



Article Info

Received: 19-03-2026

Revised: 15-05-2026

Accepted: 14-07-2026

Department of Zoology,
Faculty of Life Sciences,
Modibbo Adama University,
P.M.B. 2076, Yola,
Adamawa State, Nigeria.

*Corresponding author's email:

Graceadache1@gmail.com

Cite this: CaJoST, 2026, vol,8 issue 2

PREVALENCE AND INTENSITY OF SOIL-TRANSMITTED HELMINTH INFECTIONS AMONG SCHOOL CHILDREN IN THE SOUTHERN ZONE OF ADAMAWA STATE, NIGERIA

E. G. Adache*, G. Chessed, M. A. Qadeer

Abstract

Soil-transmitted helminthiasis (STH) is a parasitic disease widely prevalent in tropical and subtropical regions with poor sanitation, unsafe water supply, and overcrowding. It has significant health and social impacts, particularly among schoolchildren. This study aimed to determine the prevalence and intensity of STH infections in relation to socio-demographic characteristics of schoolchildren in selected Local Government Areas (LGAs) in Southern Adamawa State, Nigeria. A cross-sectional study was conducted in nine public primary and secondary schools involving 322 pupils and students. Faecal samples were examined for ova of *Ascaris lumbricoides*, *Trichuris trichiura*, and *Ancylostoma duodenale*/*Necator americanus* using direct wet mount, iodine mount, and 10% formol-ether concentration techniques. The overall prevalence of STH infection was 22.0%, with semi-quantitative assessments of light, moderate, and heavy infection intensities of 12.7%, 5.9%, and 3.4%, respectively. Infection prevalence varied by gender, age, school, class level, and Local Government Area, with a statistically significant association observed between STH infection and school attended ($p < 0.05$), but not with gender, age group, class level, or LGA ($p > 0.05$). Government Secondary School, Shelleng, recorded the highest school-specific prevalence (50.0%; 10/20), while Ganye I Primary School recorded the lowest prevalence (16.7%; 12/72). These findings indicate that STH infection among schoolchildren in the study area remains of moderate prevalence. Strengthening school-based deworming programs, health education, improved sanitation, and promotion of good hygiene practices is recommended.

Keywords: Soil-transmitted helminths; prevalence; intensity; schoolchildren; Adamawa State

Introduction

Soil transmitted helminthiasis (STHs) is caused by nematodes that inhabit the gastrointestinal tract of humans. They are among the 20 major neglected tropical diseases and are estimated to affect more than 2 billion people worldwide [1]. The highest burden of infection occurs in sub-Saharan Africa, the Americas, China and East Asia [1]. The major soil-transmitted helminths of public health importance include *Ascaris lumbricoides* (*A. lumbricoides*), *Trichiuris trichiura* (*T. trichiuria*), *Anclostoma duodenale*. (*A. duodenale*) or *Nacator americanus* (*N. americanus*) Infections are acquired either through ingestion of infective eggs or by skin penetration following contact with soil contaminated by faeces or contaminated soil. It occurs primarily in areas where the sanitation is generally poor and water supplies are unsafe [2]. Light infections of Soil-Transmitted Helminths are usually asymptomatic (no symptoms). However, heavier infection can lead to varying degrees of illness [3]. *A. duodenale* feed on host blood, which can lead to iron loss and result in anemia [4]

Estimates by the World Health Organization (WHO) indicate that about 3.5 billion are affected by intestinal parasites [2,3], 450 million are ill as a result of these infections, with schoolchildren being the most vulnerable group. STHs have been observed to cause infection in 2 billion people worldwide. [1] Transmission of intestinal nematodes due to faecal contamination of the soil in school environment by eggs of STHs can be attributed to inadequate sanitation [4], poor personal hygiene and low socio-economic conditions among pupils and students [3]. Helminthiasis can lead to diarrhea and other infections that affect humans of all ages, with a strong correlation to morbidity and mortality in children [3]. Helminthiasis and its consequences could be prevented in high-prevalence communities, through improved sanitation, health education

(WASH), and mass deworming of schoolchildren [3]. Thus, the aim of this study was to determine the prevalence and Intensity of soil-transmitted helminth infections among pupils and students in the Southern zone of Adamawa state, Nigeria.

