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Detection of Soil-transmitted Helminths and their Risk Factors in Some Local Government Primary Schools Sokoto, Nigeria

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Authors' contribution

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: Soil-transmitted helminths are among the neglected tropical disease parasites of humans and one of the major public health burdens in developing countries, particularly Sub-Saharan Africa. It is estimated that about 1.5 billion people are affected worldwide.
Aims: The study was aimed to determine the prevalence and risk factors of Soil-transmitted helminths infection among primary school children.
Study Design: This was a cross sectional, descriptive study.
Place and Duration of Study: The study was conducted among primary school children within the age of 4-15 years old in Sokoto South, Wamakko, Yabo and Dange Shuni local government areas of Sokoto State from February 2021 to July 2021.

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Methodology: Faecal samples of 252 children were collected and analyzed using formol-ether concentration technique.
Results: An overall prevalence of 6.0% was recorded. Differential prevalence of parasite species showed 6.7% *Ascaris lumbricoide*, and 93.3% hookworm infection. There was high prevalence among Males (7.2%) than Females (4.0%). The age group 10-12 has the high prevalence of 9.8%. The high prevalence of 9.5% was obtained in Yabo and Sokoto South respectively. Tap water and water closet users have the lowest prevalence of 5.3%. High prevalence of 33.3% was recorded among borehole users contaminated with soil.
Conclusion: The total low prevalence of soil-transmitted helminths may be as a result of improved awareness of the Soil-transmitted helminths in the study area. The government, non-government agencies should help in the provision of social amenities to ensure the total eradication of these diseases. The teaching of health education in both private and public schools should be encouraged by the government.

Keywords: Primary school children formol-ether; soil-transmitted helminthes; stool; Sokoto.

1. INTRODUCTION

"Soil-transmitted helminths (STHs) refer to the intestinal worms affecting humans that are transmitted through contaminated soil" [1]. "They are transmitted by eggs present in the human faeces which in turn contaminate the soil in areas where sanitation is poor. The main species that infect humans are the large roundworm (*Ascaris lumbricoides*), the whipworm (*Trichuris trichiura*), and hookworms, (*Necator americanus* and *Ancyclostoma duodenale*). Soil-transmitted helminths continue to be a serious public health problem worldwide, with more than 1.5 billion people estimated to be infected" [2]. Infections are widely distributed in tropical and subtropical areas, with the greatest numbers occurring in sub-saharan Africa, the Americas, China and East Asia. Adult worms live in the intestine where they produce thousands of eggs that pass in the faeces of infected human. If an infected human defecates outside (near bushes, in a garden, or field) or if the faeces of an infected human are used as a fertilizer, eggs are deposited on soil. *Ascaris* and whipworm eggs become infective as they mature in soil. Humans become infected with *Ascaris* and whipworm when eggs are ingested. This can happen when hands or fingers that have contaminated dirt on them are put in the mouth or by consuming vegetables and fruits that have not been carefully cooked, washed or peeled. Hookworm eggs are not infective. They hatch egg in soil, releasing larvae (immature worms) that mature into a form that can penetrate the skin of humans. Hookworm Infection is transmitted primarily by walking barefoot on contaminated soil. One kind of Hookworm (*Ancyclostoma duodenale*) can also be transmitted through the ingestion of larvae. World health organization [3] estimates "more than 1.5 billion people are infected with one or more soil-transmitted helminths. School-aged children have been shown to be the population at greatest risk of acquiring infections". "The preponderance of helminthic infection in school-aged children makes this subgroup a good target for helminth control programmes in the general population and schools provide good opportunities for implementation of control programmes" [2]. The study was completely designed to assess the parasitic hygiene of water sources in the study areas. The result of the study is expected to give a fair idea of water safety in North Western Nigerian settings.

