Detection of Hookworm (*Necator Americanus*) and Other Intestinal Parasitic Infection among Primary School Children in Sokoto Metropolis

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Authors’ contributions

This work was carried out in collaboration among all authors. Author KM designed the study, wrote the protocol and wrote the first draft of the manuscript. Author EE and MUI managed the analyses of the study. Authors MKG and SUN performed the statistical analysis while author OFA managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/SAJRM/2021/v10i130219

Received 12 April 2021
Accepted 18 June 2021
Published 06 July 2021

ABSTRACT

**Background:** Hookworm is an intestinal parasite of human and is one of the major public health burdens in developing countries, particularly in Sub-Saharan Africa. It is estimated that about 3.5 billion people globally and 450 million people are thought to be ill as a result of such infections, the majority being children.

**Aims:** The study aimed to determine the prevalence of Hookworm and other intestinal parasitic infection among primary school children

**Study Design:** This was a cross-sectional, descriptive study

**Place and Duration of Study:** This study was conducted in among patients attending Usmanu Danfodiyo University, Teaching Hospital, Sokoto, Sokoto state, between March to November, 2017.

**Methodology:** A total of 224 participants were enrolled for the study. Standard parasitological
examination was carried out on stool samples using microscopy followed by formal ether concentration methods

**Results:** Finding revealed, an overall prevalence of 4.5% out of 224 samples examined recorded for both Hookworm and other intestinal parasitic infection. There was high prevalence rate of Hookworm and other intestinal parasitic infection among males (5.3%) than females (3.6%). 29 (12%) were positive for intestinal parasitic infections. Males recorded higher prevalence than the females with 19 (11.9%) and 10 (11.8%) respectively.

**Conclusion:** The total low prevalence rate of Hookworm and other intestinal parasitic infection may be as a result of improved standard of living and awareness of the Hookworm and other intestinal parasites in the study area. The government, non-governmental agencies and private individuals should help in the provision of social amenities to ensure total eradication of these diseases. The teaching of health education in both private schools should be encouraged by the government which will go a long way in reducing prevalence and intensity of Hookworm infections among the study community.

**Keywords:** Epidemiological survey; Hookworm infection; school children; Sokoto metropolis; Sokoto State; Nigeria.

1. **INTRODUCTION**

Hookworm infection is one of the most common diseases in Nigeria, infecting people at certain periods of lifetime with far reaching disabling and debilitating effects on the individual victims and on the socio-economic development of nations. The causative organisms of the common Hookworm infection are the strongylid nematodes Necator americanus and Ancylostoma duodenale [1]. WHO [2] observed that the geographical distribution of the two main Hookworms, N. americanus and A. duodenale, used to be restricted and relatively distinct, the former being more prevalent in Europe and South Western Asia, and the latter in Tropical Africa and in the Americas. However, over the past decades, both parasites have become widely distributed throughout the tropics and rigid demarcations are no longer tenable.

In Nigeria the presumed human Hookworms, N. americanus and A. duodenale, both occured [3] and Nwosu [4] observed that these two diseases (Ancylostomiases and Necatoriasis) are associated with poor hygienic practices and improper disposal of human wastes. These features are typical of most rural and urban settlements in Nigeria where there is poor planning and inadequate public health facilities. Chigozie et al. [5] estimated that over 900 million people are infected with Hookworm disease worldwide. Hookworm infection in Nigeria is markedly seasonal because of the influence of climate on the free-living larval stages of the parasites. Obiukwu et al. [6], suggested that this factor could be of serious economic consequences if the period of heavy infection or high incidence, coincides with busy period in the agricultural communities in the country. Surveys by various workers, in different parts of Nigeria, show a remarkably high rate in both the incidence and intensity of Hookworm disease in the indigenous populations.

Hookworm infection is endemic and highly prevalent among Nigerians living between latitudes 350 N and 300 S where the disposal of faeces is inadequate or where the environmental conditions such as humidity and temperature favour the development of the infective worm larvae [7]. Chigozie et al. [5] observed that the incidence and prevalence of Hookworm infection appear to be on the increase from year to year in most rural communities around Nsukka, Anambra State and this can be said to be true for the rest of the country given the poor sanitary and waste disposal condition in the urban and rural communities. Sokoto metropolis, which is an urban settlement with poor sanitary conditions, provides a conducive environment for Hookworm infection. It is thought germane therefore to re-assess the prevalence of the infection in such area.

