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Detection of Urinary schistosomiasis, the associated risk factors, and its impact on blood parameters among *Almajiris* in two selected rural communities of Kaduna State

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Abstract

This study aimed to detect the presence of urinary schistosomiasis, the associated risk factors and its impact on blood parameters among Almajiris in two selected rural communities of Kaduna State. Urine samples were collected from 193 Almajiri subjects and processed by sedimentation method and examined under the microscope. Blood samples were also collected from the subjects and processed using SWELAB auto analyser for full blood count. A well-structured knowledge, attitude and practice (KAP) questionnaire was administered to the subjects and used to obtain demographic and other associated risk factors. The overall prevalence of urinary schistosomiasis in the 2 study areas was 16.1%. Bomo recorded 17.5% while Rafin Guza recorded 22.9% prevalence respectively. Subjects in the age-group 11-16 years had a higher prevalence of 33% (p<0.05). Among the risks factors assessed, subjects that visit the stream for swimming and used well water recorded a higher prevalence of (33.7%) and (17.2%) respectively (p<0.05). *Awareness about the disease revealed higher prevalence (p<0.05). Prevalence of the infection among the subjects was also found to be significantly associated with White blood cell (WBC) count, Lymphocyte and monocyte count (p<0.05). The present study identified the study areas to represent moderate-risk community for urinary schistosomiasis. The study advocates the use of mass treatment with Praziquantel to help in reducing the infection level and help to control transmission of the disease.*

Keyword: Urinary schistosomiasis, risk factors, haematological parameters,

INTRODUCTION

Urinary schistosomiasis caused by *S. haematobium* has been endemic in several parts of Nigeria where it causes considerable public health problems mainly among School-aged children (SAC). The infection is acquired through cercariae-polluted water during agricultural, domestic, occupational and recreational activities (Akindele et al., 2020).

The word '*Almajiri*' is derived from the Arabic word '*Almuhajirun*' meaning migrants. It refers to a traditional method of acquiring and memorising the Glorious Qur'an by children drawn from different parts of Northern Nigeria to learn and be trained in the Islamic religion under the leadership of a *Mallam*- Islamic instructors/scholar (Yunusa *et al.*, 2016).

The attempts to control schistosomiasis in Nigeria is inappreciable because the disease is a rural occupational disease which often affects those who engage in farming and fishing, and these group of people are mostly neglected from any kind of intervention (Akindele et al., 2020. The associated risk factors may include: illiteracy, lack of awareness, poor socio-economic standard and inadequate public infrastructure. Both Bomo and Rafin Guza are rural communities and engage in agricultural activities because of the availability of water body near the settlements and it is well established that the disease is endemic in areas where farming and fishing occur. Most studies on urinary schistosomiasis that has been conducted is among school-aged children (Mohammed *et al.*, 2015; Afrifa *et al.*, 2017; Adamu *et al.*, 2019; Chidiebere *et al.*, 2020; Dejon-Agobé *et al.*, 2021). However, little is known about morbidity levels among the *Almajiri* who have been neglected in terms of schistosomiasis control. Studies on the health of *Almajiri* are dearth despite constituting and appreciable number of children in Northern Nigeria.

In an effort towards achieving the goal of WHO's Neglected Tropical Diseases (NTD) 2021-2030 Roadmap in eliminating and eradicating diseases including schistosomiasis, the study aimed to detect the presence of urinary schistosomiasis in the study area and its associated risk factors among *Almajiri* as well as to assess the impact of the disease on haematological profile of both infected and uninfected *Almajiri*.

MATERIALS AND METHODS

Study area

The study was conducted in Bomo and Rafin Guza of Sabongari and Kaduna North Local Governments of Kaduna State respectively. These two locations are situated in the Northern part of the State. Bomo is located along Funtua-Sokoto Road and very close to Samaru in Zaria, Kaduna State (Figure 1) and is located 8km North West of the Ahmadu Bello University, Zaria (Olaifa *et al*., 2014). Rafin Guza is a village located at the far end of Kawo new extension in Kaduna North Local Government Area of Kaduna State (Figure 2).

