

## INTESTINAL HELMINTHIASIS AMONG CHILDREN ATTENDING PRIMARY SCHOOLS IN YORRO AND ZING LOCAL GOVERNMENT AREAS (LGAS), TARABA STATE, NIGERIA

<sup>1</sup>Garba, P., <sup>1</sup>Allahnanan, E., <sup>1</sup>Wama, E.B., <sup>1</sup>Akwa, V.Y., <sup>2</sup>Blessing, S.A., <sup>1\*</sup>Houmsou, R.S.

<sup>1</sup>Department of Biological Sciences, Taraba State University, Jalingo, Nigeria.

<sup>2</sup>National Biotechnology Research Development Agency, Jalingo, Nigeria.

### ARTICLE INFO

#### Article history:

Received 01 August 2025

Received in revised form 14 August 2025

Accepted 20 August 2025

#### Keywords:

Intestinal, Helminths, Yorro, Zing, Taraba State.

### ABSTRACT

Intestinal helminthiasis remains a significant public health challenge, particularly among school-aged children in low-resource settings. This study investigated the occurrence of intestinal helminths in relation to socio-demographic determinants, as well as the risk factors for infection in primary school children in Yorro and Zing Local Government Areas (LGAs), Taraba State, Nigeria. The study randomly enrolled five hundred (500) students from selected primary schools in Yorro and Zing LGAs. Stool samples were collected and examined using smear and Kato-Katz techniques. Structured questionnaires were administered to collect socio-demographic and behavioral data. An overall prevalence of 75.7% was found. Yorro LGA significantly had 78.8% than Zing LGA, 72.7% ( $\chi^2=7.994$ ;  $p=0.006$ ). The identified helminths were *Ascaris lumbricoides* (20.1%), hookworm (13.9%), *Trichuris trichiura* (13.3%), *Taenia solium* (13.0%), *Taenia saginata* (11.6%), and *Enterobius vermicularis* (10.7%). The behavioral and hygienic attitudes of the children were not significant as risk factors in the areas. Yorro LGA significantly had more infections than Zing LGA. *Ascaris lumbricoides* had the highest frequency among the school children. The research recommends an urgent need to deworm and improve sanitation in schools and the environment. There should also be a safe drinking water supply and comprehensive health education campaigns in schools and households.

### 1. Introduction

Intestinal helminthiasis is one of the biggest socio-economic and medical problems. Previous epidemiological studies showed that helminthiasis are among the most common infections and one of the biggest health problems of societies worldwide. Surveys on the prevalence of various intestinal helminthiasis in different geographic regions are a prerequisite for developing appropriate control strategies. Research carried out in different countries has shown that the socioeconomic situation of individuals is an important cause of the prevalence of intestinal helminths (Ziegelbauer *et al.*, 2012; Pullan *et al.*, 2014; Strunz *et al.*, 2014; Campbell *et al.*, 2018; Jourdan *et al.*, 2018; Jamaiah and Rohela, 2020; Wama *et al.*, 2022).

The intestinal helminthiasis from other infections has a high prevalence, causing about 450 million deaths among individuals worldwide every year (Markell *et al.*, 2018; Lai, 2021; WHO, 2021). Its high incidence in the poor and disadvantaged school-aged children is another factor (Nematian *et al.*, 2020). These infections cause serious damage to children's development in underdeveloped countries, and are related to failure to thrive, reduced physical activity and mental problems, anaemia, delayed growth, weight loss, fatigue, itching or rash around the anus and the vulva, and learning power (Nematian *et al.*, 2020). They are of enormous public health importance (Ikon and Useh, 2018). The intestinal helminthiasis has been reported from several African countries, including South Africa (Househam *et al.*, 2018), Gabon (Presterl *et al.*, 2019), Kenya (Mwanga *et al.*, 2021), Ethiopia (Aleka *et al.*, 2019), Tanzania (Mwinzi *et al.*, 2020), Ghana (Humphries *et al.*, 2019), and Nigeria (Ezeamama *et al.*, 2020; Omudu *et al.*, 2021).