This study, on the prevalence of Hookworm infection among children of school age in Sokoto metropolis, was designed to enable accurate statistical analysis and deductions to be made from results obtained in the various experiments performed.

The aim of this research work is to evaluate the prevalence of Hookworm infection among these children, analyse the results and state the outcome.
2. MATERIALS AND METHODS

2.1 Study Area

The study was carried out in Sokoto metropolis. Sokoto is situated in the Northern savannah vegetation belt. Sokoto Metropolis is located within the North-Western geopolitical zone of Nigeria, carved out of the defunct North Western state on third of February 1976. According to the National population Commission [8], population figures stand at 3,7026,76 persons spread over an area of 33,776.89 square kilometer of land. The population mainly consists of the Hausa/Fulani ethic group. The major occupation of the people is farming (rainy season and irrigation in the dry season) and animal husbandry. The two major seasons in Sokoto are the dry and wet seasons. The wet season spans between May and October, with an annual rainfall of between 50cm to 130cm. The dry season starts around October and last up to May. Socio-cultural characteristic are homogenous as majority of its indigenes are Muslims [8].

It lies on latitude 9.5º North and longitude 8.5º East. It has an average annual rainfall of 1,400mm (55.12inch) and the average number of rainfall days is 112 days. There is usually a sharp break between the rainy season which lasts from April or May to September or October and a dry season which lasts from November to March or April. The annual mean minimum temperature is 17.00C while the maximum is 27.20C. Mining activities have led to the artificial creation of holes and crevices where water deposits giving rise to small pools and rivers.

2.2 Study Population

The study population consists of 224 school aged children within the age of 4-16 years old, at Sokoto, North-Western, Nigeria. The subjects that were used for this study will be mainly children within the age of 4-16 years old. The research was done in three (3) primary schools. These schools include; Dambuwa Model Primary School, Sokoto, Warziri Warziri model primary School, Sokoto, Alhaji Alhaji model primary School, Sokoto.

2.3 Study Design

This was a cross-sectional study among primary school children.

2.3.1 Sampling method

Simple random sampling technique was used to recruit 224 School children into the study. A total of 400 participants were enrolled for the study. Ten (10 ml) of urine samples were collected from each participant in to universal containers.

2.3.2 Inclusion criteria

The Inclusion criteria are children within the age range of 4-16 years with no history of any major illness and have not taken anti-helminthic drugs in recent past 2 or 3 weeks before.

2.3.3 Exclusion criteria

All children that did not meet the inclusion criteria were excluded from the study; and children on anti-parasitic therapy within the last 4 weeks, those that did not consented, those that were less than 4 years or greater than 16 years of age. As well as those that have any form of internal bleeding or with a history of an underlying illness are excluded.

2.4 Sample Size Determination

Sample size determination for this research was based on the findings of 38% obtained from the previous study [9]. Number of sample size was determined using the formula;

\[ n = \frac{Z^2 \times P \times Q}{d^2} \]

\[ n = \text{Minimum sample size} \]

\[ Z \text{ (standard deviation of normal)} = 1.96 \]

\[ P \text{ (prevalence rate)} = 15.7\% \ (0.38\%) \ [9] \]

\[ Q = 1 - P \]

\[ n = \frac{(1.96)^2 \times 0.157 \times 0.843}{(0.05)^2} \]

\[ n = 204 \]

Due to attrition, 10% of 204 were added to the sample size

\[ 204 + 20 = 224 \]

Therefore the minimum sample required was 224

2.5 Sample Collection

A dry, clean wide mouth; leak-proof and labeled plastic containers were given to each participant for collection of stool sample which was done and informing the subject not to contaminate the stool with urine, water or soil. The samples were collected and transported to Medical Microbiology laboratory Usmanu Danfodiyo University Sokoto immediately for analysis.
2.6 Laboratory Analysis

Methods used include:

1. Direct microscopic examination using wet and iodine mount.
2. Sedimentation method using diethyl ether concentration method.

