Sokoto state and BakinGulbi primary school.

2.3 Study Population

The study population were children suffering from Schistosomiasis among orphanage children attending JermanUk orphanage school Sokoto and BakinGulbi comprehensive primary school

2.3.1 Inclusion and Exclusion Criteria

2.3.1.1 Inclusion Criteria: Subjects range from 6 to 15 years and who give their consent to participate in the study were included in the research.

2.3.1.2 Exclusion Criteria: Samples below 5 and above 15 years of age, attending Jerma UK orphanage home and BakinGulbi comprehensive primary School were excluded from this study.

2.4 Sample Size and Determination

Sample size was estimated using fisher's formula (Araoye, 2003) adopting a prevalence rate of 5.43% (Olayeye et al., 1999) as follows.

$N = Z^2pq/d^2$, where 'N' is the required sample size,

'Z' is the confidence interval at 95% (1.96),'p' is estimated prevalence from previous studies = 0.045%, 'q' is 1 – p, and'd' is the degree of accuracy set at 0.05. Substituting, $N= 1.96^2 \times 0.045 \times 0.946/0.05^2$ N=202

The sample size calculated was 202 and attrition risk of 10% was added; N = 220 and a total of 202 were collected for the study.

2.5 Sample Collection

Specimens were collected from children undertwenty years of age after informed consent from patrons and matrons of Jerman UK orphanage home Sokoto and the headmaster of BakinGulbi primary School Dundaye. Approximately 50ml of morning (between 10:00am and 2:00 pm) mid-catch urine sample was collected and stored in clean water-proofed plastic containers.

2.5.1 Parasitological Examination.

Approximately 50ml of urine sample was placed in a test tube and centrifuged at 3000 revolutions per minutes for 5 minutes. The supernatant was discarded,and sediment placed on a clean glass slide, covered with a cover slip, and viewed microscopically using X10 and X40 objectives for egg detection.

2.5.2. Rapid Diagnostic Test

Urine samples were collected from both schools for the studies. Positive and negative samples obtained for test and control were used as guide for the detection of egg using rapid diagnostic kit Maternoval urine CCA. 25 disposable testing strips allow for ready testing using the collected urine samples.

2.5.3 Rapid Diagnostic Kit Procedure

The foil of the rapid diagnostic strip was peeled off and placed on the bench pad properly labeled. 50ul drop of the mixed urine sample was placed on the urine window of the RDT on a flat surface and allowed to migrate. The RDT containing the urine sample was kept for 20 minutes before taking the readings.

3.0 Results

Urine samples from a total of 202 participants were examined microscopically for urinary Schistosomiasis (in two different schools). Of the 168 samples collected from UmaruKwabo Orphanage home, 26 of them were infected. Also,from the 34 samples collected in BakinGulbi primary school at Dundaye, KwalkwalawaWamakolocal government area Sokoto State, 8 participants were infected(Table 1). The age group between 11-15 had the highest infection rate of 26(13.36%), followed by the age group 5-10 with 6(2.97 %) infection rate. The lowest prevalence was recorded among the age group from 16 and above with a prevalence rate of 1(0.49%) at $p<0.045$(Table 1).The participant residing in the rural area (Dundaye) have the least prevalence of 8(3.39%) from 34 participants and those residing at urban area (Jarma UK Orphanage home) with the prevalence of 26(12.8%) from 168 participants at $p<0.252$ (Table 1). The prevalence rate of infection among the participants of primary and secondary schools tagged as Level of education, recorded the highest rate of *S. haematobium* among the primary school 20(9.9%) compared to secondary school with 14(6.9%) at $p<0.148$ (Table 1).Table 1 also indicated the prevalence rate among the male and female gender with the male having the highest prevalence of 26(12.8%) while the female gender hasthe lowest

