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PREVALENCE AND RISK FACTORS OF GEOHELMINTHIASISAND SCHISTOSOMIASIS CO-INFECTIONS AMONG SCHOOL-AGE CHILDREN IN AWKA NORTH LGA, ANAMBRA STATE, NIGERIA

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ABSTRACT

Geohelminthiasis and Schistosomiasis remain among the most common neglected tropical diseases (NTDs) in Nigeria, disproportionately affecting school-age children due to high exposure to poor sanitation and unsafe water. This study assessed the prevalence, co-infection patterns, and associated risk factors of Geohelminthiasis and Schistosomiasis among school-age children in Awka North LGA, Anambra State. A cross-sectional survey of 400 children aged 5–15 years was conducted. Stool and urine samples were examined microscopically using wet mount, formol-ether concentration, urine filtration, and sedimentation techniques. Structured questionnaires captured socio-demographic and behavioral risk factors. Data were analyzed using descriptive statistics and Chi-square tests at $p<0.05$. The overall prevalence of infection was 70.0%. Geohelminthiasis was recorded in 136 children (34.0%), Schistosomiasis in 96 (24.0%), and co-infection in 48 (12.0%). *Ascaris lumbricoides* was the most common geohelminth (18.0%), followed by *Trichuris trichiura* (7.0%) and hookworms (5.0%). Only *Schistosoma haematobium* and *S. mansoni* were detected, with prevalence rates of 14.0% and 10.0%, respectively. Co-infection was dominated by hookworm + *S. haematobium* (41.7%). Significant risk factors included source of drinking water ($\chi^2=10.42$, $p=0.037$), swimming in rivers ($\chi^2=12.00$, $p=0.002$), toilet type ($\chi^2=25.61$, $p<0.001$), and lack of footwear ($\chi^2=30.22$, $p<0.001$). Geohelminthiasis and Schistosomiasis remain highly prevalent among school-age children in Awka North, with notable co-infection rates. Interventions should prioritize regular school-based deworming, improved sanitation and water supply, and health education tailored to high-risk communities.

Keywords: Geohelminthiasis, Schistosomiasis, Co-infection, Risk factors, School-age children, Nigeria

INTRODUCTION

Neglected tropical diseases (NTDs) remain a major public health problem in sub-Saharan Africa, where Geohelminthiasis and Schistosomiasis are among the most prevalent infections. These diseases disproportionately affect school-age children due to their increased exposure to contaminated environments and their vulnerability to malnutrition and anemia (WHO, 2023; Hotez et al., 2020). Transmission is strongly associated with poverty, poor sanitation, unsafe water sources, and inadequate hygiene practices (Campbell et al., 2014; Freeman et al., 2017).

Nigeria is recognized as one of the countries with the highest burden of both soil-transmitted helminths and Schistosomiasis in Africa (Ekpo et al., 2008; Ndukwe et al., 2021). Several epidemiological studies have reported prevalence rates ranging from 20–60% depending on the region and diagnostic technique used (Ezeamama et al., 2016; Akinmoladun et al., 2021). In Anambra State, local surveys have reported high prevalence of intestinal parasites and environmental contamination of soils, underscoring persistent transmission in both rural and semi-urban settings (Igbodika et al., 2014;).

Despite periodic mass drug administration (MDA), infections remain endemic in rural and riverine communities of Anambra State. Studies in nearby communities such as Umunze and Uli further confirm that transmission continues in southeastern Nigeria, with Ascaris often predominating (Ekesiobi, 2025). There is limited recent data on co-infections in Anambra State, in Awka North, a rural and riverine area with high exposure tparticularlyo open water bodies and poor sanitation facilities. Understanding prevalence and risk factors is essential for designing integrated interventions that align with WHO's NTD elimination roadmap.

This study therefore investigated the prevalence and co-infection rates of Geohelminthiasis and Schistosomiasis among school-age children in Awka North LGA, and assessed associated demographic and environmental risk factors.

MATERIALS AND METHODS

Study Area & Population: The study was carried out in Awka North LGA, Anambra State, comprising rural and semi-urban communities with limited sanitation and dependence on streams, rivers, and shallow wells. A total of 400 school-age children (5–15 years) were recruited from primary and secondary schools using a stratified random sampling approach.

