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Prevalence of Schistosomiasis around Irrigation Schemes in the Benue River Valley, Adamawa State, Nigeria

[1]Daniel, J. L.; [2]Vandi, P.; & Aliyu, E.

[1]Department of Science Laboratory Technology, Gombe State Polytechnic, P.M.B. 0190, Bajoga, Gombe State, Nigeria. ORCID: https://orcid.org/0009-0002-1644-1284.
[2]Department of Zoology, School of Life Sciences, Modibbo Adama University of Technology, P.M.B. 2076, Yola, Nigeria.
Corresponding Author: joicedaniellawiye@gspb.edu.ng
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Abstract

Schistosomiasis is a disease of which freshwater snails that act as intermediate host and some abiotic environmental factors plays prominent roles in these infections. The aim of the study was to assess the prevalence of schistosomiasis around irrigation schemes in the Benue River Valley, Yola area of Adamawa State. Plastic container (125 ml) was given to each participant the day before the sample collection. All urine samples collected were transported in ice packs to the Department of Zoology, Modibbo Adama University, Yola for analysis. Laboratory analysis was done using the centrifugation method. 10 ml of urine was centrifuged at 1,500 rpm for 5 minutes and the residue was examined under the ×10 objective of the microscope for the presence of terminal spine ova of *S. haematobium*. A total of 1,814 people consented and were examined for urinary schistosomiasis: 244 (13.45%) were infected, the distribution in relation to gender showed that males 163 (17.18%) had higher infection than females 91 (10.52%). The study showed evidence that having water contact was associated with infection in both children and adults in these communities

Keywords: Schistosomiasis; freshwater snails; *Schistosoma haematobium;* Urine analysis; Irrigation scheme.

Introduction

Schistosomiasis remains a major public health problem in many developing countries particularly among rural populations in Sub-Saharan Africa. With more than 250 million people affected in 78 countries and over 700 million at risk of infection, the vast majority in sub-Saharan Africa, schistosomiasis represents a significant health burden (World Health Organization. [WHO]. 2023). Nigeria is considered as the most endemic country for schistosomiasis, with approximately 29 million infected people and 101 million people at risk of infection (Adenowo *et al.,* 2015).

The life cycle of the parasite typically involves two main hosts - humans and freshwater snails. The parasite develops in snails residing in freshwater (hereafter vectors). The most common species of snail that serve as hosts for schistosomes belong to the genera *Biomphalaria, Bulinus* and *Oncomelania*. Each transmits a different schistosome species: *Biomphalaria* hosts *Schistosoma mansoni* in Africa, the Caribbean and South America, *Bulinus* hosts *S. haematobium* in Africa and *Oncomelania* hosts *S. japonicum* in China, Philippines and Indonesia (WHO, 2023). The snails have different habitat requirements and controlling snail populations is a key strategy in reducing the transmission of schistosomiasis. The larval stages of the parasite, the cercariae, exits the aquatic snail into freshwater and enter the bloodstream of the human host by penetrating the skin of individuals who come into contact with contaminated freshwater (WHO, 2023). Once inside the human body, the schistosome parasites mature into adult worms and migrate to the veins surrounding the intestines or bladder causing intestinal (*S. mansoni, S. intercalatum, S. guineensis, S. japonicum, S. mekongi*) and urogenital (*S. haematobium*) schistosomiasis, with symptoms of painful and bloody defecation or urination respectively (Nation *et al.,* 2020). If left untreated schistosome infections cause immune reactions and lead to progressive organ damage (WHO, 2023). Water bodies, such as dams and irrigation schemes, that was meant to improve water supply for food security, has been a point of contacts with these snails (Food and Agriculture Organisation [FAO], 2023).

Odeniran *et al.* (2020) indicated that about one-third of the populations of Nigeria were infected by *S. haematobium*. This higher infection intensity in the population might lead to a high level of environmental contamination that resulted in higher snail infection in Nigeria. The geographic distribution of each *Schistosoma* species is closely dependent on the presence of appropriate freshwater snails that serve as the obligatory molluscan hosts. Both genus *Bulinus* and *Biomphalaria* are found in Nigeria, with *Bulinus* having wider distribution and more species, such as *B. globosus*, *B. truncates* and *B. senegalensis*, compared to *Biomphalaria* (Akinwale *et al.,* 2011). However, this research aimed to provide report on the prevalence of schistosomiasis around irrigation scheme of the Benue River valley in Adamawa State that could be used by policymakers and international organizations working on the prevention and control of schistosomiasis in the State.

