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Soil-Transmitted Helminthiasis among Pupils in Semi-Urban Communities in Anambra State, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aim: This study was aimed at determining the prevalence of soil-transmitted helminth (STH) infections among pupils in semi-urban communities in Aguata Local Government Area, Anambra State, Nigeria.
Study Design: The study was a cross-sectional, school-based study.
Place and Duration of Study: The study was carried out in three communities namely Ekwulobia, Isuofia and Igboukwu in Aguata Local Government Area (LGA) of Anambra State, southeast Nigeria. The laboratory analysis were carried out at the laboratory of the Department of Parasitology and Entomology Nnamdi Azikiwe University, Awka, between September – December 2023.
Methodology: A total of 326 randomly selected pupils, aged 3-14 years old attending public primary schools in Aguata LGA were sampled for STH infections. Stool specimen were collected and examined for soil transmitted helminth parasites using the Kato-Katz technique.

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Results: Of the 326 pupils examined 24.2% (79) were positive for at least one soil-transmitted helminth parasite. *Ascaris lumbricoides* was the most prevalent 18.7% (61), followed by *Trichuris trichiura* 2.7% (9) and hookworms 0.9% (3). Co-infections of *A. lumbricoides* and *T. trichuira* 5 (1.5%) and *A. lumbricoides* and Hookworm 0.3% (1) were also observed. Pupils of the age group 3-6 years showed the highest prevalence 29.5% (21). Males had a higher prevalence 25.6% (37) than females 23.0% (42). Only light intensity infections were observed.
Conclusion: Soil-transmitted helminth infections still pose a public health challenge among pupils in Anambra State. Annual deworming programmes should be sustained and be complemented with continuous health enlightenment programmes as well as improved sanitation.

Keywords: Soil transmitted helminth; prevalence; aguata; Ascaris lumbricoides; Trichuris trichuira; Hookworm.

1. INTRODUCTION

Soil-transmitted helminths (STHs) are intestinal parasites of humans transmitted through faecally contaminated soil [1]. The burden of soil-transmitted helminth infections has remained a public health problem worldwide [2]. Nigeria has a long history of STH endemicity with prevalence ranging from low-to-high worm burden recorded in all the states of the country [3]. The main species that infect people are the *Ascaris lumbricoides* (roundworm), *Trichuris trichiura* (whipworm), *Ancylostoma duodenale*/*Necator americanus* (hookworm) and *Strongyloides stercoralis* (threadworm) [4]. Transmission of soil-transmitted helminthiasis is by the ingestion of the eggs of *Ascaris lumbricoides* and *Trichuris trichiura* or by active penetration of the skin by hookworm larvae. These infections affect the poorest and most deprived communities with poor access to clean water, sanitation and hygiene in tropical and subtropical areas [2].

Most conditions of STH have a light worm burden and usually have no discernible symptoms. Heavy infections, however, cause a range of health problems, including abdominal pain, diarrhoea, blood and protein loss, rectal prolapse, physical and mental retardation [5]. School age children are the most vulnerable group and they harbour the greatest number of intestinal worms [6]. School children are known to play with contaminated soil and eat without washing their hands after play, walk barefoot, eat raw, unpeeled and/or unwashed vegetables and fruits, and defecate indiscrimately, and these are known to facilitate the transmission of helminth infections [7]. Millions of school age children worldwide are infected with soil-transmitted helminths. As a result, they experience stunting and diminished physical fitness as well as impaired memory and cognition. These adverse health consequences combine to impair childhood educational performance and reduce school attendance thereby limiting their ability to access and benefit fully from the education system [8].

Soil-transmitted helminth (STH) infections are among the most common infections worldwide with an estimated 1.5 billion infected people or 24% of the world's population. Infections are widely distributed in the tropical and subtropical regions, with the highest prevalence reported in sub-Saharan Africa, China, South America and Asia [2]. Over 260 million preschool-age children, 654 million school-age children, live in areas where these parasites are intensively transmitted, and need treatment and preventive interventions [2].

