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ORIGINAL ARTICLE

# Prevalence and Intensity of Soil-transmitted Helminths Among Adults Attending Nsukka Health Centre in Nsukka LGA, Enugu State, Nigeria

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**ABSTRACT**

Soil-transmitted helminths (STHs) remain a major public health concern in sub-Saharan Africa, yet evidence on their prevalence and species distribution among adults attending healthcare at Nsukka Health Center remains limited. This study was conducted to determine the prevalence and intensity of STHs among adults attending Nsukka Health Center in Nsukka LGA, Nigeria. A total of 112 stool samples were collected from adult patients attending the healthcare and examined using the direct examination method and the formol-ether concentration technique, followed by microscopic identification. Infection intensity was assessed using the Kato-Katz method, with egg counts expressed as eggs per gram (EPG) of feces. Overall, 41(36.6%) participants were infected with STHs. Among infected individuals, 25(22.3%) had *Ascaris* infection, 14(12.5%) had hookworm infection, and 2(10.5% infected females) had hookworm and *Ascaris* co-infection with *Giardia lamblia*. Sex-based analysis showed 19(46.3%) females and 22(53.7%) males among the 41 infected persons. Intensity assessment showed predominantly moderate infection: for *Ascaris*, 14 had light infection (<5,000 EPG) and 11 had moderate infection (5,000–50,000 EPG); for hookworm, 7 had light infection (<2,000 EPG), 6 had moderate infection (2,000–4,000 EPG), and one had heavy infection (>4,000 EPG). These findings demonstrate that STHs are moderately prevalent among adults attending the Health Center, with *Ascaris* being the most common. Health education, deworming programs targeting adults, and intensified promotion of handwashing, sanitation, and personal hygiene are recommended. The modest sample size and the hospital-based design may limit the generalizability of prevalence estimates, and larger community-based studies are needed to validate these findings.

**Keywords:** Adults; *Ascaris*; Hookworm; Parasite burden; Prevalence.

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## 1.0 INTRODUCTION

Soil-transmitted helminths (STHs) constitute one of the most important groups of infectious agents and are major causes of morbidity worldwide. More than a billion people have been reported to harbor at least one species of STHs, resulting in substantial impacts on growth, cognitive development, productivity, and overall health outcomes (WHO, 2008; Mascarini et al., 2010; Mascarini, 2011). Globally, the most prevalent STH species include *Ascaris lumbricoides*, *Trichuris trichiura*, hookworms (*Necator americanus* and *Ancylostoma duodenale* and *Strongyloides stercoralis* (Okwuonu et al., 2020), with estimated infections of 807 million, 604 million, and 576 million people, respectively (Mascarini et al., 2010; Mascarini, 2011; Edoa et al., 2024; Mengistu et al., 2025). The burden of these parasites remains particularly high in low- and middle-income countries where access to improved sanitation and safe water is limited, and where poverty and inadequate hygiene practices increase exposure to infective eggs and larvae (Dennis et al., 2018; Ekwezuo et al., 2025). The World Health Organization has emphasized the scale of STH-related diseases in impoverished populations, noting that approximately 80% of the "bottom billion" is infected with *Ascaris*, 60% with *Trichuris*, and 57% with hookworms (WHO, 2008; Roach et al., 2012). About a quarter of the global population are infected at some point in their lives with STHs (WHO, 2008; 2023). STH transmission is sustained by the contamination of soil with feces containing helminth eggs or larvae, especially in settings where defecation practices are unsafe and handwashing facilities are inadequate (Dennis et al., 2018; Ekwezuo et al., 2025). STHs are widespread in tropical and subtropical regions, particularly in sub-Saharan Africa, where transmission is facilitated by environmental and socio-economic conditions such as inadequate sanitation, unsafe water sources, and limited access to preventive chemotherapy (Dennis et al., 2018; Oyeyemi & Okunlola, 2023; Ekwezuo et al., 2025). Evidence suggests that the distribution and intensity of helminth infections vary across geographic zones within Nigeria, with southern regions generally reporting higher endemicity compared with northern zones (Oyeyemi & Okunlola, 2023). Such variability is likely linked to differences in climate, sanitation coverage, hygiene behaviors, and health service delivery. Although many STH studies focus on children given their vulnerability to infection-related morbidity adult populations remain an important reservoir and continue to experience infection through ongoing exposure in the community (Ekwezuo et al., 2025). Adults may contribute to environmental contamination and perpetuate transmission, yet their epidemiological profile is less frequently characterized in many endemic settings. Furthermore, the pattern of species-specific infection (e.g., *Ascaris* versus hookworm), co-infection with protozoan infection(s), and potential differences by sex can provide insight into risk factors and inform targeted control strategies. Ekwezuo et al. (2025) discovered a notable high prevalence of concurrent STHs and protozoan infections among prisoners at Nsukka Prison. In a separate study, Unigwe et al. (2022) reported 62.8% prevalence of gastrointestinal helminths in pigs killed at the Bodija abattoir in Ibadan. Although the latter investigation focused on animal hosts rather than humans, it raises public health concerns, as such infections may carry zoonotic potential and pose a risk of transmission to people. Evidence on adult STH prevalence and intensity at the local level is also essential for strengthening public health decision-making, including the design of appropriate health education and mass drug administration approaches.

