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Occurrence of Ascaris Lumbricoides, Trichuris Trichiura and Hookworm Infections Among Primary School Children in Gabasawa Local Government Area, Kano State, Nigeria

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Abstract: Soil-transmitted helminth (STH) infections remain an important public health problem among school-aged children, particularly in communities with inadequate sanitation, poor hygiene and limited access to safe water. This study determined the occurrence and intensity of Ascaris lumbricoides, Trichuris trichiura and hookworm infections among primary school children in Gabasawa Local Government Area, Kano State, Nigeria. A cross-sectional descriptive study was conducted among 255 apparently healthy primary school children aged 5–12 years. Stool samples were collected and examined macroscopically and microscopically using direct wet mount and formalin-ether concentration techniques. Parasites were identified based on their characteristic morphological features, while infection intensity was determined using the Kato-Katz technique. Data were analysed using descriptive statistics and chi-square tests, with statistical significance set at $p < 0.05$. Of the 255 children examined, 65 (25.5%) were infected with at least one intestinal helminth, while 190 (74.5%) were negative. A. lumbricoides was the most prevalent parasite, occurring in 35 (13.7%) children, followed by hookworm with 21 (8.3%) and T. trichiura with 9 (3.5%). Infection was significantly associated with age ($p = 0.027$), with children aged 8–10 years recording the highest number of infections. Although males had a higher occurrence (14.5%) than females (11.0%), the association between sex and infection was not statistically significant ($p = 0.264$). Light infections predominated for all three parasites, while heavy infections occurred only with A. lumbricoides. The study demonstrates that STH infections remain prevalent among school children in Gabasawa LGA, highlighting the need for regular deworming, improved sanitation, safe water, personal hygiene and continuous health education.

Keywords: *Soil-transmitted helminth, children, Gabasawa, Kano, Infection*

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Introduction

Soil-transmitted helminth (STH) infections are among the most common neglected tropical diseases affecting populations in tropical and subtropical regions (Bethony *et al*., 2006). The major human STHs include *Ascaris lumbricoides*, *Trichuris trichiura* and hookworms, principally *Necator americanus* and *Ancylostoma duodenale*. These parasites are transmitted through contact with soil contaminated with human faeces. Infection is strongly associated with inadequate sanitation, poor personal hygiene, unsafe disposal of human waste, contaminated food and water, and environmental conditions that favour the development and survival of parasite eggs and larvae (Hassan *et al*., 2017).

Children of school age are particularly vulnerable to STH infections because of their frequent contact with contaminated soil and inadequate adherence to personal hygiene practices. Repeated infections may result in abdominal discomfort, diarrhoea, malnutrition, anaemia, impaired physical development and poor educational performance (Oyebamiji *et al*., 2018). The World Health Organization (WHO) identifies children living in areas with inadequate sanitation and hygiene as an important target population for preventive chemotherapy against soil-transmitted helminth infections (WHO, 2024).

Ascaris lumbricoides is one of the most widely distributed intestinal nematodes of humans. Infection occurs when embryonated eggs are ingested, commonly through contaminated food, water, hands or soil. Following ingestion, larvae hatch in the intestine, migrate through the bloodstream to the lungs, ascend the respiratory tract and are swallowed before developing into adult worms in the small intestine. Heavy infections can cause abdominal pain, intestinal obstruction and nutritional impairment (Sule *et al*., 2019).

Trichuris trichiura, commonly known as the whipworm, is also transmitted through ingestion of embryonated eggs from contaminated soil, food or hands. Adult worms reside mainly in the caecum and colon. Light infections may be asymptomatic, whereas heavy infections can produce abdominal pain, chronic diarrhoea, rectal prolapse, anaemia and impaired growth (Olufotebi *et al*., 2019).