Study Area

Adamawa State is located in the Northern Eastern part of Nigeria. It lies between latitude 7o and 11o N of the equator and between longitude 11 and 14 E of the Greenwich meridian. It has an altitude of 185.9 and covers a land area of about 38.741km. It shares boundary with Taraba State in the South and West, Gombe State in its northwest and Borno State to the north. Adamawa State has an international boundary with Cameroon Republic along its Eastern border. The River Benue which is the major river in the state it rises from the highlands of Cameroon and flows south ward to join the River Niger at Lokoja. Two seasonal periods are experienced in the state: the wet and the dry seasons. The months of May to October constitute the wet season. During this period no place receives less than 60 mm of rain. The months of November to April constitute the dry season. It experiences harmattan between the months of November to February. March and April are the hottest months (42.78ºC), while November and December are the coldest months (11.11ºC). (Adebayo and Tukur, 1999).

The study will cover the community around Lake Geriyo and along the banks of the River Benue, Yola area starting from Boronji Community (behind the Adamawa State Water Board Treatment Plant) close to the Jimeta-Girei bridge at the boundary of Yola North LGA and Girei LGA, it will follow the communities of Rugange Bwatiye through Njoboliyo in Yola South LGA and Dason Bwatiye upto Dasin Hausa in Fufore LGA. These areas are characterized by farming and fishing activities all year round.

Ethical Consent

An introductory letter was obtained from the Department of Science Laboratory Technology, Gombe State Polytechnic, Bajoga, addressed to the Permanent Secretary, Adamawa State Ministry of Health, Yola . Participants were allowed to discuss anything they are not clear with, their identity and information was handled with care and it was confidential, they were told that they are all at liberty to withdraw from the study anytime they wish.

Sample Size Calculation

The sample size for this study was determined using the formula suggested by Yamane, (1973).

Where:

n=N/(1 + N(e)2)

n = the desired sample size (when population is less than 10,000)

N = the population size.

e = the acceptable sampling error

*95% confidence level and p=0.5 are assumed

Parasitological Investigation for Schistosoma

A total sampled individuals was targeted for the *S. haematobium* survey. As for the different population numbers in the study villages, sampling proportional to size was applied. After informed consent, urine samples was collected from consented participants. Plastic containers (125 ml) was distributed to each participant the day before the sample collection. Participants

were invited to submit a sample of their own morning urine in the collection containers after being instructed on the method of collection. Each participant was given a unique identification number (Koenig *et al*., 2023). The urine samples collected was transported in ice packs to the Department of Zoology, Modibbo Adama University, Yola for analysis. Laboratory analysis of the urine was done using the centrifugation method. 10 mls of urine was centrifuged at 1,500 rpm for 5 minutes and the residue was examined under the ×10 objective of the microscope for the presence of terminal spine ova of *S. haematobium*. Eggs of *S. heamatobium* was reported.

Results

The overall distribution of urinary schistosomiasis in the six communities showed that a total of 1,814 people consented and were examined for urinary schistosomiasis, 244 (13.45%) were infected. The distribution in relation to gender showed that males 163 (17.18%) had higher infection than females 91 (10.52%). There was a significant statistical difference at $p < 0.05$. The distribution in relation to age of the study participant showed that the age range 16-18 years had the highest infection with 53 (15.72%). There was no significant difference at $p > 0.05$ for prevalence in both age and education (Table 1).

The prevalence of schistosomiasis among the residence of Lake Geriyo showed that out of the 245 people examined for urinary schistosomiasis, 32 (13.06%) were infected with various degrees of infections. The distribution of infections in relation to gender showed that males were more infected, 22 (17.32%) than their female counterparts 10 (8.47%). There was statistical significant difference at $p <0.05$. The distribution of infection in relation to age showed that those who are less than 9 years had the highest 2 (22.22%), the age range 10-12 years had the least 10 (11.49%). The distribution in relation to educational status showed that those with secondary school education had the highest infections with 21 (14.79%), and the least was among those with primary school education 11 (10.68%). There was no significant difference at $p > 0.05$ for prevalence in both age and education. (Table 2)

The prevalence of urinary schistosomiasis Boronji resident's showed that out of 212 people examined 28 (13.21%) were infected with various degrees of infections. The distribution of infections in relation to gender showed that male had 20 (17.86%), while female's had 8 (8.00%). The distribution of infection from the table 3, the 13-15 age group had the highest infection 17 (20.99%), the least was among the 10-12 years old with 6 (9.52%). The distribution in relation to educational status showed that those with secondary school education had the highest infections with 22 (18.18%), and the least among those with primary school education 6 (6.59%). There was no significant difference between infection and gender, age and educational level at $p > 0.05$