\*Corresponding author: Tel.: +2348032982979

E-mail address: rs.houmsou@gmail.com

In Nigeria, an estimated 15 million individuals are suffering from ascariasis, strongyloidiasis, trichuriasis, enterobiasis, hookworm, and taeniasis (Adabara *et al.*, 2018). The transmission is usually by the fecal-oral route, which includes the ingestion of faecally contaminated water or food, person-to-person contact, and direct contact with infected faeces (Andu *et al.*, 2019). Several studies have been carried out among children in Nigeria (Oyewole *et al.*, 2016; Ojorongbe *et al.*, 2019; Asaolu *et al.*, 2020; Ezeamama *et al.*, 2020; Akinbo *et al.*, 2021), but none has been carried out in Yorro and Zing Local Government Areas, Taraba State. Therefore, this study was carried out to determine the occurrence of intestinal helminthiasis and its risk factors among the primary school children of Yorro and Zing Local Government Areas of Taraba State, Nigeria.

## 2. Materials and methods

### 2.1 Study area

This cross-sectional study was carried out in Yorro and Zing Local Government Areas of Taraba State. Yorro LGA has Kpantisawa as its headquarters with a population of 89,410 inhabitants, while Zing, equally named as the capital of the Local Government Area, has a population of 127,363 as at the 2020 census. The Local Government Areas are dominated mostly by the Mumuye tribe, which is the largest tribe in Taraba State. They are farmers and are involved in the rearing of animals.

### 2.2 Sampling procedure and sample size determination

The stratified random sampling was used for the study. The sample size was estimated using the statistical formula:

$$n = \frac{z^2 \cdot p \cdot (1-p)}{d^2} \quad (1)$$

Where:

n = required sample size,

Z standard normal deviate at a 95% confidence level (1.96),

P = estimated prevalence,

d margin of error (5%).

$$n = \frac{(1.96)^2 \cdot 0.2(1-0.2)}{(0.05)^2}$$

$$n = 245.86 \approx 246$$

After calculating the estimated sample size, each Local Government Area collected n=250.

### 2.3 Ethical considerations

Permission was obtained from the Health Research Ethical Committee (TRSHREC/2024/040), Ministry of Health, Taraba State. The Director of Primary Health Care and the Educational Secretary (ES) of Yorro and Zing Local Government Area were contacted before the beginning of the study. Additional permission was sought from the village heads of the communities selected. Children were informed of their rights to refuse to participate in the study and to withdraw at any time during the study without jeopardizing their rights.

### 2.4 Questionnaire administration

Epidemiological data were collected using a questionnaire which was constructed to assess children's family socio-economic status, age, sex, class of study, personal hygiene practices, sanitary facilities, parents' educational levels, and complaints from intestinal helminth infection.

## 2.5 Collection of stools and laboratory analysis

### 2.5.1 Collection of stools

A plastic container marked with an identification code number was given to each participant. Instructions about how to properly deliver a stool sample (uncontaminated) were explained to the participants. A questionnaire was given to each participant to help the pupil fill out after interactions.

