

# Original Research Article

## PREVALENCE AND TRANSMISSION OF SOIL TRANSMITTED HELMINTHS AMONG FARMERS LIVING ALONG THE METROPOLITAN SECTION OF RIVER KADUNA, NIGERIA.

### ABSTRACT

Soil-transmitted helminths are one of the world's most important causes of physical and intellectual growth retardation. The study was conducted to determine the prevalence and transmission of soil transmitted helminths among farmers living along the metropolitan section of river Kaduna, Nigeria. A total of 210 stool samples were randomly collected from farmers of seven (7) different farms located along the river bank. The stool samples collected were examined for soil-transmitted helminths using direct wet mount and formal ether sedimentation techniques. Questionnaires were administered to the farmers to assess their personal hygiene, sanitation and health maintenance. The prevalence of STH based on the farmers age and gender was also determined. Out of the total stool samples collected, 81(38.6%) were infected with at least one out of the four STH eggs. The eggs of Hookworm and *Ascaris lumbricoides* were the only helminths eggs detected. Hookworm was found to have a prevalence of 54.3% while *A. lumbricoides* has a prevalence of 45.7%. *Strongyloides stercoralis* and *Trichuris tichuira* both were found to have 0% prevalence. The risk factors such as personal hygiene and sanitation were found to have significant influence on the prevalence ( $p < 0.05$ ) while health maintenance shows no significant influence ( $p > 0.05$ ) on the prevalence of STH among the farmers. The age prevalence shows that group 10 – 25 have the highest prevalence of 81.3% while age 36 – 45 shows the lowest prevalence of 2.4%. The gender prevalence shows that male farmer have the highest prevalence of 41.4% out of the total infected farmers (81). The findings could be as a result of farmers' personal hygiene and sanitation on their various farms and their farm tools which acts as a medium for the transmission of the parasite egg, while the younger age group work more hours than the older age group and the male farmer spends more time in the farm than the female.

Keywords: Helminth; Prevalence; Transmission; farmer; water.

### 1. INTRODUCTION

Soil transmitted helminthiasis are diseases caused by parasitic helminths whose life cycle include the egg/larval incubation in the soil and subsequently becoming infective to man and animals via oral-route or skin penetration. These diseases include Ascariasis, Trichuriasis, and hook worm infection (Necatoriasis and Ancylostomiasis) (1). These are the most important helminthiasis among the neglected tropical diseases (2). This group of helminthiasis have been targeted under the joint action of the world's leading pharmaceutical companies and non-governmental organizations through a project launched in 2012 called the London Declaration on Neglected Tropical Diseases, which aims to control or eradicate certain neglected tropical diseases by 2020 (3). Management of some of these parasitic helminthes among farmers varies especially with their level of education, hygiene and ignorance by which some of these farmers claim that intestinal worms are useful components of food digestion (4). According to (1), the major soil transmitted helminths in Nigeria are *Ascaris lumbricoides*, *Trichuris trichura*, *Ancylostoma duodenale*, *Necator americanus*, *Strongyloides stercoralis* and *Toxocara species*. Among these, *A.*

**Comment [BA1]:** Need to add references of this information.

**Comment [BA2]:** Can we have prevalence of STH in Nigeria globally and among farmer

**Comment [BA3]:** What is the odd ratio found about correlation between hygiene and sanitation of farmers and STH eggs detected on stools collected?

**Comment [BA4]:** This is the power of signification of the result obtained but not the prevalence. Please ad the prevalence found.

**Comment [BA5]:** What is the value of prevalence obtain from this study?

*duodenale*, *N. americanus* and *S. stercoralis* are transmitted by direct skin penetration while others gain entry by oral-route. These have become the most common parasitic disease of human worldwide. Approximately two billion people are infected currently, and four billion at risk of infection, surpassing even the all-time most prevalent parasitic disease, malaria (5). An increasing number of studies of helminths epidemiology have shown that it is common for individuals to be infected with more than one species of helminths (6). Soil transmitted helminthiasis is the second largest leading cause of mortality among adult in Africa (7). The infection is promoted by poor personal hygiene habits and the use of human and animal feces as manure. These habit allows contact with feces and its accompanying microbial load including geo-helminth eggs in soil and other risk factors such as use of unclean water sources and having pools of sewage around houses (4). In Africa, the transmission of intestinal parasitic infection has been considered to increase successfully due to the frequent use of untreated human or animal dung as manure in cultivation by farmers, this also serves as a source of enhancement of zoonotic parasitic infection. (8) The distribution of parasitic infections is determined by several factor, such as environmental, food- habit, tradition, social status, economic situations among others. Each parasite has its own natural and social habitat, and favorable environment is a prerequisite for its transmission. Soil-transmitted helminths (STHs) or geohelminths are highly prevalent in poor agricultural societies, where human feces are used as fertilizer (9).

