

Research Article

# Status of School-Based Water, Sanitation, Hygiene (WASH) Resources and Soil Transmitted Helminth (STH) Infections in Rural Nigeria: A Pilot Study

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## Abstract

This pilot study was undertaken to assess the status of school-based water, sanitation and hygiene (WASH) resources and soil-transmitted helminthiasis (STH) in Njikoka LGA of Anambra State, Nigeria. Two schools: Sir Herbert Nursery/Primary School (SHNPS) Enugwu Ukwu and St. Theresa Nursery/Primary School (STNPS) Nimo were selected using multi-stage sampling technique. The status and conditions of WASH resources were determined using the modified FMOH checklist for improved WASH intervention. Stool samples were also collected from 49 and 54 pupils in the respective schools, and screened for STH infections using direct smear and formol-ether concentration techniques. Test of statistical significance was done using Mann-Whitney, Cochran and Wilcoxon Signed Rank tests in SPSS Version 25.0, at 5% significance level. Overall STH prevalence was 6.8%; 4.1% in SHNPS and 9.3% in STNPS ( $P > 0.05$ ). Males and females recorded 9.3% and 4.1% prevalence respectively ( $P > 0.05$ ). Age related prevalence were 2.7% and 17.9% for age groups 5-10 and 11-15 years respectively ( $P < 0.05$ ). Parasite (STH) specific prevalence were 3.9%, 1.0%, and 1.9% for *Ascaris lumbricoides*, *Trichuris trichiura* and Hookworm respectively ( $P > 0.05$ ). SHNPS versus STNPS recorded WASH scores of 5/5 vs. 2/5 for improved water source ( $P > 0.05$ ), 4/5 vs. 3/5 for sanitation condition ( $P > 0.05$ ) and 2/5 vs. 2/5 for environmental condition ( $P > 0.05$ ). These findings revealed: presence of STH infection, poor and unequal WASH status in the study area. Standard of WASH facilities and practices should be improved in schools, and more health education provided to enable effective control of STH infections among school-aged children.

## Keywords

WASH, STH, Prevalence, Primary School, Nimo, Enugu-Ukwu, Nigeria

## 1. Introduction

Soil transmitted helminths are parasitic worms that require soil for the development or incubation of one or more of their immature stages before becoming infective [1]. *Ascaris lum-*

*bricoides* (roundworm), *Trichuris trichiura* (whipworms) and hookworms: *Necator americanus* and *Ancylostoma duodenale* are among the commonest soil transmitted helminths

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known to parasitize man [2]. Transmission of STH is parasite dependent and humans acquire infection through one of the following ways: penetration of infective larvae and ingestion of eggs from contaminated food, water sources, soil, finger or objects. Though mild infection could be asymptomatic, signs and symptoms associated with moderate to heavy infection include: abdominal discomforts, vomiting, diarrhea, anorexia, dyspepsia, and in complicated cases, intestinal obstruction and hepato-biliary and pancreatic involvement [3]. Prolonged infection can result in malabsorption of nutrients with consequent malnutrition, iron-deficiency anemia, poor growth and impaired cognitive development [4].

Soil transmitted helminthiasis falls into a category of diseases known as Neglected Tropical Diseases and is of great public health concern. The infections are widely distributed in tropical and subtropical areas, with the greatest numbers occurring in sub-Saharan Africa, the Americas, China and East Asia [5]. In Nigeria, STH burden is higher in the South-West, South-East, and South-South regions, compared to the North East, North West and North Central regions [6]. This could be ascribed partly to the climatic conditions in the Southern regions, which favours the survival and abundance of helminths, than in dry and arid conditions in the Northern regions [6]. In Anambra State of Nigeria, studies have reported the prevalence of STH [7-12].

