



EPIDEMIOLOGICAL PROFILE OF URINARY SCHISTOSOMIASIS IN RIVERINE AREA IN ONDO WEST LOCAL GOVERNMENT (OWENA OBADORE), NIGERIA.

Adewoga , Thomas O.S¹., Adediran, Oyeduntan A.²; Adenusi, Adesegun³; ³Osuntimehin, Abimbola Abiodun⁴

¹Department of Biological Sciences, Tai Solarin University of Education Ijagun, Nigeria

²Parasitology and Entomology University of Ibadan, Nigeria

³Medical Parasitology and Entomology, Collage of Medicine, University of Lagos, Nigeria

⁴Department of Biology Education, Tai Solarin University of Education Ijagun, Nigeria

Corresponding Author: adewogats@taued.edu.ng; +2348034275046

Abstract

Urinary schistosomiasis is endemic in Nigeria and continues to pose public health challenges especially in inhabitant of rural areas. This study examined the epidemiological profile of urinary schistosomiasis in riverine area of Ondo West Local Government (Owena Obadore), Nigeria. Experimental design was used to determine the level of prevalence. Urine samples were collected, covered tightly and transported to the microbiology laboratory for analysis. A compound microscope was also used to view the egg in the urine. Also, descriptive survey design was used to determine the perception and knowledge of the pupils examined. A population sample of 130 school aged children was used for the study. Questionnaires were administered to school aged children to obtain information on their source of knowledge, perception on symptoms and prevention of schistosomiasis. Data was analysed using descriptive statistics such as frequency counts, percentages, mean and Statistical Package for Social Science (SPSS). Results of the finding show a very low level of prevalence of schistosomiasis (3.08%) in the community, though the level of prevalence recorded was higher in males with (2.30%) compared to females with (0.76%). Based on the results of findings showing low prevalence, further research should be carried out in the entire Ondo State to ascertain the prevalence of schistosomiasis.

Keywords: Epidemiology, Prevalence, Schistosomiasis, Owena, Nigeria.

1.0 Introduction

Schistosomiasis (*Bilharzia*) is a water borne parasitic disease caused by *Schistosoma*, the digenetic trematode found in the blood vessels

of man and livestock. Globally, schistosomiasis is a chronic, debilitating parasitic disease infecting more than 200 million people and is second only to malaria

in terms of public health importance (Philip, 2019). About 95% of African population is infected with the disease (Mawa *et al.*, 2021). In Nigeria, the incidence of schistosomiasis is so common in some communities that young men passed the bloody urine at some stage of the disease. There are several complications of chronic urinary schistosomiasis such as bladder cancer, which is the major cause of morbidity and mortality in endemic areas (Oyime *et al.*, 2021). According to WHO (2023), Nigeria has a high burden of communicable and non-communicable disease (NCDs), with the latter making up 27% of deaths in 2019.

Nigeria improved its child survival rates between 2015 and 2021; however, it is not yet meeting the SDG targets for neonatal or under-five mortality rates. Nigeria is endemic for four of the five NTDs amenable to preventive chemotherapy through mass drug administration (MDA). In 2020, 84% of the 31.7 million people targeted were treated with MDA. Nigeria's coverage rates of vaccination in children have historically been suboptimal and well below the 90% target rate. In 2021, the third dose of DTP-containing vaccine reached just 56%, while the coverage rate for the first dose of measles vaccine was 59%. The low coverage rates, in combination with the large population, resulted in 3.3 million under-immunized children and 2.3 million zero dose children. It is important for Nigeria to continue to strengthen its routine immunization system, while also implementing catch-up vaccination strategies in the country to ensure that no children are left unprotected from vaccine-preventable diseases in the future (WHO, 2023).

