

SOIL TRANSMITTED HELMINTHS CONTAMINATION OF UNIVERSITY OF MAIDUGURI, BORNO STATE, NIGERIA

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ABSTRACT

Soil-transmitted helminths (STHs) are a group of intestinal parasitic helminths which causes human and animal infections via oral ingestion or skin penetration with their eggs or larvae. A cross-sectional study was conducted in September and October 2023 to investigate the occurrence of STHs on the University of Maiduguri Campus, Borno State. A total of five hundred (500) soil samples were collected and processed using floatation by centrifugation technique. Generated data were analyzed using GraphPad Prism software version 5.0. Out of the five hundred (500) samples examined, 102/500 (20.4%) were positive for soil-transmitted helminths (STHs) which included eggs of *Taenia* spp. Eggs of *Taenia* species were 2.3% (3/132) and larvae of *Strongyloides* species 97.2% (129/132). Ado Bayero Hall recorded the highest prevalence of soil-transmitted helminths 38.9% (7/18), followed by Multi-Purpose Hall premises 32.0% (16/50), while the lowest was at Unimaid Garden 14.0% (7/50). *Strongyloides* larvae had the highest parasitic stage in soil 129/132 (97.7%). This study has established the presence of soil-transmitted helminths in University of Maiduguri Campus which calls for the need for proper sensitization/education of the public on soil transmitted helminths and its modes of transmission in the study area.

Keywords: Soil-Transmitted-Helminths, Soil, Contamination, Maiduguri, Campus.

INTRODUCTION

Soil-transmitted helminths (STH) is a collective term used to refer to a group of intestinal parasitic helminths, usually found in warm and moist soil that causes human and animal infections through contact with their parasitic eggs or larvae (Bethony *et al.*, 2006). Soil-transmitted helminth (STH) infections are mainly caused by the roundworm (*Ascaris lumbricoides*), whipworm (*Trichuris trichiura*) and hookworms (*Necator americanus*, *Ancylostoma duodenale* and *A. ceylanicum*) (CDC, 2022). These parasitic nematodes are among the 20 major neglected tropical diseases (NTDs) reported by the World Health Organization (WHO, 2018). The threadworm (*Strongyloides stercoralis*) although also a soil transmitted helminth, is frequently considered separately because of the different methods used for its diagnosis as well as treatment regimen (Buonfrate *et al.*, 2015; Forrer *et al.*, 2018). In addition to the STHs of humans, there are also other STHs (*Ancylostoma caninum*, *A. braziliense*, *A. suum*,

S. stercoralis, *T. vulpis*) of domestic animal origin that are zoonotic making infection with these parasites of public health concern (Da Silva *et al.*, 2016; Ma *et al.*, 2018). Soils contaminated with faecal materials are instrumental in the transmission of STHs infection. However, transmission of STHs and the associated disease burden mainly occurs in sub-tropical and tropical countries, where the climate is optimal for development of the infectious stages as reported by Brooker *et al.* (2006) and where the challenge to maintain an adequate personal hygiene and a lack of sanitation facilitate the transmission. STH attributable morbidity is mainly associated with moderate-to-heavy intensity infections and disproportionately affects both children and women of child-bearing age (WHO, 2012; WHO, 2015) contributing to impaired growth and cognitive development, malnutrition, anaemia, and school absenteeism (Drake *et al.*, 2000; WHO, 2017).