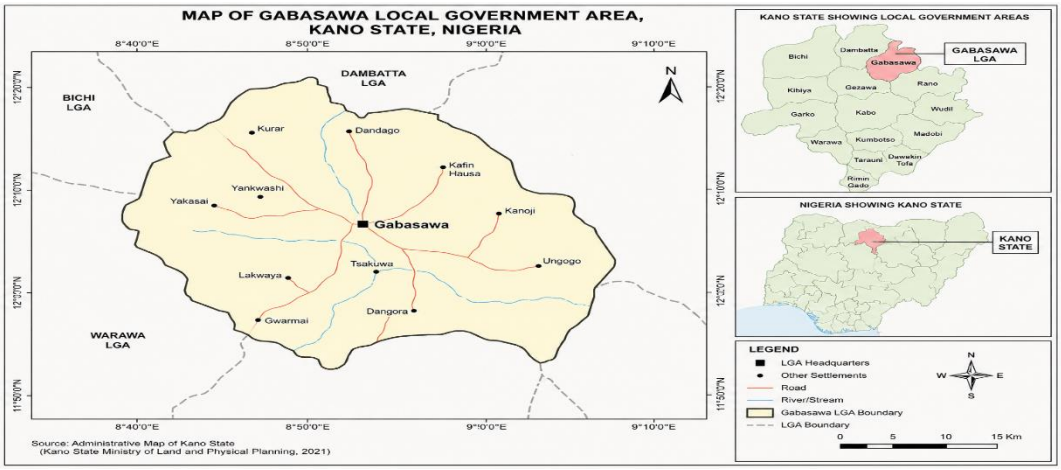
Hookworm infection differs from *Ascaris* and *Trichuris* in its principal mode of transmission. Infective hookworm larvae develop in contaminated soil and commonly penetrate human skin, particularly when individuals walk barefoot. The larvae subsequently migrate through the body and mature into adult worms in the small intestine. Hookworms attach to the intestinal mucosa and consume blood, making heavy infection an important cause of iron-deficiency anaemia (Karshima *et al*., 2018).

The global burden of STH infection remains substantial, particularly in low- and middle-income countries (Broker, 2010). WHO reports that billions of people require preventive chemotherapy for neglected tropical diseases, with children in endemic areas representing an important group requiring regular intervention. Periodic deworming, improvement of water, sanitation and hygiene (WASH), health education and environmental sanitation constitute major components of STH control (WHO, 2023, 2024). Kano State, located in northern Nigeria, contains numerous rural and semi-urban communities where agricultural activities, inadequate sanitation and limited access to improved water sources may increase exposure to soil-transmitted helminths. Gabasawa Local Government Area contains several primary schools serving children from communities with varying environmental and socioeconomic conditions. However, local epidemiological information on *A. lumbricoides*, *T. trichiura* and hookworm infections among primary school children may be limited, Hence, the study was aimed to determine the occurrence of *Ascaris lumbricoides*, *Trichuris trichiura* and hookworm infections among primary school children in Gabasawa Local Government Area, Kano State.

Materials and Methods

Study Area

The study was conducted in Gabasawa Local Government Area (LGA) of Kano State, north-western Nigeria. Gabasawa is one of the 44 Local Government Areas of Kano State and is located in the northern part of the state within the Kano North administrative area. The administrative headquarters of the LGA is situated at Zakirai. The area is approximately 605 km² in size and is located around 12.15°N latitude and 8.86°E longitude. It has a total population of 211, 204 according to 2006 census (NPC, 2011) and projected population of 393, 425 by 2026 (WPR, 2026). Gabasawa is surrounded by several Local Government Areas of Kano State and lies close to the Kano–Jigawa State boundary. The landscape is generally flat to gently undulating, with an elevation of approximately 400–430 metres above sea level. The climate is characterized by distinct wet and dry seasons, with most annual rainfall occurring during the wet season. The vegetation is predominantly savanna, with extensive areas devoted to agricultural activities (KSG, 2025).



Map of Gabasawa Local Government Area, Kano

Study Design

A cross-sectional descriptive study design was employed. This design is appropriate because it permits the determination of the occurrence of intestinal parasites within the study population during a defined period.

Study Population

The study population consist of apparently healthy primary school children aged approximately 5–12 years attending selected primary schools in Gabasawa LGA.

Inclusion Criteria

Children will be eligible if they:

- are enrolled in the selected primary schools;
- fall within the defined age range (% - 12 years);
- provide a suitable stool specimen; and
- have informed consent from their parents or guardians and assent where applicable.

Exclusion Criteria

Children will be excluded if:

- parental/guardian consent is not obtained;
- they fail to provide a stool specimen;
- the specimen is contaminated or unsuitable for examination; or

- they have recently received anthelmintic treatment, if this is included as an exclusion criterion in the approved protocol.

Sample Size

The sample size may be determined using the single-proportion formula:

$$n = \frac{Z^2 pq}{d^2}$$

Where:

- n = required sample size;
- Z = 1.96 at 95% confidence level;
- p = estimated prevalence from a previous study;
- $q = 1 - p$;
- d = 0.05 level of precision.

The prevalence of 21% according to Sule *et al*. (2019) was used in the study.

$$n = \frac{(1.96)^2(0.21)(0.79)}{(0.05)^2}$$
$$n = 255$$

Therefore, approximately 255 children were employed in the study.

