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Intestinal Parasitic Infections and Wash Practices among School-Aged Children in Anaocha Local Government Area, Anambra State, Nigeria.

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Abstract

Intestinal parasitic infections (IPIs) remain a major public health problem among children in developing countries due to poor sanitation, inadequate water supply, and unhealthy hygiene practices. This study assessed the prevalence of intestinal parasitic infections and associated water, sanitation and hygiene (WASH), knowledge, attitude and practice (KAP) factors among school-aged children in Neni, Adazi-Enu, and Akwaeze communities of Anaocha Local Government Area, Anambra State, Nigeria. A total of 310 children aged 3-14 years participated in the study. Stool samples were examined using the Kato-Katz technique and wet mount microscopy, while structured questionnaire was used to obtain information on socio-demographic characteristics, WASH conditions, and KAP. Data were analysed using SPSS version 25 at a 95% confidence level. Of the 310 children examined, 96 (30.9%) were infected with at least one intestinal parasite. *Ascaris lumbricoides* was the predominant parasite (75.0%), followed by hookworm (10.4%), Taenia species (7.3%), *Entamoeba histolytica* (4.2%), and *Trichuris trichiura* (3.1%). Akwaeze recorded the highest prevalence, while Neni had the lowest. There was no significant association ($P > 0.05$) between infection prevalence and age or gender. WASH assessment revealed adequate status in Neni (71%), partial adequacy in Adazi-Enu (42%), and inadequate status in Akwaeze (28%). Akweze with the 'inadequate WASH status' had the highest prevalence (36%) of IPIs. There was significant association of availability of WASH components and prevalence of infections ($p = 0.00001$). Responses to administered questionnaire identified poor knowledge, open defecation, poor hand-washing practices, walking barefoot, nail biting, playing with soil, and consumption of unwashed fruits as important risk factors to IPIs. The relatively high prevalence of intestinal parasitic infections observed in the study highlights the need for improved sanitation, health education, provision of safe water, and

regular deworming programmes to reduce the burden of infection among children in the study communities.

Keywords: Intestinal, Parasites, Water, Sanitation, Hygiene, Children.

INTRODUCTION

Intestinal parasitic infections (IPIs) remain among the most common neglected tropical diseases affecting populations in developing countries, particularly in areas characterized by poor sanitation, inadequate access to safe water, and poor hygiene practices (Ali *et al*., 2021; Ohuche *et al*., 2020). These infections are caused by a variety of protozoan and helminth parasites, including *Entamoeba histolytica*, *Giardia lamblia*, *Ascaris lumbricoides, Trichuris trichiura*, and hookworms (Gizaw *et al*., 2022). Transmission commonly occurs through the ingestion of contaminated food or water, contact with contaminated soil, and poor personal hygiene practices, particularly in communities where environmental sanitation is inadequate (Njambi *et al*., 2020).

The burden of intestinal parasitic infections is highest in tropical and subtropical regions where climatic conditions favour the survival and transmission of infective parasite stages (Anthony *et al*., 2022). Poor socioeconomic conditions, overcrowding, inadequate sanitation infrastructure, and limited access to potable water contribute significantly to the persistence of these infections (Okesanya *et al*., 2024). According to the World Health Organization, millions of preschool-aged and school-aged children living in endemic areas require periodic preventive chemotherapy and improved sanitation interventions to reduce infection and transmission (WHO, 2023). School-aged children are particularly vulnerable because of frequent exposure to contaminated soil, food, and water, as well as poor hygiene practices such as inadequate hand washing and walking barefoot (Sitotaw *et al*., 2020).

Intestinal parasitic infections may result in several adverse health outcomes, including malnutrition, anaemia, impaired physical growth, reduced cognitive development, and poor educational performance among affected children (Ahmed, 2023; Adu *et al*., 2026). The transmission of these infections is influenced by multiple environmental and behavioural factors, particularly access to water, sanitation and hygiene (WASH) facilities. Communities lacking adequate WASH services are more likely to experience environmental contamination with infective parasite stages, thereby increasing the risk of infection and reinfection (Gebru *et al*., 2023; WHO, 2019). Consequently, sustainable control of intestinal parasitic infections requires an integrated approach involving preventive chemotherapy, improved sanitation, access to safe water, and the promotion of healthy hygiene practices.

In Nigeria, intestinal parasitic infections remain a significant public health concern, particularly in rural communities where sanitation facilities and access to potable water are often inadequate (Alo *et al*., 2021). Previous studies conducted in Anambra State have reported prevalence rates ranging from 14.5% to 28.4% among different populations (Umeanaeto *et al*., 2024; Orjighjigh *et al*., 2024; Ikpeoha *et al*., 2024; Nnelife *et al*., 2026), suggesting that transmission dynamics may vary across communities due to differences in environmental conditions, socioeconomic status, and hygiene practices. Despite

ongoing public health interventions, including periodic deworming programmes, inadequate WASH conditions and poor knowledge of transmission pathways may contribute to continued transmission and rapid reinfection following treatment (Aribodor *et al*., 2025).

