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ORIGINAL RESEARCH ARTICLE

Evaluation of Control Strategies and Current Status of Schistosomiasis in Some Endemic Areas of Nasarawa State: A Community-Based Survey Using Advanced Diagnostic Methods

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ABSTRACT
Schistosomiasis remains a significant health challenge in Nigeria, requiring updated assessments of control strategies to guide future interventions. Despite a decade of control efforts, Schistosomiasis remains endemic in Nasarawa, with varying prevalence across LGAs. Urgent improvements in funding and integrated strategies are recommended. Nasarawa state control programs targeting children have been implemented since the 1990s. A school-based survey by the Carter Centre in 2013 identified high prevalence in several Local Government Areas (LGAs), leading to five years of Mass Drug Administration (MDA). By 2018, follow-up surveys showed a modest decline in prevalence from 12.9% to 9.0%. However, control efforts have not achieved substantial success. Therefore, in this study, we conducted a community-based survey to assess the effectiveness of current control strategies and the schistosomiasis burden in Nasarawa State. Samples were collected from 900 participants (52.4% male, 47.6% female) across three LGAs. Diagnostic methods included dipstick haematuria tests, urine filtration, Kato-Katz techniques, and polymerase chain reaction (PCR) assays for species-specific DNA detection. Overall prevalence was 11.3%, with Nasarawa LGA recording the highest prevalence (14%), followed by Doma (13%), and Akwanga showing the lowest (7.7%). *Schistosoma haematobium* was the predominant species (9.3%), compared to *Schistosoma mansoni* (2%). The study highlights a moderate prevalence of Schistosomiasis, particularly *S. haematobium*, despite existing control programs reducing infection burden. Limitations in the current methods were identified, including insufficient coverage and focus on school-aged children. The study recommends expanding surveillance to include other high-risk groups, integrating control strategies, and increasing funding from federal, state, and non-governmental organizations to achieve more effective control.

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INTRODUCTION
Schistosomiasis (also known as bilharziasis) is a parasitic disease caused by several species of digenean trematode flatworms belonging to the genus *Schistosoma*. The disease is most closely associated with some regions of Asia, Africa, and South America, mainly where freshwater snails are intermediate parasite hosts. Schistosomiasis is endemic in 76 countries, causing millions to suffer, especially in developing regions with insufficient access to clean water and sanitation (World Health Organization [WHO], 2010). Worldwide, about 700 million people are at high risk of infection, routinely exposed to infested waterbodies during agricultural, domestic, and recreational activities. Worldwide, more than 207 million people are currently infected, with 85% of these cases in Africa, where poverty and poor healthcare compound the problem (World Health Organization (WHO), 2010; Barnabas et al., 2012).

The disease leads not only to stunting, anaemia, and poor academic performance but also has widespread socio-economic and developmental implications, especially for children. These health effects create cycles of poverty and restrict future opportunities for impacted populations. The main factors for high schistosomiasis prevalence include extreme poverty, ignorance about the disease and its risk factors, inadequate public health infrastructures, and poor living conditions in tropical regions (WHO 2007). Five prominent species of Schistosoma cause the disease. *S. mansoni, S. japonicum, S. mekongi, and S. intercalatum* cause intestinal and hepatosplenic

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Schistosomiasis; *S. haematobium* causes urinary and genital Schistosomiasis.

In Africa, Schistosomiasis has a focal nature, with changes in prevalence over short distances (5–10 km). This appears to be related to the presence of water bodies that can sustain transmission. This makes natural water sources like ponds, streams, rivers, and lakes, as well as man-made sources like dams, irrigation canals, and reservoirs, perfect environments for the intermediate snail hosts. Factors like water chemistry, temperature, vegetation, turbidity, and flow dynamics – which are called environmental factors – have critical roles in transmission. Disease distribution is also sensitive to socio-economic factors, such as access to piped water, sanitation, and education. However, not all water bodies are vectors of transmission, which depends on the presence of snail hosts and human immersion in these water bodies.

According to data from 2006, Nigeria is estimated to have 116 million people at risk (out of 555 million vulnerable Africans) from Schistosomiasis, the African country with the highest burden of the disease (Hotez and Kamath, 2009). Three decades after efforts to control the disease began, much remains to be learned about its distribution and prevalence, particularly at more localized levels. Such (sub)national-level data are too coarse to facilitate the appropriate allocation of resources for control and treatment interventions.

One of the regions suffering a lot from Schistosomiasis is the Narasawa State in the central region of Nigeria. School-aged children (4–13 years) are especially susceptible due to inadequate hygiene behaviors and restricted availability of safe water (Rine et al., 2013). To date, despite gradual advancements, Schistosomiasis has not been sufficiently annexed with respect to its long-term consequence on overall public health as well as the prevalence of the disease in this area. Other contributory factors include the ignorance of disease low access to safe drinking water in schools and homes, which increase children's exposure to the infection (Ezhim et al., 2015). Although several studies have investigated the prevalence of urinary Schistosomiasis in specific parts of Nasarawa State (Adekoya, 2016), the availability of data on the extent of the disease over different transmission settings and their correlates is rare. This lack of knowledge emphasizes the demand for focused intervention design and delivery research.

The National Schistosomiasis Control Programme in Nigeria started in 1988 which aimed to distribute the anti-helminthic drugs to 75% or more of school-age children in areas of endemicity, consistent with WHO guidelines. Yet the program's success has been hampered by a lack of resources, limited coverage, and inadequate monitoring. Schistosomiasis remains one of the most critical public health issues worldwide, especially in rural communities where increased activities such as irrigation, fishing, and hydroelectric projects exacerbate exposure. The disease can also be associated with serious health complications such as bladder cancer, liver dysfunction, and anaemia. The localization of the disease and thus the requirement for region-specific interventions were further emphasised by studies from different parts of Nigeria that reported prevalence rates of between 0.3% to 13.6% in the years between 2006 and 2009 (Atu et al., 2006; Ibrahim et al., 2006; Mordi and Ngwodo, 2007; Fadeyi et al., 2009; Okonko et al., 2009; Uneke et al., 2009).

This study set out to bridge these critical knowledge gaps by examining the status of Schistosomiasis in Nasarawa State more than a decade after the commencement of control efforts. The detailed objectives are: (1) to assess of current prevalence of Schistosomiasis in the study sites, (2) to determine the species of *Schistosoma* that is responsible for the infection in the area, (3) to assess the effectiveness of the current control strategies for Schistosomiasis in Nasarawa State, and (4) to assess the overall condition of the disease in the state and its effects on the public health of the state.

MATERIALS AND METHODS

Study Areas

The study area for this research is Nasarawa State, which was carved out of Plateau State in October 1996. It is one of the eleven States in Nigeria's Middle Belt Region. Geographically, the State is located between latitude 7° 45"N to 9° 25"N and longitude 7° "E to 9°"E of the equator of the Greenwich meridian. It is bordered by Kaduna State to the North, Plateau State to the East, Taraba State, and Benue State to the south, while Kogi State and Federal Capital Territory are flanked in the west. The state has a land area of 27,1378 square kilometers and a population of about 1,826,883, estimated with a density of about 67 persons per square kilometer. The State is divided into 3 senatorial zones (i.e., Zone 1, 2, and 3) with a total of 13 local government areas i.e Karu, Kokoma, Nasarawa, Toto, Keffi, Doma, Kaena, Obi, Awe, Akwanga, Wamba, Kokona and Nasarawn Eggon (Figure 1). Akwanga, Doma and Nasarawa LGA's were selected for the study due to their proximity to water bodies and historical disease prevalence.

Training of Supporting Team

The training of the supporting team on the use of Kato-Katz techniques (for stool analysis), Filtration technique (for urinalysis), and combi 9 (for urinalysis) was conducted at the School of Remedial Studies Nasarawa State University by Professor G.A. Amuga. The research student and other 6 personnel were trained and participated in the exercise. The survey team comprises 3 laboratory scientists and 3 field teams. Training was cascaded for the field teams on the mapping methodology, community mobilization, and sample collection, while Laboratory staff were trained on sample collection and examination.