In areas endemic for the disease, it disproportionately affects poor and rural communities without access to safe drinking water and adequate sanitation, particularly agricultural and fishing populations, because people suffering from the disease contaminate

freshwater sources with their urine and excreta containing parasite eggs which hatch in water and then enter into freshwater snails to develop into infective larval form of the parasite. Inadequate hygiene and contact with infected water (during which larval forms of the parasite released by freshwater snails penetrate the skin) make children especially vulnerable to infection; and women doing domestic chores in infested water, such as washing clothes, are also at risk (Adedotun *et al.*, 2024).

Eggs of schistosomiasis are eliminated with feces or urine. Under optimal conditions the eggs hatch and release miracidia, which swim and penetrate specific snail intermediate hosts. The stages in the snail include two generations of sporocysts and the production of cercariae. Upon release from the snail, the infective cercariae swim, penetrate the skin of the human host, and shed their forked tail, becoming schistosomulae. The schistosomulae migrate through several tissues and stages to their residence in the veins. Adult worms in humans reside in the mesenteric venules in various locations, which at times seem to be specific for each species. For instance, *S. japonicum* is more frequently found in the superior mesenteric veins draining the small intestine, and *S. mansoni* occurs more often in the superior mesenteric veins draining the large intestine (Mouhamadou *et al.*, 2024).

Pathology of *S. mansoni* and *S. japonicum* schistosomiasis includes: Katayama fever, hepatic perisinusoidal egg granulomas, Symmers' pipe stem periportal fibrosis, portal hypertension, and occasional embolic egg granulomas in brain or spinal cord. Pathology of *S. haematobium* schistosomiasis includes: hematuria, scarring, calcification, squamous cell carcinoma, and occasional embolic egg granulomas in brain or spinal cord (Llanwarne & Helmbly, 2020). Human contact with water is thus necessary for infection by

schistosomes. Various animals, such as dogs, cats, rodents, pigs, horse and goats, serve as reservoirs for *S. japonicum*, and dogs for *S. mekongi* (Elena *et al.*, 2024).

Pukuma *et al.* (2023) investigated the prevalence of urinary schistosomiasis among residents of four villages (Yamidi, Akubishin, Shawara, and Dukkun) along the Hadejia River Valley in Jigawa State, Nigeria. Urine samples from 447 individuals were tested for *Schistosoma haematobium* eggs using a concentration sedimentation technique. The study found varying rates of infection across the villages, with higher prevalence in children compared to adults. The research also noted that males showed higher prevalence during the dry season, while farmers had more cases than fishermen and other occupational groups. The analysis of haematological status revealed mild anemia among infected individuals, but no significant differences were observed in prevalence based on age, sex, or occupation.

Demelash *et al.* (2021) determined the pooled prevalence of schistosomiasis and its association with gender among school-age children in Ethiopia. The analysis reviewed 50 studies from a pool of 427 identified studies. The results showed considerable regional variation in the prevalence of schistosomiasis, with the highest rates in the southern region and the lowest in the Afar region. The study found that male children were more likely to be infected with schistosomiasis compared to female children. The overall prevalence was higher than the 2018 report by the Ethiopian Ministry of Health, indicating a persistent burden of the disease among school-age children, with a significant gender difference favoring males.

Mbereko *et al.* (2020) assessed community knowledge and perceptions of schistosomiasis in the rural, resource-poor communities of Ndumo in South Africa and Ntalale in Zimbabwe. The study found high levels of

awareness of schistosomiasis, with most respondents identifying it as a waterborne disease. While many participants in both communities recognized symptoms like blood in urine, knowledge of other signs, such as schistosomiasis eggs in stool, was much lower in Ndumo. Understanding of the body parts affected by the infection was also limited. Local perceptions of the disease's lifecycle, symptoms, and treatment varied, indicating a lack of in-depth knowledge. The study recommended health education interventions alongside improvements in water and sanitation to control and prevent schistosomiasis effectively.