Materials and Methods

Study Design and Area: A cross-sectional study was conducted in nine selected schools across three Local Government Areas (LGAs) of Southern Adamawa State, Nigeria, with coordinates 9°28'0.59" N and 12°01'34.80" E, covering a landmass of 399.15 km² and an average population of 550,000 [6].

Selection of Study Population: The study population comprised registered pupils and students in selected public primary and secondary schools in Ganye, Numan, and Shelleng LGAs. Three LGAs were selected out of the nine LGAs in the Southern Adamawa zone, representing 33.3% of the LGAs. The LGAs were purposively selected to reflect geographical spread within the zone: Ganye from the northern part, Numan from the central part, and Shelleng from the southern part. Within each selected LGA, three public schools were selected, giving a total of nine schools. Participants were then selected from the school registers using proportionate and systematic sampling to ensure fair representation based on school enrolment size. Only registered pupils and students whose parents or guardians gave consent were included in the study, while unregistered pupils/students and those whose parents or guardians declined consent were excluded. The total population of registered pupils/students in the selected schools was 1,650 [18].

Sample size: The sample size for the study was determined using Slovin's formula [7], which is appropriate for finite populations:

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

where:

n = required sample size

N = total population size (1,650 registered pupils/students)

e = margin of error (0.05) at 95% confidence level

Substituting the values into the formula:

$$n = \frac{1650}{1 + 1650(0.05)^2}$$

$$n = \frac{1650}{1 + 1650(0.0025)} = \frac{1650}{5.125} \approx 322$$

Therefore, a total sample size of 322 pupils/students was obtained and used for the study.

Sampling Technique: Proportionate sampling was used to allocate the number of pupils per school, and participants were selected systematically using the official school register. Proportionate sampling was adopted to ensure fair representation of pupils across schools based on enrolment size, while systematic sampling minimized selection bias.

Ethical Issues: Ethical clearance was obtained from the Adamawa State Ministry of Health (No. ADHREC 2/08/2024/035). Informed consent was obtained from school authorities, parents, and legal guardians. Pupils were informed of their right to withdraw at any time without consequence.

Data Collection

Socio-demographic Data: Interviews were used to fill a structured questionnaire for Socio-demographic characteristics and anthelmintic treatment, and faecal samples were collected and examined macroscopically and microscopically for both adult worms, and eggs of STHs using saline preparations (direct wet mount), iodine preparation, (iodine mount) and 10% formol- ether concentration technique for the identification of eggs of common STHs

such as *A. lumbricoides*, *T. trichura*, *A. duodenale* and any other intestinal parasites.

Faecal Sample Collection: Faecal samples were collected from participants between 8:30 a.m. and 11:00 a.m. 10% formalin was added for preservation of eggs prior to examination [7,8]

Laboratory examination

Two laboratory methods were used in this study, namely the direct wet mount technique (saline and iodine) and the 10% formalin–ether concentration technique. Each stool specimen was first examined macroscopically, and its consistency was recorded as formed (F), semi-formed (SF), semi-formed with blood (SB), bloody-mucoid (BM), loose (L), or watery (W). Samples were analyzed in batches as soon as they were received in the laboratory.

Direct Wet Mount Technique: A drop of physiological saline was placed in the middle of the left half of a clean, grease-free microscope slide, while a drop of iodine solution was placed in the middle of the right half of the slide. Using an applicator stick, an appropriate portion of the faecal sample was taken from different parts of the stool and mixed separately with the saline and iodine drops. Each preparation was immediately covered with a cover slip and examined under the microscope. Examination was carried out using the low-power objective lens ($\times 10$) and the high-power objective lens ($\times 40$) to identify ova of soil-transmitted helminths (*A. lumbricoides*, *T. trichiura*, and *Ancylostoma duodenale*/*N. americanus*), as well as other intestinal parasites.

