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Medical Full Length Article

Schistosomiasis: Epidemiological Factors Enhancing Transmission In Nigeria

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Schistosomiasis or Bilharziasis is a disease caused by parasitic flatworms of the genus *Schistosoma* and remains a public health problem in many developing countries in the tropics and subtropics. Though Nigeria is endemic for the disease, only limited mapping survey has been done before 2013. This study was carried out across 19 States and the Federal Capital Territory to provide a comprehensive baseline data on schistosomiasis for targeted interventions. The data presented were obtained from standardized school surveys of *Schistosoma haematobium* and *Schistosoma mansoni* carried out between 2013 and 2015. Midstream Urine and stool samples were collected in universal specimen bottles from 108,472 pupils. Urine samples were tested for haematuria using Combi-9® reagent strip and examined for schistosome eggs using urine filtration and sedimentation techniques. Stool samples were analysed using the Kato-Katz technique. Out of the 108,472 pupils sampled, 10,349 (9.5%) were infected with schistosomes, the highest prevalence occurred in Niger State 1,879(26.1%), followed by Kebbi State 1,062(21.9%) and FCT 204(20.3%). Lowest values were recorded in Rivers and Akwa Ibom States with prevalence of 7(0.1%) and 22(0.3%) respectively. *S. haematobium* 8,486 (82%) was the predominant species in the survey compared to *S. mansoni* 1,863 (18%) The prevalence of schistosomiasis was highest among those who engaged in swimming activity 1,759 (17.0%), followed by those who play in water 1,169 (11.3%). Males 1,255 (12.13%) were more infected than females 683 (6.60%) while pupils of age group 11-16 years were more infected than 5-10 years (P>0.05). The findings revealed that the overall prevalence was within the low risk range (9.5%), although data captured by LGA showed high levels of prevalence in some LGAs of some States. Nigeria is endemic for schistosomiasis and scale-up of appropriate mass administration of medicines and Water, Sanitation and Hygiene (WASH) interventions will facilitate the elimination of the disease in the country.

Keywords: Schistosomiasis, Epidemiological factors, Transmission, Nigeria,

INTRODUCTION

Schistosomiasis or bilharziasis, one of the most prevalent Neglected Tropical Diseases, is a public health problem in many developing countries in the tropics and subtropics with approximately 240 million infected and about 700 million at risk globally (WHO, 2017). Worldwide, 900 million people do not have access to an improved water source, while an estimated 2.5 billion, half of all people in developing countries lack access to adequate sanitation (UN, 2007, WHO, 2010;). Over 90% of the disease is currently found in sub-Saharan Africa, where more than 200,000 deaths are annually attributed to schistosomiasis. Schistosomiasis is mainly caused by five species of blood-dwelling fluke of the genus *Schistosoma* namely *Schistosoma haematobium* (causing urinary schistosomiasis), *S. mansoni, S. makongi, S. intercalatum* and *S. japonicum* (causing intestinal schistosomiasis). Despite intensive efforts to control the disease, schistosomiasis together with soil-transmitted helminthiasis continue to represent more than 40% of the disease burden caused by all tropical diseases, excluding malaria (Hany, 2013).

Schistosomiasis mostly affects poor and rural communities, particularly agricultural and fishing populations. Individuals doing domestic chores in infested water, such as washing clothes, fetching water and bathing are at risk (Chitsulo, *et al.,* 2000). Contact with infected water bodies make children especially vulnerable to infection. Through insanitary disposal of urine or faeces, waterbodies are contaminated with the eggs of schistosomes. Water is needed for the survival of the infective cercariae in order to penetrate the definitive host. In rural and poor agricultural communities without pipe-borne water, the inhabitants depend on cercariae infested streams for their economic and recreational needs thereby exposing themselves to infection (Chitsulo, *et al.,* 2000).

The abiotic factors affecting schistosomiasis transmission include climatic factors such as temperature and rainfall. These factors, however, can affect the prevalence of schistosomiasis indirectly as they affect the breeding and development of the snail intermediate hosts. In addition, it has been reported that many biotic factors can affect the prevalence of schistosomiasis such as host gender and age as a result of behaviour, hormonal or genetic reasons (Ali and Hati, 2009).

Nigeria is one of the countries known to be highly endemic for schistosomiasis with an estimated 43 million at risk and 37 million requiring treatment (FMoH, 2015). The exact national distribution and disease burden of schistosomiasis was largely unknown though the presence of schistosomiasis has been dated back to 1881 especially in the Northern borders of the country where its introduction has been attributed to the arrival of Fulani herdsmen from Upper Nile Valley **(**Cowper, 1963; WHO, 1987**).** The national data available were from limited number of epidemiological surveys conducted between 2008 and 2012, among school age children in 207 of the 774 LGAs (FMOH, 2015).This study which is part of a national survey aims to determine the prevalence and distribution of schistosomiasis and to identify the associated epidemiological factors that enhance the transmission of this disease among children in 19 states and the FCT, Nigeria. It is hoped that the findings of this study will assist public health authorities to identify and implement integrated and effective control measures to reduce the prevalence and burden of schistosomiasis in the country.