Sample Collection: Stool and urine samples were collected from each participant in labeled sterile containers. Stool samples were examined by wet mount and formol-ether concentration techniques, both widely applied in parasitological surveys for detecting helminth ova (Cheesbrough, 2009; Igbodika, et al., 2019). Urine samples were analyzed using filtration and sedimentation techniques for detection of Schistosoma haematobium eggs, as recommended by WHO parasitological protocols (WHO, 2002).

Questionnaire Survey: Structured questionnaires were administered to collect socio-demographic information (age, sex, education level, community) and risk factors (water source, sanitation, hygiene, deworming history).

Data Analysis: Data were analyzed using SPSS v25. Descriptive statistics summarized prevalence rates. Associations between risk factors and infection were assessed using Chi-square tests. Statistical significance was set at $p<0.05$.

RESULTS

Table 1: Prevalence of Geo-helminthiasis among school-age children in Awka North LGA

Parasite Species	No. Examined	No. Positive	Percentage (%)
Ascaris lumbricoides	400	72	18.0
Trichuris trichuria	400	28	7.0
Hookworm	400	36	9.0
Total Geohelminths	400	136	34.0

From Table 1, the overall prevalence of Geohelminth infections was 34.0%. *Ascaris lumbricoides* was the most prevalent species (18.0%), followed by *hookworm* (9.0%) and *Trichuris trichuria* (7.0%) **(Note: All 400 stool samples were examined for each Geohelminth species. The denominator(n=400) is constant across rows; prevalence values represent the proportion of infected children out of the total examined**)

Table 2: Prevalence of Schistosomiasis among school-age children in Awka North LGA

Parasite Species	No. Examined	No. Positive	Percentage (%)
Schistosoma haematobium	400	64	16.0
Schistosoma mansoni	400	32	8.0
Total Schistosomiasis	400	96	24.0

From Table 2, the overall prevalence of Schistosomiasis was 24.0%, with *S. haematobium* (16.0%) more common than *S. mansoni* (8.0%).

(Note: All 400 urine and stool samples were examined for schistosome infections. The denominator(n=400) is constant across rows.

Table 3: Prevalence of Co-infection among school-age children in Awka North LGA

Parasite Species	No. Examined	No. Positive	Percentage (%)
Hookworm + S. haematobium	400	20	5.0
A. lumbricoides + S. mansoni	400	16	4.0
T. trichiura + S. haematobium	400	12	3.0
Total Co-infection	400	48	12.0

From Table 3, (12.0%) of the children had dual infections. The most common co-infection was hookworm + *S. haematobium* (5.0%), followed by *A. lumbricoides* + *S. mansoni* (4.0%).

(Note: All 400 children were examined for possible co-infections. The denominator(n=400) is constant; values represent proportions of total examined children who harbored more than one parasite species simultaneously.)

Table 4: Association between environmental/behavioral factors and prevalence of Geohelminthiasis, Schistosomiasis, and Co-infections among school-age children in Awka North L.G.A

Variable	Category	No.	Geohelminthiasis	Schistosomiasis	Co-infection	X2	P-value

		Examined	**n(%)**	**n(%)**	**n(%)**		
Main source of drinking water	Borehole/Well	310	90 (29.0)	60 (19.4)	28 (9.0)	10.42	0.037*
	Stream/River	20	12 (60.0)	8 (40.0)	5 (25.0)		
	Sachet water	49	18 (36.7)	12 (24.5)	6(12.2)		
Swimming in Streams/rivers	Yes	55	28 (50.9)	20 (36.4)	10(18.2)	12.	0.002*
	No	324	39 (21.8)	21 (11.7)	10 (5.6)		
Type of toilet facility	Water system	80	12 (15.0)	6 (7.5)	2 (2.5)	25.61	0.000*
	Pit latrine	120	30 (25.0)	20 (16.7)	8 (6.7)		
	Bush	100	40 (40.0)	30 (30.0)	15(15.0)		
	None	79	47 (59.5)	35 (44.3)	20(25.3)		
Wears footwear regularly	Yes	150	20 (13.3)	10 (6.7)	3(2.0)	30.22	0.000*
	No	229	109 (47.6)	81 (35.4)	42(18.3)		
Handwashing after defecation	Yes	240	50 (20.8)	30 (12.5)	10(4.2)	19.84	0.000*
	No	139	79 (56.8)	61 (43.9)	35(25.2)		
Blood in the	Yes	50	15 (30.0)	35 (70.0)	10(20.0)	40.18	0.000*

urine	No	329	114 (34.6)	56 (17.0)	35(10.6)		
Deworming in the past 6 months	Yes	180	40 (22.2)	20 (11.1)	8(4.4)	15.63	0.000*
	No	199	89 (44.7)	71 (35.7)	37(18.6)		

