Original Article

Soil-transmitted Helminths and Associated Risk Factors among Elementary School Pupils in Dadin Kowa, Jos

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Abstract

Background: Soil-transmitted helminths are intestinal parasites of humans transmitted through contaminated soil. They are considered neglected tropical diseases found mainly in areas with warm and moist climates where living condition and personal hygiene are poor. **Aim:** The aim of this study was to determine the prevalence of soil-transmitted helminths among primary school pupils in Kangang community of Dadin Kowa, Jos. **Materials and Methods:** This was a cross-sectional study of 136 elementary school pupils from three selected schools in Kangang community in Dadin Kowa of Jos South Local Government Area of Plateau State between April 2018 and June 2018. Stool samples were collected from all the consented participants in a sterile, universal sampling container prelabeled with the participant's identification number. The samples were analyzed within 2 h of collection using parasites concentration technique and microscopy. The results obtained were analyzed using SPSS version 21. **Results:** The prevalence of soil-transmitted helminthiasis among the study population was 42.6%. *Ascaris lumbricoides* (25.7%) was the most common parasites, followed by *Trichuris trichiura* (10.3%). Hookworm infection was observed in 5.1%, while strongyloidiasis caused 1.5% of STHs. The male participants had a prevalence of 55.2% compared to the females who had a prevalence rate of 44.8%. Based on the schools where the participants were recruited, STHs was more prevalence among participant from KS school with rate of 51.2% followed by EBI school (40.0%), while LP school had the least infection rate of 38.1%. **Conclusion:** This study revealed the prevalence of STHs among school pupils in Kangang community of Dadin kowa, Jos, as 42.6%. *A. lumbricoides* was the most common STHs in the area. Males were more infected than females. Age and type of toilet used by the participant were found to be significantly associated with STHs infection.

Keywords: *Ascaris lumbricoides*, hookworm, soil-transmitted helminths, *Strongyloides stercoralis*, *Trichuris trichiura*

Introduction

Soil-transmitted helminths are intestinal worms transmitted through contaminated soil, causing major health problems in tropical and subtropical regions of the world.[1] The soil-transmitted helminths (STHs) of major concern to humans are *Ascaris lumbricoides*, *Trichuris trichiura*, and hookworms (*Ancylostoma duodenale* and *Necator americanus*), each parasitizing the gastrointestinal tracts of millions of infected individuals.[2,3] These parasitic infections ultimately thrive and persist in human communities with high level of poverty, inadequate sanitation, and lack of basic health care.[1]

The Global Burden of Diseases, Injuries, and Risk Factors Study 2016 places the prevalence of infection with soil-transmitted helminths at 1.5 billion cases globally, with over 800 million cases of ascariasis and 400 million each of trichuriasis and hookworm infections.[4,5] A number of features account for this high prevalence including a ubiquitous distribution, the high number of eggs produced per parasite, the durability of eggs under a variety of environmental conditions, and poor socioeconomic status that facilitate its spread.[6] Although STH infection occurs at all ages, it is most common in children of 2–10 years, and the prevalence decreases over the age of 15 years making elementary school-age pupils the most vulnerable.[7]

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The prevalence of STHs may also be affected by climatic and seasonal changes which are important determinants of transmission of STHs infections. Adequate moisture and warm temperature are essential for egg/larval development in the soil.[8-10] For example, eggs of *A. lumbricoides* and *T. trichiura* requires high humidity for embryonation and fast development of eggs.[11,12] Previous studies had reported high STHs infections in rainy season than summer and comparatively lower incidence in winter season.[13,14]

The World Health Organization has recommended large-scale, periodic distribution of safe and efficacious antihelminthic drugs as preventive chemotherapy to at-risk populations in endemic areas for morbidity control of STH infections.[15] The current control strategies have focused on mass drug administration (MDA), in which at-risk populations are treated once or twice per year with albendazole (usually given as a single oral dose of 400 mg) or mebendazole (500 mg).[16] While preventive chemotherapy can greatly reduce morbidity from helminth infection, reinfection typically occurs rapidly after treatment.[17] Long-term STHs control and eventual elimination require improvements to water, sanitation, and hygiene (WASH) access and practices.[18]

The successful control of STHs in the United States of America, South Korea, and Japan where WASH improvements acted in concert with deworming to eliminate STHs as a public health problem supports the need for an integrated control programmed in other countries of high endemicity.[19] WASH interventions are diverse, potentially including improvements in water access (e.g., water quality, water quantity, and distance to water), sanitation access such as access to improved latrines, latrine maintenance, and fecal wastes management, and hygiene practices – handwashing before eating and/or after defecation, water treatment, soap use, wearing shoes, and water storage practices.[20] Interventions often include multiple components, for example, building ventilated-improved pit latrines while also providing hygiene education which are usually difficult to provide in developing countries because of high level of poverty.[21,22] This underscores the need for this research to provide information on the prevalence of STHs among elementary school pupils in Kangang community of Dadin Kowa community, Jos.

