



Original article

Urinary schistosomiasis and urinary tract bacterial co-infections among rice farmers in selected Local Government Areas of Niger State

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ABSTRACT

Urinary schistosomiasis is a significant neglected tropical disease that disproportionately affects communities with frequent water contact, such as rice farmers. This study aimed to determine the prevalence of urinary schistosomiasis and associated urinary tract bacterial infections among rice farmers in Agaie, Lavun, Wushishi, Borgu, Bosso and Shiroro Local Government Areas (LGAs) of Niger State, Nigeria. A total of 1159 participants were screened through urine microscopy for *Schistosoma haematobium* eggs and bacterial pathogens were identified via urine culture, bacterial load determination and biochemical tests. Results revealed an overall schistosomiasis prevalence of 32.8% and urinary bacterial infection prevalence of 51.4%, with the highest infection rates observed in the 10-19 years age group. Co-infection of urinary schistosomiasis and urinary tract bacteria demonstrated no significant ($p=0.329$). Key risk factors significantly associated with schistosomiasis included swimming, washing, and bathing in contaminated water sources. The predominant bacterial isolates identified were *Staphylococcus aureus* and *Escherichia coli*. The study underscores the urgent need for integrated disease control interventions focusing on reducing contact with infested waters and improving hygiene practices among rice farmers to curb both schistosomiasis and urinary tract infections in the region.

Keywords: Urinary schistosomiasis, Urinary tract infection, Co-infection, Rice farmers,

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INTRODUCTION

Urinary schistosomiasis, also known as bilharzia, being a parasitic infection caused by *Schistosoma haematobium*, primarily affects the urinary tract. It is estimated that more than 200million people worldwide are affected by urinary

schistosomiasis with the majority of cases occurring in sub-sahara Africa [1]. The disease is transmitted through contact with fresh water contaminated with the larvae of schistosome parasites. Infection occurs when the larvae penetrate the skin during contact with infested water. Upon penetration, the cercarial larva enters the blood stream and migrates to urinary

system where they fully matured into adult worms. The adult worms reside in the blood vessels surrounding the bladder and ureter causing inflammation, fibrosis and hematuria [2].

Urinary schistosomiasis has been considered one of the most prevalent neglected tropical diseases globally affecting millions of people in over 70 countries, particularly in sub-saharan Africa [1]. The World Health Organization (W.H.O) estimates that more than 229 million individuals require treatment for schistosomiasis each year [1]. This disease primarily affects individuals engaged in activities such as farming, fishing and domestic chores that exposed them to infested water bodies [1]. Rice farmers in particular are at higher risk due to their frequent contact with contaminated water source, during irrigation and other agricultural practices.

Urinary Tract Infections (UTIs) are caused by the pathogenic bacteria invading the urinary tract, leading to various symptoms such as frequent painful urination and lower abdominal pain [3]. Bacterial infection often presents a complicated condition with urinary schistosomiasis due to the wear and tear of epithelium by the spiny schistosoma eggs, thereby making the underlying internal tissues easily accessible to urinary tract bacterial species [4]. The presence of UTIs exacerbates the morbidity associated with urinary schistosomiasis, leading to increased health care burden and reduced productivity among affected individuals [5,6]. Studies have documented implications in an etiology of bladder cancer and other complications. A study in Ondo highlighted that bacterial urinary tract infection normally takes place when the mucosal barrier is broken down,

thereby making urinary tract an easy target for invading bacteria [4]. The co-existence of bacterial and schistosomal infection may be due to the relationship of bacteria either fixing on the cutaneous surface of the worms [8] or colonization of the caecum by bacteria [10]. It is possible that several bacteria species could be isolated from urinary schistosomiasis patients' urine following the presence of blood, the bleeding tissues resulting from the transport activities of spined eggs of *S. haematobium*. The wear and tear surfaces bleeds, releasing blood for microbial utilization as well as provide site for microbial colonization, attachment and proliferation [10]. In view of the above, this study was therefore carried out to determine the prevalence of urinary schistosomiasis and urinary tract bacterial infections among rice farmers in Niger state.

MATERIALS AND METHODS

Study area

This study was conducted in Niger e, Nigeria. The choice of this area was based on its significant rice farming activities making it a rational location to investigate the prevalence of urinary schistosomiasis and urinary bacterial infection among rice farmers. The State is politically divided into three (3) Senatorial Districts as Niger-South, Niger-East, and Niger-West. It is located between the coordinates of 9.9309° N and 5.5983° E, in the savannah belt of Nigeria, with the temperature of 20°C to 40 °C. The majority inhabitants engage in rice farming.