Ethical Consideration

Ethical approval for the study was obtained from Kano State Ministry of Health through Health service Management Board and Department of Education Gabasawa local Government Area.

Written informed consent was also obtained from parents or guardians. Confidentiality of participants' information were be maintained throughout the study.

Collection of Stool Samples

Each participating child were provided with a clean, dry, wide-mouthed, leak-proof, labelled stool container. Participants were instructed to provide a fresh stool specimen without contamination with soil, urine or water. The samples were transported to the laboratory as soon as possible for examination.

Administration of Questionnaire

A total of two hundred and fifty-five (255) questionnaires were administered to each of the selected pupils to obtain information from them on the following: Class, age, sex, and related information.

Laboratory Examination

Fresh stool specimens were examined macroscopically for colour (brown, yellow or green) consistency (semi watery, watery or formed) and also presence of blood, mucous and cestodes segment and/or adult worm (Pullan *et al*., 2014). The specimens were subsequently subjected to parasitological examination.

Direct Wet Mount

A small portion of stool were emulsified in normal saline on a clean glass slide and covered with a coverslip. An iodine preparation was also added as appropriate. The preparations were examined microscopically using the ×10 and ×40 objectives for detection of helminth eggs and other intestinal parasites (Cheesbrough, 2012).

Formalin-Ether/Concentration Technique

Furthermore, a concentration technique was used to increase the probability of detecting parasite eggs in specimens with low parasite loads. The procedure followed standard laboratory parasitological methods as described by Cheesbrough (2012).

Identification of Parasites

Identification was based on characteristic morphological features of the parasite stages. *A. lumbricoides*: characteristic oval eggs with a thick shell and mammillated outer layer. *T. trichiura*: barrel-shaped eggs with characteristic bipolar plugs. Hookworm: oval, thin-shelled eggs containing developing blastomeres (Cheesbrough, 2012).

Determination of Infection Intensity

The number of eggs per gram of faeces (EPG) was be determined using Kato-Katz method. The Kato-Katz technique is widely used for quantitative assessment of STH infections and permits estimation of eggs per gram of faeces, which can then be categorized as light, moderate or heavy infection according to WHO criteria (WHO, 2002).

Data Analysis

Data will be entered into Microsoft Excel and analysed using SPSS. Descriptive statistics will include frequencies, percentages, means and standard deviations where appropriate. Prevalence will be calculated as percentage of ratio of infected child to total number of children examined. Chi-square (χ^2) will be used to determine associations between infection status and categorical variables such as age, sex, handwashing practice, source of drinking water and toilet availability. Statistical significance was considered at $p < 0.05$.

Results

Demographic Characteristics of the Study Participant

Table 1 shows the demographic distribution of the 255 children examined in the study. The largest proportion of participants were aged 8–10 years, comprising 102 (40.0%) of the study population. This was followed by children aged 5–7 years, who accounted for 80 (31.4%), while those aged 11–12 years constituted 73 (28.6%). With respect to sex, males were slightly more represented than females, with 136 (53.4%) males compared with 119 (46.6%) females.

Table 1: Distribution of study participants according to age and sex

Variable	Category	Number	Percentage (%)
Age	5–7 years	80	31.4
	8–10 years	102	40.0
	11–12 years	73	28.6
Total		**255**	**100.0**
Sex	Male	136	53.4
	Female	119	46.6
Total		**255**	**100.0**

Overall Occurrence of Intestinal Helminths

Table 2 indicates that 65 (25.5%) of the 255 children examined were positive for intestinal helminth infection, whereas 190 (74.5%) were negative. The chi-square value was 61.2745, with a p-value of 0.0000, indicating a statistically significant difference between infected and non-infected children ($p < 0.05$).

Table 2: Overall occurrence of intestinal helminth infections

Infection status	Number	Percentage (%)	p-value
Positive	65	25.5	0.0000*
Negative	190	74.5	
Total	**255**	**100.0**	

Key: * = Result is statistically significant, $X^2 = 61.2745$

Occurrence of Individual Parasites

Table 3 demonstrates that A. lumbricoides was the most frequently detected parasite, with 35 cases (13.7%), followed by hookworm with 21 cases (8.3%) and *T. trichiura* with 9 cases (3.5%). Collectively, these infections accounted for the 65 positive cases, representing 25.5% of the 255 children examined. The p-value of 0.00001, indicating a statistically significant difference in the occurrence of the three parasite species.