In Nsukka LGA, Enugu State, Nigeria, limited localized data on adult STH burden constrain effective planning of control measures (Ekwezuo et al., 2025). Health facility-based data, in particular, are scarce despite the fact that health centers serve as primary points of contact for many adults seeking care and can provide valuable sentinel information on the local parasitic disease burden. Therefore, this study was aimed to determine the prevalence and intensity of STH infections among adults attending Nsukka Health Center in Nsukka LGA, Enugu State, Nigeria, thereby filling a key knowledge gap regarding adult-specific epidemiology and species distribution among hospital attendees in the area. Specifically, the study would assess the rate of STH infection among adults attending Nsukka Health Center and examine the distribution of infections by helminth species and sex, while interpreting infection intensity to support appropriate recommendations for control.

## 2.0 MATERIALS AND METHODS

### 2.1 Study area

This study was conducted at Nsukka Health Center, a primary healthcare facility located in Nsukka urban, Enugu State, southeastern Nigeria. Nsukka Health Center serves a catchment population drawn predominantly from Nsukka town and surrounding rural settlements within LGA. Nsukka LGA is one of 17 LGAs in Enugu State and comprises 29 autonomous communities — including Nsukka urban (the headquarters), Opi, Aku, Edem, Ede-Oballa, Obimo, Alor-Uno, Okpuje, Ibagwa-Aka, Lejja, and others — with an estimated population of 420,000 (2024 projections). The catchment population of the health center includes both urban residents with relatively better sanitation (public waste collection, pit latrines) and rural dwellers where open defecation, shared pit latrines, and unimproved water sources are common. This variability makes the area suitable for studying intestinal parasitic infections. We conducted the study from January to April 2024.

### 2.2 Ethical considerations

Ethical approval was obtained from the Enugu State Ministry of Health (Ethical No: MH/MSD/REC21/516) prior to the commencement of the study. Participants were informed that participation was voluntary and that they could withdraw at any time without penalty or loss of benefits. The written informed consent was obtained from all participants prior sample collection. Positive individuals were referred to the Health Center for treatment. To ensure confidentiality, all stool samples were assigned unique identification codes, and participant names were not recorded on specimen containers or laboratory forms. Data were stored securely in password-protected files accessible only to the research team, and physical records were kept in a locked cabinet.

### 2.3 Sample size

Participants were recruited consecutively among consenting adults attending health care at Nsukka Health Center who met the eligibility criteria over the study period. A total of 112 participants were enrolled 49 males (43.8%) and 63 females (56.2%). A Cochran's formula, $n = Z^2P[1-P]/d^2$, assuming $Z = 1.96$, $P = 25\%$, and $d = 5\%$, was used to calculate sample size (Cochran, 1963). The achieved sample of 112 was constrained by logistical and resource limitations and is acknowledged as a limitation that reduces precision and generalizability. Results should be interpreted within this context, and larger, well-resourced studies are recommended to validate these findings.

### 2.4 Study design and participant selection

This was a hospital-based study involving a random sampling technique. The study employed a consecutive sampling approach. All eligible adults attending health care at Nsukka Health Center during the study period were invited to participate. Participants included individuals attending the health center for outpatient services, routine check-ups, and community members who presented at the facility after being informed of the study through community health workers and local health talks within the health center's catchment area. Inclusion criteria were adults aged 18–70 years who had resided or attended health care within the catchment area of Nsukka Health Center for at least 12 months and provided written informed consent. Exclusion criteria included receipt of anti-helminthic treatment in the preceding six months, current pregnancy, acute diarrheal illness at recruitment, and inability to provide informed consent due to cognitive impairment or severe illness.