Two (2) Local Government Areas were selected from each of the three (3) Senatorial Districts. They were Agaie and Lavun from Niger south, Bosso and

Shiroro from Niger-North and Borgu and Wushishi from Niger-East senatorial districts. Five communities each from the study Local Government Areas were considered for this study. The communities were: Batagi, Kudogi, Muchita, Busu and Nku kuso from Lavun Local Government Area and Ekowugi, Ekossa, Esangi, Boroko and Ekowuna from Agaie LGA. The communities studied in Wushishi LGA were Maito, Tungan Kowa, Poly (Niger poly), Kwata and Bankogi respectively. Those from Borgu LGA were: Taimanai, Yangba, Dogon ruwa, Ketare and Tungan Jonathan communities. The study communities from Shiroro LGA were: Shiroro, Zumba, Kuta, Gwada and Gunu, while those of Bosso LGA were Shakwata, Tayige, Gwasu, Luku and Samakpa.

Inclusion Criteria

Individuals engaged in rice farming activities in the studied LGAs, particularly in Lavun. Both male and female farmers, inclusive of all age groups from 0 years and above. Participants consent to give urine samples for schistosomiasis and bacterial infection screening. Subjects residing in the selected LGAs during the study period.

Exclusion Criteria

Individuals are not involved in rice farming or unrelated agricultural activities. Non-residents or transient populations within the study area. Participants who did not provide urine samples or refused consent. Subjects with known chronic urinary disorders unrelated to schistosomiasis or bacterial infections.

Urine sample collection

A total of 1159 terminal urine samples were obtained into sterile specimen bottles and labelled. The bottles were

placed in a cold box containing ice pack and conveyed back to the Microbiology laboratory of Federal Medical Centre Bida, Niger State for further analysis.

Urine Microscopy

About 10 ml of urine sample was transferred into a clean centrifuge tube and centrifuged at 500rpm for 5 minutes. The supernatant was discarded, and the deposit was transferred unto a clean, greased free glass slide, covered with a piece of coverslip and examined under 40x magnification of a light microscope for detection of *S. haematobium* eggs [12].

Isolation, characterization and identification of bacteria from the urine samples

The urine samples that showed presence of schistosome eggs were subjected to microbial culture on sterile plates of cystine lactose electrolyte-deficient (CLED) agar. The inoculation was done using a sterile calibrated wire loop (the one holding 1/500ml (0.002ml) of the inoculum (Cheesebrough, 2006). The plates were incubated aerobically at 37°C overnight. The resultant colonies were counted and expressed in standard form in Colony Forming Unit (CFU/ml of the urine). The colonies counted on a plate were multiplied by 500. A countless than $\leq 10^2$ (10,000) CFU/ml were considered not significant and those with colony count of $\leq 10^4$ (100,000) to have bacteriuria while the counts $\geq 10^5$ (100,000) CFU/ml were regarded with significant bacteriuria (established UTI) [12].

Biochemical Tests

The bacterial isolates were subjected to biochemical tests (tests done to speciate, differentiate and identify bacteria) based on biochemical reactions and enzymatic

activities of the isolates. The following tests were conducted on purified cultures of the isolates: carbohydrate fermentation test (lactose), citrate utilization test, Coagulase test, decarboxylase test, indole test, methylated (MR) test, urease test and Voges-Proskauers (VP) Test [13].

Data Analysis

The recorded data were analysed using Statistical Package for Social Sciences (SPSSV23). Chi-square and logistic regression tests were used to determine the associations between the variables concerning the urinary schistosomiasis and bacterial infection of urinary tract.

The P-value of less than 0.05 was considered statistically significant.

RESULTS

Socio-demographic study of the subjects studied

Table 1 of the results obtained in this study reveals the socio demographic characteristics of the study subjects. The highest number (312) of study subjects were of age 10-19 years. This represents 26.9 %, followed by those within the age range of 20-29 years, 306 (26.4 %). The subjects of ages 50 years and above were just 67 representing 5.8 % of the study population looking at the gender, 841 (72.6 %) of the study population were male, while 318 (27.4 %) were female.

Table 1: Socio-demographic study of the studied subjects

Characteristics	Frequency (N = 1159)	Percent (%)
Age in years		
0-9	126	10.9
10-19	312	26.9
20-29	306	26.4
30-39	207	17.9
40-49	141	12.2
50 and above	67	5.8
Mean ± SD	26.2 ± 15.1	
Gender		
Male	841	72.6
Female	318	27.4

Farming experience of the studied subjects

The participants' experiences in farming as also revealed in Table 2 shows that farmers with 16-20 years of farming

experience constitute the highest number of participants' i.e. 218 representing 18.8 %, followed by those with 6-10 years' experience 193 (16.7%). Only 24 (2.1%) had over 40years of farming experience.

Table 2: Farming experience of the studied subjects

Farming experience	Frequency (n)	Percentage (%)
1-5	118	10.2
6-10	193	16.7
11-15	177	15.3
16-20	218	18.8
21-25	148	12.8
26-30	135	11.6
31-35	90	7.8
36-40	56	4.8
Above 40 years	24	2.1
Total	1159	100

Frequency of the studied subjects from the studied Local Government Area(s)

The subjects from Lavun LGA were 289 (24.9 %), followed by Agaie LGA with 264

(22,8 %), Wushishi LGA having 247 (21.3 %), Borgu LGA had 127 (11.0 %), Shiroro LGA having 119 (10.3 %) and Bosso LGA having the Lowest number of participants of 113 (9.7 %) as shown in **Table 3**.

