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Original Article

Risk Factors and Urogenital Schistomiasis Prevalence among Primary School Children in Makurdi, Nigeria

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ABSTRACT

Urogenital schistosomiasis in humans is an infection of public health importance caused by infection with *Schistosoma heamatobium*. The study investigated the risk factors and intensity of urogenital schistosomiasis among primary school pupils in Makurdi, Nigeria. Eight hundred (800) school pupils consisting of 200 per school, aged 5 – 20 years in Angwan Jukun, Angwan Reke, Agbo and Ijaha communities, respectively were enrolled for the study. Suitably designed questionnaire was used to document data on the demographics as well as relevant information of the participants. Urine samples were collected from consented participants between 10 am – 2 pm, into pre-labelled plastic sample bottles following aseptic techniques. The samples were subjected to standard parasitological techniques for determination and quantification of parasite in the zoology laboratory of Benue State University, Makurdi. Research data was subjected to chi square analysis to ascertain association of the research variables with schistosomiasis prevalence in the study area. The study filed an overall prevalence of 23.75% (190/800). Infection rates were significantly associated with age as age group 16-20 years had the highest prevalence (P<0.000). Males 25.42% (122/800) were slightly more infected than females 21.25% (68/800) (P>0.05). Water contact pattern of participants revealed a highly significant association with schistosomiasis prevalence (p<0.001)). Grazing activity 50% (1/2) displayed higher infection prevalence followed by > 1 activity 34.65% (79/228) while no infection was seen in snail hunters. The association between the presence and type of livestock sharing open water sources with the communities was statistically significant (P<0.05). Makurdi is endemic for urogenital schistosomiasis and related risk factors. The roles of other definitive hosts in ensuring continual disease transmission and possible zoonosis should be investigated.

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INTRODUCTION

Schistosomiasis ranks second only to malaria as the most common parasitic disease in Africa (Chaimah *et al.*, 2019). It is the most deadly Neglected Tropical Disease (NTD) infecting an estimated 140 million people each year, with over 90% of cases occurring in Sub-Saharan Africa (Gower *et al.*, 2017). Globally, the annual burden of Disability Adjusted Life Years (DALYs) of 1.9 million resulting from schistosomiasis has been estimated (Abajobir *et al.*, 2017). Commonly reported Schistosome species that are responsible for morbidity in humans were *Schistosoma haematobium*, *S. mansoni*, *S. intercalatum*, and *S. japonicum* (Odeniran *et al*., 2020)

Nigeria accounts for 15% prevalence of morbidity due to schistosomiasis in Sub-Saharan Africa, this places it among the moderate endemic regions despite existing control measures (Odeniran *et al.*, 2020). The World Health Organisation (WHO) set a goal for endemic countries to reduce schistosomiasis morbidity by 5% prevalence in children aged 5 to 14 by 2020 (WHO, 2013). Nigeria is far from meeting the WHO target after ten years of attempts to slow the spread of the disease. The continual inadequacy of prevention and control methods has been documented to be responsible for increased cases of schistosomiasis in Nigeria (Auta *et al*., 2020).

Morbidity is linked to agricultural and water development schemes like streams, dam, lakes, and ponds with individuals who patronize such water sources for various anthropogenic activities being at greater risk of being infected (Hosea *et al.*, 2019). Resultant outcomes such as haematuria, dysuria and hydro nephrosis can be associated with urogenital schistosomiasis as well as other debilitating symptoms accrued to intestinal schistosomiasis.

Despite national control efforts targeted at schistosomiasis, the disease still remains prevalent in Nigeria, Benue state inclusive. Prevalence data on morbidity in recent studies in Benue State ranges from 4.3% to 44.1% (Onah *et al*., 2017; Iboyi *et al*., 2018; Chikwendu *et al*., 2019; Obisike *et al*., 2021). Continual documentation of data on schistosomiasis and associated risk factors is pertinent to enhance prevention and control efforts and consequently elimination of the disease, hence the relevance of this research.