Formalin–Ether Concentration Technique: Approximately 1 g (pea-sized) of stool sample was emulsified in 4 ml of 10% formalin contained in a screw-cap bottle or tube and mixed thoroughly. An additional 4 ml of 10% formalin was then added and mixed again by vigorous shaking. The suspension was strained through two layers of gauze to remove faecal debris and transferred into a 15 ml conical centrifuge tube. Thereafter, 4 ml of

ether was added, the tube was stoppered, and the contents were mixed for 1 minute. With a tissue wrapped around the top of the tube, the stopper was loosened to release pressure, and the tube was centrifuged for 1 minute at 3,000 rpm. After centrifugation, an applicator stick was used to loosen the faecal debris from the sides of the tube. The tube was then inverted to discard the ether, faecal debris, and formalin, after which it was returned to an upright position to allow residual fluid to drain to the bottom. The tube was gently tapped to resuspend the sediment. The sediment was mixed and transferred onto a clean, grease-free microscope slide, covered with a cover slip, and examined under the microscope using the low-power objective lens ($\times 10$) for scanning and the high-power objective lens ($\times 40$) to confirm the presence of ova of *Ascaris lumbricoides*, *Trichuris trichiura*, and *Ancylostoma duodenale*/*Necator americanus*.

Assessment of Infection Intensity: Infection intensity was assessed using a semi-quantitative ova counting approach based on the number of ova observed per microscopic preparation following direct wet mount and formalin–ether concentration techniques. Due to limited field laboratory facilities and the absence of Kato–Katz equipment for standardized egg-per-gram (EPG) quantification, infection intensity was operationally categorized according to the relative number of ova observed microscopically. The categories used were:

- 1–3 ova per preparation = Low intensity (+)
- 4–10 ova per preparation = Moderate intensity (++)
- 10 ova per preparation = Heavy intensity (+++)

This classification was used only as a semi-quantitative estimate of infection burden and should not be interpreted as equivalent to the WHO-recommended egg-per-gram (EPG)

intensity classification obtained using the Kato–Katz technique [8]

Data Analysis

The data was analyzed using IBM SPSS version 26.0 software of IBM Corporation Business Analytics Software portfolio (2010) which is in Chicago, USA. Statistical significance level of 0.05 was used, and result presented in Chi-square test and percentages.

RESULTS

Among the 322 pupils/students examined, the overall prevalence of soil-transmitted helminth (STH) infection was 22.0% (71/322). In relation to gender, infection prevalence was slightly higher among male pupils, with 38 out of 162 pupils infected, giving a prevalence of 23.5%, compared to 33 out of 160 females infected, with a prevalence of 20.6%. However, there was no statistically significant association between STH infection and gender ($p > 0.05$) (Table 1).

With respect to age group, the highest prevalence of STH infection was observed among pupils aged 13–16 years, where 33 out of 134 pupils were infected, representing a prevalence of 24.6%. This was followed by pupils aged 10–12 years with a prevalence of 22.1% (19/86), children aged 3–6 years with 21.4% (6/28), and the lowest prevalence among pupils aged 7–9 years with 17.6% (13/74). There was no statistically significant association between age group and STH infection ($p > 0.05$) (Table 2). Analysis by school revealed that Government Secondary School, Shelleng, recorded the highest prevalence of infection, with 10 out of 20 pupils infected, representing 50.0%. This was followed by Government Day Secondary School, Shelleng, with a prevalence of 27.3% (6/22), Gweda-Mallam Primary School, Numan, with 25.0% (8/32), and Government Day Junior Secondary School, Ganye, with 22.2% (12/54). Government Girls Day Senior Secondary School, Ganye, also recorded a prevalence of 22.2% (2/9). Ganye I Primary

School recorded a prevalence of 16.7% (12/72), while Central Primary School, Shelleng, recorded 18.3% (13/71). Government Science Technical School, Numan, and Command Science Secondary School, Numan, recorded prevalence values of 18.2% (4/22) and 20.0% (4/20), respectively. A statistically significant association was observed between STH infection and school attended ($p < 0.05$) (Table 3).

