DOI: https://10.83080/rejost.vol6no6.321

Researchers Journal of Science and Technology (REJOST)

Impact of Five Years of Albendazole Preventive Chemotherapy on Soil-Transmitted Helminth Infections among School-Aged Children in parts of Nsit Ubium, Akwa Ibom State, Nigeria

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Abstract

Soil-transmitted helminth (STH) infections remain a significant public health challenge in sub-Saharan Africa, particularly among school-aged children in rural communities with inadequate sanitation infrastructure. This study was designed to assess the current prevalence of STH infections among school-aged children in Nsit Ubium Local Government Area, Akwa Ibom State, Nigeria, and to evaluate the impact of five years of treatment of infection burden. A cross-sectional parasitological survey was conducted among 719 primary school pupils aged 5 to 15 years, selected from six government primary schools across the study area. Stool samples were collected and examined using formol-ether concentration techniques. Of the 719 pupils examined, 244 (33.9%) tested positive for at least one STH species, compared to a baseline prevalence of 62.93% recorded five years prior, representing an absolute reduction of 29.0% and a relative reduction of approximately 46.1%. Three species were identified: *Ascaris lumbricoides* was the most prevalent (176; 24.5%), followed by hookworm (63; 8.8%) and *Trichuris trichiura* (21; 2.9%). GPS Ikot Eyo recorded the highest current prevalence (40.0%) while GPS Ndukpeise and GPS Ekwere recorded the lowest (30.8% each). Male pupils had higher infection rate (128; 35.5%) than females (116; 32.4%), though the difference was not statistically significant ($p = 0.416$). By age group, the 9–10 years cohort recorded the highest prevalence (83; 37.2%), followed by the 5–6 years group (40; 36.0%) and the 7–8 years group (71; 34.1%), with the 11–12 years group recording the lowest (50; 29.2%); no infections were detected in the 13–15 years cohort. Co-infection was observed in 15 pupils (2.1%). The most common pattern was *Ascaris*–hookworm double infection (12; 1.7%), followed by *Ascaris–Trichuris* co-infection (2; 0.3%) and one case of triple infection (1; 0.1 %). The distribution of *Ascaris*–hookworm co-infections across schools was statistically significant ($p = 0.020$). Among risk factors assessed, only handwashing before meals reached statistical significance ($p = 0.021$); toilet type, barefoot walking, drinking water source, fruit washing, and STH knowledge showed no significant associations. The highest school-level reductions were at GPS Ukat Mbak Uno (35.8 %) and GPS Ekwere (31.7%), while GPS Ikot Eyo recorded the least reduction (5.4%). Despite the overall programme success, the current prevalence of 33.9% remains above the WHO control threshold of less than 20%. It is recommended that albendazole-based preventive chemotherapy be sustained and integrated with robust water, sanitation, and hygiene interventions and health education to achieve sustainable STH control in Nsit Ubium.

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Keywords: Helminths; Transmitted; Intervention; Chemotherapy; Anthelminthic

Article history
Received: May 3, 2026
Received in revised form: July 8, 2026
Accepted for publication: July 13, 2026
Available online: July 25, 2026

1.0 Introduction

1.1 Background of study

Globally, an estimated 2 billion people are infected with the most widespread chronic human infections which are soil-transmitted helminths (STHs), or geo-helminths (Artis, 2006). This parasite prevalence are seen across tropics and subtropics regions within the economically disadvantage regions, places without functional sanitation and potable water (Brooker *et al.,* 2004). While the full economic and public health burden is difficult to measure, the WHO assumed that over one billion individuals are affected with one major species: *Ascaris lumbricoides* (roundworm), *Trichuris trichiura* (whipworm), or hookworms (*Ancylostoma duodenale* and *Necator americanus*) (Guan & Han, 2019). Those four nematodes are liable for an approximated 39 million disability-adjusted life year (DALYs) (Chan, 1997; WHO, 2019), with transmission cycles deeply rooted in poverty, poor hygiene, and inadequate sanitation. The most severe distribution are borne by Sub-Saharan Africa, with approximately 89.9 million infected school-aged children (Brooker *et al.,* 2004). Frequent exposure to infected environments and inconsistent sanitary practices are linked to this at-risk demographic (WHO, 2013). Iron-deficiency anemia and malnutrition are attributed to STHs and chronic burdens, resulting to physical and mental development impairment of children (Stephenson *et al.,* 2000).

One of the pervasive nations in Africa is Nigeria, with high geohelminthiasis burden. Data from the Federal Ministry of Health (FMOH) shows that the disease is dispersed across 190 Local Government Areas in 19 States, including Akwa Ibom State, with a national burden of 20.8% (FMOH, 2013). Additionally, government records suggest 42% of Nigeria's urban and semi urban residents have access to potable water and sanitation, a figure that dropped to 29% for those living in rural areas (Federal Government of Nigeria (FGN), 2000). Studies indicates even lower coverage rates in the official evaluation (Stoveland & Bassey, 2000; Sanusi, 2010). According to United Nations Global Annual Assessment on Sanitation (UN-GLAAS), 2012), ensuring that people have access to adequate sanitation facilities for excreta disposal along with hygiene practices is essential in reducing the number of diseases brought on by these risk factors, of which geohelminthiasis is one. The highest Disability Adjusted Life Years (DALYs), which include Years of Life Lost to mortality (YLLs) and Years Lived with Disability (YLDs), are accounted for by STH (Vos *et al.,* 2012). It receives considerably less attention in terms of monitoring and treatment, mostly in the tropics and subtropics, despite having the greatest DALYs of about 39 million (Hotez *et al.,* 2012).

Although each helminth species possesses distinct biological and epidemiological characteristics, these helminths are grouped together for control and prevention purposes. This is because they are found in same geographical regions, affect the same populations, are diagnosed using comparable techniques, they are treated by the same drugs, and similar adverse impact on human health (linked to the intensity of infection). Public health interventions used for control includes better environmental sanitation; promotion of healthy hygiene behaviours, such as hand washing and the use of footwear, through community and schools' health awareness creation, and periodic treatment of populations or targeted groups in the community. A major component of these efforts is preventive chemotherapy, which involves the large-scale distribution of anthelminthic medications to at-risk population groups.

A strategy was endorsed by WHO to control morbidity from soil-transmitted helminth infections through preventive chemotherapy without identification of specific at-risk groups living within endemic areas (a targeted treatment approach) (WHO, 2006). Individuals without infection or mild infection of soil-transmitted helminths shows no noticeable symptoms and may feel little or no effect from soil-transmitted helminth infections. In contrast significant health problems are found among individuals with moderate or heavy infections, however, even these infections are associated with non-specific symptoms, which leads to difficulty in identifying affected individuals, based solely on clinical signs and symptoms. Public health interventions to control soil-transmitted helminth infections aim to reduce the worm burden in populations and decrease the intensity of infection among heavily-infected individuals.

To achieve and sustain the elimination of STH-related morbidity among school-aged children is one of the global objectives set by the WHO for 2030 (WHO, 2019). The implementation of regular mass drug administration alongside routine anthelmintic treatments is the pursued goal for all STH infections (WHO, 2013). According to the WHO, chemotherapy is required for approximately 568.8 million school-aged children across 103 endemic nations (WHO, 2019). Roughly 500 million children were provided with preventive chemotherapy in 2021, those at-risk endemic regions represented 60%. To decrease morbidity within susceptible populations by minimizing the incidence of moderate-to-heavy severe infections is the primary aim of preventive chemotherapy (Boraschi *et al.,* 2008; Murray & Lopez, 2013).

The WHO advocates for preventive chemotherapy primarily utilizing single doses of albendazole (400 mg) or mebendazole (500 mg) to establish and uphold public health safety standards beyond initial goals. The cost-effectiveness, efficiency, and easily administered by non-medical staff favours these medications (Savioli *et al.,* 2018). Albendazole serves as a foundational element of control strategies and is extensively used in mass drug administration (MDA) programmes for school-aged children because it is a broad-spectrum anthelmintics. Minimizing morbidity from high worm burdens and disrupting transmission by decreasing the environmental concentration of helminth eggs are the strategies being focus on (Edelduok *et al.,* 2013). Despite the global implementation of albendazole-based deworming programs, the effectiveness of these interventions in reducing STHs prevalence and intensity over time varies depending on factors such as local epidemiology, reinfection rates, sanitation improvements, and community compliance (Campbell *et al.,* 2014). Studies have shown that while periodic deworming can significantly reduce infection intensity, permanent reductions in prevalence requires integrated approaches, combining MDA with enhancements in water, sanitation, and hygiene (WASH) (Freeman *et al.,* 2015).

The lack of location-specific and up-to-date data on the status of soil-transmitted helminth infections after intervention using albendazole shows a gap in knowledge significantly. It is difficult to decide if the treatment has successfully reduced the burden of disease or whether school children remain at risk of ongoing infection, without assessing infection prevalence and intensity after five years of treatment, (Griswold *et al.,* 2022). The program implementers and health authorities are uncertain, and these limits the making of evidence-based decisions regarding the modification, continuation, or integration of deworming programs with other control measures such as health education and sanitation improvement (Chong *et al.,* 2021; Landeryou *et al.,* 2022). Currently, despite the ongoing mass drug administration programs, there is limited longitudinal evidence evaluating the sustained impact of albendazole intervention in rural Nigerian settings. This study therefore aims to assess the current prevalence of soil-transmitted helminth infections and compare it with baseline data collected five years earlier, in order to evaluate the effectiveness of preventive chemotherapy in reducing infection burden among school-aged children.

2.0 Material and Methods

2.1 Study area

The study was conducted in six (6) Government Primary Schools located in six villages in Nsit Ubium Local Government Area, Akwa Ibom State, Nigeria, and the six schools were, Government Primary School Ikot Eyo, GPS Ikot Ekwere, GPS Ndukpoise, GPS Ikot Editon, GPS Ikot Edibon and GPS Ukat Mbak Uno, and it is represented in the map in (Figure 1), and the study was carried out between April 2025 to October 2025.

Nsit Ubium Local Government Area is a geographical unit situated in Akwa Ibom State, Nigeria. The region is situated between latitudes 4.7247^0 North and longitude 7.9488 East. It shares boundaries with Uruan and Okobo Local Government Areas to the north, Eket to the south, Esit Eket to the east, and Etinan and Nsit Ibom to the west. It was created in 1989 from the former Etinan Local Government Area and has its headquarters at Ikot Edibon.