MATERIALS AND METHODS

Study Setting

The study was conducted across Angwan Jukun (AJ), Angwan Reke (AR), Agbo (GB) and Ijaha (JH) communities in Makurdi, Benue State, one school was selected from each community. These

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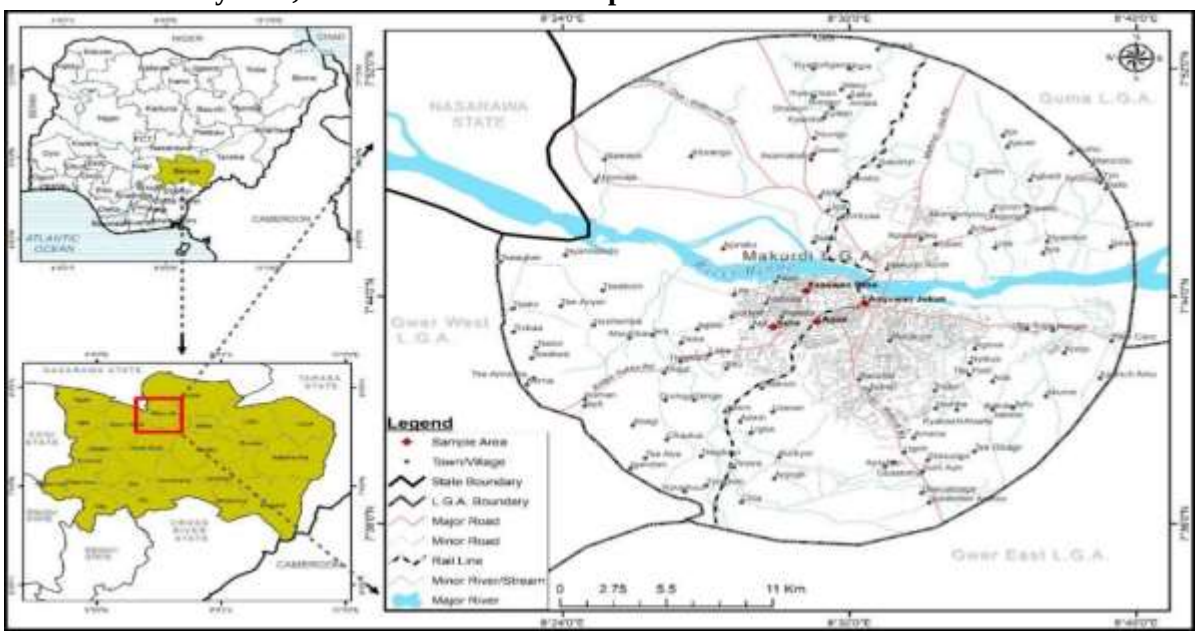
communities were selected for the study due to their proximity to the River Benue which has been a major predisposing factor for continual schistosomiasis transmission in Benue State. The study area illustrating the sampled locations is shown in Figure 1.

Figure 1: Map of the Study Area (Makurdi, Benu State) illustrating the sampled locations. In lemon is the study area, the red dots are the sampled locations.



Study Design

The study was cross sectional in design, spanning from May 2021 to August 2021.

Scope of the Study

Inclusion Criteria

Consenting primary school children within the age range of 5 to 20 years in the study areas were included in the study.

Exclusion Criteria

Primary school individuals within the age range of 5 to 20 years who did not consent to the study and pupils below age 5 years were excluded from the study.

All study subjects who tested positive for Schistosoma haematobium infection were treated with standard doses of praziquantel.

Sample Population and Sampling Technique

A simple purposive sampling procedure was used in selecting the schools as well as the study participants. The study population were primary school age children within ages 5 - 20years, in four riverine communities in Makurdi Benue State, Nigeria. A total of 800 pupils, consisting 200 participants per school across the sampled locations were enrolled for the study according to Pourhoseingholi *et al*. (2013), as stated below:

$$n = \frac{Z^2 P(1-P)}{d^2}$$

Where: n = Sample size, Z = Confidence interval at 95.0% (1.96), P = Expected Prevalence (16.4 %), d = Precision of 5% (if prevalence of ongoing disease is between 10% -90%)

Well-structured questionnaire was self-administered to obtain data on the demographics of the study participants and other relevant variables.