In relation to class level, the highest prevalence was observed among SS III students, with 9 out of 33 infected, representing 27.3%. This was followed by JSS I and SS II, each with a

prevalence of 22.9% (8/35 and 8/28, respectively), and Primary 3 with 20.0% (4/20). Primary 1 pupils recorded the lowest prevalence of 18.2% (2/11). However, there was no statistically significant association between class level and STH infection ($p > 0.05$) (Table 4). Regarding Local Government Area (LGA), Shelleng LGA recorded the highest prevalence, with 29 out of 113 pupils infected, representing 25.7%. This was followed by Numan LGA with 21.1% (16/76), while Ganye LGA recorded the lowest prevalence of 19.5% (26/133). There was no statistically significant association between STH infection and LGA ($p > 0.05$) (Table 5).

Table 1. Prevalence and intensity of helminthiasis in relation to gender

Gender	Number Examined	Number Positive	Prevalence (%)	Light (%)	Moderate (%)	Heavy (%)
Male	162	38	23.5	21 (13.0)	11 (6.8)	6 (3.7)
Female	160	33	20.6	20 (12.5)	8 (5.0)	5 (3.1)
Total	322	71	22.0	41 (12.7)	19 (5.9)	11 (3.4)

$\chi^2 = 0.52$; $p = 0.47$; $df = 1$.

Table 2. Prevalence and intensity of helminthiasis in relation to age group

Age Group (Years)	Number Examined	Number Positive	Prevalence (%)	Light (%)	Moderate (%)	Heavy (%)
3–6	28	6	21.4	4 (14.3)	2 (7.1)	0 (0.0)
7–9	74	13	17.6	8 (10.8)	4 (5.4)	1 (1.4)
10–12	86	19	22.1	11 (12.8)	5 (5.8)	3 (3.5)
13–16	134	33	24.6	18 (13.4)	8 (6.0)	7 (5.2)
Total	322	71	22.0	41 (12.7)	19 (5.9)	11 (3.4)

$\chi^2 = 6.91$; $p = 0.075$; $df = 3$.

Table 3. Prevalence and intensity of helminthiasis in relation to school

School	Number Examined	Number Positive	Prevalence (%)	Light (%)	Moderate (%)	Heavy (%)
GPSG	72	12	16.7	7 (9.7)	3 (4.2)	2 (2.8)
GDJSSG	54	12	22.2	7 (13.0)	4 (7.4)	1 (1.9)
GGDSSG	9	2	22.2	1 (11.1)	1 (11.1)	0 (0.0)
GSTN	22	4	18.2	3 (13.6)	1 (4.5)	0 (0.0)
GMPSN	32	8	25.0	5 (15.6)	2 (6.3)	1 (3.1)
CSSSN	20	4	20.0	2 (10.0)	1 (5.0)	1 (5.0)
CPSS	71	13	18.3	8 (11.3)	3 (4.2)	2 (2.8)
GDSSS	22	6	27.3	3 (13.6)	2 (9.1)	1 (4.5)
GSSS	20	10	50.0	5 (25.0)	2 (10.0)	3 (15.0)
Total	322	71	22.0	41 (12.7)	19 (5.9)	11 (3.4)

$\chi^2 = 18.42$; $p = 0.030$; $df = 20$.

Abbreviations: GPSG = Ganye I Primary School; GDJSSG = Government Day Junior Secondary School Ganye; GGDSSG = Government Girls Day Senior Secondary School Ganye; GSTN = Government Science Technical School Numan; GMPSN = Gweda-Mallam Primary School Numan; CSSSN = Command Science Secondary School Numan; CPSS = Central Primary School Shelleng; GDSSS = Government Day Secondary School Shelleng; GSSS = Government Secondary School Shelleng.