Administration of questionnaire

A structured questionnaire was administered to the male and female participants, age group 4-24, from Nasarawa local government, Doma Local government, and Akwanga local government. This was conducted before the commencement of the study to obtain the personal data of the participants, the source for drinking and bathing water, signs and symptoms of the diseases, attitudes, and practices of the participants that make them easy to contract the disease, knowledge of the diseases the control strategy information and educational level of the parents.

Ethical Clearance

An introductory letter was obtained from the Department of Zoology. During the study, an Ethical clearance was obtained from the Ethical Board of the Ministry of Health Nasarawa State, while ethical permission was obtained from the Nasarawa State Health Care Development Agency for the study areas.

Figure 1: Map of Nasarawa showing the study Areas
Source: Resaechgate.net

Population, Sample, and Sampling Techniques

The study population comprised participants from Nasarawa, Doma, and Akwanga Local Government Areas of the State because of the proximity of these areas to water bodies, records of previous studies, and to represent the entire population of the State.

The sample size was determined using the method of Sarmukaddan and Garad (2006) as follows:

$$n = \frac{Z^2 PQ}{L^2}$$

Where n = sample size
Z = standard normal distribution at 95% confidence interval = 1.96
p = prevalence rate, which is taken as 75% = 0.75

$$Q = 1 - P$$

$$Q = 1 - 0.75 = 0.25$$

L = allowable error, which is taken as 5% = 0.05

Therefore, $n = \frac{1.96^2 \times 0.75 \times 0.25}{0.05^2} = 288.12 \approx 300$

The least number of specimens to be collected for the study, as calculated, is 300 from each local government;

hence, 900 specimens were collected from the 3 local governments.

Methods of Data Collection

Snail Intermediate Host Survey

Snail intermediate hosts were examined at the study locations (sections) by agencies in statistically approved data collection sites. Nong khe sampling was performed on a long-handed scoop net. Where applicable, manual searches of the snails from different objects in the water bodies were done, with forceps picking up snails one by one. Snail intermediate hosts were observed in Doma (Rafin kusufa, Okpa-ose, okpago osota, okrpiripu, omenza), Akwanga (kogin agbo, Kogin Nghalende, kogin dedo) and Nasarawa (kogin hayi, kogin central, kogin baba gara) (Table 8). A lengthy hand using a scoop net was adopted. For the scoop net, 15 random scoops were taken at each stream for approximately 45 minutes/site. Any snails that did turn up during the survey were hand-picked while wearing gloves. The species are identified based on the shape of the outer shell (plates I). Most species can be identified using simple morphological keys. Snails can be divided into two main groups: the aquatic snails that dwell underwater and do not tolerate life out of water (e.g., Biomphalaria, Bulinus).

Examination of Snails

Upon reaching the laboratory, the snails were segregated and identified using standard keys described by Brown and Christensen (1993). Each species was analyzed in isolation. Ten snails were put into each 250ml glass beaker. One hundred millilitres (100ml) of water was added and put in sunlight for 30 minutes to help snails shed their cercariae. The cercariae in water were examined under a dissecting microscope. For each individual that tested positive for cercariae, each snail was isolated and moved into a separate beaker, and 10mls of water was added to each one. All beakers were then positioned under a light source for 30 minutes, and the water was examined for cercariae. The positive ones were separated from the negative ones, totaled in their respective groups, and wrote down them.

Collection and analysis of the stool and urine samples

Then, participants were asked to give a midstream urine sample using sterile specimen bottles. Urine samples ranged from straightforward, amber, pale, cloudy, and bloody. Haematuria was diagnosed using a Combi-9® reagent strip, and schistosome eggs were examined in the laboratory using the urine filtration technique of Kosinski et al. (2011). After that, stool samples were collected from study participants in sterile specimen bottles. The Kato-Katz technique (WHO,1991; 2010) was used to check stool samples collected from the field, looking into the existence of eggs for parasites. All stool samples were preserved with 10% formalin solution and urine samples with 1% domestic bleach (Ladan et al., 2011) and refrigerated before transfer to the Nigerian Institute of Medical Research Center YABA Lagos state for molecular work. The intensity of the infections was classified as heavy (_400 EPG), moderate (100–399 EPG), or light (1–99 EPG) according to the parameters proposed by the WHO (2002), and egg counts were expressed, and recorded as eggs per gram of faeces (EPG) for each positive sample to calculate the incidence of worm burden. Urine samples were also tested for haematuria by dipstick test (Chuncheon, Korea) (Kosinski et al. 2011), followed by microscopically examining the filtered residue for eggs of *S. haematobium* from each urine sample (World Health Organization, 1991). Additionally, *S. haematobium* egg counts were performed and recorded in eggs per 10 millilitres of urine (EP10ml) with infection intensity classified as heavy (epg>50 EP10ml) or light (1–50 EP10ml) (WHO, 2002). A total of 20% of the samples were reexamined for *Schistosoma* eggs for quality control.

Syringe Filtration Procedure

Urine filtration is one of the methods recommended by the WHO for the detection of *S. haematobium* infection, mainly in high-prevalence communities, in addition to egg Count-based criteria are recognized as effective measures for identifying communities with high, moderate, or low risk for Schistosomiasis (WHO, 2006).

Urine samples were collected from the trained participants and analyzed as described by Adeoye and Akabo (1996) following the above method using the standard filtration technique. A 5.5 cm filter paper (Whatman) was fitted on the filter assembly. The urine sample was shaken, and 10 ml was withdrawn using a syringe and injected into the filtration unit. The filter paper was gently lifted using forceps, put on a clean paper, and stained with one or two drops of iodine and 50% ninhydrin solution after filtration. After drying for around 15 sec, the stained filter paper was placed on a clean glass slide and systematically observed in the microscope at ×10 and ×40. The complete eggs were counted using the SAGE microscope (Carl Zeiss, Gottingen, Germany) and recorded as the number of eggs per 10 ml of urine.

Dip sticks Procedure

Urine dipsticks for micro haematuria in urogenital Schistosomiasis have been proposed as a cheap and rapid way of estimating prevalence of infection (Traore et al., 1998). The presence of blood in the urine micro or macro haematuria has been shown to correlate well with *S. haematobium* infection in the field, particularly among communities with a high prevalence of *S. haematobium* infection. As per the World Health Organization (WHO, 2006) guidelines for preventive chemotherapy, the prevalence of haematuria and egg count-based criteria are known genuine criteria to see the population with high, moderate and low risk for Schistosomiasis.

In this study, fresh urine specimens were collected in clean plastic containers. Field test of specimens was conducted within 2 hours of collection: where field testing was not possible, specimens were kept in refrigeration whenever feasible. A reagent strip is taken from its vial (the vials were halved to save the reagent) and labelled according to patient id. The strip's reagent areas were completely submerged in urine specimens for several seconds. After removal, the edge of the strip was wiped along the rim of the container to remove excess urine. To avoid contamination of chemical mixes, the strip was oriented horizontally on a flat surface. The strip was read 1 to 2 minutes post-immersion, and the colour of the strip was matched against the colour of the chart slotted on the bottle label. The results were entered on the monitoring form as under:

- "0" for a negative result.
- "1" trace non-haemolysed.
- "2" for trace haemolysed.
- "3" for +.
- "4" for ++.
- "5" for +++.

Kato-Katz Technique

The Kato-Katz technique is a standard tool employed in epidemiological surveys of intestinal helminths. This is utilised as a part of monitoring and evaluation programs, primarily for the detection and geographical distribution of STH and *S. mansoni* infections, which concomitantly delineates the endemicity of a region pre-control (to ascertain the treatment algorithm to be employed) (Hugo et al., 2017) similarly the Kato-Katz technique is used in post-treatment surveys to determine the control impact through identifying the prevalence and intensity of infection.