Collection and Laboratory Analysis of Urine Samples

Urine samples were collected between 10.00 am and 2.00 pm which coincided with the period of optimum egg production by parasites. The samples were wrapped in black polythene bags

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and placed on ice packs before being transported to Benue State University Zoology laboratory, for parasitological analysis (*Plate 1*).

The polycarbonate membrane filtration technique as described by Deribew *et al.,* (2022) was adopted detect and quantify juvenile forms of *Schistosoma haematobium*. Schistosome test kits containing 13mm polycarbonate membrane filters (12.0µm pore size) and 13mm plastic swinnex filter holders manufactured by Sterlitech coorporation (4620 B street, NW suite 101, Auburn WA, 98001 USA) were purchased and assembled according to the manufaturers instruction. The urine samples were screened following the under-listed steps:

- Individual urine samples were mixed properly and aspirated using a 10ml plastic syringe (*Plate 2*).
- The tip of the syringe was fixed on the anterior opening of the swinnex filter holder contain the polcarbonate filter membrane and plunger was pushed gently until the entire content of the syringe was filtered through the membrane (*Plate 2*).
- The filter paper was removed from the disassembled holder and dropped on a clean, greese-free microscope slide with the aid a sterile, blunt edge metal forcep (*Plate 3*).
- A cover slip was placed on the microscope slide and viewed using the 10x objective lens of an Olympus binocular light microscope
- A drop of lugol's iodine was applied to the filter paper before viewing to create contrast when necessary.
- Slides containing *Schistosoma haematobium* ova with the characteristic terminal spine were recorded as positive (*Plate 4*).

Plate 1: Participants urine samples stored in 60 mls sterile plastic sample bottles prior to laboratory analysis

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Plate 2: Filtration of urine samples using the polycarbonate membrane filtration technique. The arrow shows the filter holder mounted with the filtration membrane

Plate 3: Removal of filter paper from holder and screening for eggs of *S. haemtobium* using the X10 magnification of the Olympus light microscope

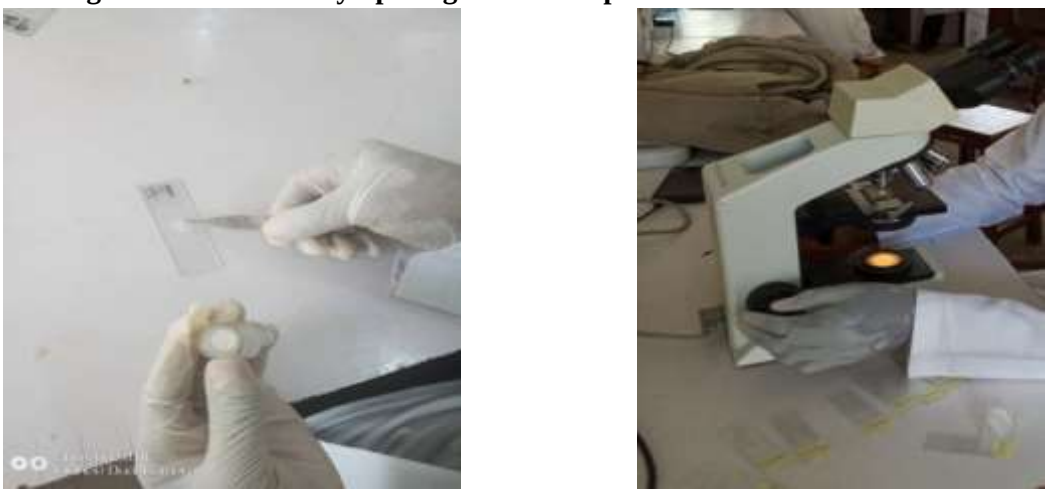
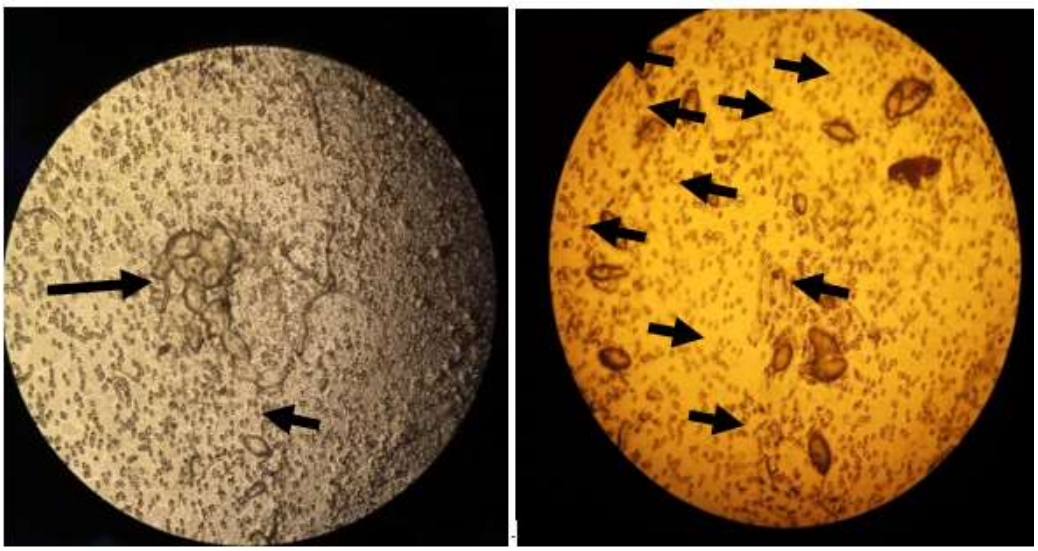


