Epidemiological Study of Soil-Transmitted Helminthic among Primary School Pupils in Jega, Kebbi State, Nigeria

M. M. Galamaji1*, A. Aisha2 and A. L. Hafsat2

1Department of Biological Science, Kebbi State University of Science and Technology, P.M.B. 1144, Aliero, Kebbi State, Nigeria.
2Waziri Umaru Federal Polytechnic, Birnin Kebbi, Kebbi State, Nigeria.

Authors’ contributions

This work was carried out in collaboration between all authors. Author MMG designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors AA and ALH managed the analysis of the study. Author AA managed the literature searches. All authors read and approved the final manuscript.

ABSTRACT

An assessment study to determine the prevalence and risk factors associated with soil-transmitted helminthiasis was carried out between Augusts to November 2017 in Jega local government area of Kebbi state, Nigeria. Stool samples were collected from each participant and structured questionnaire applied. Stool samples were examined for geo-helminthiasis by formal-ether concentration technique. A total of 200 primary school pupils were examined for soil-transmitted helminthiasis (STHs) and 43(21.5%) were found infected with different geo-helminth species. Logistic regression analysis indicates that the infection was associated with: Farming occupation (OR= 4.47, \( P < 0.0001 \), 95% CI=2.20-9.09), Gender (Odds Ratio=3.295, \( P = .01 \), 95% CI = 1.58-6.89), source of drinking water (OR = 2.55, \( P = .01 \), 95% CI = 1.28-5.07 for well water) and Regular hands washing (OR=2.46, \( P = .03 \), 95% CI=1.13-5.33). In this study, it was concluded that unhygienic behavioural variables, certain environmental and socio-demographic factors predicted...
the prevalence of soil-transmitted helminthiasis in the area. Sustainable intervention measures should include public health education, access to clean water, improved in the standard of living and adequate sanitation.

Keywords: Soil-transmitted helminthiasis; prevalence; school children; Jega; Nigeria.

1. INTRODUCTION

Soil-transmitted helminthiasis (STHs) is a disease caused by helminth parasites whose immature stages (eggs/larval) require a period of development or incubation in the soil before becoming infective. These are *Ascaris lumbricoides*, Hookworm (*Ancylostoma duodenales* and *Necator americanus*), *Trichuris trichiura*, and *Strongyloides stercoralis* [1]. They are among the leading Neglected Tropical Diseases due to its low mortality irrespective of its high morbidity even when compared with the so called “the big three,” including HIV/AIDS, tuberculosis, and malaria [2].

These infections produce adverse effects on health, growth, and learning ability with diminished physical fitness as well as impaired memory and cognition in school-aged children [3]. These adverse health consequences combine to impair childhood educational performance, reduce school attendance and subsequent productivity [3]. As Soil Transmitted Helminthes (STHs) affect education and health it thus directly or indirectly has a negative impact on economic growth. Studies have shown that infection with hookworm during childhood is associated with 43% reduction in future wage-earning capacity [4].

Infection with soil-transmitted helminthes parasites like *Ascaris lumbricoide*, and whip worm (*Trichuris trichiura*) occur through the ingestion of the infective stages of the parasites often in contaminated hand, water and food [5], while Hook worm (*Ancylostoma duodenales* and *Necator americanus*) infections occur through direct skin penetration when man come in contact with faecally contaminated soil [5].

Studies worldwide indicate that the prevalence, intensity and comorbidity of soil-transmitted helminth infections are predominant where poverty prevails, sanitation is inadequate or non-existent and where more health awareness and care is needed [6] with an average prevalence rate of 50% in developed world, and almost 95% in developing countries [7]. In consideration of the dynamics, it is estimated that STHs result in 450 million illnesses worldwide [7]. All the asserted factors are present and predominant in most developing countries, including Nigeria, particularly in rural settings.

Current documented information on the epidemiology of soil transmitted helminthic infections in Jega local government area is scanty and currently there is no control program in the area. Therefore, this study was carried out in the area with the aim of providing current epidemiological information on the prevalence of soil-transmitted helminthiasis and risk factors associated with the prevalence in the area.

