

Soil-Transmitted Helminthiasis among Children Attending General Hospital Kankara, an Insecurity-Plagued Community in Northwestern Nigeria

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ABSTRACT

Background and Objective: Soil-transmitted helminthiasis (STHs) is one of the major Neglected Tropical Diseases (NTDs) endemic among the poor regions of the world. This study surveyed STHs among children attending General Hospital Kankara, one of the insecurity-plagued areas within Katsina State. This study aimed at using the formal ether technique to assess the prevalence of STHs among children of different ages (1-15 years), sexes and settlements in Kankara General Hospital.

Materials and Methods: Stool samples of 314 were collected using sterile universal bottles among children between 1-15 years attending General Hospital Kankara. The formal-ether technique was used for the processing and examination of stool samples. Data on age, sex and settlement were collected and the Chi-square Test was used in analysing the data. **Results:** Out of 314 children, 179 (57%) were infected with one or more STHs. Sex-related prevalence of STHs cut across the two sexes, with a higher prevalence among males (58.6%). Prevalence was higher among the 1-5-year age group (60.3%) and least among the 11-15 years (51.8%) age group. Those children from neighbouring villages had a higher infection rate (62.5%) than the ones from Kankara Town (49.2%). Prevalence of parasite types was in the order *Ascaris lumbricoides* > *Hookworm* > *Trichuris trichiura* across all age groups, sexes and settlements.

Conclusion: In conclusion, soil-transmitted helminthiasis is endemic among children in Kankara and its prevalence is associated with sex, age group and settlements.

KEYWORDS

Neglected tropical diseases, *Ascaris lumbricoides*, hookworm, public health, epidemiology, mass drug administration, disease of poverty

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INTRODUCTION

Soil-transmitted helminths (STHs) refer to intestinal worms infecting humans that are transmitted *Ascaris lumbricoides* through contaminated soil¹. Khurana and Sethi² reported that roundworms (*Ascaris lumbricoides*), whipworms (*Trichuris trichiura*) and hookworms (*Ancylostoma duodenal* or *Necator americanus*) induce STH Ibrahim et al.³.



Reported some of which are zoonotic and could be transmitted through the consumption of raw contaminated fruits and vegetables and by the contact of contaminated insects and rodents with human food⁴⁻⁸. A large part of the world's population is infected with one or more of these soil-transmitted helminths: approximately 576-1,121 million people are infected with STHs (Ascaris, Whipworm and Hookworms). Humans are infected by these helminths through consumption of food or drink contaminated with embryonated eggs of roundworms and whipworms, or through active penetration of the skin by filariform (infective 3rd stage) larvae of hookworms from infested soil¹. According to Yapi *et al.*⁹ around 1.5 billion people, or 24% of the global population, were infected with STHs. According to research, children are the most sensitive population to STHs. More than 90% of this age group in Nigeria is enrolled in preschool, primary, or secondary education. According to Ogbe *et al.*¹⁰ nearly a billion people are infected with *A. lumbricoides*, 800 million with hookworms and 770 million with *T. trichiura*.

Morbidity from helminth infections includes a variety of gastrointestinal problems, iron deficiency anaemia and dysentery syndrome. STHs have been discovered as a source of morbidity and mortality in humans worldwide, notably in impoverished nations in the tropics and subtropic¹¹. There are little or no data available about the demography and prevalence of these STHs infection among children attending the General Hospital in Kankara. Hence, this work was designed to fill that gap. This study was designed to assess the occurrence of soil-transmitted helminthiasis among children visiting General Hospital Kankara in Katsina State, Nigeria.

MATERIALS AND METHODS

Study area: The study was conducted between October, 2021 to March, 2022 in the General Hospital Kankara, Kanakara Town, along Kankara-Funtua Road, in Kankara Local Government Area of Katsina State, Nigeria. Kanakara is located on Latitude 11.9173°N and Longitude 7.4222°E with a population of about 243,459 with about 119,238 children between the age of 0-14 years according to the 2006 census report.

Study design: Consecutive sampling was done in children aged 1-15 years and a total sample of 314 children was obtained. The inclusion criteria were children aged 1-15 years who attend General Hospital Kankara, from Kankara Town and other neighbouring villages within Kankara Local Government Area of Katsina State. These are security-challenged areas where the administration of antihelminthic is practically and seemingly impossible.

Sample collection

Ethical approval and consent: A letter of identification from the Head of the Department of Biological Sciences Federal University Dutsin-Ma was presented to the Medical Director of General Hospital Kankara for permission for the study. Questionnaires seeking information on age, sex, settlement, history of helminth infection and treatment were given out to the selected children at random for effective collection of data.

Sample size determination and sampled population: Sampled population were grouped into two, based on their settlement types for this study which include: Kankara Town and neighbouring villages. The children were randomly selected. A total of 314 children were involved in the study whose stool samples were examined.