The climate of Nsit Ubium is tropical, it has two seasons, the rainy season, which begin in April and ends in October, and the dry season, which starts from November to March. The area has high annual rainfall, which supports vegetation and fertile soils. These environmental conditions make the area highly suitable for diverse agricultural practices. The local population engaged in the cultivation of cassava, yam, maize, and various vegetables, cash crop production also occurs, such as oil palm and rubber, which provide raw materials for local processing and trade in markets like the Ikot Ubo market (Bassey and Etim, 2017; Udoh & Akpan, 2019). Nsit Ubium is made of two major clans, Nsit and Ubium, each has a rich heritage of traditional governance and arts. Ibibio language is the main language of the people and English for education and administration. Nsit Ubium serves as a path connecting the state capital, Uyo, to the industrial and oil-producing areas in the south, making it a strategic location for research and studies (Inyang, 2021; Ekpo & Agba, 2015).

2.2 Ethical Clearance

Stool samples were collected under hygienic, private, and respectful conditions, with appropriate protective materials such as gloves, nose masks, clean water, soap, and hand sanitizers provided to prevent contamination. All procedures were non-invasive and minimally invasive and conducted with sensitivity to avoid discomfort or embarrassment. Participants' personal information was treated with strict confidentiality, anonymized where possible, and all data securely stored with access limited to authorized personnel only.

Sequel to this, ethical approval was obtained from Ministry of health Akwa Ibom State, with reference number AKHREC 03/02/25/318, and consent forms were given to parents/guardians, school authorities and to pupils where applicable.

2.3 Study Design

The study design involved primary school children of ages 5-15years, their parent/guardians and teacher were used during the study, Randomized sampling was used to select six public schools and 20 pupils were randomly chosen per classroom with equal numbers of male and female from primary1-6, except for the first school were 19 pupils were gotten from primary 1, making it a total of 119 pupils from the first school and the remaining schools had a total of 120 pupils per school, sample collections was conducted for the period of 6months, ranging from April 2025 – October 2025 after treatment ended September 2024.

2.4 Study Population

The population was made up of 119 in the first school and 120 pupils from the remaining five schools, making a total of 719 pupils from six different primary schools.

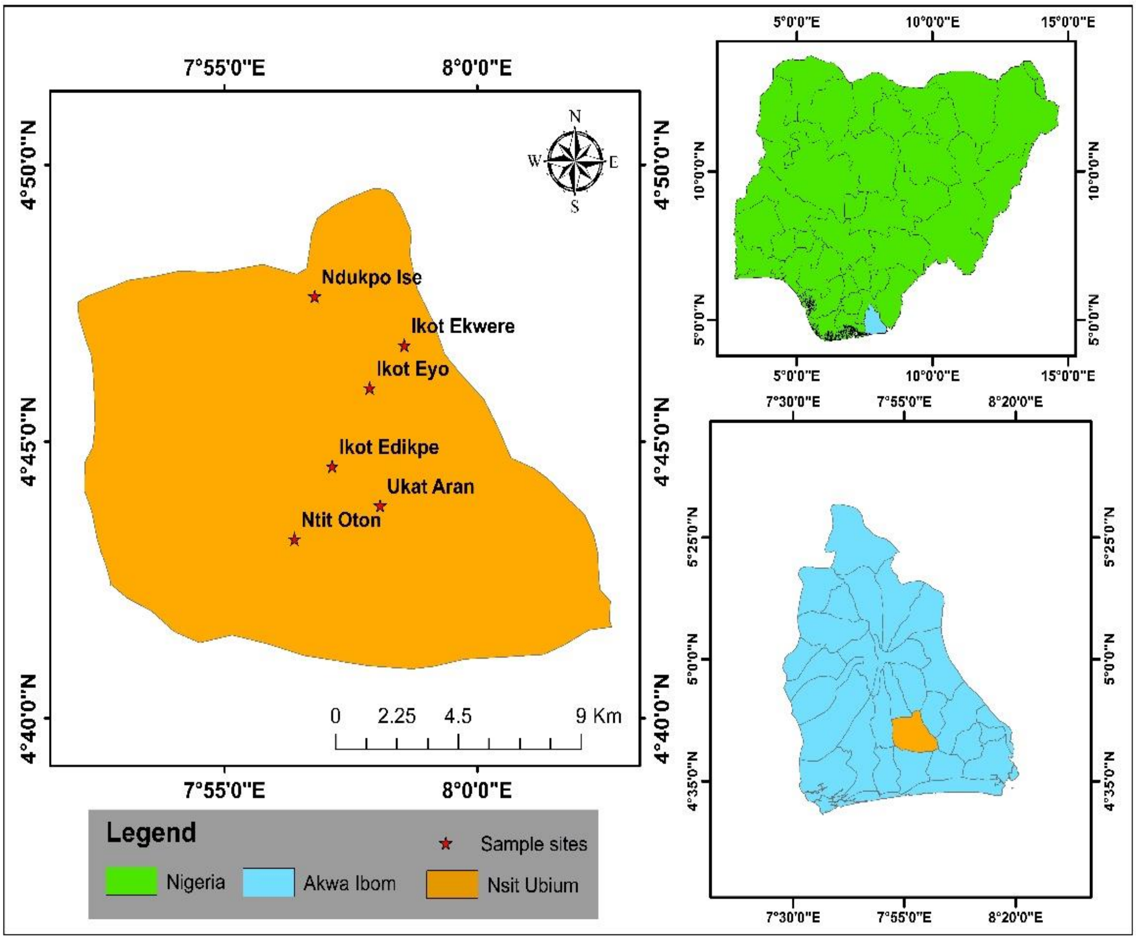

Figure 1: Map of Nsit Ubium Local Government Showing Study Area

2.5 Sample Collection

Well labelled screw cap sample bottles were distributed to the pupils with their identification number written on the bottles for pupils from age 7 years and above, they were instructed to put their faecal samples in the bottles in school after defecating, using the WHO specified method of passing out stools on clean paper, before using a dry stick to scoop the faecal sample into the sample bottle and covered properly. The children below 7 years were asked to defecate on newspapers in school, while I and two paid teachers went round to monitor and scoop the faeces into the sample bottles labelled with the identification numbers of the pupils. All sample were placed in an iced cooler and then transported to University of Uyo Health Center laboratory for analysis.

2.6 Questionnaire Survey

Questionnaires were given to the pupils to assess information on their demography, knowledge, attitude and practices (KAP) of soil transmitted helminths and basic hygiene, and sanitation. Information obtained from the participants included age, class, school, source of drinking water, type of toilet facility used, knowledge of soil transmitted helminth infections, means of treatment, hygiene and sanitation practices and location. Completed questionnaires were checked daily for completeness and consistency before data entry and analysis.

2.7 Laboratory Test

The collected samples were processed and examined using formol-ether techniques.

2.7.1 Formol-ether Concentration Technique A small amount of fresh faecal specimen was collected from the sample bottle using an applicator stick and mixed thoroughly with about 7 ml of 10% formol water in a test tube. The suspension was filtered through gauze into a centrifuge tube to remove large particles and debris. Additional formol water was added to make the volume up to about 10 ml. After that, 3 ml of ether was added to the tube. The tube was tightly stoppered and shaken vigorously for about one minute to allow proper mixing of the faecal suspension with ether. The tube was then centrifuged at approximately 3000 revolutions per minute for ab out 1–2 minutes. After centrifugation, four layers become visible. The top layer consists of ether, the second layer contains a plug of faecal debris, the third layer was formalin, and the bottom layer was the sediment containing parasite eggs, larvae, and cysts. The upper three layers were carefully discarded, leaving only the sediment at the bottom of the tube. The sediment was mixed gently, and a drop was placed on a clean microscope slide, covered with a cover slip, and examined microscopically using the ×10 and ×40 objectives (Cheesbrough, 2009).

2.8 Identification and counting of the parasites

All the parasite eggs and larvae were identified using the keys of Soulsby (1987) and Otubanjo (2013) and then counted.

2.9 Data Analysis

Data were analyzed using Microsoft Excel, SPSS version 21, which was used to enhance accuracy and competency of the computations, thereby increasing confidence of the findings. The percentage prevalence of infection attributed to differential soil transmitted infections were calculated using the standard descriptive formulae, while Chi- square test was applied to compare differences between groups based on the level of statistical significance set at $p< 0.05$.

Results were presented in frequency distribution tables and contingency tables. The findings from the laboratory analyses were further used to identify the distribution of specific helminth parasites among the study participants.

3.0 Results and Discussion

3.1 Results

This study was conducted to compare the current prevalence of soil-transmitted helminth (STH) infection with baseline prevalence data obtained five years ago, within six (6) government primary schools located in six villages in Nsit Ubium Local Government Area, Akwa Ibom State. The six schools were: Government Primary School Ikot Edibon, GPS Ndukpoise, GPS Ikot Ekwere, GPS Ikot Eyo, GPS Ikot Udo Iton, and GPS Ukat Mbak Uno. From the current investigation, three soil-transmitted helminths were identified: *Ascaris lumbricoides*, hookworm (Ancylostoma sp.), and *Trichuris trichiura*.

3.1.1 Comparison between the Prevalence of Soil-Transmitted Helminth Infections among School Children and the Baseline Data after Five Years of Albendazole Administration

A total of 719 pupils ranging from 5 to 15 years of age from the six government primary schools were examined for STH infections. Of these, 244 (33.9%) tested positive, while 475 (66.1%) were negative. The overall current prevalence rate of STH infections was 33.9%, compared to the baseline prevalence of 62.93% recorded five years prior. The school with the highest current prevalence was GPS Ikot Eyo with 48 positive cases (40.0%), followed by GPS Ikot Udo Iton with 40 positive cases (33.3%). GPS Ndukpoise and GPS Ekwere both recorded the lowest prevalence rates of 30.8% each. The differences in current infection prevalence across schools were statistically not significant ($\chi^2 = 3.385$, $df = 5$, $p = 0.641$, $p > 0.05$), as presented in Table 1.

When a direct comparison of the baseline and current prevalence rates for each school were made, substantial reductions were observed across all six schools as shown in Table 2. The most pronounced reductions were recorded at GPS Ekwere (from 62.5% to 30.8%; a reduction of 31.7%) and GPS Ukat Mbak Uno (from 68.3% to 32.5%; a reduction of 35.8%). The least reduction was observed at GPS Ikot Eyo (5.4%) as represented in a bar chart Figure 2, suggesting that this school continues to have relatively higher transmission risk. These findings collectively indicate that the five-year albendazole preventive chemotherapy programme has contributed meaningfully to reducing the burden of STH infections in the study area.