### 2.5 Sample collection

Each participant was provided with a clean, wide-mouthed, screw-capped plastic container pre-labelled with a unique identification code. Participants were instructed to collect approximately 5 g of their early-morning stool and to deliver the sealed container to the designated collection point at Nsukka Health Center or to the field team during hospital visits. Participants were asked to return specimens within two hours of collection whenever possible. For participants unable to produce a specimen within that window or who lived at a considerable distance, a longer delivery window of up to 12 hours was permitted, provided the specimen was stored in a cool, shaded location prior to transport. All returned specimens were logged upon receipt and transported to the laboratory for processing within 24 hours of collection. This flexible protocol improved compliance while maintaining specimen integrity for parasitological examination.

### 2.6 Parasite identification

Parasite identification was performed using direct smear examination and the formol-ether concentration technique, following standard parasitological protocols (Cheesbrough, 1998).

#### 2.6.1 Direct smear

Approximately 1 g of feces was emulsified in 1 mL of physiological saline on a clean glass slide, covered with a coverslip, and examined under 10× and 40× objectives of a compound light microscope.

#### 2.6.2 Formol-ether concentration

Approximately 1 g (pea-sized) of feces was emulsified in 4 mL of 10% formol-saline in a small container. The emulsion was strained through two layers of wet gauze into a centrifuge tube. An additional 4 mL of 10% formol-saline was used to rinse the container and poured through the gauze into the tube (total strained volume ~8 mL). The sample was subsequently treated with 3 mL of diethyl ether. The tube was stoppered and shaken vigorously for 30 s. We centrifuged the mixture at 2,000 rpm for 2 min. After centrifugation, four layers formed: a top ether layer, a debris plug, a formalin layer, and a bottom sediment. The top three layers were carefully decanted by rimming the debris plug with a wooden stick and pouring off the supernatant. The remaining sediment was mixed, transferred to a clean glass slide, covered with a coverslip, and examined systematically under the 10× objective for helminth eggs, larvae, and protozoan cysts. Identification was confirmed at 40× magnification based on characteristic morphological features.

#### 2.6.3 Infection intensity assessment

Infection intensity for STHs was assessed using the Kato-Katz thick smear technique, following WHO-recommended procedures (WHO, 2017; Bosch et al., 2021). A calibrated template delivering approximately 41.7 mg of sieved stool was used to prepare smears on slides, which were allowed to clear for 30–60 min before microscopic examination. Egg counts per smear were multiplied by 24 to obtain eggs per gram (EPG) of feces. Intensity categories were assigned according to WHO thresholds: *Ascaris lumbricoides*: light (<5,000 (EPG), moderate (5,000–50,000 EPG), and heavy (>50,000 EPG); Hookworm: light (<2,000 EPG), moderate (2,000–4,000 EPG), and heavy (>4,000 EPG) (WHO, 2023).

### 2.7 Data analysis

Data were arranged and examined using Microsoft Excel 2016. Percentages were computed to assess the prevalence and spread of infections according to the type of parasite and by gender. The figures were created using GraphPad Prism version 8. A Chi-square test was performed to check if there was a link between infection status and gender. P-values were set at $p < 0.05$.

## 3.0 RESULTS

### 3.1 Prevalence of soil-transmitted infections among adults

The overall prevalence of STIs among adults attending Nsukka Health Center is presented in Table 1. Of the 112 participants, 41 (36.6%) were infected with one or more intestinal parasites. Among the infected participants, 25 (22.3%) had *Ascaris lumbricoides*, 14 (12.5%) had hookworm, and 2 (1.8%) had co-infection with *Giardia lamblia* alongside *Ascaris* and hookworm infection. Both cases of *Giardia* co-infection occurred in females (n = 2; 100%), while none (0%) was observed in males.

Table **1**. Overall prevalence of soil-transmitted infections among adults attending Nsukka Health Center

| Parasite | Frequency | Prevalence (%) |
|---|---|---|
| None | 71 | 63.4 |
| *Ascaris lumbricoides* | 25 | 22.3 |
| Hookworm | 14 | 12.5 |
| *Giardia lamblia* | 2 | 1.8 |
| **Total** | **112** | **36.6** |

### 3.2 Prevalence of soil-transmitted infections by sex

Sex-specific prevalence is presented in Table 2. Of the 41 infected participants, 19 (46.3%) were females and 22 (53.7%) were males. Among infected females, 11 (57.9%) had *Ascaris*, 6 (31.6%) had hookworm, and 2 (10.5%) had *Giardia* co-infection with either hookworm or *Ascaris*. Among infected males, 14 (63.6%) had *Ascaris*, 8 (36.4%) had hookworm, and none (0%) had *Giardia* co-infection (see Table 2; Figure 1).