MATERIALS AND METHODS

Study Area

The study area comprised 19 States and the Federal Capital Territory (FCT) in Nigeria (Fig I). These States and the FCT have 456 Local Government Areas (LGAs) and an estimated population of 106,243,198 (National Population Commission, 2006). The survey was conducted in 433 out of the 456 LGAs. Twenty-one of the LGAs were previously mapped while two were not mapped due to security challenges.

Study Design and Mapping

State-wide mapping for schistosomiasis was conducted using the National protocol (FMoH 2013). The survey was cross sectional and purposive at State and LGA levels aimed at completing epidemiological mapping in Nigeria. Five primary schools/communities were randomly selected from each LGA. Fifty to sixty school age children (males and females) were randomly selected from each primary school/community using a sampling frame. Primary schools in northern Nigeria included non-formal schools (“Madrasat”/Islamic Schools).

Sample Collection and Examination

Midstream urine and stool samples were collected from 108,472 selected school children using universal specimen bottles. The urine samples were tested for haematuria using Combi-9® reagent strip and examined in the laboratory for schistosome eggs using urine filtration/sedimentation techniques. Stool samples collected from the school aged children were examined for parasite eggs using the Kato-Katz technique (WHO, 2010). The survey was based on standard diagnostic procedures for collection and examination of urine and stool samples from school age children for the presence of schistosome eggs (FMoH, 2013).

Data Analysis

Data analyses were carried out using IBM SPSS® version 20 and Epi Info 7. Descriptive statistics and Chi-square were used to test associations between variables. The statistical tests were determined at 95% level of significance.

Ethical Clearance

Ethical clearance was obtained from the National Health Research Ethical Committee (NHREC) of the FMoH. Ethical permissions obtained from the SMoH and SUBEB were conveyed to the Head of Schools. Chairmen of Parent Teachers' Association and community leaders gave consent on behalf of parents and children were allowed to decline from participation.

