Prevalence of urinary schistosomiasis in communities along the River Niger Basin areas, North-Central Nigeria

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ABSTRACT

Introduction: Urinary schistosomiasis is a chronic, progressive disease caused by the parasitic bloodworms (trematodes) *Schistosoma haematobium*. Following infection, the adult worm develops in humans and resides in the veins supplying the bladder, leading to haematuria. Globally, there are approximately 240 million infected individuals with an estimated 534,000 fatalities annually. Urinary schistosomiasis has a higher prevalence in remote areas of Nigeria. This study aimed to determine the prevalence and intensity of urinary schistosomiasis in the riverine communities along the River Niger Basin Areas in North-Central Nigeria.

Method: Urine samples were collected from 3,475 people aged between 10 and 55 years from five communities along the basin areas of the River Niger and analysed using microscopy to detect the presence of *Schistosoma haematobium* eggs.

Results: The prevalence of urinary schistosomiasis was high (72.66%), and more males were significantly infected ($p<0.05$). The egg counts revealed moderate-to-heavy infections, with farmers and miners having a significantly higher prevalence than other occupations. This infection affects all ages, peaking between ages 25 and 29.

Conclusion: The prevalence of urinary schistosomiasis in this study is high, predominantly among farmers and gold miners, affecting all ages, primarily due to climate change and gold mining activities among participants. Therefore, there is a need for targeted interventions, including health education about schistosomiasis and mass drug administration to mitigate the burden of the disease in such communities across Nigeria and elsewhere.

Keywords: prevalence, intensity, schistosomiasis, riverine communities, Nigeria

Introduction

Schistosomiasis is a chronic, progressive disease caused by the parasitic bloodworms (trematodes). Urinary schistosomiasis is caused by *Schistosoma haematobium*, transmitted from one person to another when an infected person passes the ova from urine into water bodies. The ova hatch immediately into miracidia, which are then ingested by a snail (in this case, *Bulinus spp*). Inside the snail intermediate host, the miracidia undergo metamorphosis into cercariae, which are then released and become free-swimming in the water, serving as the infective stage to man. The cercariae penetrate humans through the skin and the infective cercariae metamorphose and become adult worms in the human host and move to the predestined site, where, in this case, they reside in the veins supplying the bladder. There they continue to lay eggs, and these eggs are released into the bladder and do pass out with the urine into a water body, hence the life cycle continues.[1] The main presenting symptom of urinary schistosomiasis is haematuria.

Schistosomiasis poses a public health challenge second only to malaria globally. The prevalence of schistosomiasis infections ranks second among the major Neglected Tropical Diseases linked to poverty.[2] Globally, there are approximately 240 million infected individuals with an estimated 534,000 fatalities annually.[3] Although not causing early death, this disease has a severe, debilitating effect on individuals.[4] As in other African countries, urinary schistosomiasis has a higher prevalence in remote areas of Nigeria.[5] The prevalence within communities is linked to the presence of water reservoirs such as dams, rivers, or streams, which are crucial for meeting the domestic and recreational water needs of the local population.[6] The cercariae directly penetrate the skin of individuals engaged in water-related activities such as fishing, rice or other fadama (dry season irrigation) farming, gold washing (mining process), laundry, bathing, and swimming.[7] Individuals at the highest risk are those residing in or visiting areas where the disease is widespread.[8] In sub-Saharan Africa, more than 90% of schistosomiasis cases occur in Nigeria, with an estimated 29 million cases reported.[9] Data published in 2021 indicate approximately 29 million infected individuals, including 16 million children and young adults, with 101 million at risk in the country.[9] Given the identification of urinary schistosomiasis across various regions in Nigeria, with estimates of intensity (i.e., the number of eggs in urine samples) and prevalence rates, coupled with indications of increasing incidence,[10] the absence of current estimates underscores the need for updated information.

Nigerian school children and active young adults continue to face significant morbidity from schistosomiasis.[11] The highest infection intensities are typically observed in children aged 8 to 20 years in endemic areas but not restricted to these age groups in such endemic areas. Localized studies, such as those in Kwara State, have consistently reported high prevalence and intensity with no particular age pattern.[11] This study aimed to determine the prevalence and intensity of urinary schistosomiasis in riverine communities along the River Niger Basin Areas in North-central Nigeria.

Method

This study was carried out in riverine communities along the River Niger Basin Areas through Kwara and Niger states in North-central Nigeria. It lies within latitude 8°30′00″N and longitude 4°35′00″E, and the inhabitants in the study area are mainly civil servants, farmers, fishermen, traders, artisans, and individuals from the organized private sector.

This cross-sectional study included schools and communities and used a quantitative data collection method to assess potential predisposing risk factors. Individuals aged 10 to 55 years were randomly selected using the open research balloting system (to maintain objectivity and reduce bias in subject selection).

In addition, conditions, characteristics, outcomes, and exposure of pregnant women to malaria were studied.