Table 1: Overall Current Prevalence of STHs among School Pupils in Nsit Ubium

Schools	Number Examined	Number Positive (%)	Chi-square	df	p Value
GPS Ikot Edibon	119	43 (36.1)	3.385	5	0.641ns
GPS Ndukpoise	120	37 (30.8)			
GPS Ekwere	120	37 (30.8)			
GPS Ikot Eyo	120	48 (40.0)			
GPS Ikot Udo Iton	120	40 (33.3)			
GPS Ukat Mbak Uno	120	39 (32.5)			
Total	**719**	**244 (33.9)**			

ns – Not significant at p > 0.05

Table 2: Comparison between Baseline Data and Current Prevalence Rates

Location	Baseline Prevalence (%)	Current Prevalence (%)	Reduction (Baseline − Current)
Ikot Edibon	53.1	36.1	17.0
Ndukpoise	41.7	30.8	10.9
Ekwere	62.5	30.8	31.7
Ikot Eyo	45.4	40.0	5.4
Ikot Udo Iton	47.3	33.3	14.0
Ukat Mbak Uno	68.3	32.5	35.8

Source: field data (2025) and Ministry of Health baseline data

3.1.2 Prevalence and Distribution of Soil-Transmitted Helminth Species among School Children

Table 3 and Figure 3 represent the current prevalence and distribution of STH species across the six schools. *Ascaris lumbricoides* had the highest overall prevalence of 176 (24.5%), as seen in one of the slides in (Figure 4) followed by hookworm with 63 (8.8%) as shown in (Figure 5), and *Trichuris trichiura* with 21 (2.9%) in (Figure 6). *Ascaris lumbricoides* recorded the highest prevalence at GPS Ikot Eyo (32; 26.7%), followed by GPS Ikot Edibon (31; 26.1%), while GPS Ukat Mbak Uno recorded the lowest Ascaris prevalence (27; 22.5%). Hookworm infection was most prevalent at QIC Pri Sch (14; 11.8%), followed by GPS Ekwere (13; 10.8%), and least prevalent at GPS Ndukpoise and GPS Ikot Udo Iton (8; 6.7% each). *Trichuris trichiura* was recorded across most schools, with the lowest prevalence at GPS Ekwere (1; 0.8%) and highest at GPS Ikot Edibon and GPS Ikot Eyo (5; 4.2% each). The differences in species distribution across schools were statistically not significant for all three parasites (p > 0.05 in all cases).

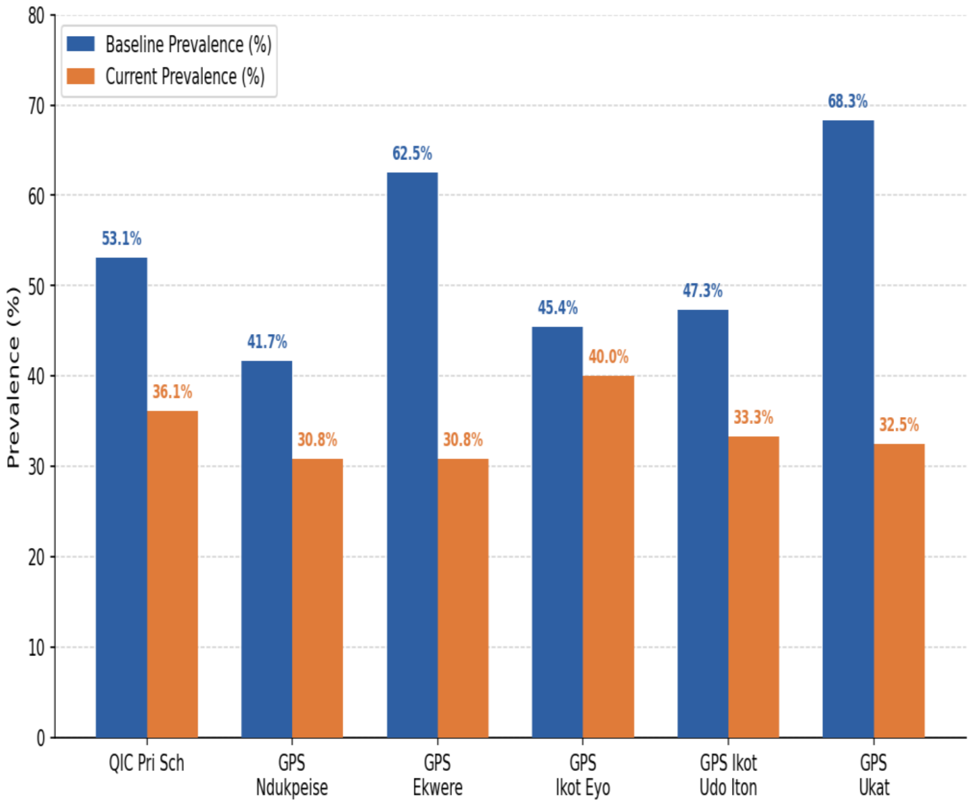

Figure 2: Comparison between Baseline Data and the Current Prevalence Rate (Source: Field Data, 2025)

Table 3: Species Specific Prevalence and Distribution among Primary School Pupils in Selected Schools

Schools	Number Examined	*Ascaris lumbricoides* (%)	Hookworms (%)	*Trichuris trichiura* (%)	Total Positive (%)
GPS Ikot Edibon	119	31 (26.1)	14 (11.8)	5 (4.2)	43 (36.1)
GPS Ndukpoise	120	29 (24.2)	8 (6.7)	3 (2.5)	37 (30.8)
GPS Ekwere	120	28 (23.3)	13 (10.8)	1 (0.8)	37 (30.8)
GPS Ikot Eyo	120	32 (26.7)	11 (9.2)	5 (4.2)	48 (40.0)
GPS Ikot Udo Iton	120	29 (24.2)	8 (6.7)	4 (3.3)	40 (33.3)
GPS Ukat Mbak Uno	120	27 (22.5)	9 (7.5)	3 (2.5)	39 (32.5)
Total	719	176 (24.5)	63 (8.8)	21 (2.9)	244 (33.9)
Chi-square		0.822	3.568	3.412	
Df		5	5	5	
p Value		0.976ns	0.613ns	0.637ns	

ns – Not significant at p > 0.05

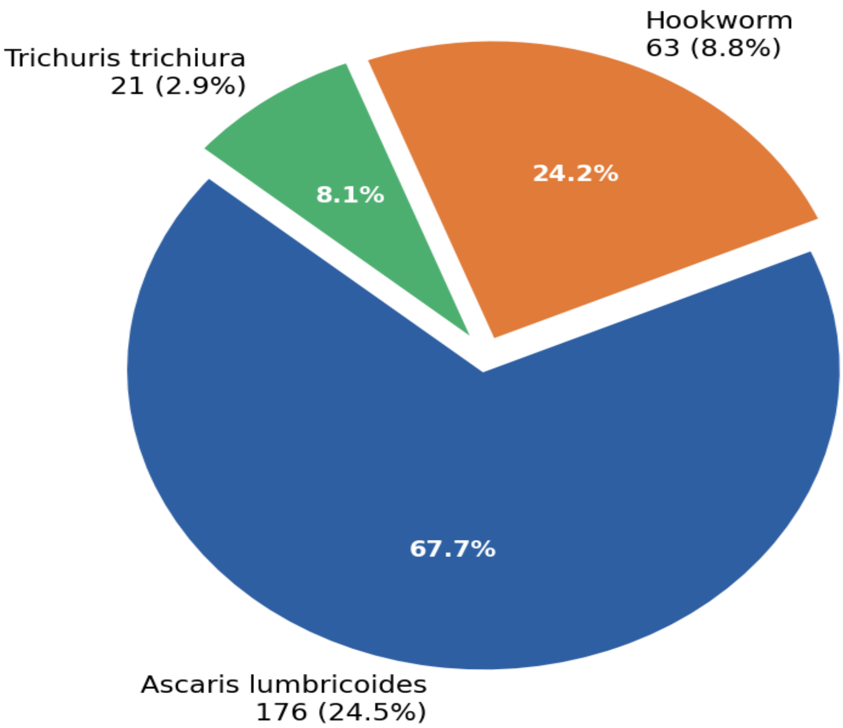

Figure 3; Overall Species-Specific Prevalence in the Six Government Primary School (Source: Field Data 2025)

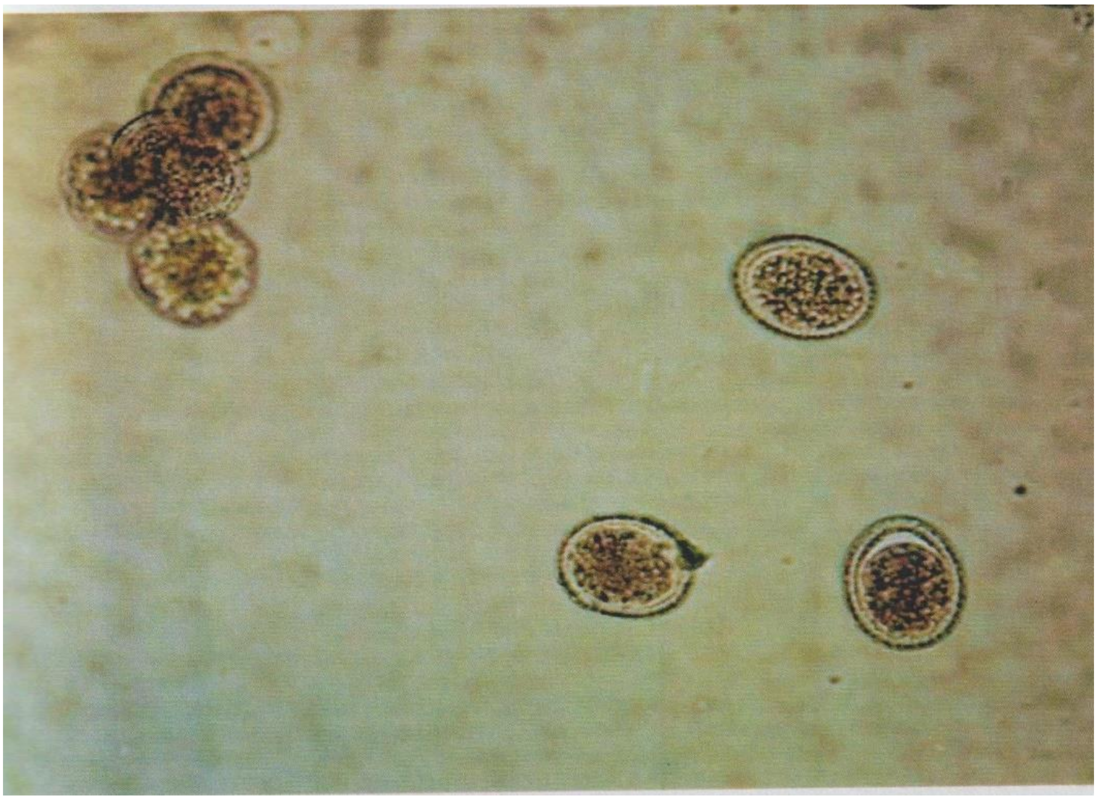

Figure 4: Egg of *Ascaris lumbricodes (*Source: Field Data, 2025)