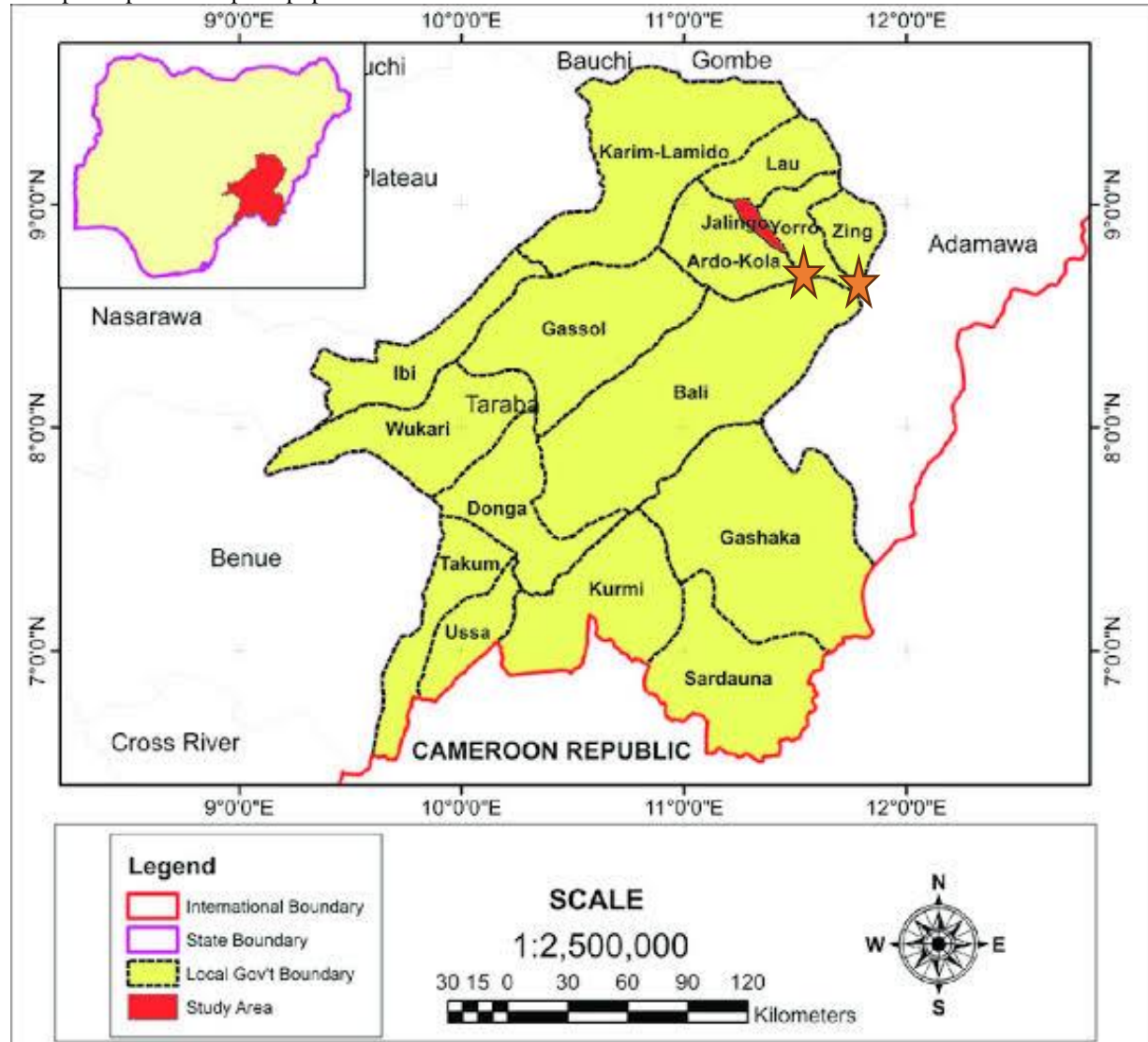


Figure 1: Map of Taraba State showing Yorro and Zing Local Government Areas

Fresh stool samples were collected from each participating school child for laboratory analysis. The samples were first inspected macroscopically, and then they samples were examined microscopically by direct methods.

### 2.5.2 Analysis of stools

The Kato-katz method was used, and it relies on a fixed volume of stool being spread onto a slide using a template, then cleared with glycerol, allowing visualization of helminth eggs under a microscope. Cellophanes were soaked in glycerol-malachite green solution overnight to clear the faecal matter and stain the background. The Kato-Katz template was used to collect a standardized amount of faeces. The template was placed on a microscope slide, and the hole was filled with the faecal sample. Excess stool was removed from the template, leaving a thin layer of faeces. After 30–60 minutes (to allow hookworm eggs to clear), the slides were examined under a light microscope using 10× and 40× objectives (WHO, 2020).

## 2.6 Data Analysis

The data generated were input into Microsoft Excel and transferred to SPSS 27.0 for analysis. Chi-square ( $\chi^2$ ) was used to find the association between the socio-demographic parameters and the infection. The binary logistic regression was used to find out the relationship between the behavioral activities and attitudes of the pupils towards the infection. The level of significance was at 95%.

## 3. Results

### 3.1 Occurrence of intestinal helminths among primary school children in Yorro and Zing LGAs, Taraba State, Nigeria

Table 1 shows the occurrence of intestinal helminths among primary school children in Yorro and Zing LGAs. The overall occurrence was 75.7% (281/371). Yorro LGA had a higher infection 78.8% (145/184), than Zing LGA, 72.7% (136/187). The highest occurrence in Zing was at Nurul Islam with 83.0% (39/47), and the least in Sabon-Gari, 52.1% (25/48), while in Yorro, Lankaviri had the highest 80.9% (38/47) and the least in Kassa, 75.0% (33/44). The chi-square test ( $\chi^2 = 19.869$ ,  $p = 0.006$ ) indicates a significant difference in the occurrence of the infection between schools.