Plate 4: Positive slides showing light infection with S. haematobium eggs (x10)



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Data Analysis

Data generated from the study was analysed using chi square to test for associations between schistosomiasis prevalence and some risk factors. Parasitological slides that contain one or more ova of the parasite were considered as positive and simple percentages were used in calculating the prevalence of *S. haematobium* across the various research variables. Associations and differences with a $p \leq 0.05$ were considered statistically significant.

Ethical Consideration

Prior to the commencement of the study, ethical approval was sought and obtained from the Benue State Ministry of Health (BSMoH). Also, oral, and written approval was sought and obtained from the parents/guardians of the study participants as well as the governing authority of the respective schools enrolled in the study. The study procedure was explained to the various parties before sample collection.

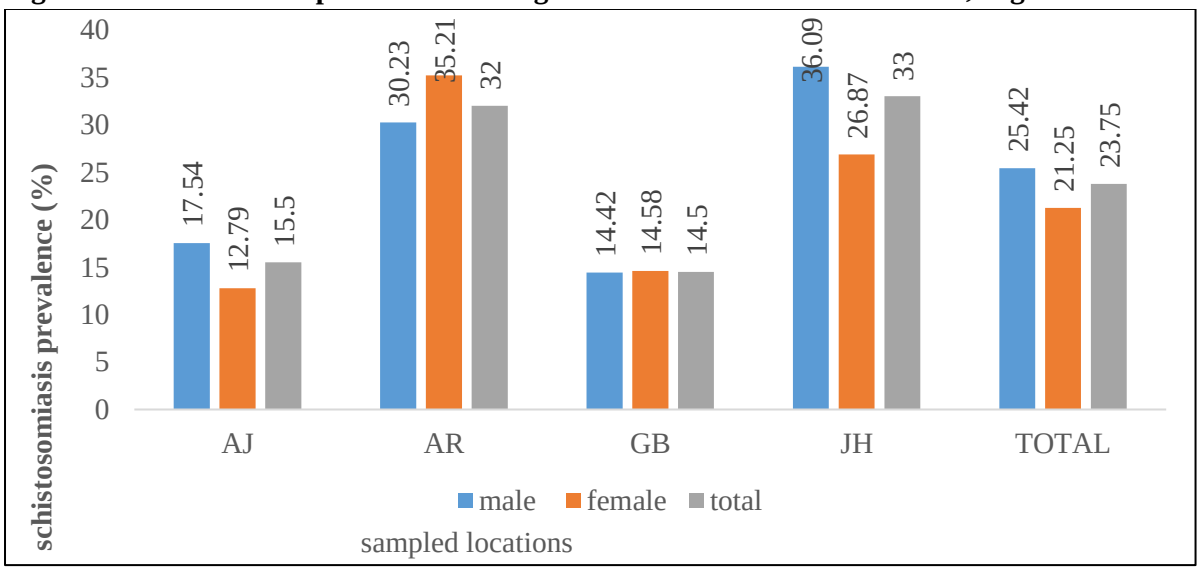
RESULTS

Prevalence of Urogenital Schistosomiasis with Respect to Sex of Study Participants in Makurdi, Nigeria

Infection rates based on sex of the study participants is as documented in *Figure 2*. Cumulatively, males 122 (25.42%) had a slightly higher prevalence compared to females 68 (21.25%). Sex was not significant determinant of schistosomiasis prevalence in the study area (P>0.05).