For effective control and eventual elimination of intestinal parasitic infections, it is important to understand the epidemiological status of infection and the factors influencing transmission within endemic communities. It is equally necessary to assess the knowledge, attitudes, and practices of affected populations regarding infection prevention. However, information on the current burden of intestinal parasitic infections and associated WASH and KAP factors among school-aged children in many communities of Anaocha Local Government Area remains limited. Therefore, this study determined the prevalence of intestinal parasitic infections and assessed associated WASH and KAP factors among school-aged children in Neni, Adazi-Enu, and Akwaeze communities of Anaocha Local Government Area, Anambra State, Nigeria, to provide evidence for the planning and implementation of effective control interventions.

Materials and Methods

Study Area

This study was conducted in Neni, Adazi-Enu, and Akwaeze communities of Anaocha Local Government Area (LGA), Anambra State, Nigeria, between September 2025 and February 2026. Anaocha LGA is located between latitude 6.0682°N and longitude 6.9963°E. The area experiences two distinct seasons, namely the rainy season (March–October) f\and dry season (November–February). The average annual rainfall is approximately 1,897 mm, with a mean temperature of 25.5°C and relative humidity ranging from 65% to 85%. Anaocha LGA had a population of 284,215 according to the 2006 National Population Census (NPC, 2006). The major occupations of the inhabitants are farming and trading.

Study Design

The study was a cross-sectional survey of intestinal parasitic infections among school-aged children.

Study population

This study targeted enrolled school aged children in primary schools in the selected communities. The study population comprised pupils aged 3–14 years attending the selected schools in 2025/2026 academic year. Children who received anthelminthic medication within the last 6 - 12 months were excluded.

Determination of Sample Size

The minimum sample size was determined using Cochran's formula ($n_0 = Z^2\ (p \times q) / d^2$) for prevalence studies. Using a prevalence of 35.2% reported by Aribodor *et al*. (2025), a minimum sample size of 350 participants was obtained. ($Z^2 = 1.96^2$; $d^2 = 0.05^2$)

Selection of Study Participants

Participants were recruited from six primary schools selected from the three study communities, with two schools selected from each community. Adazi-Enu had only two schools, and both were selected for the study. Akwaeze had 3 schools and 2 were selected by simple random sampling. Similarly, Neni had 6 schools and 2 were selected by simple random sampling. The simple random sampling in the two communities was done by writing the names of the schools in separate papers which were folded and a school boy was asked to pick any two from the pool. Participants were selected from all the classes following receipt of consent.

The selected children (study participants) were those whose parents signed and returned the informed consent letters as the consent letters were given to all parents whose children were in primary 1 to 6.

Ethical Approval

Ethical approval was obtained from the Anambra State Ministry of Health Ethics Committee (Ref. No. MH/PRS/1244/Vol.205). Permission to conduct the study was obtained from the Anambra State Universal Basic Education Board (Ref. No. ASUBEB/ADM/700). Written informed consent was obtained from parents or guardians of participating pupils, while assent was obtained from the children. Confidentiality of participants' information was maintained throughout the study.

Stool Sample Collection

Sterile, pre-labelled universal containers were distributed to participants with instructions on proper stool collection. Stool samples were collected, preserved in ice-packed containers, and transported within one hour to the Parasitology and Entomology Laboratory, Nnamdi Azikiwe University, Awka, for examination.

Though the calculated minimum sample size was 350, 310 samples were returned.

Parasitological Examination of Stool Samples

Stool samples were examined using the Kato-Katz technique and direct wet mount microscopy for the detection of intestinal parasites. The Kato-Katz method was performed according to World Health Organization guidelines (WHO, 2004), while identification of parasite ova, cysts, trophozoites, and larvae was based on the morphological criteria described by Cheesbrough (2000). A participant was considered positive when at least one intestinal parasite stage was detected in the stool sample.

It is important to note that the Kato-Katz technique has reduced sensitivity for detecting light-intensity infections and less effective for protozoan parasites such as *Giardia* and *Entamoeba* species, therefore, the presence of these protozoa may be underestimated. The use of direct wet mount microscopy complimented the Kato-Katz method to improve detection of motile protozoan trophozoites and cysts.

Quality Control

To ensure accuracy and reliability of laboratory results, prepared slides were independently examined by the researcher and a laboratory technologist. Selected samples were re-examined for quality assurance, and any discrepancies observed were resolved through repeat microscopic examination. School children who have taken anthelminthic medication within the past 6-12 months were not part of the study.

Assessment of Knowledge, Attitude, Practice, Risk factors and WASH Facilities

Structured pre-tested questionnaire was administered to the study participants obtain information on demographic characteristics, knowledge, attitudes, and practices relating to intestinal parasitic infections at school and household levels. The household KAP information was elicited to study household activities that may affect IPIs among the children even if they have adequate WASH facilities in their schools. Risk factors assessed included handwashing habits, nail biting, footwear usage, toilet usage, source of drinking water, washing of fruits and vegetables, and playing with soil.

Water, sanitation, and hygiene (WASH) facilities in the selected schools were assessed using a composite WASH index

adapted from the WHO/UNICEF School WASH Guidelines (WHO & UNICEF, 2018). Seven indicators (all contained in the WHO/UNICEF WASH guideline) were evaluated, including availability of improved water sources, functional toilets, handwashing facilities, soap and water availability, hygiene education, accessibility and cleanliness of toilets, and availability of safe drinking water. Schools were classified as having adequate (≥70%), partially adequate (40–69%), or inadequate (<40%) WASH status (WHO & UNICEF, 2018).

