Adamawa State University Journal of Scientific Research
(ADSUJSR)
Volume 12 Issue 2, 2024
ISSN: 2705-1900 (Online); ISSN: 2251-0702 (Print)
adsujsr.adsu.edu.ng

Prevalence of Schistosomiasis among Apparently Healthy School Age Children in Adamawa State, Nigeria

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(Received in October 2024; Accepted in December 2024)

Abstract
Schistosomiasis constitutes a major public health challenge in Nigeria. This study investigates the prevalence of schistosomiasis among pupils/students in Adamawa state, Nigeria. A cross sectional survey of 1500 students was conducted in primary and secondary schools from 15 out of 21 local government areas (LGAs) of Adamawa State. Stool and urine samples were collected from 100 pupils/students in each of the 15 LGAs surveyed. The data were analyzed using descriptive and inferential statistic. The results showed that the prevalence of schistosomiasis among pupils/students was (5.9 %). The prevalence was highest (7%) in Numan LGA and lowest in Song LGA (2%). The prevalence among male (22.6%) was higher than female (20.5%). The age category of 05-110 years had the highest prevalence (18.6%) while category 16-20 years had the lowest prevalence (3.1%). The result showed that there was no significant difference in the prevalence of schistosomiasis among male and female pupils/students (P=0.04). Urogenital schistosomiasis was higher (9.6%) than gastrointestinal schistosomiasis (2.2%), In addition, Southern parts of the state recorded higher infected rate with schistosomiasis than Northern and Central parts. Findings from this study revealed that schistosomiasis is a major health issue among school children in Adamawa state. Thus the need for intervention measures by government and other stakeholders in the health sector to reduce the prevalence of schistosomiasis among school age children in Adamawa state.

Keywords: Schistosomiasis, Adamawa, Prevalence, Urogenital, Apparently healthy

Introduction

Schistosomiasis is an acute and chronic disease of great public importance. It is caused by the trematode fluke of the genus *Schistosoma*, and highly prevalent in the tropics and subtropical regions of the world, especially among poor community where social infrastructures and amenities are lacking or inadequate. The disease affects over 200 million people worldwide and it is the deadliest of the neglected tropical diseases (Colley *et al.*, 2014; WHO, 2013; CDC.gov. 2011). Schistosomiasis has been adjudged the second most prevalent parasitic disease of human after malaria (WHO, 2013). It is notably an important disease during pregnancy; causing neonatal prematurity, reduced neonatal birth weight, and increased maternal morbidity and mortality (Christian *et al.*, 2004).

Schistosomiasis predominantly affects poor and rural communities, particularly agricultural and fishing populations. Poor sanitary condition such as indiscriminate defecation by infected persons cause contamination of water bodies where the snail intermediate vectors abound. Inhabitants of community are often infected during routine agricultural, domestic, occupational, and recreational activities, which expose them to infested water. In addition, certain play habits of school-age children such as swimming or fishing in infested water make them vulnerable to infection (WHO, 2021). Women doing domestic chores in infested water, such as washing clothes, are also at risk and can develop schistosomiasis (WHO, 2021). Increasing population and the corresponding needs for power and water to boost agricultural activities often result in development schemes and environmental modifications such as the creation of dams. When snail vectors and schistosome parasites come across these created water bodies, such water bodies become foci for schistosomiasis transmission (WHO, 2021).

Schistosomiasis in human is generally caused by *Schistosoma haematobium*, which causes urogenital schistosomiasis, *Schistosoma mansoni*, *Schistosoma japonicum* and *schistosoma intercalatum* which cause gastrointestinal schistosomiasis. Each species has a specific range of suitable snail hosts, so their distribution is defined by their host snails' habitat range. *S. mansoni* needs certain species of aquatic freshwater *Biomphalaria* snail. *S. intercalatum* and *S. haematobium* use certain species of aquatic freshwater snail; *Bulinus spp*, and *S. japonicum* uses amphibious freshwater *Oncomelania* spp as its intermediate host (*Colley et al*., 2014).