Anyolito *et al.* (2022) explored knowledge, attitudes, and practices regarding schistosomiasis in western Uganda, using surveys, interviews, and focus-group discussions with 337 household adults. Findings revealed that most participants had heard of schistosomiasis, were aware of its main transmission modes and symptoms, and recognized the importance of preventing water contact and using latrines. However, many faced challenges in avoiding contact with lake water, a vital resource for fisher communities. Open defecation was common due to inadequate latrines. The study also identified misconceptions, such as the belief that lake water is safe or that fish-catching practices could prevent transmission, highlighting the need for targeted health education and infrastructure improvements to reduce infection.

Andrea *et al.* (2018) examined schistosomiasis treatment awareness among South African high school students in an endemic area. The research revealed that students did not recognize the severity of schistosomiasis or their vulnerability to it. Symptoms were often confused with sexually transmitted infections, and stigma around the disease led to reluctance in seeking treatment. The study highlighted barriers to effective

treatment, including misconceptions and social stigma, suggesting that improving knowledge and health literacy about schistosomiasis could increase student participation in mass treatment campaigns. Providing comprehensive education about the disease's severity and treatment could help reduce prevalence and improve health outcomes among students.

Diepreye *et al.* (2021) investigated the gender-based differences in *Schistosoma* infection burdens in Africa, focusing on *Schistosoma mansoni* and *Schistosoma haematobium*. The review identified numerous studies involving over 200,000 participants from 23 African countries. While the overall prevalence of infection was higher in males for both species, a substantial portion of studies did not show statistically significant gender differences. The analysis revealed that the gender disparity in infection rates varied depending on the baseline prevalence in different settings, with higher male-to-female prevalence ratios observed in areas with lower baseline infection rates. The study also identified key risk factors for infection, including occupational and recreational water contact, socio-economic factors, and demographic characteristics. The authors emphasized the need for gender-focused strategies in schistosomiasis control and recommended further studies on these variables to guide prevention efforts more effectively.

Ezeh *et al.* (2019) examined the prevalence and distribution of *Schistosoma haematobium* in Nigeria, utilizing data from the Global Neglected Tropical Diseases database and other sources. The study highlighted the varying prevalence of schistosomiasis across Nigeria, with Ogun State showing the highest prevalence, while areas like Akwa Ibom and Bayelsa reported no cases. The research also categorized Nigeria into four endemic zones: hyperendemic, moderately endemic, low

endemic, and non-endemic zones. The study identified that most dams in the hyperendemic zones harbored the intermediate hosts of schistosomes, increasing the risk of transmission. The authors stressed the urgency of conducting a nationwide survey to inform schistosomiasis control strategies and to ensure more targeted and effective interventions. Such surveys are vital for understanding the geographical spread of the disease and implementing appropriate public health measures.

Ojo *et al.* (2020) conducted a cross-sectional survey to investigate the prevalence and intensity of mixed schistosome infections among schoolchildren in South-west Nigeria. The research found a 40% overall prevalence of schistosomiasis, with a significant proportion of children affected by both *Schistosoma haematobium* and *Schistosoma mansoni* infections. Notably, mixed infections were more common in females, while males exhibited higher infection intensities. The study also highlighted the occurrence of ectopic egg elimination, with a small percentage of children showing *S. mansoni* eggs in their urine, but no such cases for *S. haematobium*. Hematuria was found to be significantly associated with certain types of infection, particularly with single *S. haematobium* and mixed infections. The study provided valuable data into the co-infection dynamics, stressing the need for targeted interventions to address the diverse manifestations of schistosomiasis in affected communities.

2.0 METHODS

2.1 Study Area

The study was conducted in a district in Ondo West Local Government. The district chose was Owena Obadore. Ondo West is a Local Government Area in Ondo State, Nigeria. The district was chosen because there are no standard pipeborne water in the area and they rely mostly on the river / stream for their daily

activities such as bathing, washing and even agricultural purposes which are more likely to predispose them to the disease, schistosomiasis. It lies between latitudes 4.45¹ and 7.52¹N and longitudes 4.20 and 6.20¹E. It has an area of 970 km² and a population of 283,672 at the 2006 census. The postal code of the area is 351. The tropical climate of the state is broadly of two seasons: rainy season (April-October) and dry season (November – March). The temperature throughout the year ranges between 21⁰C to 29⁰C and humidity is relatively high. The