The WHO recommends a standardized diagnostic and quantification method, such as the Kato-Katz technique (WHO, 2002), to diagnose soil-transmitted helminth (STH) and *Schistosoma mansoni* infections since the Kato-Katz technique provides a standardized reading (eggs per gram of faeces (EPG)) and the method can be taught to laboratory microscopists relatively quickly. This is done by taking a small amount with a spatula and spreading it on a slide template that ensures a standardised amount of faeces will be examined under a microscope and the eggs counted. Although the technique can be performed without elaborated biomechanics or equipment, it is labour intensive and demands familiarity with microscopy.

In this study, a small amount of faecal material was put on newspaper or scrap paper, and press the small screen over the faecal material so that part of the faeces sieved through the screen and accumulated over the screen.

Stool samples were sieved with a plastic sieve of 0.75 mm pore size. The upper screen was thoroughly scraped in a horizontal position with a flat-sided spatula so that the sieved faeces collected could be collected on spatula. Using a spatula, open a clean template and place it on a clean glass slide; fill the hole on the template with the sieved stool. After removing the template, a plug (approximately 50 mg) of stool remained on the glass slide. The pre-soaked cellophane strip covers the faeces. In a dry climate, that will slow and inhibit the drying process but will not stop it entirely. The faecal sample was ruled adhered between the flipped microscope slide and the hydrophilic cellophane; this applied pressure caused even distribution of the faecal material to form between the microscope slide and the cellophane strip. It was then examined at lower powers of magnification of ×10 and ×40; the assessment was logistically documented and reported as the number of eggs per 50 mg of stool.

PCR, Gel Electrophoresis, and Sequencing of Schistosome Cell-Free Repeat DNA

To confirm the presence of *S. mansoni* (121 bp), *S. haematobium* (121 bp), or both species within extracted DNA, species-specific primers (*S. mansoni* : *SmPF*: 5' GAT CTG AAT CCG ACC AAC CG 3' and *SmPR*: 5' ATA TTA ACG CCC ACG CTC TC 3'; *S. haematobium* : ShDra1F: 5' TCA CAA CGA TAC GAC CAA C 3' and ShDra1R: 5' GAT CTC ACC TAT CAG ACG AAA C 3') (Hessler et al., 2017) were used to amplify repeat DNA fragments. Approximately 12% (600,000 copies per cell) of the *S. mansoni* (Hamburger et al., 1991) genome and 15% of the *S. haematobium* genome was comprised of a long repeat sequence and were available during this study. These are short tandem repeats (121 bp) non-coding sequences and are evolutionarily and genetically distinct from one another and species-specific for *S. mansoni* and *S. haematobium*. The 20 µL PCR reaction volume contained 4 µL of Master Mix (New England Biolabs, Ipswich, MA), 0.5 µL of each 10 µM primer (forward and reverse), 2 µL of DNA (1 µL for controls), and the 13.5 µL nuclease-free water. Positive controls were prepared with genomic DNA for *S. mansoni* and *S. haematobium* (BEI Resources, VA). This was treated with no-template negative control of extracted DNA from urine and stool of people never exposed to Schistosomiasis collected in Victoria Island Lagos and corresponding water control from nuclease-free water. For *S. mansoni* amplification, the initial denaturation step was performed at 95 °C for 10 min., followed by 35 cycles of denaturation at 95 °C for 30s, annealing at 65 °C for 90 s., and extension at 72 °C for 1 min. Then, 10 min of final extension at 72 °C. Analyses of *S. haematobium* were performed following the same steps except at 61 °C for 90 s during the annealing step. Each sample was amplified at least twice for each set of primers. In case any contamination issue related to negative and blank controls turned positive, all the results of that sample run were rejected, and PCR was repeated for that

sample run. Specific identification was confirmed by PCR, which provides superior sensitivity and specificity compared to microscopy.

Amplified products of all PCR were run on 2 agarose gel for confirmation of amplification of the desired size amplicon. 5 µl of PCR products from individual samples were loaded onto a 2% agarose gel (SYBR Green I; Life Technologies, NY) run alongside a 50 bp DNA ladder (New England BioLabs, MA). Sequencing was performed on random samples to verify the amplification of the species-specific DNA fragment that PCR amplified.

To characterize the amplified cell-free repeat DNA fragments that were positive for *S. mansoni* and *S. haematobium*, we sequenced 12 samples. To prepare these PCR product samples for sequencing, they were cleaned up using ExoSAP-IT (Affymetrix Inc., OH), and sequencing reads were obtained. The amplified fragments were only compared for sequence identity against the NCBI GenBank (ncbi.nlm.nih.gov) if the top search result was accepted.

Data Analysis

Prevalence was recorded as a percentage. The data collected from the questionnaire were ranked and analysed with the help of SPSS version 20.0. The significant association in the prevalence of parasite eggs identified among the Participants was compared using Chi-square. T-test was used to compare the significant difference between male and female pupils ($P<0.05$). Statistical analysis of differences in infection positivity among various age groups was done using one-way analysis of variance (ANOVA); $P<0.05$. The likelihood ratio was applied to assess the association of infection with risk factors.

RESULTS

Current status of Schistosomiasis in Nasarawa State

A Schistosomiasis survey was conducted in Nasarawa State in previously endemic areas, covering 3 Local Government Areas (LGAs) from 3 senatorial zones of the state. Samples were collected from 900 study participants, of which 472 (52.4%) were males. While 428(47.6%) are females as shown in Table 5. The age range of the sampled participants was between 4-9 years (178), 10-14 years (284), 15-19 years (245), and 20-24 years (193) as shown in Table 4.

The overall prevalence of diseases indicates that 102 (11.3%) participants are infected with the parasite, as shown in Table 1. The result revealed that both *Schistosoma* parasites are still endemic in all 3 LGAs. However, data captured by LGAs showed that the prevalence of infections varied from low to medium risk. In the 3 LGAs surveyed for Schistosomiasis, the highest prevalence was recorded in Nasarawa LGA (14%), followed by Doma (12.3%), while the lowest values were recorded in Akwanga (7.7%), and results show significant differences among the endemic areas ($P<0.05$). *Schistosoma haematobium* (9.3%) was the predominant species in the survey compared to *Schistosoma mansoni* (2%), as presented in Table 1. The result shows a higher significant difference in infection between the *S haematobium* and *S mansoni* in the endemic areas ($P<0.05$). Of the 9.3% of Participants positive for *S. haematobium,* the highest prevalence was observed in Nasarawa LGA (11.0%) followed by Doma (10.3%), and the lowest was in Akwanga LGA (6.7%) (Table 2). Of the 2.0% that were positive for *S. mansoni*, Nasarawa LGA ranked highest with a prevalence of 3.0%, followed by Doma at 2.0%, while Akwanga has 1.0% ranked the lowest for the infection (Table 3). The infection distribution by age shows that 10 – 14 years have the highest prevalence of 16.5 %, followed by the age group 15-19 years with an infection percent of (14.3%) and the least was recorded in the age group 04-09 years (4.5%) (Table 4), this shows significant difference among the age group in the study areas ($P<0.05$). The prevalence of the disease is higher in males (16.7%) than in females (5.4%); the result shows higher significant differences among the genders in the endemic areas ($P<0.05$) (Table 5). The prevalence by parasite showed that *S. haematobium* is higher in males at 13.8%, while in females is 4.4% (Table 5). Also, this study found that the prevalence of *S. mansoni* was higher in males, at 3.0%, than in their female counterparts, with 0.9% (Table 5). During the study, 4 participants were co-infected, where 0.6% was recorded in males while 0.2% was recorded in females (Table 5). The result of this study indicates that Schistosomiasis is in both moderate risk and low intensity in Nasarawa and still endemic in the study areas (Tables 2 and 3).