2. MATERIALS AND METHODS

2.1 Study Area

This study was carried out in Jega Local Government Area of Kebbi State. The area is located at latitude 12.22º North and longitude 4.38º East. The area has a total land mass of 891 square kilometres and a population of 193,352 based on [8] figures. The inhabitants are predominantly Hausa by tribe. The major occupations of the people are farming and trading.

2.2 Study Population

The minimum sample size for this study was determined using standard formula $N = \frac{Z^2 \times PQ}{R^2}$. The study population comprised of 200 primary school pupils randomly selected from five primary schools in Jega LGA, namely: Raudatus Sunnah Academy, Model Primary School Jega, Nasarawa Primary School, Gindi Primary School and Dumbegu Primary School. The schools were selected using stratified random sampling. 40 pupils were selected from each of the primary schools selected in the study area. The pupils enrolled were within the ages of 4-13 years.

2.3 Collection and Preparation of Faecal Samples

A structured questionnaire was administered to obtain information on demographic data and risk factors of acquiring STHs infection. Information
such as name of school, sex, age, parents’ occupation, source of drinking water and type of toilet facilities among others was obtained using the questionnaire.

Faecal samples were collected from 200 pupils (100 males and 100 females) from the five primary schools in the study area. Each pupil was given a sample collection bottle bearing serial number that was assigned to his/her name in the record book. The pupils were instructed to bring their early morning stool sample. The faecal samples collected were preserved in 10% formalin and transported to Zoology Laboratory, Kebbi State University of Science and Technology, Aliero for analysis.

Laboratory analysis of faecal samples was carried out using Formol-ether concentration technique as described by Cheesbrough [9]. Identification of the parasites was done using the morphology of diagnostic stages of human intestinal parasites by [10].

2.4 Data Analysis

The data collected for this study was analysed using Graph Pad Instat software version 3.05. The prevalence was calculated and express in percentages. Odds ratio (OR) was used to determine the association between certain risk factors and prevalence of the infection. P-value of ≤ 0.05 is considered significant.

2.5 Ethical Consideration

A written consent was received from the Local Government Education secretary, and parents of selected pupils were informed before samples was collected form their children.

3. RESULTS AND DISCUSSION

Of the 200 primary school pupils examined using formol-ether concentration technique, 43(21.5%) were tested positive for one or more soil-transmitted helminth parasite (Table 1). The data obtained from this study revealed that soil-transmitted helminthiasis is prevalent among the school-aged children in Jega LGA, Kebbi state, Nigeria. In this study, the Prevalence of the infection is relatively high (21.5%) compared to similar study reported by Kennedy [11] in Jaba, Kaduna state with 15.8% prevalence. The high prevalence of STHs infection observed in this study is expected and could be due to probably the fact that STHs infection is apt to occur in low socio-economic condition characterised by inadequate portable water supply, poor personal hygiene and poor sanitary disposal of excreta. According to [12] disparity in distribution may be linked to population characteristics and geographic location. In addition, it is also opined that prevalence may vary due to differences in community practices, sources of infection and other risks factors. Soil-transmitted helminthic infections are caused by ingesting the infective stages of the agent while drinking contaminated water, eating improperly washed or uncooked vegetables irrigated with contaminated water, or direct contact with contaminated soil containing the infective stages [13]. Such exposures are usually enhanced by illiteracy, poor personal and environmental hygiene which are more prevalent in this study area.

Breakdown of result in relation to schools shows that Gindi Primary school has the highest prevalence of 32.5%, followed by Dumbegu primary school (27.5%) and Nasarawa primary school (20.0%), while least prevalence of the infection was recorded in Raudatus Sunnah Academy and Model primary school Jega with the prevalence of 12.5% and 15.0% respectively.

In this study area, three species of STHs were identified. Hook worms (Ancylostoma duodenales and Necator americanus) were the predominant geo-helminth detected in 34(61.8%) pupils and Ascaris lumbricoides was the second most prevalent STHs parasite 18(32.7%) found in all the schools sampled and the least prevalent STH parasite specie was T. trichiura, detected only among 3(5.5%) pupils (Fig. 1).