Table 3: Frequency of the studied subjects from the studied Local Government Area(s)

Local Gov't	Frequency (n)	Percent (%)
Agaie	264	22.8
Borgu	127	11.0
Bosso	113	9.7
Lavun	289	24.9
Shiroro	119	10.3
Wushishi	247	21.3
Total	1159	100

Factors associated with schistosomiasis in the subjects studied

Table 4 reveals information on the risk factor associated with urinary schistosomiasis. Swimming as one of the factors had 375 farmers in consent. This represents 32.4% of the entire study population. A total of 346 (29.9%) farmers depend on river water for drinking. This is 29.9% of the study population. As for washing, 586(50.6) participants go to the water bodies (river/ponds) to wash their clothes and or eat plates. Farmer,

numbering 317 representing 32% bath in the river/pond exposing them to infection. Only very few farmers (67) representing 5.8% of the study population uses protective wares prior to their skin contact with the water body. Defecation/urination with the water bodies as a habit is exhibited by 307 (26.5%). This is capable of entering transmission. As for the awareness about urinary schistosomiasis as revealed in table 14, 393(33.9%) farmers are aware of the sickness.

Table 4: Factors associated with schistosomiasis in the studied subjects

Characteristics	Frequency	Percent
Swimming		
Yes	375	32.4
No	784	67.6
Drinking		
Yes	346	29.9
No	813	70.1
Washing		
Yes	586	50.6
No	573	49.4
Bathing		
Yes	371	32.0
No	788	68.0
Protective idea		
Yes	67	5.8
No	1092	94.2
Urine/defecate		
Yes	307	26.5
No	852	73.5
Schistosomiasis awareness		
Yes	393	33.9
No	766	66.1
Snails in your farm		
Yes	105	33.9
No	1054	66.1

Distribution of bacterial pathogens among the UTI

Bacterial pathogens implicated in the co-infections along with urinary schistosomiasis in this study include *Staphylococcus aureus* with the highest frequency of occurrence of 39(10.3%).

Table 5: Distribution of bacterial pathogens among the UTI

Bacterial pathogens	Frequency	Occurrence (%)
<i>Staphylococcus aureus</i>	39	10.3
<i>Escherichia coli</i>	30	7.9
<i>Pseudomonas aeruginosa</i>	4	1.1
<i>Proteus mirabilis</i>	8	2.1
<i>Klebsilla sp.</i>	9	2.4
<i>E. coli + S. aureus</i>	2	0.5
<i>E. coli + P. mirabilis</i>	1	0.3
Total	93	

This was followed by *Escherichia coli* having 7.9% occurrence. Others are *Klebsilla sp.* 2.4%, *Proteus mirabilis* (2.1%) and *Pseudomonas aeruginosa* (1.1%). *E. coli- S. aureus* and *E. coli-Proteus mirabilis* co-occurred at 0.5% and 0.3% respectively as indicated in Table 5.

Prevalence of schistosomiasis and bacteria in the subjects studied

Table 6 shows the prevalent rates of schistosomiasis as well as that of bacteria among the study subjects in Niger State. Considering the general prevalence of schistosomiasis, the prevalence rate stood at 31.7%, which implies that approximately 1/3 of the study population with schistosomiasis. Bacteria on the other hand shows a general prevalence

rate of 16.8% among urinary schistosoma infected individuals. This is also relatively high and symbolises urinary tract infection.

Looking at the prevalence of schistosomiasis at local government levels, the level of infections varies across the study subjects. This ranges from 11.8% as the least prevalence rate in Shiroro LGA to 40.8% in Lavun LGA. Others are Agaie (30.7%), Borgu (33.1%), Bosso (31.9%) and Wushishi (30.8%). Considering bacteria among the schistosome infected subjects, prevalence varies from 7.1% (the least) in Borgu LGA to 23.0% (the highest) in Bosso LGA. Others are Shiroro (22.7%), Agaie and Lavun (20.8%) and Wushishi (7.3%).

Schistosomiasis and bacteria among male and female subjects considered in this study stood at 31.9% and 31.1% for schistosomiasis and 15.9% and 19.2% for bacteria respectively. Prevalence of schistosomiasis with respect to age as revealed in table 16 indicates that subjects in the age range of 10-19 years is the highest (38.8%), followed by those ages 20-29years (32.0%). The lowest

prevalence was revealed against farmers of ages 40-49 years (23.4%). Others are 24.6% (ages 0-9), 32.4% (30-39years) and 25% for those farmers with ages 50 and above years. Farmers of age 10-19years also revealed the highest level of bacterial infection of 26.0% and those of ages 50years and above showing the least infection. About seventeen percent (17.5%) rate was recorded against age range of 0-9years 16.0% for 20-29 years old farmers 9.7% and 11.3% were the rates of bacterial infection among farmers of ages 30-39years and 40-49years respectively.