The sample size was determined as described by Abdulkareem et al.[4]

Ethical approval was obtained from the Ethical Review Committees of the Kwara State and Niger State Ministries of Health.

Data collection

Semi-structured and standardized proforma were administered to participants with assistance from research staff. This proforma aimed to collect demographic data, including names, ages, genders, and educational backgrounds, prior to sample collection.

Sample collection and transportation

Sample collection was conducted between 10:00 am and 2:00 pm, a period when *Schistosoma haematobium* egg excretion peaks. Participants were then provided with disposable plastic cups labelled with a code and serial number. Hand soap and sanitizers were provided for all participants to disinfect their hands before and after sample collection. From the urine specimens, 10 ml was transferred into labelled universal bottles using a syringe. The samples were preserved by adding 10 ml of 70% alcohol and carefully stored in sturdy paper cartons, secured with adhesive tape to prevent spills or displacement during transport to the laboratory.

Laboratory analysis and interpretation of results

Microscopic examination procedure for the urine filtration technique

The preserved urine samples were examined using the filtration technique with a 325 µm wire mesh. The samples were passed through the wire mesh filter, folded conically, and placed in small plastic funnels atop empty beakers or flasks. The sediment was transferred to a cross-hatched Petri dish and examined under a dissecting microscope at 20x magnification to identify characteristic *Schistosoma haematobium* eggs. Eggs were counted using a hand tally counter, and infection intensity was expressed as eggs per 10 ml of urine. The number of eggs per 10 ml of urine was counted and graded as follows: light (50-149), moderate (150- 499), and heavy (≥500). For quality control, precision, and accuracy, egg counts were performed twice. Only ova with a conspicuous terminal spine were counted.

Data analysis

All data were analysed using SPSS version 27.00, with descriptive statistics used to determine associations between observed variables, and conclusions were drawn at the 95% confidence level.

Results

This study examined 3,475 active young and old people in five communities along the River Niger in North-

Table 1. Prevalence of schistosomiasis by age, sex and other demographic variables in the study areas

Parameters	Indicators	No. Examined	Positive n (% of 3,475)	p-Value
Age (years)	10-14	222	210 (6.04)	p>0.05
	15-19	425	392 (11.28)	
	20-24	617	486 (13.99)	
	25-29	624	501 (14.42)	
	30-34	611	422 (12.14)	
	35-39	398	210 (6.04)	
	40-44	308	196 (5.64)	
	45-49	200	82 (2.36)	
	≥50	70	26 (0.75)	
	Total	**3,475**	**2,525 (72.66)**	
Sex	Male	2,611	2003 (57.64)	p<0.05
	Female	864	522 (15.02)	
	Total	**3,475**	**2,525 (72.66)**	
Educational Levels	Non-formal	428	264 (7.60)	p<0.05
	Primary	921	620 (17.84)	
	Secondary	1,281	1,016 (29.24)	
	Tertiary	845	625 (17.98)	
	Total	**3,475**	**2,525 (72.66)**	
Occupation	Trading	312	122 (4.83)	p<0.05
	Farming	1,212	980(38.81)	
	Fishing	423	386(15.29)	
	Mining	420	411 (16.28)	
	Civil Service	416	201 (7.96)	
	No particular occupation	692	425 (16.83)	
	Total	**3,475**	**2,525 (72.66)**	

Table 2. Intensity of infection by egg count among participants across communities in the study areas

	Intensity				ANNOVA (p-value)
Level		Light	Moderate	Heavy	
Score range	Infected (+ve)	1-149 eggs/ 10 mL urine	150-499 eggs/ 10mL urine	≥500 eggs/ 10mL urine	
Community A	503 (19.92)	184(7.29)	137(5.43)	182(7.21)	
Community B	506 (20.04)	167(6.61)	167(6.61)	172(6.81)	
Community C	504(19.96)	161(6.38)	171(6.77)	172(6.81)	0.01196
Community D	504 (19.96)	101(4.00)	199(7.88)	204(8.08)	
Community E	508 (20.12)	198(7.84)	166(6.57)	144(5.70)	
Total	**2,525 (100)**	**811 (32.12)**	**840(33.27)**	**874(34.61)**	

central Nigeria, and 2,525 (72.66%) tested positive for schistosomiasis, as shown in Table 1.

The infection rate peaked in the 25-29 age group (14.42%), followed closely by the 20-24 (13.99%) and 30-34 (12.14%) age groups. The age group with the lowest prevalence of infection was ≥50 years (0.75%). However, the differences in the prevalence across age groups were not statistically significant. Conversely, more males (57.64%) were infected than females (15.02%) ($P<0.05$). The prevalence by participants' educational level showed that individuals with secondary education had the highest prevalence (29.24%), followed closely by those with tertiary (17.98%) and primary (17.84%) education, with the lowest prevalence among those with non-formal education (7.60%).

Again, in Table 1, the difference in prevalence by participants' occupation was statistically significant, with the highest prevalence of 38.81% among farmers, 16.28% among miners, and 15.29% among fishermen, and the lowest (3.51%) among traders ($P<0.05$).