prevalence of 8(3.9%) at $p<0.607$. Our study also involved those who had other means of contact, such as agricultural activities as their means of recreation and those that had to swim. The highest prevalence was recorded among the swimmers with 32(15.8%) (Table 1).The study included the participants that have their sources of drinking water, such as well water,river, and borehole/tap water areas. The highest prevalence of 24(11.9%)was recorded among those who consume borehole/tap water, followed by those who drink well water 10(4.9%) at p<0.705 (Table 1).Table 1 also shows that *S.haematobium* is common in areas with contaminated water bodies.Based on our study, the participant living around endemic areas are exposed to *S. haematobium* through bathing, swimming, and agricultural activities. Table 2 shows the prevalence of *S. haematobium* infection with age as one of the risk factors, indicating that the age group between 11-15(10.9%) have the highest prevalence, while the age group greater than >15/16 (0.49%) has the least frequencyat $p<0.045$. Infection and severity may vary with gender-specific activity, and infection peaks in individuals aged 10-19 years has been recognized globally. Table 2 also shows the distribution among gender, which indicated that the male child ismore infected than the females. The study investigated the infection prevalence peak of 26(12.87%) from the participating male whereas a prevalence of (3.9%) was recorded from the female participantat p<0.07. Table 3 shows the sensitivity and specificity of *S. haematobium* using gold standard microscopy and CCA rapid diagnostic strip with the sensitivity of 16.7% and specificity of 85.7%, positive predictive value for microscopy (PPV) = sensitivity a/a +b x100/1 = 34/34 +27/168 x 100/1 = (16.7 %) and negative predictive value (NPV) b/b + a X 100 = 169/202 = (83.6%).The RDT positive predictive value (PPV) specificity c/c= c x100/1 = 128/168 + 27 x100/1 = 16.7 %, negative predictive value (NPV) = e/e + f x 100/1 = 27/27 + 128/202 = 83.7%.

Table 1 Distribution of *S. haematobium* among study population by age, gender, level of education, recreational activities, source of drinking water, and place of residence. (n = 202).

Variables	No. Examined	*S.* *Haematobium*		X^2	P-value
	n%	Positiven %	Negative n %		
Age group					
5-10	71(35.14)	6(2.9)	65(32.2)	6.221	0.04
11-15	122(60.3)	27(13.4)	95(47.0)		
>16	9(4.45)	1(0.5)	8(3.9)		
Gender					
Male	161(79.7)	26(12.8)	135(66.8)	0.264	0.60

Female	41(20.3)	8(3.9)	33((16.3)		
Education level					
Secondary	106(52.5)	14(6.9)	92(45.5)	2.093	0.14
Primary	96(47.5)	20(9.9)	76(37.6)		
Recreational activities					
Swimming	166(82.2)	32(15.8)	134(66.3)	3.979	0.04
Agriculture	36(17.8)	2(0.9)	34(16.8)		
Sources of drinking water					
Well water	65(32.2)	10(4.9)	55(27.2)	0.143	0.70
River	0(0.00)	0(0.0)	0(0.00)		
Bore hole	157(77.7)	24(11.8)	133(65.8)		
Place of residence					
Rural	34(16.8)	8(3.39)	26(12.8)	1.310	0.25
Urban	168(83.2)	26(12.8)	142(70.3)		

No. examined n (%)

Table 2. Distribution of *S. haematobium* according to Age group (n = 202)

Variables	*S. haematobium*		p-value
	Gender		
Age group	Male n %	Female n %	Total N %
5-10	5(2.4)	1(0.5)	6(2.9) 0.007
11-15	22(10.9)	5(2.5)	27(13.4)
>16	1(0.5)	0(0.00)	1(0.5)
Total	28(13.8)	6(2.9)	34(16.8)

No. examined n (%)

Table 3. Simple Logistic Regression Analysis of some variables in respect to *S. haematobium* infection

Variables	*b	**Exp(B)	Wald Statistic	p-value

		OR (95% C.I)		
Gender				
Female	0	1		
Male	0.226	0.76(0.32, 1.87)	0.337	0.56
Recreational Activities				
Agriculture	0	1		
Swimming	-2.170	0.11(0.86,0.06)	4.414	0.03

Discussion

Schistosomiasis is considered among the most neglected tropical disease by the WHO, which affects the poorer communities that receive less attention by policy makers.A total of two hundred and two (202) participants enrolled for the study from Jarma UK Orphanage home and BakinGulbi primary school. The study population may be *S. haematobium* endemic due to the availability of contaminated water bodies within the participants. A prevalence of 34 (16.8%) for gold standard sedimentation method of microscopy and 7(6.43%) of the commercially available point-of-contactCCA was recorded. The low prevalence from this study may be attributed to the response from the questionnaire which showed that all participants had been treated with praziquantel more than 3 months before this study, indicating a high reinfection rate among the participant.