General prevalence of bacteriuria/UTI among the urinary schistosome infected farmers

The results of bacteriuria obtained from this study revealed 181 (47.1%) urine samples out of 380 that revealed the prevalence of both eggs of *S. haematobium*, and bacteria pathogens have established bacteriuria (i.e $\leq 10^4$ CFU/ml). Consequently, 93(51.4%) of the bacteriuria case were significant (i.e $\geq 10^5$ CFU/ml) of the urine sample) as revealed in **Table 7**.

Table 6: Prevalence of schistosomiasis and bacteria in the studied subjects

Variables	No. of samples examined	Microscopy No. positive for Schistosoma (%)	No. positive for Bacteria (%)	p-value
General				
Niger state	1159	380 (32.8)	181 (47.6)	
Local Govt				
Agaie	264	81 (30.7)	55 (20.8)	0.0004
Borgu	127	42 (33.1)	9 (7.1)	
Bosso	113	36 (31.9)	28 (24.8)	
Lavun	289	118 (40.8)	58 (20.1)	
Shiriro	119	27 (22.7)	14(11.8)	
Wushishi	247	76 (30.8)	17 (6.9)	
Gender				
Male	841	278 (33.1)	127 (15.1)	0.752
Female	318	102 (32.1)	54 (17.0)	
Age in years				
0-9	126	35 (27.8)	18 (14.3)	0.002
10-19	312	124 (39.7)	80 (25.6)	
20-29	306	102 (33.3)	42 (13.7)	
30-39	207	66 (31.9)	19 (9.2)	
40-49	141	35 (24.8)	15 (10.6)	
50 and above	67	18 (26.9)	7 (10.4)	

Table 7: General prevalence of bacteriuria/UTI among the urinary schistosome infected farmers

No. Infected With Urinary Schistosome Examine for Bacteriuria	No. With Bacteriuria ($\leq 10^4$ CFU/ml)	No. With UTI ($\geq 10^5$ CFU/ml)
380	181 (47.6%)	93 (51.4%)

Association of Schistosomiasis and UTI in studied subjects

The statistical analysis of the results obtained in this indicates that there is no association between urinary schistosomiasis and urinary tract infections as the P-value is greater than 0.05 ($P > 0.005$) **Table 8.**

Table 8: Association of Schistosomiasis and UTI in studied subjects

Variables	Bacteriuria		X ²	P value	OR	95% CI	
	Present n, (%)	Not present n, (%)				Lower	Upper
Schistosoma							
Present	92 (51.1)	88 (58.9)	0.951	0.329	0.511	0.443	0.509
Absent	1 (100.0)	0 (0.0)					

Factors associated with schistosomiasis in bivariate analysis

Table 9 shows the results of a bivariate analysis examining the risk factors associated with schistosomiasis. Individuals that swim in water bodies in the study sites revealed significantly higher rate of infection (53.6%) when compared to those that do not swim (21.2%). The chi-square test statistics indicate a strong association between swimming and schistosoma infection (X²=123.27, P=0.00). The odds ratio (OR) of 4.301 implies that individuals that swim

are 4.3 times more likely to be infected with by schistosome that those that do not swim. Similarly, drinking, washing and bathing all show high infection rates of 37.3%, 36.5% and 40.4% respectively when compared to those that do not (29.3%, 26.7% and 27.5% respectively). The chi-square analysis indicates that these activities are study associated with schistosomiasis (P>0.05). On the other hand, use of protective wears, urinating/defecation and occurrence of snails in the farms all show no significant association with schistosoma infection rate (P>0.05).

Table 9: Factors associated with schistosomiasis in bivariate analysis among the studied subjects

Variables	Schistosomiasis		X ²	P value	OR	95% CI	
	Present n, (%)	Not present n, (%)				Lower	Upper
Swimming							
Present	206 (53.6)	169 (46.4)	123.382	0.000	4.301	3.297	5.609
Absent	174 (21.2)	610 (78.8)					
Drinking							
Present	134 (37.3)	212 (62.7)	7.901	0.005	1.436	1.102	1.872
Absent	246 (29.3)	567 (70.7)					
Washing							
Present	219 (36.5)	367 (63.5)	11.308	0.000	1.579	1.230	2.028
Absent	161 (26.7)	412 (73.3)					
Bathing							
Present	155 (40.4)	216 (59.6)	20.022	0.000	1.786	1.378	2.319
Absent	225 (27.5)	563 (72.5)					
Protective wear							
Present	26 (31.3)	41 (68.7)	1.169	0.279	0.984	0.578	1.675
Absent	354 (31.7)	738 (68.3)					
Urinate/defecate							
Present	98 (30.3)	209 (69.7)	0.141	0.706	0.917	0.691	1.216
Absent	282 (32.2)	570 (67.8)					
Heard of schisto							
Present	137 (33.6)	256 (66.4)	1.159	0.282	1.143	0.081	1.482
Absent	243 (30.7)	523 (69.3)					
Snails in farm							
Present	36 (29.5)	69 (70.5)	0.118	0.732	0.895	0.557	1.388
Absent	344 (31.9)	710 (68.1)					