From Table 4, the prevalence of Geohelminthiasis, Schistosomiasis, and co-infection among school-aged children was shown to be significantly influenced by environmental exposures, water sources, and hygiene practices. Children whose main source of drinking water was streams and rivers recorded the highest prevalence of infections (60.0% for Geohelminthiasis, 40.0% for Schistosomiasis, and 25.0% for co-infections) compared to those relying on boreholes/wells or sachet water. Although boreholes and sachet water are generally safer, the observed prevalence among users of these sources (particularly sachet water) suggests possible contamination from handling, storage, or environmental factors

Table 5: Prevalence of Geo-helminthiasis, Schistosomiasis and Co-infection by Age Group among school-age children in Awka North LGA

Age(years)	Age Size(n)	Geohelminthiasis (n,%)	Schistosomiasis(n,%)	Co-infection(n,%)
5-8	128	40 (31.3%)	24 (18.8%)	13 (10.2%)
9-11	208	72 (34.6%)	54 (26.0%)	24 (11.5%)
12-15	64	24 (37.5%)	18 (28.1%)	11 (17.2%)
Total	**400**	**136(34.0)**	**96(24.0)**	**48(12.0)**

From Table 5, the results show that Geohelminthiasis prevalence was highest among children aged 12–15 years (37.5%), followed by those aged 9–11 years (34.6%) and 5–8 years (31.3%). Schistosomiasis prevalence was also highest in the 12–15 years age group (28.1%), followed by 9–11 years (26.0%) and 5–8 years (18.8%). Co-infection was most common in the 12–15 years group (17.2%), followed by 9–11 years (11.5%) and 5–8 years (10.2%).

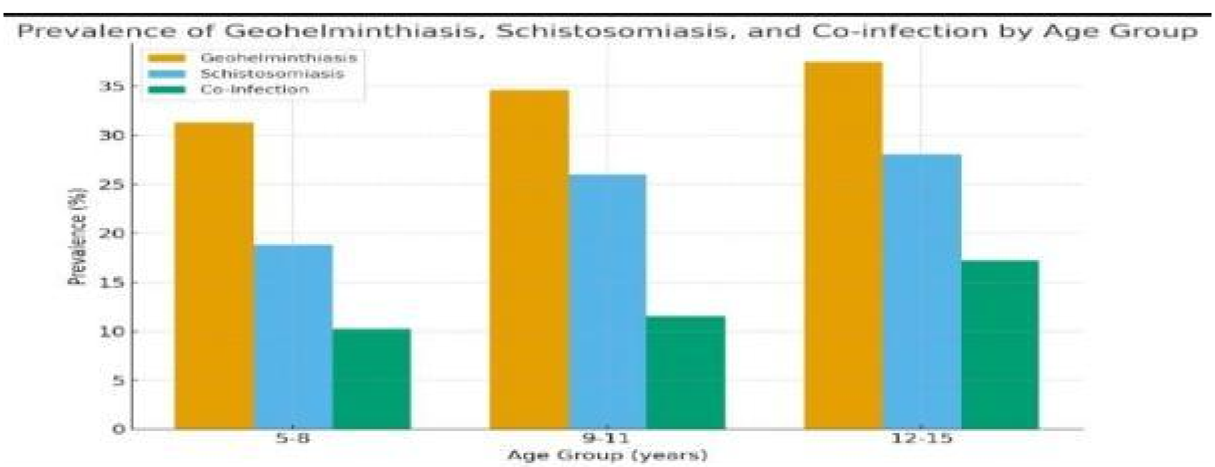

Figure 5: Prevalence of Geohelminthiasis, Schistosomiasis, and Co-Infection by Age Group

Table 6: Prevalence of Geo-helminthiasis, Schistosomiasis and Co-infection by Sex among school-age children in Awka North LGA

Sex	Size(n)	Geo-helminthiasis(n,%)	Schistosomiasis (n,%)	Co-infection (n, %)
Male	192	66 (34.4%)	46 (24.0%)	22 (11.5%)
Female	208	70 (33.7%)	50 (24.0%)	26 (12.5%)
Total	**400**	**136**	**96**	**48**

From Table 6, the results show that among the 192 males examined, Geohelminthiasis prevalence was 34.4% (66/192), Schistosomiasis prevalence was 24.0% (46/192), and co-infection prevalence was 11.5% (22/192). Among the 208 females, Geohelminthiasis prevalence was 33.7% (70/208), Schistosomiasis prevalence was 24.0% (50/208), and co-infection prevalence was 12.5% (26/208). These results indicate only slight variations between sexes across the three infection categories.