Table 1: Overall Prevalence of Schistosomiasis by Local Government in Nasarawa State

LGA	No. Examined	No. Infected (%)	*S. Haematobium*	*S. mansoni*	Mix Infection (%)
Akwanga	300	23 (7.7)	20 (6.7)	3 (1.0)	1 (0.6)
Doma	300	37 (12.3)	31 (10.3)	6 (2.0)	0 (0.0)
Nasarawa	300	42 (14.0)	33 (11.0)	9 (3.0)	3 (0.1)
Total	**900**	**102 (11.3)**	**84 (9.3)**	**18 (2.0)**	**4 (0.4)**

P<0.05

Table 2: Prevalence and Intensity of *Schistosoma haematobium* by Local Government

LGA	No. Examined	No. Infected (%)	Intensity/10ml Urine		
			Low (%)	Moderate (%)	High (%)
Akwanga	300	20 (6.7)	20 (6.7)	0 (0.0)	0 (0.0)
Doma	300	31 (10.3)	29 (9.7)	2 (0.7)	0 (0.0)
Nasarawa	300	33 (11.0)	32 (10.7)	1 (0.3)	0 (0.0)
Total	**900**	**84 (9.3)**	**81 (9.0)**	**3 (0.3)**	**0 (0.0)**

P<0.05

Table 3: Prevalence and Intensity of *S. mansoni* by Local Government

LGA	No. Examined	No. Infected (%)	Intensity/10ml Urine		
			Low (%)	Moderate (%)	High (%)
Akwanga	300	3 (1.0)	3 (1.0)	0 (0.0)	0 (0.0)
Doma	300	6 (2.0)	6 (2.0)	0 (0.0)	0 (0.0)
Nasarawa	300	9 (3.0)	9 (3.0)	0 (0.0)	0 (0.0)
Total	**900**	**18 (2.0)**	**18 (2.0)**	**0 (0.0)**	**0 (0.0)**

P<0.05

Table 4: Age Specific Prevalence of Schistosomiasis

Age	No. Examined	No. Infected (%)	*S. Haematobium*	*S. mansoni*	Mix Infection (%)
< 09	178	8 (4.5)	5 (2.8)	3 (1.7)	1 (0.6)
10 - 14	284	47 (16.5)	42 (14.8)	5 (1.8)	2 (0.7)
15 - 19	245	35 (24.3)	28 (11.4)	7 (2.9)	1 (0.6)
> 20	193	12 (6.2)	9 (4.7)	2 (1.6)	0 (0.0)
Total	**900**	**102 (11.3)**	**84 (9.3)**	**18 (2.0)**	**4 (0.4)**

P<0.05

Table 5: Sex Specific Prevalence of Schistosomiasis

Gender	No. Examined	No. Infected (%)	*S. Haematobium*	*S. mansoni*	Mix Infection (%)
Male	472	79 (16.7)	65 (13.8)	14 (3.0)	3 (0.6)
Female	428	23 (5.4)	19 (4.4)	4 (0.9)	1 (0.2)
Total	**900**	**102 (11.3)**	**84 (9.3)**	**18 (2.0)**	**4 (0.4)**

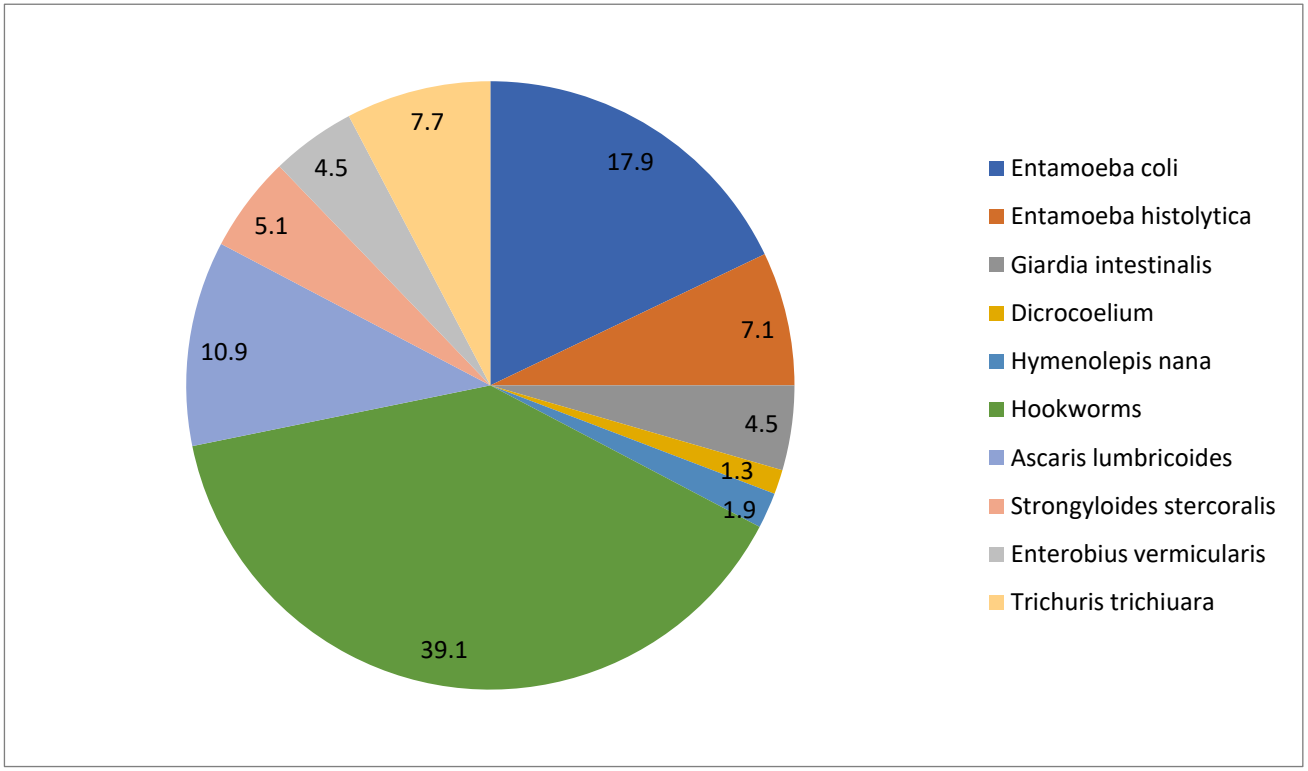

Figure 2: Other Parasite Encountered

Other Parasites Encountered

During the study, a total of 156 other intestinal parasites were encountered. The study revealed a low prevalence of these parasites, which were protozoa and other nematodes. The other parasites included protozoans such as *Entamoeba coli,* 28(17.9%), *Entamoeba histolytica* (7.1%), *Giardia intestinalis*, (4.5%) and helminths- *Dicrocoelium* species, 2(1.3%), *Hymenolepis nana*, (1.9%), Hookworms, 61(39.1%) *Ascaris lumbricoides*, 17(10.9%), *Strongyloides stercoralis*,(5.1%), *Enterobius vermicularis*, (4.5%) and *Trichuris trichiura*, (7.7%). Entamoeba coli had the highest prevalence among the Protozoans, while hookworm had the highest prevalence among the nematodes (Figure 2).

Schistosome Species Specific Identification Through Gene Sequencing

For *S. mansoni* and *S. haematobium*, this study used 121 bp fragment (Plate 1). Species identification was based on random samples sequenced. All the sequences in GenBank were compared with the sequences.

