academicJournals

Vol. 8(3), pp. 22-29, March 2016
DOI: 10.5897/IJMMS2016.1230
Article Number: CE2B06F57745
ISSN 2006-9723

http://www.academicjournals.org/IJMMS

International Journal of Medicine and Medical Sciences

Full Length Research Paper

Prevalence, epidemiological characteristics and predictors of occurrence of urinary schistosomiasis among 'Almajiri' school children in Sokoto, Nigeria

Yunusa, E. U.*, Awosan, K. J., Ibrahim, M. T. O. and Isah, B. A.

Department of Community Health, Usmanu Danfodiyo University, Sokoto, Nigeria.

Received 10 February 2016; Accepted 1 March 2016

Schistosomiasis is a major public health problem and second only to malaria as the most devastating disease in tropical countries in Africa, East Asia and South America. 'Almajiri' children are known to be exposed to conditions that place them at high risk of infectious diseases including schistosomiasis. A cross-sectional study was conducted among 272 randomly selected children studying at the 'Almajiri' Integrated Model School, Sokoto, Nigeria, to determine the prevalence, epidemiological characteristics and predictors of occurrence of urinary schistosomiasis among them from December 2013 to January 2014. Urine samples were collected from the children and examined for microhaematuria (using reagent strips) and ova of *Schistosoma haematobium* (microscopically by sedimentation technique), in addition to questionnaire administration (to obtain information on epidemiological characteristics of participants). Mean age of participants was 9.2 ± 2.0 years. About a quarter (25.7%) of participants had urinary schistosomiasis, with the highest prevalence (27.2%) in the 10 to 14 years age group. Swimming in river/pond was found to be the sole predictor of occurrence of urinary schistosomiasis (OR = 3.284, p = 0.020, 95% CI = 1.210 to 8.911). There was a strong agreement between microhematuria and detection of ova of *S. haematobium* on urine microscopy (Kappa statistics = 0.895, p = 0.0001). These findings suggest the need for school based health education program and provision of potable water, in order to prevent schistosomiasis related exposures, break the chain of infection and reduce disease burden.

Key words: Prevalence, predictors, urinary schistosomiasis, 'Almajiri' school children.

INTRODUCTION

Schistosomiasis is a major public health problem and second only to malaria as the most devastating disease in tropical countries in Africa, East Asia and South America (USAID, 2016). Despite the high burden of the disease particularly in Africa that accounted for over 85 percent of the estimated 238 million people infected with the disease in 2010 (CDC, 2016; WHO, 2010), 90 percent of the estimated 261 million people requiring preventive treatment for the disease in 2013 (WHO, 2016), and an estimated 200,000 deaths per year (USAID, 2016), the paradox is that schistosomiasis remains a neglected tropical disease.

In areas endemic for the disease, it disproportionately affects poor and rural communities without access to safe

*Corresponding author. E-mail: dryunusausmanedzu@gmail.com.

drinking water and adequate sanitation, particularly agricultural and fishing populations, because people suffering from the disease contaminate freshwater sources with their urine and excreta containing parasite eggs which hatch in water and then enter into freshwater snails to develop into infective larval form of the parasite. Inadequate hygiene and contact with infected water (during which larval forms of the parasite released by freshwater snails penetrate the skin) make children especially vulnerable to infection; and women doing domestic chores in infested water, such as washing clothes, are also at risk (WHO, 2016).

Of serious concern is the fact schistosomiasis infection is usually acquired in childhood (when children tend to spend time swimming or bathing in water containing the larval form of the parasite), the increasing prevalence and intensity of infection with age (peaking in the 5 to 14 year age group), and the fact that children also suffer the most side effects of the disease, especially poor growth and impaired cognitive development. The disease also contributes to malnutrition and disrupts school attendance (USAID, 2016); in essence, the disease has become a double edged sword as it continues to exert huge socio-economic and health tolls on these children who grow up to bear the brunt of the complications of the disease.

The 30% prevalence of urinary schistosomiasis reported among school children in Zenu community of Ghana (Tetteh-Quarco et al., 2013), 64.3% prevalence in Zengerema District of Tanzania (Mazigo et al., 2010), and 73.3% prevalence in Eastern Cape province of South Africa (Meents and Boyles, 2010) among several other studies, perfectly mirror the reported overall high burden of the disease in Africa.