Table 1: Occurrence of intestinal helminths among primary school children of Zing and Yorro LGA of Taraba State, Nigeria

Location (LGA)	Intestinal Helminths		$\chi^2$	p-value
	No. Examined	Occurrence (%)		
Infection	371	281(75.7)	19.869	0.006
Locations				
Zing				
• Sabon gari	48	25 (52.1)		
• Ibrahim Sambo	45	38 (84.4)		
• Kagong	47	34 (72.3)		
• Nurul Islam	47	39 (83.0)		
Yorro				
• Kpanti-Sawa	45	37 (82.2)		
• Kassa	48	37 (77.1)		
• Mabang	44	33 (75.0)		
• Lankaviri	47	38 (80.9)		
Sex			0.801	0.371
• Male	217	168 (77.4)		
• Female	154	113 (73.4)		
Age (Years)			0.865	0.931
• <4	89	66 (74.2)		
• 4-7	201	154 (76.6)		
• 8-11	48	37 (77.1)		
• 12-15	27	19 (70.4)		
• >15	6	5 (83.1)		

### 3.2 Occurrence of species of intestinal helminths among primary school children of Zing and Yorro LGA of Taraba State, Nigeria

Table 2 presents the frequency of intestinal helminths among primary school children in Zing and Yorro LGAs of Taraba State, Nigeria. The species that occurred were *Ascaris lumbricoides* (20.1%), hookworm (13.9%), *Trichuris trichiura* (13.3%), *Taenia solium* (13.0%), *Taenia saginata* (11.6%), *Enterobius vermicularis* (10.7%), *Schistosoma mansoni* (9.1%), and the least common *Hymenolepis* sp (8.3%).

Table 2: Occurrence of intestinal helminths among primary school children of Zing and Yorro LGA of Taraba State, Nigeria

Helminths	No.Examined	Occurrence (%)
<i>Ascaris lumbricoides</i>	159	20.1
Hookworm	110	13.9
<i>Trichuris trichiura</i>	105	13.3
<i>Enterobius vermicularis</i>	85	10.7
<i>Taenia solium</i>	103	13.0
<i>Taenia saginata</i>	92	11.6
<i>Hymenolepis</i> sp	66	8.3
<i>Schistosoma mansoni</i>	72	9.1

### 3.3 Risk factors exposing primary school children in Yorro and Zing Local Government Areas of Taraba State, Nigeria.

Table 3 shows the attitudes and behavioral risk factors exposing primary school children to intestinal helminthiasis in Zing and Yorro LGA of Taraba State, Nigeria. Children who did not wash their hands before eating, 77.0% (141/183), had a slightly higher occurrence than those who did, 74.5% (140/188). Pupils who washed their hands with soap after the toilet, 76.2% (109/143), had a slightly higher occurrence than those who did not, 75.4% (172/228). Children who didn't eat food in school, 79.1% (106/134), had a higher occurrence than those who did, 73.8% (175/237). Pupils who washed their fruits and vegetables before consumption, 76.7% (122/159), had a slightly higher occurrence than those who did not, 75.0% (159/212). However, none of the odds ratios (OR) were statistically significant. Children who drank borehole water 73.7% (151/205), had a slightly lower occurrence than those who drank well water 72.1% (101/140) and stream water 73.2% (109/149). There was no significant association between water source and infection.

Table 3: Attitude and behavioral risk factors exposing primary school children of Zing and Yorro LGAs to intestinal helminths in Taraba State, Nigeria.

Attitudes and behaviors	N	Occurrence (%)	OR	95% CI		P-value
				Lower	Upper	
<b>Risk Factors</b>						
<b>WHBE</b>						
Yes	188	140 (74.5)	1.136	0.614	2.102	0.685
No	183	141 (77.0)				
<b>WHWSAT</b>						
Yes	143	109 (76.2)	0.884	0.495	1.578	0.676
No	228	172 (75.4)				
<b>EFIS</b>						
Yes	237	175 (73.8)	2.016	0.673	6.041	0.211
No	134	106 (79.1)				
<b>CUFV</b>						
Yes	212	159 (75.0)	1.654	0.713	3.837	0.241
No	159	122 (76.7)				
<b>Source of Drinking Water</b>						
<b>DBW</b>						
Yes	205	151 (73.7)	2.383	0.516	11.008	0.266
No	166	130 (78.3)				
<b>DWW</b>						
Yes	140	101 (72.1)	1.735	0.552	5.449	0.346
No	231	180 (77.9)				
<b>DSW</b>						
Yes	149	109 (73.2)	1.048	0.410	2.681	0.921
No	222	172 (77.5)				

Keys: WHBE:Wash hands before eating; WHWSAT: Washing hands with soap after toilet; EFIS:Eat food in school; CUFV:Consumption of unwashed fruits and vegetables; DBW:Drink borehole water; DWW:Drink well water; DSW:Drink stream water.