2. MATERIALS AND METHODS

2.1 Study Area

Sokoto State is located in the extreme North Western part of Nigeria near to the confluence of the Sokoto River and Rima between longitude 4^{o} 8'E and 6^{o}54'E and latitude 12^{o}N and 13^{o}58'N. It shares boundaries with the Republic of Niger to the North, Kebbi State to the West and South-West and Zamfara State to the East. With an annual average temperature of 28.3^{o}C (82.9^{o}F). However, "maximum daytime temperatures are for most of the year generally under 40^{o}C (104.0^{o}F). The warmest months are February and April when daytime temperatures can exceed 45^{o}C (113.0^{o}F).The rainy season is from June to October during which showers are a daily occurrence. There are two major seasons, wet and dry which are distinct and are characterized by high and low malarial transmission respectively. Sokoto State has projected population of 4,602,298 people" [4].

2.2 Study Design

This is a descriptive Cross-sectional study.

2.3 Sampling Techniques

A stratified sampling technique was used to sample out the study population, the study population was divided into different strata and a simple random sampling techniques was used to sample out the study population.

2.4 Study Population

The subjects used for this study were mainly children within the age of 4-15 years old. The research was done in four (4) primary schools. These schools are;

1. Almajiri integral Model Primary School, Sokoto.
2. Barade Abubakar Jabbi Model Primary School, Sokoto.
3. Rijiya Doruwa Model Primary School, Sokoto.
4. Sarkin Kabin Yabo Mai Turare na biyu Model Primary School, Sokoto.

2.5 Sample Size Determination

The sample size was obtained using the formula;

$n = Z^2 P Q / d^2$ [5].

Where:

n = minimum sample size
z = confidence interval (1.96)
p = prevalence rate (18%) [6].
d = desired level of significance (0.05)
q = 1- P = (1- 0.18) = 0.82

Using the formula, the minimum number of sample will be;

$n = (1.96)^2 \times 0.18 \times 0.82 / (0.05)^2 = 3.8416 \times 0.18 \times 0.82 / 0.0025 = 0.5670 / 0.0025$ n = 226.8 = 227 i.e 227 samples.

10% Attrition rate (23) will be added to the sample size: 227+23=250. In order to have uniform distribution of the participants in the selected primary school 2 participants will be added 250+2=252 samples.

2.6 Inclusion Criteria

The inclusion criteria are children within the age range of 4-15 years with no history of any major illness and have not taken anti-helminthic drugs in last 2 or 3 weeks.

2.7 Exclusion Criteria

The exclusion criteria are subjects above 15 years and below 4 years and subjects under medication of anti-helminthic drugs and with a history of an underlined illness.

2.8 Study Tools

Questionnaires were distributed among the study subject which was designed to capture the socio-demographic characteristics as well as their age, gender and Local Government Area of the study subjects.

2.9 Sample Collection

Questionnaires were distributed among the study subjects and a dry, clean wide mouth; leak-proof containers were also distributed, informing the subjects not to contaminate the stool with urine, water or soil. The samples were collected, fixed with 10% formalin and transported to Medical Microbiology laboratory Usmanu Danfodiyo University Sokoto for analysis.

2.10 Macroscopic Examination

The following was observed macroscopically and recorded for each of the samples:

1. Color of the specimen: Weather light brown, dark brown or black.
2. Consistency of the specimen: Weather formed, semi formed or watery.
3. Presence of blood or mucus:
4. Presence of Adult worm:

2.11 Formol-ether Concentration Method

An applicator stick was used to emulsify an estimated 1 g (pea-size) of faeces in about 4 ml of 10% formol saline contained in a screw-cap tube. 3 ml of 10% v/v formol saline will be added to the screw-cap tube and mix well by shaking. The emulsified faeces was sieved and the sieved suspension was collected in a beaker. The suspension was transfer to a centrifuge tube and 3ml of diethyl ether was added to the tube. The tube was stopper and mixed for 1 minute. A tissue or piece of cloth was used to wrap around the top of the tube to loosen the stopper and centrifuge immediately 3000 rpm for 5 minute. An applicator stick was used to loosen the layer of faecal debris from the side of the tube and the tube was inverted to discard the ether, faecal debris, and formol saline leaving the sediment. The tube was returned to its upright position and

