https://dx.doi.org/10.4314/dujopas.v9i4b.19
ISSN (Print): 2476-8316
ISSN (Online): 2635-3490
Dutse Journal of Pure and Applied Sciences (DUJOPAS), *Vol. 9 No. 4b December 2023*

Prevalence of Urinary Schistosomiasis among Communities Residing along Hadejia Valley, Jigawa State, Nigeria

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Abstract
A study was carried out to determine prevalence of urinary schistosomiasis amongst residents livingin four communities (Yamidi, Akubishin, Shawara and Dukkun villages) residing along Hadejia, River Valley, Jigawa State, Nigeria. A total of 447 urine samples from people residing in four communities were screened for the presence or absence of Schistosoma haematobium eggs. Urine samples were screened using concentration sedimentation technique. Overall prevalence of S. haematobium in Yamidi, Akubishin, Shawara and Dukkun villages was 21.3%,14.3%,33.8% and 21.4% respectively. Prevalence of the infection was higher in children people than Adult. There was no significance difference (p>0.05) in the prevalence of urinary schistosomiasis based on age. During dry season males showed higher prevalence of urinary schistosomiasis than females in the study area. There was no significance difference (p>0.05) in the prevalence of urinary schistosomiasis based on sex. But farmers recorded higher prevalence of urinary schistosomiasis than fishermen and people with other occupation. There was no significance difference (p>0.05) in the prevalence of urinary schistosomiasis based on occupation. Haematological status variation with urinary schistosomiasis with malaria showed existence of mild anaemia with respect to age, sex and occupation. There was no statistical difference (p>0.05) in the pattern of haematological status with urinary schistosomiasis based on age, sex and occupation.

Keywords: Communities, Prevalence, Residence, Schistosomiasis, Infection

INTRODUCTION
Schistosomiasis is a major parasitic disease caused by trematode of the genus Schistosoma and is a major health problem. Urinary schistosomiasis is a form of parasitic disease

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characterized by blood in the urine (Akinneye *et al*., 2018) Globally, schistosomiasis affects 78 countries, out of which 52 are at risk of the infection (WHO, 2013). About 243 million people are affected and more than 700 million live in endemic area of the disease and those numbers about 200,000 to 300,000 people die annually and most affected people are in the developing countries (Yusuf *et al*., 2015).Schistosomiasis is considered as one of the major public health problems. It is the second most prevalent tropical disease and a leading cause of severe morbidity in several foci in Africa, Asia and South Africa Abdullahi *et al.,* 2020). The second most economical devastating parasitic disease after malaria is prevalent in tropical and sub-tropical area in poor communities without portable water and adequate sanitation (WHO, 2013). Despite the availability of effective drugs the annual death rate is around 200,000 in Sub-Saharan Africa alone making this group of parasite the most lethal in the word (CDC, 2011). Over 85% of schistosomiasis occurs in Africa and Nigeria is the most endemic country in the world for urinary schistosomiasis, which is estimated to be 25.83 million people infected (WHO, 2002). According to Useh (2013), the current picture of schistosomiasis endemicily in Nigeria is very worrysome, for instance the transmission of the diseases has increased over the years. This has been due to large scale irrigation project, which created new habitat for the water snail. (WHO, 2010). Nigeria has the highest prevalence of human schistosomiasis in Sub saharan Africa with about 62.3 million cases, which comprises over 26% of the world cases requiring treatment (WHO, 2010).

In Nigeria, schistosomiasis is due to *Schistosoma haematobium* which is wide spread constituting a public health problem particularly in children (Bala *et al*., 2012). schistosomiasis has been on the increase in Nigeria due to inadequate prevention, control and treatment (WHO, 2013). Nigeria is one of the highly endemic countries where the disease has been reported and large areas remain where the disease is known. An estimated 120 million suffer severe consequences of the infection with an estimated annual mortality rate of about 20, 000 worldwide. An estimated 20 million Nigerians need to be treated annually for the disease. In most endemic areas the highest intensities of the infection are found in children between 5 and 15 years of age. In Sub Saharan Africa alone, it is estimated that 70 million individual experience haematuria, 32 million difficulty in urination (dysuria), 18 million bladder wall pathology and 10 million major hydronephrosis from infections caused by *S. haematobium* annually. The mortality rate caused due to non functioning kidneys (from *S. haematobium*) and haematomesis has been estimated to be 150, 000 per year (Charles *et al* ., 2019).

Snails that are responsible for schistosomiasis in humans belong to one of the three genera: *Biomphalaria* species for *S. mansoni, Bulinus* species for *S. haematobium* and *Oncomelania* species for *S. japonicum* (Colley *et al.,* 2014). *Schistosoma haematobium* is transmitted by group of Planobid fresh water snails of the genus *Bulinus* found around sources of water such as streams, slow flowing rivers, ponds and irrigation canal s where the rural inhabitants rely on their recreation, occupational, domestic and agricultural activities (Houmsou *et al*., 2016). Intermediate host of schistosomiasis breeds in slow flowing stagnant water, reservoir of dams provide favourable conditions for year round transmission of the disease, even in areas where snail distribution used to be seasonal (Charles *et al*., 2019). Infection occurs through contact with cercariae that penetrate the skin and develop in the human body with urine or excreta. They hatch in fresh water and infect the appropriate hosts of *Bulinus* species, the intermediate host of *S. haematobium* (Colley *et al.,* 2014). Within the snail, they develop into cercariae which in turn release in to water with view to infecting new human host (Colley *et al.,* 2014). Transmission can take place in any type of habitat from large lakes or rivers, seasonal ponds or streams. In urinary schistosomiasis, the worm lives in the blood vessels of the bladder, only about half of the eggs are excreted in the urine. The rest stay in the body, damaging other vital

organs (Bala *et al*., 2012). It is the eggs not the worms itself that causes damage to the bladder, intestines and other organs (Bala *et al*., 2012).
Schistosomiasis is associated with poverty and poor living conditions, inadequate sanitation and poor water supply as well as unplanned water resources development (Colley *et al*., 2014). There were increase rate of infection due to exposure pattern associated with bathing, washing and farming along river and canals habouring infected snail intermediate host (Iwu *et al.*, 2015). This infection is also associated with rural agricultural and other human activities around the fresh water bodies such as swimming, fishing, washing and bathing in ponds, rivers and dams where the intermediate hosts breeds (Akinneye *et al*., 2018). The tradition of African rural women in company of their children wash household utensils in nearby stagnant water is not left out in socio economic factors (Charles *et al*., 2019). Several environmental and socio economic factors have been identified to be responsible for the continued persistence of intestinal parasitic infection in children. Some of those factors include poor sanitary conditions, unhygienic practices, lack of potable water, poor housing and poverty (Charles *et al*., 2019). People generally become infected when the infective larvae mechanically penetrate skin by contact with fresh water bodies where mollusks are prevented and hygiene is undetermined (Colley *et al*., 2014; Balla *et al*., 2015; Babamale *et al*., 2018). School age children were thought to have frequent water contact that would make them more vulnerable to schistosomiasis and hence this age group would be more associated with schistosomiasis problems (Bala *et al*., 2012). High prevalence and high intensities are found in school aged children, adolescence and adults (Makaula *et al.,* 2014). Schistosomiasis infections are usually at peak in late childhood to early adulthood. In some part of Africa, the onset of haematuria due to urinary schistosomiasis is very common in adolescence boys and due to lack of knowledge; it is seen as a normal phenomenon in some communities (Atalabi *et al*., 2014).