2.7 Macroscopic Examination

After collection, samples of stool were examined macroscopically for:
- Color of the specimen: Weather light brown, dark brown or black.
- Consistency of the specimen: Weather formed, semi formed or watery, presence of blood or mucus, presence of Adult worm, presence or absence of tape worm segments, egg or ova of the parasites and then tested for micro haematuria and proteinuria using Combi-9 reagent strips.

2.8 Preservation and Transportation of Samples

Stool samples were then preserved using 1drop of 10% Formal Saline and then transported to Laboratory for further analysis.

2.8.1 Microscopy and egg counts

The stained filter papers containing urine deposits were examined under the microscope using x10 objectives to determine the presence of ova of Hookworm and other intestinal parasites. Eggs characteristic of the parasites were counted from several fields of each positive sample and number of eggs was recorded.
2.9 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 were 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 1 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 glass slide. 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 small cysts and eggs. Small drop of iodine was dropped under the glass slide to assist in the identification of cysts. Although the motility of Strongyloides larvae will not be seen, the non-motile larvae can be easily recognized [11].

3. RESEARCH TOOLS

- QUESTIONNAIRE

Data collection was carried out using questionnaire in order to obtain socio-demographic in of the respondent. During data collection, research investigator ensures that the data were collected accurately and correctly.

- VALIDATION OF QUESTIONNAIRE

After the questionnaire was designed, it was sent to 3 experts in order to seek for their opinion as part of expert review panel to evaluate questionnaire test validity.

- DOMAIN OF THE QUESTIONNAIRE

The questionnaire survey consists of items socio-demographic characteristics of the participants as well as the risk factors associated with Schistosoma haematobium infection. The questionnaire has 3 domain which includes socio-demographic domains in section A consisting of age, gender, ethnicity and religion. Section B socio- economic data consisting of occupation, type of family, etc. section C Laboratory investigation results.

3.1 Statistical Analysis

Data were analysed using the IBM Statistical Package for the Social Sciences (SPSS) Version 20 statistical computer software package. Frequency distribution tables were constructed; and cross tabulations were done to examine the relationship between categorical variables. The chi-square test was used to compare differences between proportions. All levels of significance were set at p < 0.05

4. RESULTS

4.1 Socio-demographic Characteristics of Participants

The overall prevalence of this study was 4.5% out of the 224 subject examined for Hookworm and other intestinal parasitic infection in the study area.

Table 1 Shows frequency distributions with respect to gender, age group and local government area. 113 males have the highest prevalence of 50.4% and 111 females have the prevalence of 49.6%. A total of 200 pupils with age group of 9-12 years have the highest prevalence of 89.3% which was followed by a total of 14 pupils with age group of 5-8 years 4.5%, and total of 14 pupils with age group 13-16 years recorded the least with prevalence rate of 6.3%. a total of 100 pupils from Dange Shuni and Sokoto North local government area have the highest prevalence of 44.6% respectively while Sokoto South local government area recorded 10.7%.

Table 2 Shows frequency distribution with respect to occupation, toilet, water source and prevalence. Civil servant recorded the highest prevalence of 51.5% with a total number of 115 people, this was followed by Business which recorded 41.5% with a total number of 93, the farming recorded 4.5% with a total number of 10 and unemployed recorded the least with prevalence rate of 2.7% and a total number of 6. Water closet has the higher prevalence rate of
75.4% with a total number of 169 and pit latrines recorded a lower prevalence rate of 24.6% with a total number of 55. Tap water recorded the higher prevalence rate of 87.5% with a total number of 196 while well water recorded a lower prevalence rate of 12.5%. No infection recorded a higher prevalence of 95.5% whereas infection recorded a lower prevalence of 4.5%.

Table 3 shows the prevalence of Hookworm and other intestinal parasites with respect to gender, age group, and Local Government Area. A total of 113 male and 111 female were involved in this study. Hookworm and other Intestinal helminths were detected in 6(5.3%) of male and 4(3.6%) of female. There was no statistically significant association between gender of school children and infection with parasitic helminth (P. value = 0.768 df = 2). There was high infection rate among age group 5-8 years with a prevalence of 20% which was followed by age group 9-12 years with prevalence rate of 14.3% and age group 13-16 years recorded as the least with a prevalence rate of 3.0%. Statistical analysis shows significant association between age group and infection status. (P. value = 0.042 df =1). A high infection rate was recorded in Sokoto South Local Government Area with a prevalence of 20.8% which was followed by Dange Shuni Local Government Area with a prevalence rate of 3.0% and Sokoto North Local Government Area recorded the least with a prevalence rate of 2.0%. Statistical analysis shows significant association between local government area and infection status (P. value = 0.005 df =2).