Areas where STH is highly endemic are usually the poor and deprived communities with: poor sanitation, lack of access to safe drinking water, lack of access to good health care, poor toilet facilities and difficulty in implementation of control measures [13, 14]. As a result, the World Health Organization (WHO) recommends preventive chemotherapy (PC) through mass drug administration with Albendazole or Mebendazole to control STH-related morbidity, alongside targeted health education and improved water and sanitation [15]. The target populations include preschool-age children, School-Age Children (5-14 years), Women of Reproductive Age and adult groups particularly exposed to STH. Age group of 6-12 years has been reported to be the high risk group and most infected [16]. The target coverage for STH control in the high-risk group of school-age children as set by [15] is 75%. Most school-age children receive Anthelmintics in school-based deworming programs. In some programs that are concerned with the elimination of Lymphatic Filariasis, Albendazole is administered in addition to Ivermectin or Mectizan, and the result is increased efficacy in *T. trichiura* and *Strongyloides stercoralis* treatment [17]. [9] had earlier reported that control measures when applied can largely reduce the prevalence of intestinal helminth infections. Through school-based deworming Program, a total of about 5.4 million school age children (25.4%) were treated with Mebendazole tablets out of 21,232,039 targeted in 2013 by the National Program in Nigeria [18].

In Nigeria, NTD Program implementation-including Mass Drug Administration (MDA), and improvements in Water, Sanitation and Hygiene (WASH) – draws heavily on the

community-directed intervention model as enshrined in the NTD master plan [18]. This model is designed to engage community input through nominations and rewards of community-based distributors, who assist in tailoring intervention towards specific target groups. The engagement of community-based distribution is crucial in promoting community ownership since same communities are both the target of the intervention and primary stakeholders in its implementation [19]. However, due to the heavy burden of soil transmitted helminths on School-aged children and the cost effectiveness of relying on the existing infrastructures in schools, the WHO have focused mainly on school-aged children as major targets of anthelmintic drug Programs [5]. In the absence of overall coverage, STH infections may reoccur from few untreated individuals, especially where there is no sustenance of the drug treatment [9]. Hence there was need for adding hygiene education, improvement on water, sanitation, and hygiene to ensure sustainable control and interruption of the cycle of re-infection in the context of environmental contamination.

Operational research to evaluate impact of drug administration on STH's morbidity and prevalence, as well as identify WASH indicators is necessary to monitor progress of control program and identify challenges to the control of the disease. This is particularly important with the global focus geared towards elimination or eradication of NTDs in endemic communities. Hence, the purpose of this study was to determine the prevalence of soil transmitted helminth infections among primary school pupils as well as assess the type, condition, adequacy and usage of school-based Water, Sanitation and hygiene resources to complement the control of STH in primary schools. This will help identify areas for improvement or continuity in the implementation of the school-based Soil Transmitted Helminth infection control Programs. Results from this study will provide baseline data, emphasizing the need for tracking progress and determination of areas of high priority in STH control.

## 2. Materials and Methods

### 2.1. Study Area

This study was undertaken in Njikoka Local Government Area (LGA) of Anambra State, Nigeria. Njikoka LGA is headquartered at Abagana, and has coordinates of 6°11' N and 6°59' E. Njikoka LGA comprises: Abagana, Enugwu-Ukwu, Nawfia, Abba, Nimo and Enugwu-Agidi communities. It has a population of over 215, 000 people mostly of Igbo ethnicity.

Njikoka LGA is located in the tropical rainforest zone of Nigeria. Seasonal variations in Njikoka occur as rainy and dry seasons with temperatures varying from 18 °C to 31 °C. The rainy period of the year lasts for 9 months, from March to November. Dry season lasts for about 3 months, December to February. Due to its location in the rainforest zone, the area is characterized by a high level of humidity, which can be as

high as 90% during rainy season [20]. This high humidity, combined with warm temperatures, represent optimal condition for transmission of Soil transmitted helminthes. Government health facilities in the study area include Primary Health Centers (PHC), General Hospitals and a Psychiatric Hospital. Other health facilities are private hospitals. There are many primary schools in the study area.

## 2.2. Study Design

This pilot study was a cross-sectional survey conducted from September to December, 2021. It involved collection of basic demographic information and examination of fecal specimens from children in selected primary schools, and assessment of WASH indicators in the selected schools.

## 2.3. Study Population and Sample Selection

The study population comprised pupils currently enrolled in nursery and primary Schools in Njikoka LGA of Anambra State Nigeria, within the study period (September to December, 2021). The inclusion criteria required pupils within 5-15 years of age as recommended by [21].