Data collection

Questionnaire survey: A semi-structured questionnaire was applied to the 314 participants to collect their demographic data (age and gender) and place of residence (settlement).

Stool samples collection: Sterile sample bottles labelled with the child's name, age and sex were given to the children with the help of their parents or guidance for faecal sample collection. All the fecal samples collected were taken to the laboratory for examination.

Stool samples processing and microscopic examination for soil-transmitted: The formol ether concentration technique was used as described by Anyaegbunam and Uwa¹². Using an applicator stick 1 g of faeces mixed with normal saline was placed in a screw-cap bottle with 4 mL of 10% water. The bottle was capped and shaken for around 20 sec to mix it up. Following that, the faeces were sieved and the sieved suspension was collected in a beaker. As 3 mL of ether was added to the suspension after it was transferred to a test tube. The tube was stopped and stirred for 1 min by shaking. Following that, the cork was removed and the sample was immediately centrifuged at 3000 rpm for 1 min. After centrifugation, four layers were visible: ether, a thin layer of detritus, formalin and sediment in the bottom with parasites. After loosening the layer of faecal material with an applicator stick, the supernatant was decanted while the sediment was mixed, put on a slide and covered with a cover slip. To identify the eggs, the slide was viewed under the microscope (Celestron Lab's CB2000C Compound Binocular Microscope, Celestron, LLC, Torrance, California, United States) using the x10 objective first, then the x40 objective. The number of students infected with soil-transmitted helminths, as well as the different types of helminths, were counted and documented.

Statistical analysis: The Statistical Package for Social Sciences (SPSS) software version 23.0 (IBM Corp., Armonk, NY, USA) was used to enter and analyse data. The overall prevalence of soil-transmitted helminthiasis was estimated, Descriptive statistics were computed and stratified by gender, age group and settlement location. The Chi-square Test (95% confidence interval (CI) and a p-value of 0.05% considered significant) was used to compare the prevalence among groups.

RESULTS AND DISCUSSION

Results of the study revealed that out of the 314 children sampled at General Hospital Kankara, 152 (48%) were males while 162 (52%) were females. The age demography of the children was 146 (46%) within 1-5 years old, 112 (36%) within 6-10 years old and 56 (18%) within 11-15-year-old age groups. On the settlement of the participants, 130 (41%) were from Kankara Town while the remaining 184 (59%) were from the neighbouring villages. Out of the 314 participants sampled, 179 (57%) of them tested positive for one or more soil-transmitted helminths.

The high prevalence of STH infection (57%) reported among children visiting General Hospital Kankara is slightly lower than the prevalence reported by Auta *et al.*¹³ who reported 67.1% among primary school children in Gwagwada, Kaduna State. The Eastern part of Nigeria had a greater frequency of STHs (90.67%). In 2023 Imalele *et al.*¹⁴ reported a slightly lower prevalence of 54.4% in Calabar, the Southern part of Nigeria. In Ethiopia, Chelkeba *et al.*¹⁵ reported a decreased frequency of STH in preschool children (33%) in 2022 and the findings of this study are greater than those of Ethiopian studies published in 2014, which found a prevalence of STH infection in preschool children of 23.3%. The high frequency identified in this study is most likely because soil-transmitted helminth infection is most common in low socioeconomic settings with an insufficient water supply and poor sanitary disposal of faeces. Kankara is a security-plagued area which results in low socio-economic conditions and poor health services, resulting in poor deworming drug administration (MDA) implementation, with non-governmental organisations avoiding such areas due to security threats.

Soil-transmitted helminthiasis (STH) remains one of the leading infections that pose a threat to the health of many developing countries with poor and unhygienic environments¹⁶. STH infection is a neglected

Table 1: Prevalence rate of soil-transmitted helminthiases by sex, age group and settlement among children visiting General Hospital Kankara

Variables	Category	Sample size	Number		Prevalence (%)	Statistical analysis (95% CI)
			Negative	Positive		
Sex	Male	152	63	89	58.6	$\chi^2 = 0.287$, df = 1, p = 0.592 OR = 1.130 (0.722 - 1.768)
	Female	162	72	90	55.6	
	Total	314	135	179	57.0	
Age group (years)	1-5	146	58	88	60.3	$\chi^2 = 1.383$, df = 2, p = 0.501
	6-10	112	50	62	55.4	
	11-15	56	27	29	51.8	
	Total	314	135	179	57.0	
Settlement	Kankara Town	130	66	64	49.2	$\chi^2 = 5.473$, df = 1, p = 0.019, OR = 0.582 (0.369-0.917)
	Neighbouring villages	184	69	115	62.5	
	Total	314	135	179	57.0	

tropical illness that continues to be a major health burden, particularly in rural and security-challenged places such as Kankara, where school-aged children may suffer significant morbidity. The most recent WHO 2012 recommendation is to limit STH infection morbidity in preschool-aged children as one of the at-risk populations¹⁷. Sex-related prevalence of soil-transmitted helminths cut across the two sexes cohorts, prevalence was high among males (58.6%) and females (55.6%) $p > 0.05$. Age-related prevalence shows that soil-transmitted helminths cut across different age cohorts, prevalence was high among 1-5 years (60.3%), followed by 6-10 years (55.4%) and 11-15 years (51.8%) $p > 0.05$. Settlement-related prevalence shows that there is no significant difference in soil-transmitted helminth prevalence among neighbouring villages (62.5%) and prevalence in Kankara Town (49.2%) $p < 0.05$ as shown in Table 1.