Materials and Methods

Study area

The study was conducted among pupils of EBI, KS, and LP schools. The schools are in Kangang community of Dadin Kowa in Jos South Local Government Area of Plateau State. The study area was selected purposely, while the three schools were selected by balloting without replacement out of the total of six schools in the community. EBI and KS schools are privately owned day schools with population of 102 and 143 pupils, respectively. They both use conventional water system toilets and wells as sources of water supply. Most of the students still go to the nearby bushes to defecate as the toilets are inadequate to serve their needs. LP school is a government-owned day school with a total population of 214 pupils during the time of this study. The school lacks a functional toilet, no water supply, and students must use the bushes around to urinate and defecate.

Most of the children attending these schools live with their parents and guardians within the community. The people living in this community are mainly civil servants, farmers, traders, and artisans. The main sources of water supply for the community are from wells, streams, and a few others from borehole, as government pipe-borne water supply is almost none existence as the community is a new layout.

Study population

The study population comprised children between the ages of 4 and 14 years old attending primary school in the three selected schools.

Study design and sample size determination

The study was a cross-sectional school-based study of 136 pupils recruited using a multistage sampling technique from April 2018 to June 2018. The sample size was determined using the formula provided by Aeroye, 2003, at 95% confidence interval and a 5% expected error margin. A local prevalence of 9.0% obtained from a previous study by Mamman and Reuben, 2014, was used.[23] By calculating and adding 10% attrition, sample size of 139 was arrived at but only 136 students participated because one student from EBL school and two from LP school did not return with sample. The sample size was distributed to the three selected schools proportionately taking into consideration the total number of students in each school. The students were finally recruited by using a simple paper balloting containing "YES" or "NO," and those who picked YES were recruited into the study.

Sample collection and processing

Stool sample was collected from each participant using a sterile, leak-proof, and transparent wide-mouthed universal sampling container prelabeled with the participant's identification number. The collected samples were transported within 2 h of collection to laboratory for analysis. The stool samples were processed and examined using formol-ether concentration method. Microscopic examination was performed using ×100 and ×400 magnifications within 30 min of preparation.

Data analysis

The data obtained from the study were analyzed using Statistical Package for the Social Sciences version 21 (IBM SPSS Inc., Chicago, Illinois, USA). Proportions were compared using Chi-square with confidence limit, $P < 0.05$ considered statistically significant.

Ethical consideration

Approval for this study was obtained from the Ethics Committee of the Plateau State Specialist Hospital and Universal Basic Education Board. A written informed consent was obtained from the schools' authorities, the parents and guardians of the pupils recruited for this research. The pupils were also educated

on the health implications of soil-transmitted helminths and their assent obtained before sampling.

Results

Out of the total number of 136 pupils screened for soil-transmitted helminths in three different schools Kangang community of Dadin Kowa, 58 (42.6%) were positive for soil-transmitted helminthiasis. Soil-transmitted helminths were more prevalent among participants from KS school with rate of 51.2% followed by EBI (40%), while LP school had the least infection rate of 38.1%. However, this was not statistically significant [Table 1] ($\chi^2 = 1.89$, $P = 0.39$). *A. lumbricoides* (25.7%) was the most common soil-transmitted helminthiasis among the study population followed by *T. trichiura* (10.3%). Hookworm infection was observed in 5.1%, while strongyloidiasis caused by *Strongyloides stercoralis* was responsible for 5.1% of the infection among the study population [Table 1].

STH infection was found to be more common among age group 7–9 years followed by the age group 4–6 years. Pupils between the age group 13 and 15 years were the least infected. The prevalence in term of age was statistically significant [Table 2] ($\chi^2 = 12.65$, $P = 0.01$).

The types of toilet used by the respondents were significantly associated with the prevalence of soil-transmitted helminthiasis. Those that used conventional water system toilet were infected in 54.3%, while open field/bush defecation was associated with 40.6% of infection with STHs [Table 3] ($\chi^2 = 11.84$, $P = 0.01$).

Another risk factor that was significantly associated with soil-transmitted helminthiasis among the study population was gender. Male participants were infected in 52.5%, while female who were infected with STHs accounted for 34.7%. This association was statistically significant [Table 3] ($\chi^2 = 4.35$, $P = 0.04$).