Table 1: Overall Prevalence of Schistosomiasis at Lake Geriyo, Boronji, Rugange, Njoboliyo, Dasin Bwatiye and Dasin Hausa

Parameter	No Examined	No Infected (%)
Gender		

Parameter	No Examined	No Infected (%)
Male	949	163 (17.18)
Female	865	91 (10.52)
Total	1814	244 (13.45)
Age (Years)		
<9	97	11 (11.34)
10-14	608	76 (12.50)
13-15	664	101 (15.21)
16-18	337	53 (15.72)
≥ 19	107	11 (10.28)
Total	1814	244 (13.45)
Education		
Primary	748	95 (12.70)
Secondary	1063	156 (14.67)
Tertiary	3	1 (33.33)
Total	1814	244 (13.45)

Gender: χ^2_{cal} =13.32, df=1, χ^2_{Tab} = 7.87

Age: χ^2_{cal} =6.93, df= 4, χ^2_{Tab} = 14.86

Education: χ^2_{cal} =5.26, df= 2, χ^2_{Tab} = 10.59

Table 2: Prevalence of Schistosomiasis at Lake Geriyo

			Intensity		
Parameters	**No Examined**	**No Infected (%)**	**Mild (%)**	**Moderate (%)**	**Severe (%)**
Gender					
Male	127	22 (17.32)	9 (40.91)	13 (59.09)	-
Female	118	10 (8.47)	9 (90.00)	-	1 (10.00)
Total	245	32 (13.06)	18 (56.25)	13 (40.63)	1 (3.13)
Age (Years)					
<9	9	2 (22.22)	-	2 (100.00)	-
10-12	87	10 (11.49)	7 (70.00)	3 (30.00)	-
13-15	87	14 (16.09)	7 (50.00)	6 (42.86)	1 (7.14)
16-18	45	6 (13.33)	4 (66.67)	2 (33.33)	-
≥ 19	17	-	-	-	-
Total	245	32 (13.06)	18 (56.25)	13 (40.63)	1 (3.13)
Education					
Primary	103	11 (10.68)	6 (54.55)	4 (36.36)	1 (9.09)
Secondary	142	21 (14.79)	12 (57.14)	9 (42.86)	-
Tertiary	-	-	-	-	-
Total	245	32 (13.06)	18 (56.25)	13 (40.63)	1 (3.13)

Gender: χ^2_{cal} =15.48, df=4, χ^2_{Tab} = 14.86

Age: χ^2_{cal} =12.98, df=16, χ^2_{Tab} = 34.26

Education: χ^2_{cal} =3.10, df=4, χ^2_{Tab} = 14.86

Table 3: Prevalence of Schistosomiasis at Boronji

			Intensity		
Parameters	**No Examined**	**No Infected (%)**	**Mild (%)**	**Moderate (%)**	**Severe (%)**
Gender					
Male	112	20 (17.86)	10 (50.00)	10 (50.00)	-

Parameters	No Examined	No Infected (%)	Intensity Mild (%)	Moderate (%)	Severe (%)
Female	100	8 (8.00)	5 (62.50)	3 (37.50)	-
Total	212	28 (13.21)	15 (53.57)	13 (46.43)	-
Age (Years)					
<9	15	-	-	-	-
10-12	63	6 (9.52)	3 (50.00)	3 (50.00)	-
13-15	81	17 (20.99)	8 (47.06)	9 (52.94)	-
16-18	40	5 (12.50)	4 (80.00)	1 (20.00)	-
≥ 19	13	-	-	-	-
Total	212	28 (13.21)	15 (53.57)	13 (46.43)	-
Education					
Primary	91	6 (6.59)	3 (50.00)	3 (50.00)	-
Secondary	121	22 (18.18)	12 (54.55)	10 (45.45)	-
Tertiary	-	-	-	-	-
Total	212	28 (13.21)	15 (53.57)	13 (46.43)	

Gender: χ^2_{cal} =6.54, df=3, χ^2_{Tab} = 12.83
Age: χ^2_{cal} =14.14, df=12, χ^2_{Tab} = 28.30
Education: χ^2_{cal} =8.67, df=3, χ^2_{Tab} = 12.83