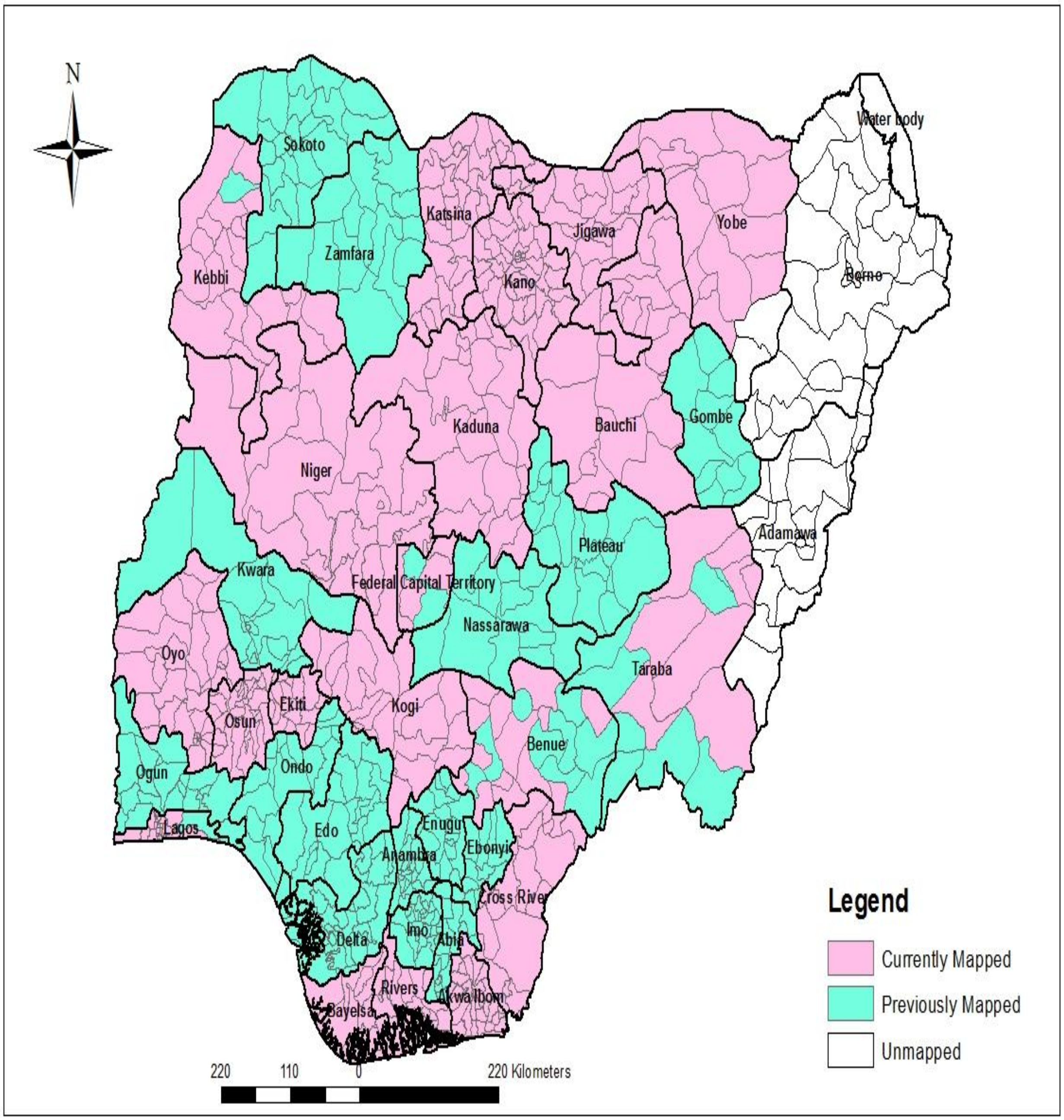

Figure 1: Map of Nigeria showing study area

RESULTS

Prevalence of schistosomiasis by state

Out of the 108,472 pupils sampled, 10,349 (9.5%) were infected with schistosomes with the highest prevalence occurring in Niger State 1,879 (26.1%), followed by Kebbi State 1,062 (21.9%) and the FCT 204 (20.3%). Lowest values were recorded in Rivers and Akwa Ibom States with prevalence of 7 (0.1%) and 22 (0.3%) respectively (Table I). The prevalence of schistosomiasis between states showed statistical significant difference (χ^2 = 7031.55, P>0.05).

Table 1: Prevalence of Schistosomiasis by states

States	**No. of persons examined**	**No.(%) Infected**	**95% CL**
Akwa-Ibom	7,866	22 (0.3)	(0.18 – 0.43)
Bauchi	4,958	675 (13.6)	(12.67 – 14.6)
Bayelsa	1,943	17 (0.9)	(0.52 – 1.42)
Benue	3,452	451 (13.1)	(11.96 – 14.24)
Cross River	4,943	283 (5.7)	(5.11 – 6.42)
Ekiti	3,523	8 (0.2)	(0.11 – 0.47)
FCT	1,003	204 (20.3)	(17.92 – 22.99)
Jigawa	6,529	743 (11.4)	(10.62 – 12.18)
Kaduna	5,861	811 (13.8)	(12.97 – 14.76)
Kano	11,004	1,531 (13.9)	(13.27 – 14.57)
Katsina	8,336	944 (11.3)	(10.65 – 12.02)
Kebbi	4,854	1,062 (21.9)	(20.73 – 23.08)
Kogi	5,272	149 (2.8)	(2.41 – 3.32)
Lagos	4,774	41 (0.9)	(0.63 – 1.18)
Niger	7,197	1,879 (26.1)	(25.1 – 27.14)
Osun	7,579	405 (5.3)	(4.88 – 5.88)
Oyo	8,110	435 (5.4)	(4.88 – 5.88)
Rivers	5,720	7 (0.1)	(0.05 – 0.26)
Taraba	1,847	103 (5.6)	(4.6 – 6.75)
Yobe	3,701	579 (15.6)	(14.49 – 16.86)
Total	**108,472**	**10,349 (9.5)**	**(9.37 – 9.72)**
Chi-square =	**7031.5514; P=0.05**		

Prevalence of schsitosomiasis by species

Only *Schistosoma haematobium* and *S. mansoni* were encountered in this study. *S. haematobium* 8,486 (82%) was the predominant species in the survey compared to *S. mansoni* 1,863 (18%) as shown in Fig. 2. Of the total pupils examined, 8.1% were positive for *S. haematobium* with highest prevalence occurring in Kebbi (21.7%), followed by Niger (19.6%) and Yobe (15.6%) States. The prevalence of *S. mansoni* was 1.8%; FCT and Niger States ranked highest with prevalence of 10.5% and 9.4% respectively while Yobe State had no *S. mansoni*. Akwa Ibom, Lagos, Katsina and Rivers States had 0.1% prevalence each (Fig 3).

Prevalence of schistosomiasis by gender

Of the total pupils infected with schistosomiasis, 68% were males and 32% females. Niger State had highest prevalence of infection in males (29.4%) and females (21.9%) while Rivers State had the least prevalence in both sexes (Table 2). The association between schistosomiasis and gender was statistically significant (χ^2 = 957.37, P<0.05).