Table 4. Shows prevalence of Hookworm and other intestinal parasites with respect to tribe, occupation, toilet, water source and intensity. Hookworm and other Intestinal parasites were detected in Hausa 6(3.2%), Yoruba 2(33.3%) and Fulani 2(7.4%) with no intestinal helminth infection among the Igbos (0.0%). There was no statistically significant association between Tribes and infection status (P. value = 0.83 df =3). A total of 115(51.3%) Civil servant, 93(41.5%) Business, 10(4.5%) Farming and 6(2.7%) Unemployed Parent occupations were used in this study. There was a high infection rate among Farmers 1(10%), followed by Business 5(5.4%) and a low infection rate among Civil servant 4(3.5%) (Table 4). No infection rate was recorded among the unemployed. Statistical analysis shows significant association between Parent occupation and infection status (P. value = 0.673 df = 3). There was a high infection rate among pupils that uses pit latrines with prevalence rate of 5.5% and a low infection rate among pupils that uses water closet with prevalence of 4.1%. Statistical analysis show no significant association between toilet and infection status (P. value = 0.973 df = 1). A total of 196 pupils that uses well water source and 28 pupils that uses tap water source water. There was a high infection rate among well water users with prevalence of 5.1% and no infection rate was recorded among tap water users. Statistical analysis shows no significant association between water source and infection status (P. value =0.463 df = 1). Shows a total of 224 pupils used in this study, of which 10 of the pupil has a prevalence of 100% light infection and 214 of the pupils have no infection. Statistical analysis shows that there is a significant association between intensity and infection status (P. value = 0.000 df = 1).

Table 5 shows the intensity of Hookworm and other intestinal parasitic infection. Hookworm has the highest prevalence of 30%, Ascaris lumbricoides and Balantidium coli recorded 20% prevalence respectively, and Hymenolepis nana, Entamoeba histolytica and a mixed infection of Hookworm and Hymenolepis nana recorded the least prevalence 10% respectively.

Table 6 shows simple logistic regressions with respect to intestinal parasite infection in relation to age group and local government area. Hookworm and other intestinal parasites were found to be higher in age group 5-8 years 2.09 times (OR, 95.5%, CI, 1.41; 46.9; p. value 0.02) higher compared to age group 9-12 years 1.50 times (OR, 95.5%, CI, 0.17; 12.93; p. value0.71). Hookworm and other intestinal parasites were also found to b higher in Sokoto South Local Government Area 1.52 times (OR, 95.5%, CI, 0.23; 9.27; p. value 0.653) higher compared to Sokoto North Local government Area 0.12 times (OR, 95.5%, CI, 0.53; 0.26; p.value0.006).

Table 6 shows multiple regression analysis with respect to intestinal parasitic infection with relation to age group. Hookworm and other intestinal parasites were found to be higher in age group 5-8 years 2.09 times (OR, 95.5%, CI, 1.41; 46.9; p. value 0.02) higher compared to age group 9-12 years 1.50 times (OR, 95.5%, CI, 0.17; 12.93; p. value 0.71).

5. DISCUSSION

The result showed an overall low prevalence rate 4.5% of Hookworm and other intestinal parasitic infection in the study population when compared
to 54.8% obtained in Jigawa [12] and 73.36% in India [13]. The low infection rate recorded in this study is in line with the prevalence rate of 11.8% reported by [14] and 15.75% observed by Luka et al. [15] in Kaduna, Nigeria. The decrease in prevalence of intestinal helminth infection observed in this study might be due to desiccation of ova as a result of high temperature and low humidity in dry season as samples were collected and analyzed during this period. The variability in prevalence could also be as a result of improved sanitary standard and personal hygiene in the study area.