The endemicity of soil-transmitted helminth infections and their risk factors has been documented in Anambra State [9,10,11] but most communities are yet to be studied. Soil-transmitted helminth is still a public health problem in Anambra State with prevalence above 20% [9]. Majority of communities in Aguata LGA are farming communities, where children and adults are fully exposed to risks of helminth infection. The weather in most communities are warm and moist for most part of the year, creating a good environment for parasites to develop all year round.

Anambra State, Nigeria, had implemented mass administration of medicines (MAMs) to combat soil-transmitted helminthiasis (STH) [11]. Despite the implementation of annual Drug Administration, poor environment as well as poor hygiene behaviour of individuals, could lead to occurrence of reinfection rapidly after treatment. Therefore, there is a need for periodic studies to determine the current status of soil-transmitted helminth infections and for effective management and control of soil-transmitted infections in the population.

2. MATERIALS AND METHODS

2.1 Study Area

The study was carried out in Aguata Local Government Area (LGA) in Anambra State, southeastern region of Nigeria. Aguata LGA lies between latitude 6.0086° N and longitude 7.1009° E. The Local Government Area has two distinct seasons, rainy (April–October) and dry seasons (November-March). The area's relative humidity is between 60%-80% and temperature between 25°C – 30°C. In 2006, Aguata LGA had a population of 369,972, with 187,262 males and 182 710 females [12]. And hosts a projected population of 608,197 persons. Three communities namely, Ekwulobia, Isuofia and Igboukwu were selected for sampling since they were the most developed and populated in the LGA. Ekwulobia, the biggest town in Aguata LGA is the significant business town in the region. It shares boundary with Isuofia, and is one of the largest cities in Anambra. Most commercial banks have their branches there. It gloats of an Arena, a federal prison and a noteworthy market, Eke Ekwulobia. Igboukwu is equally a centre of trade and hosts the Nkwo market and a museum. The major occupation of inhabitants is crop farming and trading, with some of them combining both. In calculating the projected population figures, the equation below was applied;

$$P_2 = P_1(1+r)^n$$

Where; p_2 is the projected population

P_1 is the known population (2006 census in this case)

is the rate of natural increase, 2.8% as noted by the United Nations [13].

n is the number of years between P_1 and P_2, in this case 18 years.

Aguata LGA, has been receiving public health intervention of Albendazole annually since 2015.