## 2.4. Selection of the Study Participants

A multi-stage sampling procedure was used to select participants for the study. First, random sampling technique was used to select Nimo and Enugwu-Ukwu towns for this study. Secondly Sir Herbert Nursery\Primary School (SHNPS) Enugwu-Ukwu and St. Theresa Nursery\Primary School (STNPS) Nimo were also randomly selected for this study. We selected only two schools for this pilot study so that we can highlight potentials for variations (both overall and component specific variations) in the standard of WASH between or among schools. Using a cluster survey adopted by WHO for Integrated Epidemiological Mapping and Baseline Survey of Schistosomiasis and Soil Transmitted Helminths, at least 45 school-aged children were targeted in each school [22]; we also considered that WASH assessment is school dependent and should be handled separately for a given school. Since each of the selected school population was low, Total population sampling technique was used to include 49 pupils from SHNPS and 54 pupils from STNPS, who gave consent for their stool sample to be collected.

## 2.5. Ethical Consideration and Informed Consent

A letter (Ref. No.: NAU/FBS/PAE/089) introducing the purpose of the research was obtained from the Head of Parasitology and Entomology Department, Nnamdi Azikiwe University Awka Nigeria prior to commencement of the study. This alongside the research proposal was used to obtain an

ethical approval from Anambra State Ministry of Health Nigeria (Ref. No.: MH/AWK/M/321/273), for the study. Written and verbal consents were obtained from the Head-Teachers and parents of the children participating in the survey respectively.

## 2.6. Collection of Faecal Specimen

Each pupil was provided with a sterile capped specimen bottle, an applicator stick and tissue paper (to wipe their anus after defecation). They were instructed to pass the stool on a clean white paper and use the applicator stick to transfer adequate portion of the stool into the specimen bottle provided. The capped specimen bottles were returned and labeled with given specific identification (ID) numbers for each pupil. All samples collected were transported to the Laboratory Unit of Parasitology and Entomology Department, Nnamdi Azikiwe University Awka Nigeria for examination on the same day.

## 2.7. Parasitological Examination of Faecal Specimen for Soil Transmitted Helminths

The study adopted two methods of parasitological examinations, namely: Direct Smear Technique with Saline and Formol-Ether Concentration Technique. These were used to detect the diagnostic stage(s) of soil transmitted helminth parasites in the fecal specimens collected from the pupils. The faecal specimen examination was carried out following the standard procedure described by [2].

## 2.8. Assessment of WASH (Water, Sanitation and Hygiene) Indicators

The type, conditions, adequacy and usage of WASH resources in the selected schools were assessed using a modified FMOH recommended checklist for improved WASH intervention in schools [12, 21]. The status and condition of the WASH resources were carefully observed during field visitations and were scored 1 or 0 point as appropriate (Table 1). For each WASH resource component (water component, sanitation component and hygiene component), a cumulative test score was computed.

## 2.9. Data Analysis

Data obtained were entered into Microsoft Excel spreadsheets, and analyzed using SPSS version 25.0. Data were expressed as absolute counts and percentages in relevant Tables. At 5% significance level, the following statistical analyses were conducted: Mann-Whitney Test to compare prevalence between or among various categories of the variables (school, gender, and age group) studied, Cochran Test for comparing the prevalence of different species of the identified STHs and Wilcoxon Signed Rank Test that Compared WASH scores of the two schools.

**Table 1.** Modified FMoH Recommended Checklist for Improved WASH Intervention in Schools.

WASH resource	Scores and Interpretation
Water Component	
Improved Water source	Borehole present =1, Absence=0
Condition of water source	If functional=1, if not=0
Distance of water source	Within the school premises=1, if not=0
Frequency of water supply	If accessible all day=1, if not=0
Number of water sources	Presence of at least one source=1, if not=0
Sanitation Component	
Presence of Toilet	If present=1, if not=0
Condition of Toilet	Toilet without odor, flies or littering fecal matter=1, if not=0
Type of toilet in use	Presence of improved toilet facility (flush or pour, pit latrine with lid) =1, absence= 0
Soaps in toilet	Presence of soaps in toilet=1, Absence=0
Presence of water or tissue for use after defecation	If present=1, Absent=0
Hygiene Component	
Presence of bushes	Presence of bushes=0, Absence=1
Presence of garbage can	If present=1, Absent=0
Provision of hand-wash facility	Presence of water and soap=1, Absence=0
Presence of authorized food vendors within school premises	Authorized food vendors = 1, unauthorized food vendors = 0
Usage of common cups in classrooms	Present = 0, absence=1

### 3. Results

The demography of the study participants across the primary schools is shown in [Table 2](#). In both schools combined, males were 54 (52.4 %) and females were 49 (47.6 %). Age group 5-10 years was 75 (72.8 %) whereas 11-15 years was 28 (27.2 %). School-specific details for age and gender of the pupils are demonstrated in [Table 2](#).