In all five communities where the study was conducted, the prevalence of infection was relatively similar, ranging from 5.43% to 7.84%. The small differences observed among the communities were not statistically significant ($p>0.05$). Also, there was an even distribution of infection intensity across the study areas (Table 2).

Figure 1 shows activities predisposing community members to schistosomiasis infection in the study areas.

In Figure 2, the numbers from 0 to 5 indicate the range of urine colours and haematuria levels across different areas of the study.

Discussion

Prevalence of schistosomiasis

The study finds that, proportionately, individuals in the communities have a significant schistosomiasis infection rate. The prevalence of urinary schistosomiasis among community inhabitants in the riverine areas was high, at 72.66%. This aligns with the World Health Organization's classification of the area as heavily endemic, highlighting the urgent need for intensified control measures.[3] This suggests that environmental and socio-economic factors significantly influence the transmission of urinary schistosomiasis in these communities, as previously reported,[5] emphasising that children and young adults living near rivers and lakes are more susceptible to infection. Joseph et al.[6] reported a prevalence rate of 8.9%, which is lower but still comparable in their study area.

This high prevalence rate from this study compares with previous findings in Kwara State, where Abdulkareem et al.[4] recorded a high prevalence of 45.6% and Bolaji[7] recorded 58.7% in similar communities, attributing the higher rate to the presence of extensive irrigation projects, water reservoirs, and frequent river contact, which significantly impact local socio-economic practices.

Prevalence by age groups

Although prevalence rates varied across age groups, the differences were not significant. The higher rate of infection seen among the 25-29 age group may be explained by this group being the most active in the study population,

Figure 1. Activities of participants in infected water that favour the spread of schistosomiasis (Credit: Amase Nyamngee)

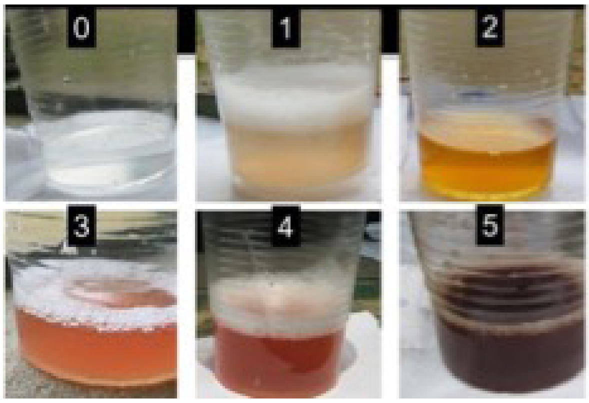

Figure 2. The appearances of different urine samples collected from participants

compared with the lower prevalence observed in the≥50 age group, who apparently have reduced water-contact activities. Similarly, findings from Muhammad et al.[8] recorded a high prevalence of 62.86%, and Obonogbigho et al.[9] also recorded a prevalence of 19.3% among similar age groups. According to them, the high prevalence was attributed to more frequent engagement in water-related activities such as swimming, mining, and playing in rivers.

Prevalence by sex

This study found that more males (57.64%) were infected than females (15.02%), and this difference was statistically significant. These data indicate that social stigma associated with open bathing may hinder females from actively participating in high-water-contact activities. The higher prevalence among males aligns with findings from Abdullahi & Ramatu,[10] who reported 38.2% among males and 15.0% among females. However, the prevalence observed among females may be due to indiscriminate farming activities in these communities that involve both males and females.

Quantification of eggs by schools in the communities

The quantification of Schistosoma eggs in urine samples provides critical insight into infection intensity among participants in these communities. This distribution of egg intensity was categorized as light, moderate, or heavy, with most infections falling into the heavy category. This high intensity in our findings is attributable to a lack of understanding of the biology of schistosomiasis transmission and of water-contact activities as a means of livelihood in these communities, which predisposes community members to repeated infection, resulting in a heavy egg load in their urine. The high egg-count intensity observed in our findings indicates that the transmission of infection to others, or even reinfection within the same group, is more likely, posing a severe risk of schistosomiasis spread in these communities.

Concusion

There is a very high prevalence of urinary schistosomiasis among community inhabitants in riverine areas along the river Niger in North-Central Nigeria. The intensity of this infection is also very high, affecting people of all ages, both males and females. We recommend targeted interventions to reduce water contact, improve sanitation, and introduce health education.

Conflict of interest: none

Authors' contribution: AN: Conception and design of the study, analysis and interpretation of data; drafting of the article. MJS: Literature search and assemblage of data. IRT: study design, field work, laboratory work. KYA: Provision, Collection, and assemblage of data. SMK: Literature search, Provision, Collection, and assemblage of data. AAA: Study design, revising the write-up, and administrative, technical, and logistic support.

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Study Limitation: This was a community-based study; thus, there is a possibility of community overlap. Several of the participants did not know their exact age. However, we implemented a calendar of events to overcome this challenge.

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