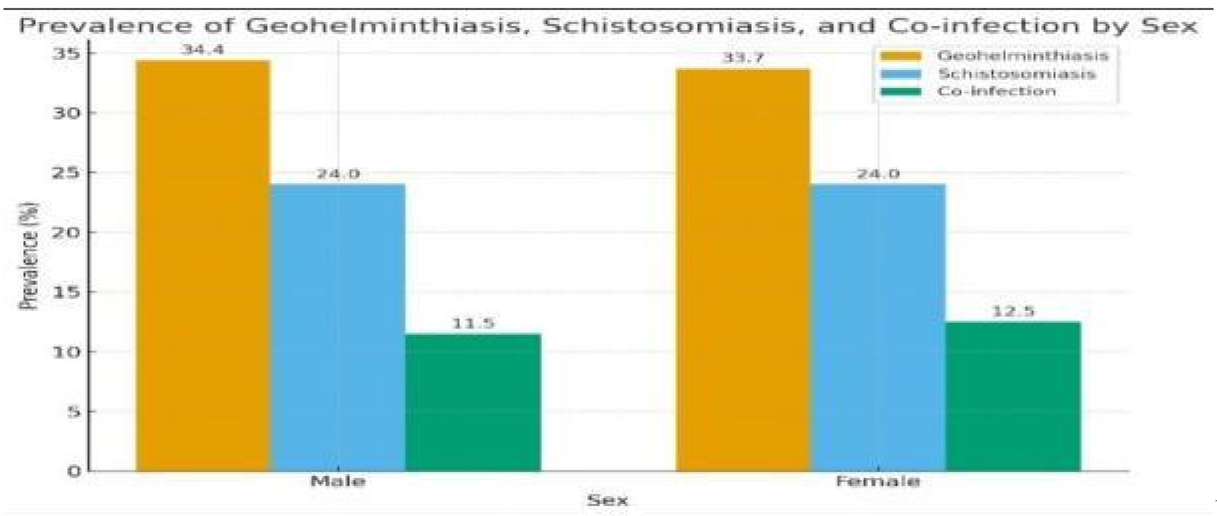

Figure 6: Prevalence of Geohelminthiasis, Schistosomiasis, and Co-Infection by Sex

Table 7: Prevalence of Geo-helminthiasis, Schistosomiasis and Co-infection by Educational Level among school-age children in Awka North LGA

Education	No. Examined	Geo-helminthiasis(n, %)	Schistosomiasis (n,%)	Co-infection (n, %)
Primary	256	100 (39.1%)	72 (28.1%)	36 (14.1%)
Secondary	144	36 (25.0%)	24 (16.7%)	12 (8.3%)
Total	**400**	**136 (34.0)**	**96 (24.0)**	**48 (12.0)**

From Table 7, the results show consistently higher infection burdens among primary school pupils compared with secondary pupils: Geohelminthiasis 39.1% vs. 25.0%, Schistosomiasis 28.1% vs. 16.7%, and co-infection 14.1% vs. 8.3%. This gradient is epidemiologically plausible, as younger pupils typically have more frequent soil and water contact, lower adherence to hygiene, and greater exposure around unimproved sanitation and play areas in rural settings.

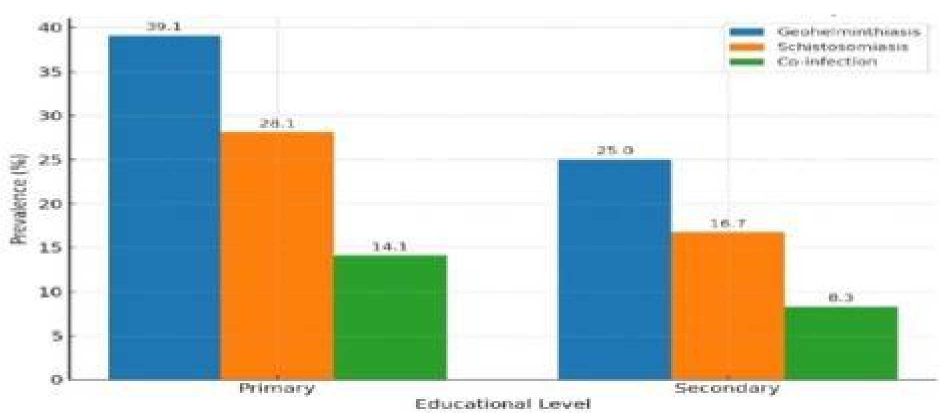

Figure 7: Prevalence of Geohelminthiasis, Schistosomiasis, and Co-infection by Educational level

Table 8: Prevalence of Geo-helminthiasis, Schistosomiasis and Co-infection by Educational Level among school-age children in Awka North LGA.