Urinary schistosomiasis leads to varieties of clinical manifestation such as haematuria, dysuria and suprapubic pain, bladder-wall pathology and hydronephrosis respectively (Colley *et al*., 2014). Other health impact associated with the disease are risk of anaemia, bladder cancer, nutritional deficiencies, delay puberty in children and impairment of cognitive development in infected individual as well as decreasing physical activities, school performance, work capacity and productivity (Colley *et al*., 2014; Akinneye *et al*., 2018).Preventive treatment which should be repeated over a number of years will reduce and prevent morbidity (Akinneye, *et al*., 2018). However preventive chemotherapy for schistosomiasis, were people and communities are tested for large-scale treatment is only required in 52 endemic countries with moderate to high transmission, with estimated 101 million persons at risk and 26 million people infected (WHO, 2018). It has been advocated during sixty fifth (65th world health assembly, that member state should intensify control intervention and initiation of elimination programme for schistosomiasis. This still remains a dream for several countries in Sub Saharan Africa particularly Nigeria where the coverage for the preventive chemotherapy for Schistosomiasis is 40% (WHO, 2013). The non-implementation of the policies is impeded by the lack of political commitment, lack of public health infrastructures and the necessary resources to initiate and sustain control programmes across the country (Houmsou *et al*., 2016). The aim of the study was to assess prevalence of urinary schistosomiasis and haematological profile of the subjects in the study area.

MATERIALS AND METHODS

Study Area

This study was conducted in the in dry season spanning over three month amongst residents of four selected villages (Yamidi, Akubishin, Shawara and Dukkun) along Hadejia valley, Jigawa State, Nigeria. Prevalence relationship of the infections was established in the study area. The sites are all endemic for schistosomiasis infections Abubakar *et al*., 2017). Participant 5 to 75 years old, were enrolled according to their infection status. *Schistosoma haematobium* and malarial parasites infections were detected along with some haematological parameters and all data were recorded for analysis accordingly.

Hadejia Local Government is located in the north eastern part of Jigawa State. It lies between 9^0 37′ E and 10^0 35′ E Longitude and 13^0 02′ N Latitude. The climate of the region is wet and dry type, rainfall spread between June and September with mean Annual rainfall of 315mm. The soil in the study area is sandy in nature except in Fadama area that has clay-loam soil. River Hadejia (Plate 1) provides water for irrigation and fish production (Abubakar *et al*., 2017). People in the area are farmers that grow both rain fed and irrigated crops, some are animal breeders and businessmen (Gambo *et al*., 2020)

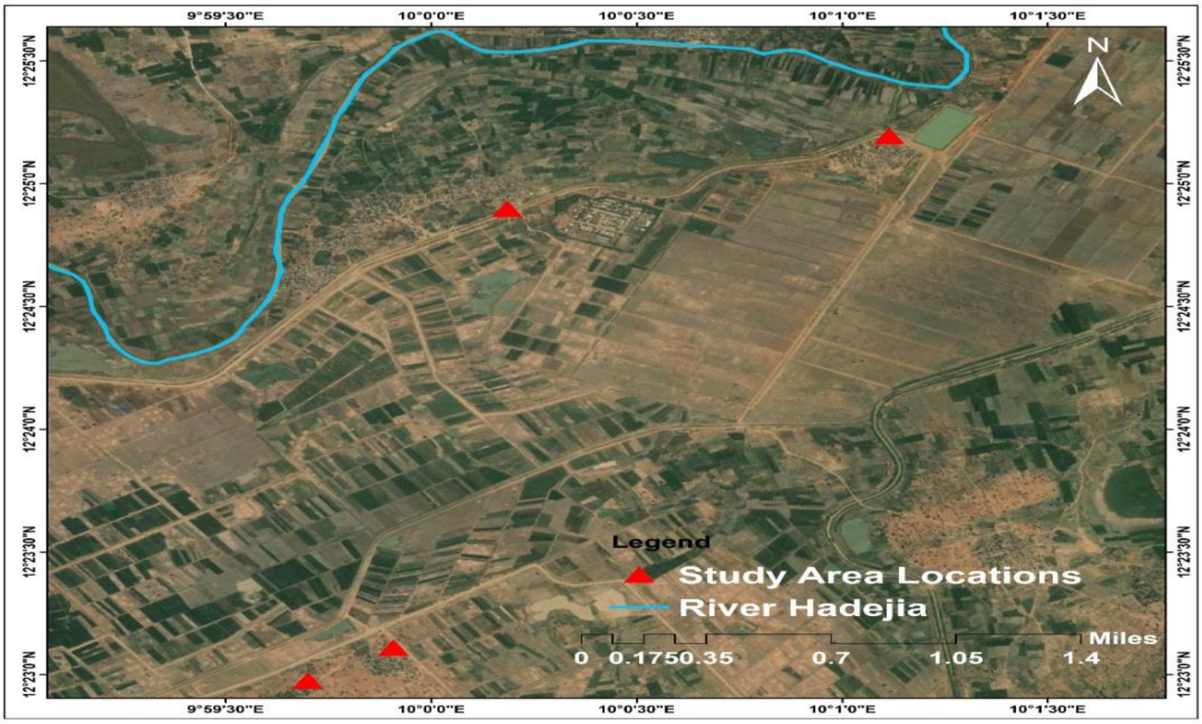

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Figure 1: showing the location of the study area

Ethical Considerations

The study was conducted with strict compliance to ethical review committee of the Ministry of Health Jigawa State, Nigeria. Informed consent was sought from the study participants who were adequately informed of the nature and importance of the study prior to the specimen collection.

Study population

The required sample size was determined using single population proportion formula and assuming 76.8% proportion of urinary schistosomiasis from previous study by Akinneye *et al.* (2018).

$$n = p(1 - P)\left(\frac{Z}{E}\right)^2 \; n \; = \; sample\ size$$

$Z \; = \; is\ the\ confidence\ level\ (Z \; = \; 1.96\ for\ 95\%)$

$E \; = \; is\ the\ desired\ magin\ of error$

p = is the proportion of schistosomiasis in the population from Previous study

$= \; 76.8\%$

$= \; 0.768$

$$n = 0.768(1 - 0.768)\left(\frac{1.96}{0.05}\right)^2$$

$n \; = \; 274$

Subjects who were both young and adult of both sexes were screened for the presence or absence of urinary schistosomiasis and malaria parasite in both the selected villages. The purpose of study was explained to the subjects in order to obtain their consent. The subjects were asked to provide urine samples between 10:00am and to 2:00pm for examination when excretion of eggs is greatest (Cheesbrough, 2014) a blood sample was collected to determine presence or absence of malaria parasite (Cheesbrough, 2014). Urine and blood samples were collected along with personal data that consist of name, sex, address, occupation and presence or absence of haematuria from each subject.