Table **2**. Prevalence of soil-transmitted infections by sex at Nsukka Health Center

| Sex | *Ascaris* (N) | % | Hookworm (N) | % | Giardia (N) | % | Total (N) | % |
|---|---|---|---|---|---|---|---|---|
| Female | 11 | 57.9 | 6 | 31.6 | 2 | 10.5 | 19 | 46.3 |
| Male | 14 | 63.6 | 8 | 36.4 | 0 | 0 | 22 | 53.7 |

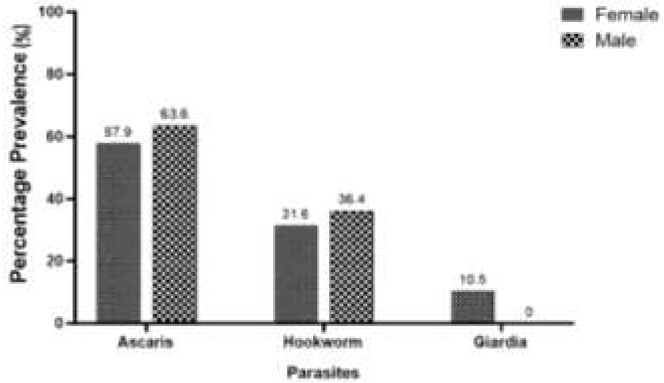


*Figure 1. Prevalence of soil-transmitted infection by sex among adults at* Nsukka Health Center

### 3.3 Intensity of soil-transmitted infections among adults

Among the 25 participants infected with *A. lumbricoides*, 14 (56.0%) had (+) intensity and 11 (44.0%) had (++) intensity. For hookworm infection (n=14), 7 (50.0%) showed (+) intensity, 6 (42.9%) showed (++) intensity, and 1 (7.1%) had (+++) intensity. *Giardia* co-infection: for the 2 participants with *Giardia* co-occurring with a soil-transmitted helminth, 1 (50.0%) had (+) intensity and 1 (50.0%) had (+++) intensity. Overall, the observed burden was predominantly low-to-moderate for *A. lumbricoides* and hookworm, with heavy intensity observed in a smaller proportion of cases (Table 3, Figure 2).

Table **3**. Intensity of soil-transmitted infections among adults at Nsukka Health Center

| Parasite | | Intensity | | |
|---|---|---|---|---|
| | N | + | ++ | +++ |
| *Ascaris* | 36 | 14 | 22 | 0 |
| Hookworm | 22 | 7 | 12 | 3 |
| *Giardia* | 4 | 1 | 0 | 3 |

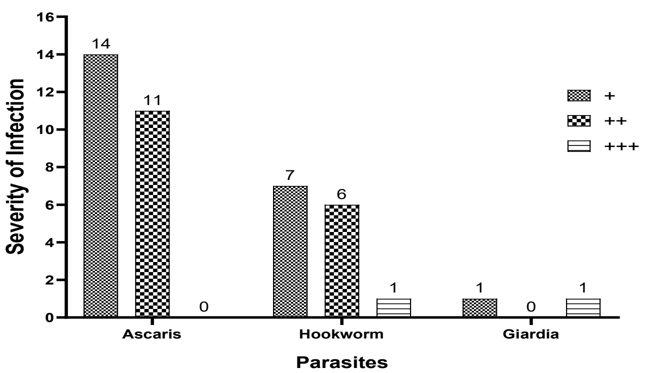


*Figure 2. Intensity of soil-transmitted infection among adults at* Nsukka Health Center