DISCUSSION

The occurrence of urinary schistosomiasis and associated bacteria tract infections among rice farmers in Niger State, Nigeria was ascertained in this study. The prevalence rate of urinary schistosomiasis in the study area was 31.7%. This rate of infection was moderate compare to world health organization (W.H.O) standard of 50% hyper-infection in infected individuals. The moderate prevalence rate of urinary schistosomiasis in this study may be attributed to occupational activities of rice farmers such as irrigations, harvesting, planting and maintenance which may expose the infected individuals to infected water sources. Another possible reason why the prevalence rate of this infection in the area is high could be due to lack of protective measures, such as wearing of waterproof "clothing, gloves and boots while working in the farms, health-seeking behaviors either to the cultural or social factors, lack of awareness of stigma associated with the disease.

The prevalence rate (31.7%) was higher than the report from the study conducted by Abubakar et al. [14] and Sadiq et al. [15] who independently reported 28.6%, 27.9% and 26.8% in Abeokuta, Kano and Saudi Arabia respectively. The prevalence was also low compared to recent studies by [16, 17, 18, 19, 20, 21, 22] who reported in their studies 36.7%, 46.2%, 42.3%, 40.5% and 36% among rice farmers in Mokwa (L.G.A), Niger, Kogi and Anambara states respectively. The rate from the study was also lower compared to some international studies by [21] (33.2%) and [22] (42.5%) in Cote d'ivoire, Egypt and Ghana respectively. These variations in the prevalence rate could be due to differences in geographical locations,

Climatic condition, individual health behavior and variation in cultural norms. The high rate of infection reported from studies could also be attributed to specific epidemiological characteristics of those regions, differences in preventive measure and access to health care.

The highest rate of urinary schistosomiasis was found in Lavun (L.G.A) with (40.8%) compared to other local governments. This is in line with the reports by [17] and [24]. The reason could be as a result of presence of freshwater snails inhabiting the river bodies serving as sources of water to rice farms, thus exposing the farmers to the infections. The farms in this local government get their water from rivers interconnected with rivers in other local governments. Majority of the residents, particularly rice farmers, make use of the river as the sole water sources for their irrigation, planting and other agricultural activities. These river bodies may be invaded with snail species harboring the schistosome parasites, thereby exposing the rice farmer to schistosomiasis. Regular maintenance of rice plants and longer duration of exposure to this contaminated river or water source could be the reason for higher rate recorded in these regions.

Regarding gender (Sex), this study demonstrated that males had higher rate of schistosomiasis (31.9%) compared to female (31.1%). Although the differences is not statistically significant ($P > 0.05$), the finding was in conformity with the studies of [4, 10]. These studies all reported high schistosomiasis infection rates in males compared to their female counterparts. The reason could be that, male farmers tend to have more often direct contact with contaminated water sources such as river, ponds and marshes where the

intermediate host snails of the parasite reside. Another possible reason might be linked to cultural roles, gender norms, where men are frequently assigned or engaged in agricultural activities including rice farming [4].

Considering age, this study found higher occurrence of urinary schistosomiasis in the participants within the range of 10-19 Years (38.83%). This is in agreement with the recent independent reports from [25, 26, 27]. The age-related result from this study however, counter the reports of [28, 29, 30]. Although this study did not show significant association between age and urinary schistosomiasis ($P > 0.05$), the high prevalent in younger rice farmers could be due to the fact that some young rice farmers have more frequent and prolonged exposure to contaminated water sources such as rice paddies and irrigation canals where schistosome parasite are commonly found. This category of rice farmers may also be more likely engaged in activities such as washing, swimming and fishing as well as playing in these water sources; hence increasing their risk of infection [29].

The occurrence of UTIs among the study subjects from this study was (51.4%), which can be considered as moderate based on WHO standard threshold of 50% of hyper infection. However, this occurrence rate was higher than the rate reported by [4] in part of Ondo state. The occurrence of UTI in this study was also lower than the rate reported by [25, 31, 3] who have all documented in their various studies a slightly higher rate of UTIs. The UTIs recorded in this study may be due to abuse of antibiotics as most people paid regular visits to patent medicine store instead of Basic health centers in the communities/LGA [4]. The study noted

that the occurrence of UTI was higher in females compared to males. This finding is supported by those of [4, 32, 3, 31]. The wider surface of female genitalia and the shortness of the urethra in female urinary tract could possibly dispose them to UTIs than men counter parts. More so, hormonal changes during menstrual cycle can affect the urethra and surrounding tissue making female more susceptible to bacterial and increasing their risk of UTIs.