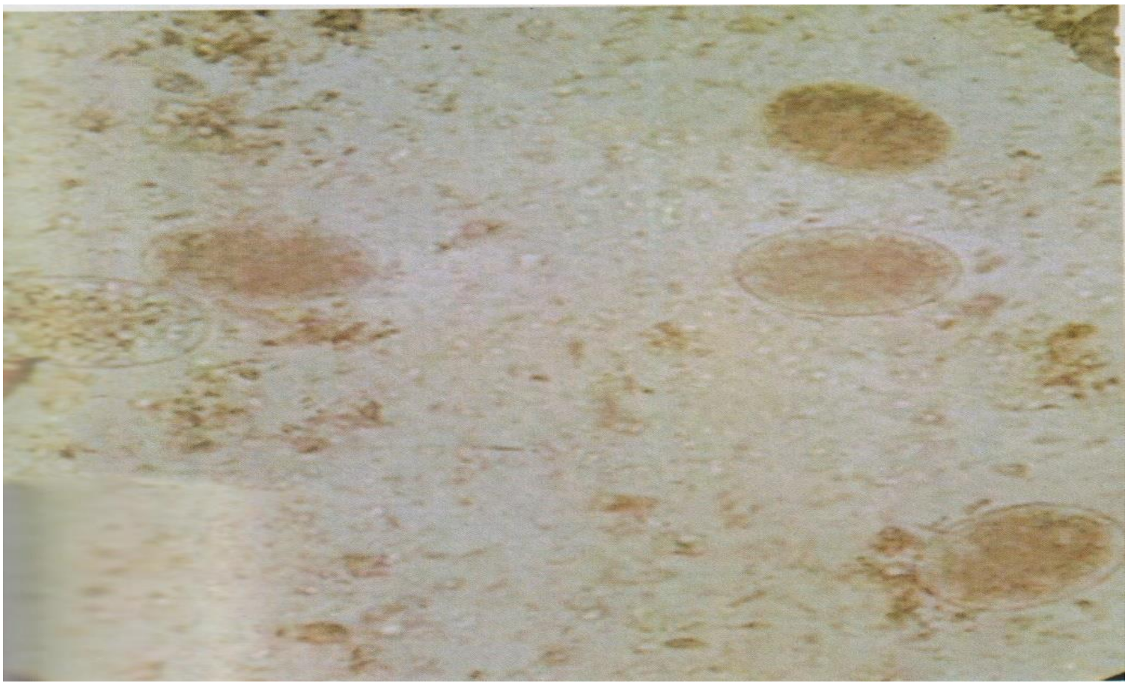

Figure 5: Egg of *Ancylostoma sp (*Source: Field Data, 2025)

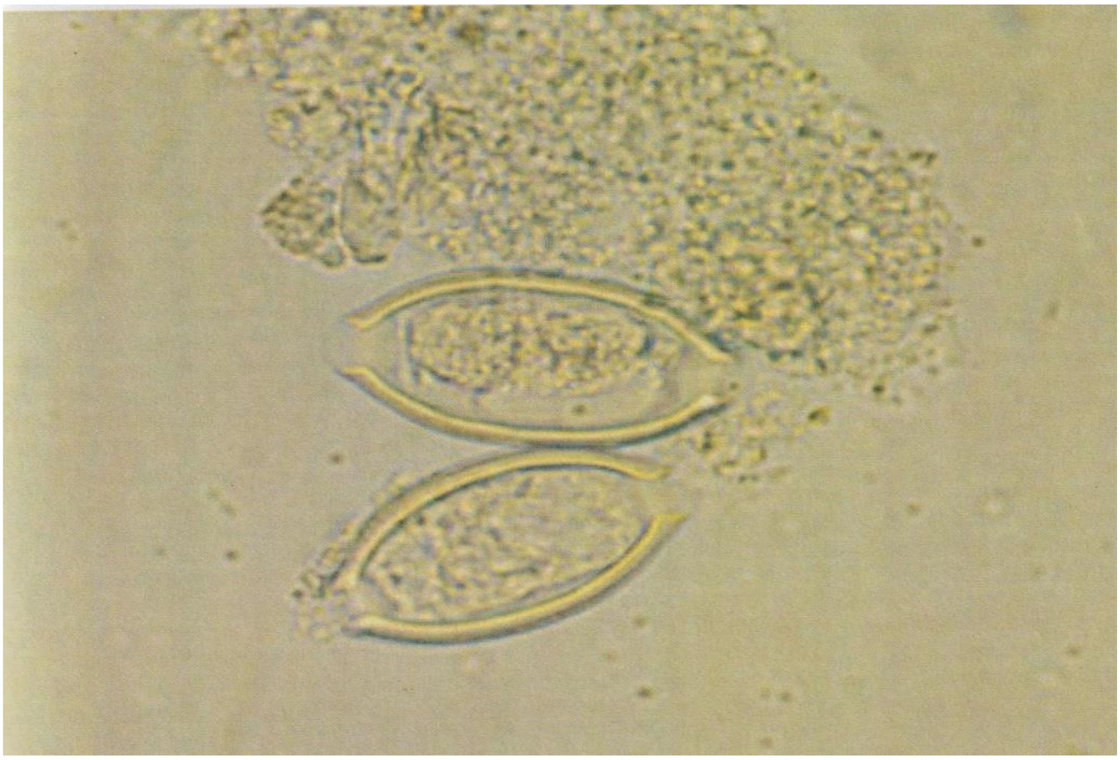

Figure 6: Eggs of *Trichuris trichiura* (Source: Field Data, 2025)

3.1.3 Current Prevalence of STHs in Relation to Sex of School Children

The results in Table 4 show that out of the 719 primary school pupils examined, 361 (50.2%) were male and 358 (49.8%) were female. The overall sex-specific prevalence of STH infections showed that males had a slightly higher infection rate of 128 (35.5%) compared to females at 116 (32.4%) as shown in Figure 3. This difference was, however, statistically not significant ($\chi^2 = 0.661$, df = 1, $p = 0.416$, $p > 0.05$), indicating that sex is not a major determinant of STH infection in this study population.

Table 4: Overall Prevalence of STHs in Relation to Sex of Pupils

Sex	Number Examined	Number Positive (%)	Chi-square	df	p Value
Male	361	128 (35.5)	0.661	1	0.416ns
Female	358	116 (32.4)			
Total	**719**	**244 (33.9)**			

ns – Not significant at p > 0.05.

3.1.4 Prevalence of STH Species Distribution in Relation to Sex of School Children

The species-specific distribution by sex is shown in (Table 5) and (Figure 7). In both males and females, *Ascaris lumbricoides* had the highest infection rate (176; 24.5%), followed by hookworm (63; 8.8%), and *Trichuris trichiura* (21; 2.9%). Male pupils recorded a higher prevalence of *Ascaris lumbricoides* (94; 26.0%) than females (82; 22.9%), while females had a marginally higher hookworm prevalence (33; 9.2%) compared to males (30; 8.3%). *Trichuris trichiura* was near-equally distributed, with males recording 11 (3.0%) and females 10 (2.8%). Chi-square analyses revealed no statistically significant differences in the distribution of any of the three STH species between males and females (p > 0.05 for all species), suggesting that both sexes face comparable exposure risks.

Table 5: Prevalence and Distribution of STH Species in Relation to Sex of Pupils

Sex	Number Examined	Ascaris lumbricoides (%)	Hookworms (%)	Trichuris trichiura (%)	Total Positive (%)
Male	361	94 (26.0)	30 (8.3)	11 (3.0)	128 (35.5)
Female	358	82 (22.9)	33 (9.2)	10 (2.8)	116 (32.4)
Total	**719**	**176 (24.5)**	**63 (8.8)**	**21 (2.9)**	**244 (33.9)**
Chi-square		0.831	0.082	0.000	
Df		1	1	1	
p Value		0.362ns	0.774ns	1.000ns	

ns – Not significant at p > 0.05.

3.1.5 Current Prevalence of STHs in Relation to Age Groups of School Children

Pupils in the 9–10 years age group had the highest prevalence (83; 37.2%), closely followed by those in the 5–6 years group (40; 36.0%) and the 7–8 years group (71; 34.1%). The 11–12 years age group recorded a lower prevalence (50; 29.2%), and the 13–15 years group had no recorded infection, though this group comprised only 6 pupils. The differences across age groups were statistically not significant ($\chi^2 = 6.576$, df = 4, p = 0.160, p > 0.05) Table 6, and represented in Figure 8.

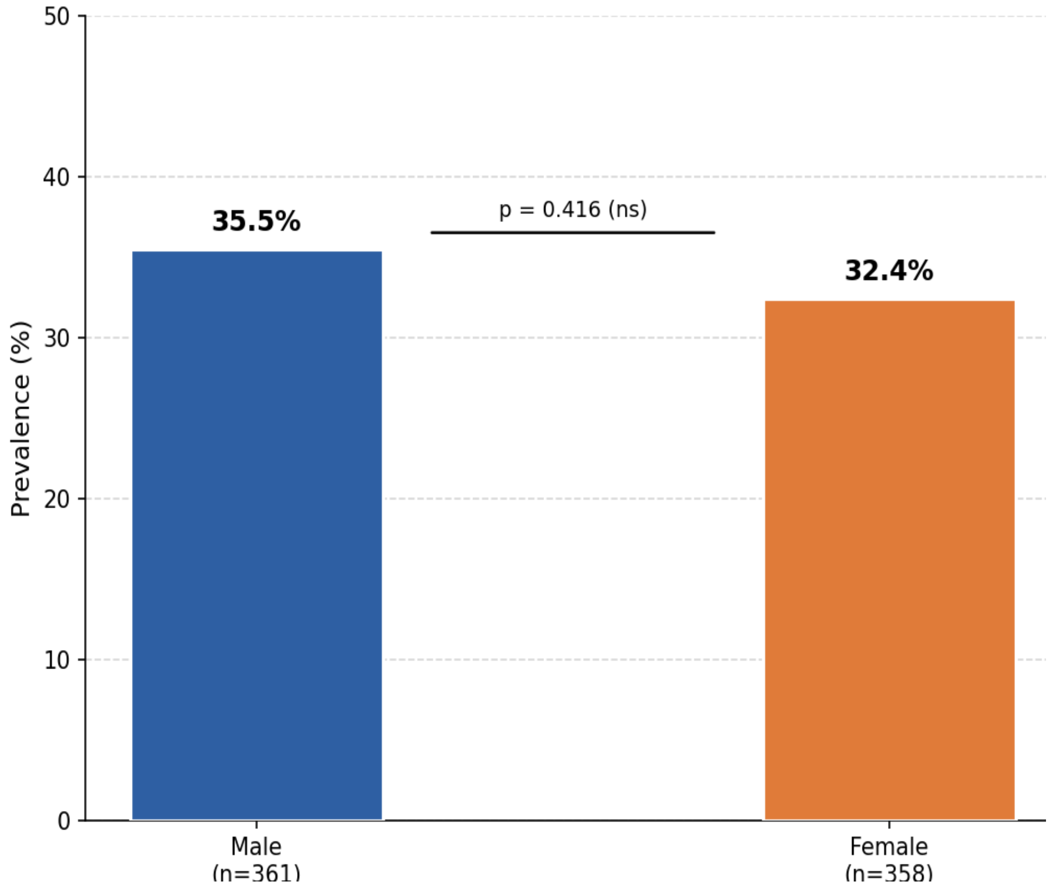

Figure 7: Current Prevalence of STH Species in relation to Sex (**Source:** Field Data, 2025)