Urogenital schistosomiasis is often accompanied by haematuria (blood in urine). Fibrosis of the bladder and ureter are observed, and kidney damage is sometimes diagnosed in advanced cases. Bladder cancer due to deposition of egg of *S. haematobium* is another possible complication in the later stages (WHO, 2025). In women, urogenital schistosomiasis may present with genital lesions, vaginal bleeding, and nodules in the vulva. In men, urogenital schistosomiasis can induce pathology of the seminal vesicles, prostate, and other organs. This disease may also have other long-term irreversible consequences, including infertility. It has also been considered to be a risk factor for HIV infection, especially in women (WHO, 2021). Gastrointestinal schistosomiasis can result in abdominal pain, diarrhoea, and blood in the stool. Liver enlargement is common in advanced cases, and frequently associated with an accumulation of fluid in the peritoneal cavity and hypertension of the abdominal blood vessels. When the eggs of *S. mansoni* and *S. japonicum* are trapped in the portal system, it elicits hepatosplenic inflammation and liver fibrosis (Gryseels *et al.,* 2006).

The economic and health effects of schistosomiasis are considerable and the disease disables more than it kills (WHO, 2021). In children, schistosomiasis can cause anaemia, stunting and a reduced ability to learn, although the effects may be reversible with treatment, chronic schistosomiasis may in some cases result in death. The number of deaths due to schistosomiasis is difficult to estimate because of hidden pathologies such as liver and kidney failure, bladder cancer and ectopic pregnancies due to female genital schistosomiasis (WHO, 2021). Schistosomiasis is also known to be endemic in Nigeria and chronic disease cases result from the most prevalent or endemic areas. In such an area, children can get their first infection as early as two years of age, after which the intensity of infection increases with exposure over the first 10 years (Colley *et al.,* 2014).

Schistosomiasis control currently focuses on reducing disease through periodic, large scale population treatment with praziquantel, however, a more comprehensive approach including potable water, adequate sanitation, and snail control would also reduce transmission. Estimates have shown that about 236.6 million people required preventive treatment for schistosomiasis in 2019, out of which more than 105.4 million people have been treated (WHO, 2021). The situation in Adamawa state may not be different, however in view of the global effort by the WHO to eradicate/mitigate the effect of schistosomiasis by the year 2030, there is need for continuous monitoring of the prevalence of this disease. This will help ascertain the extent of compliance to the WHO declaration.

Materials and Methods

Description of Study Area

Adamawa State is located on latitude 9° 19' 60.00" (1016'8.040"N), longitude 12°29'59.99"E and about 592m above sea level. Topographically, it is a mountainous land crossed by large river valleys of Benue, Gongola and Yedzeram (Adebayo and Tukur, 1999). The valleys of the Mount Cameroon, Mandara Mountains and Adamawa Plateau form part of the landscape. Adamawa state has a total land area of thirty-eight thousand seven hundred square kilometers (38,700 Km^2) with three senatorial zone namely Northern senatorial zone comprising of five local government (Madagali, Michika, Mubi North, Mubi South, Maiha). Central senatorial zone (Hong, Gombi, Song, Girei, Fufore, Yola North, Yola South) and Southern senatorial

ADSUJSR, 12(2) 195 -202, December 2024
ISSN: 2705-1900 (Online); ISSN: 2251-0702 (Print)
adsujsr.adsu.edu.ng

zone (Toungo, Ganye, Jada, Mayo-belwa, Numan, Demsa, Shelleng and Guyuk) (Saka, 2013). Adamawa state experiences two seasons; the dry season (November-April) and the wet season (May to October). The state experiences an average rainfall of 211 mm and mean temperature is 25.9 °C (Adebayo and Tukur, 1999; Pukuma, 2016). The vegetational zones include, Northern Guinea Savannah, Southern Guinea Savannah, and Sudan Savannah (Saka, 2013).