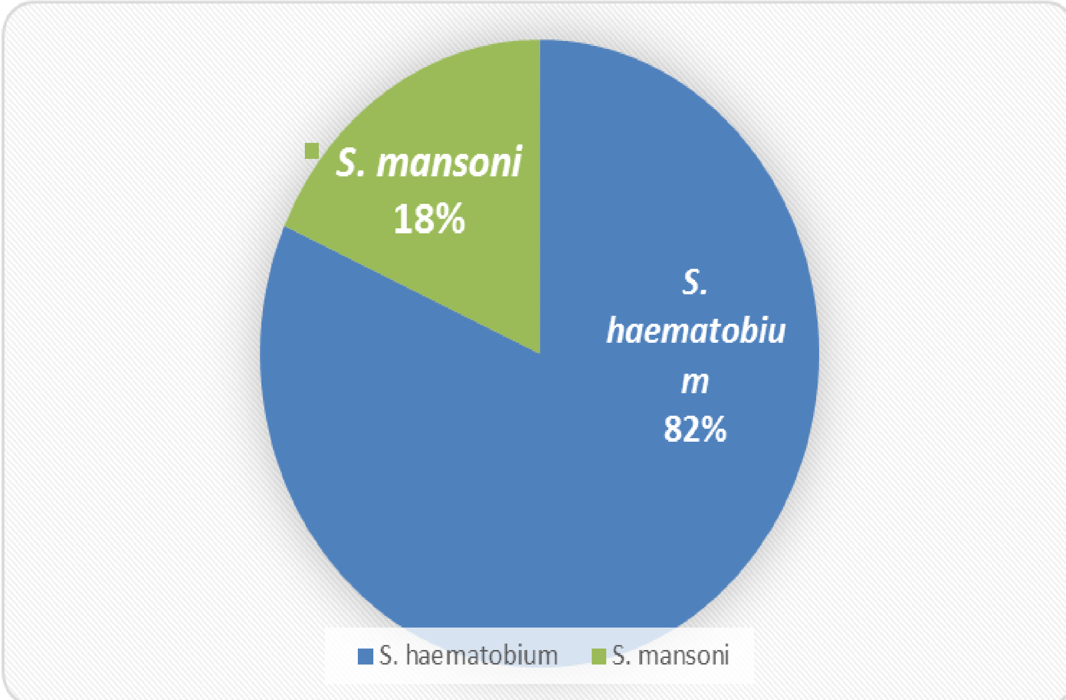

Figure 2: Overall Prevalence of S. haematobium and S. mansoni

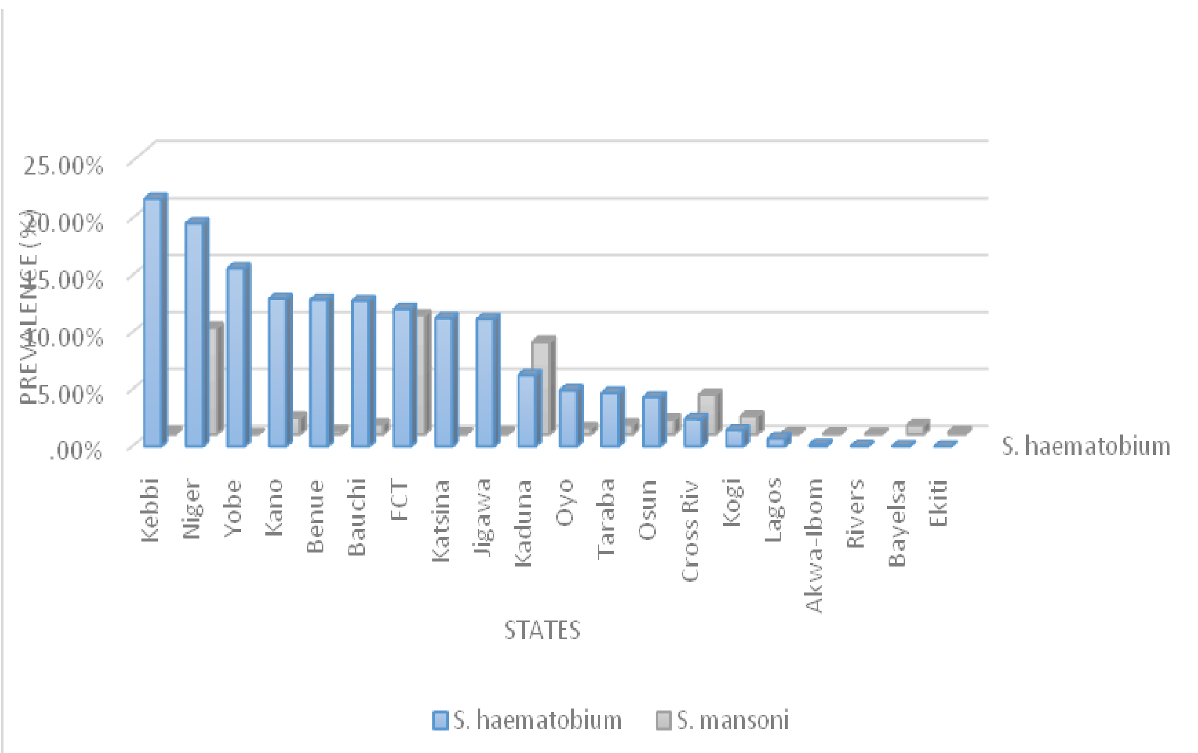

Figure 3: Prevalence of S. haematobium and S.mansoni by State

Table 2: Gender-related Prevalence of Schistosomiasis

State	No Examined	Male No. (%) Infected	No Examined	Female No. (%)
Niger	4054	1191 (29.38)	3143	688 (21.89)
Kebbi	3349	852 (25.44)	1505	210 (13.95)
FCT	498	118 (23.69)	505	86 (17.03)
Yobe	1990	376 (18.89)	1711	203 (11.86)
Kano	5898	1053 (17.85)	5106	478 (9.36)
Kaduna	3119	535 (17.15)	2742	276 (10.07)
Katsina	4435	753 (16.98)	3901	191 (4.90)
Bauchi	2590	437 (16.87)	2368	238 (10.05)
Jigawa	3575	597 (16.70)	2954	146 (4.94)
Benue	1891	287 (15.18)	1561	164 (10.51)
Taraba	955	62 (6.49)	892	41 (4.60)
Cross River	2544	155 (6.09)	2399	128 (5.34)
Osun	3876	218 (5.62)	3703	187 (5.05)
Oyo	4127	227 (5.50)	3983	208 (5.22)
Kogi	2731	84 (3.08)	2541	65 (2.56)
Bayelsa	976	9 (0.92)	967	8 (0.83)
Lagos	2337	21 (0.90)	2437	20 (0.82)
Akwa-Ibom	4027	13 (0.32)	3839	9 (0.23)
Ekiti	1865	6 (0.32)	1658	2 (0.12)
Rivers	2833	2 (0.07)	2887	5 (0.17)
Total	57670	6996 (12.13)	50802	3353 (6.60)
Chi-square = 957.37; P=0.05				

Prevalence of schistosomiasis by age group

Schistosomiasis was found to be more prevalent among the 11-16 years age group (53%) compared to the 5-10 years (47%). In the age groups examined, Niger State had the highest prevalence of schistosomiasis with 24.1% and 29.4% for 5-10 and 11-16 years respectively. The lowest prevalence of 0.04% and 0.2% were recorded in Rivers State for both age groups respectively (Fig. 4). Statistically, it was also observed that there was significant difference between prevalence of disease by age groups (χ^2 = 139.48, P<0.05).