Statistical Analysis

Data obtained were analysed using the Statistical Package for Social Sciences (SPSS) version 25. Descriptive statistics were used to summarize prevalence, KAP, and WASH variables, while Chi-square (χ^2) tests were used to determine associations between intestinal parasitic infections and selected variables. Statistical significance was established at a 95% confidence level with $p \leq 0.05$ considered significant.

Results

Result of the 310 stool samples examined showed that 96 (30.9%) were positive for at least one intestinal parasite infection. Children aged 3-6years had the highest (36.9%) prevalence while those aged 11-14years had the least (27.6%). In the 3-6years age group, infection was highest in Akwaeze (19%), followed by Adazi-Enu (10.7%) and Neni (7.1%). Among children aged 7–10 years, Neni recorded the highest infection rate (11.5%), while Akwaeze had the lowest (7.9%). For the 11–14 years age group, Adazi-Enu had the highest infection rate (11.5%), followed by Akwaeze (9.2%) and Neni (6.9%). The chi-square test ($\chi^2 = 8.655$, $p = 0.194$) shows that there was no statistically significant difference in infection rates across the age groups in the three communities (Table 1).

Infection status by gender in the schools across the communities was 33.5% for males and 27.7% for females. Males showed slightly higher infection rates than females in the three communities. However, statistical analysis result ($\chi^2 = 2.291$, $df = 3$, $p = 0.514$) indicates that the difference in infection rates between males and females was not statistically significant ($p > 0.05$) even within the communities. (Table 2)

Species distribution of intestinal parasites in the study area showed that *Ascaris* infection was the most prevalent (75%). The highest *Ascaris* prevalence was recorded in Neni (82.1%), followed by Akwaeze (74.2%) and Adazi-Enu (69.7%). Hookworm infection was less common, with Akwaeze recording the highest prevalence (14.3%), while Neni and Adazi-Enu had 10.7% and 6.1% respectively. *Taenia* infection was observed at low levels in all three communities, whereas *Trichuris* and *Entamoeba histolytica* were detected only in Adazi-Enu. There was no statistically ($\chi^2 = 10.530$, $p = 0.230$) significant difference in parasite distribution among the communities. (Table 3)

Results of WASH indicators assessed which include access to clean toilets, hygiene education, soap and water availability, presence of hand-washing stations, functional toilets, improved water sources, and safe drinking water showed that one school (School B) in Neni community met most of the WASH indicators, scoring 5 out of 7 (71%), and was classified as having an adequate WASH status. School A scored 2 out of 7 (29%) and was classified as inadequate. Mean score (%) for both schools in Neni was 50% hence the community is classified as Partially adequate. In Adazi-Enu community, School A was classified as Inadequate (29%), School B Partially inadequate (42%), while the community was classified as Inadequate (36%) from the

mean score of both schools. Both schools (0%; 29%) in Akwaeze and the community (15%) were classified as Inadequate.

Result in Table 5 shows WASH status and prevalence of intestinal parasites in the study communities. Schools in Neni community which had an adequate WASH status recorded 24% prevalence. In Adazi-Enu schools where WASH status was partially adequate, 32% prevalence was recorded while schools in Akwaeze with inadequate WASH conditions recorded the highest (36%) prevalence of infection. When compared with schools which had adequate WASH status, children in schools with partially adequate WASH status (OR = 1.5) and inadequate WASH status (OR = 1.8) had higher odds of intestinal helminth infection. This association was statistically significant ($P = 0.00001$).

The Table 6 presents the demographic characteristics of infected children. The results show that children (Participants) in Primary 1–2 had the highest (44.7%) prevalence. With respect to parents' occupation, children whose parents are traders had the highest prevalence (43.7%). Children whose parents had secondary school education also recorded the highest prevalence (40.6%) of intestinal parasites.

Result presented in Table 7 showed that in Neni community, majority of the children (67.8%) indicated that intestinal parasitic infections cannot be acquired from eating sugary foods, while many of the respondents in Adazi-Enu (51.5%) reported having no idea and most respondents in Akwaeze (60%) believed infections can always be acquired this way. Regarding transmission through penetration of larvae into the skin, most respondents in Neni (78.5%) and Adazi-Enu (78.7%) indicated that infections cannot be acquired through penetration. In Akwaeze, 54.2% of respondents believed penetration is not a mode of transmission.

Tables 8-10 shows attitude and practices of the respondents (children) predisposing them to IPIs. At home, majority of respondents obtained their drinking water from wells, accounting for 67.8% in Neni, 72.7% in Adazi-Enu, and 82.8% in Akwaeze, while smaller proportions used boreholes and pumps, and none reported using sachet water at home. At school, most respondents drank water brought from home, representing 57.1% in Neni and 100% in both Adazi-Enu and Akwaeze. In Neni community, 42.8% of respondents reported using borehole water at school, while no respondents in Adazi-Enu and Akwaeze reported using boreholes, pumps, or wells at school (table 8).

On environmental and behavioural practices of the respondents, majority of the respondents reported disposing of household waste into gutters (55.2%), while 34.3% dispose of waste outside the house and 10.4% either reported burning it. High percentage (60.4%) of the children reported playing with soil. More than half (52.0%) reported nail-biting habits, while 48.9% indicated that they walk barefoot (Table 9).