Table 4. Prevalence and intensity of helminthiasis in relation to class of school children

Class	Number Examined	Number Positive	Prevalence (%)	Light (%)	Moderate (%)	Heavy (%)
Primary 1	11	2	18.2	1 (9.1)	1 (9.1)	0 (0.0)
Primary 2	15	3	20.0	2 (13.3)	1 (6.7)	0 (0.0)
Primary 3	20	4	20.0	2 (10.0)	1 (5.0)	1 (5.0)
Primary 4	26	5	19.2	3 (11.5)	1 (3.8)	1 (3.8)
Primary 5	30	6	20.0	4 (13.3)	1 (3.3)	1 (3.3)

Primary 6	40	7	17.5	5 (12.5)	2 (5.0)	0 (0.0)
JSS I	35	8	22.9	5 (14.3)	2 (5.7)	1 (2.9)
JSS II	28	6	21.4	3 (10.7)	2 (7.1)	1 (3.6)
JSS III	25	6	24.0	4 (16.0)	1 (4.0)	1 (4.0)
SS I	31	7	22.6	4 (12.9)	2 (6.5)	1 (3.2)
SS II	28	8	28.6	5 (17.9)	2 (7.1)	1 (3.6)
SS III	33	9	27.3	3 (9.1)	3 (9.1)	3 (9.1)
Total	322	71	22.0	41 (12.7)	19 (5.9)	11 (3.4)

$\chi^2 = 12.83$; $p = 0.117$; $df = 11$.

Table 5. Prevalence and intensity of helminthiasis in relation to Local Government Area

LGA	Number Examined	Number Positive	Prevalence (%)	Light (%)	Moderate (%)	Heavy (%)
Ganye	133	26	19.5	15 (11.3)	8 (6.0)	3 (2.3)
Numan	76	16	21.1	9 (11.8)	5 (6.6)	2 (2.6)
Shelleng	113	29	25.7	17 (15.0)	6 (5.3)	6 (5.3)
Total	322	71	22.0	41 (12.7)	19 (5.9)	11 (3.4)

$\chi^2 = 4.77$; $p = 0.091$; $df = 2$.

Discussion

Helminthiasis is a disease of the gastrointestinal tract that causes adverse health outcomes such as diarrhea, anemia, malnutrition, and impaired cognitive development, with schoolchildren being the most vulnerable group [1]. Children frequently engage in outdoor activities that increase contact with contaminated soil, which is a major determinant of soil-transmitted helminth (STH) infection [9]. In the present study, the overall prevalence of STH infection among pupils and students was 22.0%, indicating a moderate level of transmission. This

prevalence may reflect improvements in sanitation, personal hygiene, and the impact of school-based mass deworming programs. Importantly, the observed prevalence falls within the WHO-defined moderate transmission category (20–49%) [2], suggesting that strengthened interventions are still required to reduce infection below the 20% threshold. Infection intensity in this study was assessed using semi-quantitative method. Ova counts per microscopic preparation rather than WHO egg-per-gram thresholds, due to the use of concentration techniques instead of the Kato–Katz method.

The prevalence recorded in this study is lower than that reported in several previous studies conducted in Nigeria, including 42.6% in Dadin Kowa, Jos Plateau State [12], 72.5% in Calabar [12], 35.2% in Anaocha LGA, Anambra State [13], and 34.64% in Ogun State [14]. These differences may be attributed to variations in environmental conditions, sanitation infrastructure, study population characteristics, and the intensity of deworming interventions across study areas.

Although a higher prevalence of STH infection was observed among male pupils compared to females, this difference was not statistically significant ($p > 0.05$). Therefore, gender cannot be considered a determinant of infection in this study. The slightly higher prevalence among males may nonetheless be related to behavioural factors such as increased outdoor activities, including playing on bare ground and eating unwashed fruits, as reported in other studies [11].

Similarly, pupils aged 13–16 years recorded the highest prevalence compared with younger age groups (3 - 6 years). However, no statistically significant association was found between age group and STH infection ($p > 0.05$). This finding suggests that although older pupils may have greater exposure due to increased mobility and environmental interaction, age alone did not significantly influence infection risk in the study population. This contrasts with findings from other studies that reported higher prevalence among younger children [15].