Table 4.3: Distribution of *A. lumbricoides, T. trichiura* and hookworm

Parasite	Number	Percentage (%)	p-value
A. lumbricoides	35	13.7	0.00001*
Hookworm	21	8.3	
T. trichiura	09	3.5	
Total	**65**	**25.5**	

Key: * = Result is statistically significant, $X^2 = 17.0606$

The illustrative findings indicate that *A. lumbricoides* had the highest prevalence, followed by hookworm, while *T. trichiura* had the lowest prevalence.

Occurrence According to Age

Table 4 shows that children aged 8–10 years recorded the highest number of positive cases, with 32 infections, followed by children aged 5–7 years with 18 cases and those aged 11–12 years with 15 cases. There is statistically significant association between age group and helminth infection at the 5% significance level ($p<0.05$).

Table 4: Distribution of helminth infections according to age

Age group	Examined	Positive	Prevalence (%)	p-value
5–7 years	80	18	7.1	0.027306
8–10 years	102	32	12.5	
11–12 years	73	15	5.9	
Total	**255**	**65**	**25.5**	

Key: * = Result is statistically significant, $X^2 = 7.2013$

Occurrence According to Sex

Table 5 shows that males had 37 positive cases (14.5%), while females had 28 positive cases (11.0%). The association between sex and helminth infection was not statistically significant. Although more infected children were male than female, the difference was not statistically significant.

Table 5: Distribution according to sex

Sex	Examined	Positive	Prevalence (%)	p-value
Male	136	37	14.5	0.264288
Female	119	28	11.0	
Total	**255**	**65**	**25.5**	

Key: * = Result is not statistically significant, $X^2 = 1.2462$

Parasite Intensity

Table 6 demonstrated the intensity of infection among the positive children. *A. lumbricoides* had infections classified as light, moderate and heavy, whereas hookworm and *T. trichiura* were reported as having light and moderate infections only. For *A. lumbricoides*, the result reports 23 (66.3%) light infections, 10 (27.7%) moderate infections and 2 (6.0%) heavy infections. This indicates that light infection was predominant. Hookworm similarly showed a predominance of light infection, with 17 (84.6%) reported as light and 4 (15.4%) as moderate, with no heavy infection recorded. *T. trichiura* showed 6 (66.7%) light and 3 (33.3%) moderate infections, with no heavy infection.

Table 6: Intensity of infection among positive children

Parasite	Light	Moderate	Heavy
A. lumbricoides	23 (65.7%)	10 (28.6%)	2 (5.7%)
Hookworm	17 (81.0%)	4 (19.0%)	0 (0.0%)
T. trichiura	6 (66.7%)	3 (33.3%)	0 (0.0%)

Discussion

The predominance of school-aged children in intestinal helminth studies is epidemiologically important because children in this age group have frequent exposure to contaminated soil, water and food and may have behavioural practices that increase the risk of acquiring soil-transmitted helminths (STHs). The major STHs of public-health importance include *Ascaris lumbricoides*, *Trichuris trichiura* and hookworms. Transmission occurs principally through contamination of the environment with human faeces, particularly where sanitation and hygiene are inadequate (WHO, 2023).

The demographic structure of the present study is also comparable with recent Nigerian investigations. For example, a 2025 study among children aged 5–12 years in Calabar examined a similar school-age population and reported that STH infections remain an important health concern among children and adolescents (Usang *et al*., 2025). The slight male predominance observed in the present study does not necessarily imply greater susceptibility of males to helminth infection; rather, it may simply reflect the sex composition of the sampled population. Sex-specific differences in STH infection can be influenced by behavioural, occupational, environmental and cultural factors rather than biological sex alone.

The prevalence of 25.5% demonstrates that approximately one out of every four children examined was infected with at least one intestinal helminth. Although the majority of children were uninfected, the observed prevalence represents a substantial public-health concern because helminth infections among school children may contribute to abdominal discomfort, anaemia, impaired nutritional status, poor physical development and reduced school performance, particularly when infections are persistent or of high intensity. The finding is lower than the pooled Nigerian prevalence of 54.8% reported in a systematic review and meta-analysis of STH infections among Nigerian children. However, the same review demonstrated considerable geographical variation, with prevalence differing according to region, study setting, environmental conditions and study period (Karshima, 2018). The present prevalence is also reasonably close to the 28.8% reported in a 2025 school-based study in Calabar, Nigeria, where *A. lumbricoides* was the predominant parasite (Usang *et al*., 2025).