the fluid was allowed from the side of the tube to drain to the bottom. The bottom of the tube was tapped to resuspend and mix the sediment. The sediment was transferred to a slide, and cover with a cover slip. The preparation was examined microscopically using the 10x objective with the condenser iris closed sufficiently to give good contrast, and using the 40x objective to examine eggs or larvae of the helminth. Although the motilite larvae will not be seen, the non-motile larvae can be easily recognized [7].

2.12 Statistical Analysis

Data were collected and analyzed using statistical package for social sciences (SPSS) version 23. Chi-square (Pearson) as a statistical test of association or significance was used to measure association or significance on the effects of different variables on the Soil-transmitted helminth among the primary school children. Values were considered statistically significant at $p < 0.05$.

3. RESULTS

A total of 252 subjects were enrolled for the study, an overall prevalence of 6.0% was obtained, out of the 252 participants examined for Soil-transmitted helminth infections.

Table 1 shows the prevalence and distribution of Soil-transmitted helminthes infection with respect to Socio-demographic variables. A total of 153 male and 99 female were involved in this study. Soil-transmitted helminths were detected in 11(7.2%) of male and 4(4.0%) of female. There was no statistically significant association between gender of school children and infection with Soil-transmitted helminths (p-value = 0.30 df = 1). There was high infection rate among age group 10-12 years with a prevalence of 10(9.8%) which was followed by age group 13-15 years with a prevalence rate of 5(7.6%) and there was no infection rate in the age group 4-6 years and 7-9 years respectively. There was statistically significant association between age group and infection status. (P-value = 0.04 df =3). A high infection rate was recorded in Yabo and Sokoto South Local Government Area with a prevalence of 6(9.5%) respectively, which was followed by Dange Shuni Local Government Area with a prevalence rate of 3(4.8%) and there was no infection rate in Wamakko Local Government Area. There was no statistically significant association between local government area and infection status (p-value = 0.07 df =3).

Table 2. Shows prevalence and distribution of Soil-transmitted helminth infection with respect to tribe, occupation, toilet and water source. Soil-transmitted helminth were detected in Hausa 14(6.4%), Fulani 1(3.2%) with no infection rate among Yoruba and Igbo 0(0.0%) respectively. There was no statistically significant association between Tribes and infection status (p-value = 0.76 df =2). A total of 107 Civil servants, 86 Business, 53 Farming and 6 Unemployed Parent occupations were used in this study. There was a high infection rate among civil servant 9(8.4%), followed by Business 4(4.7%) and a low infection rate among farming 2(3.8%), No infection rate was recorded among the unemployed. Statistical analysis shows no significant association between Parent's occupation and infection status (p-value = 0.52 df = 3).

Table 1. Prevalence and distribution of soil-transmitted helminthic infection with respect to socio-demographic variables among study participants in Sokoto, Nigeria

Variables	Soil-transmitted helminths		Total	χ^2	*p-value*
	Infected n=15	Uninfected n=237	N=252		
	n %	n %	n (%)		
Gender					
Male	11(7.2)	142(92.8)	153(100)	1.06	0.30
Female	4(4.0)	95(96.0)	99(100)		
Age Group					
Age Group					
4-6	0(0.0)	38(100)	38(100)	8.33	0.04*
7-9	0(0.0)	46(100)	46(100)		
10-12	10(9.8)	92(90.2)	102(100)		
13-15	5(7.6)	61(92.4)	66(100)		
Local Government					
Yabo	6(9.5)	57(90.5)	63(100)	7.01	0.07
Dange Shuni	3(4.8)	60(95.2)	63(100)		
Sokoto South	6(9.5)	57(90.5)	63(100)		
Wamakko	0(0.0)	63(100)	63(100)		