Table 10 shows the practices of the respondents. Majority (53.1%) of the children reported defecating in bushes at home. Similarly, majority (70.8%) of the children indicated that they use bushes as toilet facilities at school. With regard to fruit hygiene, 34.3% reported eating fruits without washing them.

Results of the effect of sanitation and hygiene practices of the children on intestinal parasites infections shows more 57.2% of the children reported that they sometimes eat fruits without washing them. Only 21.8% indicated that they always wash their hands after using the toilet. Also,

37.5% reported washing their hands before eating, while 25.0% of the respondents indicated that they do not wash their hands before eating. Majority (60.4%) reported that they do not wash their hands after playing at school, while 46.8% indicated that they do not wash their hands after playing at home.

Table1: Status of intestinal parasitic infections by age among the school-age children in Anaocha LG.A

AGE	No. examined	No. (%) infected Neni	No. (%) infected Adazi-enu	No. (%) infected Akwaeze	**Total No. (%) infected**
3-6	84	6 (7.1)	9 (10.7)	16 (19.0)	**31 (36.9)**
7-10	139	16 (11.5)	14 (10.1)	11 (7.9)	**41 (29.5)**
11-14	87	6 (6.9)	10 (11.5)	8 (9.2)	**24 (27.6)**
Total	**310**	**28 (9.0)**	**33 (10.6)**	**35 (11.3)**	**96 (30.9)**

χ^2 = 8.655 df = 6, *p*-value = 0.194, P > 0.05

Table 2: Status of intestinal parasitic infections by gender among school-age children in Anaocha LGA.

Gender	No. examined	No. (%) infected Neni	No. (%) infected Adazi-enu	No. (%) infected Akwaeze	Total No. (%) infected
Male	173	19 (11.0%)	18 (10.4%)	21 (12.1%)	58 (33.5%)
Female	137	9 (6.6%)	15 (10.9%)	14 (10.2%)	38 (27.7%)

χ^2 = 2.291, df = 3, *p*-value = 0.514, P > 0.05

Table 3: Status of intestinal parasitic infections among the three communities in Anaocha LGA. (N = 96)

Communities	***Ascaris*** No (%) prevalence	***Hookworm*** No. (%) prevalence	***Taenia*** No. (%) prevalence	***T. Trichiura*** No. (%) prevalence	***E. histolytica*** No. (%) prevalence
Neni	23 (82.1%)	3 (10.7%)	2 (7.1%)	0	0
Adazi-Enu	23 (69.7%)	2 (6.1%)	2 (6.1%)	3 (9.1%)	3 (9.1%)
Akwaeze	26 (74.2%)	5 (14.3%)	3 (8.6%)	0	0
Total	**72 (75%)**	**10 (10.4%)**	**7 (7.3%)**	**3 (3.1%)**	**4 (4.2%)**

χ^2 = 10.530, df = 8, *p*-value = 0.230, P > 0.05

Table 4: WASH evaluation using WASH indicators (recommended by WHO) with regards to Intestinal Parasitic infections status among Neni, Adazi-Enu and Akwaeze communities

Communities	Accessible & clean toilets	Hygiene education practice	Soap & water	Presence of hand-washing stations	Functional toilets	Availability of improved water source	Safe drinking water	Total score	Wash status
NENI									
School A	No (0)	No (0)	No (0)	No (0)	No (0)	Yes (1)	Yes (1)	29%	Inadequate
School B	Yes (1)	Yes (1)	No (0)	No (0)	Yes (1)	Yes (1)	Yes (1)	71%	Adequate
Total	Yes (1)	Yes (1)	No (0)	No (0)	Yes (1)	Yes (1)	Yes (1)	50%	Partially adequate
ADAZI-ENU									
School A	No (0)	No (0)	No (0)	No (0)	No (0)	Yes (1)	Yes (1)	29%	Inadequate
School B	No (0)	No (0)	No (0)	No (0)	Yes (1)	Yes (1)	Yes (1)	42%	Partially adequate
Total	No (0)	No (0)	No (0)	No (0)	Yes (1)	Yes (1)	Yes (1)	36%	Inadequate
AKWAEZE									
School A	No (0)	No (0)	No (0)	No (0)	No (0)	No (0)	No (0)	0	Inadequate
School B	No (0)	Yes (1)	No (0)	Yes (1)	No (0)	No (0)	No (0)	29%	Inadequate
Total	No (0)	Yes (1)	No (0)	Yes (1)	No (0)	No (0)	No (0)	15%	Inadequate

Table 5: WASH status and infection prevalence among the three communities

Communities	WASH status	No. Examined	No. (%) infected
Neni			
School A	Inadequate	53	16 (30.1)
School B	Adequate	61	12 (19.6)
Total	**Partially adequate**	**114**	**28 (24.0)**
Adazi-Enu			
School A	Inadequate	49	18 (36.7)
School B	Partially adequate	52	15 (28.8)
Total	**Inadequate**	**101**	**33 (32.0)**
Akwaeze			
School A	Inadequate	48	20 (41.6)
School B	Inadequate	47	15 (31.9)
Total	**Inadequate**	**95**	**35 (36.0)**

χ^2 = **148.55;** df = 2; *p*-value = **0.00001**

Table 6: Demographic characteristics of the infected children in the three communities