Differences between studies may result from variations in sanitation facilities, availability of potable water, climatic conditions, soil characteristics, personal hygiene, frequency of deworming, socioeconomic conditions, diagnostic methods and the timing of sample collection. WHO identifies poor sanitation, unsafe water and inadequate hygiene as major conditions sustaining STH transmission (WHO, 2023).

The predominance of *A. lumbricoides* is consistent with findings from several Nigerian studies. A systematic review and meta-analysis identified *A. lumbricoides* as the most prevalent STH species among Nigerian children, with a pooled prevalence of 44.6% (Karshima, 2018). Similarly, the 2025 Calabar study reported *A. lumbricoides* as the most prevalent parasite, occurring in 19.6% of participants (Usang *et al*., 2025). The relatively high occurrence of *A. lumbricoides* may be associated with the biological characteristics of the parasite. Its eggs are highly resistant to environmental conditions and can remain viable in contaminated soil for extended periods. Consequently, children who play on contaminated ground or consume food or water contaminated with infective eggs may become infected.

From the finding of the present study, the 8–10-year group had the highest age-specific prevalence. This calculation provides a clearer epidemiological comparison than the percentages currently presented in the table, because the reported 7.1%, 12.5% and 5.9% represent the positive children as percentages of the entire sample of 255, rather than prevalence within each age group. The finding agrees with evidence that school-aged children constitute an important population at risk for STH infection. The Nigerian systematic review reported particularly high prevalence among

school-aged children (Karshima, 2018). A recent Nigerian study also observed relatively greater STH prevalence among older children/adolescents compared with younger children (Oyeyemi and Okunlola, 2023). However, age-related patterns may differ between communities. In some settings, younger children may have greater exposure because of playing on contaminated soil and inadequate hygiene, whereas older children may have increased environmental exposure through outdoor activities.

Males had a somewhat higher observed prevalence, but the statistical test indicates that this difference could reasonably have occurred by chance. This finding is comparable with recent Nigerian research. In the 2025 Calabar study, STH prevalence was also somewhat higher among males (30.2%) than females (27.7%), although the difference was relatively small (Usang *et al*., 2025). The slightly higher prevalence among males could be related to behavioural differences, such as greater participation in outdoor activities, contact with soil and recreational activities that increase exposure to infective stages. Nevertheless, sex itself may not be a major determinant of infection where males and females share similar environmental and socioeconomic conditions (Jordan *et al*., 2018).

The predominance of light infections is epidemiologically encouraging because heavy infections are more likely to produce significant morbidity. Nevertheless, light infections should not be regarded as clinically irrelevant, particularly where repeated infections occur or where multiple parasitic infections are present. The predominance of light infection observed in this study is consistent with a recent Nigerian school-based study from Calabar, where all identified STH infections were classified as light intensity (Usang *et al*., 2025). It also supports the concept that infection intensity can vary considerably between communities depending on environmental contamination, frequency of exposure, sanitation and previous preventive chemotherapy.

The absence of heavy hookworm and *T. trichiura* infections in the present study may indicate relatively low transmission intensity or the effects of previous deworming programmes. Preventive chemotherapy is an important component of STH control, and evidence from Nigeria indicates that repeated mass drug administration can reduce STH burden when appropriately implemented (Oyeyemi and Okunlola, 2023). However, continued environmental transmission can result in rapid reinfection following treatment if sanitation and hygiene conditions remain inadequate. WHO therefore emphasizes that preventive chemotherapy should be complemented by improvements in water, sanitation and hygiene (WHO, 2025).

Conclusion

The study established that intestinal helminth infections remain an important public health concern among school-aged children in the study area. Out of the 255 children examined, 65 (25.5%) were infected with at least one of the investigated intestinal helminths, while 190 (74.5%) were negative. Among the parasites investigated, *Ascaris lumbricoides* was the most prevalent, occurring in 35 (13.7%) children, followed by hookworm in 21 (8.3%) and *Trichuris trichiura* in 9 (3.5%). Age was found to be significantly associated with intestinal helminth infection. Children aged 8–10 years recorded the highest number of positive cases, followed by those aged 5–7 years and 11–12 years. The assessment of infection intensity showed that light infections predominated among the infected children. Moderate infections were also observed, particularly among children infected with *A. lumbricoides*, hookworm and *T. trichiura*, while heavy infections were recorded only for *A. lumbricoides*. Overall, the findings demonstrate that intestinal helminthiasis continues to affect school-aged children in the study area. The persistence of infection highlights the importance of integrated control measures, including regular deworming, improved environmental sanitation, access to safe water, proper disposal of human faeces, handwashing, use of footwear and continuous health education.

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