These nematodes have a global prevalence estimated to be around 1.2 billion, 795 million, and 740 million people for *Ascaris lumbricoides*, *Trichuris trichiura* and hookworms respectively (CDC, 2022). It is also estimated that over one fifth of the world population are infected with at least one STH species, resulting in an estimated total disease burden of 3.4 million disability adjusted life years (DALYs) (Jourdan *et al.*, 2018). In sub-Saharan Africa (SSA), infections by these nematodes account for approximately 85% of the neglected tropical diseases, with hookworm infection responsible for almost half of the infection in SSA's poorest communities (Hotez and Kamath, 2009). Over the past decades, there are reports of considerable reductions in the intensity of STH infections through a combination of measures including preventive chemotherapy, improved water supplies and sanitation, as well as hygiene education programs implemented in different countries in sub Saharan Africa (Sartorius *et al.*, 2000; Mupfasoni *et al.*, 2019). Nevertheless, the STH infection continues to pose a major socio-economic challenge and remains an important public health problem in many countries in SSA including Nigeria (Lustigman *et al.*, 2012). The occurrence of soil transmitted helminthiasis in Nigeria differs from region to region (Odinaka *et al.*, 2015). Soil contamination by cats, stray dogs and other animals' faeces are relatively high (Fang *et al.*, 2015; Sedionoto & Anamnart, 2017). Humans especially children who often play in the sand have been reported to be associated with soil-transmitted helminths infections with an estimated 8 million children around the world been affected, causing diarrhea, chronic, and acute diseases that may expose children to death (WHO, 2016). Although several studies have been conducted on the prevalence of intestinal helminthiasis in Nigeria (Olaniyi *et al.*, 2007; Adefioye *et al.*, 2011), there are still localities for which epidemiological information is not available (Odinaka *et al.*, 2015). Currently, there is no information on the extent of parasite contamination of soil in University of Maiduguri campus, thus the importance of this work is aimed at determining the presence of ova/larvae of STHs in soil samples as well as the association of soil transmitted helminth contamination between various locations within the University of Maiduguri Campus.

MATERIALS AND METHODS

STUDY AREA

This study was carried out in University of Maiduguri located in Maiduguri, the capital and largest urban center in Borno State, Nigeria between September and October 2023. The University of Maiduguri lies between latitude 11°51'N and longitude 13°05'E with a student population of 75

thousand (University Registry Record, 2019). The temperature of Maiduguri ranges between 34°C to 42°C with mean annual rainfall of 647mm (LCRI, 2007). The sampling points in the study area were the Commercial Centre, football fields, Mosques, Church (Chapel), Multi-purpose hall premises, Unimaid Motor Park, student's hostels, and Unimaid garden within University of Maiduguri, Borno State.

STUDY DESIGN

The study was designed as a cross sectional study. A purposive random sampling technique was adopted in selecting sites for soil collection in each of the sampling locations (Commercial Centre, Football fields, Mosques, Church (Chapel), Multi-Purpose Hall premises, Student's hostels, Unimaid garden, and park).

SAMPLE SIZE DETERMINATION

The sample size was estimated using the formula of Thrusfield (2007), where the estimated prevalence of 50% was used and desired absolute precision value of 5% was used.

$$n_0 = \frac{\{1.96^2 \times P_{exp} \times (1 - P_{exp})\}}{d^2}$$

$$n_0 = \frac{3.842 \times 0.5 \times 0.5}{0.0025} = 384$$

To increase precision, the sample size was increased by 30%. A total sample size of 500 soil samples was used for this study.

SAMPLE COLLECTION AND TRANSPORTATION

Approximately 100g of soil was collected at a depth of 2 – 3 cm (Hassan and Oyebamiji, 2018) from different points within the eight sampling sites. Sample collection was carried out in the early hours of the day between 6.00 and 11.00 am, when the infective stages are present on the topsoil. A total of 500 soil samples were collected using a small shovel. Each of the samples from each sampling sites were stored in properly labelled sterile polythene bag and transported to the Parasitology Research Laboratory of the Department of Veterinary Parasitology and Entomology, Faculty of Veterinary Medicine, University of Maiduguri where they were immediately analysed.

SAMPLE PROCESSING

About 5 g each of the soil sample were mixed thoroughly with distilled water. The suspension was strained through a

sieve mesh size 200 μm to remove coarse particles. The filtrate was centrifuged at 1000 RPM for 3 min and the supernatant decanted. The resulting sediment was further broken up by shaking and tapping the tube. The sediment was mixed with saturated salt solution (specific gravity 1.2) to the brim of the test tube and allowed to stand for a few minutes with a cover slip on the tube to collect any floating egg or larvae. The cover slip was removed and examined under the microscope at $\times 10$ and $\times 40$ objectives (Auta et al., 2014; Hassan et al., 2017).