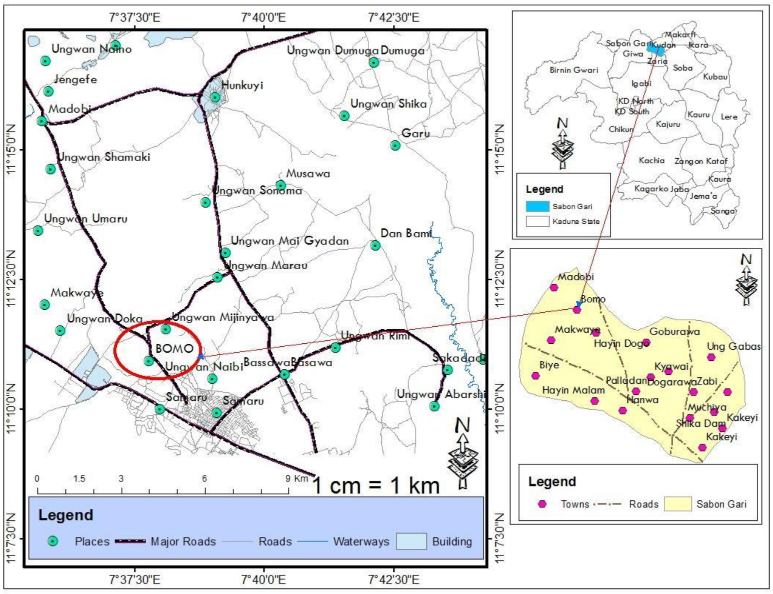

Figure.1: Map of Bomo and its environment.
Source: GIS Lab Department of Geography ABU Zaria Using (ArcGIS 10.3 Software).

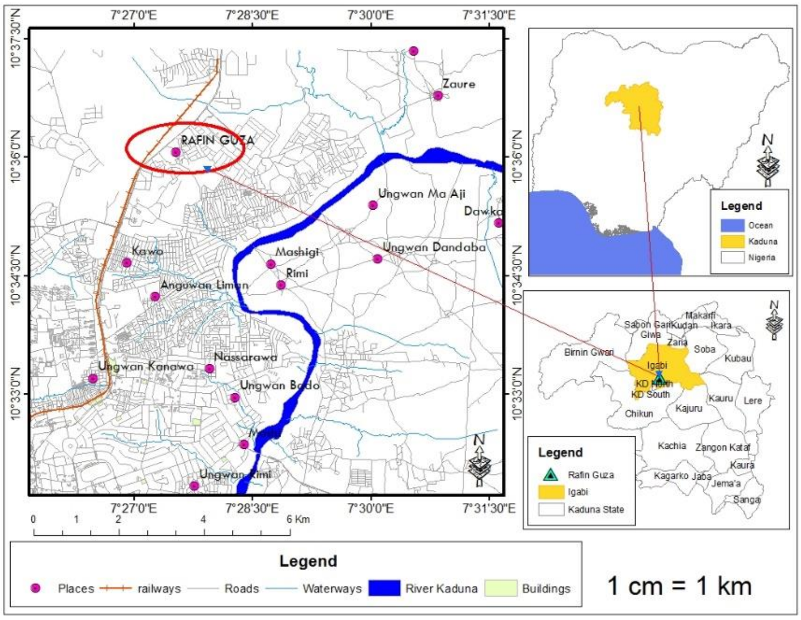

Figure.3: Map of Rafin Guza and its environment.
Source: GIS Lab Department of Geography ABU Zaria (ArcGIS 10.3 Software).

Ethical clearance
The study was conducted after ethical approval was obtained from Kaduna State Ministries of Education **(KDS/MOEST/ESP/475/2017/VOL1)** and Health **(MOH/ADM/744/Vol1/600)** respectively. Familiarity visit was carried out to the *Tsangaya* of the various villages and the purpose and benefits of the study were explained to the *Mallam*. At the start of data collection of each study site, the *Almajiri* were gathered and basic information about schistosomiasis such as the (causative agent, snail vector, means of transmission and symptoms) was explained to them.

Inclusion criteria
Almajiris between the probable ages of 5-16 years who agrees to participate were enrolled for the study.

Study design and Study population
The study was a random and cross-sectional study conducted between February to April 2019 among apparently healthy *Almajiris*. The study includes 193 *Almajiris* between the age of 5-16 years from various *Tsangaya* in Bomo and Rafin Guza settlements of Kaduna State.

Sample size determination: Sample size was calculated using the formula by Charan and Bitmas (2013). A prevalence of 10.5% was used to compute the minimum sample size based on previous studies on schistosomiasis in Bomo (Bishop and Akoh, 2018).

Sampling techniques

Questionnaire administration
A well-structured knowledge, attitude and practice (KAP) questionnaire was administered to each participant by an aid in the local language (Hausa). Each questionnaire was assigned a number that corresponds to the urine and blood sample collected.