Similarly in Nigeria, the 30.5% prevalence of urinary schistosomiasis reported among school children in Keffi town, Nasarawa state (Ishaleku et al., 2012), 47.6% prevalence in two peri-urban communities in Osun state (Babatunde et al., 2013), 53.8% prevalence in Azumini, Abia state (Amechi, 2014), 60.8% prevalence in Sokoto metropolis, Sokoto state (Singh and Muddasiru, 2014), and 64.3% prevalence in Langai, Plateau state (Banwat et al., 2012), show the enormity of the burden of the disease in the country.

Almajirai (singular: Almajiri) is a Hausa word meaning immigrant children in search of Quranic education. In Nigeria, Almajirai are usually between the ages of seven and fifteen and mostly found in the Northern states including Kano, Kaduna, Katsina, Sokoto, Kebbi, and Zamfara among others. Sokoto state alone harbours about 1.1 million Almajiri children scattered around the state. Almajiri children are known for roaming the streets, farm lands, waste dumping sites and swimming in dirty and contaminated water. They are deprived of the basic necessities of life, plunged into poverty and may not be trained in the skills required to make them productive in future. They are known to face several social problems such as parental deprivation, food insecurity, and sleeping in overcrowded conditions that expose them to various health hazards particularly communicable diseases (Christian, 2010; Kabir et al., 2005).

The enormous socio-economic burden of schistosomiasis on the affected population exposed to the disease, and the correlation between disease burden and host characteristics including age, lifestyles and occupation that contribute to exposure to infection (such as swimming in infected water, fishing), in addition to other ecological parameters, have been documented in several studies (Patz et al., 2000; Brouwer et al., 2003, 2004).

Most of the previous studies carried out in Sokoto state (Bello et al., 2003, 2014; Singh and Mudashiru, 2014; Kabiru et al., 2013) had focused majorly on disease burden and socio-demographic characteristics of the study subjects, there is dearth of literature on the epidemiological parameters that favor the transmission of the disease in the study area. This study was therefore conducted to determine the prevalence, epidemiological characteristics and predictors of occurrence of urinary schistosomiais among 'Almajiri' school children in Sokoto, Nigeria. The findings would be invaluable in designing appropriate strategies for the prevention and control of the disease, particularly among this 'at risk' population.

MATERIALS AND METHODS

Study design and population

This was a cross-sectional study among children studying at the 'Almajiri' Integrated Model School at Tudun-Yandogo community, Dange-Shuni Local Government Area, Sokoto state, Nigeria, from December 2013 to January 2014. Most of the pupils were from the 23 Local Government Areas in Sokoto state, while a few came from the neigboring states.

The sample size was estimated at 272 using the statistical formula for estimating the sample size for descriptive studies (Ibrahim, 2009), 64.3% prevalence of urinary schistosomiasis among school age children from a previous study (Banwat et al., 2012), adjustment for a finite population of 800 pupils (obtained from the school records), precision level of 5% and an anticipated response rate of 90%. Children aged 5 years and above were considered eligible for enrolment into the study, those currently on treatment for urinary schistosomiasis or recently treated (less than 12 weeks) for the disease were excluded. The study subjects were selected proportionately in each of the 13 classes in the school by systematic sampling technique using the list of students in the respective classes to constitute the sampling frame.

Epidemiological characteristics

A set of pretested, semi-structured, interviewer administered questionnaire was used to obtain information on respondent's socio-demographic characteristics and schistosomiasis related exposures. It was reviewed by senior colleagues in the Department of Community Health, Usmanu Danfodiyo University, Sokoto; translated into Hausa version and then back translated into English by senior researchers in the social sciences department of the university to ascertain content validity. The Hausa translated version of the questionnaire was used for data collection. It was pretested among 15 students studying at the Federal Government owned Almajiri school located in Sokoto metropolis, the necessary corrections were effected based on the observations made during the pretest. The questioonaires were numbered using the identification number issued to the participants. Five community health officers assisted in questionnaire administration after training on survey research, the objectives of the study, selection of study subjects and questionnaire administration.