The prevalence of urinary schistosomiasis among residents of Rugange showed that out of the 322 people examined 43 (12.95%) were infected with various degree of infections. The distribution of infection in relation to gender showed that males had 29 (16.76%), while female's had 14 (9.40%) infected people. The distribution of infection in relation to age showed that the age range 16-18 years had the highest infection with 10 (17.80%), the least was in less than 9 years old 1 (6.25%). The distribution in relation to educational status showed that those with tertiary education had the highest of infection with 1 (33.334%). There was no significant difference in infection for gender, age and educational level at $p > 0.05$ (Table 4).
The prevalence of schistosomiasis among the residents of Njoboliyo showed that out of the 331 people examined for urinary schistosomiasis, 32 (9.67%) were infected with various degree of infections The distribution of infections in relation to gender showed that male's had 26 (15.29%), while females had 16 (9.94%) infected people. The distribution in relation to age showed that the age range 16-18 years had the highest infection with 9 (14.28%), and the least 10-12 years 13 (10.74%). The distribution of infection in relation to educational status showed that those with secondary school education had the highest of infections with 26 (13.40%), and the least was among those with primary school education 14 (10.22%). There was no significant difference in infection for gender, age and educational level at $p > 0.05$ (Table 5).
The prevalence of schistosomiasis among the people in Dasin Bwatiye is shown in table 4.22 Out the 339 people examined for urinary schistosomiasis, 53 (29.78%) were infected with various degree of infections. The distribution of infections in relation to gender showed that males had the highest 29 (16.29%), followed by females had 24 (13.48%). The distribution of infection in relation to age showed that the age range less than 9 year 4 (20.00%) had the

highest infection and the least was among the 10-12 year old 15 (13.27%). The distribution in relation to educational status showed that those with secondary school education had the highest infection with 33 (16.26%), followed by those with primary school education with 20 (14.71%). There was no significant difference in infection for gender, age and educational level at $p > 0.05$ (Table 6).

Table 4: Prevalence of Schistosomiasis at Rugange

			Intensity		
Parameters	**No Examined**	**No Infected (%)**	**Mild (%)**	**Moderate (%)**	**Severe (%)**
Gender					
Male	173	29 (16.76)	17 (58.62)	12 (41.38)	-
Female	149	14 (9.40)	8 (57.14)	6 (42.86)	-
Total	322	43 (12.95)	25 (58.14)	18 (41.86)	-
Age (Years)					
<9	16	1 (6.25)	-	1 (100.00)	-
10-12	99	12 (12.12)	7 (58.33)	5 (41.67)	-
13-15	108	15 (13.89)	8 (53.33)	7 (46.67)	-
16-18	56	10 (17.86)	7 (70.00)	3 (30.00)	-
≥ 19	43	5 (11.63)	3 (60.00)	2 (20.00)	-
Total	322	43 (12.95)	25 (58.14)	18 (41.86)	-
Education					
Primary	136	21 (15.44)	12 (57.14)	9 (42.86)	-
Secondary	183	21 (11.48)	13 (61.90)	8 (38.10)	-
Tertiary	3	1 (33.33)	-	1 (100.00)	-
Total	322	43 (12.95)	25 (58.14)	18 (41.86)	

Gender: χ^2_{cal} =5.20, df=3, χ^2_{Tab} = 12.83
Age: χ^2_{cal} =2.33, df=12, χ^2_{Tab} = 28.30
Education: χ^2_{cal} =1.58, df=6, χ^2_{Tab} = 18.56

Table 5: Prevalence of Schistosomiasis at Njoboliyo

			Intensity		
Parameters	**No Examined**	**No Infected (%)**	**Mild (%)**	**Moderate (%)**	**Severe (%)**
Gender					
Male	170	26 (15.29)	14 (53.85)	12 (46.15)	-
Female	161	14 (9.94)	11 (68.75)	2 (12.50)	1 (6.25)
Total	331	40 (9.67)	25 (78.13)	14 (43.75)	1 (3.13)
Age (Years)					
<9	17	2 (11.76)	-	2 (100.00)	-
10-12	121	13 (10.74)	10 (76.92)	3 (23.08)	-
13-15	121	15 (12.40)	7 (46.92)	7 (46.67)	1 (6.67)
16-18	63	9 (14.29)	7 (77.78)	2 (22.22)	-
≥ 19	9	1 (11.11)	1 (100.00)	-	-
Total	331	40 (9.67)	25 (78.13)	14 (43.75)	1 (3.13)

