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Soil-Transmitted Helminth Infections and the Associated Risk Factors in Pre-Primary School Children, Kiwangwa Rural Ward, Bagamoyo District, Tanzania

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ABSTRACT: Pre-primary school children remain hard to reach the mass drug administration programmes in control of soil-transmitted helminth infections. In the present study, the stool samples of 115 pre-primary school children in Kiwangwa rural ward, Bagamoyo district, Tanzania were studied in order to determine the prevalence and intensity of soil-transmitted helminths and their relationships with the associated risk factors. The samples were analyzed with the Kato-Katz technique. The intensity of infections was categorized according to the World Health Organization limits as light, moderate or high. The overall mean prevalence was found to be 3.8%. Regarding the intensity, among the 115 pre-primary school children four children were found positive. One student had co infection of *Ascaris lumbricoides* and hookworm with light intensity, two children had moderate intensity infection of hookworm and one child had moderate intensity infection of *Ascaris lumbricoides*. The prevalence of soil-transmitted helminth infection was higher in children who did not have: treated water for domestic use, own toilet facilities, practice of wearing shoes and washing hands before eating and after defecation. This study highlights the importance of hygiene in pre-primary school children as an additional opportunity for mass drug administration programme in Tanzania. In addition, community participation in providing health education to children at home should be improved as well as the risk factors such as toilet facilities, hand washing facilities, water for domestic use to avoid and reduce the transmission of soil-transmitted helminths.

Key words: Prevalence, Intensity, Soil-transmitted helminths, *Ascaris lumbricoides*, Pre-primary school, Risk factors

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INTRODUCTION

According to World Health Organization, greater than one billion people are chronically infected with soil-transmitted helminths (Montresor et al., 1998). The most common species of soil-transmitted helminths are *Ascaris lumbricoides*, hookworms (*Ancylostoma duodenale* and *Necator americanus*) and *Trichuris trichiura* (Kelechi et al., 2015 and Julia et al., 2016). The global prevalence of *Ascaris lumbricoides*, hookworms and *Trichuris trichiura* are about 1000, 900-1300 and 500 million of people, respectively (Brooker et al., 2006; Hotez and Ehrenberg, 2010; World Health Organization, 2012). Still soil-transmitted helminths infections are considered to be the most prevalent infections of mankind. These days, soil-transmitted helminths have been one among the most prevalent neglected tropical diseases as they persist absolutely in the poorest populations (Hotez et al., 2009 and Njiru et al., 2016).

As per the results from a study done among schoolchildren in a Lake Victoria shore line ward, Tanzania proved that the prevalence of hookworms was second to intestinal schistosomiasis (Mazigo et al., 2012 and Ajanga et al., 2006). The prevalence of soil-transmitted helminths is prominently attributed to hookworms and *Trichuris trichiura* and *Ascaris lumbricoides* (Brooker et al., 2000; Clements et al., 2010; Teresia et al., 2016) in Kenya. The prevalence of hookworm infections observed in both Tanzania and Kenya were greater than 30% (Lwambo et al., 1999 and Handzel et al., 2003). Prevalence of ascariasis of <1% (Lwambo et al., 1999) was reported in a study done at Magu District, Tanzania. According to the report given by Handzel et al. (2003), the prevalence for *Ascaris lumbricoides* and *Trichuris trichiura* was 22.9% and 17.9%, respectively in Kenya's Nyanza Province.

Even though the soil transmitted helminths can infect all members of a population, there are specific groups who are more susceptible and are at a greater risk of infection (Brooker and Bundy, 2008 and Hotez et al., 2006). The most susceptible groups are preschool children, school-aged children and women of child-bearing age, including adolescent girls (Keiser and Utzinger, 2008 and Taylor-Robinson et al., 2007).

Preschool and school-aged children are likely to harbor several intestinal worms. As a result they will experience growth stunting, diminished physical fitness, impaired memory, cognition and anemia because of intestinal blood loss (Crompton and Nesheim, 2002 and Hotez et al., 2004). All these consequences impair childhood educational performance and reduce school attendance (Crompton and Nesheim, 2002 and Hotez et al., 2004).

There is little information about the prevalence and intensity of soil transmitted helminths among pre-primary school children in Kiwangwa rural ward, Bagamoyo district, Tanzania. Poverty, poor sanitation and inadequate water supply influence the presence of soil transmitted helminths. In Bagamoyo rural areas 2 percent of the total household has no toilets. It is estimated that 92 percent of all rural households use the traditional pit latrines and 4 percent had flush toilets and 2 percent used improved pit latrines. The remaining 0.1 percent of households had other unspecified types of toilets. The percentage of population served with clean water in all rural areas in Bagamoyo district is below 65% and the most common source of water for the remaining percentage is from unprotected wells (Anence, 2013). All these conditions show that soil transmitted helminthes are prevalent in the district. The present study is designed to provide data on the prevalence and intensity of soil transmitted helminthes among pre-primary school children in Kiwangwa rural ward, Bagamoyo district, Tanzania.