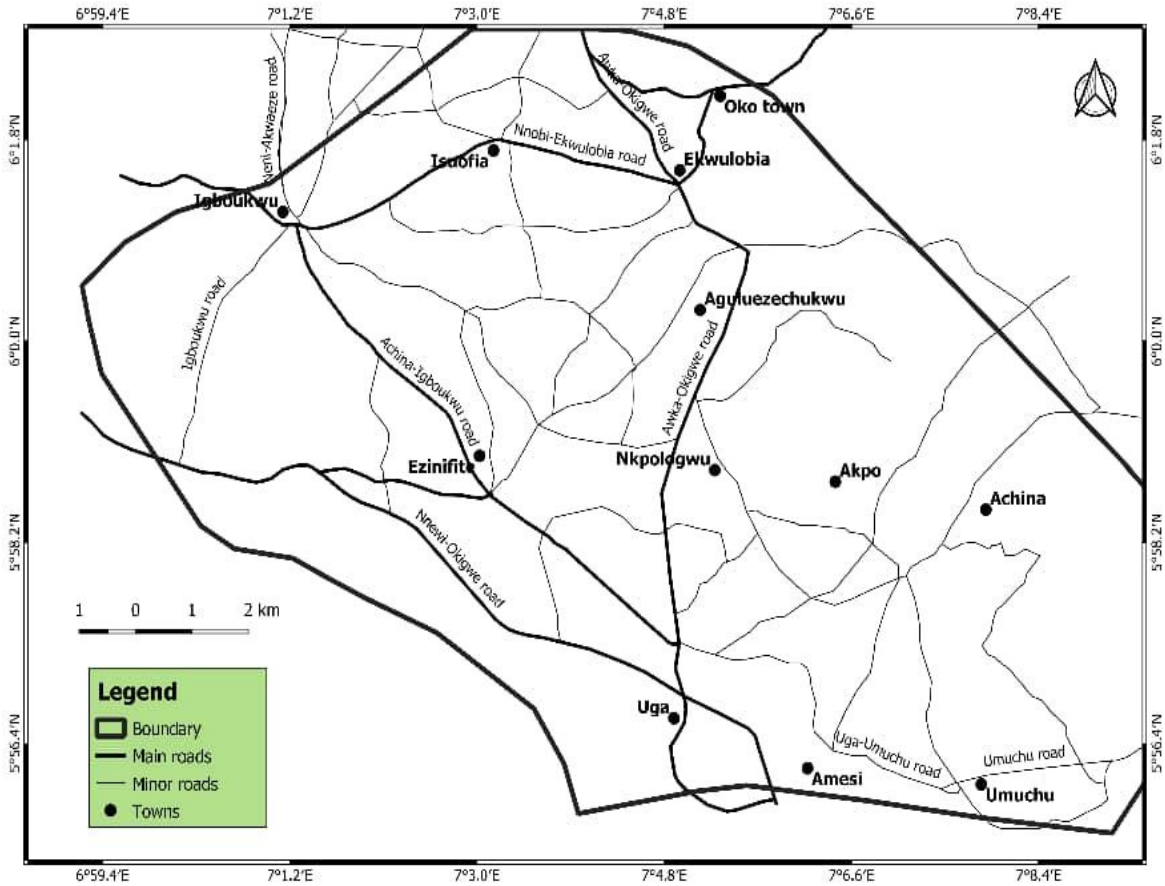

Fig. 1. Map of Aguata LGA showing the study communities

Source: Department of Geography and Meteorology, Nnamdi Azikiwe University Awka.

2.2 Study Design

The study was a cross sectional study. This study involved laboratory examination of faecal samples using Kato-Katz technique. Sample collection was a one-time collection carried out between September 2023 – December 2023. Participants were drawn from primary schools in Aguata LGA through random sampling technique.

2.3 Study Population

The study population consisted of pupils within the age range 3 years to 14 years old, in the primary schools selected for study in Ekwulobia, Isuofia and Igboukwu communities in Aguata LGA. A total of 1431 pupils was recorded in the selected schools. Out of which five hundred and ten (510) pupils were recorded from Ekwulobia, four hundred and fourty five (445) pupils from Isuofia and four hundred and seventy six (476) pupils from Igboukwu.

2.4 Sample Size Determination

Sample size was estimated using the sample size estimation formula by Yamane [14].

$$n = \frac{N}{1 + N(e)^2}$$

Where n = sample size, N = total number of study population (1431). e = probability level (*P* = 0.05). The estimated sample size was 318.

However, a total of 326 children were randomly recruited for the study from six randomly selected schools in the study area, two (2) from each town. The name of schools in each community was separately written on a sheet of paper. The sheets of paper were then folded and shuffled and two (2) schools were then randomly picked by ballot. The process was repeated for the 3 communities. Nine (9) pupils were selected from each class across the six schools via balloting to mitigate bias in age group and grade levels. However, pupils who did not return their consent form or withdrew from the study were randomly replaced. Parents/guardians of these selected pupils were properly educated on the importance of this research before they signed consent forms. Those pupils whose parents or guardians consented were recruited for the study and were given study identification numbers.