Table 6: Current Prevalence of STHs Based on Age Groups

Age Groups (Years)	Number Examined	Number Positive (%)	Chi-square	df	p Value
5 – 6	111	40 (36.0)	6.576	4	0.160ns
7 – 8	208	71 (34.1)			
9 – 10	223	83 (37.2)			
11 – 12	171	50 (29.2)			
13 – 15	6	0 (0.0)			
Total	**719**	**244 (33.9)**			

ns – Not significant at p > 0.05

Ascaris lumbricoides was consistently the most prevalent species in all age groups, with the highest prevalence recorded in the 9–10 years cohort (60; 26.9%) Table 7. Hookworm was most prevalent in the 7–8 years group (22; 10.6%), and *Trichuris trichiura* was most prevalent in the 9–10 years group (9; 4.0%). No infections were detected in the 13–15 years age group. Differences in species distribution across age groups were not statistically significant for any species (p > 0.05).

4.1.6 Co-infection of STHs among School Children

Table 8 presents the pattern of co-infection (polyparasitism) among the school pupils. A total of 15 pupils (2.1%) were found to harbour more than one STH species simultaneously. Both double and triple parasitism were observed. *Ascaris lumbricoides* and hookworm co-infection was the most frequently recorded double infection with 12 cases (1.7%), followed by *Ascaris lumbricoides* and *Trichuris trichiura* co-infection with 2 cases (0.3%). Hookworm and *Trichuris trichiura* co-infection was not observed. Triple parasitism (*Ascaris lumbricoides* + hookworm + *Trichuris trichiura*) was recorded in one case (0.1%), at GPS Ekwere.

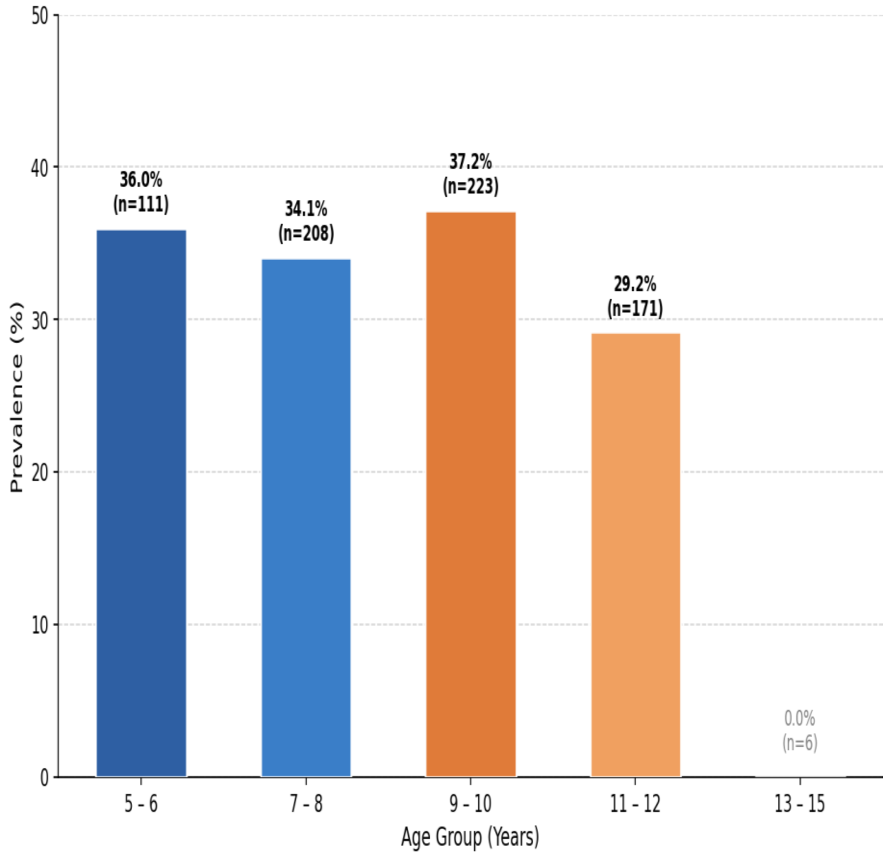

Figure 8: Current STH Prevalence Based on Age Group (Source: Field Data, 2025)

Table 7: STH Species Encountered in Relation to Age Groups of Pupils

Age Group (Years)	Number Examined	Ascaris lumbricoides (%)	Hookworms (%)	Trichuris trichiura (%)	Total Positive (%)
5 – 6	111	28 (25.2)	10 (9.0)	4 (3.6)	40 (36.0)
7 – 8	208	50 (24.0)	22 (10.6)	7 (3.4)	71 (34.1)
9 – 10	223	60 (26.9)	17 (7.6)	9 (4.0)	83 (37.2)
11 – 12	171	38 (22.2)	14 (8.2)	1 (0.6)	50 (29.2)
13 – 15	6	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Total	**719**	**176 (24.5)**	**63 (8.8)**	**21 (2.9)**	**244 (33.9)**
Chi-square		3.479	1.972	4.841	
Df		4	4	4	
p Value		0.481ns	0.741ns	0.304ns	

ns – Not significant at p > 0.05

School-level co-infection analysis showed that GPS Ikot Edibon recorded the highest prevalence of Ascaris–hookworm co-infection (6; 5.0%). The chi-square test for the school distribution of Ascaris–hookworm co-infection was statistically significant (χ^2 = 13.339, df = 5, p = 0.020), indicating that this pattern of co-infection was not uniformly distributed across schools. Other co-infection combinations did not show statistically significant school-level variation.

Table 8: Current Co-parasitism Encountered Among Pupils in the Primary Schools

Schools	No. Exined	*A. lumbricoides* + Hookworms (%)	*A. lumbricoides* + *T. trichiura (%)*	Hookworms + *T. trichiura* (%)	*A. lumbricoides* + Hookworms + *T. trichiura* (%)
GPS Ikot Edibon	119	6 (5.0)	1 (0.8)	0 (0.0)	0 (0.0)
GPS Ndukpeise	120	2 (1.7)	1 (0.8)	0 (0.0)	0 (0.0)
GPS Ekwere	120	3 (2.5)	0 (0.0)	0 (0.0)	1 (0.8)
GPS Ikot Eyo	120	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
GPS Ikot Udo Iton	120	1 (0.8)	0 (0.0)	0 (0.0)	0 (0.0)
GPS Ukat Mbak Uno	120	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Total	**719**	**12 (1.7)**	**2 (0.3)**	**0 (0.0)**	**1 (0.1)**
Chi-square		13.339	4.011	–	4.011
Df		5	5	–	5
p Value		0.020*	0.548ns	–	0.548ns

** Significant at p < 0.05; ns – Not significant at p > 0.05, – Not applicable (zero events across all cells)*

3.1.7 Risk Factors Associated with STH Infections among School Children in Nsit Ubium

Table 9 presents the risk factor analysis for STH infection among the school pupils. Several behavioural, environmental, and socio-economic factors were assessed.

Regarding toilet facility type, the highest prevalence was observed among pupils who used open defecation in the bush (17; 35.4%), followed by pit latrine users (170; 34.8%), while water closet users had the lowest prevalence (57; 31.1%). Chi-square analysis revealed no statistically significant association between toilet type and STH infection (χ^2 = 0.823, df = 2, p = 0.663). The odds ratios for pit latrine (OR = 1.182; 95% CI: 0.821–1.701) and bush use (OR = 1.174; 95% CI: 0.603–2.286) relative to water closet were above unity, suggesting slightly elevated risk, though not statistically significant.

Handwashing before eating was the only risk factor that reached statistical significance in this study. Pupils who reported washing their hands before meals had a significantly higher infection rate (203; 36.2%) than those who did not (41; 25.9%) (χ^2 = 5.314, df = 1, p = 0.021). The odds ratio for non-hand washers was 0.618 (95% CI: 0.416–0.918), suggesting that not washing hands before meals was paradoxically associated with a lower rate of recorded infection, an unexpected finding which may reflect reporting bias or other confounding in data collection.

Table 9: Risk Factors Identified Among School Children in Nsit Ubium

Factor	Number Examined	Number Positive (%)	Chi-square	df	p Value	OR (95% C.I.)
Type of Toilet Facility						
Pit toilet	488	170 (34.8)	0.823	2	0.663ns	1.182 (0.821–1.701)
Water closet	183	57 (31.1)				1 (ref)
Bush (open defecation)	48	17 (35.4)				1.174 (0.603–2.286)
Handwashing Before Eating						
Yes	561	203 (36.2)	5.314	1	0.021*	1 (ref)
No	158	41 (25.9)				0.618 (0.416–0.918)
Washing of Fruits Before Eating						
Yes	449	150 (33.4)	0.140	1	0.708ns	1 (ref)
No	268	94 (35.1)				1.077 (0.783–1.481)
Handwashing After Toilet						
Yes	623	209 (33.5)	0.198	1	0.656ns	1 (ref)
No	96	35 (36.5)				1.137 (0.726–1.778)
Walking Barefoot						
Yes	359	121 (33.7)	0.003	1	0.959ns	0.980 (0.719–1.334)
No	360	123 (34.2)				1 (ref)
Source of Drinking Water						
Tap water	309	112 (36.2)	2.248	2	0.325ns	1 (ref)
Stream water	350	116 (33.1)				0.872 (0.632–1.203)
Sachet water	60	16 (26.7)				0.640 (0.345–1.186)
Knowledge of STHs						
Yes	478	152 (31.8)	2.627	1	0.105ns	1 (ref)
No	241	92 (38.2)				1.324 (0.958–1.830)
Mode of Treatment						
Hospital	76	24 (31.6)	0.211	2	0.900ns	1 (ref)
Self-medication	362	124 (34.3)				1.129 (0.664–1.918)
Native treatment	281	96 (34.2)				1.124 (0.653–1.935)
Total	**719**	**244 (33.9)**				

* *Significant at $p < 0.05$; ns – Not significant at $p > 0.05$; OR – Odds Ratio; CI – Confidence Interval; ref Reference category*

For handwashing after toilet use, higher prevalence was noted among those who did not wash (35; 36.5%) compared to those who did (209; 33.5%), though the difference was not statistically significant ($\chi^2 = 0.198$, $p = 0.656$). Walking barefoot showed virtually no association with STH infection ($\chi^2 = 0.003$, $p = 0.959$), contrary to the expected pattern for hookworm transmission. Washing of fruits before eating was also not significantly associated with STH infection ($\chi^2 = 0.140$, $p = 0.708$). Regarding drinking water source, pupils drinking sachet water had the lowest prevalence (16; 26.7%), compared to tap water users (112; 36.2%) and stream water users (116; 33.1%), though the differences were not statistically significant (χ^2 = 2.248, df = 2, p = 0.325). Pupils with no knowledge of STHs had a higher infection rate (92; 38.2%) compared to those with knowledge (152; 31.8%), though this was not statistically significant (χ^2 = 2.627, p = 0.105). Mode of treatment also showed no significant association with infection status (χ^2 = 0.211, p = 0.900).