Variable	Category	Number of responses in the Communities (%)			Total (N= 96)
		Neni (n= 28)	Adazi-Enu(n=33)	Akwaeze (n= 35)	
Class	Primary 1 – 2	11 (39.2%)	11 (33.3%)	21 (60%)	43 (44.7%)
	Primary 3 – 4	11 (39.2%)	12 (36.3%)	6 (17.1%)	29 (30.2%)
	Primary 5 – 6	6 (21.4%)	10 (30.3%)	8 (22.8%)	24 (25.0%)
Parents occupation	Farmers	15 (53.5%)	6 (18.1%)	11 (31.4%)	32 (33.3%)
	Traders	10 (35.7%)	22 (66.6%)	20 (57.1%)	42 (43.7%)
	civil servants	3 (10.7%)	5 (15.1%)	4 (11.4%)	12 (12.5%)
Parents level of education	Parents have informal education	13 (46.4%)	0	9 (25.7%)	22 (22.9%)
	Parents have primary education	7 (25%)	5 (15.1%)	11 (31.4%)	23 (23.9%)
	Parents have secondary education	7 (25%)	19 (57.5%)	13 (37.1%)	39 (40.6%)
	Parents have tertiary education	1 (3.5%)	9 (27.2%)	2 (5.7%)	12 (12.5%)

Table 7: Pupils' Knowledge of intestinal parasites mode of transmission

Category	Number of responses in the Communities (%)			Total(N = 96)
	Neni (n = 28)	Adazi-Enu(n=33)	Akwaeze(n = 35)	
IPI can never be gotten from eating sugary things	19 (67.8%)	1 (3.0%)	3 (8.5%)	23 (23.9%)
IPI can always be gotten from eating sugary things	3 (10.7%)	9 (27.2%)	21 (60%)	33 (34.3%)
IPI can sometimes be gotten from eating sugary things	6 (21.4%)	6 (18.1%)	7 (20%)	19 (19.7%)
Have no idea if IPI can be gotten from eating sugary things	0	17 (51.5%)	2 (5.7%)	19 (19.7%)
IPI can never be gotten from penetration of larva in the skin	22 (78.5%)	26 (78.7%)	19 (54.2%)	67 (69.7%)
IPI can always be gotten from penetration of larva in the skin	2 (7.1%)	3 (9.0%)	1 (2.8%)	6 (6.25%)
IPI can sometimes be gotten from penetration of larva in the skin	3 (10.7%)	4 (12.1%)	12 (34.2%)	19 (19.7%)
Have no idea if IPI can be gotten from penetration of larva in the skin	1 (3.5%)	0	3 (8.5%)	4 (4.1%)

Table 8: Source of the infected children's drinking water

Category	Number of responses in the Communities (%)			Total(N = 96)
	Neni (n = 28)	Adaz-Enu (n= 33)	Akwaeze (n = 35)	
Borehole as source of drinking water at home	2 (7.1%)	6 (18.1%)	6 (17.1%)	14 (14.5%)
Pump as source of drinking water at home	7 (25%)	3 (9.0%)	0	10 (10.4%)
Well as source of drinking water at home	19 (67.8%)	24 (72.7%)	29 (82.8%)	72 (75%)
Sachet water as source of drinking water at home	0	0	0	0
Borehole as source of drinking water at school	12 (42.8%)	0	0	12 (12.5%)
Pump as source of drinking water at school	0	0	0	0
Well as source of drinking water at school	0	0	0	0
Water from home as source of drinking water at school	16 (57.1%)	33 (100%)	35 (100%)	84 (87.5%)

Table 9: Environmental and behavioural practices of the children

Category	Number of responses in the Communities (%)			Total(N = 96)
	Neni (n = 28)	Adaz-Enu(n= 33)	Akwaeze(n = 35)	
You throw home waste materials into the gutter	14 (50%)	16 (48.4%)	21 (60%)	53 (55.2%)
You throw home waste materials outside	9 (32.1%)	14 (42.4%)	10 (28.5%)	33 (34.3%)
You burn home waste materials	3 (10.7%)	3 (9.0%)	4 (11.4%)	10 (10.4%)
Yes, you play with soil	18 (64.2%)	22 (66.6%)	18 (51.4%)	58 (60.4%)
No, you do not play with soil	5 (17.8%)	7 (21.2%)	5 (14.2%)	17 (17.7%)
Sometimes, you play with soil	5 (17.8%)	4 (12.1%)	12 (34.2%)	21 (21.8%)
Yes, you bite your nails with teeth	14 (50%)	19 (57.5%)	17 (48.5%)	50 (52.0%)
No, you do not bite your nails with teeth	5 (17.8%)	3 (9.0%)	4 (11.4%)	12 (12.5%)
Sometimes, you bite your nails with teeth	9 (32.1%)	11 (33.3%)	14 (40%)	34 (35.4%)
Yes, you walk barefooted	5 (17.8%)	20 (60.6%)	12 (34.2%)	37 (38.5%)
No, you do not walk barefooted	5 (17.8%)	5 (15.1%)	2 (5.7%)	12 (12.5%)
Sometimes, you walk barefooted	18 (64.2%)	8 (24.2%)	21 (60%)	47 (48.9%)