In this study the age groups 5 to 8 years were the most affected with a prevalence rate of 20% while age group 13 to 16 years were the least affected with a prevalence rate of 3.0%. The difference in infection rates between the age group was statistically significant ($P = 0.042$). Using Multiple Logistic Regression Analysis, Hookworm and other intestinal parasitic infection were found to be higher in age group 5-8 years 8.08 times (OR, 95.5%, CI, 1.41; 46.9; $p$ value 0.02) higher compared to age group 13-16 years. This is in agreement with earlier report of Kelechi et al. [16] who reported the highest prevalence of 33.9% within the age group 6 to 8 years. Children in this age group engage in play activities in contaminated environment that could facilitate transmission of intestinal helminths.

There was low prevalence of Hookworm and other intestinal parasitic infection of among males than females as compared with the study conducted in Imo, Nigeria by [16], with prevalence rate of 38.4% in male and 21.1% in females. This is also in line with the increase in the prevalence rate of Hookworm and other intestinal parasitic infection in Bahir Dar; Ethiopia with prevalence rate of intestinal parasitic infection of 33.5% in males and 32% in and females reported by [17]. This could be because the majority of the study population was children of farmers and males usually accompany their fathers to the farm. Males are also known to be more adventurous. This is in agreement with the report of [6].

The children also tend to be less cautious of their personal hygiene because they are not old enough to understand the need for general cleanliness, unlike their counterpart in the age group 13 to 16 years in which the information rate was very low. A lower infection rate in the age group of 13 to 16 years may be due to the psychosocial development of the mid-adolescent as they are more self-conscious of their personal hygiene and outward appearance to attract their opposite sex. This mid-adolescent is less likely to walk around barefooted.

| Variables (V)       | Frequency (F) | Percentage (%) |
|---------------------|---------------|----------------|
| **Gender**          |               |                |
| Male                | 113           | 50.4           |
| Female              | 111           | 49.6           |
| **Age group**       |               |                |
| 5-8                 | 10            | 4.5            |
| 9-12                | 200           | 89.3           |
| 13-16               | 14            | 6.3            |
| **LGA**             |               |                |
| Dange Shuni         | 100           | 44.6           |
| Sokoto North        | 100           | 44.6           |
| Sokoto South        | 24            | 10.7           |
Table 2. Frequency distribution with respect to occupation, toilet, water source and prevalence

| Variables (V)       | Frequency (F) | Percentage (%) |
|---------------------|---------------|----------------|
| **Occupation**      |               |                |
| Civil servant       | 115           | 51.3           |
| Business            | 93            | 41.5           |
| Farming             | 10            | 4.5            |
| Unemployed          | 6             | 2.7            |
| **Toilet**          |               |                |
| Pit                 | 55            | 24.6           |
| Water closet        | 169           | 75.4           |
| **Water Source**    |               |                |
| Tap water           | 196           | 87.5           |
| Well water          | 28            | 12.5           |
| **Prevalence**      |               |                |
| Infection           | 10            | 4.5            |
| No infection        | 214           | 95.5           |

Table 3. Distribution of intestinal parasite infection based on gender, age Group and local Government area

| Variables          | Hookworm       | Total | p. value |
|--------------------|----------------|-------|----------|
|                    | Infected       | Uninfected | N     |         |
|                    | n (%)          | n (%)  | (%)     |         |
| Gender             |                |        |         |         |
| Male               | 6 (5.3)        | 107 (94.7) | 113 (100) | 0.763    |
| Female             | 4 (3.6)        | 107 (96.4) | 111 (100) |         |
| Age Group          |                |        |         |         |
| 5-8                | 2 (20)         | 8 (80.0) | 10 (100) | 0.042    |
| 9-12               | 2 (14.3)       | 194 (85.7) | 14 (100) |         |
| 13-16              | 6 (3.0)        | 2 (97.0) | 200 (100) |         |
| LGA                |                |        |         |         |
| Dange Shuni        | 3 (3.0)        | 97 (97.0) | 100 (100) | 0.005    |
| Sokoto North       | 2 (2.0)        | 98 (98.0) | 100 (100) |         |
| Sokoto South       | 5 (28.0)       | 19 (79.2) | 24 (100)  |         |

The distribution of Hookworm and other intestinal parasites was not associated with parent occupation. However, increased infection rate among farmer’s children (10%) may be as a result of poor sanitation and frequent contact with polluted soils. Children whose parents are unemployed had the least prevalence (0.0%) which may be due to their improved standard of living as they live with their relatives whose parents are employed.