3.1.8 Comparison between Post-Treatment Prevalence and Baseline Pre-Intervention Data

The results of this study clearly demonstrate a significant reduction in the prevalence of STH infections among school-aged children in Nsit Ubium following five years of albendazole preventive chemotherapy (PC). The overall baseline prevalence, recorded approximately five years ago, was 62.93%, compared to the current prevalence of 33.9%, representing an absolute reduction of 29.0% and a relative reduction of approximately 46.1%. This finding affirms the efficacy of albendazole as a deworming agent when administered consistently through school-based mass drug administration (MDA) programmes.

The most significant reductions were observed at GPS Ukat Mbak Uno (from 68.3% to 32.5%; reduction = 35.8%) and GPS Ekwere (from 62.5% to 30.8%; reduction = 31.7%), suggesting effective drug coverage in these communities (table 2). The smallest reduction was at GPS Ikot Eyo (from 45.4% to 40.0%; reduction = 5.4%), which warrants further investigation into potential barriers such as drug compliance, re-infection rates, or environmental contamination. Notwithstanding, the general downward trend across all six schools is consistent with the global evidence base supporting albendazole-based preventive chemotherapy as a cornerstone of STH control strategies.

3.2 Discussion of Findings

The current study recorded an overall STH prevalence of 33.9% among primary school pupils in Nsit Ubium Local Government Area, Akwa Ibom State, Nigeria. This finding is consistent with the continued endemic nature of STH infections in rural communities of sub-Saharan Africa, where environmental, socioeconomic, and infrastructural conditions sustain parasite transmission cycles. While this prevalence represents a notable reduction from the baseline figure of 62.93%, it nonetheless indicates that STH infections remain a moderate public health concern in the study area, as the current level still exceeds the World Health Organization (WHO) threshold of less than 20% required for a community to be classified as having achieved control of moderate-intensity infections (WHO, 2022).

A comparable prevalence was reported by Ekpo *et al.* (2020), who documented STH prevalence rates ranging from 28.0% to 45.0% among school-aged children across selected rural communities in southern Nigeria following periodic mass drug administration (MDA) rounds. Similarly, Ojurongbe *et al.* (2020) recorded an overall STH prevalence of 31.4% among primary school children in Osun State, Nigeria, a figure closely aligned with the present study findings. These parallels suggest that despite ongoing deworming programmes, transmission persists at levels that are epidemiologically significant, particularly in communities with poor sanitation coverage and limited access to clean water.

By contrast, studies conducted in more urbanized settings tend to report reduced prevalence figures. Umar *et al.* (2019) documented a prevalence of 18.6% in Kano, an urban northern Nigerian setting, attributing the lower burden to relatively better access to sanitation infrastructure and health services. The higher prevalence observed in Nsit Ubium compared to such urban environments may be explained by the predominantly rural character of the study communities, which are characterised by open defecation, reliance on contaminated water sources, and limited health education. These environmental and behavioural determinants are well established in the literature as key drivers of STH transmission (Adekunle *et al.,* 2021).

Furthermore, *Ascaris lumbricoides* was the most prevalent species (24.5%), consistent with findings from numerous Nigerian studies that identify *A. lumbricoides* as the dominant STH species in the country (Ugbomoiko *et al.,* 2017; Adediran *et al.,* 2022). The predominance of ascariasis in tropical and subtropical regions has been linked to the remarkable environmental resilience of Ascaris eggs, which can survive in moist, warm soils for extended periods and are highly resistant to chemical and thermal degradation (Bethony *et al.,* 2006). This environmental durability partially explains why *A. lumbricoides* is more resistant to control through drug administration alone, as reinfection from contaminated soil occurs rapidly in the absence of complementary sanitation measures.

The age-stratified analysis in the present study revealed that pupils in the 9–10 years age group recorded the highest STH prevalence (37.2%), followed by those in the 5–6 years group (36.0%) and the 7–8 years group (34.1%). The 11–12 years group recorded a lower prevalence of 29.2%, and no infections were detected in the small cohort of 13–15-year-olds (n = 6). Despite these observable trends, the differences across age groups did not reach statistical significance ($\chi^2 = 6.576$, df = 4, $p = 0.160$), indicating that age was not a statistically independent determinant of infection risk within this study population. This finding diverges from several earlier studies that reported strong age-dependency in STH prevalence.

The peak prevalence observed in the 9–10 years age cohort is biologically and behaviourally plausible. Children within this age range are old enough to engage in unstructured outdoor play and soil contact without adult supervision, yet may not have developed adequate hygiene habits or hand-washing practices. Studies conducted in Nigeria and other sub-Saharan African countries have similarly noted that children between 6 and 12 years tend to bear the highest STH burden, given their frequent contact with contaminated soil during play and farming activities (Brooker *et al.,* 2010; Pullan *et al.,* 2014). Adediran et al. (2022) specifically reported peak infection rates among children aged 8–11 years in Cross River State, a neighbouring state sharing similar ecological conditions with Akwa Ibom.

The relatively elevated prevalence among the youngest group (5–6 years) observed in this study is equally important from a public health standpoint. Young children in this age group may not yet be fully enrolled in MDA programmes, particularly if they have not attained minimum school-enrolment age, leaving them potentially excluded from routine deworming activities. The WHO Preventive Chemotherapy guidelines (WHO, 2017) recommend extending deworming coverage to pre-school children aged 2–5 years precisely because this cohort frequently escapes school-based MDA, yet experiences high transmission risk due to intensive soil contact and immature immune responses. The apparent gradual decline in prevalence as children approach adolescence may reflect a combination of acquired immunity, reduced soil exposure, and cumulative benefit from repeated drug treatment.

With regard to sex distribution, male pupils recorded a slightly higher prevalence (35.5%) than females (32.4%), though this difference was statistically non-significant ($\chi^2 = 0.661$, df = 1, $p = 0.416$). This pattern is consistent with findings from Umar *et al*. (2019) and Adediran *et al*. (2022), who similarly observed higher infection rates in male children without significant sex differences. The slight male predominance may be attributable to behavioural factors: boys in rural Nigerian communities are generally more likely to engage in outdoor activities involving contact with soil, farming, and play in open spaces compared to girls, who tend to spend more time indoors assisting with domestic activities (Albonico *et al.,* 2004). However, the absence of statistical significance in this study suggests that in the context of Nsit Ubium, both sexes face broadly comparable exposure risks, likely because mixed farming activities and open defecation practices are pervasive across both genders in rural communities of this region.

An interesting species-level sex disparity was observed in hookworm infection, where females recorded a marginally higher prevalence (9.2%) compared to males (8.3%), although this was not statistically significant. A similar pattern was observed by Ojurongbe *et al*. (2020) in Osun State, where hookworm prevalence was slightly higher in girls. One proposed explanation relates to the practice of female children going barefoot during domestic water and firewood collection tasks involving soil contact in farm areas. Taken together, the sex and age findings suggest that STH control strategies in Nsit Ubium should adopt a universal approach targeting all school-aged children rather than risk-stratifying by demographic subgroup, given the broadly homogeneous risk profile observed.

Polyparasitism is the simultaneous harboring of more than one parasite species, it was documented in 2.1% (15/719) of pupils in the present study. The predominant co-infection pattern was *Ascaris lumbricoides* and hookworm double infection, recorded in 12 pupils (1.7%), and followed by *Ascaris lumbricoides* and *Trichuris trichiura* in 2 pupils (0.3%), and one case (0.1%) of triple infection involving all three species detected at GPS Ekwere. Notably, no Hookworm–Trichuris co-infection was observed in the absence of *A. lumbricoides*. The overall co-infection rate of 2.1% in the current study is substantially lower than baseline figures typically reported in pre-MDA surveys from the region, suggesting that the albendazole preventive chemotherapy programme has contributed to a reduction not only in single-species infections but also in polyparasitism.

These findings of this study contrast with higher co-infection rates reported in studies from communities with limited or no ongoing deworming activities. Ugbomoiko *et al*. (2017) reported polyparasitism in approximately 8.0% of school children in Kwara State, while Adediran *et al.* (2022) documented mixed infections in 5.3% of pupils in Cross River State. The relatively low co-infection rate in the present study may be a direct consequence of sustained albendazole MDA, given that albendazole is broad-spectrum and effective against *A. lumbricoides*, hookworm, and *T. trichiura* simultaneously, thus reducing the probability of maintaining simultaneous multi-species infections (WHO, 2017).

The statistically significant school-level variation in Ascaris–hookworm co-infection ($\chi^2 = 13.339$, df = 5, p = 0.020), with QIC Primary School recording the highest rate (5.0%), warrants specific attention. QIC Ikot Akpan Abia is a relatively larger school with a higher student population and more diverse community catchment, potentially encompassing children from areas with varying sanitation profiles. The co-occurrence of *A lumbricoides* and hookworm infections within the same host reflects shared transmission pathways, both parasites are transmitted via faecal-contaminated soil, with Ascaris eggs ingested through contaminated hands, water, or food, and hookworm larvae penetrating the skin through contact with contaminated soil (Bethony *et al.,* 2006; Hotez *et al.,* 2008). Communities where open defecation remains common and children routinely walk barefoot on faecally contaminated ground provide optimal conditions for simultaneous acquisition of both parasites.

The observation of triple parasitism - albeit in a single case - is epidemiologically noteworthy in the context of an ongoing MDA programme. Triple infection suggests either a failure of drug coverage for that individual (non-compliance or absence during drug distribution), reinfection from a highly contaminated environment following treatment, or, less commonly, the possibility of reduced drug efficacy. Sahu *et al.* (2019) similarly documented triple infections in residual clusters within deworming programmes, identifying high household density and poor WASH access as predisposing factors. The implications of polyparasitism extend beyond mere infection status: children harbouring multiple STH species experience additive negative effects on nutritional status, cognitive performance, and growth, reinforcing the public health urgency of eliminating even low - prevalence co-infections through complementary control measures.