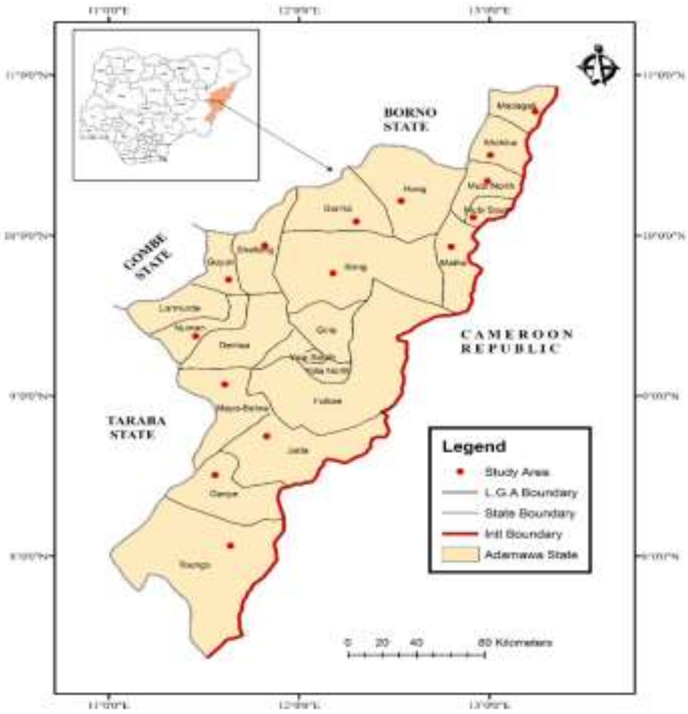

Figure 1: The study area indicating samples collection areas

Study Design and Population

A cross-sectional study design was adopted in collecting data used in determining the prevalence and distribution of schistosomiasis in school age children (Yaro *et al.*, 2018). The study population includes children aged between 5-20 years and studying in Government schools in Adamawa state. Criteria for inclusion into the study include children who are studying in Government Secondary/Primary Schools in Adamawa state. Children who are not enrolled in school, as well as visitors and teachers were excluded from the study.

Sample Size Determination

The sample size was estimated using a formula for survey sample size estimation at 95% level of confidence $n = \frac{Z^2\,(1-p)}{2L^2}$ Kogi, (2019)

Where n = the required sample size

Z = value of the standard normal distribution (1.96) corresponding to a significance level of 0.05 for a 2-sided test.

L = margin of error (0.05)

p = prevalence from previous study 11% (or 0.11) based on study conducted by Naphtali *et al*. 2018.

Therefore, Sample size (n) = 1500

Sample Collection and Examination

Stool sample was collected in the morning using a wide mouth, tight and leak proof sample bottle with aid of a spatula. The bottles were labelled with the participant's identification number, sex, age, time and date of collection. The specimen was preserved with 10% formalin and transported within six (6) hours to the laboratory. The stool was processed using parasites using concentration technique (formol ether method) and examined under a microscope. Two separate slides per sample was prepared and viewed under microscope by two separate technicians (Chessbrough, 2000).

Urine samples were collected, and transported to the laboratory. The specimen was allowed to sediment for 12 hours and the supernatant was decanted leaving 10 to 20 ml of sediment in the tube. The sediment was placed in centrifuge tubes and centrifuged at 500 rpm for 5 min using automated centrifuge (thermo scientific) with capacity of seventy-six (76) samples at a time. The supernatant was decanted carefully, leaving 2-3ml of the sediment in the test tubes. With a pipette, the sediment was mixed and a drop was placed on a microscope slide, a cover slip was then placed on top of the sediment. The specimen on the microscope slide was observed at magnifications of x10 and x40 (Chessbrough, 2000). Two slides per sample were prepared and read by separate technicians.

Data Processing

Data was analysed using XL STATA software version 2021.3.1. A histogram was used to graphically check for normality. For normally distributed variables such as age of the child, mean and standard deviation was calculated. Variables such as sex were reported as absolute frequencies with associated percentages; Chi-square test was used to ascertain association with development of schistosomiasis. For variables whose expected frequencies were less than 5, Fishers exact Chi-square test was used.