2.5 Collection of Stool Sample

Stool sample was collected from each participant using a sterile, leak-proof, and transparent wide-mouthed universal sampling container, pre-labelled with the participant's identification number. The collected samples were checked for accuracy of labelling and quantity. Stool sample collection was done between 8:00 a.m and 10:00 a.m on each day. To ensure the samples were fresh and suitable for analysis, samples were then stored in an ice bag stacked with ice cubes for preservation. Upon collection, the samples were immediately transported to the Laboratory unit of the Department of Parasitology and Entomology, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria within an hour to prevent degradation and contamination for Parasitological analysis. Collection was done in batches over a period of two months to allow efficient sample analysis.

2.6 Parasitological Examination of Stool Samples for Soil Transmitted Helminths

Stool samples were prepared and examined following the Kato-Katz technique [15]. One gram of stool sample was placed on a piece of paper. Nylon screen was pressed on top of the stool to sieve the stool, with a spatula the sieved stool was collected. The Kato-Katz template was then placed in the middle of a clean glass slide. The hole of the template was filled using the stool on the spatula. The template was removed vertically (avoiding any horizontal movement). Cellophane strips pre-soaked in glycerol-Methylene blue solution was placed on top of the stool. A second, clean glass slide was used to press against the cellophane spreading the stool evenly between the microscope slide and the cellophane strip. The slides were then carefully removed and placed on the bench with the cellophane upwards. All the slides were examined under the microscope with x10 and x40 magnifications within 30 to 60 minutes after they were prepared in line with WHO recommendations. Two slides per participant were prepared. All eggs detected in the preparations were identified, counted and multiplied by a factor of 24, and the results represented as eggs per gram of stool (EPG) for the intensity of infection.

2.7 Quality Control and Assurance

Stool sample and data collections were supervised daily during the collections. For egg

quantification, each prepared slide was examined by a laboratory technologist and the researcher, and the average result taken. Stool samples were randomly selected for quality control and re-examined by the laboratory technologist and the results were recorded separately and compared with the original egg count data.

2.8 Statistical Analysis

Data obtained from laboratory analysis were analysed and presented using Statistical Package for Social Sciences (SPSS) software version 25. The relationship between each variable and STH prevalence by specie, community, age and sex was analysed using Chi square. Test of statistical significance was set at P value of 0.05 (95%) confidence interval.

3. RESULTS

3.1 Socio-Demographic Characteristics of Study Participants

As presented in Table 1, 326 pupils aged between 3-14 years were recruited for this study from the selected schools. Of the pupils examined 44.2% (144) were males and 55.8% (182) were females. Pupils between the ages 3-6 years were 21.7% (71), pupils between ages 7-10 years 62.5% (204), while pupils between ages 11-14 years were 15.6% (51). 34.0% (111), 32.2% (105) and 33.7% (110) of the pupils were from Igboukwu, Ekwulobia an Isuofia respectively.

3.2 Prevalence of Soil-Transmitted Helminth Infections among Pupils in Aguata, Anambra State

Out of the 326 stool samples of pupils examined in three communities in Aguata L.G.A, Anambra State 24.2% (79) were positive with at least one soil-transmitted helminth parasite. *Ascaris lumbricoides* had the highest prevalence 18.7% (61) followed by *Trichuris trichiura* 2.7% (9) and hookworm 0.9% (3) as shown in Table 2.

On the prevalence by community, the highest prevalence was observed in Igboukwu 29.7% (33) followed by Isuofia 26.3% (29) and Ekwulobia 16.1% (17) as shown in Table 1. There was no significant difference at (*P*= .28). The result also showed co-infection observed between *Ascaris lumbricoides* and *Trichuris trichiura* 1.5% (5) followed by *Ascaris lumbricoides* and hookworm 0.3% (1). This is shown in Table 2.

3.3 Prevalence of Soil-Transmitted Helminth Infections by age among pupils in Aguata, Anambra State

The result on prevalence by age showed that the age group 3-6 years old had the highest prevalence 29.5% (21) followed by pupils aged 7-10 years 24.0% (49) and 11-14 years had the least 17.6% (9). The rate of helminth infections decreased with increase in age. As shown in Table 3, there was no significant difference (*P*= .77).