Sex-related prevalence, (Table 2), soil-transmitted helminth infection was (55.6%) in females and (58.6%) in males. The infection rate for each helminth was *Ascaris lumbricoides* is slightly higher in males (41.4%) and females (40.67%), followed by hookworm (8.6%) and (7.2%) in females and males and lastly *Trichuris trichiura* (1.9%) and (5.3%) in females and males respectively. Showing a significant p-value of $p > 0.05$. The prevalence of STH species according to age, *Ascaris lumbricoides* was highest in 1-5 years (42.5%), followed by 11-15 (41.3%) and 6-10 years (39.3%). Hookworm prevalence was high among the age group 1-5 years (8.2%), followed by the age group of 6-10 years (8.0%) and then 11-15 years (7.1%). The prevalence of *Trichuris trichiura* was high among the age 1-5 years (4.8%), followed by 6-10 years (2.7%) and then 11-15 years (1.8%) with an overall significant p-value of 0.973 ($p > 0.05$). Prevalence of parasites types was in the order *Ascaris lumbricoides* > *Hookworm* > *Trichuris trichiura* across all age groups and all sexes this is slightly different from the results reported by Imalele *et al.*¹⁴ in 2023 and Pasaribu *et al.*¹⁸ in 2019 in Calabar Nigeria and Sumatera, Indonesia respectively with the prevalence of parasites types in the order *Ascaris lumbricoides* > *Trichuris trichiura* > *Hookworm*. This could be a result of a low level of hygiene in the study area and the uncontrolled habit of walking or playing barefoot on contaminated soil in the study area. This is confirmed by the observations of Anyaegbunam and Uwa¹². The observed decrease in helminth infection with an increase in age would suggest that the age and the prevalence of helminth parasite infection have an inverse connection. This could be attributed to an increase in awareness and appropriate hygiene practices among the elderly. The high prevalence, on the other hand, among the Children age groups in this study may be attributed to the fact that younger age groups spend most of their leisure time outdoors, playing and foraging in garbage dumps and eating carelessly with unwashed hands while the older age group are mostly engaged in useful domestic work in the house and thus hardly had time to play on garbage dumps. Salawu and Ughele¹⁹ and Abe *et al.*²⁰ in Osun and Nasarawa State respectively, in Nigeria reported that no significant difference in the prevalence of infection amongst school-age children according to age and gender thus suggesting that all age groups and genders are exposed to a similar risk of STHs infection this report is not in concordance with our findings. This could be a result of regional and cultural divides. Similar results have been reported by the high prevalence

Table 2: Prevalence of parasites according to type of parasite and multiple infections among children attending General Hospital Kankara

Variable	Category	Sample size	Negative (%)	<i>Ascaris lumbricoides</i> (%)	<i>Hookworm</i> (%)	<i>T. trichiura</i> (%)	<i>Ascaris+ Hookworm</i> (%)	<i>Ascaris+ T. trichiura</i> (%)	<i>Hookworm+ T. trichiura</i> (%)	Statistical analysis (95% CI)
Sex	Male	152	61 (40.1)	63 (41.4)	11 (7.2)	8 (5.3)	7 (4.6)	1 (0.7)	1 (0.7)	LR = 7.006, df=6, p=0.320 (0.415-0.434)
	Female	162	74 (45.7)	66 (40.67)	14 (8.6)	3 (1.9)	2 (1.2)	1 (0.6)	2 (1.2)	
	Total	314	135 (43.0)	129 (41.1)	25 (8.0)	11 (3.5)	9 (2.9)	2 (0.6)	3 (1.0)	
Age group (years)	1-5	146	60 (41.1)	62 (42.5)	12 (8.2)	7 (4.8)	3 (2.1)	1 (0.7)	1 (0.7)	LR = 5.322, df = 12, p = 0.973 (0.970 - 977)
	6-10	112	50 (44.6)	44 (39.3)	9 (8.0)	3 (2.7)	3 (2.7)	1 (0.9)	2 (1.8)	
	11-15	56	25 (44.6)	23 (41.3)	4 (7.1)	1 (1.8)	3 (5.4)	0 (0.0)	0 (0.0)	
Total	314	135 (43.0)	129 (41.1)	25 (8.0)	11 (3.5)	9 (2.9)	2 (0.6)	3 (1.0)		
Settlement	Kankara town	130	62 (49.2)	49 (37.7)	12 (9.2)	3 (2.3)	3 (2.3)	1 (0.8)	0 (0.0)	LR = 6.664, df = 6, p = 0.458 (0.448 - 0.468)
	Neighbouring villages	184	73 (62.5)	80 (43.5)	13 (7.1)	8 (4.3)	6 (3.3)	1 (0.5)	3 (1.6)	
	Total	314	135 (43.0)	129 (41.1)	25 (8.0)	11 (3.5)	9 (2.9)	2 (0.6)	3 (1.0)	