Procedure for Urine Examination

Quantitative examination of single urine specimen was done using modified concentration sedimentation technique for the detection of eggs of *S. haematobium* (Cheesbrough, 2014). The subjects were given specimen bottles for sample collection. The urine samples were preserved with three drop of Hypochlorite to stop the eggs from hatching and later transported to Biology Laboratory in the Department of Science Laboratory Technology, Binyaminu Usman Polytechnic, Hadejia. Jigawa State, Nigeria for the detection of eggs. Ten (10mL) of the urine sample were collected in a clean dry container. It was then placed into a centrifuging machine for centrifugation; RCF = 44.72g. The supernatant was discarded and a drop of the sediment was placed on the glass slide and covered with cover slip. It was examined microscopically using low power time (×10) objective lens. The numbers of eggs in the preparation was recorded (Cheesbrough, 2014).

Blood Sample Collection

Blood samples were collected aseptically from the subjects until the required sample size was achieved. A total of 4 mL venous blood sample was collected using sterilized vacutainer needle/holder dispensed into Ethylene Di-amine Tetra Acetic Acid (EDTA) bottle and mixed properly to avoid blood clot for malaria parasite diagnosis, packed cell volume and haemoglobin concentration (Salisu *et al.*, 2020).

Haemoglobin Estimation (Sahli Method)

Graduated measuring tube was filled up to graduation line (mark 2) with 0.1 NHCL

Blood was sucked up to20µL of the capillary tube precisely up to the mark, the pipette was wiped point and blow in to the measuring tube. A good mixture was achieved by repeating suction and blowing. The mixture was dark brown and clear after about one minute.

Distilled water was added by means of water pipette and mixed with glass stirrer until the colour of the solution matches with colour of the test rod.

Results was read using the diffused day light exactly three minutes after adding the blood to the 0.1 NHCL. Note that there are other Sahli apparatus whose procedures are slightly different from the above (Salisu *et al*., 2020).

Determination of Packed Cell Volume

Packed Cell Volume measures the percentage volume of blood that is occupied by the red cells. The value is called Packed Cell Volume (PCV) and blood from the EDTA container was allowed to enter heparinized capillary tube, until the tube was filled to about three quarter. The end of capillary tube that is free of blood was sealed with placticine. The sealed tube was centrifuged for 15 minutes at 300 rpm, after which the values were read directly using microhaematocrit reader (Cheesebrough, 2014; Salisu *et al*., 2020).

Red Blood Cells Count

Procedure:

Sample collection

Equipments were clean and dried and the diluting fluid was poured into a watch glass by the side.

Blood was collected from the EDTA blood specimen bottle.

The red blood cell (RBC) pipette was hold to the base of the blood specimen bottle. Blood was sucked to the 0.5 mark. The pipette was withdrawn and excess blood was clean from the tip using cotton wool. If the bloods overshoot above the 0.5 mark, it was brought down to the mark by dabbing tip on cotton wool.

The diluting fluid was sucked to the 101 mark, holding the pipette horizontally.

Charging the chamber

Shoulder of the counting chamber was moisten lightly and the cover slip was press firmly on the chamber to make it air tight so that it can hold the blood mixture on the counting chamber. Two or three drops of blood was discarded from the pipette to get rid of fluid contained in the stem as it is ordinary dilute fluid without blood cells.

The cover slip was pushed slightly backward to expose small portion of the counting area on the counting chamber. The exposed area was touched with the tip of pipette and the pipette was tilts slightly upright so that the diluted blood goes under the cover slip to fill the chamber by capillary action. Sufficient fluid was allowed to run under the cover the counting area without including any air bubbles and without overflowing surrounding grooves. Air bubbles indicate that the counting area is not sufficiently clean and free from grease. Then slide cover slip was put back to cover the counting area.

Focusing and counting corpuscles

The counting chamber was placed on the stage of the microscope and allowed stand for 1 minute for the corpuscles to settle.

Chamber was examined using ''× 10'' objective. If distribution of the cells is uneven, the chamber must be clean and dried and the charging process should be repeated.

If the distribution of the cells is uneven, proceed to count the cells using ''× 40'' objectives. Count the number of corpuscles overlapping the top and left hand sides together with those inside the square are counted. While those overlapping the bottom.

and the right hand side are not counted.

Calculation

Volume of diluted blood over each smaller square = 1/4000 mm^3 (Since depth of the chamber isc1/10 mm area is 1/ 4000 mm^3.

Volume of diluted blood over 80 smaller squares = 80/4000 mm^3.

Let × be the number of corpuscles counted over 80 smaller squares.

Then × corpuscles are present in 80/4000 mm^3 of the diluted blood.

Blood is diluted 1 to 200.

So × corpuscles are present in 80/4000 × 1/200 mm^3 of diluted blood = 1/10, 000 mm^3 of undiluted blood.

Therefore 1 mm^3 of undiluted blood contains × times 10, 000 corpuscles (Salisu *et al*., 2020).

Statistical Analysis

Data was analyzed statistically using statistical package for social sciences (SPSS) software at $p<0.05$ level of significance to determine if there was an association between the variables. Chi-square(X^2) test was employed to determine the degree of association between prevalence of the infection, age, sex and occupation.

RESULTS AND DISCUSSION

A total of 447 Subjects were successfully screened in the study area. Out of this number, 330 were males and 117 were found to be females in all the villages where in the study took place. The overall prevalence of urinary schistosomiasis in Yamidi, Akubishin, Shawara and Dukkun was 21.3%, 14.3%, 33.8% and 21.4% respectively. Results of this study indicates that urinary schistosomiasis was present in all the four screened villages. However, there was no statistical difference ($p>0.05$) in the prevalence of urinary schistosomiasis based on age in the study area. Table 1 summarizes the prevalence of urinary schistosomiasis among the subjects in the study area based on age. Prevalence of the infection was found to be higher in young people than people with older age group in all the four villages. In Yamidi village, people aged 5 – 15 years recorded higher prevalence of 7.5% and lower prevalence of 1.3% was recorded among people aged 56 years and above. In Akubishin village, higher prevalence of 7.1% was recorded among people aged 16 – 25 years, while least prevalence of 1.4% was recorded among people aged 36 -45 years. In Shawara village, also higher prevalence of 11.3% was obtained among people aged 05 – 15 years and lower prevalence of 2.5% was recorded among people aged 46 – 55 years. In Dukkun village, similarly higher prevalence of 5.0% was obtained among people 05 – 15 years and least prevalence of 1.3% was obtained among people aged 56 years and above. There was no significant difference ($p>0.05$) in the prevalence of urinary schistosomiasis among villages of the study area based on age.