Urine sample collection and processing
Pre-labelled screw capped plastic container was given to each *Almajiri*. Urine sample was collected between the hours of 10:00 and 14:00 for optimum egg passage (Ibironke *et al*., 2011).The urine was transported within 2 hours in a cooler containing ice to the Parasitology Laboratory of the Department of Microbiology, Ahmadu Bello University, Zaria. The urine was centrifugated at 4000rpm for ten minutes. The deposit was place on to a clean grease free glass slide after discarding the supernatant. It was examined under the microscope at x10 and x40 objective lens for *S. haematobium*. (Cheesbrough, 2009)

Determination of haematological parameters
Five (5) millilitres of venous blood were collected by a trained phlebotomist using a sterile disposable plastic syringe after cleaning the venous puncture site with 70% alcohol. The blood was then transferred to a pre-labelled EDTA container and rolled for adequate mixing of the blood and anticoagulant was dispensed into the SWELAB Haematological analyser 2.0 to carry out the differential count which was expressed as the percentage of each cell type related to the total Leucocyte count and the results was reported in absolute numbers (X 10^9/l) (Lewis *et al*., 2006)

Data analysis
Data was doubled entered in Microsoft excel and checked for consistency and analysed using SPSS version 26.0. The infection prevalence defined as the percentage of individual with *S. haematobium* eggs in urine was calculated and Chi square test was used to determine statistical differences between two variables.

RESULTS

Out of the 193 *Almajiri* sampled, 31 (16.1%) were infected with *S. haematobium*, among which Bomo recorded 10 (10.5%) out 0f 97 while Rafin Guza recorded 21(21.8%) out of 96 prevalence respectively (P=0.023). (Table 1) study reveals higher prevalence (33%) among the older age group of 11-16 years than those aged 6-10 years (6.9%) (P=0.001; OR=0.240; CI: 0.093-0.616) (Table 2).

The result reveals that there was no significant difference in the prevalence of *S. haematobium* infection among subjects that use pit as toilet facility (9.7%) and those that do not use 19.8) (P=0.458; OR=0.844; CI: 0.410-1.918) (Table 3). Similarly, *Almajiri* who do not go to for fishing recorded insignificantly higher prevalence of 17.1% than those who did not go (13.2%) (P= 0.335; OR=0.736; CI: 0.296-1.825) (Table 3). However, the result of the study reveals that the prevalence of *S. haematobium* among the subjects was significantly higher among those that use borehole water (18%) as their water source than those that use well water (17%) (P=0.000; OR=0.844; CI: 0.390-1.926) (Table 3). Similarly, *Almajiri* who visited the water body for swimming recorded significantly higher prevalence of 28.6% than those who do not go to swim (0.04%) (P=0.000; OR=11.318; CI: 4.110-31.164). A significantly higher prevalence of 10.1% was recorded among *Almajiri* who had knowledge of the disease than those who did not (P=0.005; OR=3.014; CI: 1.372-6.618) (Table 3).

The result of the study revealed that there was a significant difference in some of the assessed haematological parameters of the study subjects compared to the uninfected. The result indicated that the WBC's counts of the infected subjects (7.60 ±2.083 x10^9/l) was significantly higher than those of the uninfected (6.71 ±1.944 x10^9/l) (P=0.007) (Table 4). Similarly, the lymphocyte count of the infected subject (40.48 ±16.649 x10^9/l) was significantly lower than that of the uninfected (46.94 ± 12.487 x10^9/l) (P=0.021) (Table 4). Additionally, the monocyte counts of the infected 11.65 ± 4.988 x10^9/l) was also significantly higher than those of the uninfected (9.48± 3.661 x10^9/l) (P=0.010) (Table 4). Finally, the Haemoglobin, platelet and granulocyte counts of the infected subjects did not significantly from that of the uninfected.