### 1.2 Statement of Research

Despite the increased emphasis on the role of good sanitation and hygiene in the control of soil transmitted helminths, huge number of the population still do not understand the relationship between the two, particularly in rural villages and slums (10). Soil transmitted helminthiasis is associated with chronic and asymptomatic morbidity in human. The morbidity associated with Soil Transmitted Helminths infection include iron deficiency anemia, malnutrition, growth and developmental disorders including short stature and cognitive developmental disorders (11). Low hygiene, lack of sanitation, use of both animal and human feces as fertilizers can also expose the farmers to the infective stages of geohelminths. WHO (12) reported that approximately 1.5 billion people are infected with soil transmitted helminths. making it a globally distributed disease. Major control of the disease is still based on periodical deworming to eliminate infecting worms, health education to prevent re-infection, and improved sanitation to reduce soil contamination with infective eggs.

## 2. MATERIALS AND METHODS

### 2.1 Study Area

The study was conducted within Kaduna metropolis. Kaduna State is located in the Northwest Geopolitical zone of Nigeria. It lies longitude 6-9E and 11–30N. It has distinct wet (April to October) and dry season (November to March) and within the guinea savannah zone of Nigeria. The state shares geopolitical boundaries with Katsina and Zamfara States to the North, Plateau and Bauchi States to the East, Nasarawa State and Federal Capital to the South, Niger State to the West and Kano State to the Northwest. It has a population of about 7,474,369 (2013 projection) (13). The state has 23 Local Government Areas. The farmers used for this study are those along river Kaduna farm and in the following location.

1. Barnawa
2. Kabala Doki
3. Kabala West
4. Unguwan Mu'azu
5. Nassarawa
6. Unguwan Rimi
7. Malali

### 2.2 Sample Size Estimation

Base on the pervious study of (14) where the projected prevalence of 2.2% was obtained, the sample size was determined using the formula described below (15).

$$N = \frac{Z^2 pq}{D^2}$$

Where N = the number of samples that were collected

**Comment [BA6]:** What epidemiological situation of STH in Nigeria? Number of people (children, adults disagragated by gender) infected in Nigeria????

**Comment [BA7]:** the first time that this abbreviation should be mentioned was in the abstract not here

**Comment [BA8]:** can we have the percentage of farmers out of that population as a whole? or even the percentage of the primary sector in the total population?

**Comment [BA9]:** You have mentioned the study

**Comment [BA10]:** You have to review this sentence, it is not complete or something is wrong

Z = the normal deviation (1.96 for an alpha of 0.05) corresponding to a confidence interval of 95%.

P = the proportion of symptomatic and asymptomatic people that were expected to harbor geohelminths (2.2%)

$$Q = 1 - P(1 - 0.02) = 0.978$$

$D^2$  = is the precision of the estimates, which is taken as 5% (-0.05)

Substituting the values in the formula:

$$N = \frac{(1.96)^2 \times 0.022 \times 0.978}{(0.05)^2}$$

$$N = \frac{0.08265587}{0.0025}$$

$$N = 33.06$$

$$N = 33$$

The sample size was approximated to 30 farmers per farm area. This sum up to a total sample of 210 farmers.

### 2.3 Sample Collection

Wide-mouth screw capped sample bottles bearing serial numbers and district name was given to the leader of each farm to share among the farmers after a brief explanation on how and when to collect the samples. A brief explanation on the importance of the research to their health and community at large was given also. The samples were collected in the month of June-July, October-November 2019 because in the months of August and September, the river is usually filled up and the farmers moved away from the river banks.

### 2.4 Laboratory Analysis of Fecal Sample

The fecal samples were preserved with 10% formalin and transported to the laboratory of the Nigeria Defence Academy (NDA) Hospital, Afaka Kaduna. The collected specimen were examined for the colour consistency (Formed/Semi formed/unformed/watery) and presence of blood/worm/segment. The analysis was carried out via direct smear method and formal ether concentration technique (16).

#### 2.4.1 Direct Smear Method

A drop of normal saline was placed on a clean slide with the aid of a clean dropper and one gram (1g) of feces was placed on the slide and mixed using a glass rod to obtain a thin smear, the slide was then cover with a cover slip and a drop of lugol's iodine added at the edge of the cover slip to diffuse into the saline mount. The smear was examined under a binocular light microscope for the presence of geohelminth using the X10 objective lens and X40 objective lens (16).