**Table 2.** Demography of Study Participants across the Primary Schools Surveyed.

School Name	Variable	Category	Number examined (%)
Sir Herbert N/Ps	Gender	Male	29 (59.2)
		Female	20 (40.8)
	Age range	5-10 years	33 (67.3)
		11-15 years	16 (32.7)
St. Theresa N/Ps	Gender	Male	25 (46.3)
		Female	29 (53.7)
	Age range	5-10 years	42 (77.8)
		11-15 years	12 (22.2)

The prevalence of STH in the study population is demonstrated in Table 3. Overall prevalence was 6.8% ( $n = 7$ ). Among the three species / group of STH parasites detected, highest prevalence (3.9%) was recorded with *A. lumbricoides* infection, while the least (1.0%) was *T. trichiura* infection. There was no significant difference in the prevalence of different species STHs identified ( $p = .097$ ). The prevalence was

higher (9.3%) in STNP, and there was no significant difference in the school-based prevalence between the two schools ( $p = .299$ ). Males showed a higher prevalence of 9.3% ( $p = .299$ ), and the infections were more prevalent in age group 11-15 years. A significant difference was observed between the age groups ( $p = .007$ ).

**Table 3.** Prevalence of STH infections in the Study Area.

Variable	Categories	Number examined	Number infected	Prevalence rate
Species of STH detected	<i>A. lumbricoides</i>	103	4	3.9%
	<i>T. trichiura</i>	103	1	1.0%
	Hookworm	103	2	1.9%
School	SHNPs	49	2	4.1%
	STNPs	54	5	9.3%
Gender of the pupils	Male	54	5	9.3%
	Female	49	2	4.1%
Age group of the pupils	5-10 years	75	2	2.7%
	11-15 years	28	5	17.9%

Table 4 displays the WASH resource scores of the two schools. SHNP recorded a higher WASH score of 11 out of 15 available points (73.3%) than STNPS with 7 points (46.7%). However, the difference in the overall WASH scores between the two schools was not statistically significant ( $p = .317$ ). For water component, a higher cumulative score of 5 (100%) was recorded at SHNPS, though not statistically significant ( $p$

$= .083$ ). The result of sanitation condition showed a better cumulative score of 4 (80%) for SHNPS and it was not statistically significant ( $p = .564$ ). The cumulative test score for the environmental hygiene was same, 2 (40%) in both schools, though the scores are on different items. Thus, no significant difference was observed ( $p = 1.000$ ) in the hygiene component of the two schools.

**Table 4.** WASH Resources Scores of the Selected Schools within the Study Area.

WASH Resources		Scores by Schools	
Components	Specific items	SH N/Ps	ST N/Ps
Water component	Water source	Hand pump Borehole (1.0)	Borehole (1.0)
	Number of water sources	One (1.0)	One (1.0)
	Conditions of water sources	Functional (1.0)	Not functional (0.0)
	Frequency of water supply	Daily (1.0)	None (0.0)
	Distance of water source	Within (1.0)	None (0.0)
	Total score	5.0	2.0
Sanitation component	Presence of toilet	Present (1.0)	Present (1.0)
	Type of toilet	Water Closet (WC) (1.0)	Water Closet (WC) (1.0)



WASH Resources		Scores by Schools	
Components	Specific items	SH N/Ps	ST N/Ps
Hygiene component	Condition of toilet	Dirty (0.0)	Clean (1.0)
	Provision of soap for hand wash	Present (1.0)	None (0.0)
	Provision of tissue \ water for use	Yes (1.0)	None (0.0)
	Total score	4.0	3.0
	Presence of bushes	No (1.0)	Yes (0.0)
	Presence of garbage cans	Yes (0.0)	Yes (0.0)
	Usage of common cups	Yes (0.0)	No (1.0)
	Presence of hand wash facilities	Yes (1.0)	No (0.0)
	Presence of authorized food vendors.	No (0.0)	Yes (1.0)
	Total score	2.0	2.0
Grand Total Score		11.0 / 15.0	7.0 / 15.0