In this study, prevalence of soil-transmitted helminthiasis in relation to age of the pupils showed that 5-7 years age group had the highest prevalence of 18(25.7%) and 8-10 years age group had 14 pupils infected out of 60 with 23.3% prevalence while 11 – 13 years age group had the least with 11 pupils infected out of 70 and prevalence rate of 15.7% (Table 1). Odds ratio value of 1.41 and 1.17 for 5-7 years and 8-10 years age group respectively showed positive associations between the age group and the infection while odds ratio value of 0.59 for 11-13 years shows negative association between the age group and the infection. However, the result shows that the association is statistically not significant. Similar observations were made by [14] in Mbaitoli in Imo State, Nigeria. There was statistically significant association between prevalence of infection and age and this may be due to their level of exposure to the risk factors.
Younger children are more susceptible to STHs infection than older children. They are known for maintaining poor personal hygiene as this plays an important role in transmission of STHs infections. Geo-helminthes are transmitted through the contamination of the environment, especially the soil where the children usually play in the open fields and eat food without washing hands. Thus, as age increases, exposure to STHs infection decreases possibly due to improved personal hygiene. As the children grow there is better awareness in hand washing and other personal hygiene measures, this reduce the risk of the children from being infected.

The prevalence of STH parasites in relation to gender in this study area is shown in Fig. 2. Gender wise prevalence was higher among males (31.0%) compared to their female counterpart (12.0%). In this study, significant association between the infection and gender was observed \((OR = 3.30, P = 0.0011)\). In Jaba, Kaduna state [11] made similar observation. This may be due to the fact that males have fewer restrictions than the females whose leisure hours are strictly controlled. The males are free to swim, play games and work in the farms and gardens than their protected female counterparts.

Table 1 shows the prevalence of the infection in relation to hygiene behaviour. Washing hands before eating was strongly associated with the STHs infection \((OR = 2.46, P = 0.032)\). Highest prevalence of the parasites was recorded among subjects who do not wash their hands regularly before eating \((22.76\%)\) than those who regularly wash their hands before eating \((19.48\%)\). The result of this study shows that hand washing before eating was significantly protective. Pupils who only washed occasionally or do not wash at all before eating were more likely to be infected than those who washed their hands regularly. Hand washing is an economical method of primary prevention.

Table 1 depicts the summary of the prevalence of STHs according to whether the pupils wear their foot-wears or not. Higher prevalence was observed among the subjects who do not wear their foot-wears regularly \((21.97\%)\) while low prevalence was observed among those that wear their foot-wears regularly \((20.59\%)\). The result of this study shows positive association between foot-wears usage the prevalence of the infection \((OR=1.09, P = 0.97)\). Generally, transmission of the infection can be during outdoor play with no slippers or shoes on soil contaminated with faecal matter containing the infective stage of the parasites [15]. Some of the children might have contacted the infection through ingestion of geo-helminth eggs in contaminated food or water, eating with or licking unwashed contaminated hands and fingers especially during outdoor play in the soil [16]. Combination of defecating in open spaces, playing in soil and the geo-phagus habit of the children could be a good source of helminth infections [17].

The prevalence of geo-helminthiasis among the participants in relation to socio-demographic variables is shown in Table 2. In this study, variation in prevalence of STHs with respect to source of water supply was observed. Prevalence based on water source showed that the prevalence was higher in the pupils who used wells \((31.6\%, OR=2.55, P = .01)\) as their source of drinking water and least in those that used either borehole \((14.9\%, OR= 0.44, P = .03)\) or pipe-borne water \((17.4\%, OR= 0.74, P = .81)\) as their source of drinking water (Table 2). An odds ratio of 2.55 and \(P = .01\) obtained for respondents that use well water showed statistically significant association between the water source and the prevalence of the disease. The findings also showed an strong association between patterns of infection and access to good water supply and sanitation. Access to boreholes/taps resulted in lower infection rate than other less safe sources of water (well water) supply. The association of water sources to soil-transmitted helminthic infection as observed in this study is similar to that of [18] in Nsukka zone.