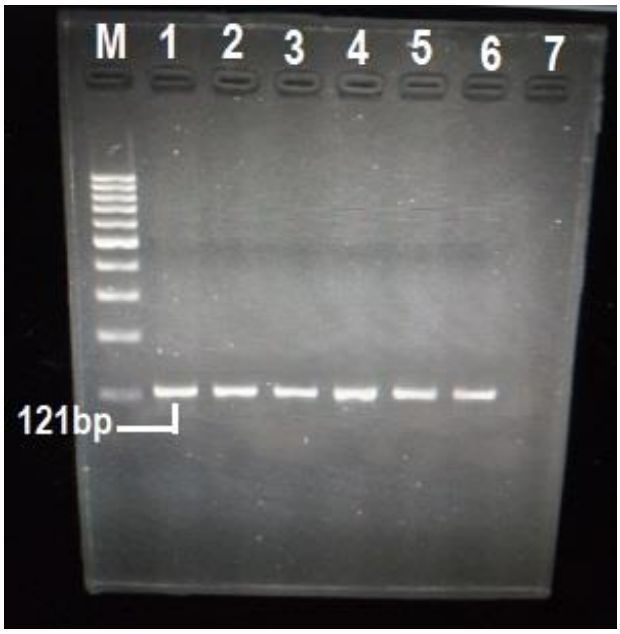

Plate 1: Detection of 121 bp of DraI repeat sequence of *Schistosoma haematobium* and 121 bp of SM1 repeat sequence of *Schistosoma mansoni* employing Sh primers. M = 100 bp size markers, lane 1 = positive control for *Schistosoma haematobium*, lanes 2 and 3 = egg-positive samples for *Schistosoma haematobium*, lane 4 = positive control for *Schistosoma mansoni*, lanes 5 and 6 = egg-positive samples for *Schistosoma mansoni samples*, and lane 7 = blank.

In *S. mansoni,* the 121 bp Sm1-9 repeat fragment (GenBank: M61098. 1) and for *S. haematobium,* the 121 bp Dra1 repeat fragment [GenBank: DQ157698. 1) were employed, and the outcome was configured as the best-matched with 98% - 100% identity. Multiplex PCR with species-specific primers demonstrated the amplified fragment and high homology, and sequencing showed validation of species-specificity primers and also the uniqueness of repeat fragments of both schistosome species.

For *S. haematobium*, this work uses a DraI repeat sequence of 121 bp with Sh primers with M 100 bp as size markers (lane 1 is a positive control, lanes 2 and 3 are egg-positive samples from Nasarawa State (Plate 1). In contrast, 121 bp of SM1 repeat sequence were also utilized using Sh primers for S. mansoni. Where lane 4 was the positive control, lanes 5 and 6 were egg-positive samples from Nasarawa state, and lane 7 was the blank.

Evaluation of Status of Schistosomiasis in Nasarawa State

The research also revealed that Carter Centre conducted Statewide mapping studies in 2013 in selected Local Government Areas (LGAs) in Nasarawa State, where 11,332 school-aged children were sampled from 226 schools. The LGAs then received different combinations of MDA for 5 years. Then, in 2018, the Centre repeated the exercise, revisiting 196 (87%) schools, adding another six (totaling 202 schools), and taking blood samples from 9,660 children. The centre determined the overall prevalence and intensity of infection and examined associations with sex, age, behaviours; water, sanitation, and hygiene (WASH), and treatment regimen. Both surveys used urine heme detection dipsticks for Schistosoma haematobium, with egg counts included as an additional diagnostic test in 2018.

Using the prevalence results from the 2013 survey, LGAs, the administrative units for treatment decisions, were stratified for MDA for SCH either annually or every other year (between 2013 and 2018). Praziquantel was administered in all LGAs in 2013, 2014, 2016, and 2018; administratively reported coverage generally exceeded 90% among school-age children but was as low as 61%. While the respective statewide net school enrolment rate at the time ranged from 53.2% in the study years (Carter Centre, 2022), this information was not accessed/respected by the selected schools surrounding communities.

The 2018 follow-up survey was carried out at the same schools by the centre to assess whether there were any changes in the burden of disease and also to assess whether the frequency of MDA in the different LGAs should be adjusted. This report presents the results of 2013 surveys with 2018 surveys and conclusions about MDA impacts over this period.

However, the prevalence of *S. haematobium* and *S. mansoni* among all students sampled in 2013 (12.9% [95% confidence interval [CI]: 11.1–14.9%, design effect 3.0]) dropped statistically significantly in 2018 to 9.0% (95% CI: 7.5–10.9%, design effect 3.0) (P, 0.05) as shown in Table 6 and 7. Nasarawa state fell by more than 4% points

downwards, from 15.0% (95%CI:11.9–18.6%) to 10.6% (95%CI: 8.1–13.8%),

The most common Schistosomiasis infections envied in positive children were *S. haematobium* (65.0% in 2013 and 55.0% in 2018), while *S. mansoni* was detected in 37.8% vs 47.6% of samples in 2013 and 2018, respectively. Had we only used dipsticks or egg counts in 2018 to identify *S. haematobium*, these 2018–2030 results would have been significantly different. In both surveys, Schistosomiasis was more prevalent in boys than in girls. In total, 12.2% of boys were positive compared with 9.9% of girls (P, 0.05). This association remained true both for 2013 (14.0% vs. 11.6%, P, 0.05) and for 2018 (10.1% vs. 7.9%, P, 0.05) (Tables 6 and 7).

In 2013 (11.9% versus 13.5%, P, 0.05) and 2018 (7.2% versus 11.0%, P, 0.05), SCH was less prevalent in 6–10 year old children than in their older counterparts. Similarly, as for gender, associations between age group and *S. mansoni* were not statistically significant

in 2013 (P 5 0.61) but not in 2018 (P 0.05). While there was a significant association between the older age group and *S. haematobium* (6.8% in older children and 5.2% in younger) in the combined analysis (P 0.05), this association was no longer significant when each survey year was analysed independently.

This study carried out a Schistosomiasis survey in Nasarawa in 2022 in already endemic areas of the state. The study was conducted in 3 Local government areas (Akwanga, Doma, and Nasarawa LGAs) across 3 senatorial zones of the state, which had already been declared endemic by the centre. This study was undertaken to assess the effect of the control strategies after more than 10 years and to determine the current status of the diseases in the study areas. The samples were collected from 472 (52.4%) males and 428(47.6%) females, thus yielding a total of 900 samples. The age range included sampled participants aged 4-9 years (178), 10-14 years (284), 15-19 years (245) and 20-24 years (193).

Of the 3 local governments surveyed for Schistosomiasis, the highest prevalence occurred in Nasarawa LGA (14%), followed by Doma (12.3%), while the lowest values were recorded in Akwanga (7.7%) prevalence; this shows significant differences among the endemic areas (P<0.05). *Schistosoma haematobium* (9.3%) was the predominant species in the survey compared to *Schistosoma mansoni* (2%), which is similar to the finding of the centre. The centre also found out that *S. haematobium* has the highest prevalence in Nasarawa LGA, followed by Doma, and the lowest in Akwanga; this is also similar to the finding of this research. For the 2% that were positive for *S. mansoni,* Nasarawa LGA ranked highest with a prevalence of 3%, followed by Doma 2%, while Akwanga has 1% ranked the least for the infection; this is almost similar to the finding of the centre (Table 6 and 7). The disease's prevalence is higher in males (16.7%) than in their female counterparts (5.4%), similar to the center's finding. The infection distribution by age showed that the highest prevalence of 16.5 % was recorded in the age group 10 – 14 years, followed by 15-19 (14.3%), and the least was recorded in the age group 04- 09 years (4.5%). Though the number of participants and age groups varies in the study area, the result shows fluctuation in prevalence (Table 7). The result of this study indicates that Schistosomiasis is in both moderate risk and low intensity in Nasarawa and still endemic in the study areas. Also, the result showed a slight increase in infection in the study areas of 11.3% as against the 9.4% result of Cater centre in 2018. In the same vein, the result of this study indicates that there is fluctuation in prevalence among the LGAs of the study were in some reduction of the infection baseline and intermediate some years compared to the current status. On the other hand, in some LGAs, there was an increase in prevalence (Figures 3 and 4).