## 4. Discussion

STH infection is still present in Njikoka LGA of Anambra State Nigeria, though with lower overall prevalence than earlier report in Nimo [8] and some other parts of Anambra State [7, 9, 10, 12, 23]. The prevalence of STH infection reported in this study reflects the status of helminthiasis morbidity among school-aged children in the study area. This re-emphasized that STH is a public health problem among school-aged children. Notably, our overall prevalence result is higher than 1.9% earlier recorded in Nnewi [24] and 6% reported in some other parts of Anambra State, Nigeria [11]. More so, three different STH: *A. lumbricoides*, *T. trichiura* and Hookworm were seen to infect the pupils, unlike in the study by [12] where only *A. lumbricoides* and Hookworm were reported. As noted in previous studies and corroborated by present study, school children mostly wear shoes when they attend school, and pull them off while playing on school fields; this practice favours Hookworm transmission. It was observed in this study that open defecation is common, especially around toilet areas and play ground, and must have enhanced the spread of these STHs. Findings from the present study has equally supported the view that *A. lumbricoides*, with faecal-oral route of transmission, is the most prevalent STH infecting school-aged children.

Prevalence of STH stratified by gender showed no significant difference between male and female participants. It suggests that school aged children of both gender have equal risk and/or exposure to STH infections. Similar condition of prevalence stratified by gender has also been reported by [8, 9, 12]. Contrary to the report of [11], school aged children between 11 to 15 years had a significantly higher prevalence of

STH infection compared to their counterparts aged 5 to 10 years. Though the two age groups may be found on the same playground together, younger children still enjoy higher level of care and protection from their parents and caregivers. Compared with older children (11 to 15 years), they have reduced level of adventurous activities, and might get assistance with hand wash, general body cleanliness, as well as fruit and vegetable washing.

This pilot study therefore highlights the importance of providing school-based safe water, sanitation and hygiene resources as veritable tools to compliment other control measures for STH infections. The prevalence of STH in relation to WASH scores noted in both schools (as reflected in the school-based prevalence results), though not statistically different, validates opinion that WASH resources may have secondary influence on the transmission of STH [25-27], especially when the usage is frequent and efficient [12].

On a scale of 15 points, overall WASH scores of 7 and 11 recorded in this study is poor and within the range of 3 to 15 reported by [12], among primary schools in a different rural location in Anambra State of Nigeria. The most underused component is Hygiene. In STNPs, no single component scored more than 3/5, unlike in SHNPs where Water component and Sanitation component scored 5/5 and 4/5 respectively. Water as a crucial component of WASH resources, is important for drinking and hand washing. For STNPs with lower WASH resources, water was not available in the school premises and pupils sourced water outside the school premises, thus increasing their chances of exposure to infections transmitted through unsafe water sources [28].

Nevertheless, STH prevalence levels in both schools were below 20%, and did not require Mass Drug Administration (MDA), but rather treatment of infected individuals only [29].

The record of prevalence in SHNPs despite its higher WASH score is an indication of continuous or ongoing transmission, notwithstanding the availability of WASH resources. For instance, adequate toilet facility was provided in SHNPs, yet the WC and the environs were very dirty and littered with faeces. This showcased poor sanitation and hygiene practice. Considering the STH prevalence, there is a possibility that infected individuals identified in this study were either: already infected before the introduction of the WASH resources, not captured in a mass deworming programme, or failed to comply with mass deworming programme. It is also possible that they were infected or reinfected from other individuals (including adult populations), as usage of common cup for drinking water and presence of unauthorized food vendors were recorded. Unauthorized food handlers include adult individuals who might be asymptomatic carriers of disease pathogens, in this context, STH. These pupils get exposed and infected with species of STH that are transmitted through faecal-oral route. Usage of common cup for drinking is equally a good promoter of STH infection and reinfection. It is therefore, reasonable to argue that reduction in the transmission of STH among School aged Children cannot be accomplished or sustained only by just providing WASH resources. Adequacy, maintenance, health education, enforcement on frequent and efficient use, and monitoring has to be put in place for us to achieve the intended results.