## 4.0 DISCUSSION

The present study assessed the prevalence and intensity of soil-transmitted helminths (STHs) among adults attending Nsukka Health Center in Enugu State, southeastern Nigeria. The overall STH prevalence of 36.6% observed in this study is consistent with several reports from the region. Imalele et al. (2023) reported a similar prevalence among adults in Cross River State, the figure aligning closely with the present finding. Similarly, Karshima et al. (2018) found a higher prevalence among children residing in local communities in Nigeria likely reflecting the predominantly agricultural occupation of their participants and its associated soil contact. The comparability of these findings suggests that the catchment population of Nsukka Health Center shares similar epidemiological characteristics with other adult populations across southeastern Nigeria. The predominance of *Ascaris lumbricoides* (22.3%) in the present study mirrors the pattern reported by Achi et al. (2017) in Abakaliki and by Nwadike et al. (2026) in Anambra State, where *Ascaris* was the most frequently encountered STH species. These studies collectively affirm that *A. lumbricoides* remains the dominant STH among adult populations across southeastern Nigeria, attributable to its hardy eggs, peridomestic transmission, and the region's warm, moist climate. The predominance of *Ascaris* may be explained by its effective transmission route through ingestion of embryonated eggs present in contaminated soil, dust, water, or on fomites such as unwashed hands and contaminated food. Adults engaged in routine activities that increase contact with potentially contaminated soil especially farming and handling of organic materials are at heightened risk. In contrast, studies from other parts of Nigeria show a different species distribution. In northern Nigeria, Adamu et al. (2025) reported hookworm as the predominant STH, reflecting differences in soil type, rainfall patterns, and farming practices. In both Edo and Delta States, Asemota et al. (2012) found *Trichuris trichiura* to be most common, possibly due to higher humidity and prolonged egg survival in swampy soils. These intra-country variations underscore the importance of local ecological and behavioral factors in shaping STH epidemiology.

The present study's finding also diverges from Kache et al. (2020) in southern Thailand, where hookworm predominated among elderly rural populations, and from Ahmed et al. (2022) in Oromia, Ethiopia, where overall prevalence was lower (21.5%). These discrepancies are likely attributable to differences in climate, predominant soil types, sanitation coverage, and the age structure of the study populations. However, the most useful comparisons remain those drawn from within the same geographical region (southeastern Nigeria), where ecological and socio-demographic conditions are broadly similar and therefore provide a more valid context for interpreting the findings. The second most prevalent STH in this study was hookworm (12.5%). This aligns with findings from Ibidapo & Okwa (2008) in rural community in Nigeria, suggesting that hookworm remains an important contributor to STH burden in similar environmental settings. However, the current result disagrees with Ahmed et al. (2022), who reported *Trichuris trichiura* as the second most prevalent species in Jimma town, Oromia, Ethiopia. Variation in local sanitation practices, footwear use, and hygiene behavior likely contributes to species-specific differences. Hookworm transmission is strongly associated with skin penetration by infective larvae from contaminated soil, meaning that practices such as walking barefoot and exposure to moist, contaminated ground can increase infection risk. Sex-specific analysis revealed differences in infection distribution. Males had a higher proportion of *Ascaris lumbricoides* infection compared with females, and a similar pattern was observed for hookworm, where males also showed a higher proportion of infection. This consistent male predominance across both dominant STH species suggests that exposure pathways differ by sex, likely mediated by behavioral and occupational factors. Males in the study catchment are more engaged in outdoor work and farming activities that increase direct contact with contaminated soil, and they may be less likely to use protective measures such as appropriate footwear. Tashikuta et al. (1995) similarly noted an increased risk of *A. lumbricoides* in settings where toilet usage involves inadequate water supply and hygiene control, a pattern that may disproportionately affect males who work away from home. Tandukar et al. (2005) also reported higher hookworm risk among males, attributing this to sex-based differences in daily activities and hygiene-related behaviors. Crompton & Nesheim (2002) emphasized that sanitation quality is a key determinant of STH transmission, reinforcing the view that unequal access to, or differences in adherence to, hygienic practices can shape sex-specific infection patterns for both *Ascaris* and hookworm. These findings underscore that toilet hygiene and proper sanitation practices are important not only for children the traditional focus of STH control programs but also for adult populations, since adults often serve as reservoirs sustaining community transmission.