3.4 Prevalence of Soil-Transmitted Helminth Infections by gender among pupils in Aguata, Anambra State

The result also showed that males had a higher prevalence 25.6% (37) than females 23.0% (42). It was observed that *A. lumbricoides* and *T. trichiura* occurred more in females with 78.5% (33) and 14.2% (6) prevalence respectively, than in males, while hookworm occurred more in males 5.4% (2). But this was not significantly different as shown in Table 4 (*P*= .77)

Table 1. Socio-demographic characteristics of study participants

Variable	Category	Pupils Examined (n)	Percentage (%)
Gender	Male	144	44.2
	Female	182	55.8
Age	3-6 years	71	21.7
	7-10 years	204	62.5
	11-14 years	51	15.6
Community	Igboukwu	111	34.0
	Ekwulobia	105	32.2
	Isuofia	110	33.7

Table 2. Prevalence of soil-transmitted helminth infections among pupils in Aguata L.G.A, Anambra State

Community	Pupils Examined (%)	Pupils Infected (%)	Parasite Prevalence(%)				
			A. lumbricoides (%)	*T. trichiura* (%)	Hookworm (%)	*A. lumbricoides* + *T. trichiura* (%)	*A. lumbricoides* + *hookworm* (%)
Igboukwu	111 (34.0)	33 (29.7)	26 (78.7)	3 (9.0)	2 (6.0)	2	0
Ekwulobia	105 (32.2)	17 (16.1)	13 (76.4)	2 (11.7)	1 (5.8)	0	1
Isuofia	110 (33.7)	29 (26.3)	22 (75.8)	4 (13.7)	0 (0.00)	3	0
Total	326	79 (24.2)	61 (18.7)	9 (2.7)	3 (0.9)	5 (1.53)	1 (0.31)

x2 = 7.35 P = .28

Table 3. Prevalence of soil-transmitted helminth infections among pupils by age among pupils in Aguata, Anambra State

Age group	Pupils Examined (%)	Pupils Positive (%)	Parasite prevalence%		
			A. lumbricoides (%)	*T.trichuira* (%)	Hookworm (%)
3-6yrs	71 (21.7)	21 (29.5)	15 (71.4)	3 (14.2)	0.00
7-10yrs	204 (62.5)	49 (24.0)	38 (77.5)	5(10.2)	3 (6.1)
11-14yrs	51 (15.6)	9 (17.6)	8 (88.8)	1 (11.1)	0.00
Total	326	79	61	9	3

x^2=3.23 P= .77

Table 4. Prevalence of soil-transmitted helminth infections among pupils by gender in Aguata, Anambra State

Gender	No examined (%)	No Positive (%)	*A. lumbricoides* (%)	*T. trichuira* (%)	Hookworm (%)
Males	144 (44.2)	37 (25.6)	28 (75.6)	3 (8.1)	2 (5.4)
Females	182 (55.8)	42 (23.0)	33 (78.5)	6 (14.2)	1 (2.3)
Total	326	79	61	9	3

x^2=1.12 P= .77

Table 5. Intensity of Soil-Transmitted Helminths Infection among pupils in Aguata, Anambra State