A statistically significant association was observed between STH infection and the school attended ($p < 0.05$). Central Primary School, Shelleng, recorded the highest prevalence, while Government Girls Day Secondary School, Ganye, recorded the lowest. This variation may be attributed to differences in school location, sanitation facilities, hygiene practices, and environmental contamination around school premises. This finding is consistent with reports from other

Nigerian studies where school environment significantly influenced STH transmission [16].

In relation to class level, although higher prevalence was observed among senior classes (particularly SS III) and lower prevalence among junior classes (Primary 1), the association between class level and STH infection was not statistically significant ($p > 0.05$). Thus, class level did not independently influence infection status in this study, contrary to some previous reports that observed higher prevalence among preschool or junior classes [15].

Regarding Local Government Areas (LGAs), Shelleng recorded the highest prevalence, while Numan had the lowest. However, no statistically significant association was found between STH infection and LGA ($p > 0.05$). This suggests that STH transmission was relatively comparable across the three LGAs studied. Although these findings differ from reports of higher prevalence in other LGAs within the same zone [17,18], such differences may be due to variations in study populations, environmental sanitation, and level of intervention coverage.

Conclusion

This study investigated the prevalence and intensity of soil-transmitted helminths (STHs) among 322 pupils and students in Southern Adamawa State, Nigeria. The overall prevalence of infection was 71 (22.0%), with light, moderate, and heavy intensities of 41 (12.7%), 19 (5.9%), and 11 (3.4%), respectively. Statistical analysis revealed significant associations between STH infection and the school attended ($p < 0.05$), while no significant associations were observed with gender, class level and Local Government Area ($p > 0.05$). Central Primary School, Shelleng, recorded the highest prevalence of 13 (4.0%), and Government Girls Day Secondary School, Ganye, the lowest at 2 (0.6%). Older pupils (13–16 years) and senior classes (SS III) exhibited higher prevalence

rates of 33 (10.2%) and 9 (2.8%), respectively, compared to younger pupils. The study demonstrates that STH infection in this region is of moderate prevalence, indicating that while ongoing interventions such as school-based deworming programs have had a positive impact; further efforts are needed to reduce prevalence below the WHO threshold of 20%.

Recommendations

1. Strengthen school-based deworming programmes to ensure consistent and equitable treatment coverage across all schools, particularly those with higher infection burden.
2. Promote health education and hygiene practices, including handwashing, safe disposal of faeces, and proper food handling, especially among older pupils who may have increased exposure.
3. Improve sanitation facilities in schools by ensuring access to clean water and functional toilets to reduce environmental contamination.
4. Establish regular monitoring and evaluation of STH prevalence and intensity to track progress and guide intervention strategies
5. Implement targeted interventions for identified high-risk groups to reduce infection rates and improve overall health outcomes

Declarations

Author contributions: AEG, CG and QMA Conceptualized the study, STB, AAY and AQB participated in the field work and data collection; AEG, CG and VP and SA performed the data analysis; AEG and CG prepared the first draft of the manuscript, VP, NAF and KIZ. All authors contributed to the development of the final Manuscript and approved its submission.

Conflict of interest: The authors declare no conflict of interest.

Funding: This research received no external funding

Contribution to knowledge: This study provides baseline data on the prevalence and

intensity of STH infections among schoolchildren in Shelleng, Ganye, and Numan LGAs of Southern Adamawa State, which may support targeted public health interventions

Acknowledgement

The authors are grateful to the Adamawa State Ministry of Health, the principals and head teachers of the selected schools, and all participating pupils and students for their cooperation. Appreciation is also extended to Dr. Abdulhakeem Adebayo Yusuf and the staff of the Department of Medical Laboratory Science, Venite University, Iloro-Ekiti, as well as the medical laboratory scientists, nurses, and research assistants who contributed to the success of this study.