annual rainfall varies from 2,000mm in the Southern areas to 1,150mm in the Northern areas. The State enjoys luxuriant vegetation with high forest zone (rain forest) in the south and sub-savannah forest in the northern fringe. There is a maze of numerous rivers, creeks and lakes in and around Ondo State with very prominent rivers like Owena, Ala, Oluwa, Oni, Awara, Ogbese and Ose. Generally, the land rises from the coastal part of Ilaje, Ese-Odo and Okitipupa areas to highlands and steps down at the Northern parts of the state.

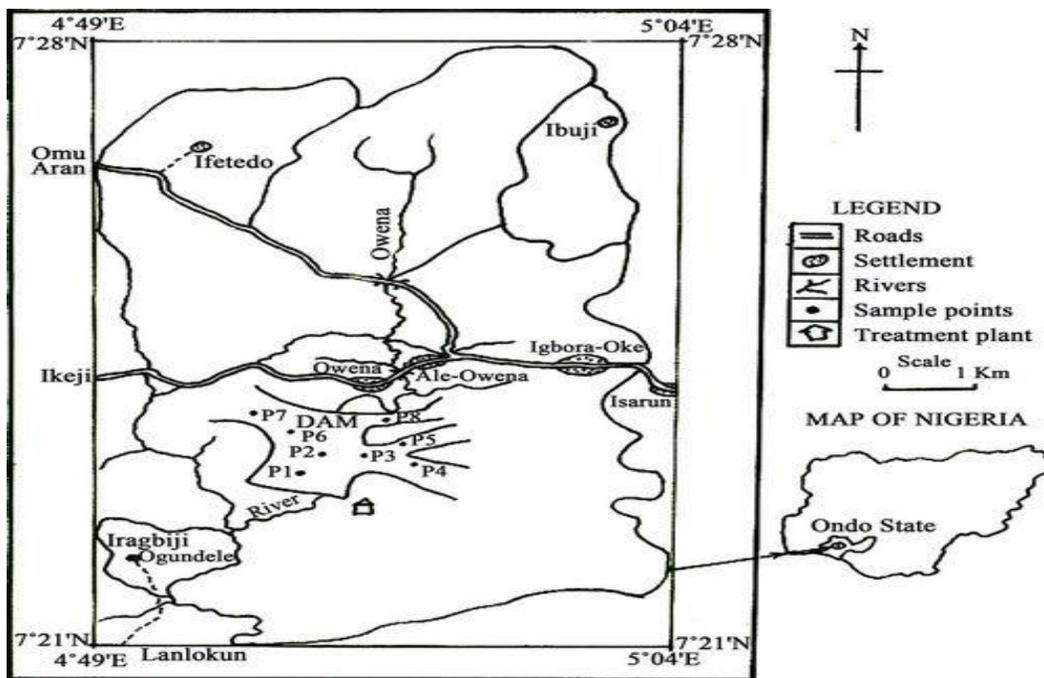


Figure 1. Map of Ondo State
Source: Oyedotun and Obatoyinbo (2012)

2.2 Ethical Approval / Informed Consent

Ethical approval for the study was obtained from the Ministry of Health, Owena districts, Ondo state and informed consent of the pupils was sort from their parents and teachers of their schools.

2.3 Materials Used

The materials used for the study were test tube, test tube rack; centrifuge; water; cotton wool; microscope glass slide; kha–tubes;

urine samples; cotton wool; slides; cover slips; microscope; gloves and collecting bottles.

2.4 Urine Sample Collection

Urine samples were collected between 10:00 and 14:00h, being the time of maximal egg output, into 3mm wide-mouthed, dry, sterile, clean bottles containing few drops of formalin (as preservative), covered tightly and

transported to the microbiology laboratory for analysis, according to Cheesbrough (2005).