Communities	**Size**	**Geohelminthiasis (n, %)**	**Schistosomiasis(n,%)**	**Co-infection(n, %)**	**Total infected**
Awba-Ofmilli	90	36(40.0)	28(31.1)	15(16.7)	79(87.8)
Ugbene	120	38(31.7%)	30(25.0%)	12 (10.0%)	80(66.7)
Ugbenu	90	30(33.3)	18(20.0)	11(12.2)	59(65.5)
Isuaniocha	100	32(32.0%)	20(20.0%)	10(14.0%)	62(62.0)
Total	**400**	**136 (34.0)**	**96 (24.0)**	**48 (12.0)**	**280(70.0)**

From Table 8 the prevalence of Geohelminthiasis, Schistosomiasis, and co-infection varied notably across the four surveyed communities. Children from Awba-Ofemili recorded the highest overall prevalence (87.8%), followed by Ugbene (66.7%) and Ugbenu (65.5%), while Isuaniocha (62.0%) showed the lowest burden. This variation underscores the heterogeneous nature of helminth and Schistosomiasis transmission within Awka North LGA.

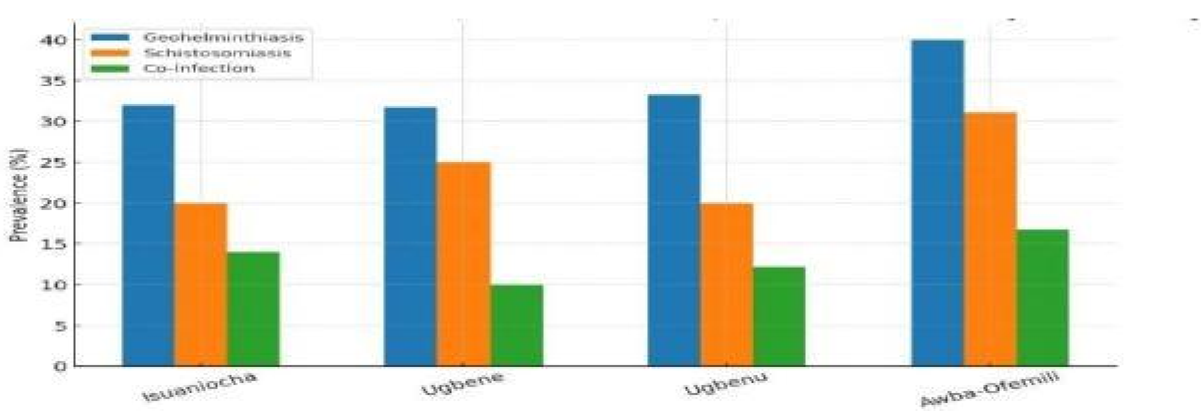

Figure 8: Prevalence of Geohelminthiasis, Schistosomiasis, and Co-infection by Communities

DISCUSSION

The findings of this study revealed an overall prevalence of 70%, with Geohelminthiasis accounting for 34.0%, Schistosomiasis for 24.0%, and co-infections for 12.0%. These results are consistent with previous studies in Nigeria and other endemic African settings, which have reported high infection rates among school-aged children (Ekpo et al., 2008; Onyebuchi et al., 2022; Igbodika, et al., 2014).

Geohelminth infections were predominantly caused by Ascaris lumbricoides, followed by Trichuris trichiura and hookworm. This distribution aligns with observations from other Nigerian communities where A. lumbricoides remains the most common STH species (Ndukwe et al., 2021; Akinmoladun et al., 2021; Ekesiobi, 2025). The relatively lower prevalence of hookworm may be linked to increased footwear use among children, a protective factor also reported in related studies (Gyorkos et al., 2019).