#### 2.4.2 Formalin Ether Concentration Technique

Two gram (2g) of feces was mixed into a test tube containing 10ml of distilled water, and strained through a gauze-sieve into a centrifuge tube and centrifuged at approximately 2,500rpm for 3 min, the supernatant was decanted. 10% normal saline was added to the sediments and mixed with a glass rod for 30 seconds. 3ml of ether was added and shaken vigorously, the mixture centrifuged again for about 2min at 2000rpm: after which the debris was poured away and 2 drop of lugol's iodine was added and shaken. A pipette was used to collect the sediments and placed on a slide to examine under light microscope using x10 objective lens and x40 objective lens (16).

### 2.5 Identification of Parasite

Laboratory diagnosis and atlas was used to identify the parasite egg/larvae based on morphological characterization. (16).

### 2.6 Administration of Questionnaires

A structured questionnaire was administered to the farmers to obtain information on their age sex, level of education, source of water, type of fertilizer used, contact activities and personal hygiene, Farmers who were not able to read were helped by the researcher to read the questionnaires out and also translate it as this enables the farmer to answer the questions, correctly.

### 2.7 Data Analysis

Data obtained in the study was analyzed using statistical package for social science (SPSS version 16.0), Chi-square test was used to compare the prevalence of STH among farmers and associated risk factors at 95% significance level ( $P < 0.05$ ).

## 3. RESULTS

### 3.1 Overall prevalence of soil-transmitted helminths detected among farmers in the study area.

**Comment [BA11]:** The method used to obtain this sample size and the the sample do not corresponding. N that you have obtained is the total number of farmer or stools that you have to collect.  
Please find another sample size that will match with the number of sample that you have collected (210 farmers)

The overall prevalence of soil-transmitted helminths detected among farmers in the study area presented in (table 3.1) shows that out of 210 farmers examined, 81(38.6%) are infected with at least one species of the helminth parasites. The highest prevalent species was hookworm with a prevalence of 45.3% where *T. trichiura* and *S. stercoralis* have zero 0% prevalence irrespectively.

**Table 3.1: Overall prevalence of soil-transmitted helminthes farmers sampled in different locations.**

Locations	Number of Sample examined	No Positive	% Positive	<i>Ascaris lubricoides</i>	Hook worm	<i>Stongyloides Stercoralis</i>
Barnawa	30	19	63.3	07	12	0
Kabala Doki	30	18	60.0	10	08	0
Kabala West	30	10	33.3	06	04	0
U/Mu'azu	30	15	50.0	09	06	0
Nasarawa	30	09	30.0	01	08	0
U/Rimi	30	05	16.7	03	02	0
Malali	30	05	16.7	01	04	0
<b>Total</b>	<b>210</b>	<b>81</b>	<b>38.6</b>	<b>37</b>	<b>44</b>	<b>0</b>

**Comment [BA12]:** Was it number of positive? Positive or No positive? Because when we are using this number for determining the percentage of positive, we have the same number inside the column of % Positive. Please review it.

### 3.2 Prevalence of soil transmitted helminths in relation to risk factors.

The prevalence of soil transmitted helminths in relation to risk factors is presented in table 3.2. Results shows that based on personal hygiene, 158 farmers farm without gloves and boots, 168 farmers eat in their farms, 180 farmers clean up at the river after farming, 178 farmers spend more time at the farm and 151 eat raw vegetables directly from the farms.

Based on sanitation, the result shows that 154 farmers make use of water from the river to farm after rainy season, 185 of the farmers make use of organic fertilizers, and 176 farmers use their hands directly to apply the organic fertilizer in the farm. Due to lack of toilet, 190 of these farmers practice open defecation and 136 of the farmers use the rivers water for other activities such as washing, cleaning of farm tools and sometimes bathing.

Based on the health maintenance, the study shows that 113 farmers were aware of STH as a disease, 142 do develop symptoms which are related to those of STH, 117 farmers practice self-medication, 71 farmers visit hospital when sick and 94 farmers prefer to take herbal medications.

**Comment [BA13]:** Please give just the percentage inside the senteces. For the numbers of farmers we can get it inside the table.

