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Prevalence and intensity of urinary schistosomiasis and their effects on packed cell volume of pupils in Jaba LGA, Nigeria

Henry Gabriel Bishop, Helen Ileigo Inabo, Elijah Ekah Ella

ABSTRACT

Aims: Urinary schistosomiasis is a persistent health burden among African children. They are mostly unaware of the risks of transmission of schistosomiasis via cercariae-infested water bodies and hence more infections occur. This study was aimed at assessing the prevalence and intensity of urinary schistosomiasis and their effects on packed cell volume (PCV), and the association of the disease with some socio-demographic and risks factors among pupils in Jaba LGA of Kaduna State, Nigeria. Methods: Awareness lectures were organized in pre-selected public primary schools. A total of 505 pupils volunteered to participate in the study. From each volunteered pupil, 10 ml urine and 2 ml blood samples were collected. The urine samples were concentrated by centrifugation; the sediments were examined microscopically using 10x and 40x objectives for *Schistosoma haematobium* egg(s) while count/10 ml urine was recorded. Intensity categories were taken as light infection (with <50 eggs/10 ml urine) and heavy infection (with >50 eggs/10 ml urine). Blood samples were used for PCV determination by microhematocrit centrifuge technique (HCT); anemic PCV was <34%, normal PCV was ≥34 and ≤45%, high PCV was ≥46%. Results and data on sociodemographic and risk factors were subjected to various statistical analyses at p = 0.05 with IBM SPSS Version 21. Results: An overall prevalence of 12.3% was obtained for urinary schistosomiasis. Three villages (Bitaro, Ankun and Kwoi) recorded the highest prevalence of the infection. However, the infection was absent in two villages (Nok and Sambang). The highest intensity among the pupils was 204 eggs/10 ml urine. The central area had the highest mean intensity of 6.77 eggs/10 ml urine. Areas of highest prevalence did not coincide with areas of highest intensity. The infection and its intensity were higher among the females (15.5%, 4.18 eggs/10 ml urine) than the males (9.1%, 1.22 eggs/10 ml urine) respectively. Similarly, the females had higher light and heavy infections than the males. There was an observed increase of urinary schistosomiasis with increase in pupils' class. Both the infection and its intensity had gradual 'wave-like' increases with rise in age of the pupils. Only two signs/symptoms (painful micturition, urine color), and one risk factor ('Fadama' farming) were statistically associated with urinary schistosomiasis. The prevalence of anemia was found to be 8.1% while 37.6% of the pupils had normal PCV; the remaining study population had abnormally highly PCV. There was a statistically significant association between urinary schistosomiasis and anemia among the pupils ($\chi 2 = 11.870$; df = 2; p = 0.003). Though anemia was recorded both among the infected and uninfected pupils, a higher occurrence of the anemia (17.7%) was observed in pupils infected with urinary schistosomiasis than those who were not infected (6.8%). The

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cause of the anemia in the later may be due to other diseases. There was higher level of non-occurrence of urinary schistosomiasis in pupils with high PCV (56.4%). Heavy infections with urinary schistosomiasis among the pupils, with a statistical significance (χ^2 = 12.807; df = 4; p = 0.012) led to higher occurrence of anemia of 20.0% than light infections which caused 17.2% of anemia. Conclusion: With an overall prevalence of 12.3% and varying levels of intensity, urinary schistosomiasis is still prevalent in Nigeria which calls for concerted efforts to eradicate its menace in all affected regions. Whatever that affects the health of children should not be neglected. The female pupils were significantly more affected than the male pupils and hence are predisposed to further complications like female genital schistosomiasis (FGS) and bladder cancers. The disease is associated with painful micturition and red/brown-colored urine. Farming on 'Fadama' (i.e., waterlogged) farms enhances the acquisition of the disease. Heavy infection with the worms exacerbates the anemia in children. There was a total unawareness of the disease in Jaba LGA of Kaduna State, Nigeria, which is a major promoter of exposure to the cercariae of the schistosomes during water-contact activities.

Keywords: Intensity, Jaba LGA, Nigeria, Pupils, *Schistosoma haematobium*, Unawareness, Urine

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INTRODUCTION

Schistosomiasis is a chronic parasitic disease caused by blood flukes [1, 2]. These blood flukes (or trematode worms) are prime examples of complex multicellular pathogens that flourish in human hosts despite the presence of immune responses mounted against them [3]. Adult schistosomes possess a range of adaptations which enable them to partially overcome human host's defenses and possibly live and reproduce for many years in the host who becomes relatively resistant to new infections [4]. These worms have complex and indirect life cycles involving intermediate (snail) hosts and definitive hosts.

Majorly, populations of tropical and subtropical countries, especially children who indulge in water-based activities in unsafe or cercarial-infested water bodies are affected [2, 5–8]. The three main species of *Schistosoma* that cause diseases in man are: *Schistosoma mansoni*, *Schistosoma haematobium* (*S. haematobium*) and *Schistosoma japonicum* [9, 10]. Other distributions of *Schistosoma intercalatum* in Central Africa and *Schistosoma mekongi* in Cambodia and Lao People's Democratic Republic can also cause human infections [2, 11]. Among all the species of *Schistosoma*, *S. haematobium* is the only cause of urinary schistosomiasis; all others cause intestinal schistosomiasis [6, 10].

Urinary schistosomiasis is diagnosed by microscopic detection of *S. haematobium* eggs in urine as a gold standard [6, 12]. Humans become infected by penetration (or dermo-invasion) of intact skin by active cercariae which are attracted to the warmth of body and skin lipids [13].

Schistosoma haematobium has been regarded as a 'neglected schistosome' [14–16] despite its implication in HIV/AIDS co-infection and a burden of bladder cancer development. Though most of the infected individuals in endemic areas of Nigeria suffer from light infections, the disease adversely impacts on the economic and general health conditions of the affected communities [7, 17]. Consequently, the workforce is affected due to weakness and lethargy, and the academic performances of school children are affected [7, 18, 19].