Co-infection of urinary schistosomiasis and urinary tract bacteria was extensively studied among rice farmers in the study area. This study demonstrated no significant association ($p > 0.05$) between UTI and urinary schistosoma infection with a percentage occurrence of 51.1%. This finding is in agreement with the findings of [31, 32, 3, 32] who all similarly reported high bacteria-schistosoma co-infections among rice farmers in their various studies. The high prevalence of co-infections among schistosomiasis infected individuals from this study may be linked to weakened immune system caused by schistosome worms. A compromised immune system can make schistosomiasis infected individuals more vulnerable to urinary tract bacterial infection. Furthermore, migration of schistosome parasites through body particularly through blood vessels can cause tissue damage in urinary tract creating an environment for bacteria colonization and infection. Obstruction and stagnation caused by schistosomiasis in bladder or urethral due to formations of granulomas or fibrosis can impair normal urinary flow, leading to urine retention and stagnation hence creating conducive environment for bacteria growth thereby increasing the chance of urinary tract infections.

The bacteria strains isolated from the urine samples positive in *Schistosoma haematobium* in the study were predominantly *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella pneumonia*, *Proteus* spp and *Pseudomonas aeruginosa*. These species of bacteria isolated in this study have been previously reported to be isolated from urine samples [33, 34, 25]. The occurrence of *S. aureus* could be due to its association with human skin and affinity for wet areas with high levels of salt content. It should also be of great concern as reported by [33] that it could be a sign of a serious infection of acute abscess. For *E. coli* the reasons for its co-existence and high occurrence with urinary schistosomiasis could be attributed to geographical overlap ring, weakened immune system, contact with contaminated water sources and lack of proper hygiene practices. Its occurrence further demonstrates the severity of infection in schistosomiasis infected individuals and the increased risk of co-infection.

Considering the risk factors that could contribute to transmission of prevalence of urinary schistosomiasis among the rice farmers in the study area, the study showed that swimming, drinking, washing and Bathing were significant risk factors responsible for transmission of the infection among the studied subject in the study area. This finding was in conformity with the study of [35,36,37] who reported that swimming, drinking, washing and bathing were significant risk factors contributing to prevalence and transmission of urinary schistosomiasis in their various studies. Swimming or having any form of contact with freshwater bodies such as ponds, rivers or lakes contaminated with schistosome infected snails can increase risk factors of urinary

schistosomiasis. Same is applicable to drinking or consumption of contaminated waters from contaminated sources like lakes, rivers or ponds can exposure to infection. Additionally, washing and bathing can expose individual to frequent contact with contaminated water during the activities, especially in areas where schistosomiasis is endemic, and can increase the risk of infection. Open defecation or urination in or near water sources can contaminate the environment and contribute to the transmission of schistosomiasis [38]. However, other risk factors considered in the study such as use of protective wear, schistosomiasis awareness and snails in farm where not significant in the study area. This is in line with the study by [35, 39, 40] who demonstrate that protective wear, open urination/defecation, schistosomiasis awareness and snails in farms shows significant association with urinary schistosomiasis in their respective studies. The difference in the findings of this study could be due to geographical factors, climatic condition and attitudes and behaviours of the study participant in various studied location.

CONCLUSION

Urinary schistosomiasis and associated urinary tract bacterial infections co-infection as determined in this study is relatively high and can lead to higher health risks such as carcinoma and the likes. Rice farmers in Niger State are at high health risks and economic loss as sick farmers may have reduced or no participation with direct consequences on the yield. Continuous body contact with infested water will ensure transmission of both urinary schistosomiasis and associated urinary tract bacterial infections co-infection. Control efforts

should focus on health education, provision of safe water sources, and snail control measures to reduce transmission.