Table 10: Sanitation and hygiene practices of the children

Category	Number of responses in the Communities (%)			Total(N = 96)
	Neni (n = 28)	Adaz-Enu(n= 33)	Akwaeze(n = 35)	
Water cistern is where you pass faeces at home.	6 (21.4%)	5 (15.1%)	3 (8.5%)	14 (14.5%)
Pit toilet is where you pass faeces at home.	3 (10.7%)	17 (51.5%)	11 (31.4%)	31 (32.2%)
Bush is where you pass faeces at home.	19 (67.8%)	11 (33.3%)	21 (60%)	51 (53.1%)
Water cistern is where you pass faeces at school.	28 (100%)	0	0	28 (29.1%)
Pit toilet is where you pass faeces at school.	0	0	0	0
Bush is where you pass faeces at school.	0	33 (100%)	35 (100%)	68 (70.8%)
Yes, you eat fruits without washing them.	15 (53.5%)	9 (27.2%)	9 (25.7%)	33 (34.3%)
No, you do not eat fruits without washing them.	3 (10.7%)	11 (33.3%)	4 (11.4%)	18 (18.7%)
Sometimes, you eat fruits without washing them.	10 (35.7%)	13 (39.3%)	22 (62.8%)	55 (57.2%)
Yes, you wash your hands with soap and water after using the toilets.	10 (35.7%)	8 (24.2%)	3 (8.5%)	21 (21.8%)
No, you do not wash your hands with soap and water after using the toilets.	15 (53.5%)	19 (57.5%)	26 (74.2%)	60 (62.5%)
Sometimes, you wash your hands with soap and water after using the toilets.	3 (10.7%)	6 (18.1%)	6 (17.1%)	15 (15.6%)
Yes, you wash your hands with soap and	8 (28.5%)	17 (51.5%)	11 (31.4%)	36 (37.5%)

water before eating.				
No, you do not wash your hands with soap and water before eating	2 (7.1%)	9 (27.2%)	13 (37.1%)	24 (25%)
Sometimes, you wash your hands with soap and water before eating	18 (64.2%)	7 (21.2%)	11 (31.4%)	36 (37.5%)
Yes, you wash your hands in school after playing	7 (25%)	5 (15.1%)	6 (17.1%)	18 (18.7%)
No, you do not wash your hands in school after playing	15 (15.5%)	16 (48.4%)	27 (77.1%)	58 (60.4%)
Sometimes, you wash your hands in school after playing	6 (21.4%)	12 (36.3%)	2 (5.7%)	20 (20.8%)
Yes, you wash your hands at home after playing	3 (10.7%)	9 (27.2%)	3 (8.5%)	15 (15.6%)
No, you do not wash your hands at home after playing	20 (71.4%)	10 (30.3%)	15 (42.8%)	45 (46.8%)
Sometimes, you wash your hands at home after playing	5 (17.8%)	14 (42.4%)	17 (48.5%)	36 (37.5%)

Discussion

The present study revealed an overall prevalence of intestinal parasitic infections of 30.9% among school-aged children in Anaocha Local Government Area, Anambra State. This prevalence is higher than the 6.8 %, 14.5%, 24.2% and 27.7% reported by Egbuche *et al.* (2025), Umeanaeto *et al*. (2024) Ikpeoha *et al*. (2024) and Egbuche *et al.* (2017), respectively, but lower than the 44.2% and 38.1% documented by Nwankwo *et al*. (2021) and Egbuche *et al*. (2024) from other communities in different local government areas of Anambra State. Variations in prevalence across studies may be attributed to differences in environmental sanitation, access to safe drinking water, personal hygiene practices, socio-economic conditions, study populations, and diagnostic methods employed. Despite ongoing control efforts, the prevalence recorded in the present study indicates that intestinal parasitic infections remain a significant public health concern among school-aged children in the study area. The continued occurrence of these infections suggests persistent exposure to contaminated environments and inadequate interruption of transmission pathways within the communities.

The distribution of intestinal parasite species showed that *Ascaris lumbricoides* was the predominant parasite. Other parasites identified included hookworm, *Taenia* species, *Entamoeba histolytica* and *Trichuris trichiura*. The predominance of *Ascaris lumbricoides* is consistent with reports from other studies by Alo *et al*. (2021), Ikpeoha *et al*. (2024), Egbuche *et al*. (2024), Egbuche *et al.* (2025) and Okechukwu *et al.* (2024), who similarly identified *Ascaris* as the most common intestinal parasite among school children. The high prevalence of *Ascaris* infection may be explained by the remarkable resistance of its eggs to environmental conditions, allowing them to remain viable in soil for prolonged periods (Okechukwu *et al.,* 2024) and facilitating transmission through contaminated food, water, hands, and fomites. The detection of hookworm and *Taenia* species further suggest ongoing environmental contamination and continued exposure to infective stages of parasites within the study communities (Alo *et al.,* 2021). Although differences in parasite distribution were observed among the communities, the absence of a statistically significant association ($p > 0.05$) indicates that the burden of infection was relatively widespread and uniformly distributed across the study area, reflecting common environmental and behavioural risk factors.