DATA ANALYSIS

Prevalence of soil transmitted helminths was calculated using the following formula:

$$\text{Prevalence} = \frac{\text{Total number of positive soil sample}}{\text{Total number of soil samples examined}} \times 100$$

The results were categorized and summarized into tables. The differences in prevalence were tested for level of association using Chi-Square test on GraphPad Prism version 5.0 (2007) and values of $p \leq 0.05$ were considered significant throughout the study.

RESULTS

PREVALENCE OF SOIL TRANSMITTED HELMINTHS IN UNIVERSITY OF MAIDUGURI CAMPUS BASED ON LOCATION

Out of the five hundred (500) soil sample examined, 20.4% (102/500) were positive for soil transmitted helminths (STHs).

The prevalence of soil transmitted helminths in soil samples was highest from the Multi-Purpose Hall (MPH) premises 32.0% (16/50), followed by hostels 24.6% (29/118), Mosques 23.3% (7/30), Unimaid Motor Park 22.0% (11/50), Chapel of Grace 18.0% (9/50), Commercial Centre 17.9% (7/39), Football Fields 14.2% (16/113) and lowest recorded from Unimaid Garden 14.0% (7/50).

However, statistical analysis revealed no significant difference in the prevalence among locations ($\chi^2 = 9.942$, $P = 0.1918$) (Table I).

PREVALENCE OF SOIL TRANSMITTED HELMINTHS CONTAMINATION BASED ON SAMPLING MONTHS

The soil samples collected in the month of October had a higher prevalence of 22.0% (33/150), while those collected in September has a prevalence of 19.7% (69/350).

However, there was no significant difference in the infection rate observed between months ($P < 0.05$) ($\chi^2 = 0.3378$, $P = 0.5611$) as shown in Table II.

DISTRIBUTION OF PARASITIC STAGES OF SOIL TRANSMITTED HELMINTHS RECOVERED ON THE UNIVERSITY OF MAIDUGURI CAMPUS.

Out of the 102 positive samples reported in this study, larvae of *Strongyloides* spp (Figure I) were found in 101 samples while eggs of *Taenia* spp (Figure II) were found in only a sample. Overall, a total 132 different parasitic stages were seen in this study. Most of the parasitic stage reported were of *Strongyloides* larvae 97.7% (129/132) while only 2.3% (3/132) eggs of *Taenia* species were seen (Table III).

TABLE I: PREVALENCE OF SOIL-TRANSMITTED HELMINTHES ON THE UNIVERSITY OF MAIDUGURI CAMPUS, BASED ON LOCATION

Location	No. of samples	No. of Positive samples	Prev. (%)	χ^2	P - Value
Comm. centre	39	7	17.9	9.942	0.1918
Hostels	118	29	24.6		
Church (Chapel)	50	9	18.0		
Mosques	30	7	23.3		
Football fields	113	16	14.2		
MPH premises	50	16	32.0		
Garden	50	7	14.0		
Park	50	11	22.0		
Total	500	102	20.4		

TABLE II: PREVALENCE OF SOIL TRANSMITTED HELMINTHS CONTAMINATION ON THE UNIVERSITY OF MAIDUGURI CAMPUS BASED SAMPLING MONTH

Month	No. of Sample Examined	No. of Positive sample	Prev. (%)	χ^2	P Value
Sept.	350.0	69.0	19.7	0.3378	0.5611
Oct.	150.0	33.0	22.0		
Total	500.0	102.0	20.4		

TABLE III: DISTRIBUTION OF PARASITIC STAGES OF SOIL TRANSMITTED HELMINTHS RECOVERED ON THE UNIVERSITY OF MAIDUGURI CAMPUS

Species (Parasitic stages)	No. recovered	Prevalence (%)
<i>Taenia</i> spp (egg)	3.0	2.3
<i>Strongyloides</i> spp (larvae)	129.0	97.7
Total	132.0	100.0

NB: Number of parasitic stages per positive sample were counted to give the total above



Figure I: Larva of *Strongyloides* spp.