REFERENCES

1. World Health Organization (WHO). (2020). Schistosomiasis: Key facts. Retrieved from <https://www.who.int/news-room/fact-sheets/detail/schistosomiasis>.
2. Colley, D. G., Bustinduy, A. L., and Secor, W. E. (2020). Human schistosomiasis. *The Lancet*, 383(9936), 2253-2264.
3. Abdulla, B. S., Ibrahim, K. Y., Adamu, S., Magaji, R. A., Gamawa, A., Mustapha, M., Oladele, T., Usman, M., Ndako, J. A., Okafor, E., Yahaya, M., Zailani, S., Adebayo, A., Isa, A., Sambo, Y., Usman, M., Smith, T., Brown, A., Jones, R., Ahmed, S. and Wang, L. (2022). Schistosomiasis and Urinary Tract Infections. *Journal of Parasitology and Infectious Diseases*, 10(3), 215-230.
4. Kikelomo J. K., Anthony, K. O., and Ebenezer, O. D. (2023). Risk factors affecting the occurrence of urinary schistosomiasis and urinary tractinfections in some communities of Ondo State, Nigeria. *Journal of Water and Health* Vol 21 No 1, 27 doi: 10.2166/wh.2022.186.
5. Yahaya, L., Ibrahim, M., & Musa, A. (2022). Prevalence and Risk Factors of Urinary Schistosomiasis in a North Nigerian Community. *Journal of Public Health Research*, 38(4), 302-311.
6. Zailari, H., Abdullahi, A., & Sani, M. (2022). Diagnosis and Management of Urinary Schistosomiasis in Children: A Case Series from Northern Nigeria. *Pediatric Infectious Disease Journal*, 25(1), 45-52.
7. Oyeyemi, O. T., Jeremias W. J., Fortini, R. and Grenfell, Q. (2023). Schistosomiasis in Nigeria: Gleaning from the past to improve current efforts towards control. *One Health*, 2020; vol 11 Elsevier. <https://doi.org/10.1016/j.onehlt.2020.100183> PMID: 33072838
8. Ayabina, D.V., J. Clark, H. Bayley, P.H.L. Lamberton, J. Toor and T.D. Hollingsworth, (2021). Gender related differences in prevalence, intensity and associated risk factors of Schistosoma infections in Africa: A systematic review and meta-analysis. *PLoS Neglected Tropical Disease*, Vol. 15. 10.1371/journal.pntd.0009083.
9. Cheesbrough, M. (2006). District Laboratory Practice in Tropical Countries, 2nd edition, Part 2. Cambridge University Press, Cambridge. P. 113.
10. Ochei, J. and Kolhatkar, A. (2000). *Medical Laboratory Science; Theory and Practical*, 6th edition, Tata McGraw-Hill Publishing Company, New Delhi. Pp. 644-58.
11. Adeoye, O., Ajibesin, K. K. and Akin-Ojo, C. (2021). Knowledge, attitude and behavior regarding urinary schistosomiasis and its associated risk factors among male rice farmers in Abeokuta, Nigeria. *International Journal of Public Health*, 66(6), 103506.
12. Al-Shehri, H., Abo-Amer, S., Alhejaili, F. and Alsaedi, K. (2020). Prevalence and risk factors of urinary schistosomiasis among rice farmers in Jazan Region, Saudi

- Arabia. *Journal of Infection and Public Health*, 13(11), 1772-1777.
13. Oderinde, B. S., Ajayi, M. B., and Yahaya, J. (2020). Prevalence and predictors of urinary schistosomiasis among rice farmers in Mokwa Local Government Area, Niger State, Nigeria. *African Journal of Parasitology Research*, 3(3), 108-115.
 14. Abubakar, A., Ibrahim, I. and Suleiman, N. (2022). Prevalence of urinary schistosomiasis among rice farmers in Niger state, Nigeria: A combined parasitological and serological approach. *J Infect Dev Ctries*. 16(1): 65-71
 15. Sadiq I. A., Adekeye, R., Halid I, et al. (2021). Prevalence of urinary schistosomiasis and its associated risk factors among rice farmers in Katcha, Niger State, Nigeria. *BMC Infect Dis*;21(1):914. doi:10.1186/s12879-021-06699-8
 16. Akinro, B. O., Ochigbo, G., Emikpe, B. O. and Ekwunife, C. A. (2021). Prevalence and risk factors associated with urinary schistosomiasis amongst rice farmers in Kogi State, Nigeria. *Journal of Parasitic Diseases*, 45(2), 332-339.
 17. Ekwunife, C. A., Ochigbo, G., Akinro, B. O. and Emikpe, B. O. (2023). Prevalence and correlates of urinary schistosomiasis among rice farmers in Anambra State, Nigeria: Implications for control. *PLoS Neglected Tropical Diseases*, 17(5), e0009349.
 18. Assaré, R. K., Hürlimann, E. & Ouattara, M. (2018). Sustaining control of *Schistosoma mansoni* in western Cote d'Ivoire: Results from a SCORE study baseline survey. *PLoS Neglected Tropical Disease* ;12(8):e0006767. doi:10.1371/journal.pntd.0006767
 19. Elmorshedy, H., Bergquist, R., El-Ela, N. E. A., Eassa, S. M. and Elsokary, A. M. (2021). Urinary schistosomiasis among rice farmers in the Nile Delta, Egypt: prevalence, knowledge, attitudes and practices. *Pathogens and Global Health*, 115(3), 145-156.
 20. Kikelomo, R., Adeyinka, O., & Olumide, F. (2022). Knowledge and Attitudes Towards Urinary Schistosomiasis Among Adolescents in a Rural Community in Nigeria. *Journal of Community Health*, 30(2), 89-97.
 21. Ibrahim U, Bobbo A. A., Nwuba, R. I., Oyeniran, O. A., Siminialay, I. M. (2022). Co-infection of urinary schistosomiasis and urinary tract bacteria infections among rice farmers in Katcha local government area, Niger State, Nigeria. *Journal of Public Health Africa*, (1):1577. Published 2022 Jan 31. doi:10.4081/jphia.2022.1577
 22. Emmanuel, D. A., Ignatius, M. and Timothy, A. (2023). Bacteria Co-Infection in Urinary Schistosomiasis among Vulnerable Children in Safana District of Katsina State-Nigeria. *Bacteriology Journal*, 13 (1): 1-7. <https://doi.org/10.17311/bj.2023.1.7>
 23. Ahmed, A., Smith, B. L. and Jones, C. D. (2023). Urinary Schistosomiasis in Sub-Saharan Africa: A Review of Current Literature. *Journal of Parasitology*, 45(2), 117-126.
 24. Tukur, L. U., Belonwu, R. O., Opara, H. N. and Bala, A. U. (2020).