2.4.1 Procedure

The sample bottles were labelled using the identification number issued to the participants. The 130 test tubes were washed while urine samples were collected. Each sample was labelled with names and age of the pupils, assuring that the urine was put inside the test tube is in same level. The urine was put in the test tube rack and plugged the centrifuge opposite and adjacent to each other and spinned for 5 minutes. The samples were put inside the centrifuge 10, 10, opposite each other and adjacent each other and spinned for 5 minutes. Thereafter, it was removed, decanted and supernatant dispensed into the test tube; tapped the test tube twice and put a drop on the slide; covered the specimen on the slide with the cover slip and put the slide inside the microscope and view both magnification of x10 wet preparation.

2.4.2 Egg Counts

The materials used for the egg counts are gloves, bottle, test tube, cotton wool, formalin, compound microscope, MC: master slide, disposable pipettes and centrifuge.

2.4.3 Egg Counts Procedure

The urine was labelled according to their gender and age with name. The test tube was sterilized. The disposable pipettes were used to draw out the urine and put 10ml inside the test tube. The four test tubes were put inside the centrifuge and spinned for 10mins. The test tube was removed and the supernatant was decanted 2 drops of the urine were put on the MC: master slide on the two lines of the slide. Thereafter, a compound microscope was used to view the egg in the urine.

2.4.4 Instrumentation

A self-developed and close ended questionnaire was used to obtain information on students' perception on source of knowledge, signs, symptoms, prevention and of schistosomiasis. The instrument comprises of two sections (A and B). Section A contains demographic information of the respondents, while section B addressed research questions pertaining to the study. The questionnaire was given to the experts in the field of epidemiology to take a critical look at the relevance of the items of the instrument in relation to the activities measured. Their suggestions were considered and approved after ensuring the content validity. A pilot study was conducted among pupils who are not part of the study population. The data collected from the pilot study was collated and analyzed using Cronbach alpha. Also, Pearson Product Moment Correlation (PPMC) was adopted in determining the reliability coefficient to the instruments and a correlation co-efficient was obtained. Reliability coefficient for the instrument was 0.91; this is an indication that the instrument used was reliable for the study within the acceptable limits.

2.5 Data Analysis

Descriptive statistics such as frequency counts, percentages and mean were used to analyse the data obtained using Statistical Package for Social Science (SPSS v.20).

3.0 RESULTS

Table 1 show that only four children were infected with the percentage prevalence of 3.08%, with 2.30% for male and 0.76% for female, respectively.

Table 1: Prevalence of haematuria in the participants

Total Population of pupils	No of Positive		No of Negative		% prevalence		Total % Prevalence
	By Gender		By Gender				
	M	F	M	F	M	F	
130	3	1	89	37	2.30%	0.76%	3.08%

Table 2 revealed that four (4) children were infected. On the first infected child, 24 eggs were found (10 eggs in right side and 14 eggs in left side); 56 eggs were found in the second infected child (40 eggs in right side and 16 eggs in left side); 32 eggs were found in the third infected child (20 eggs in right side and 12 eggs in left side); while 76 eggs were

found in the fourth infected child (50 eggs in right side and 26 eggs in left side).

Moreover, the infected child with 24 eggs was classified as “mild”, the infected child with 56 eggs was classified as “heavy”; the infected child with 32 eggs was classified as “mild” while the infected child with 76 eggs was classified as “severe”.

Table 2: Degree of Intensity of Schistosomiasis

Participants	Total of egg count	Level
Pupil 1	24 eggs	Mild
Pupil 2	56 eggs	Heavy
Pupil 3	32 eggs	Mild
Pupil 4	76 eggs	Severe

Table 3 show the sources of knowledge of the pupils with regards to the disease, schistosomiasis. The table shows that 15.4% of the respondents had the knowledge of schistosomiasis from health clinic / hospitals;

13% of the respondents were aware through the mass media; 19.7% of the respondents were aware in the school while 51.9% of the respondents have no source.