Table 6: Evaluation of *S. mansoni* Prevalence in Nasarawa State

LGA	Baseline (2013) (%)	No of Samples	Mid-Term (2018) (%)	No of Samples	Current (2022) (%)	No of Samples
Akwanga	3.3	451	3.3	398	1.0	300
Doma	-	190	0.7	146	2.0	300
Nasarawa	4.8	315	0.8	236	3.0	300

Source: The Carter Centre 2022

Table 7: Evaluation of *S. haematobium* Prevalence in Nasarawa State

LGA	Baseline (2013) (%)	No of Samples	Mid-Term (2018) (%)	No of Samples	Current (2022) (%)	No of Samples
Akwanga	10.3	451	0.5	398	6.7	300
Doma	17	190	10.3	146	9.7	300
Nasarawa	19.8	315	15.6	236	10.7	300

Source: The Carter Centre 2022

Table 8: Snail Survey in Some of Water Bodies in Nasarawa State

Villages / communities	Rivers	Type	Snail genus	No of *Biomphalaria sp* (%)	No of *Bulinus sp* (%)	Total (%)
DOMA LGA						
1. Sarkin Dawaki	Rafin Kusufa	River	Biomphalaria & Bulinus	4 (14.8)	6 (8.5)	10(10.3)
2.Ikygo-ose	Okpa-ose	Pond	Bulinus	0(0.0)	3 (4.2)	3(3.1)
community	Okpago osota	River	Biomphalaria & Bulinus	6 (22.2)	5 (7.0)	11(11.3)
3.Algye road	Okpiripu	River	Bulinus	0 (0.0)	12 (16.9)	12(12.4)
4.Andoma	Omenza	River	Bulinus	0 (0.0)	7 (9.9)	7 (7.2)
AKWANGA LGA						
1. Papam	Kogin Agbo	River	Biomphalaria & Bulinus	4 (14.8)	8 (11.3)	12(12.4)
Bayan dutse						
2.Ancho Bayan dutse	Kogin Nghalende	River	Biomphalaria & Bulinus	6 (22.2)	3 (4.2)	9 (9.3)
3. Katanza	Kogin dedo	River	Bulinus	0 (0.0)	5 (7.0)	5 (5.2)
NASARAWA LGA						
1. Hayin gada	Kogin Hayi	River	Bulinus	0 (0.0)	4 (5.6)	4 (4.1)
2.Anguwan wada	Kogin central	River	Biomphalaria & Bulinus	2 (7.4)	7 (9.9)	9 (9.3)
3.Bakin kogi	Kogin baba gara	River	Biomphalaria & Bulinus	5(18.5)	11 (15.5)	16 (16.5)
Total (%)				**27 (27.8)**	**71 (73.2)**	**97 (100.0)**

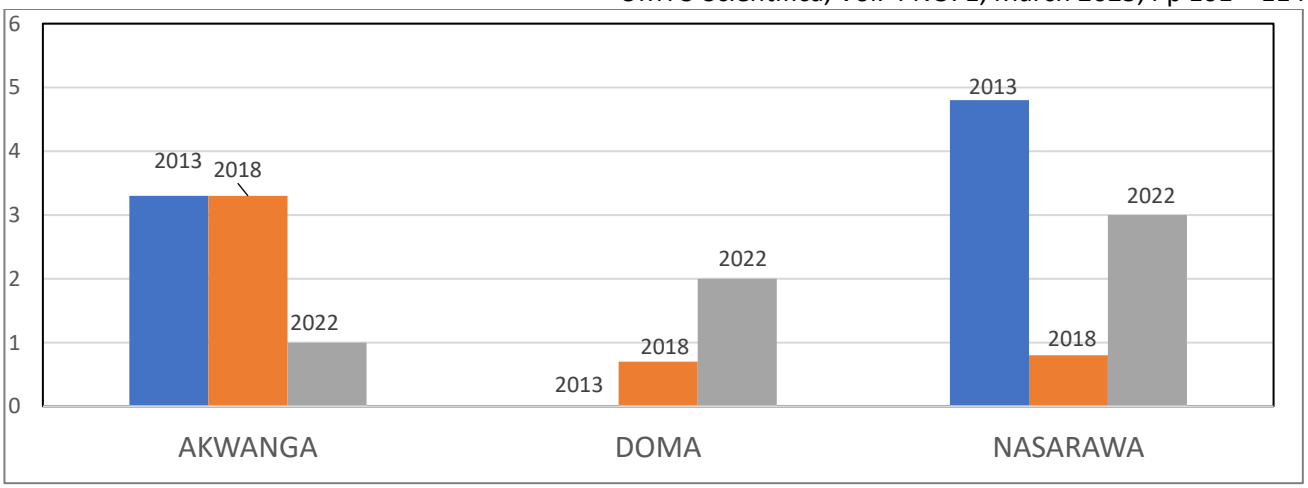

Figure 3: Bar Chart Illustrating Percentage of Prevalence (x-axis) of *S. mansoni* and Impact of Control Strategies by Local Government Areas in Nasarawa State (y-axis).

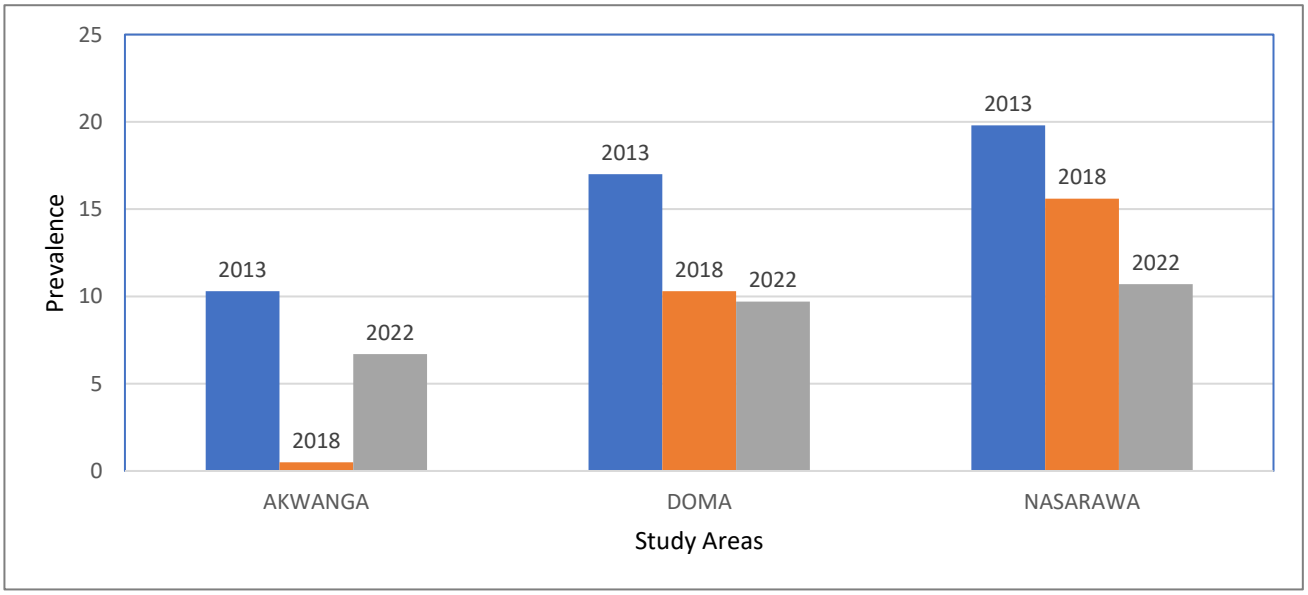

Figure 4: Bar Chart Illustrating Percentage of Prevalence of *S haematobium* and Impact of Control Strategies by Local Government Areas in Nasarawa State.