**Statistically Significant (p-value ≤0.05)*

Table 2. Prevalence and distribution of soil-transmitted helminthic infection with respect to tribe, occupation, toilet and water source variables among study participants in Sokoto, Nigeria

Variables	Soil-transmitted helminths		Total	χ^2	*p-value*
	Infected n=15	Uninfected n=237	N=252		
	n %	n %	n (%)		
Tribe					
Hausa	14(6.4)	206(96.6)	220(100)	0.54	0.76
Yoruba	0(0.0)	1(100)	1(100)		
Fulani	1(3.2)	30(96.8)	31(100)		
Igbo	0(0.0)	0(0.0)	0(0.0)		
Occupation					
Civil Servant	9(8.4)	98(91.6)	107(100)	2.24	0.52
Business	4(4.7)	82(95.3)	86(100)		
Farming	2(3.8)	51(96.2)	53(100)		
Unemployment	0(0.0)	6(100)	6(100)		
Toilet					
Water Closet	6(5.3)	107(94.7)	113(100)	0.15	0.69
Pit	9(6.5)	130(93.5)	139(100)		
Water Source					
Tap Water	8(5.3)	142(94.7)	150(100)	4.93	0.29
Well water	6(6.8)	82(93.2)	88(100)		
River/Stream	0(0.0)	9(100)	9(100)		
Sachet(Pure)	0(0.0)	2(100)	2(100)		
Borehole	1(33.3)	2(66.7)	3(100)		

Table 3. parasites distribution with respect to gender, age group, local government and water source variables among study participants in Sokoto, Nigeria

Variables	*Ascaris lumbricoide*	Hookworm
	n=1	n=14
	n %	n %
Gender		
Male	1(9.1)	10(90.9)
Female	0(0.0)	4(100.0)
Age Group		
4-6	0(0.0)	0(0.0)
7-9	0(0.0)	0(0.0)
10-12	1(10.0)	9(90.0)
13-15	0(0.0)	5(100.0)
Local Government		
Yabo	1(16.7)	5(83.3)
Dange Shuni	0(0.0)	3(100.0)
Sokoto South	0(0.0)	6(100.0)
Wamakko	0(0.0)	0(0.0)
Water Source		
Tap water	0(0.0)	8(100.0)
Well water	1(16.7)	5(83.3)
River/Stream	0(0.0)	0(0.0)
Sachet(Pure) water	0(0.0)	0(0.0)
Borehole	0(0.0)	1(100.0)
Prevalence	1(6.7)	14(93.3)

There was a high infection rate among pupils that uses pit latrines with prevalence rate of 9(6.5%) and a low infection rate among pupils that uses water closet with prevalence of 6(5.3%). Statistical analysis show no significant association between toilet and infection status (p-value = 0.69 df = 1). A Total of 150 pupils that uses tap water source followed by 88 pupils that uses well water, 9 pupils uses river/stream, 2 pupils use sachet (pure) water and 3 pupils that uses borehole water source. There was a high infection rate among borehole water users with prevalence of 1(33.3%), followed by well water users with a prevalence of 6(6.8%), low infection rate among tap water users with a prevalence of 8(5.3%) and no infection rate was recorded among river/stream and sachet (pure) water users. Statistical analysis shows no significant association between water source and infection status (p-value =0.29 df = 4).