Results

A total 1500 school children were enrolled for the study and provided stool and urine samples for screening. Results from the processed stool and urine samples revealed an overall prevalence of 9.6% for *S. haematobium*, 1.9% for *S. mansoni* and 0.26 % for *S. intercalatum,* (Table 1).

Prevalence of gastrointestinal and urogenital Schistosomiasis based on gender revealed that males had 22.6%, while females had 20.5%, male had higher odds 1.1 of being infected than female 0.9 (Table 2).

Sugu in Ganye local government area had the highest prevalence (27%) of urogenital schistosomiasis, followed by Numan (14%), while Toungo and Kiri in Shelleng, and Lamurde in Mubi South and Mayo-belwa had 13% and 10% respectively (Table 3). The prevalence of urogenital schistosomiasis in Muchalla in Gombi was 8%, Guyuk, Mildu in Madagali and Maiha had 7% each, Vimtim in Mubi North had 6%, Bazza in Michika had 5%, Bula in Song had 4%, while Jada had the least (Table 2).

Similarly, the prevalence of intestinal schistosomiasis was highest in Mildu in Madagali (7%), followed by Jada (5%), Maiha and Hong had 4% each, Kiri (3%), Bazza and Vimtim (2%) each, while Muchalla in Gombi, Mayo-belwa, Guyuk, Toungo, Numan, Sugu in Ganye recorded 1% respectively. Samples from Bula in Song and Lamurde in Mubi South did not show any evidence of infection (Table 3).

Prevalence of schistosomiasis by age showed that children in age bracket 11-15 years had the highest infection rate of 15% followed by 5-10 years (9.31%) and 16-20 years (1.57%) (Table 4)

Table 1: Prevalence of intestinal and urogenital schistosomiasis infections based on species among primary and junior secondary school students in Adamawa state

Species	No. examined	No. infected	Prevalence%
S. heamatobium	1500	144	9.6
S. mansoni and *S. intercalatum*	1500	29 4	1.9 0.26
Total	3000	177	5.9

Note: 1500 sample each was collected for stool and urine microscopy

Table 2: Prevalence of gastrointestinal and urogenital helminths based on sex among primary and junior secondary school students in Adamawa State

Gender	No. Examined	Uninfected	Infected (%)	Odds ratio	95% CI
Males	807	625(77.4)	182(22.6)	1.1	0.8822-1.4473
Female	693	551(79.5)	142(20.5)	0.9	0.7479-1.1037
Total	1500	1176(78.4)	324(21.6)		

T-test value= 15.89 df= 1 p value= 0.0400, % = percentage, No= number

Table 3: Prevalence of intestinal and urogenital schistosomiasis infections among primary and junior secondary school students in Adamawa state

School	Urinary schistosomiasis		Intestinal Schistosomiasis		Overall Prevalence(%)
	No. Examined	No. infected	No. Examined	No. infected	
GSS Numan	100	14	100	1	7.5
GSS Toungo	100	13	100	1	7
GSS Sugu	100	27	100	1	14
GSS Guyuk	100	7	100	1	4
GSS Lamurde	100	10	100	0	5
GDSS Vimtim	100	6	100	2	4
GDSS Bazza	100	5	100	2	3.5
GDSS Mildu	100	7	100	7	7
GDSS Shangui	100	10	100	4	7
GDSS Kiri	100	13	100	3	8
GSS Mayo-belwa	100	10	100	1	5.5
GSS Jada	100	3	100	5	4
GSS Gombi	100	8	100	1	4.5
GDSS Bula	100	4	100	0	2
GSS Maiha	100	7	100	4	5.5
Total	1500	144	1500	33	177(5.9%)

Table 4: Prevalence of gastrointestinal and urogenital schistosomiasis based on age of student in Adamawa state

Age group	No. Examined	No. Infected (%)
5-10	514	96 (18.6)
11-15	730	219 (30.0)
16-20	256	08 (3.1)

Discussion

Schistosomiasis remains a significant public health challenge in Nigeria, recognized as the most endemic country for the disease in West Africa. With approximately 29 million people infected and 101 million at risk (Dawaki *et al*., 2016), the burden is immense. This study recorded three *Schistosoma* species responsible for human infections in Adamawa State: *Schistosoma haematobium* (9.6%), *Schistosoma mansoni* (1.9%), and *Schistosoma intercalatum* (0.26%). Filgona (2019) similarly identified these species in this region, further underscoring the endemicity of schistosomiasis in the area.