Findings on age-related prevalence showed that children aged 3–6 years recorded the highest prevalence of infection, followed by those aged 7–10 years, while children aged 11–14 years had the lowest prevalence. The relatively higher infection rate among younger children may be attributed to increased contact with contaminated environments during play activities, inadequate handwashing practices, and limited awareness of personal hygiene. Younger children are also more likely to engage in behaviours such as geophagia and indiscriminate hand-to-mouth activities, which increase exposure to infective stages of parasites. However, the observed differences were not statistically significant ($p > 0.05$), suggesting that children across all age groups remain vulnerable to infection in environments where sanitation and hygiene conditions are suboptimal. This finding agrees with Atta *et al.* (2018) and Ikpeoha *et al*. (2024), who similarly reported higher infection rates among younger children without a significant association between age and infection status. The lack

of statistical significance implies that exposure to intestinal parasites is not restricted to a particular age category but affects school-aged children generally within the study communities.

On Gender-related infection, findings showed a slightly higher prevalence among males than females, although the difference was not statistically significant ($p > 0.05$). The higher prevalence observed among males may be related to greater participation in outdoor recreational activities, which could increase exposure to contaminated soil and environmental sources of infection. Nevertheless, the absence of a significant association suggests that both male and female children experience comparable environmental exposures and share similar sanitation and hygiene conditions within their homes and schools. This observation is consistent with the findings of Egbuche *et al*. (2024), who also reported no significant difference in infection prevalence between sexes. The findings indicate that gender alone is not a major determinant of intestinal parasitic infection in the study area.

A notable finding of this study was the relationship between Water, Sanitation and Hygiene (WASH) conditions and infection prevalence. One school in Neni community which recorded the highest WASH 'adequacy' score had the lowest prevalence of intestinal parasitic infections among the school-aged children, while the second school in Neni and the schools in Adazi-Enu and Akwaeze, having 'inadequate' WASH conditions, recorded higher prevalence rates. The WASH pattern observed in the study area is consistent with the earlier findings of Egbuche *et al*. (2026) in Aguleri, who described it as a mosaic pattern characterized by spatial heterogeneity in water, sanitation and hygiene (WASH) conditions and practices within a community, epidemiological unit or geographically defined area, with significant implications for public health and an increased risk of WASH-related disease transmission. This heterogeneity may facilitate sustained infection and parasite persistence, even at reduced transmission intensity, while contributing to disproportionately higher prevalence among certain highly exposed population groups, as demonstrated for *Ascaris lumbricoides* by Egbuche *et al*. (2026), with potential implications for the transmission dynamics of other gastrointestinal parasitic infections identified in the present study. This demonstrates the important role of sanitation, access to safe water, and hygiene practices in reducing transmission of intestinal parasites. Adequate WASH facilities reduce environmental contamination with infective stages of parasites, interrupt faeco-oral transmission pathways, and promote healthier behavioural practices among children. Similar observations have been reported by Nwankwo *et al*. (2021) and Egbuche *et al*. (2024), who identified inadequate sanitation facilities, poor hygiene practices, and limited access to potable water as major contributors to the persistence of intestinal parasitic infections among school children. The findings reinforce the importance of strengthening WASH interventions as a key strategy for sustainable parasite control.

Environmental sanitation and behavioural practices among infected children further highlight important pathways of transmission. More than half of the respondents disposed household waste in gutters, frequently played with soil, and reported nail-biting habits. In addition, a considerable proportion walked barefoot either regularly or occasionally. These practices increase the likelihood of exposure to infective eggs, larvae, and cysts present in

contaminated environments. Soil contact and poor waste disposal contribute to environmental contamination, while walking barefooted facilitates transmission of soil-transmitted helminths such as hookworm through skin penetration. Similar observations have been reported by Atta *et al.* (2018), Nzeukwu *et al*. (2022), and Gebru *et al*. (2023), who identified poor environmental sanitation, soil exposure, and inadequate personal hygiene as important risk factors for intestinal parasitic infections. The persistence of these behaviours suggests that environmental and behavioural interventions are needed alongside routine deworming programmes.

Sanitation and hygiene practices among infected children were generally poor. Open defecation remained common both at home and at school, particularly in Adazi-Enu and Akwaeze. Many respondents also reported consuming fruits without proper washing and failing to wash their hands consistently after using the toilet, before meals, or after playing. These practices facilitate faeco-oral transmission and contribute to the continued circulation of infective stages of parasites within the environment. Similar findings have been reported by Atta *et al*. (2018), Njambi *et al*. (2020), and Bello *et al*. (2025). The widespread occurrence of these risk behaviours indicates that inadequate sanitation infrastructure alone does not fully explain infection transmission; behavioural factors and hygiene awareness also play critical roles in sustaining infection within the communities.

The socio-demographic characteristics of infected children showed that most parents were traders and farmers, while only a small proportion were civil servants. Secondary education was the most commonly reported educational level among parents, whereas tertiary education was least represented. Although the present study did not establish a direct statistical association between parental socio-demographic characteristics and infection status, the observed pattern may suggest a potential influence of socio-economic and educational factors on children's risk of infection. Parents with higher educational attainment may possess greater awareness of disease prevention and hygiene practices, while higher socio-economic status may improve access to sanitation facilities and safe water. Similar observations were reported by Amisu *et al.* (2023) and Oyebamiji (2023), who associated lower educational attainment and informal occupations with poorer hygiene practices and increased vulnerability to intestinal parasitic infections. These findings underscore the importance of considering broader socio-economic determinants when designing parasite control programmes.