- Prevalence and risk factors of urinary schistosomiasis and associated complications among rural rice farmers in Kano State, Nigeria. *Nigerian Journal of Parasitology*, 41(2), 259-266.
25. Adeneye, A. A., Adeleke, A. A., and Ofoezie, I. E. (2023). Urinary schistosomiasis in Nigeria: A review of recent epidemiological studies. *Journal of Parasitology and Vector Biology*, 12(8), 93-100.
26. Babadi, M. A., Sarkari, B. and Kheirandish, F. (2021). Prevalence of urinary tract infections in children with urinary schistosomiasis: A systematic review and meta-analysis. *BMC Infectious Diseases*, 21(1), 1-11.
27. Owolabi, O. Y., Adejimi, A. O., and Owolabi, A. S. (2021). Urinary schistosomiasis and bacterial urinary tract infections among farmers in Kwara State, Nigeria. *African Health Sciences*, 21(1), 115-124.
28. Musa, I. J., Ekpo, U. F., Mohammed, A. B. and Ugbomoiko, U. S. (2022). Prevalence and risk factors of urinary tract infections among individuals with and without urinary schistosomiasis in rural areas of Niger State, Nigeria. *BMC Urology*, 22(1), 16. <https://doi.org/10.1186/s12894-022-00960-9>
29. Hamza, I. A., Habib, I. A., Ibrahim, A. A, et al. (2022). Risk factors and clinical impact of urinary bacterial tract infections in coexistence with urinary schistosomiasis among rice farmers. *International Journal of Infectious Diseases*. 118: 106-112.
30. Kone, K. J., Onifade, A. K. and Dada, E. O. (2022). Occurrence of urinary schistosomiasis and associated bacteria in parts of Ondo State, Nigeria. *PLoS Global Public Health*, 2 (10), e0001119. <https://doi.org/10.1371/journal.pgph.0001119>.
31. Uwandu, C. U., J. N. Dike-Ndudim, and C. W. Ndubueze, (2022). Epidemiological studies on urinary schistosomiasis and bacterial co-infection in some rural communities of Abia State, Nigeria. *World Journal of Biology and Pharmaceutical. Health Science*, 10: 065-072.
32. Kitano, H., N. Shigemoto, Y. Koba, T. Hara and K. Seiyaet al., (2021). Indwelling catheterization, renal stones, and hydronephrosis are risk factors for symptomatic *Staphylococcus aureus*-related urinary tract infection. *World Journal of Urology*, 39: 511-516.
33. Fenwick, A. (2020). The global burden of neglected tropical diseases. *Public Health*, 181, 74-81. <https://doi.org/10.1016/j.puhe.2019.11.015>
34. Sokolow, S. H., Jones, I. J., La, D., Lafferty, K. D., Langwig, K., and Kuris, A. (2018). Reduced transmission of human schistosomiasis after restoration of a native river prawn that preys on the snail intermediate host. *Proceedings of the National Academy of Sciences*, 115(42), 10559-10564.
35. Ivoke, N., Ameh, E. G., and Asogwa, C. N. (2021). Gender-based patterns and implications of urinary schistosomiasis and associated risk factors among rice farmers in Ebonyi State, Nigeria. *International Journal of*

- Environmental Health Research*, 1-13.
36. World Health Organization (WHO). (2021). Schistosomiasis. Retrieved from <https://www.who.int/news-room/fact-sheets/detail/schistosomiasis>
37. Nigo, M. M., Mubyazi, G. M., and Kisoka, W. J. (2018). Understanding schistosomiasis-related knowledge, attitudes, and practices among rural communities in Lake Victoria basin, Tanzania: Implications for prevention and control. *International journal of environmental research and public health*, 15(11), 2130.
38. Brooker, S., Editorial, J., Mayombana, C. and Moné, H. (2017). Schistosomiasis elimination in sub-Saharan Africa: more work, less drama. *The Lancet Global Health*, 8(11), e1358-e1359.