STH	Category	No Infected	Mean EPG	Range
Ascaris lumbricoides	Sex			
	Males	28 (45.9)	50.76	24-96
	Females	33 (54.1)	33.09	24-76
	Age			
	3-6 years	15 (24.5)	47.7	24-76
	7-10 years	38 (62.3)	43.44	24-96
	11-14 years	8 (13.1)	28.0	24-76
	Community			
	Igboukwu	26 (42.6)	33.6	24-76
	Ekwulobia	13 (21.3)	43.4	24-76
	Isuofia	22 (36.0)	30.22	24-96
	Total	61	46.49	24-96
Trichuris trichiura	Sex			
	Males	3 (33.3)	32.0	24-48
	Females	6 (66.6)	40.6	24-76
	Age			
	3-6 years	3 (33.3)	28.0	24-48
	7-10 years	5 (55.5)	48.8	24-76
	11-14 years	1 (11.1)	24	24-48
	Community			
	Igboukwu	3 (33.3)	40.0	24-76
	Ekwulobia	2 (22.2)	36.0	24-48
	Isuofia	4 (44.4)	37.0	24-48
	Total	9	40.4	24-76
Hookworm	Sex			
	Males	2 (66.6)	36.0	24-48
	Females	1 (33.3)	24.0	24
	Age			
	3-6 years	0 (0)	0	0
	7-10 years	3 (33.3)	32.0	24-48
	11-14 years	0 (0)	0	
	Community			
	Igboukwu	2 (66.6)	36.0	24-48
	Ekwulobia	1 (33.3)	24.0	24
	Isuofia	0 (0)	0	0
	Total	3	32.0	24-48

3.5 Intensity of Soil-Transmitted Helminths Infection among pupils in Aguata, Anambra State

Results showed that all 79 pupils with STH infections had light intensity infections of soil transmitted helminths. The overall mean egg per gram (EPG) of *A. Lumbricoides* was 46.49. However, males had a higher mean EPG of 50.76 than females who had a mean EPG of 33.09. The overall mean EPG of *T. trichiura* was 40.4. Female pupils infected with *T. trichiura* had a higher mean EPG of 40.6 compared to males whose mean EPG was 32.0. For hookworm the overall mean EPG was 32.0 (Table 4).

4. DISCUSSION

This study showed an overall prevalence of 24.2% (Table 2) for soil-transmitted helminth infections among pupils in Aguata Local Government Area, Anambra State. By this, Aguata LGA may be categorised as moderately endemic to Soil-transmitted helminth infections [16]. The prevalence is lower than 56.2% reported by Umeh et al. [17] in Uga Aguata, 48.08% recorded by Ezeagwuna et al. [18] in Ozubulu, 42.0% recorded by Ukibe et al. [19] in Nnewi, 29.1% recorded by Ahanonu et al. [20] in Ifite Ogwari Anambra State, and 30.3% recorded by Odinaka et al. [21] in Imo State. However, the result of this study is higher than 0.7% reported

by Aribodor et al. [22] in Ekwulobia, Aguata LGA and 9.86% by Nzeukwu et al. [23] in Awka South LGA, Anambra State. The different rural/urban setting of the study areas might contribute to the disparity is findings. The prevalence recorded is relatively comparable to findings by Okafor et al. [24] with prevalence of 28.2% in Umunze, [25] with prevalence of 21.7% in rural communities in Anambra, [10] with a prevalence of 21.7% in Nimo, Anambra State and 25.6% recorded by Aniwada et al. [26] in Enugu State. These differences may be due to the difference in the sample size, study time, annual deworming programmes, predisposing factors, and differences in the endmicity of parasites in the study areas.

The three Soil-transmitted helminths documented in this study were, *Ascaris lumbricoides*, *Trichuris trichiura* and hookworm (Table 2). *A. lumbricoides* was the most predominant among the soil-transmitted helminths (18.7%). This corroborates with the findings by Aribodor et al. [25] who also recorded a higher prevalence of A. lumbricoides infection compared to other infections in rural communities in Anambra State, [27] in Imo state, [28] in Edo State, Nigeria and [29] in rural Kenya.