Urine sample collection and analysis

Terminal urine samples were collected between 10:00 and 14:00 h, being the time of maximal egg output (Cheesbrough, 2005), into wide-mouthed, dry, sterile, clean bottles containing few drops of household bleach (as preservative), covered tightly and transported to the main microbiology laboratory of the Usmanu Danfodiyo University Teaching Hospital, Sokoto, Nigeria for analysis. The sample bottles were labelled using the identification number issued to the participants. The urine samples were examined for microhaematuria (using Medi-Test Combi 9 strips) and ova of *Schistosoma haematobium* (microscopically using standard sedimentation technique as described by Cheesbrough (2005)). All eggs were counted, recorded in the data sheet designed for the study, and the intensity of infection was graded based on the World Health Organization (WHO) criteria (WHO, 2002), as light (1 to 49 eggs per 10 ml of urine), heavy (≥ 50 to 499 eggs per 10 ml of urine), and severe (≥ 500 eggs per 10 ml of urine). Likewise, the community risk status was classified based on the WHO criteria (WHO, 2006) as low (<10% prevalence by parasitological method), moderate (≥ 10% but < 50% prevalence by parasitological method), and high (≥ 50% prevalence by parasitological method). Three laboratory technologists were recruited to assist in urine sample collection after training them on the objectives and conduct of the study.

Data analysis

Data entry, processing and statistical analysis were done using SPSS version 20 and Microsoft Excel computer statistical software packages after data cleansing. The chi-square test was used for bivariate analysis involving categorical variables. Kappa statistic was used to measure agreement between microhaematuria and diagnosis of urinary schistosomiasis. Logistic regression analysis was used to determine the variables that predict schistosomiasis infection. All levels of significance were set at $p < 0.05$.

Ethical consideration

Institutional ethical clearance was obtained from the Ethical Committee of Usmanu Danfodiyo University Teaching Hospital, Sokoto, Nigeria. Permission to conduct the study was granted by the Sokoto state Ministry of Religious Affairs. The Principal of the school signed the parental informed consent on behalf of the children (and they also accented to participate in the study).

RESULTS

All the 272 questionnaires administered were retrieved and analyzed. All the participants were males and Moslem by religion. Their age ranged from 6 to 24 years (Mean = 9.2 ± 2.0), but majority (71.7%) were in the 10 to14 years age group. For most of the respondents, their father had only quranic education (62.5%), were either farmers (36.8%) or businessmen (39.0%). Majority of participants were from Sokoto state (74.7%), while about a fifth of them (22.3%) were from Zamfara state. A larger proportion of participants (57.6%) were from rural non-riverine areas (Table 1).

Schistosomiasis related exposures among participants

The participants reported high prevalence of schistosomiasis related exposures. Majority of participants wash their clothes and other items in river or stream (89.0%), and bath with water from the river (70.9%). Also, about half of participants (51.5%) swim in river or pond, while close to half of them (47.8%) work on swampy farm (Table 2).

Prevalence of urinary schistosomiasis among participants

Close to half of participants (49.0%) reported ever passing blood in urine at one time or the other, while about a quarter of them (26.9%) had microhaematuria (on urinalysis) as shown in Table 3.

About a quarter, 70 (25.7%) of the 272 participants had ova of *Schistosoma hematobium* in their urine (Figure 1). Although, all the participants had light-intensity infection, as none of them had up to 50 ova of *S. haematobium* per 10 ml of urine, with a 25.7% prevalence of urinary schistosomiasis, the school ('Almajiri' Integrated Model School, Sokoto, Nigeria) was classified as 'moderate-risk community'.

There was a strong agreement between micro-haematuria and detection of ova of *S. haematobium* on urine microscopy (Kappa's statistics = 0.895, $p < 0.001$).

Factors associated with occurrence of urinary schistosomiasis among participants

Urinary schistosomiasis was statistically significantly more prevalent among children in the 10 to 14 years age group compared to those in the other age groups (χ^2 = 1.974, p = 0.043), and less prevalent among children whose fathers were farmers compared to those whose fathers were businessmen, civil servants or artisans (χ^2 = 9.357, p = 0.021) as shown in Table 4. However, in logistic regression analysis there was no predictor of occurrence of urinary schistosomiasis among the socio-demographic variables.

Similarly, urinary schistosomiasis was statistically significantly more prevalent among children that swim in river or pond (26.4%) compared to those who do not (14.6%); χ^2 = 12.76, p = 0.001 (Table 5). Logistic

Table 1. Socio-demographic profile of participants.