There was a high prevalence rate (5.5%) of Hookworm and other intestinal parasitic infections recorded in those children that uses pit latrine to pass excreta against users of water closet system toilets with a prevalence rate of (4.1%). This could be explained by the fact that poor personal hygiene and usage of faecally contaminated floor which may contribute to high level transmission of intestinal parasitic infection. These observations were also made by [5,6].

The association between sources of drinking water with Hookworm and other intestinal parasites was not significant. However, pupils who use well water have higher prevalence of Hookworm and other intestinal parasitic infection (5.1%) than pupil that uses tap water with a prevalence of (0.0%). This may be due to bouncing back of contaminated water into the well during fetching of water which would be used for domestic activities including drinking. Also most wells are not covered when not in use as such is it is prone to be contaminated by parasite driven by wind.
Table 4. Distribution of intestinal parasite infection based on tribe, occupation, toilet water source and intensity

| Variables       | Hookworm Infected | Hookworm Uninfected | Total | p. value |
|-----------------|-------------------|---------------------|-------|----------|
|                 | n (%)             | n (%)               | N (%) |          |
| Tribe           |                   |                     |       |          |
| Hausa           | 6 (3.2)           | 182 (96.8)          | 188 (100) | 0.083 |
| Yoruba          | 2 (33.3)          | 4 (66.7)            | 6 (100) |          |
| Fulani          | 2 (7.4)           | 25 (92.6)           | 27 (100) |          |
| Igbo            | 0 (0.0)           | 3 (100)             | 3 (100) |          |
| Occupation      |                   |                     |       |          |
| Civil servant   | 4 (3.5)           | 111 (96.6)          | 115 (100) | 0.673 |
| Business        | 5 (5.4)           | 88 (94.6)           | 93 (100) |          |
| Farming         | 1 (10.0)          | 9 (90.0)            | 10 (100) |          |
| Unemployed      | 0 (0)             | 6 (100)             | 6 (100) |          |
| Toilet          |                   |                     |       |          |
| Pit             | 3 (5.5)           | 52 (94.5)           | 55 (100) | 0.973 |
| Water closet    | 7 (4.1)           | 162 (95.9)          | 169 (100) |          |
| Water source    |                   |                     |       |          |
| Well water      | 10 (5.1)          | 186 (94.9)          | 196 (100) | 0.463 |
| Tap water       | 0 (0.0)           | 28 (100)            | 28 (100) |          |
| Intensity       |                   |                     |       |          |
| No infection    | 0 (0)             | 214 (100)           | 214 (100) | 0.001 |
| Light infection | 10 (100)          | 0 (0.0)             | 10 (100) |          |

Table 5. Intensity of hookworm and other intestinal parasitic infection

| Parasites                  | Intensity of parasitic infection | Total |
|---------------------------|---------------------------------|-------|
|                           | No Infection                  | Light Infection | Moderate Infection | Heavy Infection | Very Heavy Infection | N (%) |
| Hymenolepis nana          | 0 (0)                          | 1 (10)          | 0 (0)              | 0 (0)           | 0 (0)                | 10 (100) |
| Hookworm and H. nana      | 0 (0)                          | 1 (10)          | 0 (0)              | 0 (0)           | 0 (0)                | 10 (100) |
| Hookworm                  | 0 (0)                          | 3 (30)          | 0 (0)              | 0 (0)           | 0 (0)                | 10 (100) |
| Ascaris lumbricoides      | 0 (0)                          | 20 (20)         | 0 (0)              | 0 (0)           | 0 (0)                | 10 (100) |
| Entamoeba histolytica     | 0 (0)                          | 1 (10)          | 0 (0)              | 0 (0)           | 0 (0)                | 10 (100) |
| Balantidium coli          | 0 (0)                          | 2 (20)          | 0 (0)              | 0 (0)           | 0 (0)                | 10 (100) |