#### 4. Discussion

The study conducted in Yorro and Zing Local Government Areas (LGAs) of Taraba State revealed an overall prevalence of 75.7% with Yorro LGA exhibiting a slightly higher prevalence (78.8%) than Zing LGA (72.7%). These findings align with several studies conducted among school-aged children in Nigeria. Intestinal helminthiasis remains a significant public health concern, particularly among primary school children in Nigeria. A study conducted in Abua/Odual LGA, Rivers State, by Living-Jamala *et al.* (2018) reported a prevalence of 70.5%, with *Trichuris trichiura* being the most prevalent helminth (52.3%), followed by *Ascaris lumbricoides* (19.8%). In a study conducted in Abayi, Osisioma Ngwa LGA, Abia State, by Ukpai *et al.* (2024), a prevalence of 43.3% among 648 pupils, with *Ascaris lumbricoides* (40.8%) and *Entamoeba coli* (38.9%) being the most common parasites identified. These studies, including the current one in Zing and Yorro LGAs, highlight the persistent burden of intestinal helminth infections among Nigerian school children. However, some studies have reported lower prevalences. A study in Wukari LGA of Taraba State observed a prevalence of 36.5% (Ede *et al.*, 2014). Another study in the Akpo community, Anambra State, by Aribodor *et al.* (2013), reported a prevalence of 46.0%, with *Ascaris lumbricoides* (19%) and *Trichuris trichiura* (13%) being the predominant parasites. These variations in prevalence rates could be attributed to differences in environmental conditions, socioeconomic status, hygiene practices, and access to healthcare services across different regions. The significant difference in infection rates between schools in the current study suggests that localized factors, such as sanitation facilities, availability of clean water, and health education programs, would influence the prevalence of infections.

The study conducted among primary school children in Zing and Yorro Local Government Areas (LGAs) of Taraba State, Nigeria, revealed a diverse prevalence of intestinal helminths. The most common species identified was *Ascaris lumbricoides*, which aligns with findings of Okafor & Azubike (1992) in Nimo, Anambra State, Nigeria. Similarly, research in Abayi, Osisioma Ngwa LGA, Abia State, Nigeria, found a prevalence of 40.8% for *A. lumbricoides* among primary school pupils (Ukpai *et al.*, 2024). These variations may be attributed to differences in environmental sanitation, hygiene practices, and health education across regions. The observed hookworm prevalence of 13.9% is consistent with findings from other studies. A study in Nimo reported a hookworm prevalence of 13.0% (Okafor &

Azubike, 1992). However, the study in Abayi reported a lower prevalence of 17.1% for hookworm infections (Ukpai *et al.*, 2024). These differences could result from variations in soil contamination, footwear usage, and agricultural practices that expose individuals to infective larvae. The prevalence of *Trichuris trichiura* in this study (13.3%) is higher than that reported in Nimo (15.3%) (Okafor & Azubike, 1992) but lower than the 3.3% reported in Abayi (Ukpai *et al.*, 2024). These discrepancies may be due to differences in environmental conditions, sanitation infrastructure, and public health interventions targeting soil-transmitted helminths. The combined prevalence of *Taenia solium* (13.0%) and *Taenia saginata* (11.6%) in this study is notably higher than the 2.2% prevalence of *Taenia* species reported in Wukari LGA, Taraba State (Ede *et al.*, 2014). This significant difference could be attributed to variations in dietary habits, such as the consumption of undercooked pork or beef, and differences in livestock rearing practices between regions. The prevalence of *Enterobius vermicularis* (10.7%) in this study is higher than the 0.1% reported in Nimo (Okafor & Azubike, 1992). This variation might be due to differences in personal hygiene practices, overcrowding, and the implementation of health education programs in schools. The prevalence of *Schistosoma mansoni* (9.1%) in this study is higher than the 0.3% reported in Nimo (Okafor & Azubike, 1992). This difference could be linked to varying levels of exposure to infested water bodies, which is influenced by local water contact activities such as swimming, fishing, or agricultural irrigation practices. The prevalence of *Hymenolepis* species (8.3%) in this study is higher than the 1.0% reported in Wukari LGA, Taraba State (Ede *et al.*, 2014). Factors such as differences in hygiene practices, exposure to intermediate hosts like beetles or fleas, and environmental sanitation may contribute to this variation. The occurrence of multiple infections in this study indicates a high level of exposure to various helminth species. This finding is consistent with reports from other studies, such as the one in Abayi, which documented mixed infections among primary school pupils (Ukpai *et al.*, 2024). Multiple infections can exacerbate health complications, leading to more severe nutritional deficiencies, anemia, and impaired cognitive development in children.