DISCUSSION

Of the 20 million individuals in need of schistosomiasis preventive chemotherapy in the endemic countries of the world, Nigeria ranks first (WHO, 2020). Despite the increased focus on schistosomiasis control following the 2001 World Health Assembly (WHA) Resolution (WHO, 2001), transmission seems unabated—at 74% mass drug administration (MDA) coverage index. Nigeria is finally fulfilling the 75% minimum benchmark for endemic countries. Yet despite this potentially desirable feat, Schistosomiasis seems a disease we will continue to fight for another decade. Prevalence in school-age children has gone up to 70% (Morenikeji and Eleng, 2013), and in a mass population that was never placed among a high-risk population prevalence of about 20% has been observed (Salawu and Odaibo, 2013)

Rine et al. (2013) stated Nigerian States endemic to the disease include Nasarawa State, which has been revealed to have very poor personal hygiene among school-aged children between the ages of 4 - 13 years old. 2013). Some authors reported a lack of awareness of the disease, portable water supply in schools and homes in Nasarawa State and its environment put the children at high risk of exposure to the disease (Ezhim et al. 2015). Across Nasarawa State, various studies on schistosomiasis prevalence have been conducted (Adekoya, 2016).

Findings of the prevalence of Schistosomiasis in this study were found to be a moderate risk at the less acute intensity (11.3%), indicating that the area is still endemic to the disease. It also can be inferred from the result that urinary Schistosomiasis is highly endemic (9.3%), whereas intestinal Schistosomiasis is less (2%); this can be due to the transmission of urinary Schistosomiasis by Bulinus Sp snails or the high prevalence of vector snails Bulinus sp. in the waterways of northern Nigeria than Biomphalaria sp. Causing intestinal Schistosomiasis (Pukuma and Musa, 2007). This high prevalence of urinary Schistosomiasis in these areas could be because a large proportion of the population, especially the rural population, depends on

untreated water from natural water sources to meet their daily need for water, from which they may take the infections owing to urinary Schistosomiasis being a water-borne disease as well as a water-associated infection if a population is in frequent contact with freshwater(28)due to farming and fishing practices which may lead to high infection rate and continuous re-infection(29).

Permendikbud no.12 2019, point 14. 11% of the total target per head. This finding has a moderate and lower risk compared to that reported by Rine et al., 2013 observed 16.3% Urinary Schistosomiasis Among Secondary School Students in Lafia, Nasarawa State, Nigeria. However, the outcome is less than that reported by Nduka et al. 2019 in states like Niger (26.1%), Kebbi (21.9%), FCT (20.3%), Yobe (15.6%), Kano (13.9%), Kaduna (13.8%), Bauchi (13.6%) and Benue (13.1 percent). But this finding is higher than the result of Okwori et al. (2014), 5.3% *S. mansoni* prevalence in Gadabuke district, Nasarawa State (Tchuem et al. (2019) reported a prevalence of 3.19 % in Keffi LGA, Nasarawa. Nduka et, al. 2019 had lower case in states such as Rivers (0.1%), Ekiti (0.2%), Bayelsa (0.9), Lagos (0.9%), Akwa Ibom (0.3%), Kogi (2.8%), Osun (5.4%), Oyo (5.4%), Taraba (5.6%) and Cross river (5.7%). Similarly, the same result was recorded in states like Katsina (11.3) and Jigawa (11.4%. The decrease in prevalence from 2013–2018 indicates some success of MDAs, but the increase in 2022 indicates that even in 2023, there were lapses in sustained control efforts.

In this survey, males had a higher prevalence of the infection (16.7%) compared to the value in females (4.4%). This finding agrees with Ajanusi et al. (2005), who found a prevalence of 19.40% among males and 3.11% among females. For example, Gadzama and Apkiri (2009) reported a 23.7% prevalence among male students and 0% among female students. The difference between males (18.7%) to females (8.1%) difference was higher than earlier work conducted with Rine et al. (2013). This was not telling, similar to Amuga et al. 2020. The low prevalence rates among females compared to males in the present study may have been due to the sheltered and guarded lifestyle of females in the study areas, as dictated by religious and moral principles. This result might be due considering men are highly active. The unbridle swimming, fishing, and irrigation were primarily performed by males compared to females, especially from school hours onwards. Specifically, this behavior increases the male risk of infection as water exposure and cercariae exposure are linearly correlated to infection risk (Abdullahi et al., 2011).

However, *S. haematobium* infection was significantly higher in our study participants aged 11–15. This is similar to the result of Abdullahi et al. (2011) reported that age groups 9-12 and 11- 15 years had a prevalence rate of 20% and 50.0% respectively. Bello and Edungbola, 1992 reported a high prevalence rate among this age group. Age group 11-15 would also record a higher prevalence (Rine et al., 2013). This ranges from adulthood, whereby these age groups are seen to be adventurous enough to engage in activities that require more contact with water as they are mature enough to engage in other activities such as passing in fish, swimming, and irrigation compared to those of the lower age. With respect to the source of water supply, the highest prevalence rate was observed among students using the stream as a main source of water. This is consistent with the results of Amuga et al. (2020) . This may be because of the age group-related activities and behaviours for always going to water bodies for swimming or washing clothes, which exposed them to regular contact with infested water bodies.

The persistence of *S. haematobium* as the predominant species underscores the need for targeted intervention in rural water management.

CONCLUSION

This study highlights persistent Schistosomiasis endemicity in Nasarawa, with moderate prevalence levels and significant gender disparities. Sustained funding, enhanced WASH programs, and targeted community engagement are critical to achieving long-term disease control.

LIMITATION OF THE STUDY

This study is a community-based research, so the study examined a single urine and stool sample per individual. Due to the low sensitivity of the employed microscopy diagnostic technique, the true prevalence of Schistosomiasis is likely considerably higher than the reported prevalence. It must be mentioned here that due to the large size of the population, collected samples from communities where there is, at least, some degree of literacy, but in some poor settlements where children don't even go to school; they play around in sand and water and live in very poor hygienic conditions the prevalence may be much higher than the reported case in this study. Longitudinal studies with larger sample sizes and integrated environmental monitoring are essential for more comprehensive evaluation.

SUGGESTION FOR FURTHER STUDIES

It is important to note that in Nasarawa state, epidemiological data are still lacking on female genital Schistosomiasis (FGS) despite its significant reproductive health impact. Female Genital Schistosomiasis affects at least 56 million women in endemic areas, causing considerable inequity by misdiagnosis and confusion with symptoms of sexually transmitted infections, social exclusion due to the impact on fertility, marital discord, depression, and sexual and reproductive morbidity-related stigma for women and girls (UNAIDS 2019). The infection may be so common in afflicted communities that its clinical significance is downplayed, and other sub-clinical morbidities are ignored. With current awareness

of cervical cancer screening in Nigeria, integration of FGS screening into already existing cervical screening programs, especially in Schistosomiasis endemic areas, could reduce its adverse reproductive health implications in affected women. Therefore, other researchers should conduct a survey on female genital Schistosomiasis.

REFERENCES:

Abdullahi, M. K., Bassey, S. E. & Oyeyi, T. I. (2011). The epidemiology of *Schistosoma haematobium* infections in the 44 Local Government Areas of Kano State, Nigeria. *Nigerian Journal of Parasitology,* 32(1), 19-24

Adekoya RA. (2016) "Prevalence and factors associated with urinary schistosomiasis among school aged children, in Lafia Local Government Nasarawa State, Nigeria". Unpublished B. Sc. Research Thesis Submitted to Federal University of Lafia: 7-42.

Ajanusi, J., Usei, N. M., Sani, A., Esievo, K. A. N. & Umoh, J. U. (2001). Index of potential contamination for urinary Schistosomiasis in five settlements near river Kubanni in Zaria. *Nigeria Journal of Parasitology*,24(60),23-25.

Amuga G.A., Nebe O.J., Nduka F.O., Njepuome N., Dakul D.A., Isiyaku S., Ngige E., Jibrin S., Jacob S.M., Nwoye I.A., Urude R., Aliyu S.M., Garba A., Adamani W., Anagbogu I.A., Nwosu C.O., Dixon R., Clark A. and Adeoye G.O. (2020). Schistosomiasis: Epidemiological Factors Enhacing Transmission in Nigeria. Global Reseach Journal of Public Health and Epiodemiology: ISSN-2360-7920: Vol. 8(7): pp, 023-032.