Knowledge of intestinal parasitic infections among interviewed children was generally poor and characterised by several misconceptions. A considerable proportion of respondents incorrectly believed that intestinal parasitic infections could be acquired through eating sugary foods, while knowledge of transmission through larval penetration of the skin was also inadequate. Although school children in Neni demonstrated relatively better awareness than those in the other communities, misconceptions remained common across all study locations. Poor understanding of transmission pathways may contribute to the persistence of risky behaviours such as inadequate handwashing, open defecation, consumption of unwashed fruits, and frequent exposure to contaminated environments. Similar findings were reported by Gebru *et al*. (2023), who documented inadequate knowledge of intestinal parasite transmission among school children in Eastern Ethiopia. The

findings highlight the need for comprehensive school-based health education programmes aimed at improving knowledge of parasite transmission, prevention, and control among children and their caregivers.

Findings on attitude revealed both positive and concerning patterns. Overall, 54.1% infected children considered IPIs to be a serious infection, while 45.8% did not. However, attitudes towards prevention were strongly positive: all 96 children (100%) believed that IPI could be prevented and expressed willingness to adopt preventive measures. In addition, 63.5% considered handwashing important for preventing IPI. The difference between recognizing the preventability of infection and consistently demonstrating preventive behaviours suggests that positive attitudes may not necessarily translate into appropriate practices, particularly where children face environmental and infrastructural limitations.

Among the practices assessed, soil contact, barefoot walking and handwashing were particularly relevant to the transmission context. Regular soil play was reported by 60.4% infected children. Barefoot walking was also common, with 38.5% reporting regular and 48.9% occasional barefoot walking. These behaviours are important because contaminated soil may serve as an environmental medium for infective parasite stages, while barefoot exposure can provide an opportunity for hookworm larvae to penetrate the skin. Atta *et al*., (2018) similarly reported frequent soil contact and poor hygiene practices among school children in Nigeria, while Nzeukwu *et al*., (2022) reported higher intestinal parasite prevalence among pupils who practiced nail biting and frequently played with sand. However, the present study was descriptive and did not establish these behaviours as statistically significant risk factors.

Handwashing provided an important illustration of the gap between attitude and practice. Although 63.5% of infected children considered handwashing important in preventing IPI, 62.5% reported that they did not wash their hands with soap and water after using the toilet, while 60.4% reported not washing their hands after playing at school. This discrepancy suggests that awareness of the importance of handwashing does not necessarily result in consistent practice. Similar differences between knowledge, hygiene behaviour and available WASH conditions have been reported in other settings. Atta *et al*., (2018) documented poor handwashing and footwear practices among Nigerian school children, whereas Njambi *et al*., (2020) reported substantially higher handwashing practices among school children in Kenya. Bello *et al*., (2025) also reported relatively high handwashing after toilet use among secondary school students in Ogun State, although consistent use of soap and water remained low.

Well water was the predominant household drinking-water source, reported by 75.0% infected children, while 87.5% relied on water brought from home for drinking at school. At school, all infected children in Adazi-Enu and Akwaeze reported bringing water from home. In addition, substantial differences in sanitation were observed between communities, with all infected children in Adazi-Enu and Akwaeze reporting open defecation at school, compared with the use of water cistern toilets by all infected children in Neni. These findings do not establish that particular water sources or sanitation conditions caused infection, but they

demonstrate the environmental context in which preventive behaviours occur.

Overall, the findings demonstrate that intestinal parasitic infections remain prevalent among school-aged children in Anaocha Local Government Area. The predominance of *Ascaris lumbricoides*, coupled with poor sanitation, inadequate hygiene practices, misconceptions regarding disease transmission, and suboptimal WASH conditions, suggests continued environmental contamination and active transmission within the study communities. Effective control of intestinal parasitic infections in the area will require integrated interventions involving periodic deworming, improved sanitation facilities, access to safe water, hygiene promotion, strengthened school-based health education, and active community participation. Such integrated approaches are essential for reducing infection burden and achieving sustainable control of intestinal parasitic infections among school-aged children

Conclusion

This study confirms the continued occurrence of intestinal parasitic infections among school-age children in Anaocha Local Government Area, Anambra State, indicating ongoing exposure to contaminated environmental sources. The persistence of infection appears to be associated with inadequate sanitation facilities, suboptimal hygiene practices, and gaps in knowledge regarding transmission and prevention. The difference between recognizing the preventability of infection and consistently demonstrating preventive behaviours suggests that positive attitudes may not necessarily translate into appropriate practices, particularly where children face environmental and infrastructural limitations. Although infection patterns varied across demographic groups, exposure was generally widespread among the children. These findings highlight the need for integrated control measures, including improved water, sanitation and hygiene (WASH) conditions, strengthened health education, and regular deworming programmes. In Adazi-Enu and Akweze communities, there is need to prioritise school sanitation (toilet construction, abolition of open defecation in school grounds), provision of hand-washing facilities and health education. For Neni community, there is need to consolidate existing WASH gains and intensify health education to correct misconceptions even where infrastructure is adequate.

Conflict of Interest

The authors declare no conflict of interest.

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Author's contribution

Umeokpala and Uzochukwu designed the study; Umeokpala, Ikpeoha and Umeanor collected specimen/data; Umeokpala, Chibuoke and Umeanor did laboratory analysis of samples. Uzochukwu, Umeokpala and Obiefule analysed the data. Umeokpala and Uzochukwu wrote the manuscript; all the authors read and made inputs to the draft manuscript.

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