Parameters	No Examined	No Infected (%)	Intensity Mild (%)	Moderate (%)	Severe (%)
Education					
Primary	137	14 (10.22)	9 (34.62)	4 (28.57)	1 (7.14)
Secondary	194	26 (13.40)	16 (61.54)	10 (38.46)	-
Tertiary	-	-	-	-	-
Total	331	32 (9.67)	25 (78.13)	14 (43.75)	1 (3.13)

Gender: χ^2_{cal} =9.76, df=4, χ^2_{Tab} = 14.86
Age: χ^2_{cal} =9.47, df=16, χ^2_{Tab} = 34.26
Education: χ^2_{cal} =3.10, df=4, χ^2_{Tab} = 14.86

Table 6: Prevalence of Schistosomiasis at Dasin Bwatiye

Parameters	No Examined	No Infected (%)	Intensity Mild (%)	Moderate (%)	Severe (%)
Gender					
Male	178	29 (16.29)	16 (55.17)	13 (44.83)	-
Female	161	24 (13.48)	13 (54.17)	10 (41.67)	1 (4.17)
Total	339	53 (29.78)	29 (54.72)	23 (43.40)	1 (1.89)
Age (Years)					
<9	20	4 (20.00)	1 (25.00)	3 (75.00)	-
10-12	113	15 (13.27)	10 (66.67)	5 (33.33)	-
13-15	130	21 (16.15)	9 (42.86)	11 (52.38)	1 (4.76)
16-18	64	11 (17.19)	7 (63.64)	4 (36.36)	-
≥ 19	12	2 (16.67)	2 (100.00)	-	-
Total	339	53 (15.63)	29 (54.72)	23 (43.40)	1 (1.89
Education					
Primary	136	20 (14.71)	12 (60.00)	7 (35.00)	1 (5.00)
Secondary	203	33 (16.26)	17 (51.52)	16 (48.48)	-
Tertiary	-	-	-	-	-
Total	339	53 (15.63)	29 (54.72)	23 (43.40)	1 (1.89)

Gender: χ^2_{cal} =1.14, df=4, χ^2_{Tab} = 14.86
Age: χ^2_{cal} =8.21, df=16, χ^2_{Tab} = 34.26
Education: χ^2_{cal} =1.30, df=4, χ^2_{Tab} = 14.86

At Dasin Hausa, the prevalence of urinary schistosomiasis showed that out of the 365 people examined 56 (15.34%) were infected with various degrees of infections. The distribution of infections in relation to gender showed that males had 37 (19.58%), while females had 19 (10.80%). There was significant difference at $p< 0.05$. The distribution of infection in relation to age showed that the age range older than 19 years had the highest infection with 3 (23.08%), and the least was among less than 9 year old age group 2 (10.00%). The distribution in relation to educational status showed that those with primary school education had the highest of infections 23 (15.86%), and the least was among secondary school education 23 (15.00%).

There was no significant difference in infection for age and educational level at $p > 0.05$ (Table 7).

Table 7: Prevalence of Schistosomiasis at Dasin Hausa

			Intensity		
Parameters	**No Examined**	**No Infected (%)**	**Mild (%)**	**Moderate (%)**	**Severe (%)**
Gender					
Male	189	37 (19.58)	21 (56.76)	16 (43.24)	-
Female	176	19 (10.80)	15 (78.95)	3 (15.79)	1 (5.26)
Total	365	56 (15.34)	36 (64.29)	19 (33.93)	1 (1.79)
Age (Years)					
<9	21	2 (10.00)	-	2 (100.00)	-
10-12	125	20 (16.00)	16 (80.00)	4 (20.00)	-
13-15	137	19 (13.87)	10 (52.63)	8 (42.11)	1 (5.26)
16-18	69	12 (17.39)	8 (66.67)	4 (33.33)	-
≥ 19	13	3 (23.08)	2 (66.67)	1 (33.33)	-
Total	365	56 (15.34)	36 (64.29)	19 (33.39)	1 (1.79)
Education					
Primary	145	23 (15.86)	16 (69.57)	6 (26.09)	1 (4.35)
Secondary	220	33 (15.00)	20 (60.61)	13 (39.39)	-
Tertiary	-	-	-	-	-
Total	365	56 (15.34)	36 (64.29)	19 (33.93)	1 (1.79)

Gender: χ^2_{cal} =17.30, df=4, χ^2_{Tab} = 14.86
Age: χ^2_{cal} =9.34, df=16, χ^2_{Tab} = 34.26
Education: χ^2_{cal} =2.39, df=4, χ^2_{Tab} = 14.86