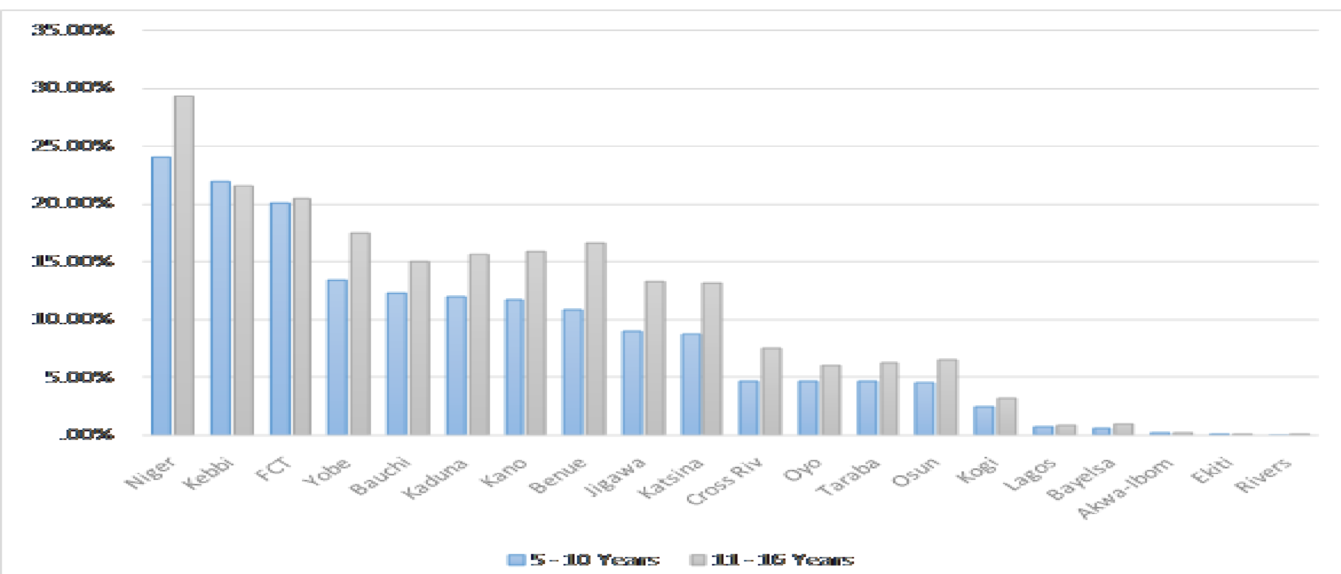

Figure 4: *Prevalence of schistosomiasis by age group*

Prevalence of schistosomiasis by water contact activities

The prevalence of schistosomiasis was highest among those who engaged in swimming (17.0%) followed by those who played in water (11.3%) as shown in Fig. 5. Males had more contact with water bodies than females and showed higher prevalence. Children aged 11-16 years had more contact with water bodies (Figs. 6 &7).