MATERIALS AND METHODS

Study area

The study was conducted in some selected and consented primary schools in Jaba Local Government Area (LGA) of Kaduna State, Nigeria. The area is located in the Northern hemisphere on Latitude 9° 19' 47"N to Latitude 9° 36' 35"N, and in the East on Longitude 7° 56' 24"E to Longitude 8° 12' 36"E. The area is occupied by the Ham People, a people notable for the rich Nok culture that possesses the Nok Terracotta carbon-dated to about 2000–2500 years ago. 'Kwain' (or Kwoi which means 'Community of the United') serves as the political capital of the LGA. It has many villages that include Bitaro, Nok, Kwoi, Zshiek (Kurmin Musa), Dung (also called Jaban Kogo), Chori, Fai, Ketere, Sambang Gida, Sambang Daji, Dura, Ankun, Gora, Kurmi Danagana, Tunga and many other Ham settlements in the Southern parts of Kaduna

State [20]. The people of the area are predominantly farmers; they cultivate large quantities of gingers, *Digitaria exilis*, (popularly called 'acha' or 'hungry rice'), cocoyam, guinea corn, millet and maize among many others.

Awareness talks and enrollment of volunteers

Awareness talks on schistosomiasis, its danger, transmission, control and prevention were delivered in pre-selected/consented primary schools in Jaba LGA. The pupils were informed of the need to volunteer to be part of this study by willingly submitting their urine and blood samples for laboratory diagnoses. Those pupils that volunteered to be part of the study were 505 in number; they were given consent forms to present to their parents/guardians for full permission to enroll them. Confidentiality was applied on all data collected from them and result of laboratory tests was issued to each participated pupil. Those that had infection(s) were immediately referred to the hospital for medical attention.

Urine and blood samples collection

The pupils who consented to participate in the study were briefed and guided on how to collect 10 ml of their urine into provided sterile (wide-mouth) sampling bottles with screw caps between 10 am and 1 pm [21]. Then 2 ml of venous blood were collected into 5 ml EDTA K-3 bottle using new sterile syringe and needle for each volunteered pupil that had submitted a urine sample. The urine samples were screened away from sunlight by enclosing them in dark polythene bags. Both sample types from each pupil were simultaneously labeled and placed into separate ice containers. The samples were taken for analysis at the Bacteriology/Parasitology Laboratory in the Department of Microbiology, Faculty of Science, Ahmadu Bello University Zaria, Nigeria.

Structured questionnaires administration

Those pupils who submitted urine and blood samples were administered structured questionnaires. The questionnaires captured some sociodemographic and risk factors associated with urinary schistosomiasis. Assistance by respective class teachers and head teachers were sought for interpretation from English language into easily understood dialect of the study area.

Method for determination of packed cell volume (PCV)

The blood samples were brought out of the cold container and allowed to reach the room temperature upon arrival at the laboratory. The PCV of each pupil was determined by the microhematocrit centrifuge technique (HCT). Two plain capillary tubes were filled with a blood sample to three-fourth their heights and sealed carefully by means of Bunsen flame to the (2 mm) red demarcation on each tube. The tubes were spun in the microhematocrit centrifuge at relative centrifugation force (RCF) of 12,000–15,000 xg for 5 minutes, after which the PCV were read by correctly adjusting the red-packed-cells columns on the Hematocrit Reader and an average of the two values recorded [21]. Anemic PCV was <34%, normal PCV was between ≥34 and ≤45%, high PCV was ≥46% [22].

Detection and quantification of Schistosoma hematobium eggs in urine

Each urine sample was gently shaken to stir up any sediment in the sampling bottle and transferred into a labeled centrifuged tube. Normal saline was used to rinse the bottle where sediments still remained. Centrifugation was performed at a speed of 3000 rpm for 3–5 minutes and the supernatant was carefully decanted [21]. The sediments obtained in the centrifuge tube was tapped on the bench and mixed by gentle shaking. A Pasteur pipette was used to transfer all the sediments into a clean, grease-free glass slide. A drop of Lugol's iodine solution was added and a cover slip was placed over the wet mount and positioned under the light microscope. The entire wet mount was screened for egg(s) of *Schistosoma haematobium* using 10x and 40x objectives, while count of eggs/10 ml of urine was taken [21]. Where the sediments from a sample could not be contained in a single wet mount, multiple wet mounts were made from such a sample and the egg counts pooled together.

Statistical analysis

Data collected of socio-demographic and risk factors of urinary schistosomiasis together with laboratory findings were subjected to chi-square (χ^2) and likelihood ratio (LR) analyses with the IBM SPSS Statistics Version 21 at p=0.05. Final results were presented in charts and tables.

RESULTS

Out of 505 urine samples of pupils examined, *Schistosoma haematobium* ova were detected in 62 of the samples with a prevalence of 12.3 % (Figure 1). The eggs of this parasite were yellow-brown, oval in shape with terminal spines; some of the eggs were shorter but majority were slender (Figure 2).

The level of intensity of urinary schistosomiasis was determined by obtaining counts of eggs/10 ml of urine sample and their simple average calculated as shown in Table 1. The highest mean intensity was found among pupils in Primary 6, followed by those in Primary 4 and Primary 2 respectively. The female pupils in all the classes had higher intensity than the corresponding male pupils. The highest mean intensity in the females was 9.74 eggs/10 ml urine which occurred among the female pupils in Primary 6; whereas that of the males was 2.91

eggs/10 ml urine and it occurred among the male pupils in Primary 4. There was no statistical significance (χ^2 = 6.850; df = 5; p = 0.232) in the class distribution of the disease, but higher occurrence was obtained in the senior class category (Primary Class 4–6) and lower in the junior class category (Primary Class 1–3).

Gender was a statistically significant factor in the occurrence of urinary schistosomiasis (χ^2 = 4.926; df = 1; p = 0.026) as indicated in Table 2. There was a remarkable higher occurrence of the infection among the female pupils (15.5%) than in the male pupils (9.1%). Hence, female pupils were about twice more infected with urinary schistosomiasis than the male pupils.

This study found that in an independent t-test pupils within the age of 10.96±2.15 years had statistically significant occurrence of urinary schistosomiasis compared to pupils of 9.70±2.17 years (*t* = 4.251, df =503, *p* = 0.000). The occurrence of urinary schistosomiasis increased in a 'wave-like' fashion with rise in the pupils' age. Though the highest occurrence of 62.1% was found among the older pupils of 15 years of age, no occurrence was recorded in pupils within 4-6 years age bracket (Figure 3).