Discussion

This study assessed the prevalence of *Schistosoma haematobium* infection across six communities situated along irrigation schemes and riverbank settlements of the Benue River Valley. An overall prevalence of **13.45%** was recorded, with consistently higher infection among males across all locations. Age-specific distribution revealed a predominance of infection among **older adolescents (16–18 years)**, while educational level showed no statistically significant associations. These findings demonstrate persistent transmission within these ecologically suitable communities and align with recent reports of **localized hotspots** of urinary schistosomiasis in Nigeria and sub-Saharan Africa (Enabulele *et al.,* 2021; Adenusi *et al*., 2024). The moderate prevalence observed reflects ongoing transmission driven by daily water contact associated with fishing, farming, domestic washing, and recreational activities—behaviours that have been identified as major risk factors in recent epidemiological studies (Salawu & Odaibo, 2020).

Recent surveys across Nigeria show a wide distribution of schistosomiasis prevalence depending on geography, snail ecology, and human behaviour. The prevalence of 13.45% in the present study is however l**ower** than reports from northern and southwestern riverine

hotspots, where prevalence ranged between **27–53%** (Ijaiya *et al*., 2020; Adenusi *et al*., 2024), and **Comparable** to community-level findings of **10–20%** observed in southeastern and north-central Nigeria (Enabulele *et al*., 2021). But it is **Higher** than the low transmission zones (<5%) identified in WASH-improved communities. These variations confirm that schistosomiasis remains **focally distributed**, a pattern repeatedly emphasized in current mapping studies and WHO technical reports (WHO, 2022).

East African irrigation zones report persistent meso- to hyper-endemicity due to strong human–water–snail interaction. Systematic reviews show that **snail density and habitat suitability** strongly predict human prevalence (Wang *et al.,* 2024). Community-level surveys in Cameroon, Zambia, and Ethiopia reveal prevalence ranges between **10–40%,** similar to values found here (Halwindi *et al.,* 2023). Schistosomiasis had a high prevalence in Ghana, at 71% (Ghana Ministry of Health, 2023)

These trends reinforce that riverine and irrigation-based livelihoods create highly favourable conditions for *S. haematobium* transmission, consistent with ecological realities of the Benue floodplain. A significant sex difference was observed in all communities, with males having markedly higher infection rates. Similar findings from 2020–2024 studies attribute this pattern to increased involvement in **fishing, irrigation, watering livestock**; longer duration of **recreational swimming**; greater exposure during **agricultural work** (Ijaiya *et al.,* 2020; Salawu & Odaibo, 2020; Adeniji *et al*., 2023). Recent gender-disaggregated analyses conclude that males consistently exhibit up to **2–3 times** higher odds of urinary schistosomiasis due to behavioural exposure, not biological susceptibility (Enabulele *et al*., 2021). The peak prevalence among 16–18-year-olds aligns with recent studies showing **older adolescents and young adults** play a key role in sustaining transmission (Salawu & Odaibo, 2020; Adenusi *et al.,* 2024).

Recent WHO guidelines (2022) emphasize expanding treatment coverage to adolescents beyond typical school-aged categories, supporting our findings. The communities in this study lie along irrigation channels, seasonal floodplains, and the Benue River—all of which provide: slow-moving shallow waters, submerged vegetation, and favourable microhabitats for **Bulinus spp.**, the intermediate snail host. This ecological suitability aligns with observations from recent snail mapping and eco-epidemiological studies which highlight **snail habitat persistence** as a primary determinant of schistosomiasis hotspots (Wang *et al*., 2024). Moreover, frequent **riverbank agriculture**, **dry-season irrigation**, and **year-round fishing** in the study area mirror conditions described in similar African river basins where transmission persists despite long-term MDA Modern ecological surveillance approaches—including snail monitoring, drone-based habitat mapping, and environmental DNA detection—have been recommended for riverine hotspots (Wang *et al.,* 2024).

Conclusion

Findings from this study demonstrate ongoing transmission of *S. haematobium* across multiple irrigation-dependent communities in the Benue River Valley, with infections concentrated

among males and older adolescents. These patterns reflect similar trends reported in recent African schistosomiasis studies. Public health interventions must prioritize: expanded MDA to include adolescents and adults, integrated WASH improvements, ecological surveillance of snail habitats, and behaviour-change communication targeting high-risk groups. With appropriate targeting and integration of control strategies, the burden of schistosomiasis in the Benue River Valley can be significantly reduced.

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