Regarding protozoan involvement, the study identified *Giardia lamblia* as occurring alongside hookworm and *Ascaris* in co-infection, appearing only among females in this sample. Both cases of *Giardia* co-infection were observed in females, representing 10.5% of infected females and 1.8% of the total sample. Co-infection patterns can be influenced by differences in water handling, food preparation practices, and exposure to contaminated water sources. Amidou et al. (2020) reported similar associations involving *Giardia* and diarrhea-related risk factors in South Africa, highlighting how water- and hygiene-related behaviors can contribute to transmission of both helminths and intestinal protozoa. The exclusive occurrence of *Giardia* co-infection among females in this study may reflect their greater involvement in domestic activities such as water collection, food preparation, and child care, which increase exposure to contaminated water sources. However, given the small number of co-infection cases, this observation should be interpreted with caution and warrants further investigation in larger studies. Intensity grading showed that most infections were of low to moderate intensity, with fewer participants exhibiting heavy intensity. The relatively low-to-moderate intensity observed may reflect factors such as health education, periodic deworming campaigns, and improved hygiene practices that reduce transmission intensity over time. WHO recommendations generally emphasize deworming and hygiene promotion as strategies to reduce morbidity from STHs (WHO & PAHO, 2015). Supporting this, Taylor-Robinson et al. (2019) emphasized the public health relevance of deworming programs in endemic settings. The finding that *Giardia* co-infection occurred alongside both light- and heavy-intensity helminth infections is consistent with the general understanding that parasite intensity can vary depending on exposure level and host factors. Brahmantya et al. (2020) similarly reported predominantly low-intensity infections in their study, reinforcing that intensity is not uniformly high across infected populations. Although this study was facility-based rather than a community-wide survey, the prevalence and patterns of infection remain informative of the local epidemiological context. Many patients of the Nsukka Health Center catchment area rely on farming and are likely to be in contact with potentially contaminated soil. This is consistent with Samuel et al. (2016) and Karshima (2018), who reported that helminth infections are common among farmers and people living in areas with unhygienic and contaminated soil conditions. Such environmental exposure, combined with potential gaps in hand hygiene, sanitation, and safe disposal of feces, can sustain adult STH transmission.

## Limitations

The study has several limitations. First, the sample size was modest and constrained by logistical and resource limitations, which may limit the precision of prevalence estimates and subgroup analyses. Second, as a facility-based study conducted at a single health center, the findings may not be fully generalizable to the entire Nsukka LGA population, particularly residents who do not regularly attend the health center. Third, the cross-sectional design captures infection status at a single time point and cannot establish temporal relationships between risk factors and infection. Fourth, the use of a single Kato-Katz smear per participant may have underestimated true prevalence, particularly for light-intensity infections, although the addition of the formol-ether concentration technique helped mitigate this limitation. Fifth, data on key variables such as occupation, and educational status were not collected but not analyzed in relation to infection status in the present study — a more comprehensive risk factor analysis would strengthen future work. Despite these limitations, the study provides useful baseline data on STH prevalence and intensity among adults in this setting, a demographic often overlooked in favor of school-aged children in most deworming programs.

## Conclusion

Conclusively, this study found a moderate prevalence (36.6%) of soil-transmitted helminth infections among adults attending Nsukka Health Center, with *Ascaris lumbricoides* being the predominant species. Most infections were of low to moderate intensity. Males showed a higher infection burden than females, likely reflecting occupational and behavioral exposure differences. *Giardia* co-infection was observed exclusively among females, though the small number of cases limits interpretation. These findings highlight that adults in this setting remain an important reservoir of STH transmission and should not be excluded from control programs. Larger, community-based studies incorporating risk factor analysis and molecular characterization of parasite species are recommended to further elucidate the epidemiology of STHs in the region.

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## Conflict of interest

The authors declare that they have no conflicts of interest.

## Authors contribution

EAO, CTO and POU conceived the study; POU and ESO collected and conducted data analysis and interpretation, while HCE and NIO organized the data. POU drafted the initial version of the manuscript. EAO, CTO, ESO, HCE, NIO, IAN, CMO, CCE and OCU participated in reviewing of the draft. All authors approved the manuscript for publication after review.

## REFERENCES

Achi, E. C., Njoku, O. O., Nnachi, A. U., Efunshile, A. M., Mbah, J. O., Aghanya, I. N., and Nnemelu, P. O. (2017). Prevalence of intestinal parasitic infections among under five children in Abakaliki Local Government Area of Ebonyi State. *Eur J Pharm Med Res*, **4**(4), 218-22.

Adamu, R., Abd Aziz, N. A., Mustafa, M., and Shohaimi, S. (2025). Soil-transmitted Helminth (STH) Infections in Northern Nigeria between 2000-2022: A Review. *UMYU Journal of Microbiology Research (UJMR)*, **10**(1), 39-55. https://doi.org/10.47430/ujmr.25101.005

Ahmed, Z., Degefa, T., Tesfaye, M., Sultan, S., Elias A. E., Zuber, H., Ali, S., Azam, K., Husen, A., Yasin, J. and Wieser, A. (2022). Prevalence and intensity of soil transmitted helminth infections and associated risk factors among household heads living in the peri-urban areas of Jimma town, Oromia, Ethiopia: A community–based cross sectional study. *PLOS ONE Neglected Tropical Disease.* https://doi.org/10.1371/jornal.pone.0274702

Amidou, S., Nicoline, F. T., Itumeleg, S. and Mbati, P. (2020). Prevalence and genetic characterization of *Giardia lamblia* in relation to diarrhea in Limpopo and Gauteng provinces, South Africa. *Parasite Epidemiology and Control of Open Access Journal,* **9(1).** DOI: 10.1016/j.parepi.2020.e00140

Asemota O, O., Nmorsi OP, G., Isaac C, C., Umukoro D, O., and Akhile A, O. (2012). Distribution of intestinal parasites among school-age children in Delta and Edo State of Nigeria. *Parasitologists United Journal*, **5**(2): 121 – 126.