In STNPS, where a higher prevalence of STH and lower WASH score were observed, the available toilet facilities were not accessible to the pupils, and there was presence of bushes. It is a common experience that the clean and well-maintained toilets are reserved for the teachers. The challenge of lack of toilet, limited accessibility and maintenance by school management have been identified as potential factors that influence the practice of open defecation on play grounds and nearby bushes by pupils [30]. This establishes the need for effective provision and maintenance of toilets in the primary school systems. Lack of access to safe water and hand wash facilities may have also contributed to the high burden of STH infections recorded among children attending STNPS. Thus, it is imperative to take into cognizance, issues of adequacy and maintenance of WASH resources to ensure sustained and effective intervention effect on STH transmission and control. Hygiene education should be incorporated into the primary school curriculum, as this will encourage long-term positive behavioral changes among pupils, both in school and at home [31, 32].

## 5. Conclusions

The result of this study suggests that there is: an ongoing transmission of Soil Transmitted Helminth Infection, poor WASH status and unequal availability / usage of items under each WASH component in the study area. Although the prevalence recorded was below the 20% treatment level that requires a mass administration of drug, it is important based

on the current understanding of the dynamics of STH to initiate and/or sustain adequate control efforts in the area to maintain the low prevalence or even eliminate the disease in the area. Complimentary intervention such as safe water, sanitation, and hygiene (WASH) education should also be ensured so as to reduce transmission of STH in the studied areas and other low WASH resource schools. This should take cognizance of specific items in WASH components that is of high priority in a given area and school. This study collaborating other numerous reports have shown that the burden of Soil Transmitted Helminth infections can be reduced with improvement in WASH resources thus reaffirming the importance of complimenting chemotherapy with safe water, hygiene and sanitation.

## Abbreviations

FMoH	Federal Ministry of Health
MDA	Mass Drug Administration
PC	Preventive Chemotherapy
PHC	Primary Health Centre
SPSS	Statistical Package for Social Sciences
STH	Soil Transmitted Helminth
WASH	Water, Sanitation and Hygiene
WC	Water Closet
WHO	World Health Organization

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## Author Contributions

**Chukwudi Egbuche:** Conceptualization, Formal Analysis, Methodology, Resources, Supervision, Writing-review & editing

**Cornelius Amoke:** Project administration, Resources, Writing-review & editing

**Uchenna Okalu:** Investigation, Methodology, Writing-original draft

**Francisca Egbuche:** Investigation, Writing-original draft, Writing-review & editing

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## Data Availability Statement

The data supporting the outcome of this research work has been reported in this manuscript.

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## Conflicts of Interest

The authors declare no conflicts of interest.

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## Biography



**Chukwudi Michael Egbuche** is an Associate Professor in the department of Parasitology and Entomology at Nnamdi Azikiwe University Awka Nigeria. He completed his PhD in Public Health Parasitology and Entomology from Nnamdi Azikiwe University in 2019, and his Master of Science in Public Health Parasitology and Entomology from the same institution in 2012. In addition, he holds Certificates in Biostatistics and Bioinformatics from reputable Institutions and workshop attendance respectively. Dr. Egbuche is currently the Head of Department of Parasitology and Entomology, Nnamdi Azikiwe University Awka. Dr. Egbuche has participated in many Public Health related activities in Nigeria as a/an: Team Leader, Coordinator, Monitoring and Evaluation Officer, WHO Inde-

pendent Monitor, Technical Staff and Research Assistant. He was the Local Organizing Chairman of the 3<sup>rd</sup> South East Parasitology and Public Health Society of Nigeria Annual Symposium and Exhibition for Science, Technology, Innovation and Entrepreneurship. He currently serves on the Editorial Boards of three academic journals, and has been invited as a Resource Person, Technical Committee Member, and Session Chair at national conferences.



**Ofoma Cornelius Amoke** obtained his Bachelor's degree in Parasitology and Entomology from Nnamdi Azikiwe University Awka Nigeria, in 2007, followed by a Master's degree and a Ph. D. in Parasitology and Public Health from the University of Nigeria in 2011 and 2016, respectively. In 2015, he earned a certificate in Data Analysis and Modelling in Aquatic Ecosystems from the UNESCO Institute for Water Education in Delft, Netherlands. He is currently a Senior Lecturer in the Department of Zoology and Environmental Biology at Michael Okpara University of Agriculture, Umudike Nigeria. With over a decade of experience in teaching and research, Dr. Amoke is highly skilled in public health research, data collection and analysis, and technical report writing. He is a committed mem-

ber of the National Technical Working Group on the Lymphatic Filariasis Elimination Program in Nigeria, where he contributed significantly to the development of the national assessment guidelines. Dr. Amoke has led several major national public health initiatives. Notably, he coordinated the epidemiological analysis for the National Tuberculosis, Leprosy, and Buruli Ulcer Control Programme across five southeastern states in Nigeria.