The Southern part of Adamawa state exhibited the highest prevalence compared to Central and Northern regions. This disparity can be attributed to the area's lowland topography, crisscrossed by rivers such as the Benue and Gongola, which create

ADSUJSR, 12(2) 195 -202, December 2024
ISSN: 2705-1900 (Online); ISSN: 2251-0702 (Print)
adsujsr.adsu.edu.ng

swamps, lakes, and other stagnant water bodies ideal for the breeding of snail intermediate hosts. Human activities like irrigation farming, particularly around the canals of Savannah Sugar Company in Numan and Lamurde local government areas and the dams at Kiri in Shelleng, further support the survival and proliferation of these hosts. Similar findings were reported by Birma *et al.* (2017) and Kaleson *et al*. (2022), who recorded high prevalence rates in Southern Adamawa communities such as Kiri. Additionally, Naphtali *et al*. (2017) documented significant prevalence along the river Benue in Numan local government.

Urogenital schistosomiasis was most prevalent in Ganye (27%), followed by Numan (14%) and Jada (3%), while intestinal schistosomiasis was highest in Madagali (7%), followed by Jada (5%) and Shelleng (3%). These findings align with broader studies across Nigeria and other regions. For example, Dawaki *et al.* (2016) reported an overall schistosomiasis prevalence of 17.8%, with *S. mansoni* and *S. haematobium* affecting 8.9% and 8.3% of the population, respectively. Other studies have highlighted even higher prevalence rates, such as Otuneme *et al.* (2014) with 38% for *S. intercalatum* in rural Ogun State, and Gambo *et al.* (2021), who reported 49.2% urogenital schistosomiasis in Kano state among school pupils.

The emergence of *S. intercalatum* is particularly noteworthy. While rarely encountered, its presence in this study, and reports from other regions (Otuneme *et al*., 2015; Bassey and Orutugu, 2016; Odoya *et al.*, 2016) suggests potential cross-border migration or zoonotic transmission. This trend necessitates increased surveillance and targeted interventions.

Gender and age-based prevalence showed unique patterns. Unlike previous studies by Filgona (2019) and Dunah *et al.* (2000), which observed gender differences, this study found similar infection rates among males and females, likely due to shared water contact activities. Children aged 11–15 years exhibited the highest prevalence. This is consistent with findings by Usang *et al*. (2020) and Filgona (2019). This trend reflects increased water-related activities and social interactions among this age group. However, older individuals (20+ years) also showed significant infection rates (40%), possibly due to occupational exposure, such as fishing and farming, as reported by Pukuma *et al.* (2022) and Birma *et al.* (2017).

The overall schistosomiasis prevalence of 5.9% in Adamawa places it within the moderate-risk category, requiring preventive chemotherapy (praziquantel treatment) at least once every two years (WHO, 2022). However, the prevalence of **9.6%** for *Schistosoma haematobium*, which is alarmingly close to the WHO-defined threshold of **≥10%**, indicates a potential public health challenge, and need for intensified control measures, particularly in highly affected subpopulations such as Ganye, Numan, Toungo, Shelleng, Gombi, Mayobelwa and Mubi where prevalence of urinary schistosomiasis in this study are high and above the WHO threshold (WHO, 2022).

Conclusion

This study reaffirms schistosomiasis endemicity in Adamawa state, with variation by region, gender, age. Although the overall prevalence of schistosomiasis in Adamawa state by this research remains below the WHO high-risk threshold, the 9.6% prevalence of *S. haematobium* signals a need for vigilance and proactive intervention. By implementing strategic control measures such as large-scale surveys targeting all age groups, snail control measures, enhanced health education, and improved sanitation to reduce exposure to contaminated water sources, Adamawa can aim to reduce prevalence further and move towards the WHO goal of schistosomiasis elimination.

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