This study revealed a notable prevalence of intestinal helminth infections among school-aged children in Yorro and Zing LGA, Taraba State, Nigeria, highlighting *Ascaris lumbricoides*, *Trichuris trichiura*, and hookworms as the most commonly encountered species. These results emphasize the urgent need for sustained deworming programs, improved sanitation, and health education initiatives to effectively control and prevent intestinal helminth infections in the study area.

## References

- Adabara, N. U., Ige, A. O., Bokhan, O., and Momojimoh, A. (2018). Prevalence of intestinal helminths among primary school children in Nigeria. *International Journal of Biomedical*, 2(2), 88-89.
- Akinbo, F. O., Okaka, C. E., Omoregie, R., & Olowu, A. O. (2021). Intestinal helminthiasis among school-aged children in a rural community of Edo State, Nigeria. *Journal of Parasitology Research*, 2021, Article ID 5587493. <https://doi.org/10.1155/2021/5587493>
- Aleka, Y., Tamir, W., Birhanu, M., & Alemayehu, A. (2019). Prevalence and associated risk factors of intestinal parasitic infections among school children in North Ethiopia. *BMC Research Notes*, 12(1), 1–5. <https://doi.org/10.1186/s13104-019-4127-x>
- Amoke, O. C., & Amadi, A. N. C. (2015). Prevalence of intestinal helminth infections among school-aged children in Elele, South-South Nigeria. *Applied Biological Research*, 17(1), 94–98. <https://doi.org/10.48165/>
- Andu, A. A., Anosike, J. C., & Chima, N. C. (2019). Transmission dynamics of intestinal parasites among children in a semi-urban community in North-Central Nigeria. *Nigerian Journal of Parasitology*, 40(2), 212–218.
- Aribodor, D. N., Okechukwu, P. A., Eneanya, O. A., & Etaga, H. O. (2013). Prevalence and associated risk factors of intestinal helminth infections among 5-14 year olds in Akpo Community, Anambra State, Nigeria. *Nigerian Journal of Parasitology*, 34(2), 245-257
- Asaolu, S. O., Ofoezie, I. E., Odumuyiwa, P. A., Sowemimo, O. A., & Ogunniyi, T. A. (2020). Effect of health education and sanitation on intestinal helminth infections among school children in rural Nigeria. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 114(3), 169–176. <https://doi.org/10.1093/trstmh/trz106>
- Audu, R., Omilabu, S. A., Peenze, I., and Steele, D. (2019). Viral diarrhea in young children in two districts of Africa. *Central African Journal for Medicine*, 48, 59-63. 41
- Awolaju, B. A., and Morenikeji, O. A. (2021). Prevalence and intensity of intestinal parasites in five communities in southwest Nigeria. *African Journal of Biotechnology*, 8(18), 4542-4546.
- Campbell, S. J., Savage, G. B., Gray, D. J., Atkinson, J.-A. M., Soares Magalhães, R. J., Nery, S.V., ... & McManus, D. P. (2018). Water, sanitation, and hygiene (WASH): a critical component for sustainable soil-transmitted helminth and schistosomiasis control. *PLoS Neglected Tropical Diseases*, 8(4), e2651. <https://doi.org/10.1371/journal.pntd.0002651>