The mean of counts of eggs/10ml urine adopted a 'wave-like' pattern of increase. No egg was detected in urine samples of pupils within 4–6 years age bracket. The mean of counts peaked at age 15 years (Figure 4), which was similar to the age prevalence pattern in Figure 3. However, the Spearman's correlation (r_s) *and* Pearson product-moment correlation (*r*) run to determine the relationship between age of pupils and *Schistosoma haematobium* egg count/10ml of urine (i.e., intensity) in Jaba LGA showed weak, positive correlations, which were statistically significant (r_s = 0.172, P =0.000; *r* = 0.131, P = 0.003).

The prevalence of urinary schistosomiasis according to sampling locations in Jaba LGA showed high statistical significance (χ^2 = 38.599; df = 9; p = 0.000). The highest occurrence was found among pupils from Bitaro (23.2%) followed by Ankun (22.2%) and Kwoi (20.3%), whereas no occurrences were recorded among pupils from Nok (0.0%) and Sambang (0.0%) as given in Table 3.

The mean intensity of *Schistosoma haematobium* eggs in urine samples of pupils from the 10 different sampling locations were analysed by means of ANOVA. Although no statistical significance was obtained (since F = 1.419; df = 9; p = 0.177), the highest means of counts of eggs/10 ml of urine were 6.77 and 4.88 among pupils from the Central Area and Bitaro respectively (Table 3).

The level of urinary schistosomiasis among pupils versus sampling locations showed statistical significance (χ^2 = 50.094, df = 18, p = 0.000). This was categorized as 'light' and 'heavy' infections, with egg counts of <50 eggs/10 ml and ≥50 eggs/10 ml urine respectively. Light infections occurred most among the pupils from Bitaro (44.2%), followed by those from Kwoi (21.2%) and Ankun (9.6%). Heavy infections were most found among pupils from the Central Area (40.0%), followed by those from Bitaro (30.0%). Light infection was absent among pupils from Nok and Sambang. Also, heavy infection was not found in pupils from Chori, Dura, Gora, Nok and Sambang (Table 4).

Table 5 gives the age-related distribution of level of urinary schistosomiasis among the pupils in Jaba LGA (with χ^2 = 44.715 df = 22; p = 0.003). Both heavy and light infections occurred mostly in pupils of age 15 years.

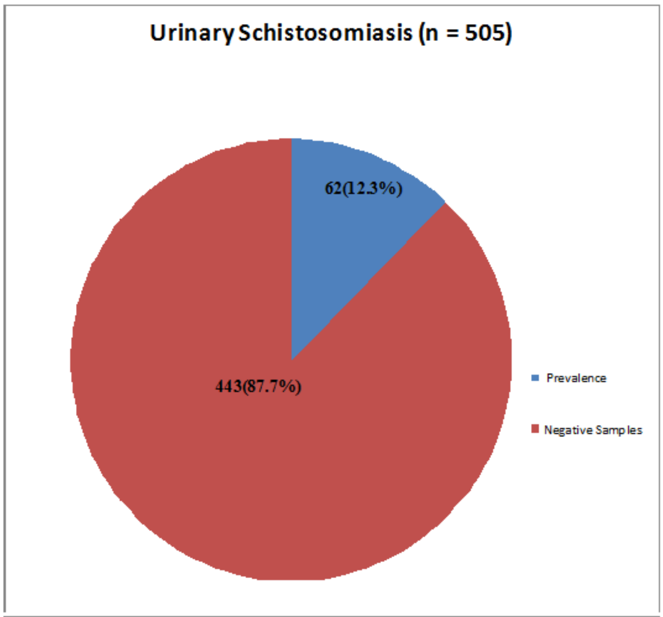

Figure 1: Overall prevalence of urinary schistosomiasis among pupils of Jaba LGA of Kaduna State, Nigeria.
(*t-test* = 4.251, df =503, *p* = 0.000)

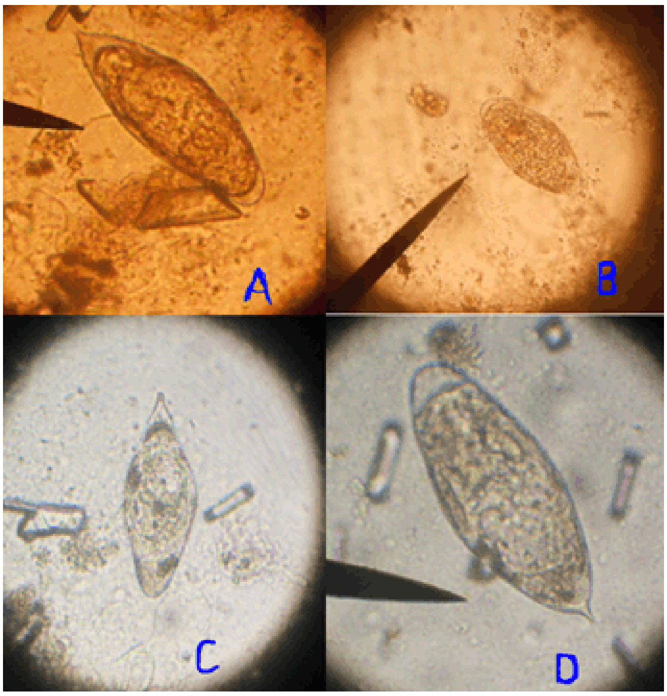

Figure 2: Various appearances of *S. haematobium* ova in urine samples of pupils from Jaba LGA, Kaduna State, Nigeria. (A, and B) wet mounts stained with Lugol's iodine; (C and D) - without Logol's iodine on 40x objective).

There was no heavy infection among pupils in age 4, 5, 6, 8, 11 and 14 years. Also, only pupils in age 4, 5 and 6 did not have light infections.

The prevalence of anemia among pupils in Jaba LGA was found to be 8.1%, while 37.6% of the pupils had normal PCV. The remaining study population (54.3%) had abnormally high PCV (Figure 5).