**KEY:** Light infection = 1 - 100  
Moderate infection = 101 - 400  
Heavy infection = 401 - 1000  
Very heavy infection = 1000 and above
Table 6. Simple logistic regressions with respect to intestinal parasite infection in relation to age group and local government area

| Variables     | *b | **EXP(B) OR(95.5%)CI | Wald statistic | p. value |
|---------------|----|----------------------|----------------|---------|
| **Age group** |     |                      |                |         |
| 13-16         | 0  | 1.00                 |                |         |
| 5-8           | 2.09 | 8.08(1.405, 46.9)    | 5.48           | 0.02    |
| 9-12          | 0.41 | 1.50(0.17, 12.93)    | 0.14           | 0.71    |
| **LGA**       |     |                      |                |         |
| Dange shuni   | 0  | 1.00                 |                |         |
| Sokoto South  | 0.42 | 1.52(0.23, 9.27)     | 0.20           | 0.653   |
| Sokoto North  | -2.14 | 0.12(0.53, 0.26)    | 7.68           | 0.006   |

**KEY:** *b = Coefficient of Statistic
**EXP(B) = Regression coefficient of crude odd ratio OR(95.5%)CI

Table 7. Multiple regression analysis with respect to intestinal parasitic infection with relation to age group

| Variables     | *b | **EXP(B) OR(95.5%)CI | Wald statistic | p. value |
|---------------|----|----------------------|----------------|---------|
| **Age group** |     |                      |                |         |
| 13-16         | 0  | 1.00                 |                |         |
| 5-8           | 2.09 | 8.08(1.405, 46.9)    | 5.48           | 0.02    |
| 9-12          | 0.41 | 1.50(0.17, 12.93)    | 0.14           | 0.71    |

**KEY:** *b = Coefficient of Statistic
**EXP(B) = Regression coefficient of crude odd ratio OR(95.5%)CI

This result shows that Hookworm and other intestinal [parasitic infection in univariate analysis was found to be higher in Sokoto South 1.52 times (OR, 95.5%, CI, 0.23; 9.27; p<0.0653) higher compared to Sokoto North 0.12 times (OR, 95.5%, CI, 0.53; 0.26; p<0.006). There was no statistically significant difference between the Local Government Area p<0.05. This may be due to lack of access to basic care and education [16].

Hookworm recorded highest prevalence 30%, Ascaris Lumbricoides and Balantidium coli recorded 20% prevalence respectively, and Hymenolepis nana, Entamoeba histolytica and a mixed infection of Hookworm and Hymenolepis nana recorded the least prevalence 10% respectively, this study is similar to the finding of [18]. The high prevalence of Hookworm and other intestinal parasitic infection could be as a result of not wearing protective shoes while within and outside the school premises and more eating food without washing of hands.

6. CONCLUSION

The study demonstrates that there was low prevalence of Hookworm and other intestinal parasites (4.5%) 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 dry season, low humidity, improved standard of living and awareness of Hookworm and other intestinal parasites in the study area.

7. RECOMMENDATIONS

Based on the findings, the following recommendations were made:

1. The government, non-governmental agencies and private individuals should help in the provision of social amenities to ensure total eradication of this disease. The teaching of health education in both private school should be encouraged by the government
2. Children should be educated on the need to always observed good personal hygienic practices and behavioral activities both at school and home. Parent should also teach their children about the dangers in playing in contaminated soil and walking barefooted.
3. Comprehensive investigation of intestinal helminth infection should not be limited to the children alone but also be extended to their parent and other communities within the local government area for effective control.

4. Mass deworming of school children with anti-helminthic drugs such as albendazole, or combination therapy with praziquantel should be regularly administered at least twice in a year. This would reduce the prevalence and intensity of infections drastically.

These measures will not only increase the effectiveness of parasite control but also protect children from having other condition associated with the infection.

CONSENT AND ETHICAL APPROVAL

Ethical clearance was obtained from the Ethical committee of the ministry of health, Kebbi State in accordance with the code of Ethics for Biomedical Research involving Human subjects. The relevance and benefit of the study was explained to all of the subjects to ensure their voluntary participation and a written informed consent was taken from each subject.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here: http://www.sdiarticle4.com/review-history/69816

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