Infection prevalence showed highly significant association with the age group of the study participants across the sampled locations (P=0.000). Prevalence rates of 30 (37.00%), 94 (27.89%), 66 (17.23%) was recorded in ages groups 16-20, 11-15 and 05-10 years, respectively. This is as presented in *Table 1*.

Figure 2: Sex-associated prevalence of urogenital schistosomiasis in Makurdi, Nigeria



N.E = number examined; N.I = number infected

Association of Schistosomiasis with Water Contact Across the Sampled Locations in Makurdi, Nigeria

Table 2 shows the prevalence of schistosomiasis with respect to the water contact behaviour of the participants studied. Those who attested to using water bodies in their communities 160 (28.47%) were more infected than those who do not 30 (12.61%). In addition, participants who patronized the stream/river daily were more infected 75 (43.35%) than those who did on weekly basis 85 (31.85%). There was a strong statistical association between infection rates and water contact behaviour of the subjects (P=0.000).

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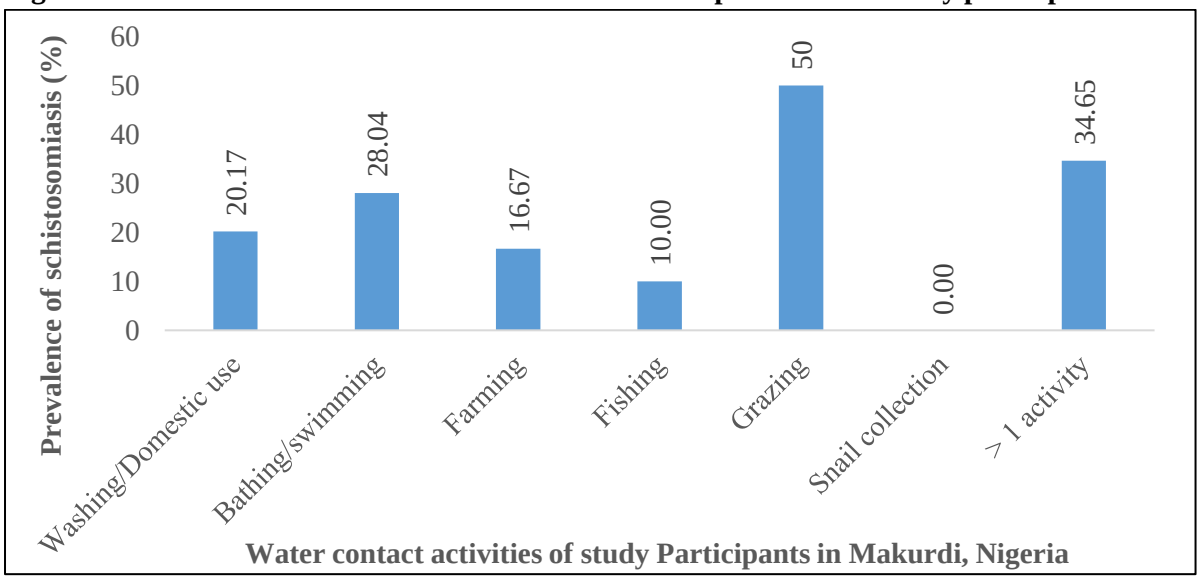
Relationship between Water Contact Activities of Study Participants and Schistosomiasis Prevalence in Makurdi, Nigeria