The analysis of risk factors in this study revealed that most assessed variables - including toilet facility type, barefoot walking, drinking water source, fruit washing practices, and STH knowledge, did not achieve statistical significance as independent predictors of STH infection. The only variable that reached statistical significance was handwashing before meals ($\chi^2 = 5.314$, df = 1, $p = 0.021$). This finding, however, produced an unexpected direction of association: pupils who reported washing their hands before meals had a higher recorded prevalence (36.2%) than those who did not (25.9%). This paradoxical result likely reflects reporting bias, social desirability bias in questionnaire responses, or confounding by other unmeasured variables. It is well established in epidemiological literature that self-reported hygiene behaviours are frequently overestimated by respondents, particularly in settings where children are aware of expected responses (Bieri *et al.,* 2013). Children who are infected may also have been coached by parents or teachers about hygiene practices in response to prior health education, without necessarily practising those behaviours consistently.

The absence of a statistically significant association between barefoot walking and STH infection is a particularly notable finding given the biological expectation that hookworm transmission is predominantly transcutaneous and therefore dependent on direct skin-soil contact facilitated by walking barefoot (Brooker *et al.,* 2010). However, this null finding is not unprecedented in the Nigerian literature. Umar *et al.* (2019) similarly found no significant association between footwear use and hookworm infection among school children in Kano, suggesting that the relative contribution of this risk factor may be confounded by other transmission routes or that hookworm prevalence in the study area was insufficiently high to detect an independent barefoot-walking effect. In the present study, the relatively low hookworm prevalence (8.8%) compared to *A lumbricoides* (24.5%) reduces the statistical power to detect hookworm-specific transmission risk factors.

The lack of statistical significance for toilet facility type including open defecation is somewhat surprising, as open defecation is consistently identified in sub-Saharan African literature as a primary driver of STH transmission through environmental faecal contamination (Pullan *et al.,* 2014; WHO, 2022). The non-significant result in this study may reflect several factors: the relatively small proportion of pupils reporting exclusive open defecation (48/719, 6.7%), the cross-sectional nature of the study which captures a snapshot rather than cumulative exposure, and the possibility that the overall sanitation environment in Nsit Ubium is sufficiently contaminated across all toilet-use groups as to minimise differential risk. This interpretation aligns with the concept of environmental faecal saturation, in which soil and water contamination are so widespread that individual household sanitation practices have limited protective effect (Freeman *et al.,* 2017).

Drinking water source showed a trend toward lower prevalence among sachet water users (26.7%) compared to tap water (36.2%) and stream water (33.1%) users, although this did not reach significance ($p = 0.325$). The directionally lower prevalence among sachet water consumers is consistent with the rationale that treated, packaged water reduces exposure to Ascaris and Trichuris eggs, which may be waterborne in addition to soil-borne. Adekunle et al. (2021) similarly reported lower STH prevalence among children in Nigerian households with access to treated piped water, underscoring the protective potential of improved water supply. The non-significance in the current study may reflect the small number of sachet water users (n=60), limiting statistical power. Pupils without knowledge of STHs recorded higher prevalence (38.2%) compared to those with knowledge (31.8%), though this too was non-significant (p = 0.105), suggesting a weak but directionally plausible protective effect of health awareness. Collectively, these risk factor findings emphasis that STH control in Nsit Ubium requires a multi-sectoral approach integrating deworming with WASH improvements and targeted health education, rather than relying solely on any single intervention.

The comparison of current (post-intervention) and baseline (pre-intervention) STH prevalence data provides the most critical evidence for evaluating the public health impact of the five-year albendazole preventive chemotherapy programme in Nsit Ubium. The overall baseline prevalence of 62.93% has declined to a current prevalence of 33.9%, representing an absolute reduction of 29.0% and a relative reduction of approximately 46.1%. This substantial decline unambiguously demonstrates the efficacy of albendazole-based school-based MDA as a tool for reducing STH burden in this setting. School-level analysis further corroborates this trend, with statistically meaningful reductions observed across all six study schools, ranging from 5.4% (GPS Ikot Eyo) to 35.8% (GPS Ukat Mbak Uno).

This level of reduction is consistent with global evidence on the effectiveness of albendazole-based PC. The WHO (2022) reports that regular annual or biannual MDA with albendazole or mebendazole typically reduces STH prevalence by 30–60% in endemic communities within 3–5 years of programme implementation, which closely mirrors the 46.1% relative reduction observed in this study. Comparable results have been documented within Nigeria: Ekpo *et al*. (2020) reported a 40.3% relative reduction in STH prevalence following four years of school-based MDA in Ogun State, while Adediran et al. (2022) documented an approximate 50% reduction after five years of biannual deworming in Cross River State. The present findings from Nsit Ubium thus align with both global and Nigerian programme evidence, affirming that albendazole MDA, when administered consistently, produces measurable reductions in STH burden in rural endemic communities.

Notwithstanding the overall success of the programme, several school-level and mechanistic issues merit critical discussion. The remarkably small reduction of 5.4% at GPS Ikot Eyo (from 45.4% to 40.0%) stands in stark contrast to the reductions at other schools and warrants specific investigation. Persistent transmission at GPS Ikot Eyo may reflect lower drug distribution coverage or compliance at that school, proximity to environmental transmission hotspots such as open water bodies or uncontrolled defecation areas, or potentially higher rates of reinfection from a highly contaminated local environment. Reinfection following albendazole treatment is well documented in the literature and occurs rapidly within 3–6 months in communities with uncontrolled environmental contamination and poor WASH access (Brooker *et al.,* 2010; Coffeng *et al.,* 2020). The presence of persistent transmission at a single school within a multi-school MDA programme illustrates the epidemiological concept of residual endemic foci, wherein localised environmental, social, or programmatic factors sustain infection even within an otherwise effective control programme.

A critical observation is that despite the substantial progress achieved, the current overall STH prevalence of 33.9% remains above the WHO target of less than 20% for moderate-intensity infection control. This finding is not unique to Nsit Ubium. Multiple Nigerian programmes have similarly documented residual transmission above WHO thresholds following sustained MDA (Ojurongbe *et al.,* 2020; Umar *et al.,* 2019), highlighting the well-established limitation that drug-based PC alone is insufficient to achieve the WHO elimination-as-a-public-health-problem target, set for realisation by 2030 (WHO, 2021). The WHO's current roadmap explicitly acknowledges that reaching the 2030 goals requires integrating MDA with improvements in WASH, behaviour change communication, and food hygiene - the so-called SAFE strategy (Surgery, Antibiotics, Facial cleanliness, Environmental improvement) analogy that has proven effective in trachoma control (Freeman *et al.,* 2017).

Concerns regarding drug compliance, coverage gaps, and the potential for drug tolerance also merit consideration. Mass drug administration programmes in Nigeria and across sub-Saharan Africa frequently face implementation challenges including incomplete school attendance during drug distribution days, parental refusal, and inadequate supervision of drug ingestion, leading to less-than-optimal effective coverage (Kabatereine *et al.,* 2011). Furthermore, while clinically confirmed albendazole resistance in human STH populations remains under investigation, sub-optimal egg reduction rates following treatment have been reported in some African settings, raising questions about whether sustained pressure with a single drug class over five or more years may be selecting for reduced drug susceptibility in parasite populations (Vercruysse *et al.,* 2011). Periodic assessment of therapeutic efficacy through standardised Kato-Katz egg reduction rate (ERR) studies, as recommended by WHO (2017), would be valuable in Nsit Ubium to monitor for any emergence of drug tolerance and to guide decisions about treatment frequency and drug rotation. Overall, while the five-year albendazole preventive chemotherapy programme in Nsit Ubium has produced a meaningful and programmatically significant reduction in STH burden, continued investment in both pharmacological and non-pharmacological control strategies is essential to achieve the goal of sustainable STH control and ultimately elimination as a public health problem.

4.0 Conclusion

Soil-transmitted helminths species causing helminthic infections among children in the study area includes *A. lumbricoides*, *T. trichiura* and hookworms. The study revealed that *A. lumbricoides* was the most prevalent parasite among the children. Based on the findings of this study, it demonstrates that five years of Albendazole based preventive chemotherapy has reduced the prevalence of soil transmitted helminth infections; however, moderate transmission persists among school-aged children. This indicates that while mass drug administration is effective in reducing infection burden, it is insufficient for elimination. Sustainable control requires integrated interventions, including improved water supply, sanitation infrastructure, and hygiene education to reduce reinfection.

Acknowledgements

The first author really appreciates her supervisors for their encouragement and support throughout the study, which led to the successful completion of her work. The authors are also appreciative of their colleagues and other members of staff of the Department of Animal and Environmental Biology, University of Uyo, Nigeria, for their assistances during the entire work.

Fundings: This research was funded by the authors

Declaration of Interest: The authors declare that there are no known financial or personal relationships that could have influenced the work reported in this paper.

References

Adediran, A., Adetokunbo, O., & Abiodun, P. (2022). Impact of five-year deworming programme on soil - transmitted helminths in Cross River

State, Nigeria. *Nigerian Journal of Parasitology*, 43(1), 55–68.

Adekunle, O. F., Afolabi, O. O., & Okunade, K. S. (2021). Prevalence and risk factors of soil- transmitted helminth infections among school-aged children in Ogun State, Nigeria. *Journal of Tropical Medicine and Public Health*, 14(2), 112–121

Albonico, M., Crompton, D. W. T., & Savioli, L. (2004). Control strategies for human intestinal nematode infections. Advances in Parasitology, 42, 277–341.

Artis, D. (2006). New weapons in the war on worms: Identification of putative mechanisms of immune-mediated expulsion of gastrointestinal nematodes. *International Journal for Parasitology*, *36*(6), 723–733.

Bassey, E. J., & Etim, S. O. (2017). Agricultural productivity and soil fertility status in Nsit Ubium, Akwa Ibom State. *Journal of Tropical Agriculture and Food Science*, *5*(2), 114 – 122.

Bethony, J., Brooker, S., Albonico, M., Geiger, S. M., Loukas, A., Diemert, D., & Hotez, P. J. (2006). Soil - transmitted helminth infections: Ascariasis, trichuriasis and hookworm. *The Lancet*, *367*(9521), 1521 – 1532.