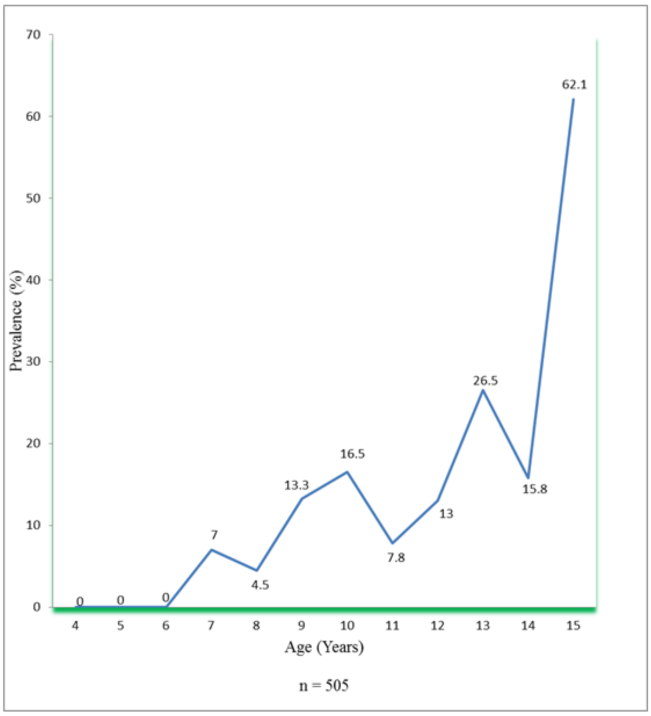

Figure 3: Age prevalence of urinary schistosomiasis among pupils in Jaba LGA

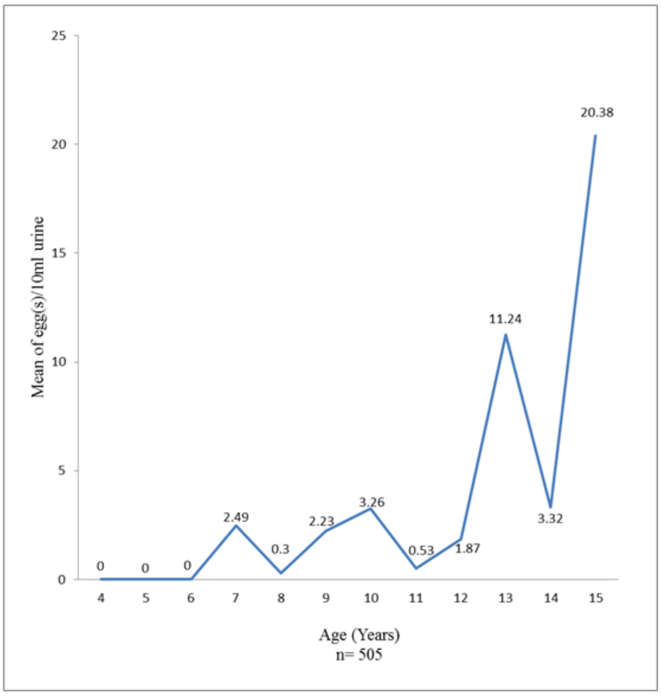

Figure 4: Age pattern of intensity of urinary schistosomiasis. Spearman's correlation coefficient (r_s) = 0.172, P =0.000; Pearson correlation coefficient, (r) = 0.131, P = 0.003

There was a statistically significant association between urinary schistosomiasis and anemia among the pupils ($\chi^2 = 11.870$; df = 2; p = 0.003). Though anemia was recorded both among those with urinary schistosomiasis and uninfected pupils, a higher occurrence of the anemia

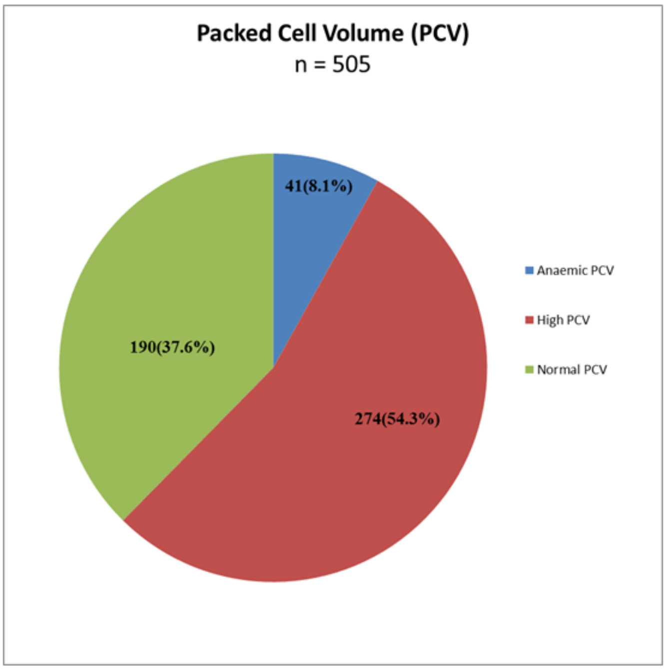

Figure 5: Prevalence of anemia among the pupils in Jaba LGA, Kaduna State, Nigeria.
Keys: Anemic PCV was < 34%, Normal PCV was between ≥34 and ≤45%, High was ≥46%

Figure 6: River Dhugk Gira and River Langk Wada, the most popular rivers in Bitaro, Jaba LGA, (notably for swimming, fishing and washing by pupils and the members of the community).

(17.7%) was observed in pupils infected with urinary schistosomiasis than those who were not infected (6.8%). The cause of the anemia in the later may be due to other diseases as indicated in Table 6.

Heavy infections with urinary schistosomiasis among the pupils, with a statistical significance ($\chi^2 = 12.807$; df = 4; p = 0.012) led to higher occurrence of anemia of 20.0% than light infections which caused 17.2% of anemia as indicated in Table 7.

The relationship between the level of urinary schistosomiasis and the gender of the pupils in Jaba LGA was insignificant ($\chi^2 = 5.166$; df = 2; p = 0.076), but female pupils had higher proportions of light and heavy infections than the male pupils (Table 8).