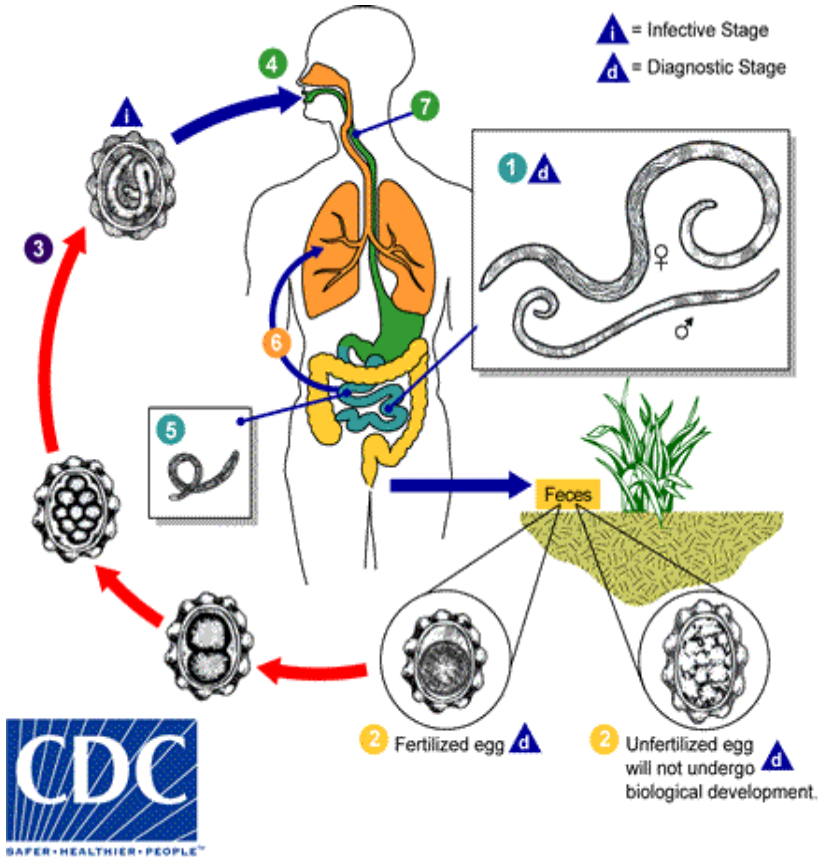

Fig. 1. Life cycle of *Ascaris lumbricoides* [8]

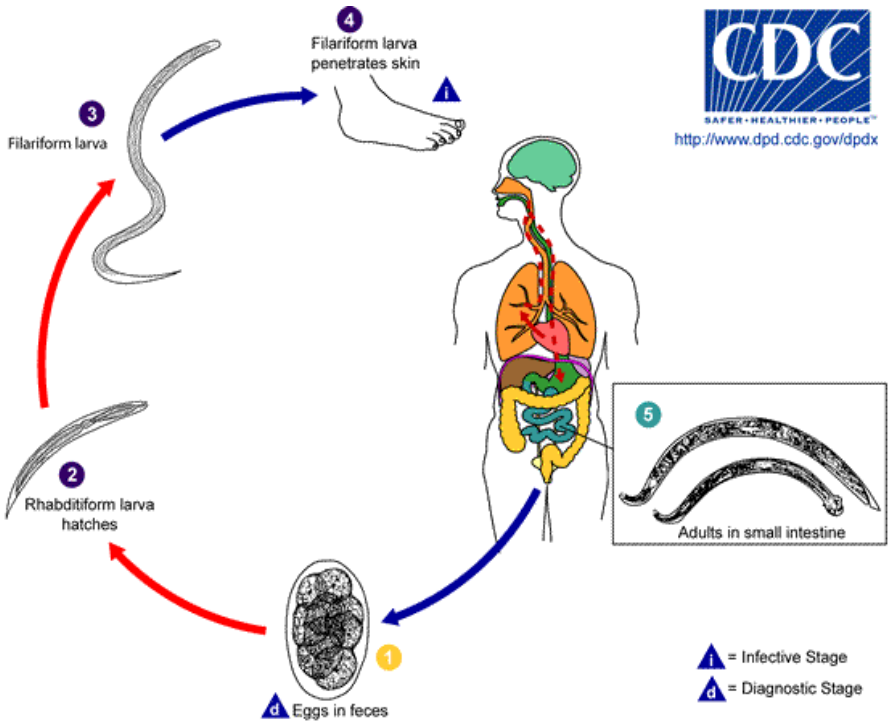

Fig. 2. Life cycle of Hookworm [8]