Variables	Number	Percentage
Age groups (in years) n = 272		
5-9	29	10.7
10-14	195	71.7
15-19	47	17.3
>19	1	0.4
Father's level of education (n = 264)		
None	2	0.8
Quranic only	165	62.5
Primary	9	3.4
Secondary	78	29.5
Tertiary	10	3.8
Father's occupation (n = 244)		
Farming	100	36.8
Business	106	39.0
Civil servant	35	12.9
Artisan	3	1.1
State of origin (n = 206)		
Sokoto	154	74.7
Zamfara	46	22.3
Kano	3	1.5
Others	3	1.5
Nature of place of residence (n = 257)		
Rural riverine	109	42.4
Rural non-riverine	148	57.6

Table 2. Schistosomiasis related exposures among participants

Type of exposure*	Number (n = 272)	Percentage
Swim in river or pond	140	51.5
Wash clothes/other items in river/stream	242	89.0
Bath with water from the river	192	70.9
River as main source of water for drinking	12	4.4
Work on swampy farm	130	47.8

*Multiple responses allowed.

regression analysis also shows that children who swim in river or pond were three times more likely to have urinary schistosomiasis compared to children who do not (Odds ratio (OR) = 3.284, p = 0.020, 95% Confidence Interval (CI) = 1.210 to 8.911) as shown in Table 6.

DISCUSSION

Schistosomiasis related exposures were very prevalent among the participants; majority of participants wash their clothes and other items in river or stream (89.0%), bath with water from river (70.9%), and swim in river or pond (51.5%). This is of public health concern as it exposes the prevailing lack of access to potable water in the rural communities in Sokoto and Zamfara states where most of the participants resided before migrating to the city.

About a quarter (25.7%) of the participants in this study had urinary schistosomiasis, this may be attributed to the fact that a sizable proportion of the participants (42.4%)

Table 3. Prevalence of hematuria among participants

Hematuria	Number	Percentage
Ever passed blood in urine (n = 271)		
Yes	134	49.0
No	135	50.0
I can't remember	2	1.0
Microhaematuria (on urinalysis, n = 268)		
Present	72	26.9
Absent	196	73.1

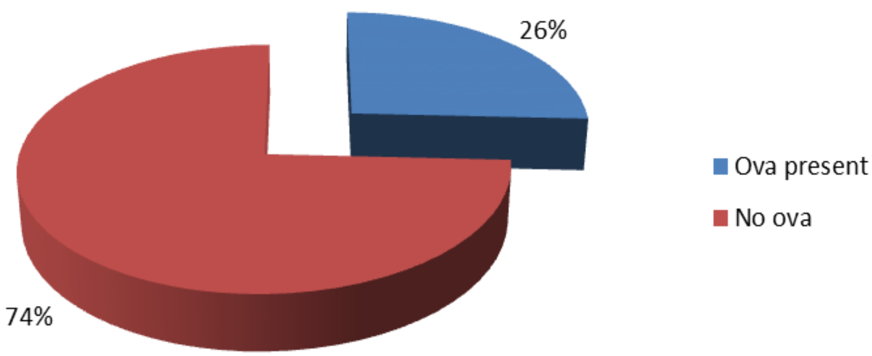

Figure 1. Prevalence of urinary schistosomiasis among participants.

Table 4. Distribution of occurrence of urinary schistosomiasis by socio-demographic profile of participants.

Variables	Presence of ova of *Schistosoma hematobium* in urine		Test of significance
	Yes [Number (%)]	No [Number (%)]	
Age groups (in years)			
5-9	7 (24.1)	22 (75.9)	$\chi^2 = 1.974$, df = 1, p = 0.043
10-14	53 (27.2)	142 (72.8)	
15 and above	10 (21.3)	38 (79.7)	
Education status of father			
Quranic	43 (26.1)	122 (73.9)	$\chi^2 = 1.037$, df = 4, p = 0.904
Primary	3 (33.3)	6 (66.7)	
Secondary	20 (25.6)	58 (73.4)	
Tertiary	2 (20.0)	8 (80.0)	
None	1 (50.0)	1 (50.0)	
Occupation of father			
Farmer	15 (15.0)	85 (85.0)	$\chi^2 = 9.357$, df = 3, p = 0.021
Business	34 (32.1)	72 (67.9)	
Civil servant	12 (34.3)	23 (65.7)	
Artisan	1 (33.3)	2 (66.7)	
Nature of place of residence			
Rural riverine	32 (29.4)	77 (70.6)	$\chi^2 = 2.009$, df = 1, p = 0.156
Rural non-riverine	32 (21.6)	116 (78.4)	

Table 5. Distribution of occurrence of urinary schistosomiasis by exposure status of participants.