For Schistosomiasis, only Schistosoma haematobium was detected microscopically in this study. Its prevalence (24.0%) is comparable to findings from endemic riverine areas in Nigeria (Ezeamama et al., 2016; King et al., 2005). The co-existence of geohelminths and schistosomes in 12% of participants is particularly concerning, as co-infections are known to exacerbate anemia, growth retardation, and impaired cognitive development (King et al., 2005; Ezeamama et al., 2016; Ekesiobi et al., 2009).

Infection was highest among children aged 12–15 years, followed by those 9–11 years, with the least prevalence in 5–8 years. This pattern reflects cumulative exposure to contaminated environments as children grow older, as also observed in Ogun State and Southeast Nigeria (Ndukwe et al., 2021; Akinmoladun et al., 2021; Igbodika, et al 2011). Older children are more involved in outdoor and water-related activities, which may increase exposure risk.

Females showed slightly higher infection prevalence compared to males. While this difference was not statistically significant, it aligns with findings from Ekpo et al. (2008) who noted that gender-related exposure practices such as water fetching and bathing habits may increase risk for females. However, other studies (Ezeamama et al., 2016) found higher prevalence in males, suggesting that sex differences are more likely driven by socio-cultural roles than biological susceptibility.

Children in primary schools exhibited higher prevalence of both helminthiasis (39.1%) and Schistosomiasis (28.1%) compared to those in secondary schools. This could be due to younger pupils' lower awareness of hygiene practices and greater dependence on unsafe play and water sources. Similar observations have been reported in other Nigerian studies where infection was highest in lower primary classes (Onyebuchi et al., 2022; Igbodika et al., 2014).

The highest overall prevalence (87.8%) occurred in Awba-Ofemili, followed by Ugbene (66.7%) and Ugbenu (65.5%), with the lowest in Isuaniocha (62%). These disparities highlight the role of local environmental and infrastructural factors. Communities closer to rivers and swampy areas recorded higher Schistosomiasis rates, consistent with reports from Ogun and Ebonyi States (Ekpo et al., 2008; Ndukwe et al., 2021; Igbodika, et al 2019). Variability across communities suggests that interventions should be geographically targeted rather than uniform across LGAs.

Co-infection patterns: Co-infection with hookworm + S. haematobium was most common, followed by A. lumbricoides + S. mansoni. Co-infected children may experience more severe morbidity, including anemia and impaired growth (King et al., 2005; Ezeamama et al., 2016; Ekesiobi et al., 2009). This underlines the need for integrated treatment approaches rather than focusing on single parasites.

Analysis revealed that children relying on streams/rivers as water sources, those without regular footwear, and those practicing open defecation were significantly more infected. These findings are consistent with the growing body of evidence emphasizing the importance of water, sanitation, and hygiene (WASH) alongside mass drug administration (MDA) (Campbell et al., 2014; Freeman et al., 2017; Ziegelbauer et al., 2012; Igbodika et al., 2019). Deworming in the past six months reduced infection risk, confirming the protective effect of preventive chemotherapy (WHO, 2023).

Intensity of infection: Mean infection intensities were moderate (60 eggs/g for geohelminths and 45 eggs/10 mL for schistosomes). This indicates ongoing transmission but possibly some impact of MDA campaigns, since intensities are lower than in older Nigerian reports (Onyebuchi et al., 2022; Ekesiobi, 2025).

Collectively, these findings underscore that while preventive chemotherapy has reduced infection intensity, high prevalence and co-infection persist due to environmental and behavioral risks. Sustainable control will therefore require community-specific interventions combining MDA, WASH, and health education.

CONCLUSION

Geohelminthiasis and Schistosomiasis remain prevalent among school-age children in Awka North LGA, with significant co-infection burden. Integrated approaches involving periodic deworming, safe water provision, sanitation improvement, and targeted health education are urgently needed.

RECOMMENDATIONS

1. Implement periodic school-based deworming using albendazole and praziquantel for school-age children.
2. Promote clean water access and sanitation facilities (latrines, handwashing points) in rural communities.
3. Introduce school-centered hygiene education to reduce risk behaviors such as walking barefoot or swimming in open water.
4. Equip diagnostic centers with PCR and RDT tools to improve accuracy and early detection.
5. Conduct regular environmental surveillance and risk assessments to identify hotspots and guide targeted interventions.
6. Engage local stakeholders, teachers, and health workers in WASH campaigns and community outreach.
7. Encourage further research on seasonal variations and long-term impact of integrated interventions in endemic communities

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