Various prevalence rates were recorded against the water contact activities practiced in the study location as follows: Grazing 1 (50%), >1 activity 79 (34.65%), bathing/swimming 53 (28.04%), washing 24 (20.17%), farming 2 (16.67%) and fishing 1(10.0%). Those who collected snails were not infected 2 (0.00%). Infection rate was not dependent on anthropogenic activities in the participants (P>0.05). This is as presented in *Figure 3*.

Figure 3: Water contact activities versus schistosomiasis prevalence of study participants



Schistosomiasis Study in Relation to Sharing of Water Bodies with Alternative Host(S) in the Communities

The prevalence of urogenital schistosomiasis based on the availability of alternative definitive hosts in the sampled locations was also evaluated as illustrated in *Table 3*. There was a highly significant relationship between the presence of other hosts and infection rates across the location sampled (P=0.000). Participants who attested to sharing natural water sources with such hosts were more infected 156 (27.37) that those who did not 34 (14.78%).

In addition, the infection rates as regards the types of ruminant hosts are: Pigs 3(37.50%), >1 host 100 (31.55%), goats 6 (30.00%), cattle 42 (23.20%) and sheep 5 (11.36%). Schistosomiasis prevalence was significantly associated with the type of alternative definitive host(s) domicile in the sampled locations (P<0.05).

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Table 1: Associations between infection prevalence of age of study participants

Age (Yrs)	AJ		AR		GB		JH		TOTAL		x^2	p-value
	NE	NI (%)	N.E	N.I (%)	N.E	N.I (%)	N.E	N.I (%)	N.E	N.I (%)		
05 - 10	129	20 (15.50)	109	24 (22.02)	111	15 (13.51)	34	7 (20.59)	383	66 (17.23)	20.531	0.001*
11 - 15	62	10 (16.13)	91	40 (43.96)	83	12 (14.46)	101	32 (31.68)	337	94 (27.89)		
16-20	9	1 (11.11)	0	0 (0)	6	2 (33.33)	65	27 (41.54)	80	30 (37.50)		
Total	200	31 (15.50)	200	64 (32.00)	200	29 (14.50)	200	66 (33.00)	800	190 (23.75)		

*NE = number examined; NI = number infected; * There is a significant difference as p-value (<0.001) <0.05*

Table 2: Prevalence of Schistosomiasis based on the water-contact attitude of the study participants in Makurdi, Nigeria

		AJ		AR		GB		JH		Total		p-value
		N.E	N.I(%)	N.E	N.I(%)	N.E	N.I(%)	N.E	N.I(%)	N.E	N.I(%)	
Stream/river access	Yes	154	26 (16.88)	124	51 (41.13)	124	24 (19.35)	160	59 (36.88)	562	160 (28.47)	<0.001*
	No	46	5 (10.87)	76	13 (17.11)	76	5 (6.58)	40	7 (17.5)	238	30 (12.61)	
	Total	200	31 (15.5)	200	64 (32)	200	29 (14.5)	200	66 (33)	800	190 (23.75)	
Frequency of visit	Daily	78	20 (25.64)	37	32 (86.49)	11	3 (27.27)	47	20 (42.55)	173	75 (43.35)	<0.001*
	Weekly	76	6 (7.89)	87	19 (21.84)	113	21 (18.58)	113	39 (34.51)	389	85 (21.85)	
	Total	154	26 (16.88)	124	51 (41.13)	124	24 (19.35)	160	59 (36.88)	562	160 (28.47)	

** There is a significant difference as p-value (<0.001) < 0.05*

Table 3: Relationship between schistosomiasis and presence of alternative hosts in the study area