Table 3: Source of knowledge of Schistosomiasis

Health centre for schistosomiasis control	Frequency	Percentage (%)
Health clinic / hospitals	53	15.4
Mass media	45	13
School	68	19.7
No source	179	51.9
Total	345	100%

EPIDEMIOLOGICAL PROFILE OF URINARY SCHISTOSOMIASIS IN RIVERINE AREA IN ONDO WEST LOCAL GOVERNMENT (OWENA OBADORE), NIGERIA.

Table 4 shows respondents perception on signs and symptoms of schistosomiasis. The result indicates the major signs and symptoms of schistosomiasis perceived by the

respondents are: fatigue (16.2%); pale face (anaemia) (12.2%); itching (9.3%); diarrhoea (8.4%); and burning urination (8.4%).

Table 4: Perception on signs and symptoms of Schistosomiasis

Signs and Symptoms	Frequency	Percentage (%)
Haematuria	-	-
Abdominal pain	20	5.8
Diarrhoea	29	8.4
Fever	27	7.8
Burning urination	29	8.4
Blood in stool	24	7
Vomiting	22	6.4
Itching	32	9.3
Pale face (anaemia)	42	12.2
Fatigue	56	16.2
Loss of appetite	25	7.2
Cough	12	3.5
Swollen abdomen	24	7
Dysentery	1	0.3
Do not know	2	0.6

Table 5 shows the perception of respondents on prevention of schistosomiasis. The result indicates the major prevention of schistosomiasis perceived by the respondents are: avoiding swimming / bathing in ponds /

streams (20%); avoiding drinking untreated water (18.6%); avoiding washing clothes in ponds / streams (18%); washing hands before eating (17.4%).

Table 5: Perception on prevention of Schistosomiasis

Prevention	Frequency	Percentage (%)
Avoid playing with soil	12	3.5
Washing hands before eating	60	17.4
Avoid swimming / bathing in ponds / streams	69	20
Washing vegetables / fruit before eating	37	10.7
Taking anti-schistosomal drugs	39	11.3
Avoid drinking untreated water	64	18.6
Avoid washing clothes in ponds / streams	62	18
Do not know	2	0.6

4.0 DISCUSSION OF FINDINGS

The result of the finding shows a very low prevalence of 3.08% in the community, though the level of prevalence was recorded higher in males with (2.30%) compared to females with (0.76%). This finding aligns with the study of Demelash *et al.* (2021), who determined that male children were more likely to be infected with schistosomiasis compared to female children. Their analysis of various studies confirmed the higher prevalence of schistosomiasis in males, which is consistent with the higher male prevalence observed in the current study. Additionally, the finding also reflects the observations of Diepreye *et al.* (2021), who noted that the overall prevalence of *Schistosoma* infection was higher in males across various African countries. This can be attributed to increased exposure due to activities such as fishing and farming, which are more common among males. However, this finding is not in line with the study of Ojo *et al.* (2020), which reported higher infection intensities in males but found mixed infections to be more common in females, highlighting the complex nature of gender-based differences in schistosomiasis prevalence.

However, the high prevalence observed among males compared to females could be attributed to many outdoor activities engaged by males which exposed them to infected water. This finding aligns with the study by Pukuma *et al.* (2023), who identified higher prevalence rates of schistosomiasis in males during the dry season, particularly among those who engage in outdoor activities such as farming and fishing. The study suggests that the high prevalence in males is a direct result of increased water contact during these

activities. Similarly, Diepreye *et al.* (2021) stated that the gender disparity in infection rates was linked to occupational and recreational water contact, with males being more exposed to waterborne pathogens due to their engagement in outdoor activities. This finding is supported by the work of Mbereko *et al.* (2020), who also noted that occupational exposure, such as farming and fishing, plays a significant role in the higher infection rates observed in males, particularly in rural communities.