Variables	Presence of ova of *Schistosoma hematobium* in urine		Test of significance
	Yes [Number (%)]	No [Number (%)]	
Swim in river/pond			
Yes	46 (26.4)	128 (73.6)	χ^2 = 12.76, df = 1
No	21 (14.6)	140 (85.3)	p = 0.001
Source of water for washing			
River	6 (42.9)	8 (57.1)	
Stream	0 (0)	2 (100)	χ^2 = 2.854, df = 3
Well	44 (22.7)	150 (77.3)	p = 0.415
Tap	17 (25.0)	51 (75.0)	
Source of water for bathing			
River	5 (38.5)	8 (61.5)	χ^2 = 1.756, df = 2
Well	51 (26.6)	141 (73.4)	p = 0.416
Tap	14 (73.7)	5 (26.3)	
Source of water for drinking			
River	4 (33.3)	8 (66.7)	χ^2 = 1.246,
Stream	0 (0)	2 (100.0)	df = 3
Well	49 (26.8)	134 (73.2)	p = 0.742
Tap	17 (33.9)	54 (76.1)	
Work on swampy farm			
Yes	36 (27.7)	94 (72.3)	χ^2 = 0.741,df = 2
No	33 (25.8)	95 (74.2)	p = 0.779

Table 6. Logistic regression analysis for predictors of occurrence of urinary schistosomiasis among participants.

Type of exposure	Odds ratio (OR)	p value	95% Confidence Interval (CI)	
			Lower	Upper
Swim in river or pond	3.284	0.020	1.210	8.911
Wash clothes/other items in river/stream	1.428	0.433	0.586	3.481
Bath with water from the river	1.721	0.360	0.539	5.499
River as main source of water for drinking	0.567	0.436	0.136	2.366
Work on swampy farm	0.845	0.778	0.262	2.724

in this survey were from rural riverine areas where children have unrestricted access and exposure to schistosoma breeding bodies of water. This finding is in concordance with that obtained in a study among school age children in the lower river Volta basin in Ghana by Nkegbe et al. (2010) that reported a prevalence of 21%, but it is much lower than the 60.8% prevalence reported in a study among school children in Sokoto metropolis by Singh and Mudashiru (2014).

Although, all the participants in this study had light-intensity infection as none of them had up to 50 ova of *S. haematobium* per 10 ml of urine (WHO, 2002), with a 25.7% prevalence of urinary schistosomiasis, the school ('Almajiri' Integrated Model School, Sokoto, Nigeria), was classified as 'moderate-risk community' (WHO, 2006), and all the school-age children in the school are expected to have preventive chemotherapy by mass administration of praziquantel, at a dose of 40 to 60 mg/kg body weight, in single or divided doses, every 2 years (WHO, 2006).

Almost equal proportion of participants that currently pass blood in urine (26.9%) had urinary schistosomiasis (25.7%), and there was a strong agreement between selfreported current hematuria and detection of ova of *S. haematobium* on urine microscopy (Kappa's statistics = 0.895, p = 0.001). This finding is consistent with the pathophysiology of the disease (with hematuria accompanying shedding of ova from the bladder), and it supports the use current hematuria for a presumptive diagnosis of the disease especially in resource poor settings endemic for the disease. This would facilitate prompt treatment of those infected, reduce their risk of developing complications of the disease and halt transmission of the disease in the community.

The prevalence of urinary schistosomiasis among the participants in this study, rose from 24.1% among those in the 5 to 9 years age group, to a peak of 27.2% among those in the 10 to 14 years age group and then dropped to 21.3% among those aged 15 years and above. This is similar to the findings in the study by Brouwer et al. (2003) where the prevalence of urinary schistosomiasis rose from 23.6% in the 5 to 9 years age group, to a peak of 29.2% in the 10 to 14 years age group and then dropped to 20.1% in the 15 to 19 years age group.

Another study by Amadu et al (2001) in Wurno, Sokoto state, also reported a similar pattern with the prevalence rising from 6.5% in the 5 to 9 years age group, reaching a peak of 30.3% in the 10 to 14 years age group and then dropped to 8.7% in the 15 to 19 years age group. These findings could be due to the agricultural practices in these communities and the fact that grown up children (10 years and above) were more likely to be involved in farming, fishing and other forms of contact with contaminated water that expose them to the risk of the disease than those in the younger age group.