Bieri, F. A., Gray, D. J., Williams, G. M., Raso, G., Li, Y. S., Yuan, L., He, Y., Li, R. S., Guo, F. Y., Li, S. M., & McManus, D. P. (2013). Health-education package to prevent worm infections in Chinese schoolchildren. *New England Journal of Medicine,* 368(17), 1603–1612

Boraschi, D., Alemayehu, M. A., Aseffa, A., Chiodi, F., Chisi, J., Del Prete, G., Doherty, T. M., Elhassan, I., Engers, H., & Gyan, B. (2008). Immunity against HIV/AIDS, malaria, and tuberculosis during co-infections with neglected infectious diseases: Recommendations for the European Union research priorities. *PLoS Neglected Tropical Diseases*, *2*(6), e255.

Brooker, S., Bethony, J., and Hotez, P. J. (2004). Human hookworm infection in the 21st century. *Advances in Parasitology*, *58*, 197–288.

Brooker, S., Clements, A. C., and Bundy, D. A. P. (2010). Global epidemiology, ecology and control of soil-transmitted helminth infections. *Advances in Parasitology*, 62, 221–261.

Campbell, S. J., Savage, G. B., Gray, D. J., Atkinson, J. M., Magalhaes, R. J. S., Nery, S. V., McCarthy, J. S., Velleman, Y., Wicken, J. H., Traub, R. J., Williams, G. M., Anderson, E. M., & Clements, A. C. (2014). Water, sanitation and hygiene (WASH): A critical component for sustainable soil-transmitted helminth and schistosomiasis control. *PLOS Neglected Tropical Diseases*, *8*(4), e2751.

Chan, M. S. (1997). The global burden of intestinal nematode infections – fifty years on. *Parasitology Today*, *13*(11), 438–443.

Cheesbrough, M. (2009). *District Laboratory Practice in Tropical Countries*, Part 1 (2nd ed.). Cambridge, United Kingdom: Cambridge University Press.

Chong, N. S., Smith, S. R., Werkman, M., and Anderson, R. M. (2021). Modelling the ability of mass drug administration to interrupt soil - transmitted helminth transmission: Community - based de-worming in Kenya as a case study. *PLOS Neglected Tropical Diseases*, *15*(8), e0009625

Coffeng, L. E., Vlaminck, J., Oliveira, R. G., Cools, P., & Vercruysee, J. (2020). Predicted impact and cost-effectiveness of soil-transmitted helminth programs in West Africa. *Clinical Infectious Diseases,* 70(Suppl 3), S169–S177

Edelduok, E. G., Eke, F. N., Evelyn, N. E., Atama, C. I., & Eyo, J. E. (2013). Efficacy of a single dose albendazole chemotherapy on human intestinal helminthiasis among school children in selected rural tropical communities. *Annals of Tropical Medicine and Public Health*, *6*(4), 413–417.

Ekpo, A. H., & Agba, M. S. (2015). Local government and rural development in Nigeria: A study of Akwa Ibom State. *International Journal of Development and Sustainability*, *4*(3), 320–335.

Ekpo, U. F., Omotayo, A. M., Abolarin, O. S., Sam-Wobo, S. O., Mafiana, C. F., & Ogunniyi, T. A. B. (2020). Reduced prevalence of soil-transmitted helminths following four years of mass drug administration in Ogun State, *Nigeria. Parasites and Vectors*, 13(1), 209.

Federal Government of Nigeria. (2000). *National water supply and sanitation policy*. Department of Water Supply and Quality Control, Federal Ministry of Water Resources. https://washmatters.-wateraid.org/publications/water-and-sanitation-in-nigeria-a-briefing-on-national-policy

Federal Ministry of Health. (2013). *Nigeria master plan for neglected tropical diseases (NTDs)*. Federal Ministry of Health.

Freeman, M. C., Chard, A. N., Nickolay, B., Garn, J. V., Okoyo, C., Kihara, J., Njenga, S. M., Pullan, R. L., Brooker, S. J., & Mwandawiro, C. S. (2015). Association between school and household-level water, sanitation and hygiene condition and soil transmitted helminth infection among Kenyan school children. *Parasites & Vectors*, *8*(1), 412.

Freeman, M. C., Chard, A. N., Nikolay, B., Garn, J. V., Clasen, T., Ogden, S., & Reithinger, R. (2017). Associations between school- and household-level water, sanitation and hygiene conditions and soil-transmitted helminth infection among Kenyan school children. *Parasites and Vectors*, 10(1), 147.

Guan, M., & Han, B. (2019). Association between intestinal worm infection and malnutrition among rural children aged 9–11 years old in Guizhou Province, China. *BMC Public Health*, *19*(1), 1204.

Griswold, E., Eigege, A., Adelamo, S., Mancha, B., Pede, E., Ityonzughul, C., Sambo, Y., & Richards, F. O. (2022). Impact of three to five rounds of mass drug administration on schistosomiasis and soil-transmitted helminths in school-aged children in North-Central Nigeria. *The American Journal of Tropical Medicine and Hygiene*, *107*(1), 132–142.

Hotez, P. J., Brindley, P. J., Bethony, J. M., King, C. H., Pearce, E. J., & Jacobson, J. (2008). Helminth infections: The great neglected tropical diseases. *Journal of Clinical Investigation*, 118(4), 1311–1321.

Hotez, P. J., Asojo, O. A., & Adesina, A. M. (2012). Nigeria: Ground zero for the high prevalence neglected tropical diseases. *PLOS Neglected Tropical Diseases*, *6*(7), e1600.

Inyang, I. R. (2021). *Environmental resources and development in the Qua Iboe river basin*. Heritage Publishers.

Kabatereine, N. B., Malecela, M., Lado, M., Zaramba, S., Amiel, O., & Kolaczinski, J. H. (2011). How to (not) integrate vertical programmes for the control of major neglected tropical diseases in sub-Saharan Africa. *PLOS Neglected Tropical Diseases*, 5(6), e1236.

Landeryou, T., Maddren, R., Rayment Gomez, S., Kalahasti, S., Mekonnen, Z., Liyew, E. F., Kebede, B., & Anderson, R. M. (2022). Longitudinal monitoring of prevalence and intensity of soil-transmitted helminth infections within the Geshiyaro project in Ethiopia. *PLOS Neglected Tropical Diseases*, *16*(9), e0010408

Murray, C. J. L., & Lopez, A. D. (2013). Measuring the global burden of disease. *New England Journal of Medicine*, *369*(5), 448–457.

Ojurongbe, O., Oyeniran, O. A., Adefioye, O. A., Adeniran, A. A., Obosi, L. A., & Bolaji, O. S. (2020). Soil-transmitted helminth infections among primary school children in Osun State, Nigeria. *International Journal of Infectious Diseases,* 98, 214–220.

Otubanjo, O. A. (2013). Identification of helminth eggs and larvae. In Parasites of man and animals. Lagos, Nigeria: Concept Publications Limited.

Pullan, R. L., Smith, J. L., Jasrasaria, R., & Brooker, S. J. (2014). Global numbers of people infected with soil-transmitted helminths in 2010. *Parasites & Vectors*, *7*(1), 1–15.

Sahu, S., Sahoo, P. K., Rout, A., Sahoo, N., & Panda, P. (2019). Polyparasitism and its associated risk factors among school-going children in Odisha, India. *Tropical Parasitology*, 9(2), 91–96.

Sanusi, Y. A. (2010). Institutional and socio-economic factors in water supply and sanitation in Nigerian urban settlements. *Theoretical and Empirical Researches in Urban Management*, *5*(6), 66–81.

Savioli, L., Albonico, M., Colley, D. G., Gazzinelli, A., Jansaneh, I., Keiser, J., King, C. H., Mbabazi, P. S., Montresor, A., Odermatt, P., Utzinger, J., & Zhou, X. N. (2018). 2017: A landmark year in the history of schistosomiasis control and elimination. *Infectious Diseases of Poverty*, *7*(1), 1–11.

Soulsby, E. J. L. (1987). Helminths, arthropods and protozoa of domesticated animals (7th ed). London, United Kingdom: Bailliere Tindall

Stephenson, L. S., Holland, C. V., & Cooper, E. S. (2000). The public health significance of *Trichuris trichiura*. *Parasitology*, *121*(S1), S73–S95.

Stoveland, S., & Bassey, B. U. (2000). Status of water supply and sanitation in 37 small towns in Nigeria. Governors Seminar/ Donors Conference, Abuja.

Udoh, J. P., & Akpan, P. A. (2019). Land use patterns and rural livelihoods in South-Southern Nigeria: A case of Nsit Ubium. *Nigerian Journal of Geography and the Environment*, *13*(1), 88–101.

Ugbomoiko, U. S., Dalumo, V., Ariza, L., Weymann, L., Renz, A., & Heukelbach, J. (2017). Soil-transmitted helminths and Schistosoma mansoni infections in schoolchildren from semi-urban communities in Kwara State, Nigeria. *Parasites and Vectors*, 10(1), 524

Umar, A. S., Mohammed, Y., Kabir, M., & Abdullahi, Z. M. (2019). Prevalence and risk factors of soil-transmitted helminthiasis among school-aged children in urban Kano, Nigeria. *Annals of African Medicine*, 18(3), 148–154.

United Nations Global Annual Assessment on Sanitation (GLAAS). (2012). *UN-Water GLAAS annual assessment of sanitation and drinking water in Pakistan*. UN-Water.

Vercruysse, J., Behnke, J. M., Albonico, M., Ame, S.M., Angebault, C., Bethony, J.M.., Engels, D., Guillard, B., Hoa, N.T.V., & Kang, G. (2011). Assessment of the Anthelmintic Efficacy of Albendazole in School Children in Seven Countries Where Soil-Transmitted Helminths Are Endemic. *PLOS Neglected. Tropical. Diseases*. 2011, 5, e948

Vos, T., Flaxman, A. D., Naghavi, M., Lozano, R., & Michaud, C. (2012). Years lived with disability (YLDs) for 1160 sequelae of 289 diseases and injuries 1990-2010: A systematic analysis for the Global Burden of Disease Study 2010. *The Lancet*, *380*(9859), 2163–2196.

WHO (2006). Child growth standards; length/ height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age. Methods and development. Geneva: World Health Organization 2006.

WHO (2011). Helminth control in school-age children: a guide for managers of control programmes. 2nd edition. Geneva: World Health Organization; 2011.

WHO (2013). Environmental Sanitation and Hygiene Development, Geneva. https://apps. who.int/iris/rest/bitstream-ms/1274751 (Retrieved on 22nd Feburary, 2021).

World Health Organization. (2017). Guideline: Preventive chemotherapy to control soil-transmitted helminth infections in at-risk population groups. WHO Press.

WHO (2019). World Health Statistics: An Overview, Geneva. https://apps.who.-int/iris/bitstream/handle/10665/311696/WHO-DAD-2019.1-eng.pdf (Retrieved on 12th March 2019).

World Health Organization. (2022). Soil-transmitted helminth infections (Fact sheet). https://www.who.int/news-room-/fact-sheets/detail/soil-transmitted-helminth-infections