		AJ		AR		GB		JH		TOTAL			
		N.E	N.I(%)	N.E	N.I(%)	N.E	N.I(%)	N.E	N.I(%)	N.E	N.I(%)	χ^2	p-value
Presence of other hosts	Yes	150	24 (16.00)	150	54 (36.00)	112	21 (18.75)	158	57 (36.08)	570	156 (27.37)	14.334	<0.001*
	No	50	7 (14.00)	50	10 (20.00)	88	8 (9.09)	42	9 (21.43)	230	34 (14.78)		
	Total	200	31 (15.50)	200	64 (32.00)	200	29 (14.50)	200	66 (33.00)	800	190 (23.75)		
Hosts	Cattle	24	2 (8.33)	13	1(7.69)	95	18 (18.95)	49	21 (42.86)	181	42 (23.20)	10.514	0.033*
	Goats	4	2 (50.00	12	3 (25.00)	1	0 (0.00)	3	1 (33.33)	20	6 (30.00)		
	Sheep	9	1 (11.11)	34	4 (11.76)	0	0 (0.00)	1	0(0.00)	44	5 (11.36)		
	Pigs	2	0(0.00)	0	0(0.00)	0	0(0.00)	6	3 (50.00)	8	3 (37.50)		
	>1 host	111	19 (17.12)	91	46 (50.55)	16	3 (18.75)	99	32 (32.32)	317	100 (31.55)		
	Total	150	24 (16.00	150	54 (36.00)	112	21 (18.75)	158	57 (36.08)	570	156 (27.37)		

** There is a significant difference as p-value (<0.001; 0.033) < 0.05*

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Prevalence of Urogenital Schistosomiasis in Pupils Across the Sampled Locations

A total of 800 school age children were enrolled for the study of which 190 (23.75%) tested positive to urogenital schistosomiasis. Based on the sampled locations, the highest infection rate was recorded in JH 66 (33.00%) closely followed by AR 64 (32.00%). AJ and GB have prevalence of 31 (15.50%) and 29 (14.50%) respectively. This is as captured in *Table 4*.

Table 4: Prevalence of Urogenital Schistosomiasis across the Sampled Locations in Makurdi, Nigeria

Locations	No. Examined	No. Infected	Prevalence (%)
Angwan Jukun (AJ)	200	31	15.50
Agwan Reke (AR)	200	64	32.00
Agbo (GB)	200	29	14.50
Ijaha (JH)	200	66	33.00
Total	800	190	23.75

DISCUSSION

In the study, the Sex of respondents was not a determinant of the infection although, males were slightly more infected than females. Similar findings have been filed in Katsina (Yunusa *et al*., 2016; Auta *et al*., 2020), Sokoto (Muhammad *et al*., 2019) and Ebonyi (Nwachukwu *et al*., 2018). However, schistosomiasis sex-associated data that differs from the current study have been recorded in Kano, Kebbi and Cross River States, where sex/gender roles had significant impact on the exposure levels to *S. haematobuim* and infections were significantly associated with males study participants (Dawaki *et al.*, 2016; Hassan *et al*., 2017 and Opara *et al.*, 2021). It is general knowledge that societal gender roles encourage male participation in activities such as fishing, farming, swimming, grazing, as characterises the study area etc. This facilitates greater exposure to cercacriae infested water and consequently higher chances of infection, as seen in this study. According to Ojo *et al*. (2021), socio-cultural or behavioural factors which focuses mainly on differences in water contact pattern between males and females have been responsible for the frequently observed gender-related differences in schistosomiasis infection.

Also, the study outcome showed a significant relationship between age and schistosomiasis prevalence, with age group 16-20 years being the most infected. This agrees with other research findings in Sokoto, (Iduh & Bwari 2021), Kastina (Auta *et al.,* 2020) and Benue (Iboyi *et al.,* 2018) respectively. This can be attributed to the fact that water-contact activities tend to increase with age and peaking at adolescence, as supported by Ojo *et al.* (2021). Reports that conflict this research has been observed in various age groups. High prevalence of urogenital schistosomiasis was recorded in younger children between ages 11-15 years in Bomo in Kaduna State and Oju, Benue State (Omenessa *et al.,* 2015; Chiwendu *et al.,* 2019), 11- 13 years in Cross river (Opara *et al.* 2021), 9-12 years in Jalingo (Hosea *et al.,* 2019) and 4-6 years in Wamakko, Sokoto state (Muhammed *et al,* 2019).