An intriguing finding in this study was the lower prevalence of urinary schistosomiasis among children of farmers (15.0%) as compared to children of businessmen (32.1%), artisans (33.3%) and civil servants (34.3%). This is explainable in the context of the fact that the children of farmers were not unlikely to have been exposed to the disease and could have been educated on the preventive measures for the disease in the course of accessing healthcare services. Swimming in infected pools of water and streams/rivers could have been the major source of infection among children whose fathers were non-farmers.

In sharp contrast to the similarity in the prevalence of urinary schistosomiasis among children from rural riverine (29.4%) and rural non-riverine areas (21.6%) in this study, Phiri et al. (2000) observed a very high prevalence of urinary schistosomiasis among children resident in rural riverine (86.1%) compared to those resident in rural non- riverine areas (12.1%).

Children who swim in river/pond were three times more likely to have urinary schistosomiasis compared to those who do not (OR = 3.284, p = 0.020, 95% CI = 1.210 to 8.911). This finding is consistent with the documented pathogenesis of the infection in which schistosome cercariae penetrate the body following exposure to cercarial contaminated water. The higher risk (40.1%) of schistosoma infection among children who had contact with stream/pond in a study by Satayathum et al. (2006) further corroborate the finding in this study.

The higher prevalence of urinary schistosomiasis among participants whose source of water for washing was river/pond in this study (although not statistically significant) compare well with the findings in the study by Kloos et al. (2006), that reported 58.9% prevalence of urinary schistosomiasis among participants whose source of water for washing was river, 42.1% prevalence among those whose source of water for bathing was stream, and 32.0% prevalence among those whose source of water for drinking was stream/river. This finding highlights the risks rural populations are exposed to as a result of lack of access to potable water, and it underscores the need to make provision of potable water in the rural populations a top priority.

Conclusion

This study demonstrated high prevalence of urinary schistosomiasis among children in "Almajiri" Integrated Model School, Sokoto, Nigeria, with the highest prevalence in the 10 to 14 years age group. Similarly, schistosomiasis related exposures were very prevalent among them, particularly swimming in river/pond which was found to be the sole predictor of occurrence of urinary schistosomiasis. These findings suggest the need for school based health education program and provision of potable water, in order to prevent schistosomiasis related exposures, break the chain of infection and reduce disease burden. In addition, being a moderate-risk community, all the school-age children in the school should have preventive chemotherapy by mass administration of praqizuantel once in 2 years.

Conflict of interests

The authors have not declared any conflict of interests.

ACKNOWLEDGEMENTS

The authors would like to thank the Hon. Commissioner, Ministry of Religious Affairs and Hon. Commissioner, Ministry of Health, Sokoto State, Nigeria, and the principal of 'Almajiri' Integrated Model School Dange-Shuni, Sokoto, for granting them permission to conduct the study. They also thank all the children that participated in the study for their cooperation.

REFERENCES

Amadu T, Abubakar U, Danga C (2001). Schistosomiasis in Wurno district of Sokoto State, Nigeria. Nig. J. Parasitol. 22(1&2):81-84.

Amechi EC (2014). Urinary schistosomiasis among school age children in some rural communities of Abia state, South Eastern Nigeria. Anim. Res. Int. 11(2):1953-1957.

Babatunde TA, Asaolu SO, Sowemimio OA (2013). Urinary schistosomiasis among pre-school and school aged children in two peri-urban communities in Southwest Nigeria. J. Parasitol. Vector Biol. 5(7):96-101.

Banwat M, Ogbonna O, Daboer J (2012). Prevalence of urinary schistosomiasis in school aged children. Langai, Plateau State: Pre- and Post-intervention. Nig. J. Med. 21(2):146-149.

Bello A, Jimoh AO, Shittu SB, Hudu SA (2014). Prevalence of urinary schistosomiasis and haemato-proteinuria in Wurno rural area of Sokoto state, Nigeria. Orient. J. Med. 26(3-4):114-121.

Bello YM, Adamu T, Abubakar U, Mohammad AA (2003). Urinary schistosomiasis in some villages around the Goronyo dam, Sokoto state, Nigeria. Nig. J. Parasitol. 24(1):109-114.

Brouwer KC, Ndhlovu PD, Wagatsuma Y, Munatsi A, Shiff CJ (2004). Urinary Schistosomiasis in Zimbabwe school children: Predictors of morbidity. Afr. Health Sci. 4(2):115-118.