Also, the result on perception of the respondents on signs and symptoms of schistosomiasis shows that larger percentage perceived that, fatigue (16.2%) was the major symptoms while the least (0.3%) believed that dysentery was the symptom for schistosomiasis. This finding aligns with the study by Anyolito *et al.* (2022), which revealed that respondents were aware of certain symptoms of schistosomiasis, such as blood in urine, but showed limited understanding of other symptoms. Fatigue, often linked with chronic schistosomiasis, could easily be perceived as the most common symptom in the current study, reflecting a general lack of detailed knowledge about the disease. Similarly, Mbereko *et al.* (2020) found that participants in both South Africa and Zimbabwe had varied knowledge of schistosomiasis symptoms, with some only identifying the more prominent symptoms, such as hematuria, while others had limited recognition of less common symptoms. This finding contrasts with the study by Andrea *et al.* (2018), which revealed that South African high school students had limited recognition of schistosomiasis symptoms and

EPIDEMIOLOGICAL PROFILE OF URINARY SCHISTOSOMIASIS IN RIVERINE AREA IN ONDO WEST LOCAL GOVERNMENT (OWENA OBADORE), NIGERIA.

misidentified them as sexually transmitted infections, indicating a gap in awareness that may be present in the current community.

5.0 Conclusion and recommendations

The result of the finding shows a very low prevalence in the community (Owena, of their perception on symptoms was also low, they do not have clearer understanding of the symptoms enough.

Based on the results of findings of the study, further research should be carried out in the entire Ondo State to ascertain the prevalence of the infection and the presence of snail species involved in transmission in the area, which will provide a better epidemiological data for the state as a holistic approach for the prevention and control programs in the state. The government should also be proactive in organising awareness programs for mostly people in remote areas, so as to be more enlightened and informed on the decapitating effect of the disease.



Plate 1. Picture of some participants used for the study

Obadore) riverine area in Ondo West Local Government. The source of awareness on schistosomiasis in the community was low, as larger percentage do not have source of information.



Plate 2: A picture depicting the researcher and the participants bathing in the river located in Obadore Area, Ondo West Local Government

REFERENCES

- Adedotun, S. B., Adedotun, O. D., Ogundahunsi, D. S., & Ewedairo, S. K. (2024). Assessment of water supply and water quality in the rural area of Obokun Local Government, Osun State, Nigeria. *Peer-Reviewed Preprint Manuscript*, 3, 1-15.
- Anyolito, M., Poels, K., Huyse, T., Tumuslime, J., Mugabi, F., Tolo, C., Masquillier, C., & Nyakato, V. (2022). Knowledge, attitudes, and practices regarding schistosomiasis infection and prevention: A mixed-methods study among endemic communities of western Uganda. *PLOS Neglected Tropical Diseases*, 16(2), e0010190. <https://doi.org/10.1371/journal.pntd.0010190>