The study observed a highly significant association between water contact pattern in communities and schistosomiasis infection rates. Those who had daily access to open water bodies were more infected *table 3*. In a study by Opara *et al*. (2021), frequent visitation of streams was also significantly associated with urogenital schistosomiasis. The presence and access to cercariae-infested fresh water bodies has been confirmed to be relevant for successful transmission of schistosomiasis in endemic regions, with the study area inclusive.

In addition, those who grazed animals around the water bodies in the communities were the most infected. Schistosomiasis has been significantly linked to various water-contact activities in Nigeria such as: Swimming (Omenesa *et al.,* 2015; Auta *et al*., 2020; Odeniran *et al*., 2020; Opara *et al.,* 2021), fishing (Kabiru *et al.,* 2013) and farming (Alabi *et al.,* 2018). According to

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Odeniran *et al*. (2020), consistent exposure to water-contact could result in persistent infection if control is not strategically introduced in schistosomiasis endemic areas. Therfore, the grazers in the study were most infected because they require the water source to cater for themselves and their livestock alike, there by exposing them to frequent contact with water-borne cercariae.

Schistosomiasis prevalence was significantly associated with the availability of alternative definitive host(s) for the infection in the study locations. The hosts documented included cattle, goats, sheep, and pigs. There is research evidence to support the role of livestock in transmission of schistosome parasites that infect both livestock and humans. Novel molecular evidence has revealed events of natural hybridization between 3 schistosome species in Senegal: *S. haematobium* in humans, *S. bovis* and *S. curassoni* which are primarily parasites of domestic livestock (Webster *et al.,* 2013). In the same study by Webster *et al.* (2013), Senegalese children were found excreting *S. haematobium*/ *S. curassoni* hybrids, and *S. curassoni* hybrids were recovered from slaughtered cattle as well. These records are pointers to the fact that the presence of livestock hosts in Makurdi, Nigeria is an added risk factor for schistosomiasis transmission and zoonosis.

This study documented overall prevalence of 23.75% for urogenital schistosomiasis. Both higher and lower rates of infection than in the current study have been documented in across various regions of Benue State; 44.1% in two communities in Benue (Onah *et al.,* 2017), 20.00% in Oju (Chikwendu *et al.,* 2019), 16.4% in Kastina-ala (Iboyi *et al.,* 2018) and 4.3% in Otukpo (Obisike *et al.,* 2021). Morbidity rates that contrast the outcome of this research have also been documented in other parts of Nigeria. In ascending order of prevalence: 1.4% in Bauchi (Usman & Babeker, 2017), 6.3% in Cross River (Opara *et al.,* 2021), 8.3% in Kano (Dawaki *et al*., 2015), 18.5% in Taraba (Hosea *et al*., 2019), 19.5% Zaria (Omenesa *et al.,* 2015), 21.3% in Katsina (Auta *et al*., 2020), 31.0% in Osun (Ojo *et al*., 2021), 37.0% in Sokoto (Iduh & Bwari 2021) and 52.1% in Ogun (Alabi *et al*., 2018).

The variation in schistosomiasis prevalence in the current study as compared with other locations within and outside Benue state could be accrued to disparity in sample size, study duration, ecological settings of the study locations as well as differences in the prevailing risk factors for the infection in the study area. Also, the recent COVID 19 pandemic coupled with the continuous security challenges in Benue State has placed a lid on schistosomiasis control efforts in Makurdi and its suburbs.

CONCLUSION AND RECOMMENDATIONS

Makurdi is endemic for urogenital schistosomiasis. Risk factors associated with the infection were water contact pattern and activities, age and availability of alternative hosts. Hence, regular studies should be carried out in Makurdi and other parts of Benue State to inform accurate planning of State Control Programmes. Also, research should consider animal hosts studies to unravel the possibilities of zoonotic schistosomiasis in endemic communities.

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