The level of the urinary schistosomiasis did not influence the onset of (visible) hematuria among the pupils in this study ($\chi^2 = 3.105$; df = 2; p = 0.212). All the pupils with heavy infections did not present with hematuria. Generally, 4.5% of the pupils presented with hematuria but no eggs of *Schistosoma haematobium* were recovered; the hematuria may be due to parasitic or other non-parasitic origins. However, 9.6% of the pupils with light infections presented with hematuria (Table 9).

In Table 10, five risk factors of urinary schistosomiasis among school pupils were considered in this study. There was a statistically important association between urinary schistosomiasis and 'Fadama' farming ($\chi^2 = 14.300$; df = 1; p = 0.000). The pupils that made up the study population were unaware of urinary schistosomiasis. Pupils that wash their clothes in rivers/streams had more infections (14.7%) than those who wash their clothes at home (10.8%).

Appearances of some of the rivers in Jaba LGA of Kaduna State in Nigeria are shown in Plate II. Most of the rivers are surrounded by immediate wet fields locally referred as 'Fadama' for rice, cocoyam and sugarcane farming. The rivers are used for swimming, fishing, irrigation and washing by pupils and the members of the communities. The photograph was taken in the late evening when activities were not on-going.

The level of formal education of the pupils' parents had no statistical link with acquisition of urinary schistosomiasis by their children/wards ($p > 0.05$). However, lowest detection of *Schistosoma haematobium* eggs was observed in pupils whose parents did not acquire any formal education. Occurrence of the infection among the pupils increased as fathers' level of formal education increased (Table 11).

From data obtained via administered structured questionnaires on signs and symptoms of urinary schistosomiasis, only painful micturition ($\chi^2 = 5.135$; df = 1; p = 0.023) and cloudy brown/red-colored urine ($\chi^2 = 20.604$; df = 4; p = 0.000) had statistical relevance with the disease as shown in Table 12. Even though pupils with fever had more infection with *Schistosoma haematobium* (22.2%) than those without fever, it was insignificant together with the presence of abdominal pain and frequent urination.

DISCUSSION

In this study, the presence of urinary schistosomiasis was established by the detection of terminal spine eggs in urine samples of the pupils. Cheesbrough [21] had stated that diagnosis of schistosomiasis is by detection of eggs in urine or stool, which remains the gold standard.

The prevalence of 12.3% for urinary schistosomiasis among the pupils was much lower than many other findings which had claimed an endemicity of schistosomiasis in Nigeria. The prevalence in this study was lower than 31.3% reported in Abuja-Nigeria [22]. Other prevalence reports include 79.4% among children of Ezza-North LGA of Ebonyi, Nigeria [20], 41.5% in Benue-Nigeria [23], 78.4% in Lagos-Nigeria [24], 34.1% in Enugu-Nigeria [25], 48.7% in Borno-Nigeria [26], and 19.5% in Kaduna-Nigeria [27]. Compared to these high-prevalence areas, Jaba LGA had a lower burden of urinary schistosomiasis. This could be due to the fact that the area has relatively fewer fast-flowing streams and rivers that may not provide adequate breeding zone for cercariae and snails (especially *Bulinus* spp and *Physopsis* spp). Also many of the streams/rivers in the LGA are used for bathing and washing of clothes by many members of the communities. Detergents and soaps have adverse effects on cercariae/snails; hence these agents help in shortening the lifecycle and propagation of cercariae [28].

Also, this study uncovered a lesser prevalence of urinary schistosomiasis as compared to 15.2% prevalence reported in Mali by [29]. A prevalence of 20.7% was found in a retrospective study in Kumasi [30] and 30.7% had also been reported in Ghana [31]. A considerably higher prevalence of 35.9% was found in Ethiopia [32], and a prevalence of 42% among primary school children in South Africa [33]. Although a relatively low prevalence was obtained in this study, it is still higher than reported 4.5% prevalence in Abini and the absence of the infection in Ukwelo-Obudu communities of Cross River-Nigeria [34], and reported 6.3% prevalence among children of Ngbo-West LGA in Ebonyi-Nigeria [20], and 8.3% in Kano-Nigeria [35].

The statistically significant higher prevalence (of 15.5%) of urinary schistosomiasis amongst the females than in the males (9.1%) in this study is among a few reports of higher occurrence of schistosomiasis amongst the females. This finding supports the work of Oluwasogo and Fagbemi [24], in which females (60.9%) were more infected than males (39.2%). But this observed phenomenon opposes many findings which had suggested higher risks on the males [19, 22, 25, 27, 36]. Most of those studies that had implicated the male gender with higher risk of *Schistosoma* infections had been conducted in locations where the females were restricted from swimming activity. In Jaba LGA, both the females and the males had no traditional/religious restrictions from participating in swimming activity. In addition, there was an unequal exposure risks between the genders; females participated more in rice farming and other

Table 1: Occurrence and Intensity of Urinary Schistosomiasis according to Class of Pupils

Primary Class	No. of Samples Examined	*Positive Cases No (%)	Range of Count	Female Mean of Eggs/10ml urine	Male Mean of Eggs/10ml urine	Class Mean of Eggs/10ml urine
1	74	7(9.5)	0-5	0.34	0.14	0.24
2	79	5(6.3)	0-103	3.32	0.56	1.65
3	84	8(9.5)	0-62	2.48	0.19	1.50
4	104	15(14.4)	0-130	4.13	2.91	3.47
5	92	15(16.3)	0-78	5.14	2.09	3.72
6	72	12(16.7)	0-204	9.74	0.38	5.32
Total	505	62(12.3)	0-204	4.18	1.22	2.69

*χ^2 = 6.850; df = 5; P = 0.232, LR = 7.178; df = 5 P = 0.208

Table 2: Gender-related Distribution of Urinary Schistosomiasis among Pupils in Jaba LGA

Gender	No. of Samples Examined	No. Positive (%)	No. Negative (%)
Female	251	39 (15.5)	212 (84.5)
Male	254	23 (9.1)	231 (90.9)
Total	505	62 (12.3)	443 (87.7)

χ^2 = 4.926; df = 1; P = 0.026, LR = 4.973; df = 1; P = 0.026

Table 3: Occurrence and mean intensity of urinary schistosomiasis according to sampling locations