Table 1: Prevalence of Urinary Schistosomiasis among People Based on Age in the Dry Season of the Study Area

				Urinary				**Schistosomiasis**				
		Yam			**Aku**			**Sha**			**Duk**	
Age Range (Yrs)	**NE**	**NI**	**PR (%)**	**NE**	**NI**	**PR (%)**	**NE**	**NI**	**PR (%)**	**NE**	**NI**	**PR (%)**
05 – 15	24	12	7.5	16	4	2.9	14	9	11.3	7	4	5.0
16 – 25	36	8	5.0	30	10	7.1	15	7	8.8	13	7	8.8
26 – 35	18	4	2.5	24	-	-	12	2	2.5	12	3	3.8
36 – 45	34	4	2.5	26	2	1.4	16	5	6.2	14	2	2.5
46 – 55	24	4	2.5	24	-	-	12	2	2.5	12	-	-
56 – Above	24	2	1.3	20	4	2.9	11	2	2.5	9	1	1.3
P value = 0.3324												
Total	**160**	**34**	**21.3**	**140**	**20**	**14.3**	**80**	**27**	**33.8**	**67**	**17**	**21.4**

Key: Yam = Yamidi Village, Aku. = Akubishin Village, Sha = Shawara Village, Duk = Dukkun Village, Yrs = Years, NE = Number Examined, NI = Number Infected, PR = Prevalence, (%) = Values in Parenthesis are Percentage; There was no Statistical Difference (p>0.05) in the Prevalence of Urinary Schistosomiasis Based on Age in the Study Area.

Table 2 Summarizes prevalence of urinary schistosomiasis among people based on sex and occupation during dry season in the study area. Males were found to have higher prevalence of urinary schistosomiasis in all the four villages of the study area than females i.e. in Yamidi village higher prevalence was 17.5% in males while lower prevalence of 2.9% was in females. In Akubishin village, higher prevalence of 11.4% was recorded in males than females that recorded lower prevalence of 2.9%. Similarly in Shawara village, higher prevalence of 31.3% was observed in males and lower prevalence of 25% was recorded in females, but in Dukkun village high prevalence of 20.9% was observed in male and lower prevalence of 4.5% was found in females. The association between the sex category and prevalence was consistent across the villages under the study. There was no significant difference (p>0.05)in the prevalence of urinary schistosomiasis among the study areas based on sex.

Prevalence of urinary schistosomiasis based on occupation shows farmers in all the four villages have higher prevalence than fishermen that to have least prevalence. In Yamidi village farmers had higher prevalence of 11.3%, followed by 6.3% prevalence in people with other occupation and least prevalence was among farmers with 3.7% prevalence. In Akubishin village, higher prevalence of 7.1% was recorded among farmers, followed by 5.7% prevalence among fishermen and least was among people with other occupation that recorded 1.5% prevalence. In Shawara village, higher prevalence of 25% was recorded among farmers, followed by fishermen with prevalence of 7.5% and least prevalence of 1.3% was among people with other occupation. In Dukkun village, higher prevalence of 17.9% was observed among farmers, followed with people with other occupation that recorded 4.5%% prevalence and lower prevalence of 3.0% was recorded among fishermen. There was no statistical difference (p>0.05) in the prevalence of urinary schistosomiasis based on occupation.

Table 2: Prevalence of Urinary Schistosomiasis among People Based on Sex and Occupation in the Dry Season of the Study Area

				Urinary				**Schistosomiasis**				
		Yam			**Aku**			**Sha**			**Duk**	
Variable	**NE**	**NI**	**PR (%)**	**NE**	**NI**	**PR (%)**	**NE**	**NI**	**PR (%)**	**NE**	**NI**	**PR (%)**
Sex												
Male	110	28	17.5	114	16	11.4	54	25	31.3	52	14	20.9
Female	50	6	3.75	26	4	2.9	26	2	2.5	15	3	4.5
P value = 0.8945												
Total	**160**	**34**	**21.3**	**140**	**20**	**14.3**	**80**	**27**	**33.8**	**67**	**17**	**25.4**
Occupation Farming	84	18	11.3	96	10	7.1	50	20	25	52	12	17.9
Fishing	10	6	3.7	6	2	1.5	10	6	7.5	2	2	3.0
Others	66	10	6.3	38	8	5.7	20	1	1.3	13	3	4.5
P value = 07797												
Total	**160**	**34**	**21.3**	**140**	**20**	**14.3**	**80**	**27**	**33.8**	**67**	**17**	**25.4**

Key: Yam Yamidi Village, Aku. Akubishin Village, Sha = Shawara Village, Duk = Dukkun Village, Yrs = Years, NE = Number Examined, NI = Number Infected, PR = Prevalence, (%) = Values in Parenthesis are Percentage; Others = Other Occupation (Traders, Civil servants, Students, House wives). there was no Statistical Difference (p>0.05) in the Prevalence of Urinary Schistosomiasis Based on Sex and Occupation in the Study Area.

Table 3 shows the haematological status variation with urinary schistosomiasis based on age during dry season. People aged 05 – 15 years recorded lowest haematological values in most of the villages but, higher haematological parameters were observed among people with older age group. Generally, mild anaemia existed among people with younger ages, while adult showed normal values. In Yamidi village, higher mHb (15.2g %) mPCV (45.5%) and mRBC (4.1m/mm^3) were recorded among people aged 56 years and above while lower mHb (11.2g %) mPCV (33.2%) and mRBC (4.2m/mm3) were recorded among people aged 26 – 35 years. In Akubishin village, higher mHb (14g %) mPCV (42%) and mRBC (4.4m/mm^3) were recorded among people aged 36 – 45 years and least mHb, (12g %) mPCV (35.2%) and mRBC (4.2m/mm^3) were recorded among people aged 5 – 15 years. In Shawara village higher mHb (14.3g %) mPCV (42.9%) and mRBC (3.9m/mm^3) were recorded among people aged 26 – 35 years. but lower mHb (11.9g %) mPCV (35.4%) and mRBC (3.2m/mm^3) were recorded among people aged 5 – 15 years. In Dukkun village higher mHb (14.0g %) mPCV (41.8%) and mRBC 4.1m/mm^3) were recorded among people aged 36 – 45 years and lowest mHb (12.0g %) mPCV (33.4%) and mRBC (3.8m/mm^3) were recorded among people aged 5 – 15 years. There was no statistical difference (p>0.05) in the haematological status variation with urinary schistosomiasis based on age, which means there was no significant interaction between the age and haematological status across villages.