Table 1: Prevalence of urinary schistosomiasis based on study site

Location	Number examined	Number infected (%)	df	p-value
Bomo	97	10 (10.3)	1	*0.023
Rafin Guza	96	21 (21.8)	1	
Total	193	31 (16.1)		

*p < 0.05 is considered significant

Table 2: Age - related prevalence of urinary schistosomiasis in Bomo and Rafin Guza

Age group (years)	Number examined	Number Infected (%)	df	λ^2	p-value	OR	CI
5 -10	87	6 (6.89)	1	9.870	*0.001	0.240	0.093 - 0.616
11-16	106	35 (33.0)					
Total	193	31 (16.1)					

*p < 0.05 is considered significant, OR= Odds ratio, df = degree of freedom, CI = Confidence Interval

Table 3: Prevalence of urinary schistosomiasis among *Almajiri* with respect to some risk factors in the study areas

Risk factor	Number examined	Number infected (%)	Df	λ^2	p-value	OR	CI
Facility							
Pit	92	9 (9.7)	1	0.093	0.458	0.844	0.410-1.918
None	101	20 (19.8)					
Total	193	31 (16.1)					
Source of water							
Bore hole	94	14 (14.9)	1	29.783	*0.000	0.844	0.390-1.926
Well	99	17 (17.2)					
Total	193	31 (16.1)					
Visit to the stream/ Swimming							
Yes	77	26 (33.7)	1	29.78	*0.000	11.318	4.110-31.164
No	116	5 (4.3)					
Total	193	31 (16.1)					
Fishing							
Yes	53	7 (13.2)	1	0.442	0.335	0.736	0.296-1.825
No	140	24 (17.1)					
Total	193	31 (16.1)					
Aware of infection							
Yes	69	16 (8.2)	1	8.005	*0.005	3.014	1.372-6.618
No	124	15 (7.7)					
Total	193	31 (16.1)					

Key: df = degree of freedom, CI = Confidence Interval,*p < 0.05 is considered significant

Table 4: Comparison of selected haematological indices between infected and non-infected *Almajiris*

Haematological indices	*S. haematobium* Infected	Non-infected	P-value
	Mean ± SD	Mean ± SD	
Haemoglobin (g/dl)	11.96 ± 1.282	11.92 ± 1.149	0.843
WBC ($x10^9/l$)	7.60 ± 2.083	6.71 ± 1.944	*0.007
Platelet ($x10^9/l$)	230.54 ± 71.801	248.54 ± 81.572	0.183
Lymphocytes ($x10^9/l$)	40.48 ± 16.649	46.94 ± 12.487	*0.021
Monocytes ($x10^9/l$)	11.65 ± 4.988	9.48 ± 3.661	*0.010
Granulocyte ($x10^9/l$)	38.48 ± 6.667	39.04 ± 7.791	0.667

*$p < 0.05$ is considered significant

DISCUSSION

The overall prevalence of urinary schistosomiasis in the two studied areas was observed to be 16.1% and this calls for concern considering the global effort of controlling the disease burden. The lacks of awareness and parental care, inadequate toilet facility, proximity to cercariae infested water body, lack of access to the mass drug administration among the *Almajiri* all contributed to the moderately high point prevalence of urinary schistosomiasis in this study. However, Bishop and Akoh (2018) reported a lower prevalence of 10.5% in Zaria, Kaduna State; while Omenesa *et al* (2015) reported a higher prevalence of 19.5% among school pupils in Bomo and Adamu *et al*. (2019) reported a higher prevalence of 27% among school children in Kaduna State. However, the estimated mean prevalence of urinary schistosomiasis in Nigeria is 39.1% (Morenikeji *et al*., 2014), which implies that Nigeria is categorized to be a moderately endemic country regarding schistosomiasis.

The higher prevalence observed among the *Almajiri* in Rafin Guza may be attributed to the fact that more irrigation and fishing activities are carried out there than in Bomo. Also, the population of infected snail intermediate host may be higher at the time of sampling in Rafin Guza. This coincides with the work by Yunusa *et al*. (2016), who observed that areas close to the bodies of water or irrigation canals are more exposed to *S. haematobium* infection and the Tsangaya sampled in Rafin Guza were closer to the stream than the ones in Bomo.

The study reveals higher prevalence among the older age group (11-16 years), this could be because children of that age group are more adventurous hence tend to frequent the water body more than the younger ones. Akindele *et al*. (2020), reports that the age group between 0-20 years are important in the spread of this disease due to the fact that higher fecundity of the worms is observed among these age group and they are more engaged in increase activities that bring them in contact with water bodies. Therefore, the MDA directed at this age group could play a vital role in the reduction of infection in these areas studied.

The higher prevalence observed among *Almajiri* who used borehole water for their domestic needs may be because the study reveals that the *Almajiris'* visit to the water body is not for domestic needs but for recreation and agricultural purposes. This finding is not in agreement with that of Yunusa *et al*. (2016), who observed that lack of potable water is a risk factor for transmission of urinary schistosomiasis among *Almajiri* in Sokoto.