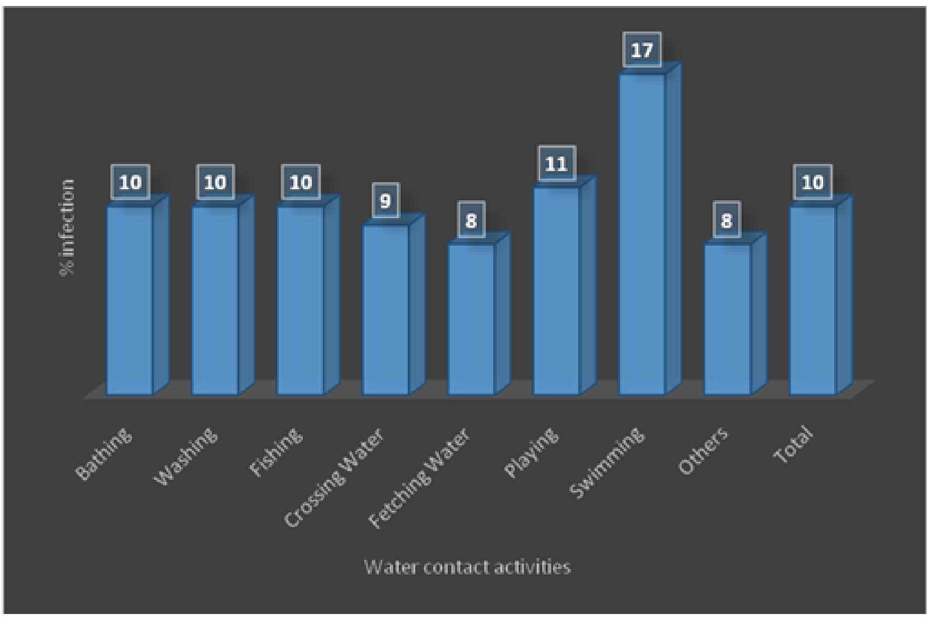

Figure 5: Prevalence of schistosomiasis in relation to water contact activities

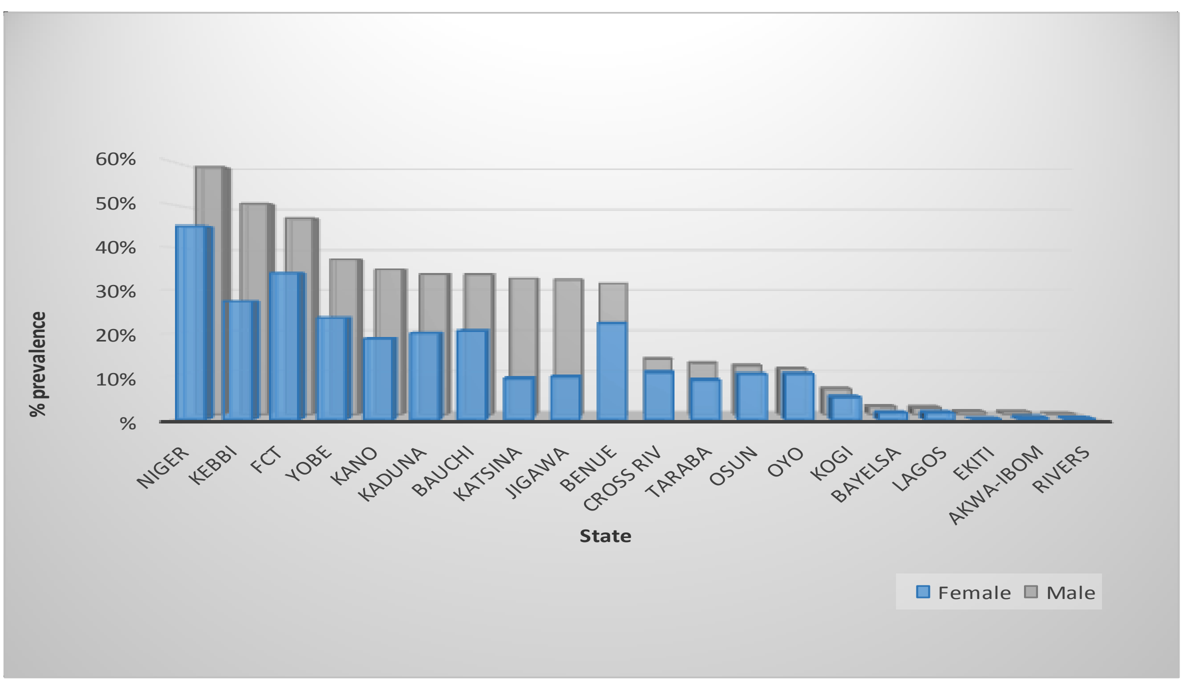