T. trichiura: Trichuris trichiura

observed among male children than the female does not agree with similar studies in the eastern part of the country where observations of Anyaegbunam and Uwa¹² concluded that the prevalence of STHs was more common in females than in males. The results agree with the findings of Abe *et al.*²⁰. In Nasarawa where the result of the study shows a reverse outcome where males are more exposed to contaminated environments in the northern part of Nigeria due to the culture of restricting females from moving around and the males are not restricted and are also responsible for carrying out farm work thus exposing them to STHs infection. The high incidence of *A. lumbricoides* may be related to the infective ova's remarkable resilience to desiccation and the direct route of infection, which increases longevity and promotes infectivity²¹.

Prevalence according to settlement (Table 2), soil-transmitted helminth infection was (62.5%) in neighbouring villages and (49.2%) in Kankara Town. The infection rate for each helminth was *Ascaris lumbricoides* is slightly higher in neighbouring villages (43.5%) and Kankara Town (37.7%), followed by hookworm (9.2%) in Kankara Town and (7.1%) in neighbouring villages and lastly *Trichuris trichiura* (3.3%) and (2.3%) in neighbouring villages and Kankara Town respectively. Showing an insignificant p-value of 0.458. A high prevalence rate was recorded among children living in neighbouring villages than in Kankara Town due to a low level of hygiene awareness which could be a result of poverty. The occurrence of STHs ova/larvae among children within the settlements is a public health problem since it provides a source of infection for unwitting individuals. As a result, STHs were found in 57% of the faeces samples investigated. This can be attributed to the high level of contamination of soil samples in the settlements around Kankara. As a result, little or no mass Drug administration, in addition to the yearly mass treatment of endemic communities with albendazole/mebendazole, as recommended by the WHO, an integrated approach to STH control in the research region will be required. This strategy will include improved personal cleanliness and environmental sanitation, as well as health education^{14,20,22-24}.

The study is applicable in public health education and the treatment of STH diseases. This study has provided insight into the prevalence of STHs among children in Kankara, which can assist inform public health policies and initiatives to reduce the burden of STH infections in the area. The findings may be relevant in the development of effective treatment techniques for STH infections, thereby improving the health and well-being of those infected.

The implication of this study is on one hand to educate the public about the importance of adequate sanitation and hygiene practises in preventing STH infections, perhaps lowering the number of STH illnesses in the area. STH infections can have a large financial impact on individuals and society. The study on the other hand can assist in determining the economic impact of STH infections, which can then be used to drive policy decisions on investments in public health infrastructure and programmes. This study thus, recommends a holistic and integrated approach by Government and Non-Governmental Organizations to actively engage its relevant agencies in providing adequate security to health workers to embark on mass Drug administration of deworming drugs and sensitization of the populace on the need for proper sanitation and good hygiene. This study is limited to children within the age range of 1-15 years attending general hospital Kankara from Kankara town and its nearby villages, where security is a challenge, thus predisposing them to the menace of helminthiasis. A total of 314 children were randomly selected and the duration of the study was three months.

CONCLUSION

Soil-transmitted helminthiasis infection is endemic among children in Kankara, with the high prevalence reported in this study. Prevalence is associated with the sex, age group and settlement of individuals who participated in the study. *Ascaris lumbricoides* is the commonest parasite in the area, while *Trichuris trichiura* was rare. Mass drug administration (MDA) intervention in the Kankara Local

Government Area by the State Ministry of Health, in collaboration with the Federal Ministry of Health and other partners needs to be better strategized. Public Health awareness on neglected tropical diseases and prevention among caregivers and guardians of children is highly encouraged.

SIGNIFICANCE STATEMENT

Kankara is a security-challenged area with poor hygiene and sanitation. And has suffered poor implementation of mass drug administration (MDA) intervention due to the risk to the lives of health workers carrying out such an important role. This study has shown the effect of MDA when compared to previous research conducted in areas with a history of MDA, where such areas recorded a lower prevalence than areas with little or no history of MDA. This study also shows a high prevalence of STH in association with sex, age group and settlement of individuals.

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