The KAP questionnaire reveals that awareness of schistosomiasis amongst the study population was very minimal. This calls for great concern because one of the interesting risk factors to the continued endemicity of the disease is lack of awareness of the cause of the disease. Other factors that contribute to the continued endemicity observed in this study include; and inadequate toilet facilities.

Lack of access to toilet facility had contributed minimally to the higher prevalence among the *Almajiri*. The reason for this is not far-fetched because transmission of schistosomiasis involves contact of the eggs with water to hatch and infect the specific snail intermediate host (*Bulinus spp*).

Considering the risk factors associated with the cercariae-infested water body, the study finding reveals that *Almajiri* who admitted going to the water body to swim had higher prevalence than those who do not go, this may be because of the longer contact time spent in the cercariae infested water as observed by (Omenesa *et al*., (2015). Interestingly, lower prevalence was observed among *Almajiri* who do not know about the disease and it could be attributed to the lack of parental care.

As regards to fishing which is mostly carried out in Bomo, the *Almajiri* who admitted not fishing recorded higher prevalence than those who went to fish. This may be because they visit the water body for reasons other than fishing such as: agricultural or recreational purposes.

The haemoglobin levels of infected and non-infected participants were quite similar. The reason for this observation may not be far-fetched because the *Almajiri* live an impoverished condition, hence they may all have anaemia of similar extent not necessarily due to urogenital schistosomiasis. The anaemia among the schistosome infected group may be as a result of the pathology of adult Schistosome in the bladder (Dejon-Agobé *et al*., 2021).

There was a significant difference in the total WBC counts of both groups, with the level among the infected *Almajiri* being higher because eosinophil levels usually rise in parasitic infection as a result of host's immune response to the presence of the adult schistosomes in the blood stream. This finding corroborates with those of Afrifa et al in Ghana and Dejon-Agobe et al in Ghana and in Gabon (Afrifa *et al*., 2017; Dejon-Agobé *et al*., 2021).

Platelet counts of both groups was within the normal range which is in line with (Hoffbrand *et al*. (2006). However, the count for the uninfected group is slightly higher than that of the infected group and it is not statistically significant ($p>0.05$). However, Dejon-Agobé *et al*.(2021) also revealed Platelet counts within the normal range among Gabonese children infected with schistosomiasis.

The lymphocytes counts were observed to be below the normal range and statistically significant amongst both groups ($p<0.05$). Reason may be there is an underlying viral infection (Hoffbrand *et al*., 2006), or some form of stress and malnutrition that the *Almajiris* live with (Sarkingobir *et al*., 2019), observed that the majority of *Almajiri* rely on begging for food while 25% especially the older ones do engage in menial work to find food and other needs. In the course of these menial work, the *Almajiri* face harsh treatment and physical injury which results to stress.

The monocytes count of both groups was observed to be higher than normal with that of the infected being much higher. Blood monocyte count higher than 0.8×10^9/L may be indicative of an existing bacterial or protozoan infection, connective tissue disorders, leukaemia and other malignancies according to Hoffbrand *et al*. (2006). The presence of aforementioned morbidities among this vulnerable group is highly expected due to their lack of parental care and impoverished way of life.

The granulocyte count of both groups is far above the normal count which is indicative of heavy infection among the study subjects. The granulocytes are among the most important cell types during helminthic invasion. Their main role is to engulf and destroy invading pathogens and parasites (Makepeace *et al*., 2012).

The discrepancies in the values of the haematological parameters observed in this study may be as consequence of several factors, such as; age of the study participants, acquired immunity among the *Almajiri*, number of contact with infested waters, worm burden, sampling size and sampling techniques as observed by Dessie *et al*. (2020).

The major limitation of this study was that the intensity of the infection was not determined and the auto analyser used does not count each type of polymorph, rather it gives the reading of granulocytes.

CONCLUSION

The present study areas were in the Northern part of Kaduna State which represents moderate-risk community for urinary schistosomiasis. Lacks of; parental care, MDA intervention, awareness of the cause of the disease and inadequate toilet facility are the determining factors for the infection. Mass treatment with Praziquantel will help in reducing the infection level so also measures such as sanitation. Public awareness campaign needs to be emphasized especially amongst these group of the Northern Nigeria population.

Competing interest

The authors declare that they have no competing interests

Authors' contribution

HJB and IHI conceived the study. HJB drafted the proposal, undertook the statistical analysis and drafted the manuscript. The sample collection and laboratory analysis were carried out by HJB under the supervision of OSO. All authors contributed to the manuscript writing and approved the submitted version.

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