Table 3: Some Haematological Status Variation with Urinary Schistosomiasis Based on Age in the Dry Season of the Study Area

				Urinary				Schistosomiasis				
		Yam			Aku			Sha			Duk	
Age Range (Yrs)	**mHb (g/%)**	**mPCV (%)**	**mRBC (m/mm^3)**	**mHb (g/%)**	**mPCV (%)**	**mRBC (m/mm^3)**	**mHb (g/%)**	**mPCV (%)**	**mRBC (m/mm^3)**	**mHb (g/%)**	**mPCV (%)**	**mRBC (m/mm^3)**
05-15	11.8	35.5	3.5	12	35.2	4.2	11.9	35.4	3.2	12.6	33.4	3.8
16- 25	14.0	42.0	3.9	13.6	4.2	4.3	12.0	36.2	3.7	14.3	43.2	3.5
26-35	11.2	33.5	4.2	-	-	-	14.3	42.9	3.9	13.4	40.8	4.1
36-45	12.3	37.0	4.6	14	42.0	4.4	14.1	38.4	3.4	14.0	41.8	4.1
46-55	12.3	38.5	3.4	-	-	-	13.4	40.6	3.8	13.3	40.1	3.7
56-Above	15.2	45.5	4.1	13	40.0	4.4	12.7	38.3	3.9	14.0	42.8	3.9
P value = 0.1227												
Total	**12.8**	**38.7**	**4.0**	**13.2**	**39.6**	**4.3**	**13.1**	**36.6**	**3.7**	**13.6**	**40.4**	**3.9**

Key: Yam = Yamidi Village, Aku = Akubishin Village, Sha = Shawara Village, Duk = Dukkun Village, Yrs = Years, NE = Number Examined, NI = Number Infected, mHb = Mean Haemoglobin Concentration, mPCV = Mean Packed Cell Volume, mRBC = Mean Red Blood Cell Count, (%) = Values in Parenthesis are percentage, g/% = gram percent, m/mm^3 = Million Cells per Cubic Millimeter; there was no Statistical Difference (p>0.05) in the Haematological Parameters with Urinary Schistosomiasis Based on Age.

Table 4: shows the haematological status variation with urinary schistosomiasis based on sex during dry season in the study area. Males were found to have high haematological parameters than females in all the four villages of the study area. Generally the haematological parameters also show normal values among people of all sexes. In Yamidi village, higher mHb (13g %) mPCV (41.8%) and mRBC (4.2m/mm^3) were recorded among males than females that recorded lower mHb (12g %) mPCV (35.3%) and mRBC (3.8m/mm^3). In Akubishin village higher mHb (13.9g %) mPCV (41.6%) and mRBC (3.8m/mm^3) were recorded in males, but lower mHb (12.4g %) mPCV (37.5%) and mRBC (4.0m/mm^3) were recorded in females.

Similarly in Shawara village higher mHb (14.5g %) mPCV (38.2%) and mRBC (3.8m/mm^3) were recorded in males, but lower mHb (11.6g %) mPCV (35.0%) and mRBC (3.9m/mm^3) were recorded in females. In Dukkun village also higher mHb (14.6g %) mPCV (41.4%) and mRBC (3.9m/mm^3) were recorded in males than females that recorded lower mHb (12.5g %) mPCV (39.3%) and mRBC (3.8m/mm^3). There was no statistical difference (p>0.05) in the pattern of haematological status with urinary schistosomiasis based on sex.

Haematological parameters observed in the present study shows normal among people infected with urinary schistosomiasis based on occupation in the study area. In Yamidi village, higher mHb (13.8g %) mPCV (41.3%) and mRBC (4.2m/mm^3) were recorded among people with other occupation, while least mHb (12.5g %) mPCV (38.0%) and mRBC (3.8m/mm^3) were recorded among farmers. In Akubishin village higher mHb (13.7g %) mPCV (41.05%) and mRBC (4.5m/mm^3) were recorded among farmers, but people with other occupation recorded lower mHb (12.8g %) mPCV (38.0%) and mRBC (4.2m/mm^3). In Shawara village higher mHb (15.5g %) mPCV (39.2%) and mRBC (3.9m/mm^3) were recorded among fishermen but lower mHb (12.1g %) mPCV (34.5%) and mRBC (3.5m/mm^3) were recorded among people with other occupation. In Dukkun village higher mHb (14.5g %) mPCV (44.7%) and mRBC (3.9m/mm^3) were recorded among fishermen, while lower mHb (12.5g %) mPCV (36.2%) and mRBC (3.9m/mm^3) were recorded among people with other occupation. There was no significant difference (p>0.05) between haematological status and urinary schistosomiasis based on occupation. There was no evidence that haematological status variation with urinary schistosomiasis varies significantly based on occupation.

Table 4: Some Haematological Status Variation with Urinary Schistosomiasis Based on Sex and Occupation in the Dry Season of the Study Area

		Yam		Urinary	Aku			Schistosomiasis Sha		Duk		
Variable	**mHb (g/%)**	**mPCV (%)**	**mRBC (m/mm^3)**	**mHb (g/%)**	**mPCV (%)**	**mRBC (m/mm^3)**	**mHb (g/%)**	**mPCV (%)**	**mRBC (m/mm^3)**	**mHb (g/%)**	**mPCV (%)**	**mRBC (m/mm^3)**
Sex												
Male	13.6	41.8	4.2	13.9	41.6	4.6	14.5	38.2	3.8	14.6	41.4	3.9
Female	12.0	35.5	3.8	12.5	37.5	4.0	11.6	35.0	3.5	12.5	39.3	3.8
P value = 05866895												
Total			**4.0**	**13.2**		**4.3**	**13.1**	**36.6**	**3.7**	**13.6**	**40.4**	**3.9**
	12.8	**38.7**			**39.6**							
Occupation	12.6			13.7		4.5	12.8	36.0	3.7	13.8	40.3	4.0
		38.0	3.8		41.0							
Farming												
Fishing				13.1		4.3	14.5	39.2	3.9	14.5	44.7	3.9
	12.1	36.8	3.8		39.2							
Others				12.8		4.2	12.1	34.5	3.5	12.5	36.2	3.9
	13.8	41.3	4.2		38.6							
P value = 0.798155												
Total				**13.2**		**4.3**	**13.1**	**36.6**	**3.7**	**13.6**	**40.4**	**3.9**
	12.8	**38.7**	**3.7**		**39.6**							

Key: Yam = Yamidi Village, Aku = Akubishin Village, Sha = Shawara Village, Duk = Dukkun Village, Yrs = Years, NE = Number Examined, NI = Number Infected, mHb = Mean Haemoglobin Concentration, mPCV = Mean Packed Cell Volume, mRBC = Mean Red Blood Cell Count, (%) = Values in Parenthesis are percentage, g/% = gram percent, m/mm^3 = Million Cells per Cubic Millimeter; Others = Other Occupation (Traders, Civil servants, Students, House wives), there was no Statistical Difference ($p>0.05$) in the Pattern of Haematological Parameters with Urinary Schistosomiasis Based on Sex and occupation.