4. DISCUSSION

The result showed an overall prevalence rate of 6.0% of Soil-transmitted helminth infection in the study population when compare to 74.0% obtained in Sokoto [9], 46.3% in Ile-Ife South Western Nigeria [10], 42.6% in Jos North Central Nigeria [11] and 75.6% in India [12]. The low infection rate recorded in this study is in line with the prevalence rate of 18.0% reported by Bopda and Kamgno [6] and 23.3% reported by Shumbej et al. [13]. The decrease in prevalence of Soil-transmitted helminths infection observed in this study might be due to massive deworming by the State Neglected Tropical Disease Control Agency. The variability in prevalence could also be as a result of improved sanitary standard and personal hygiene in the study area.

There was low prevalence rate among Females (4.0%) than Males (7.2%) as compared to the study conducted in Cameroon with high prevalence rate in Females (54.2%) than Males (45.8%) reported by Bopda and Kamgno [6]. This might be due to lack of personal hygiene of male subjects and their participation in the farming when they accompanied their parent. The low infection recorded in female is in line with the study conducted in Imo, Nigeria by Kelechi et al. [14], prevalence rate of 38.4% in Males and 21.1% in Females.

In this study the age group 10-12 years were the most affected with a prevalence rate of 9.8%. This might be due to lack of personal hygiene and reduce parental care within the age group, followed by the age group 13-15 years with a prevalence rate of 7.6%. There was no prevalence rate recorded in the age group 4-6 and 7-9 years. The difference in infection rates between the groups was statistically significant (p-0.04) This is in agreement with earlier report of Kiran Singh et al. [9] who reported the highest prevalence 44.0% within the age group 11-13 years. Also by Kelechi et al. [14] who reported high prevalence of 31.0% within the age group 11-13 years. Children in this group are not extremely under parental care when compare to the age group 4-6 and 7-9 years so their level of poor sanitary and personnel hygiene predisposed them to Soil-transmitted helminth infections.

This result shows that Soil-transmitted helminths infection was found to be higher in Sokoto South and Yabo with a prevalence of 9.5% respectively. This might be due to lower level of health education. There was no statistically significant association between local Governments areas with a p-value of 0.07.

The distribution of Soil-transmitted helminths was not associated with parent, tribe and occupation with a p-value of 0.76 and 0.52 respectively.

This results shows that pit latrine users have the highest prevalence of Soil-transmitted helminths infection with a prevalence rate of 6.5% and the water closet users with the least prevalence rate of 5.3%. This might be due lack of hand washing after defecation and walking barefooted around the toilet area contaminated with faeces. This Study was in accordance with the study reported by Aniwada et al. [15] with the highest prevalence among pit latrine users (67.8%) and the least prevalence among water closet users (1.52%). There was no statistically significance with a p-value of 0.67.

This study shows that borehole water users have the highest prevalence of 33.3%. This might be as a result of children contaminating the borehole water, followed by well water users 6.8%, tap water users 5.3%, river/stream and sachet (pure) water users with a prevalence of 0.0%. This is in agreement with the study reported by Aniwada E.C. et al. [15] with the highest prevalence among borehole users (28.3%) and the least prevalence among Stream water users (22.7%). There was no statistically significant with a p-value of 0.29.

5. CONCLUSION

The study demonstrates that there was low prevalence of Soil-transmitted helminths infection among primary school children in the study area. However, Males are more affected than Females. The overall low prevalence rate may be as a result of deworming by the State Neglected Tropical diseases control agency, improved awareness of Soil-transmitted helminth parasites in the study area.

ETHICAL APPROVAL

Approvals for this study were obtained from Ministry of health, Ministry of education and school authorities including their headmasters in order have access to the children and their samples (stool).

CONSENT

The informed consent was read to the understanding of study subjects in the language they understood before they were enrolled for the study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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