**Table 3.2: Distribution of soil-transmitted helminthes in relation to risk factors**

Risk factors	Total	Number of. Yes	%	P-Value	T	df
<b>Cultural practices personal hygiene</b>						
Farming without gloves and boots	210	158	75.2	0.000	10.8	4
Eating while farming	210	163	77.6			
Cleaning up at the river	210	180	85.7			
More time at the river	210	178	84.8			
Eating raw vegetables	210	151	71.9			
<b>Sanitation</b>						
River water to farm	210	154	73.3	0.03	6.232	4
Organic fertilizer	210	185	88.1			
Application of fertilizer with hands	210	176	83.8			
Open defecation	210	190	90.5			
User river for other activities	210	136	64.8			
<b>Health maintenance</b>						
Knowledge of STH	210	113	53.8	0.850	0.202	4
Symptoms	210	142	67.6			
Self medication	210	117	55.7			
Visit the doctor	210	71	33.8			
Herbal treatment	210	94	44.8			

**Comment [BA14]:** Risk or protector factors are determine by the Odd Ratio. Please determine the odd ratio of each risk factors before this conclusion.

### 3.3 Prevalence of soil transmitted helminths in relation to age and gender.

Table 3.3 presents the prevalence of soil transmitted helminths in relation to gender and age. Results shows that the highest prevalence in the male gender was recorded in the age 10 – 25 (100.0%) and the least percentage in 36 – 45 (13.8%) age bracket. The highest prevalence in the female was recorded also in 10 – 25 (50.0%) age bracket and the least prevalence in the 36 – 45 (6.25%) age bracket.

**Table 3.3: Prevalence of soil transmitted helminths in relation to age and gender**

Age group (Years)	Male			Female		
	No. examined	No. infected	% infected	No. examined	No. infected	% infected
10 – 25	10	10	100.0	6	3	50.0
26 – 35	30	29	96.9	8	3	37.5
36 – 45	29	4	13.8	16	1	6.3
46–Above	100	27	27.0	11	4	36.4
<b>Total</b>	<b>169</b>	<b>70</b>	<b>41.4</b>	<b>41</b>	<b>11</b>	<b>26.8</b>

**Comment [BA15]:** With a comma, it can be considered as number but the other one above does not have a

### 3.4 Prevalence of soil transmitted helminths in relation to gender.

Table 3.4 presents the prevalence of soil transmitted helminths in relation to gender. The table shows that out a total 210 samples examined containing 169 males and 41 females, 70 males and 11 females were positive to at least one of the soil transmitted helminths accounting to 41.4% and 26.8% percentage prevalence respectively. The result shows that the male percentage prevalence is higher than the female.

**Table 3.4: Prevalence of soil-transmitted helminthes in relation to gender**

Gender	No. of samples exam	No. positive	%+ve
Male	169	70	41.4
Female	41	11	26.8
<b>Total</b>	<b>210</b>	<b>81</b>	<b>38.6</b>

### 3.5 Prevalence of soil transmitted helminths in relation to age.

Table 3.5 presents the prevalence of soil transmitted helminths in relation to age. Results shows that the highest prevalence was recorded in age group 10 – 25 years with 81.3%. This is followed by age group 26 – 35 (15.2%) and age group above 46 year (14.8%). The lowest prevalence was recorded in age group 36 – 45 years with 11.1%.

**Table 3.5: Prevalence of soil transmitted helminthes in relation to age.**

Age group (Yrs)	No. examined	No.+ve (%)
10-25	16	13 (81.3)
26-35	38	32 (84.2)
36-45	45	05 (11.1)
46-Above	111	31 (27.9)
<b>Total</b>	<b>210</b>	<b>81</b>

### 3.6 Distribution of different species of soil transmitted helminths in relation to age.

The prevalence of different species of soil transmitted helminths in relation to age as (table 3.6) shows that age group 10 – 25 has the highest prevalence of Hook worm and 36 – 45 years has the lowest with a prevalence of *A. lumbricoides*.

**3.6: Distribution of different species of soil transmitted helminthes in relation to age.**

Age group (Yrs)	<i>A. lumbricoides</i>	<i>T. trichiura</i> (%)	Hookworm (%)	<i>S. Stercoralis</i> (%)
10-25	9 (24.3%)	0	8 (18.1%)	0
26-36	16 (43.2%)	0	29 (65.9%)	0
36-45	5 (13.5%)	0	3 (6.8%)	0
46-Above	7 (18.9%)	0	4 (9%)	0
<b>Total</b>	<b>37</b>	<b>0</b>	<b>44</b>	<b>0</b>

**Comment [BA16]:** Please review this table 3.6. Element inside this table or these values inside is not correct.

**Comment [BA17]:** The sum of these species is 17 but for this same age group inside the table 3.5 it is 13 the sum of positive of this age group 10-25. When you will considered the good value please you have to generated again the percentage of each group for this column