Sampling Location	No. of Samples examined	*Prevalence No. (%)	**Intensity (Mean of Eggs/10ml of urine)	Standard Error of Mean
Ankun	27	6 (22.2)	3.30	2.301
Bitaro	112	26(23.2)	4.85	2.018
Central Area	57	7(12.3)	6.77	3.335
Chori	30	1(3.3)	0.10	0.100
Dura	21	1(4.8)	0.29	0.286
Gora	26	4(15.4)	0.73	0.358
Kwoi	59	12(20.3)	2.73	1.451
Nok	33	0(0.0)	0.00	0.000
Sambang	78	0(0.0)	0.00	0.000
Yadi-Pyok	62	5(8.1)	2.47	1.443

* χ^2 = 38.599; df = 9; p = 0.000, LR = 50.200; df = 9; p = 0.000
**ANOVA Value (F) = 1.419; df = 9; P = 0.177

Table 4: Distribution of level of urinary schistosomiasis across sampling locations in Jaba LGA, Kaduna State, Nigeria

Level of Infection	Samples Size	Ankun	Bitaro	Central Area	Chori	Dura	Gora	Kwoi	Nok	Sambang	Yadi-Pyok
None	443	21 (4.7)	86 (19.4)	50 (11.3)	29 (6.5)	20 (4.5)	22 (5.0)	47 (10.6)	33 (7.4)	78 (17.6)	57 (12.9)
Light	52	5 (9.6)	23 (44.2)	3 (5.8)	1 (1.9)	1 (1.9)	4 (7.7)	11 (21.2)	0 (0.0)	0(0.0)	4(7.7)
Heavy	10	1 (10.0)	3 (30.0)	4 (40.0)	0 (0.0)	0 (0.0)	0 (0.0)	1(10.0)	0(0.0)	0(0.0)	1(10.0)
Total	**505**	**27 (5.3)**	**112 (22.2)**	**57 (11.3)**	**30 (5.9)**	**21 (4.2)**	**26 (5.1)**	**59 (11.7)**	**33 (6.5)**	**78 (15.4)**	**62 (12.3)**

χ^2 = 50.094, df = 18, P = 0.000, LR = 59.532; df = 18; P = 0.000

Table 5: Age-related distribution of the level of urinary schistosomiasis among pupils in Jaba LGA, Kaduna State, Nigeria

Age (Years)	No. of Samples Examined	No Infection No. (%)	Light Infection No. (%)	Heavy Infection No. (%)
4	2	2 (100.0)	0 (0.0)	0 (0.0)
5	10	10 (100.0)	0 (0.0)	0 (0.0)
6	19	19 (100.0)	0 (0.0)	0 (0.0)
7	43	40 (93.0)	2 (4.7)	1 (2.3)
8	67	64 (95.5)	3 (4.5)	0 (0.0)
9	75	65 (86.7)	9 (12.0)	1 (1.3)
10	97	81 (83.5)	13 (13.4)	3 (3.1)
11	77	71 (92.2)	6 (7.8)	0 (0.0)
12	54	47 (87.0)	6 (11.1)	1 (1.9)
13	34	25 (73.5)	6 (17.6)	3 (8.8)
14	19	16 (84.2)	3 (15.8)	0 (0.0)
15	8	3 (37.5)	4 (50.0)	1 (12.5)
Total	505	443 (87.7)	52 (10.3)	10 (2.0)

χ^2 = 44.715 df = 22; P = 0.003, LR = 40.665 df = 22; P = 0.009

Table 6: Relationship between urinary schistosomiasis and anemia among pupils in Jaba LGA

Status of Urinary Schistosomiasis	No. of Samples Examined	Anemic PCV No. Positive (%)	Normal PCV No. Positive (%)	High PCV No. Positive (%)
Not Infected	443	30 (6.8)	163 (36.8)	250 (56.4)
Infected	62	11 (17.7)	27 (43.5)	11 (38.7)
Total	505	41 (8.1)	190 (37.6)	274 (54.3)

χ^2 = 11.870; df = 2; P = 0.003, LR = 10.401; df = 2; P = 0.006

Table 7: Effect of the level of urinary schistosomiasis on pupils' packed cell volume

Level of Infection	No. of Samples Examined	Anemic PCV No. Positive (%)	Normal PCV No. Positive (%)	High PCV No. Positive (%)	Total
None	443	30 (6.8)	163 (36.8)	250 (56.4)	443 (87.7)
Light	52	9 (17.3)	24 (46.2)	19 (36.5)	52 (10.3)
Heavy	10	2 (20.0)	3 (30.0)	5 (50.0)	10 (2.0)
Total	505	41(8.1)	190 (37.6)	274 (54.3)	505 (100.0)

χ^2 = 12.807; df = 4; P = 0.012, LR = 11.353; df = 4; P = 0.023

Table 8: Relationship between the level of urinary schistosomiasis and gender of pupils

Level of Infection	No. of Samples Examined	Female No. Positive (%)	Male No. Positive (%)	Total
None	443	212 (47.9)	231 (52.1)	443 (87.7)
Light	52	32 (61.5)	20 (38.5)	52 (10.3)
Heavy	10	7 (70.0)	3 (30.0)	10 (2.0)

χ^2 = 5.166; df = 2; P = 0.076, LR = 5.237; df = 0.073

Table 9: Effect of level of urinary schistosomiasis on occurrence of haematuria among pupils in Jaba LGA, Kaduna State

Level of infection	No. of Samples Examined	Absence of Hematuria No. Positive (%)	Presence of Hematuria No. Positive (%)
None	443	423 (95.5)	20 (4.5)
Light	52	47 (90.4)	5 (9.6)
Heavy	10	10 (100.0)	0 (0.0)
Total	505	480 (95.0)	25 (5.0)

χ^2 = 3.105; df = 2; P = 0.212, LR = 3.108; df = 2; P = 0.211

Table 10: Risk factors associated with urinary schistosomiasis among primary school pupils in Jaba LGA