- Ede, P. R. A., Ikeh, E. I., & Dashe, N. (2014). Prevalence of intestinal parasites among primary school children. *Highland Medical Research Journal*, 14(1).
- Ejezie, G. C., Onyezili, N. N., Okeki, G. C., and Enwonwn, C. O. (2021). Study of environmental health in a rural Nigerian community. *Community Epidemiology Microbiology and Immunology*, 31, 163-172.
- Ezeamama, A. E., Bustinduy, A. L., Nkwata, A. K., Martinez, L., Pabalan, N., Boivin, M. J., & King, C. H. (2020). Cognitive deficits and educational loss in children with helminth infection: A systematic review and meta-analysis. *PLOS Neglected Tropical Diseases*, 14(1), e0007970. <https://doi.org/10.1371/journal.pntd.0007970>
- Househam, K. C., Mann, M. D., and Bowie, M. D. (2018). Enteropathogens associated with acute infantile diarrhea in Cape Town. *South African Medical Journal*, 73, 83-87.
- Humphries, D., Mosites, E., Otchere, J., Twum, W. A., Jones-Sanpei, H., Harrison, L. M., & Capuano, C. (2019). Epidemiology of hookworm infection in Ghana: A community-based survey. *American Journal of Tropical Medicine and Hygiene*, 100(1), 130–137. <https://doi.org/10.4269/ajtmh.18-0517>
- Ikon, G. M., and Useh, M. F. (2018). Epidemiology of gastrointestinal helminths among pupils in urban and suburban communities in Nigeria. *Journal Medical Laboratory Sciences*, 8, 1-6.
- Ilechukwu, G. C., Ilechukwu, C. G., Ozumba, A. N., Ojinnaka, N. C., Ibe, B. C., & Onwasigwe, C. N. (2010). Some behavioural risk factors for intestinal helminthiasis in nursery and primary school children in Enugu, south-eastern Nigeria. *Nigerian Journal of Clinical Practice*, 13(3), 288-293.
- Jamaiah, I., and Rohela, M. (2020). Prevalence of intestinal parasites among members of the public in Kuala Lumpur, Malaysia. *Journal of Tropical Medicine and Public Health*, 36, 68–71.
- Jourdan, P. M., Lambertson, P. H. L., Fenwick, A., & Addiss, D. G. (2018). Soil-transmitted helminth infections. *The Lancet*, 391(10117), 252–265. [https://doi.org/10.1016/S0140-6736\(17\)31930-X](https://doi.org/10.1016/S0140-6736(17)31930-X)
- Lai, K. P. (2021). Intestinal protozoan infections in Malaysia. *Southeast Asian Journal of Tropical Medicine Public Health*, 23, 578–586.
- Living-Jamala, U., Eze, N. C., & Nduka, F. O. (2018). Prevalence and intensity of intestinal helminth infections and associated risk factors among school-aged children in Abua/Odual Local Government Area, Rivers State. *Journal of Applied Life Sciences International*, 16(2), 1-7.
- Luka, S. A., Ajogi, I., and Umoh, J. U. (2020). Helminthosis among primary school children in Lere Local Government Area, Kaduna State, Nigeria. *The Nigerian Journal of Parasitology*, 21, 109-116.
- Markell, E. D., John, D. T., and Krotoski, W. A. (2018). *Medical Parasitology*. Philadelphia, PA: W. B. Saunders.
- Mwanga, J. R., Lwambo, N. J., Rumisha, S. F., Vounatsou, P., & Utzinger, J. (2021). Intestinal parasitic infections among school children in rural western Kenya: prevalence, risk factors, and spatial distribution. *Acta Tropica*, 215, 105787. <https://doi.org/10.1016/j.actatropica.2020.105787>
- Mwinzi, P. N., Montgomery, S. P., Owaga, C. O., Mwanje, M. T., Muok, E. M., Ayisi, J. G., ... & Secor, W. E. (2020). Integrated community-directed intervention for schistosomiasis and soil-transmitted helminths in western Kenya. *BMC Public Health*, 20, 112. <https://doi.org/10.1186/s12889-020-8217-3>
- Nematian, J., Nematian, E., Gholamrezanezhad, A., and Ali Asgari, A. (2020). Prevalence of intestinal parasitic infections and their relation with socioeconomic factors and hygienic habits in Tehran primary school students. *Acta Tropica*, 92, 179–186.
- Obiukwu, M. O., Umeanaeto, P. U., Eneanya, C. I., & Nwaorgu, G. O. (2008). Prevalence of gastrointestinal helminths in school children in Mbaukwu, Anambra State, Nigeria. *Nigerian Journal of Parasitology*, 29(1), 15-19.
- Odu, N. N., Akujobi, C. O., Maxwell, S. N., and Nte, A. R. (2022). Impact of mass deworming of school children in rural communities in Rivers State, Nigeria: Option for program sustainability. *Acta Parasitologia*, 2(2), 20-24.
- Odu, N. N., Elechi, V. I., and Okonko, I. O. (2018). Prevalence of intestinal helminth infection among primary school children in urban and semi-urban areas in Port Harcourt, Rivers State, Nigeria. *World Rural Observations*, 5(1), 52-61.
- Odu, N. N., Okonko, I. O., and Erhi, O. (2022). Study of neglected tropical diseases (NTDs): Gastrointestinal helminths among school children in Port Harcourt, Rivers State, Nigeria. *Report and Opinion*, 3(9), 6-16.
- Oguche, S., Okafor, H. U., Watila, I. M., & Meremikwu, M. M. (2016). Predictors of intestinal helminthic infections among school children in Gwagwalada, Abuja, Nigeria. *Nigerian Journal of Paediatrics*, 43(4), 238-243.
- Ojurongbe, O., Ojo, J. A., Adefioye, O. A., Adeyeba, O. A., & Olowe, O. A. (2019). Soil-transmitted helminth infections among primary school children in Osogbo, Nigeria. *Journal of Infectious Diseases and Immunity*, 11(2), 10–17.
- Oluwole, A. S., Ekpo, U. F., Karshima, S. N., & Sam-Wobo, S. O. (2023). Soil-transmitted helminthiasis among school-aged children in selected primary schools in southwest Nigeria: a cross-sectional study. *Christian Journal for Global Health*, 11(1), 83-92.