The prevalence of 16.8% of the gold standard microscopy is high compared to other studies that reported 12.3% in Jaba LGA kaduna-Nigeria by Bishop et al., (2016), 0.83% among some rice farmers in kaduna-Nigeria by Awawu et al., (2018) but lower than the study that reported 38.3% in Sokoto-Nigeria by Kabiru et al., (2013), 21% reported in Nguru LGA, Yobe-Nigeria by Dogana et al., (2014), 30% in Dutsinma and Tsafa LGA Katsina-Nigeria by Atalabi et al., (2016), 34% reported in Argungu LGA Kebbi-Nigeria by Fana et al., (2009) 41.5%, inBenue-Nigeria by Houmsu et al., (2012), and 39% Wamako LGA Sokoto-Nigeria by Adulrasheed et al., (2017).The CCA Rapid diagnostic strip was able to detect 7 positive cases from the confirmed microscopic positive cases with a prevalence of 7(20.6%) which is slightly above the study that reported 15.5% in some part of Kaduna-Nigeria by Awua et al., (2018).A zero (0%) sensitivity and specificity were recorded in Zanzibar-Uganda and Niger-West Africa by Stothard et al. (2006), 0% was also recorded in Unguja Uganda by Stothard et al. (2008). A repeated study showed a prevalence of 9% in Zanzibar by Stothard et al. (2009), while a higher sensitivity was also reported by De clercq et al. (1997),Legesse (2007), and Erko (2007).Stothard et al.(2006) states that “it is clear that available formulation of CCA dipstick has no value for detection of urinary schistosomiasis and the absolute failure of the CCA gives cause for concern”. While previous study has shown that urine-CCA have to be useful in *S. haematobium* detection using Enzyme Linked Immunosorbent Assay (ELISA) and not lateral flow cassette/Dipstick (Stothard et al 2009).

From the comparison of this study and previous studies on both the gold standard microscopy and theCCA strips above, the gold standard shows a better tool in the diagnosis and control of urinary schistosomiasis of *S. haematobium* in poorer

communities than the strips, even thoughthe strip is easier and quicker compared to microscopy. This is because the strip has higher chances of missing the eggs of *S. haematobium* due to some environmental conditions like temperature, humidity etc. making it difficult for early detection and management of the disease oroutbreak. Also, the poor sensitivity could be due to some additional factors in this study such as geographical location and preservative (10% formaldehyde) used in preserving the urine sample.This study is in accordance with some aspects of the reports stated above on the prevalence of *S. haematobium* associated risk factors, such as water bodies, age and gender of the participants based on the administered questioners. A statistical significance was observed among those selected swimming as part of their recreational activities and the male participants as stated above.Hence, among the children living in Sokoto, *S. haematobium*is a major public health problem with attendant morbidity and mortality due to poor knowledge.

Conclusion

The result of this study conducted among school-aged children shows the establishment of *S. haematobium* in the study area with moderate prevalence of 16.8%. The result also shows significant correlation between the associated risk factors and *S. haematobium* using simple multiple regression analysis with significant difference. The value of the gold standard microscopy and CCA Rapid diagnostic strip (RDT)shows that the gold standard microscopy is a better tool for the diagnosis for *S. haematobium* with a sensitivity of 16.7% and specificity of 85.7%from 202 samples. The RDT sensitivity of 16.7 and specificity of 83.7 from 34 microscopically confirmed samples. The PPV of 13.9 % and NPVof 82.4% versusPPV of 16.7 % and NPV of 83.7% indicate significant results but with different sample size. More specific and sensitive molecular based detection of *S. haematobium* can be carried out using ELISA and Polymerase Chain Reaction (PCR).

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