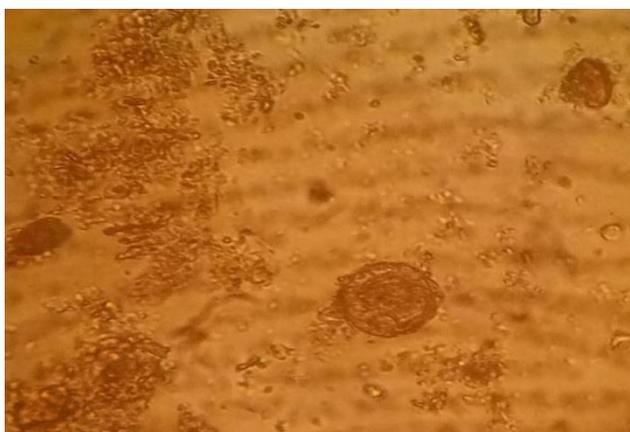


Figure II: Egg of *Taenia* spp x40 magnification

DISCUSSION

The larvae occurring free-living in soil may have contributed significantly to the recovered larvae and the presence of these parasitic helminth eggs and larvae in soil is of great epidemiological concern (Hassan *et al.*, 2017) as the larvae of *Strongyloides* species have been known to be transmitted

through percutaneous means and thus increases the chances of infection to the unsuspecting public.

The recovery of *Strongyloides* larvae as the most encountered parasite is in agreement with earlier reports (Amoah *et al.*, 2006; Abougrain *et al.*, 2017; Hassan *et al.*, 2017). However, this is in disagreement with Ogbolu *et al.* (2011), Oyebamiji *et al.* (2018) and Hassan & Oyebamiji (2018) where they reported hookworms as the most encountered and Adekeye *et al.* (2016) where *Ascaris* was reported as the most common parasite associated with soil contamination. Other species reported by other researchers from soil samples included hookworms, *Ascaris*, *Toxocara*, *Isoospora*, *Toxascaris*, *Cryptosporidium*, *Trichuris*, and *Eimeria* species (Ogbolu *et al.*, 2011; Hassan *et al.*, 2017; Adekeye *et al.*, 2016; Oyebamiji *et al.*, 2018; Hassan & Oyebamiji 2018).

Across the various sampled sites, Ado Bayero Hall had the highest prevalence followed by MPH premises and Ummah mosques while football fields and Unimiad garden had the least prevalence. However, there is no statistical significance between prevalence of STHs in relation to sampling points. This is in disagreement with Oyebamiji *et al.* (2018) and Hassan & Oyebamiji (2018) who reported that prevalence of STHs in relation to sampling sites during the sampling period varied significantly. The higher occurrence of infection rate among samples collected from MPH premises 32% (16/50) and hostels 24.6% (29/118) than those from other locations maybe due to high human activities in these areas and these areas lack good drainage system.

CONCLUSION

The results from this study revealed that two STHs (*Taenia* spp. and *Strongyloides* spp.) were present in soil samples examined in University of Maiduguri campus. Therefore, proper environmental sanitation and personal hygiene should be inculcated into the habits of both students and residents on the University campus to promote the effective control of STHs.

There is a need to improve health education to help create awareness on the dangers these STHs pose to human and animal health, as well as its prevention and control, and the transmission of these parasites. This will help reduce transmission within the study area.

Parasitic contamination of soils should be regarded as a public health problem, and so this data will be helpful in the development of appropriate control and prevention policies that will help prevent the transmission of soil-transmitted helminthiases.

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CONFLICT OF INTEREST

No conflict of interest was encountered during the course of the work.

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