Bosch, F., Palmeirim, M. S., Ali, S. M., Ame, S. M., Hattendorf, J. and Keiser, J. (2021). Diagnosis of soil-transmitted helminths using the Kato-Katz technique: What is the influence of stirring, storage time and storage temperature on stool sample egg counts? *PLoS Neglected Tropical Diseases*, **15(1):** e0009032. DOI: 10.1371/journal.pntd.0009032

Brahmantya, B. I., Haikal, P. I., Ryalino, C. and Sudarmaja, M. (2020). Risk factors and Prevalence of Soil transmitted helminths infections. *Open Access Macedonian Journal of Medical Science.* **8:** 521-524. *https://doi.org/10.1016/j.parepi.2025.e00473*

Cheesbrough, M. (1998). Parasitological Test in District Laboratory Practice in Tropical Countries. Monica Cheesbrough. *Tropical Health Technology*, pp 184-235. *https://doi.org/10.1017/CBO9780511581304.007*

Cochran, W. G. (1963). Sampling Techniques, 2nd Ed., New York: John Wiley and Sons, Inc.

Crompton, D. W. and Nesheim, M. C. (2002). Nutritional impact of intestinal helminthiasis during the human life cycle. *Annu Rev Nutr,* **22**: 35–59. *DOI: 10.1146/annurev.nutr.22.120501.134539*

Dennis, A., Kwaku, P. A., Dennis, K. G., Agyei, O., Seeba, A., Gyan, B., Dosoo, D., Adeniji, E. and Iddrisu, L. F. (2018). Epidemiology of soil transmitted helminth infections in the middle of Ghana, Africa. *Parasite Epidemiology and Control of Open Access Journal,* **3(3)**. *DOI: 10.1016/j.parepi.2018.e00071*

Edoa, J. R., Adégbitè, B. R., Honkpéhèdji, Y. J., Zinsou, J. F., Boussougou-Sambe, S. T., Woldearegai, T. G., ... and Dejon-Agobé, J. C. (2024). Epidemiology of soil-transmitted helminth infections and the differential effect of treatment on the distribution of helminth species in rural areas of Gabon. *Tropical medicine and health*, **52(1):** 3. *DOI: 10.1186/s41182-023-00567-z*

Ekwezuo, J. C., Nnodim, C. C., Okwuonu, E., Ngwu, G. I., Agbedo, E. C., Aguzie, I. O. N., ... and Audu, J. M. (2025). Prevalence of soil-transmitted helminths and protozoan parasites' infections among inmates in Nsukka Correctional Centre. *Journal of Biological Research and Biotechnology,* **23(3)**. *DOI: 10.4314/br.v23i3.4*

Ibidapo, A. C. and Okwa, O. (2008). The Prevalence and intensity of soil transmitted helminths in a rural community, Lagos suburbs, South West Nigeria. *International Journal of Agriculture and Biology.* **10:** 89-92.

Imalele, E. E., Effanga, E. O., and Usang, A. U. (2023). Environmental contamination by soil-transmitted helminths ova and subsequent infection in school-age children in Calabar, Nigeria. *Scientific African*, **19**: e01580. *https://doi.org/10.1016/j.sciaf.2023.e01580*

Kache, R., Phasuk, N., Viriyavejakul, P. and Punsawad, C. (2020). Prevalence of soil transmitted infections and risk associated risk factors among elderly individuals living in rural areas of Southern Thailand; **20:** 1882. *https://doi.org/10.1186/s12889-020-09986-7*

Karshima, S. N. (2018). Prevalence and distribution of soil-transmitted helminth infections in Nigerian children: a systematic review and meta-analysis. *Infectious diseases of poverty*, **7**(04), 1-14. *DOI: 10.1186/s40249-018-0451-2*

Mascarini, S. L. (2011). Prevention of Soil transmitted Helminths Infection. *Journal of Global Infectious Disease;* **3(2):** 175-182. *https//doi:10.4103/0974-777X.81696*