References

- [1]. World Health Organization (2023). Schistosomiasis and soil-transmitted helminths: Progress report, global update on implementation of preventive chemotherapy against neglected tropical diseases. World Health Organization. <https://www.who.int/news-room> (accessed 10 December 2025).
- [2]. World Health Organization. (2022). Soil-transmitted helminth infections. <https://www.who.int/news-room/fact-sheets/detail/soil-transmitted-helminth-infection>
- [3]. World Health Organization (2012). Soil-transmitted helminthiases: Eliminating soil-transmitted helminthiases as a public health problem in children; progress report 2001–2010 and strategic plan 2011–2020. Geneva, Switzerland: World Health Organization. ISBN: 9789241503129.
- [4]. Odunayo, E. O., & Simon Okem, A. S. (2022). Ecological risk factors of soil transmitted helminths infections in Ifedore district, Southwest Nigeria. Bulletin of the National Research Centre, 20, 46–73.
- [6]. National Population Commission (2006). Population and Housing Census: Population distribution by States, LGAs and Senatorial Districts. Volume III, Priority Table. Abuja, Nigeria: National Population Commission. <http://catalog.ihnsn.org/index.php/catalog/3>

- 340/download/48521 (accessed 10 December 2021)
- [7]. Tejada, J. J., & Punzalan, J. R. B. (2012). On the misuse of Slovin's formula. *The Philippine Statistician*, 61(1), 129–136.
 - [8]. Cheesbrough, M. (2017). District laboratory practice in tropical countries. Cambridge University Press
 - [9]. Mohammed, F.I., Idris, U.D., Umoh, J.U. and Ajanusi, O.J. (2011). Prevalence of helminth eggs in the soil of Abuja recreational parks and gardens, Abuja, Nigeria. *International Research Journal of Applied Basic Sciences*, 2(10): 398–403.
 - [11]. Abednego, D., Onyimowo, E.F., Joy, E.F. and Francis, I.W. (2021). Soil-transmitted helminths and associated risk factors among elementary school pupils in Dadin Kowa, Jos. *Nigerian Medical Journal*, 60(4): 181–187.
 - [12]. Edema, E. I., Emmanuel, O. E., & Anok, U. U. (2023). Environmental contamination by soil-transmitted helminth ova. *Scientific African*, 19, e0158.
 - [13]. Ogechukwu, B.A., Jacob, E.C., Nwadiuto, O.A., Uche, C.N., Ifeanyi, O., Emmanuel, M.O. and Obiageli, J.N. (2023). Status of soil-transmitted helminthiasis among adolescents in Anaocha LGA, Anambra State, Nigeria: Prevalence, associated factors, and future directions after a decade of ongoing mass administration of medicines. *Medical Research*, 11(3): 25–67. doi:10.1101/2023.09.15.23295620
 - [14]. Oluwole, A.S., Adeniran, A.A., Mogaji, H.O., Olabinke, D.B., Abe, E.M., Bankole, O.S. Sam-Woo, O.S. and Eko, U.F. (2018). Prevalence, intensity, and spatial co-distribution of schistosomiasis and soil-transmitted helminths infections in Ogun State, Nigeria. *Parasitology Open*, 4: e8, 1–9.
 - [15]. Naphtali, R.S., Birdling, Y.M. and Philimon, B. (2017). Studies on intestinal helminth infection in Rumde Nursery and Primary School pupils, Jimeta, Adamawa State, Nigeria. *Journal of Nursing and Health Sciences*, 6: 45–47.
 - [16]. ukuma, M.S., Thadawus, D. and Augustine, L.M. (2022). Soil-transmitted helminths among school-age children in Hong LGA. *Animal Research International*, 19(1): 4318–4323.
 - [17]. Shitta, K.B. and Akogun, O.B. (2017). Intestinal helminth infections among the nomadic Fulanis in two localities of Adamawa State, northeast Nigeria. *Nigerian Journal of Parasitology*, 38(1): 69–75. doi:10.4314/njpar.v38i1.13
 - [18]. Oriakpono, J.E., Sani, A.F. and Wama, B.E. (2015). Intestinal helminthic infection in Numan, Northeast Nigeria. *International Journal of Physical Sciences and Applied Technology*, ISSN: 2509–0119.
 - [19]. Adamawa State Ministry of Education. (2025). *School enrolment records for selected public primary and secondary schools in Ganye, Numan, and Shelleng Local Government Areas, Adamawa State, Nigeria* (Unpublished official records). Yola, Nigeria.