Figure 6: Prevalence of schistosomiasis by water contact activities and gender

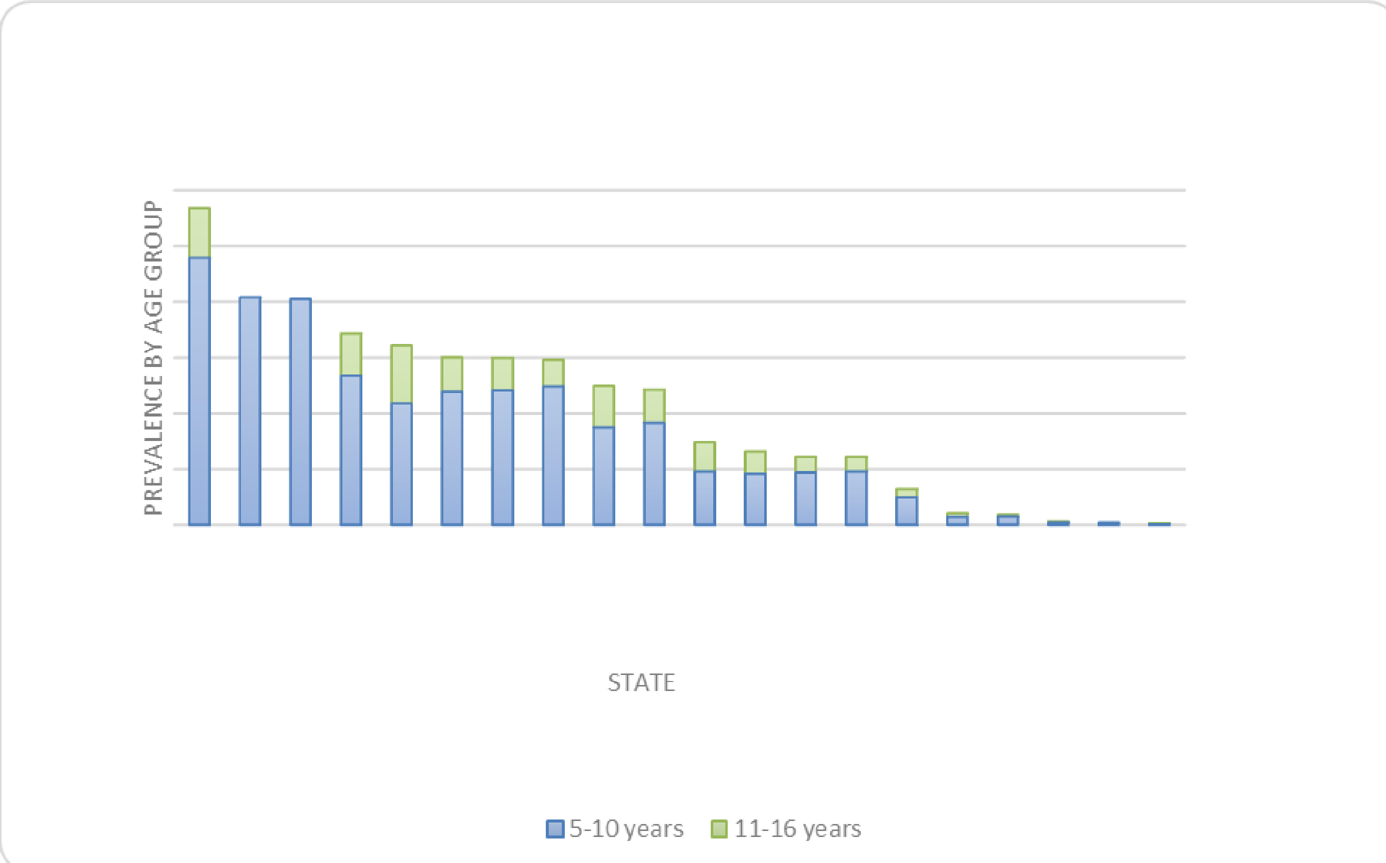

Figure 7: Prevalence of schistosomiasis by water contact activities and age group