Risk Factor	Response Category	No. of Samples Examined	Positive No. (%)	Negative No. (%)
Awareness of Schistosomiasis#	Unaware	505	62 (12.3)	443 (87.7)
	Aware	0	0 (0.0)	0(0.0)
'Fadama' Farming*	No	376	34 (9.0)	342 (91.0)
	Yes	129	28 (21.7)	101 (78.3)
Fishing in River/Stream**	No	396	52 (13.1)	344 (86.9)
	Yes	109	10 (9.2)	99 (90.8)
Swimming in River/Stream**	No	178	27 (15.2)	151 (84.8)
	Yes	327	35 (10.7)	292 (89.3)
Place of Laundering@	Home	315	34 (10.8)	281 (89.2)
	River/Stream	190	28 (14.7)	162 (85.3)

#No computed statistics because unawareness was a constant.
*χ^2 = 14.300; df = 1; P = 0.000, LR = 12.915; df = 1; P = 0.000
**χ^2 = 1.243; df =1; P = 0.265, LR = 1.319; df = 1; P = 0.251
†χ^2 = 2.134; df =1; P = 0.144, LR = 2.080; df = 1; P = 0.149
@χ^2 = 1.711; df = 1; P = 0.191, LR = 1.679; df = 1; P = 0.195

Table 11: Association of parental level of formal education and urinary schistosomiasis status of pupils in Jaba LGA

Parent Category	Level of Formal Education	No. of Samples Examined	No. (%) Positive	No. (%) Negative
Mother*	None	58	2 (3.4)	56 (96.6)
	Primary	94	13 (13.8)	81 (86.2)
	Secondary	302	43 (14.2)	259 (85.8)
	Tertiary	51	4 (7.8)	47 (92.2)
	Total	505	62 (12.3)	443 (87.7)
Father**	None	59	4 (6.8)	55 (93.2)
	Primary	63	6 (9.5)	57 (90.5)
	Secondary	299	40 (13.4)	259 (86.6)
	Tertiary	84	12 (14.3)	72 (85.7)
	Total	505	62 (12.3)	443 (87.7)

* χ^2 = 6.418; df = 3; P = 0.093, LR = 7.947; df = 3; P = 0.047
** χ^2 = 2.750; df = 3; P = 0.432, LR = 3.041; df = 3; P = 0.385

Table 12: Sign/symptoms associated with urinary schistosomiasis among the pupils in Jaba LGA, Kaduna State, Nigeria.

Symptom	Category	No. of Samples Examined	No. (%) Positive	No. (%) Negative
Hematuria*	No	480	57 (11.9)	423 (88.1)
	Yes	25	5 (20.0)	20 (80.0)
Painful micturition**	No	473	54 (11.4)	419 (88.6)
	Yes	32	8 (25.0)	24 (75.0)
Frequent micturitiona	No	496	61 (12.3)	435 (87.7)
	Yes	9	1 (11.1)	8 (88.9)
Abdominal paina	No	496	61 (12.3)	435 (87.7)
	Yes	9	1 (11.1)	8 (88.9)
Feverb	No	487	58 (11.9)	429 (88.1)
	Yes	18	4 (22.2)	14 (77/8)
Urine colorc	Brown and cloudy	2	1 (50.0)	1 (50.0)
	Cloudy	39	5 (12.8)	34 (87.2)
	Milky-white	91	9 (9.9)	82 (90.1)
	Red and cloudy	92	23 (25.0)	69 (75.0)
	Yellow-orange	281	24 (8.5)	257 (91.5)

* χ^2 =1.457; df = 1; P = 0.227, LR = 1.266; df = 1; P = 0.260; ** χ^2 = 5.135; df = 1; P = 0.023, LR 3.951; df = 1; P = 0.041; [a] χ^2 = 0.012; df = 1; P = 0.914, LR = 0.012, df = 1; P = 0.913; [b] χ^2 = 1.714; df = 1; P = 0.190, LR = 1.439; df = 1; P = 0.230; [c] χ^2 =20.604; df = 4; P = 0.000, LR = 17.315; df = 4; P = 0.02

'Fadama' activities. Individuals with heavy infections are most prone to chronic complications [37]. By extension, the females are not only at a higher risk of developing complications like female genital schistosomiasis (FGS), but they stand the risks of decreased fertility, abortions, vaginal discharge, contact bleeding and increased risk of HIV infection in concomitant urinary schistosomiasis [38].

Many reports on the prevalence of schistosomiasis had focused on age-group prevalence. This type of disease-reporting has not explained the occurrences in each age. Furthermore, conclusions made on an age-group may not adequately define a particular age characteristics. Hence, in this study the prevalence of urinary schistosomiasis for each age was calculated, which gave a 'wave-like' pattern of elevation with increase in ages of the pupils. The absence of the infection in pupils within ages 4, 5 and 6 years (unlike the older pupils) could be due to the fact they are too young to engage in constant water-based activities like swimming, wadding or 'Fadama' farming. Older pupils can engage freely and/or indiscriminately in water activities [36].

Aside the obviously high prevalence of urinary schistosomiasis in the females, this study revealed a higher percentage of heavy infections among the females (70.0%) than among the males (30.0%). The highest mean intensity of 9.74 eggs/10 ml urine among the females occurred among pupils in Primary 6; however, in the males it was 2.91 eggs/10 ml urine found among pupils in Primary 2. In an overall, the females had higher mean intensity (of 4.18 eggs/10 ml urine) than males (1.22 eggs/10 ml urine). An inclusion of behavioral difference between the genders could be used to explain reasons for the higher intensity/level of urinary schistosomiasis among the female pupils. Schistosomes are attracted to skin lipids [13] and since females (including those that are pupils) often apply high-scented perfumes, body creams and oils, they stand a higher chance of been repeatedly infected during water-contact activities. Though Bigwan et al. [36] had linked a higher prevalence of schistosomiasis in males to some socio-cultural practices such as bathing, washing, swimming, irrigation-farming and fishing in rivers/ponds, the reverse was the case in this study. Repeated infection episodes enhance the development of heavy infection/high intensity.