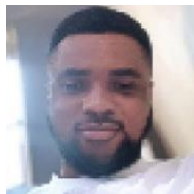
**JohnPaul Uchenna Okalu** is a graduate of the Department of Parasitology and Entomology, Nnamdi Azikiwe University, Awka, where he earned a Bachelor of Science degree in 2021. His academic interests focus on the epidemiology of Neglected Tropical Diseases and Public Health research in rural communities. He has presented a scientific paper during the World NTD Day celebration at Nnamdi Azikiwe University in 2022 and contributed an abstract to the 2022 Book of Abstracts at the 46th Annual Conference of the Parasitology and Public Health Society of Nigeria. This article marks his first publication in a peer-reviewed journal.



**Francisca Egbuche** is a graduate of Parasitology and Entomology Department of Nnamdi Azikiwe University Awka Nigeria. She graduated in 2019. She completed her Master of Science in Public Health Parasitology and Entomology in 2024. Currently she is seeking for Ph.D. position in any reputable University. She is an emerging researcher, and has since graduation actively engaged in research as a field, laboratory and writing assistant, while also teaching Biology at the secondary school level.



**Ugochukwu Obiakor** is a Researcher and Lecturer at Nnamdi Azikiwe University, Awka. He completed his M.Sc. in Public Health Parasitology in 2021. Mr. Obiakor is a member of various Public Health professional bodies in Nigeria. He has also served as a member of International Conference Planning Committee, as well as Technical Committee member, Research Assistant, and Technical Assistants in various research groups. His research interests are on vector-borne diseases, parasites, public health, epidemiology, Neglected Tropical Diseases and Vector Biology. He is currently pursuing Ph.D. in the same Institution.



**Michael Chimezie** is a graduate of Parasitology and Entomology Department of Nnamdi Azikiwe University Awka Nigeria. He graduated in 2021 with an impressive Cumulative Grade Point Average of 4.40 on a 5 point scale. He is an emerging researcher with a strong academic background in Parasitology and Entomology. Since graduation, he has actively engaged in research as a field and writing assistant, while also teaching science at the secondary school level—an experience that has strengthened both his communication skills and scientific foundation. His work is driven by a commitment to advancing public health, with a long-term goal of specializing in vaccine development and disease prevention. Chimezie has received hands-on training in malaria microscopy from Lagos University

Teaching Hospital, the National Arbovirus and Vector Research Institute, and the Nigerian Institute of Medical Research, all in Nigeria. He is deeply motivated to contribute to global health through impactful, interdisciplinary research.

## Research Field

**Chukwudi Michael Egbuche:** Disease epidemiology, Monitoring/Evaluation of diagnostic and control tools, Formulation and evaluation of pesticide activities, Ecology of disease vectors, Molecular characterization of drug resistance markers, Population genetics

**Cornelius Ofoma Amoke:** Malaria, Lymphatic filariasis, Schistosomiasis, Onchocerciasis, Soil Transmitted Helminthiasis

**JohnPaul Uchenna Okalu:** Epidemiology, Neglected Tropical Diseases, Vector-borne Diseases, Public Health, Environmental Health

**Francisca Ginikachukwu Egbuche:** Vector-borne Diseases, Malaria Research, Neglected Tropical Diseases, Vector Ecology, Disease surveillance and Epidemiology

**Ugochukwu Anthony Obiakor:** Vector-borne Diseases, Malaria Research, Parasite Immunology, Public Health and Epidemiology, Neglected Tropical Diseases, Vector Biology

**Michael Chibueze Chimezie:** Medical Entomology, Medical Parasitology, Molecular Entomology, Molecular Parasitology, Vector Control and Insecticide Resistance, Epidemiology of Parasitic Diseases, Veterinary Parasitology, Veterinary Entomology