Brouwer KC, Ndhlovu PD, Wagatsuma Y, Munatsi A, Shiff CJ (2003). Epidemiological assessment of *Schistosoma haematobium*-induced kidney and bladder pathology in rural Zimbabwe. Acta Trop. 85(3):339-347.

CDC (2016). Schistosomiasis. Centre for Disease Control and Prevention, Atlanta. Available at: http:wwwnc.cdc.gov/travel/yellowbook/2016/infectious_diseases_related-to-travel/schistosomiasis.

Cheesbrough M (2005). District Laboratory Practice in Tropical Countries Part 1 (2nd edition). New York, USA. Cambridge University Press.

Christian P (2010). Nigeria's Almajiri Children: learning a life of poverty and violence. Available at: http://edition.cnn.com/2010/WORLD/africa/01/07/nigeria.children.radicalization/

Ibrahim T (2009). Research methodology and dissertation writing for health and allied health professionals. Abuja, Nigeria. Cress Global Link Limited.

Ishaleku D, Yako AB, Usman D, Azamu SA (2012). Schistosoma haematobium infection among school children in Keffi town, Nasarawa state, Nigeria. Scholarly J. Med. 2(7):104-107.

Kabir M, Iliyasu Z, Abubakar IS, Ahmad DZ (2005). Medico-social problems of itinerant quranic scholars in Kano. Nig. J. Paediatr. 32(1):15-18.

Kabiru M, Ikeh EI, Aziah I, Julia O, Fabiyi JP, Mohamed RA (2013). Prevalence and intensity of schistosoma haematobium infections: a community based survey among school children and adults in Wamakko town, Sokoto state, Nigeria. Int. J. Trop. Med. Public Health. 2(1):12-21.

Kloos H, Rodrigues JC, Pereira WR, Velasquez-Melendez G, Loverde P, Oliveira RC, Gazzinelli A (2006). Combined methods for the study of water contact behavior in a rural schistosomiasis-endemic area in brazil. Acta Trop. 97(1):31-41.

Mazigo HD, Waihenya R, Mkoji GM, Zinga M, Ambrose EE (2010). Intestinal schistosomiasis prevalence, knowledge, attitude and practices among school children in an endemic area of north western Tanzania. J. Rural Trop. Public Health 9:53-60.

Meents EF, Boyles TH (2010). Schistosoma haematobium prevalence in school children in the rural Eastern Cape Province South Africa. S. Afr. J. Epidemiol. Infect. 25(4):28-29.

Nkegbe E (2010). Prevalence of schistosomiasis among school children in the lower river volta basin in Ghana. Gomal J. Med. Sci. 8(1):54-56.

Patz JA, Graczyk TK, Geller N, Vittor AY (2000). Effects of environmental change on emerging parasite diseases. Int. J. Parasitol. 30(12-13):1395-405.

Phiri K, Whitty CJM, Graham SM, Ssembatya-Lule G (2000). Urban/rural differences in prevalence and risk factors for intestinal helminth infection in southern Malawi. Ann. Trop. Med. Parasitol. 94(4):381-387.

Satayathum SA, Muchiri EM, Ouma JH, Whalen CC, King CH (2006). Factors affecting infection or reinfection with Schistosoma haematobium in coastal Kenya: survival analysis during a nine-year, school-based treatment program. Am. J. Trop. Med. Hyg. 75(1):83-92.

Singh K, Muddasiru D (2014). Epidemiology of schistosomiasis in school aged children in some riverine areas of Sokoto, Nigeria. J. Public Health Epidemiol. 6(6):197-201.

USAID (2016). Schistosmiasis. United States Agency for International Development's Neglected Tropical Disease Program. Available at: http:www.neglecteddiseases.gov/target_diseases/schistosomiasis/.

WHO (2016). Schistosomiasis fact sheet. World Health Organization, Geneva. Available at: http://www.who.int/schistosomiasis/en/

WHO (2010). Schistosomiasis fact sheet No 115. World Health Organization, Geneva. Available at: http:www.who.int/mediacentre/factsheets/fs115/en/

WHO (2006). Preventive chemotherapy in human helminthiasis. Coordinated use of anthelminthic drugs in control interventions: a manual for health professionals and programme managers. World Health Organization, Geneva. Available at: http://apps.who.int/iris/bitstream/

WHO (2002). Prevention and control of schistosomiasis and soil transmitted helminthiasis. Report of a WHO Expert Committee. WHO Technical Report Series 912. World Health Organization, Geneva. Available at: http://apps.who.int/iris/bitstream/