- Andrea, L., Nqobile, Z., Ame, O., Eyrun, F., & Myra, T. (2018). Treating schistosomiasis among South African high school pupils in an endemic area, a qualitative study. *BMC Infectious Diseases*, 18, 239-249. <https://doi.org/10.1186/s12879-018-3180-x>
- Cheesbrough, M. (2005). *District laboratory practice in tropical countries* (2nd ed., Vol. 1). Cambridge University Press.
- Demelash, W., Biniyam, S., Yohannes, T., & Zeleke, H. (2021). Prevalence of Schistosomiasis (*S. mansoni* and *S. haematobium*) and its association with gender of school-age children in Ethiopia: A systematic review and meta-analysis. *Parasite Epidemiology and Control*, 13, e00210. <https://doi.org/10.1016/j.parepi.2021.e00210>
- Diepreye, V., Jessica, C., Helena, B., Poppy, H., Jaspreet, T., & Deirdre, H. (2021). Gender-related differences in prevalence, intensity, and associated risk factors of *Schistosoma* infections in Africa: A systematic review and meta-analysis. *PLOS Neglected Tropical Diseases*, 15(11), e0009083. <https://doi.org/10.1371/journal.pntd.009083>
- Elena, P., Angelina, M., Andrea, M., Martina, P., Carmelo, B., & Giuseppe, M. (2024). Insights into the epidemiology, pathogenesis, and differential diagnosis of schistosomiasis. *European Journal of Microbiology and Immunology*, 14(2), 86-96. <https://doi.org/10.1556/1886.2024.00014>
- Ezeh, C. O., Onyekwelu, K. C., Akinwale, O. P., Shan, L., & Wei, H. (2019). Urinary schistosomiasis in Nigeria: A 50-year review of prevalence, distribution and disease burden. *Parasite*, 26, 1-10. <https://doi.org/10.1051/parasite/201901010>
- Llanwarne, F., & Helmby, H. (2020). Granuloma formation and tissue pathology in *Schistosoma japonicum* versus *Schistosoma mansoni* infections. *Parasite Immunology*, 43, e12778. <https://doi.org/10.1111/pim.12778>
- Mawa, P. A., Kincaid-Smith, J., Tukahebwa, E. M., Webster, J. P., & Wilson, S. (2021). Schistosomiasis morbidity hotspots: Roles of the human host, the parasite, and their interface in the development of severe morbidity. *Frontiers in Immunology*, 12, 635869. <https://doi.org/10.3389/fimmu.2021.635869>
- Mbereko, A., Chimbari, M., Manyangadze, T., & Mukaratirwa, S. (2020). Knowledge and perceptions of schistosomiasis, a water-borne disease, in two semi-arid rural areas of South Africa (Ndumo) and Zimbabwe (Ntalale). *Food and Waterborne Parasitology*, 21, e00091. <https://doi.org/10.1016/j.fawpar.2020.e00091>

EPIDEMIOLOGICAL PROFILE OF URINARY SCHISTOSOMIASIS IN RIVERINE AREA IN ONDO WEST LOCAL GOVERNMENT (OWENA OBADORE), NIGERIA.

- Mouhamadou, G., Doucoure, S., Sow, D., Sokhna, C., & Ranque, S. (2024). Freshwater snail-borne parasitic diseases in Africa. *Tropical Medicine and Health*, 52, 1-18. <https://doi.org/10.21307/tmh-2024-021>
- Oyedotun, T. D. T., & Obatoyinbo, O. (2012). Hydro-geochemical evaluation of groundwater quality in Akoko North West Local Government Area of Ondo State, Nigeria. *Ambi-Agua, Taubaté*, 7(1), 67-80. <https://doi.org/10.4136/ambi-agua.1105>
- Ojo, J. A., Adedokun, S. A., Akindele, A. A., Olorunfemi, A. B., Otutu, O. A., Ojuronbe, T. A., Thomas, B. N., Velavan, T. P., & Ojuronbe, O. (2020). Prevalence of urogenital and intestinal schistosomiasis among school children in South-west Nigeria. *PLOS Neglected Tropical Diseases*, 15(7), e0009628. <https://doi.org/10.1371/journal.pntd.009628>
- Oyime, P. A., Donald, P. M., Malcolm, K. J., & Catherine, A. G. (2021). Schistosomiasis with a focus on Africa. *Tropical Medicine and Infectious Disease*, 6, 109. <https://doi.org/10.3390/tropicalmed6030109>
- Philip, T. L. (2019). Schistosomiasis. *Advances in Experimental Medicine and Biology*, 3, 45-70. https://doi.org/10.1007/978-1-4614-6435-8_5
- Pukuma, M. S., Qadeer, M. A., Abubakar, S., Inuwa, Y., & Umar, S. (2023). Prevalence of urinary schistosomiasis among communities residing along Hadejia Valley, Jigawa State, Nigeria. *Dutse Journal of Pure and Applied Sciences (DUJOPAS)*, 9(4), 209-226. <https://doi.org/10.36610/djopas.2023.09.04.04>
- World Health Organization. (2023). *Country disease outlook – Nigeria*. <https://www.afro.who.int/sites/default/files/2023-08/Nigeria.pdf>