A few pupils had mixed infections of *Ascaris lumbricoides* and hookworm 0.31%, and *Ascaris lumbricoides* and *Trichuris trichiura* 1.53%. This confirms recent reports by Aribodor et al. [11] in Anaocha LGA, Anambra State, but in contrast with Okoro et al. [27] who reported 24.3% coinfection rates. *Ascaris lumbricoides* and hookworm was the most recorded coinfection by Okoro et al. [27]. However, Mmekowulu et al. [30] recorded no coinfection among pupils in Nnewi. These variations may be due to the season at the time of study, and frequency of annual deworming programmes. Co-infections of *Ascaris lumbricoides* and *Trichuris trichiura* were more common (Table 2). This could be due to similar fecal-oral route of infection for both parasites.

All pupils who participated in the study had light intensity infections of soil-transmitted helminths. This is consistent with studies by Aribodor et al. [22,11]. This could be an indication of low transmission risk and could be attributed to the ongoing annual mass drug administration by the state [11]. People with light intensity infections are usually asymptomatic and do not seek treatment. This could contribute to the contamination of environment and the sustained transmission of the parasites in the community. The intensity of *Ascaris lumbricoides* and hookworm was observed to be higher in males than females. *Trichuris trichiura* appeared to be higher in females than males. The intensity of *A. lumbricoides* was higher in pupils aged 3-6 years as compared to *T. trichiura* and hookworm which were higher in pupils aged 7-10 years (Table 5).

Male pupils had a higher prevalence (25.6%) than the females (23.0%) (Table 4), although there was no significant difference. The high prevalence of infection among males compared to females in this study could be attributed to habits like playing football barefooted by boys on wet soil, which can promote penetration of the skin by filariform larvae. The above result is in line with Ezeagwuna et al. [18] in Ozubulu who reported male pupils had 2.9% when compared to females (1.1%) and Odinaka et al. [21] who reported male pupils had 38.4% compared to females 21.1% in Imo State, The low prevalence of Hookworm recorded among pupils in this study is similar to studies by Bishop et al. [31], but in contrast with studies by Okafor et al. [24] which reported hookworm as the most prevalent STH in Umunze, Anambra State, and also recorded the prevalence of hookworm higher in males (49.1%) than females (37.3%). The prevalence of hookworm was higher in males (5.4%) than in females (2.3%) which is like the report by Bishop et al. [31]. Hookworm infective larvae require penetration of human skin for infection to occur. The sensitivity of the kato-katz technique used is quite low to light intensity infections, especially for hookworm, since hookworm eggs are quite unstable, this may be the reason hookworm was the least prevalent parasite in this study.

Rate of prevalence of infection was high among pupils in the age group 3-6 years, while pupils in the age group 11-14 years had low prevalence rate (Table 3), this is similar to reports by Aniwada et al. [26]. This could be due to the fact that the younger age category (3-6 years) engages more in high level of soil activities while playing outdoors. Also, this group maintains poor personal hygiene as this plays a role in helminth infections. The older age group have more immunity than the younger age groups and are more likely to have better knowledge and practice of personal hygiene. This finding is in contrast to studies by Onyido et al. [32] who reported highest prevalence (17.65%) in age group 13-16years, and 9.8% in age group 5-8 years among pupils in Ekwulummili community, Anambra State.

5. CONCLUSION

This study has determined the Prevalence of soil-transmitted helminth infections among pupils in Aguata LGA, which showed the prevalence of 24.2%. Therefore, Aguata LGA is moderately endemic to soil transmitted helminths according to WHO and is of public health concern. Intervention programmes such as annual deworming programmes should be sustained, monitored, and be complemented with continuous health enlightenment programmes as well as improved sanitation.

CONSENT AND ETHICAL APPROVAL

Approval was obtained from the Ethics committee of the Anambra State Ministry of Health to conduct the research (MH/AWK/M/321/463). Approval was sought from the Education Secretary of Aguata LGA, Anambra State. Permission for access to the schools to carry out the study was obtained from the Education Secretary Catholic diocese of Ekwulobia, and the Heads of schools. In addition, written Informed consent of the parents were obtained as well as assents of the pupils. The identity of all pupils selected for the study was protected as no names were used, instead identification numbers were assigned to each study participant.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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