Plate 1 showing river Hadejia

Plate 2 showing children swimming in river Hadejia which flows across the study area

The overall prevalent rates of urinary schistosomiasis observed in Yamidi, Akubishin, Shawara and Dukkun village were 21.3%, 14.3%, 33.8% and 21.4% respectively. Prevalent rate of the infection in Yamidi, Akubishin and Dukkun villages were low while in Shawara village the overall prevalence was found to be moderate (WHO, 1985). This finding shows urinary schistosomiasis existed in the study area. The disease was therefore of great public significant in the study area. The higher prevalence obtained in Yamidi and Shawara villages may be due to the shortest distance with the transmission site (irrigation scheme and river Hadejia) while Akubishin village that had lowest prevalence, because of longer distance from the transmission site (Akinneye *et al.*, 2018). Dukkun village is far from the transmission site there by recording a moderate prevalence of 21. 4%. This may be due to proximity of the village with a water reservoir in the irrigation scheme that produces additional surface water that increases breeding place of snail intermediate host.

The presence of urinary schistosomiasis in the study area may be due to exposure of contaminated water by the inhabitant. (Bichi and Abubakar, 2009). Irrigation scheme, river

Hadejia and Dingare dam that create a suitable ecology for the transmission and spread of schistosomiasis. Occupation such as farming and fishing is another factor that contributes to the prevalence (Duwa *et al*., 2007; Abubakar *et al*., 2017; Faith *et al*., 2021). It can also attribute to ignorance, poverty, poor living conditions, inadequate sanitation, poor water supply as well as unplanned water development (Babagana and Ibrahim, 2015). The prevalence rates recorded in the present study in Yamidi and Dukkun villages' are 21.3% and 21.4%. These finding are similar to the work of Yaro *et al*. (2020) who reported the prevalence (23.2%) of urinary schistosomiasis in Adamawa State, Nigeria. These finding are similar to the work of Adamu *et al.* (2019) who reported (20.0%) prevalence in epidemiology survey of urinary schistosomiasis among Secondary School Students in Kaduna State, Nigeria. In Shawara village, the overall prevalence of 33.8% was recorded in the present study. The results of the work are in conformity with the work of Cletus and Ukwubile (2016) who reported (32.5%) prevalence of urinary schistosomiasis in Bali Town, Bali local Government Area Taraba State, Nigeria. The prevalence of 14.3% reported in Akubishin village is similar to the work of Akinneye *et al*. (2018) who reported (13.8%) prevalence of urinary schistosomiasis among Secondary School Students in Ifedore Local Government, Ondo State, Nigeria. The work of Nathaniel *et al* (2016) reported similar prevalence of 12.8% in epidemiology survey of urinary schistosomiasis among secondary school students in Chikun Local Government Area, Kaduna State, Nigeria.

The finding in the present study is much lower than the finding elsewhere. Hounsou *et al.* (2016) who reported (58.4%) prevalence of urinary schistosomiasis among children in Murbai and Surbai communities of Ardo-Kola Local Government Area of Taraba State, Nigeria. This value was higher than values reported in the present study. Similarly Mudassiru *et al* (2017) who reported (60.8%) prevalence of urinary schistosomiasis on gender-aged group of primary school children in Sokoto South and Kware Local Government Area, Sokoto State, Nigeria. Likewise in work conducted by Bala *et al* (2012) who reported (74%) prevalence of urinary schistosomiasis in Abarma village Gusau, Nigeria. These prevalent rates are higher than the values recorded in the present study.

In the current study the overall prevalence of the infection was much higher than that reported in other areas. In the work of Yasir *et al.* (2017) who reported (1.82%) prevalence as well as Abdullahi *et al.* (2020) who reported (7.7%) prevalence of urinary schistosomiasis among primary school pupils in Dawakin Kudu Local Government Area, Kano State Nigeria which are all lower than the present work.

Prevalence of urinary schistosomiasis with respect to age group during dry season was found to be higher among people with younger age group than people with older age group in all the four villages of the study area. However similar observations have been reported elsewhere. The current study was found to be similar to the work of Yaro *et al.* (2020) who reported (36.6%) prevalence of urinary schistosomiasis among resident along river Benue, Adamawa State, Nigeria. among people aged 5 – 15 years than people aged 45 – 54 years that reported 9.0% prevalence rate. The work in the present study was also found to be in conformity with the work of Solomon *et al.* (2022) who reported (13.8%) prevalence of urinary schistosomiasis among school children in Sokoto State, Nigeria among pupil aged 5 – 11 years than 12 – 19 years that reported 7.5% prevalence, thus supporting the present study. Anchaw *et al.* (2020) supported the assertion that children have higher infection rate than old people, because of frequent water exposure to water bodies, they indulge in water contact activities such as swimming and fishing as observed among children swimming in river Hadejia, (water body that flows across the study area) (plate 2).

The significant infection rate with age can be attributed to play habit. Children are more likely to engage in independent water-based play. This observation implies that frequency of water contact is important factor in schistosomiasis prevalence (Anchaw *et al.,* 2020).The high infection rate in children also might be attributed to increase worm burden and high fecundity rate of schistosoma parasite due to possible development of concomitant immunity common to schistosomiasis (Bala *et al.,* 2012).

Prevalence of urinary schistosomiasis among people based on sex in the dry season was found to have higher prevalence among males than females in the study area. The consequent occurrence of the parasite in males than females may be related to traditional belief and socio cultural behaviours of the people in the study area. Majority of the females are restricted in their movement. Their contact with water bodies was therefore less compared to their males' counterparts. Moreover, matured female is unethical to swim naked (Nathanial *et al.,* 2016; Omenesa *et al.,* 2015). The relationship of urinary schistosomiasis infection and human gender has been previously studied in many endemic areas. The findings of Omensa *et al.* (2015) reported higher prevalence of urinary schistosomiasis in males (17.5%) than females (2%) similarly the finding by Yaro *et al.* (2015) that worked on resident along river Benue, Adamawa State, Nigeria reported 25% prevalence of urinary schistosomiasis among males (25%) than females (20.8%). The work in the present study was in consonance with work of Nathaniel *et al.* (2016) who reported higher prevalence of urinary schistosomiasis in males (16.2%) than females (09.9%) in Chikun Local Government Area of Kaduna State, Nigeria.

Prevalence of urinary schistosomiasis based on occupation in dry season in this study showed higher prevalence among farmers, followed by people with other occupation and least prevalence was observed among fishermen. The work in the present study was in conformity with the work of Houmsou *et al.* (2016) who reported on urinary schistosomiasis in children living in Murbai and Surbai communities of Ardo-Kola Local Government Area of Taraba State that activities such as fishing, farming predispose children to infection. Those activities were found to be the norm in most Nigerian population (WHO, 2016). Studies in the present research also was in line with the work of Abdullahi *et al.* (2020) who reported higher (3.4%) prevalence rate of urinary schistosomiasis among pupils whose parents are farmers in Dawakin Kudu Local Government Area, Kano State, Nigeria than pupils whose parents are fishermen that reported (1.7%). The finding in the present studies was also supported by Yassir *et al.* (2017) that discover children whose parents are farmers reported high prevalence of the infection.