- Omudu, E. A., Amuta, E. U., and Feese, J. I. (2021). The prevalence of intestinal helminths in children with different socio-economic backgrounds in Makurdi, Nigeria. *28th Annual Conference Abstract (63) Nigeria Society for Parasitology*, 20, 71.
- Oyewole, F. O., Ariyo, F., & Odaibo, A. B. (2016). Prevalence and risk factors associated with intestinal parasitic infections among school children in a peri-urban community in southwest Nigeria. *BMC Public Health*, 16, 142. <https://doi.org/10.1186/s12889-016-2841-5>
- Oyibo-Usman, K., Abdulazeez, M. T., Mohammed, M., & Lawal, A. S. (2023). Prevalence of helminth infections among primary school children in Gusau Local Government Area, Zamfara State. *FUDMA Journal of Sciences*, 6(5), 180-189.
- Presterl, E., Zarfel, G., Schuster, G., Graninger, W., & Hirschl, A. M. (2019). Intestinal helminths in children from Gabon. *Journal of Infection in Developing Countries*, 13(5), 431–435. <https://doi.org/10.3855/jidc.11432>
- Pukuma, S. M., & Sale, M. (2007). Prevalence of gastrointestinal helminth infections among children of Vunoklang Primary School in Moderei Ward of Girei Local Government Area of Adamawa State, Nigeria. *Nigerian Journal of Parasitology*, 27(1), 73-75.
- Pullan, R. L., Smith, J. L., Jasrasaria, R., & Brooker, S. J. (2014). Global numbers of infection and disease burden of soil-transmitted helminth infections in 2010. *Parasites & Vectors*, 7, 37. <https://doi.org/10.1186/1756-3305-7-37>
- Strunz, E. C., Addiss, D. G., Stocks, M. E., Ogden, S., Utzinger, J., & Freeman, M. C. (2014). Water, sanitation, hygiene, and soil-transmitted helminth infection: a systematic review and meta-analysis. *PLoS Medicine*, 11(3), e1001620. <https://doi.org/10.1371/journal.pmed.1001620>
- Ukam, U. A., Enogiomwan, I. E., Offiong, E. E., & Chinyere, O.-A. (2020). Prevalence of human intestinal helminthic infections among school-age children in Calabar, Cross River State, Nigeria. *International Journal of Tropical Disease & Health*, 41(9), 55-63.
- Ukpai, O. M., Nwogwugwu, A. O., & Amaechi, E. C. (2024). Prevalence of gastrointestinal parasites among primary school pupils in Abayi, Osisioma Ngwa L.G.A, Abia State, Nigeria. *Zimbabwe Journal of Science and Technology*, 17(1), 18–27.
- Wama, E.B., Houmsou, R.S., Garba, L.C., Amuta, E.U., Kela, S.L. (2022). Use of rivers' water, inadequate hygiene, and sanitation as exposure of internally displaced persons (IDPs) to urogenital schistosomiasis and soil-transmitted helminthiasis in Jalingo Local Government Area (LGA), Taraba State, Nigeria. *Journal of Water, Sanitation and Hygiene for Development*, 12 (11), 792. DOI:10.2166/washdev . 2022.089.
- World Health Organization. (2020). Soil-transmitted helminth infections. Retrieved from <https://www.who.int/news-room/fact-sheets/detail/soil-transmitted-helminth-infections>
- World Health Organization. (2021). *Control of Tropical Diseases. Kashmir, India*. Geneva, Switzerland: World Health Organization. <https://www.who.int/news-room/fact-sheets/detail/soil-transmitted-helminth-infections>.
- Ziegelbauer, K., Speich, B., Mäusezahl, D., Bos, R., Keiser, J., & Utzinger, J. (2012). Effect of sanitation on soil-transmitted helminth infection: systematic review and meta-analysis. *PLoS Medicine*, 9(1), e1001162. <https://doi.org/10.1371/journal.pmed.1001162>