Table 1: Prevalence of soil-transmitted helminths among the study population

School	Number tested	Number positive (%)
EBI	30	12 (40.0)
KS	43	22 (51.2)
LP	63	24 (38.1)
Total	136	58 (42.6)

χ^2=1.89, *d*=2, *P*=0.39

Table 2: Prevalence of soil-transmitted helminths infections according to age groups

Age group	Number tested	Number positive (%)
4-6	22	10 (45.5)
7-9	47	29 (61.7)
10-12	50	15 (30.0)
13-15	17	4 (23.5)
Total	136	58 (42.6)

χ^2=12.65, *d*=3, *P*=0.01

Table 3: Prevalence of soil-transmitted helminths among the study population in relation to risk factors

Risks factors	Number tested	Number positive (%)	χ^2	*P*
Gender				
Male	61	32 (52.5)	4.354	0.04
Female	75	26 (34.5)		
Sources of water				
Stream	25	12 (48.0)	0.472	0.79
Well	72	29 (40.3)		
Pipe borne	39	17 (43.6)		
Types of toilet				
Pit latrine	34	7 (20.6)	11.844	0.01
Water system	70	38 (54.3)		
Bush/open field	32	13 (40.6)		
Wearing of footwear				
Always	59	25 (42.4)	0.003	0.95
Occasionally	77	33 (42.9)		
Handwashing after defecation				
Always	66	24 (36.4)	5.964	0.05
Occasional	60	32 (53.3)		
Never	10	2 (20.0)		

Discussion

The prevalence of soil-transmitted helminths among the study population was 42.6%. This was lower than the 58.2% reported in under five in a rural community in Mangu, central zone of the state.[24] The lower prevalence in this research could be due to the fact that this research was conducted in the city where there are better living condition and proper sewage disposal than in the rural areas where sewage disposal is mainly in the bush/open field. In another study, a prevalence of 24.6% was reported among Fulani herders by Okolo and John.[25] The lower prevalence in their study could be because the study was conducted in older age group who may be more conscious of their health and well-being than the younger age group.

Studies in other parts of the country reported different prevalent rates.[26,27] This may probably be due to the timing of the research, the standard of living of the various communities where such researches were conducted and the periodic deworming and access to health facilities the study population, especially children in urban areas. Variable prevalence rates have been reported in other African countries such as 12.6%, 27.6%, and 43.8% were reported in Ethiopia, Kenya, and Cameroon, respectively, with the same reason as given above probably playing significant role.[28,29]

Comparatively, it has been reported that the prevalence of STHs is lower in developed countries because of effective implementation of MDA – albendazole and mebendazole and potable water supply, good sanitation, and hygiene (WASH).[5,15]

The most common cause of soil-transmitted helminthiasis in this study was *A. lumbricoides* responsible for 25.7%

of the infection followed by *T. trichiura* (10.3%), while hookworm accounted for 5.1% and *S. stercoralis* the least (1.5%) [Table 4]. This is consistent with reports from other parts of the country.[25,26,30] Similar findings have also been reported in other African countries as well as in Indonesia.[29,31] However, this is contrary to a report in Kenya where hookworm was reported to be the most common caused of helminthiasis.[28]

The prevalence rate of STHs in this study based on age group was statistically significant [Table 2] ($\chi^2 = 12.65$, $P = 0.01$). The age group 7–9 years was responsible for the highest prevalence rate of 61.7%. This was possibly because the children in this age group are more adventurous and less concern about their personal hygiene. They commonly wandered into the bush/forest where people patronized for open defecation, either for hunting or looking for fruits such as mango making them prone to infection with STHs.[32] The age group 13–15 years was the least infected possibly because they are more mature and becoming more conscious of their personal hygiene and increasing immunity. They tend to play less in unhygienic environment than the younger age group. Other studies have reported similar findings of high prevalence among this age group.[12,14,24]

There was statistically significant difference of STHs infection between male and female [Table 3] ($\chi^2 = 4.36$, $P = 0.04$). The males' participants were responsible for 52.5% of the infection, while the female participants were infected in 34.5%. This may possibly be due to the fact that male children are known to be more adventurous,[33] exploring their environment which may predispose them to getting STHs infection than the females who are usually more engaged in domestic activities.

Another risk factor that was significantly associated with STHs infection is the types of toilet used by the population. Those that have conventional water system toilet were more infected (54.3%) followed by those participants who used bush/open field defecation (40.6%) as a means of sewage disposal. Those who use pit latrine are the least infected [Table 3] ($\chi^2 = 11.84$, $P = 0.01$). The use of conventional water system toilet was associated with high risk of soil-transmitted helminthiasis possibly because they have inadequate water supply to adequately keep the toilet neat and therefore predispose to contamination with fecal matter and hence infection with STHs. Other risk factors such as sources of water, wearing of footwears, and washing of hands after defecation were not significantly associated with STHs infection in this study.

Table 4: Species of soil-transmitted helminths among the study population

Parasite species	Number positive (%)
Ascaris lumbricoides	35 (25.7)
Trichuris trichiura	14 (10.3)
Hookworms	7 (5.1)
Strongyloides stercoralis	2 (1.5)
Total	58 (42.6)

Conclusion

The prevalence rate of STHs was 42.6% with *A. lumbricoides* identified as the most prevalent parasite. Age group 7–9 years, the male gender, and types of toilet were identified as significant risk factors associated with soil-transmitted helminthiasis among the study population. These emphases the need for reintroduction of MDA and regular deworming to reduce the complications associated with the infections. Potable water supply, sanitation, and improved personal hygiene (WASH) should also be encouraged in our schools and communities to stem the tide of STHS infections.

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Conflicts of interest

There are no conflicts of interest.

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