**Comment [BA18]:** You can not have 32 positive from 38 farmer stools examined and when disagragated this same positive by species you have 45 (16+29) for the age group 26-36

**Comment [BA19]:** Same comment

**Comment [BA20]:** Same comment

## 4. DISCUSSION

In this study, the overall prevalence (38.6%) of soil transmitted helminths detected is higher than 34.2% detected by (17). The high prevalence detected may be due to the presences of water body along the study area which the farmer result to whenever there are in need of water (18). Assessing some of the risk factors such as personal hygiene and sanitation by the use of questionnaires shows that some of these farmers do not use hand gloves and farming boots while at the farm, do not wash their hands properly and some of the farmers consume raw vegetables directly from the farm. The results also show that most of these farmers spend more time in the farm than at home and while at the farm, such farmers make use of the water obtained from the river for many different activities.

**Comment [BA21]:** By who? In which study? Conducted where? which year?

Farmers who do not have proper hygiene are more at risk of the infection than farmers who practice proper personal hygiene such as wearing of shoes and gloves. Gloves wearing reduced the risk of infection from the eggs of the helminths by preventing the parasite from penetrating into the skin pores or attaching themselves to the nails of the farmers for oral consumption. This study shows the presence of *A. lumbricoides* and Hookworm among the farmers. This findings is in agreement with the findings of (19) who reported that hookworms and *T. trichiura* are the major types of helminthes found in farmers that have direct contact to the soil. Also in agreement were studies reported by (20) and (21) who both stated that farmer who make use of organic fertilizers in their farms such as human and animal feces to improve the soil are more likely to be infected with STH. (22) stated in his study and reported that farmers who used cattle dung in their farmland showed positive results for helminths infection. (21) reported that the consumption of raw untreated food will also increase helminths infection. The absence of good latrine to famers is accompanied with high risk of acquiring helminths infection (23) and the use of soap and water in washing hands and bathing by farmers can reduce the risk of infection from the parasite (24).

**Comment [BA22]:** With activities precisely?????

**Comment [BA23]:** Who? Conducted were? Which year?

**Comment [BA24]:** Please review this discussion because in this study you 0% of *T. trichiura* found in your analysis at the farmer soil.

(25) reported that transmission of STH is related to the climate with adequate moisture and warm temperature essential for larval development in the soil. The high prevalence of these parasite could therefore be due to lack of personal hygiene and poor sanitation, such as farming and applying fertilizer without hand gloves and boot, direct eating of raw unwashed vegetable from the farm and swimming and bathing in the river after farming. The findings in this study is in agreement with (26, 27). (28) also reported that infection multiply among individuals who lack good hygiene, educational background, health maintenance and good source of water.

**Comment [BA25]:** Does the farmer of this study used organic (such as human and animal feces) fertilizers in their farms????? If not then you have have to leave this part. When you have to mentioned a study conducted by an authors, you have to mentioned his name and collaborators, the site of the study and the year.

Gender prevalence shows that the male (86.4%) are more infected than female (13.6%). This could be as a result of the time female spend on the farms which is lesser when compare to the male who nearly spend all day at the farms. Female also have work specifications during the farming activities and therefore do not engage in all farming activities. Also, the male engage in outdoor activities more, thereby making them more susceptible to STH infections than female (29). This result agrees with (30, 31 and 32) in their research among school age pupils where each researchers have attribute their finding to gender differences in activities.

Generally, some of these farmers might have contacted infections through ingestion of helminths eggs in contaminated raw vegetables, drinking untreated water or while engaging in farming with no gloves or boots on farm lands where untreated human and animal waste are use as fertilizers to increase farm products (33). The comparison the of the expected and observed values according to the chi square test show small discrepancy on the farmers health management as a risk factor that could possible prone them to contacting soil transmitted helminths.

**Comment [BA26]:** Please discuss only your results obtained with the others results of authors.

## 5. CONCLUSION

In conclusion, Soil Transmitted Helminths (STH) is prevalent among farmers along the metropolitan section of river Kaduna and that *Ascaris lumbricoides* and Hookworm are the most common species as they were found to be present in the study population. Male sex due to their outing activities on farm, personal hygiene like consumption of unwashed vegetables/fruits on the farm, sanitation and defecation on farmland which is conversely used as manure and health maintenance increase the risk of STH infections.

## ETHICAL APPROVAL

The experiment management, sample handling and care were approved by the Research and Ethics Committee of the Department of Biological Sciences, Nigeria Defence Academy, Kaduna, Kaduna State.

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