A proportion of pupils in each Primary class in Jaba LGA had urinary schistosomiasis; however, there were increases in both prevalence and intensity of the infection from junior classes (Primary 1–3) to senior classes (Primary 4–6). Though there was no statistical significance in those relationships, the observed increases could have been due to more water-contact activities among the older pupils. It shows further that urinary schistosomiasis is unrelated to the class of a pupil as a risk factor.

The highest occurrence of urinary schistosomiasis among pupils in Bitaro, Ankun and Kwoi could be due to more availability of rivers/streams and the dense water-contact activities among the pupils compared to other locations. Pupils in Sambang and Nok recorded an absence of the infection with fewer rivers/streams and reduced water-contact activities among the pupils; members of these two communities depend largely on borehole and well water. High water-contact activities, promotes a higher risk of contracting the infection. However, the highest mean count of *S. haematobium* eggs (of 6.77/10 ml urine) was found in the Central Area and not in the location of higher occurrence of the infection. Hence, high prevalence of the infection did not coincide with high intensity of infection because repeated exposure is required to enhance the development of a heavy infection or high intensity.

The overall occurrence of 2.0% heavy infections, 10.3% light infections and egg count ranging between 0–204 eggs/10 ml urine among the pupils in Jaba LGA was far less than the range of 21–1138 eggs/10 ml urine and 62.7% heavy infections reported by Ossai et al. [26]. This further indicated that pupils in Jaba LGA had relatively low level of urinary schistosomiasis. Nevertheless, the infected population continues to pose risk to other uninfected pupils and members of the community. This will also gradually increase the cost of personal and public health maintenance.

The 8.1% prevalence of anemia among the pupils could have resulted from multiple sources: dietary deficiency of iron, leukemia, heavy loss of blood and/or parasitic diseases. It has been noted that hematological indices of apparently healthy individuals can be affected by certain factors like age, gender, cultural background, nature of body build, social activities, nutrition, altitude and other environmental factors [39]. One of such hematological parameters considered in this study was PCV and classified as 'anemic', 'high' or 'normal' [21]. With statistical relevance, urinary schistosomiasis caused and/or enhanced the development of anemia among the pupils. Pupils who become recurrently infected may develop anemia, malnutrition and even learning difficulties [40]. The anemia can be related to the cumulative loss of blood in terminal hematuria associated with the disease [28] as well as the continuous feeding on glucose and blood products by schistosomes [37]; making urinary schistosomiasis a chronic symptomatic disease [41].

Though schistosomiasis has been reckoned as of one of the world's most prevalent public health problems [36] and Nigeria stands as one of Africa's most endemic countries [27, 42], with several control/intervention programmes the prevalence of urinary schistosomiasis seemed not to be decreasing. This is partly due to improper implementation of the control measures, unawareness and increased water-contact activities among members of rural communities. In this study, pupils who wash their clothes in rivers/streams had higher occurrence of the infection than those who wash at home.

The pupils who did not participate in swimming activities were more infected (15.2%) than those who were swimmers (accounting for 10.7%), but it was not statistically significant. Some other studies [27, 35] had positively associated schistosomiasis with water-contact activities (like swimming) in river/stream. The population in this study might have acquired most the infections through other water-based activities such as washing or wading in rivers/streams or irrigation farming, indicating that the disease has multiple means of transmission via skin or body contact with cercariae-infested water.

Pupils' parents' level of formal education did not show any statistical relationship with urinary schistosomiasis in them. However, the lowest prevalence was observed among pupils whose parents did not have any formal education. Perhaps, the tight working schedules of educated parents and late return from work gave their children/wards opportunities to indulge in unsafe water-contact activities. Pupils whose mothers attained tertiary education had lower infection. However, the prevalence of the infection increased steadily among the pupils as their fathers' level of formal education increases. This finding did not agree with the work of Houmsou et al. [23] who reported that children whose parents did not attain any formal education as well as those with primary education recorded the highest prevalence of urinary schistosomiasis.

Some symptoms could be useful in the diagnosis of urinary schistosomiasis. Red/brown-colored urine (a sign of hematuria) and painful micturition witnessed by some of the subjects in study statistically indicated their associations with the disease. The association of hematuria with urinary schistosomiasis had been emphasized by many researchers [35, 43] and described as a classic or main sign/symptom of the disease [2, 44]. Pains suffered during urination by infected pupils are direct effects of tissue inflammation, destruction of internal vesical or ureterovesical sphincter mechanism or minor granulomata due to immunological reactions to both schistosomes and their eggs [37, 45–47].

The completely zero-level of awareness of schistosomiasis among pupils in Jaba LGA is indicative of negligence of the disease in Nigeria, a characteristic that defines it as a 'neglected tropical disease (NTD)' in the condition of poverty [2]. Hence, unawareness was a constant, and remains a strong risk factor in the continuous spread of the infection. This opposes the considerable awareness of 74.5% by pupils in rural communities of Kano State, Nigeria [37] where a lower prevalence of 8.3% was obtained as against the

12.3% prevalence obtained in this study with complete unawareness of the infection and its risks. The pupils in Jaba LGA are at continued risk of getting infected because of unawareness and continuous engagement in activities in cercariae-infested-water bodies. But it is anticipated that the organized awareness talks on schistosomiasis in pre-selected schools for this study will help in reducing the risks of exposure on enlightened pupils.

CONCLUSION

Jaba LGA is considerably an area of mild burden of urinary schistosomiasis, accounting for prevalence of 12.3%. Female pupils from the LGA had higher prevalence and intensity of the disease. Hence, they are faced with heightened risks of developing some complications like female genital schistosomiasis (FGS) and irreversible infertility. Prevalence and intensity of urinary schistosomiasis had 'wave-like' patterns of increase with rise in the ages of pupils. Anemia can result due to urinary schistosomiasis, a condition which can be severe with high worm burden. One of the basic factors promoting the continuous spread of schistosomiasis is lack of awareness of the disease, as more children stand at risk in most communities in Jaba LGA. 'Fadama' farming, painful micturition and red/brown-colored urine were statistically associated with urinary schistosomiasis among the study population. In view of the impacts of urinary schistosomiasis on health/development of African children, concerted efforts by government, school authorities, parents and researchers should be intensified in the control and prevention of the infection; treatment of infected/risk groups and early reporting of research/ case findings should be encouraged.

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