Atu M, Clusters L. (2006). Catabolic pathways Acyclic Monoterpenes and leucine in pseudomonous aeruginosa. *Applied and Environmental Microbiology.*

Barnabas, B., Aliyu, M. B., Gbate, M., Obi, U. P. and Attairu, A. A. (2012). Survey schistosomiasis and other intestinal helminthiases among school-aged children in Bida, Niger State, Nigeria.*Journal of Pharmaceutical and Biomedical Sciences,*15: 1-2

Bello, A. B. & Edungbola, L. D. (1992). *Schistosdoma haematobium*: A neglected common parasitic disease of children. *Acta Paediatric.*, 1(8), 601-604. **[Crossref]**

Brown N.C. Christesen T.E., Elliott W.B. and Margentheler R.D. (2012). Invetor Sentiment and Pro-forma Earning Disclosures. Journal of Accounting Research 50. 1-40. **[Crossref]**

Ezhim M., *et al.* (2015): "The prevalence of urinary schistosomiasis among primary school children in a northern Nigeria population". *International Journal of Advance Research* 3.11 511-519.

Fadeyi et al. (2009). Antigen Detection of History. *International journal of health Resarch.*

Gadzma, I. M. K. & Akpiri, R. F. (2009). Prevalence and sensitivity of Eosinophiluria in the diagnosis of urinary Schistosomiasis among secondary school students in Zaria, Nigeria. *Best Journal,* 6(2), 85-88.

Hamburger J, Turetske T, Kapeller I, Deresiewicz R 1991. Highly repeated short DNA sequences in the genome of Schistosoma mansoni recognized by a species-specific probe. *Mol Biochem Parasitol* 44: 73-80. **[Crossref]**

Hotez, P. J. and Kamath, A. (2009). Neglected tropical diseases in sub-saharan Africa: review of their prevalence, distribution, and disease burden. *PLoS Neglected Tropical Diseases*, 3, e412. **[Crossref]**

Hugo C. T., Alison A. B., Julia C. D., Jane M. W, Déirdre H.T., Fiona M. F., Roy M. A. (2017). Economic Considerations for Moving beyond the Kato-Katz Technique for Diagnosing Intestinal Parasites As We Move Towards Elimination.*Trends in Parasitology*, Vol. 33, No.6 **[Crossref]**

Ibrahim H. Hassan MR. Abduu S.B. Chidinma, F. Aliyu Z.I Bello S.S . Ishiaku, Y.M. (2009). Blood biochemisty profile and carcass charsteritics weavers. *Journal of Animal science*

Kosinski KC, Bosompem KM, Stadecker MJ, Wagner AD, Plummer J, Durant JL, *et al.* (2011).Diagnostic accuracy of urine filtration and dipstick tests for *Schistosoma haematobium* infection in a lightly infected population of Ghanaian school children. *Acta Tropica.*2011; 118:123 127. **[Crossref]**

Ladan, .U., Abubakar, U., Abubakar, K., Bunza,M.D.A., Nasiru,M., Ladan, M.J., (2011). Gender and age – specific prevalence of urinary Schistosomiasis in selected villages near a Dam site in Gusau Local Government Area. Zamfara State, Nigeria. Niger. *Journal Parasitol.* 32, 57.

Mordi R.M, Ngwodo POA. (2007). A study of blood and gastro intestinal parasites in Edo State. *African Journal of Biotechnology.* **[Crossref]**

Morenikeji OA, Eleng IE**. (**2016). Renal related disorders in concomitant *Schistosoma* haematobium–Plas-modium falciparum infection among children in a rural community of Nigeria. *Journal of Infectious Publication Health.* 2016; 9: 136–142. **[Crossref]**

Nduka F.O., Nebe O.J., Njepuome N., Dakul D.A., Anagbogu I.A., Ngige E., Jacob S.M., Nwoye I.A., Nwankwo U., Urude R., Aliyu S.M., Garba A., Adamani W., Nwosu C.O., Clark A., Mayberry A., Mansiu K., Nwobi B., Isiyaku S., Dixon R., Adeoye G.O. and Amuga G.A. (2019). Epidemiological Mapping of Schistosomiasis and Siol Transmitted Helminthiasis for Intervention Strategies in Nigeria. Nigerian Journal of Parasitology: ISSN 111741445: Vol. 40(2). **[Crossref]**

Okonko I.O, *et al* (2009). Incidence of Urinary tract infections (UTI) among pregnant women in

ibadan, south-western Nigeria. *Africal journal of Biotechnology Vol.8(23) pp6649-6657*.

Okwori AEJ, sidi M, Ngwai YB, Obiekezie SO, Makut MD, Chollom SS, oke IO and Adikwu TI. (2014) Prevelence of schistosomiasis among primary school children in Gadabuke District Toto LGA, North Central Nigeria. *British microbiology research journal*. 4 (3): 255-261. **[Crossref]**

Pukuma M. S. Musa S.P. (2007). Prevelence of Urinary Schistosomiasis among residents of Wuduku Lamurde Local Government Area of Adama . Nigerian Journal of Parasitology. Vol.28. No.2. **[Crossref]**

Rine C. Reuben, Habibu Tanimu, Jasini A. Musa. (2013). Epidemiology of Urinary Schistosomiasis Among Secondary School Students in Lafia, Nasarawa State, Nigeria Journal of Biology, Agriculture and Healthcare, ISSN 2224- 3208 (Paper) ISSN 2225 093X (Online) Vol.3, No.2. www.iiste.org

Salawu OT, Odaibo AB. (2013). Schistosomiasis among pregnant women in rural communities in Nigeria. *Internal Jounal Gynecologist Obst*. 2013; 122: 1–4. **[Crossref]**

Sarmukaddan S. B. and Garad S. G. (2006): On validity of Assumptions while Determining Sample Size. Indian Journal of Community Medicine.

Tchuem-Tchuenté Louis-Albert, N'Goran Eliézer K.(2019) Schistosomiasis and soil-transmitted helminthiasis control in Cameroon and Cote d'Ivoire: implementing control on a limited budget. *Parasitology*. 2019.

The Carter Center (2022): Impact of Three to five rounds of mass drug admistration on Schitosomiasis and Soil-Tranmitted Helminths in School-Aged Children in North Central Nigeria. *American Journal of Tropical Medical Hygiene* 107(1):p132. **[Crossref]**

Traoré M, Maude GH, Bradley DJ. (1998). Schistosomiasis haematobia in Mali: rate in school- age children as index of endemicity in the community. *Tropical Medicine and International Health*.; 3: 214-221 **[Crossref]**

Uneke, C, Ugwuok-Adibuah, S, Nwakpu, K, Ngwu, B (2010). An assessment of *Schistosoma haematobium* infection and Urinary tract bacterial infection amongstschool children in rural eastern Nigeria. *The internet journal. of Laboratory medicine*, 4:1. **[Crossref]**

WHO (1991) The control of Schistosomiasis. Second report of the WHO expert committee.WHO Tech Rep Ser 830: 1–86.

WHO (2001) Schistosomiasis and soil-transmitted helminth infections. Geneva:

WHO 2007. Report of high prevelence of Schistosomiasis: An Operational Manual for Programme Managers. WHO; Geneva, Swizterland: 2007.

WHO 2020 . Ending the Neglect to Attain the Sustainable Development Goals—A Road Map for Neglected Tropical Diseases 2021–2030. World Health Organization; Geneva, Swizterland: 2020.

World Health Organization (WHO) (2010). Helminth control in school-age children. A guide for managers of control programmes. Secondthed.

World Health Organization. (2006). Preventive chemotherapy in human helminthiasis coordinated use of antihelmintic drugs in control interventions: a manual for health professionals and programme managers. World Health Organization; Geneva, Switzerland: Available from: who.int.

World Health Organization. (2013) Schistosomiasis Progress Report (2001–2011) and Strategic Plan (2012–2020). World Health Organization Press; Geneva, Switzerland: 2013. Available from: ber 9,

World Health Organization. (2002). Helminth control in school-age children: A guide for managers of control programmes. Geneva: World Health Organization.