DISCUSSION

The prevalence data of schistosomiasis in this study was within the low risk range (9.5%), although higher prevalence was recorded in some LGAs. Schistosomiasis was observed in all the States surveyed except Rivers State. The range of the prevalence of schistosomiasis in the LGAs of the States was in agreement with the findings from other studies that considered schistosomiasis as a focal disease (Remigio *et. al*., 2016). The prevalence, intensity of infection, and transmission of schistosomiasis is determined by numerous factors including socio-economic, human behaviour, ecological and biological factors which influence the interactions between human and infected snail intermediate hosts.

Schistosoma haematobium was more prevalent than *S. mansoni* in the present survey. This agrees with similar reports in Nigeria (Cowper, 1963, Ekpo and Mafiana, 2004; Agi and Okafor, 2005; Ejima and Odaibo, 2010). States such as Kebbi, Niger and Yobe with very high prevalence of *S. haematobium* may be linked to presence of freshwater bodies and dams. These dams and other natural water bodies support irrigation and provide recreational facilities for school age children who frequent these sources for different activities which enhance transmission. The large rivers may not be implicated in the transmission of schistosomiasis, however water sustained by them through seasonal flooding and impoundment may provide habitats for the survival and growth of the snail intermediate hosts (Useh & Ejezie, 1999). The water bodies are not only sources of water for domestic uses but also serve as social, occupational, religious and recreational sites for the communities. Dams and other freshwater bodies have been implicated in epidemiology of schistosomiasis in Nigeria and Africa (Steinmann *et al.,* 2006, Nduka *et al.,* 2006, Ifeanyi *et al*., 2009 and Bala *et al*., 2012).

High salinity waters may not support the survival of freshwater snail intermediate hosts of schistosomes and may account for the low prevalence observed in Rivers, Akwa Ibom, Bayelsa and Lagos States that border the Atlantic Ocean and have brackish water bodies. This increase in salinity of water bodies in these areas is supported by previous studies (Kefford *et al.,* 2005; Nwankwoala and Udom, 2009; Nwankwoala and Ngah, 2014). Also implicated are the dredging of the Port Harcourt harbor and influence of land reclamation which have admitted saline water into the aquifer in the areas. The availability and use of improved infrastructure such as provision of boreholes were observed and may have contributed to the low prevalence recorded in some of these states. However, in Cross River also a coastal State, five LGAs had moderate risk factors. These LGAs are situated in the northern part of the State bordering Benue State where the infection was also moderate. The low prevalence in Ekiti State could be explained by the deworming programme for schistosomiasis which was launched in 2010 although treatment has not been consistent over the years.

Males had higher prevalence of schistosomiasis than females in this survey, suggesting that they were more exposed to infections. This has been linked to increased and prolonged water contact activities by males such as swimming, farming, fishing and bathing especially during the peak hours of cercariae shedding by snail intermediate hosts. Females are engaged in low risk activities of washing and fetching water which usually occur in the early mornings and late evenings when cercariae shedding is low (Anya & Okoronkwo 1991). Moreover, limited exposure of the female bodies during these activities has been reported (Worrell, *et al.,* 2011).

The high (53%) prevalence of schistosomiasis among pupils, 11 – 16 years old, is suggestive of possible frequent water contact activities in this age group. Pupils of this age range frequent water bodies for recreational activities like swimming than those in the younger ages (Kloos *et al.,* 1998; Worrell, *et al.,* 2011; Omonijo *et al.,* 2013). This is exemplified by the fact that in Niger State where the prevalence of schistosomiasis was high, it occurred more in this age group (11 – 16 years), particularly, along the major water points in the State. The prevalence of schistosomiasis in Kebbi State and the FCT were within the same range among the different age groups. This could be attributed to the high temperature in the two States that encourages more water contact activities (swimming) by this age group. Age-related activities and behaviour, frequency of exposure and development of immunity are known to play important role in the distribution of schistosomiasis (Daniel *et.al.*, 2007).

CONCLUSION

This study reveals endemic prevalence of schistosomiasis among rural children in some LGAs of Kebbi and Niger States. This requires an urgent need to implement an integrated, targeted and effective schistosomiasis control. Sustainable control programmes are essential to prevent the transmission of infection to new areas. Mass administration of medicines to school age children and adult population in the endemic areas should be scaled up. Furthermore, periodic distribution of medicine, health education, personal hygiene, proper sanitation practices and provision of clean and safe drinking water are imperative in order to curtail the transmission and morbidity caused by schistosomiasis.

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