The high prevalence among farmers could be probably attributed to the nature of their occupation that makes them have frequent contact with infested water. Farmers and fishermen are usually in frequent contact with water bodies. The moderate prevalence in people with other occupation like businessmen and civil servant in the study area might have some water contact activities that exposed them to the infection. The low prevalence among fishermen in the study area might be because of reduction in the water contact activities by fishermen because of less abundance of fish in the river due to over fishing that make them to be less exposed to infection (Yassir *et al.,* 2017).
Anaemia was categorized for both male and females as Hb value < 11.0 g/% (WHO, 2011). Anaemia classification was further categorized as follows (Hb – 10.9 g/%) was mild, (Hb 7 – 9.9 g/ %) was moderate and severe anaemia was (Hb < 7.0 g/%) (WHO, 2011). Anaemia in males was also defined as follows Hb value < 13 g/% or PCV value < 39 % or RBC value < 5.0 m/mm^3. But in females anaemia was defined as Hb value < 12g/% or PCV value < 36% or

RBC value < 4.5m//mm^3 (WHO, 2011; Sembulingam and Sembulingam, 2012; Jonathan *et al*., 2016). The haematological values reported in the present study according to age, sex and occupation in relation to urinary schistosomiasis shows mild anaemia, which is in line with values reported by (WHO, 2011; Semulingam and Sembulingam, 2012; Jonathan *et al*., 2016) as shown.

Haematological parameters of subjects with urinary schistosomiasis based on age during dry season shows people aged 05 – 15 years recording lower haematological parameters than people with older age group in most of the villages of the study area. The mean haematological values recorded based on age show mild anaemia among people with younger age group, while people with older age group recorded normal haematological values. There was no significant interaction between the sex and haematological status across villages. This can be explained by the fact that most of the people have light infection of *S. haematobium*, since only heavy infection that is linked with haematuria (Nyarko *et al.,* 2018). Observation of normal haematological parameters recorded in adult in the present study could be as a result of control effort of government in the study area through provision of portable drinking water and used of praziquantel that reduced the infection rate, this agrees with observation by Keptcheu *et al.* (2020) who observed normal haemoglobin level among children as a result of administration of Praziquantel which result in reduced pathological conditions.

Haematological parameters reported among people with urinary schistosomiasis based on sex show males have recorded higher haematological values than females in the study area. The haematological values recorded based on gender revealed mild anaemia. This could be explained by the fact that urinary schistosomiasis infection was moderate with light intensity and no haematuria existed in the studied population. This finding similar to the work of Keptcheu *et al.* (2020) that obtained higher haemoglobin concentration in *S. haematobium* infected respondents. The work in the present study is contrary to the report of Ruth *et al.* (2018) that reported children with heavy infection had a lower mean haemoglobin level. Haematological parameters of subjects with urinary schistosomiasis based on occupation during dry season showed normal values. Normal haematological values recorded could be because of moderate infection with no haematuria obtained in the present study. This might probably be explained by the fact that most of the infected people with infection have developed immunity and lived without problem in the study area. (Keptcheu *et al.,* 2020).

CONCLUSION

Urinary schistosomiasis is still a disease of public health importance in the study area. Proximity to water bodies, irrigated farming and fishing were found to be associated with presence of schistosomiasis. Prevalence of urinary schistosomiasis was found to be higher among people with older age group than people with younger age group. Prevalence of urinary schistosomiasis was found to be higher among males than females. High prevalence of urinary schistosomiasis was observed among farmers, followed by people with other occupation and list prevalence was observed among fishermen. Association between the subjects and urinary schistosomiasis infection showed mild anaemia.

There is a need to enhance health education programmes by environmental health workers and civic societies among local inhabitants about the potential risk with contact with water body. There is a need to carryout nationwide survey to help in planning and evaluating schistosomiasis control measures.

Acknowledgement

The authors thank the staff of the ministry of Health Jigawa State for the issuance of ethical clearance. We extend our thanks to Adamu Garba and Abubakar Muhammad laboratory staff of the Department of Science Laboratory Technology, Binyaminu Usman Polytechnic for their technical assistance which made this research a success. The authors wish to acknowledge the support of community heads in ensuring successful collection of samples.

Conflict of Interest

The authors declare that there is no conflict of interest regarding publication of this paper.

REFERENCES

Abdullahi, A.M., Lurwan, M., Tinnoye, O.O. and Muhammad A. (2020). Prevalence of Schistosomiasis among Primary School Pupils in Dawakin Kudu Local Government Area, Kano State, Nigeria. *ARC Journal of Urology*, **5** (1):15 – 20.

Adamu, A.M., Dzikwi, A.A., Akele, O.I., Alimi, Y.A., Adikwu, A.A., Idoko, S.I- - - *et al* (2019). Epidemiology of Urinary Schistosomiasis among Secondary School Students in Kaduna State, Nigeria. *Journal of Community Medicine and health Education,* **9:** (2) 1 – 5.

Anchaw, Z.G., Silas, P.C and Shaibu, M.A (2016). Prevalence of *Schistosoma haematobium* among Qur'anic School Pupils in Zaria, Kaduna State. *Journal of Micro Biology Research***,** **5:** (2): 92 – 97.

Akinneye, J.O., Fasidi, M.M., Afolabi, O.J. and Adesina, J. (2018). Prevalence of Urinary Schistosomiasis among Secondary School Student in Ifedore Local Government Ondo State, Nigeria, *International Journal of Tropical Disease,* **1**: (1): 1 – 6.

Atalabi, T.E., Lawal, U., Ipinlaye, S.J. (2014). Prevalence and Intensity of Genito-Urinary Schistosomiasis and Associated Risk Factors among Junior High School Students in Two Local Government Areas Around Zobe Dam in Katsina State, Nigeria. Parasites Vectors, **9** (388): 1 – 12.

Babamale, O., Kolawole, O., Abulganiyu, K., Abdulkareem, O.A. and Ugbamako, U.S. (2018). Urogenital Schistosomiasis among School Children and Associated Risk Factors in Selected Rural Communities of Kwara State, Nigeria. *Journal of Tropical Med*icine, **5**: 1 – 5.

Bala, A.Y., Bala, A.Y., Ladan, M.U. and Mainasara, M. (2012). Prevalence and Intensity Urinary Schistosomiasis in Abarma Village, Gusau, Nigeria. A Preliminary Investigation. *Science World Journal,* **7:** (2) 1 – 4.

Balla, H.J., Babagana, S. and Ibrahim, H. (2015). Incidence of Urinary Schistosomiasis Out of School Pupil and ''Almajiris Dikwa, North Eastern Nigeria. *Global Journal of Medicine Research,* **15**: (2). 234 – 242.

Bichi, A.H. and Abubakar, S. (2009). Urinary Schistosomiasis among Resident of Wasai Dam in Minjibir Local Government, Kano State, Nigeria. *Biological and Environmental Science and Technology Journal,* **6** (3): 93 -97.

CDC (2011). The Burden of Schistosomiasis. Global Health Division of Parasitic Diseases and Malaria.

Charles, O.E., Kenechukwu, O.O., Olaoluwa, P.A., Ly, S. and Hu, W. (2019). Urinary Schistosomiasis in Nigeria: A 50 Year Review of Prevalence, Distribution and Disease Burden. *Parasites Journal*, **26**: (19). 1 – 14.