A noticeable disparity was observed among various occupations, where prevalence varied from 17.1\% - 39.4\%. The prevalence of STH parasites in pupils whose parent’s occupation is farming was 26(39.4\%) out of 66. Prevalence of the parasites was low in pupils whose parent’s occupation are civil servant and trading/business with total infected cases of 6(17.1\%) and 11(11.1\%) respectively. An odds ratio value of 4.47 showed that there is intimate association between farming as occupation and the prevalence of the infection and the association is strongly significant \((P <0.0001)\). Some occupational practices have been associated with enteric parasitic infections. Subjects from farming families were significantly at risk of the infection compared to other occupations tested in this study. Zoonotic exposures and other agricultural practices in some regions are key.
Factors for transmission. The use and recycling of wastes, household sewage, human and animal excreta in agriculture and aquaculture has a long history in many countries [19]. The reuse of excreta and wastewater for crops and fish ponds may provide many positive benefits, such as cheap fertiliser, reliable source of nutrition and water, reduce commercial fertilisers, improve soil-structure and increase productivity [19]. However, transmission of enteric pathogens is a fundamental public health issue associated with these practices. In developing countries, excreta-related diseases are very common, and faecal sludge and wastewater contain high concentrations of excreted pathogens such as viruses, bacteria, protozoa cysts, and helminthes eggs that may cause gastro-intestinal complications in humans.

Level of education showed no significant association with the prevalence (O.R = 1.36, P = .55) despite higher infection rate among illiterates (23%) than in those who had formal education (18%). Furthermore, there was correlation of educational background with infection rates. Illiterates were almost two times prone to infection than those who can read and write. The observations made are possible despite the influence of other factors such as type of occupation of residents. It is often upheld by many that well-educated people are more likely to practice good personal hygiene than those who have only low level of education or are illiterate. Since level of sanitation and hygiene both affect transmission of this parasites, it is expected that the rate of infection among illiterates will be higher when compared to those with good education.

![Specie-specific prevalence of STHs in percentage](image)

**Fig. 1. Prevalence of different species of geo-helminthes observed in the study area**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Number examined</th>
<th>Number positive (%)</th>
<th>Chi-square</th>
<th>OR</th>
<th>P-value</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age of the pupil</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 – 7</td>
<td>70</td>
<td>18(25.7)</td>
<td>0.65</td>
<td>1.41</td>
<td>0.42ns</td>
<td>0.70-2.82</td>
</tr>
<tr>
<td>8 – 10</td>
<td>60</td>
<td>14(23.3)</td>
<td>0.051</td>
<td>1.17</td>
<td>0.82ns</td>
<td>0.56-2.41</td>
</tr>
<tr>
<td>11 -13</td>
<td>70</td>
<td>11(15.7)</td>
<td>1.46</td>
<td>0.59</td>
<td>0.23ns</td>
<td>0.27-1.25</td>
</tr>
<tr>
<td>Total</td>
<td>200</td>
<td>43(21.5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hand washing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>123</td>
<td>33(26.8)</td>
<td>4.59</td>
<td>2.46</td>
<td>0.032*</td>
<td>1.13-5.33</td>
</tr>
<tr>
<td>Yes</td>
<td>77</td>
<td>10(13.0)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>200</td>
<td>43(21.5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foot wear</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>132</td>
<td>29(30.0)</td>
<td>0.002</td>
<td>1.09</td>
<td>0.97ns</td>
<td>0.53-2.23</td>
</tr>
<tr>
<td>Yes</td>
<td>68</td>
<td>14(20.6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>200</td>
<td>43(21.5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Keys: ns – not significant, * statistically significant, OR – odds ratio, CI – confidence interval**
This study revealed 21.5% prevalence of soil-transmitted helminthiasis among primary school pupils in Jega LGA. The prevalence is associated to a significant extent with a few important variables of human behaviour, certain environmental and socio-demographic factors. Sustainable intervention measures should be implemented to reduce the burden of this neglected disease, part of which should include health education, improved access to clean water, improvement in the standard of living and adequate sanitation. More studies are needed in this and other settings with similar epidemiological features to further evaluate these factors.

ACKNOWLEDGEMENT

The authors gratefully acknowledge the kind support and co-operation of Jega local education authority, Head masters, guardians, and pupils who volunteered to participate in this study for their contribution.

COMPETING INTERESTS

Authors have declared that no competing interests exist.
REFERENCES

18. Onuoha EO. Patterns of transmission, prevalence and intensity of soil transmitted helminthiasis in Nsukka zone, Enugu state, Nigeria. PhD theses of biological science department, Nigeria University Nsukka; 2009.
DOI:10.11648/j.bio.20150306.12

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sciencedomain.org/review-history/27743