Mascarini-Serra, L. M., Telles, C. A., Prado, M. S., Mattos, S. A., Strina, A., Alcantara-Neves, N. M., and Barreto, M. L. (2010). Reductions in the prevalence and incidence of geohelminth infections following a city-wide sanitation program in a Brazilian Urban Centre. *PLoS Neglected Tropical Diseases*, **4(2):** e588. *https://doi.org/10.1371/journal.pntd.0000588*

Mengistu, B., Maddren, R., Collyer, B., and Anderson, R. M. (2025). Trends in the prevalence and intensity of soil-transmitted helminth (STH) infection in Ethiopia 2000 to 2023: a systematic review. *Parasites & Vectors*, **18(1):** 340. *DOI: 10.1186/s13071-025-06928-3*

Nwadike, C. C., Mgbachi, A. J., Ogbuefi, E. O., Olisa, C. S., Obiefule, I. E., Nnatuanya, I. O., Okeke, O. A., Okpara, C. C., Anayor, G. C., and Ezedialu, C. M. (2026). Prevalence of Intestinal Parasites among Primary School Children in Idemili North Local Government Area of Anambra State, Southeast Nigeria. International Journal of Pathogen Research, **15**(4): 136 – 157. *DOI: 10.9734/ijpr/2026/v15i4474*

Okwuonu, E. S., Aguzie, I. O. N., Atama, C. I., and Ani, C. P. (2020). A review on geohelminths and pharmaceuticals. *Journal of Biologics Research and Development*, **1:** 92-112.

Oyeyemi, O. T., and Okunlola, O. A. (2023). Soil-transmitted helminthiasis (STH) endemicity and performance of preventive chemotherapy intervention program in Nigeria (in year 2021). *Scientific Reports*, **13(1):** 10155. *DOI: 10.1038/s41598-023-37402-8*

Roach, R. R., Octain, J., and Friedman, E. (2012). Soil-Transmitted Helminths. Book Chapter In book: Helminthiasis. IntechOpen, pp.345-351. *DOI: 10.5772/intechopen.87143*

Samuel, F., Mirko, S., Winkler, P., Dung, S., Christian, S., Jurg, U. and Gueladio, C. (2016). Intestinal parasite infections and associated risk in communities. *Parasites and Vectors,* **9:** 537-544. *DOI: 10.1002/hsr2.70473*

Tandukar, S., Adhikari, N., Ansari, S., Shrestha, A., Gautam, J. and Sharma, B. (2005). Intestinal parasitosis in school children of Lalitpur district of Nepal. *Biomedical Central Open Access Journal*, **6:** 1-6. *DOI: 10.1186/1756-0500-6-449*

Tashikuta, J. G., Scott, M. E., Gray-Donald, K. (1995). *Ascaris lumbricoides* infection and environmental risk factors in an urban African setting. *Ann Tropical Medical Parasitology,* **89:** 505-514. *DOI: 10.1080/00034983.1995.11812983*

Taylor-Robinson, D. C., Donegan, S., Chaplin, M., and Garner, P. (2019). Public health deworming programs for soil-transmitted helminths in children living in endemic areas. *Cochrane Database of Systematic Reviews,* **(9).** *DOI: 10.1002/14651858.CD000371.pub7*

Unigwe, C. R., Egwu U. L., and Ukwueze S. C. (2022). Prevalence of gastro-intestinal helminths of slaughtered pigs at Bodija abattoir, Ibadan, Oyo State, Nigeria. *Journal of Biological Research and Biotechnology*, **20(2):** 1506-1512. DOI:10.4314/br.v20i2.1

WHO (2008). World Health Statistics 2008. https://www.who.int/docs/default-source/gho-documents/world-health-statistic-reports/en-whs08-full.pdf

WHO (2015). Investing to Overcome the Global Impact of Neglected Tropical Diseases. https://reliefweb.int/report/world/investing-overcome-impact-neglected-tropical-disease-third-who-report-neglected

WHO (2017). Deadly worms- A look at soil transmitted helminths. https://www.who.int/health-topics/soil-transmitted-helmithiasis

WHO (2023). Soil-transmitted helminths. https://www.who.int/news-room/fact-sheets/detail/soil-transmitted-helminth-infections

WHO and PAHO (2015). Soil transmitted helmithiases and communicable disease prevention, control and elimination. World Health Organization and Pan America Health Organization collaborating center. *https://www.paho.org/en/topics/soil-transmitted-helminthiasis*