Cletus, A.U., Ukwebile, T.T. and Timothy, T. (2016). Prevalence Rate of Urinary Schistosomiasis in Bali Town, Bali Local Government Area Taraba State. *Journal of Public Health and Community Medicine*. 1 (1): 18 – 21.

Cheesbrough, M. (2014). District Laboratory Practice in Tropical Countries, Laboratory Diagnosis of *Schistosoma haematobium* Infection. Part1, *Cambridge University Press*, 236 – 240.

Colley, D.G., Buslinduy, A.L., Secor, W.E. and King, C.H. (2014). Human Schistosomiasis, *Lancet*, **383** (9936): 2253 – 2284.

Duwa, R.M. (2007). Single Dose Praziquantel and its Effect on Growth in Relation to *Schistosoma haematobium* Count. M. Sc. Thesis, Department of Biological Sciences Bayero University, Kano, Nigeria.

Faith, F.F., Luke, E.E. and John, T.F. (2021). Prevalence of Urinary Schistosomiasis among Primary School Pupils. *Journal of Micro Biology and Infectious Disease*, **11 (**2): 95 – 104.

Gambo, J., Shafri, H.Z.M, Yusuf, Y.A., Abubakar, A., Babura, B.S. and Idris, A.M. (2020). Utilization of Earth Observation Technology for Mapping Spatio-temporal Changes in Urban Water Bodies (Ponds) and its Environmental Impacts in Hadejia, Nigeria, *International Conference of Moroccan Geomatics,* 1 – 8.

Houmsou, R.S., Agere, H., Wama, B.E., Bingbeng, J.V., Amuta, E.U. and Kela, L. (2016). Urinary Schistosomiasis among Children in Murbai and Surbai Communities of Ardo-Kola Local Government Area, Taraba State, Nigeria. *Journal of Tropical Medicine,* **7** (47): 1 – 8.

Iwu, R.O., Azoro, A.V. and Onuaha, J. N. (2015). Urinary Schistosomiasis: Water Contact Frequency and Infectivity among School-aged Pupil/Student in Ummuahia Community of Iheme Mbako Local Government Area of Imo State, Nigeria. *Journal of Parasitology and Vector Biology*, **7** (3): 53 – 57.

Keptcheu, T.D., Payne, V.K., Lehman, L.G. and Gongue, T. (2020). Some haematological Parameters among Urinary Schistosomiasis-Malaria Co-infected Children in Suburb of Malentonen Health District, West Region Cameroon. *International Journal of Tropical Disease and Health*, **41** (**7**): 34 – 44.

Makaula, P., Sadalaki, J.R., Muula, A.S., Kayuni, S., Jemu, S. and Bloch, P. (2014). Schistosomiasis in Malawi: *A Systematic Review Vectors,* 570.

Mudassiru, D., Abdulhadi, J., Dahiru, M. and Samaila A. (2017). Intensity of Urinary Schistosomiasis on Gender-Aged Group of Primary School in Sokoto South and Kware Area of Sokoto State, *Nigeria. Brazilian Journal of Biological Sciences,* **4** (7): 181 – 194.

Nathaniel, Y.M., Anthony, J.D. and Auwalu, U. (2016). Prevalence of Urinary Schistosomiasis among Secondary School Students in Chikun Local Government Area Kaduna State, Nigeria. *International Journal of Scientific and Engineering Research*, **7 (**10): 1366 – 1371.

Omenesa, H.O., Bishop, H.G. and Raji, H.M. (2015.Prevalence of Urinary Schistosomiasis among Pupils Attending Primary School in Bomo Village, Zaria Kaduna State, Nigeria. *International Journal of Research in Engineering and Science,* **3** (51): 14 – 19.

Ruth, N., Kwasi, T. and Augustine, A. (2018). *Schistosoma haematobium*, *Plasmodium falciparum* Infections and Anaemia in Children in Accra, Ghana. *Journal for Tropical Medicine and Vaccines*, 4 (3). 1 – 21.

Salisu, A., Abdusalam, M.K., Sunday, O.O., Waziri, B.I., Jibril, A.I. and Sani, M. (2020). A Practical Guide to Experiment in Human Physiology. *Bayero University Press*, 1 – 24.

Sembulingam, K. and Sembulingam, P. (2012). Essential of Medical Physiology Sixth Edition, Jampee Brothers Medical Publishing Limited, New Delhi, 67 – 88.

Soloman, M.G., Garba, A., Tongvwan, T., Dashal, S.G., Agom, D.D and Igbinosa, I. (2022). Prevalence, Intensity and Risk Factors of Urinary Schistosomiasis Among Primary School Children in Silame, Sokoto State, Nigeria. *Microbes and Infectious Diseases,* 4 (2): 695 – 703.

WHO (2010). Working to Overcome the Global Impact on Neglected Tropical Diseases. *First WHO Report on Neglected Tropical Diseases Geneva*, Switzerland, 132.

World Health Organization (2002). Prevention and Control of Schistosomiasis and Soil Transmitted Helminthiasis WHO Technical Report Series. **1** (912): World Health. Organization, Genera.

WHO (2011). Haemoglobin Concentration for the Diagnosis of Anaemia and Assessment of Severity, Vitamin and Minarals Nutrition Information System, World Health Organization, Geneva, Switzerland.

WHO (2013). Schistosomiasis Progress Report (2001 – 2011) and Strategic Plan (2012 – 2020).GenevaSwitzerland: http://www.who.Int/Schistosomiasis/resources/en/.Accessed.

Useh. F.M (2013): Schistosomiasis, http//:dxdoi.org/10.5772/53533.

WHO (2013). Schistosomiasis Progress Report (2001 – 2011) and Strategic Plan (2012 – 2020).GenevaSwitzerland: http://www.who.Int/Schistosomiasis/resources/en/.Accessed.

WHO (2015). Guidelines for Treatment of Malaria, 3rd Edition, Geneva, Switzerland: 2015 [Google Scholar].

WHO (2016). Guideline: Daily Iron Supplementation and Malaria Risk. *Lancet*; 8: e1001125.

WHO (2018 Yang). World Malaria Report 2018, WHO, Geneva, Switzerland [Goggle Scholar]

Yassir, S., Randa, E.E., Theerakamol, P., Azzam, A. and Muhammed, A.Z. (2017). Epidemiology of Urinary Schistosomiasis among School Children in the Asaial Village River Nile, State, Sudan. *Iran Journal of Parasitology,* **12** (2): 284 – 291.

Yaro, M.B., Naphtali, R.S. and Alo, E.B. (2015). Prevalence and Intensity of Urinary Schistosomiasis among Residents along River Benue, Adamawa State, Nigeria. *Nigerian Journal of Pure and Applied Science,* **33** (1): 3577 – 3584.

Yusuf, F.I., Modn, A.M. and Naphtali, A. (2015). Study on Schistosomiasis in Three Communities along Lake Alau. *International Journal of Science and Technical,* **3** (2): 73 – 79.