MATERIALS AND METHODS

Study area, population and design:

The study was conducted in the rural ward of Kiwangwa, Bagamoyo district, Tanzania. Bagamoyo is one of the 6 districts of the Pwani Region of Tanzania. Bagamoyo is bordered to the west by the Morogoro region, to the east by the Indian Ocean, North by the Tanga region, and to the south by the Kibaha district. According to the 2012 Tanzania national census, the population of the Bagamoyo district was 311740. Kiwangwa is one of the sixteen wards at Bagamoyo district in Pwani region of Tanzania and is an administrative rural ward. As per 2012 census, the ward has a total population of 14586.

Study population is the preprimary school children at Kiwangwa rural ward who were present during the study period. A cross-sectional descriptive study was undertaken to establish the prevalence and intensity of soil-transmitted helminths infections among pre-primary school children.

Sampling procedure

Simple random sampling technique was used. The following strategies were followed:

- Simple random sampling to obtain 3 villages from six villages
- Simple random sampling to obtain one school or centre where preprimary school children are found from each village
- Systematic sampling to obtain children where as 112 preprimary school children were recruited.

Study variables

The independent variables include age, sex and knowledge of preprimary school children on soil transmitted helminths. The dependent variables are prevalence and intensity of soil transmitted helminths.

Inclusion and exclusion criteria

All selected pre-primary school children who were living in the selected study area for at least three months, whose parents/guardians were able to sign a written consent form and willing to participate in the study were included in the study. Pre-primary school children who had a history of being clinically ill, used drugs for deworming within a period of one month before the study and the parents/guardians refused to sign a written consent form were not included in the study. Two pre-primary school teachers were recruited as research assistants from Kiwangwa rural ward. They were trained on how to give instructions to pre-primary school children about the collection of stool sample before starting sample collection exercise.

Ethical consideration and confidentiality

Permission to conduct the study at Kiwangwa rural ward, Bagamoyo district was obtained from District Executive Director, District Medical Officer and District Education Officer. The permission from the parents of the children was obtained by sending informed consent form and directed to sign if they accepted the involvement of their children. All the information obtained from the

participants was treated confidentially and shared only by the study team.

Collection of stool specimen

One day before collection of stool specimen, the research including its benefits was explained to teachers and selected pre-primary school children. Each of the selected school children were provided with a labeled clean plastic container, a piece of applicator stick, a plain paper and a consent form. The plastic containers had a code number. The code number of the container and the name of the children who took that particular container were recorded in a note book. The children were instructed that, once they got home, they should give the consent form to their respective parents/guardians to read. The children were instructed that if they were allowed to participate, the morning of the next day they should defecate on a piece of paper provided (to avoid contamination from the toilet environment). Using an applicator stick a portion of the stool was picked on a piece of paper, transfer it into the clean plastic container provided, cover it and then come with it to school. On delivery, the next day, using a list of names with their corresponding code numbers, children were called one after the other by name for collecting the stool specimen. The number on the container is compared with the number recorded when they are provided the container to check if it is the right container for her/him. The stool specimen was mixed immediately with 10% formalin to preserve the morphology of the eggs.

Screening for soil-transmitted helminths

The stool specimen was fixed with 10% formalin and taken to Bagamoyo district hospital for laboratory analysis. The stool specimens were processed using Kato-Katz technique employing a 41.7 mg template. Standard operating procedures were followed for maintaining a good quality study as described by the World Health Organization. The examination of the specimen was done by two observers for the same prepared slide. The number of eggs of each species were recorded and converted into the number of Eggs Per Gram of feces (EPG) in order to analyze the intensity of infection. EPG was calculated by multiplying egg count by conversion factor (i.e. 24 for 41.7 mg template).

Data analysis

Data collected were coded, entered into computer and analyzed using SPSS version 16 software. Frequency tables and cross tabulations were produced for each of the study variables. Data analysis was carried out by running descriptive statistics and cross tabulations.

RESULTS

Demographic information

Samples were collected from four schools. They are Kiwangwa, Kwawema, Bago and Msinune. Sampled school children were from pre-primary class. The study involved a total of 115 pre-primary school children whose parents/guardians signed consent forms. Among 115 pre-primary school children 52.2 % were boys and 47.8% were girls. The participated children were categorized according to their age, zone of residence, parent education and school where they were studying. The results are presented in table 1. The number and percentage of participants were higher in the categories like: age group 5-6 years; living at lowland plateau zone; parents are non-educated and are from Kwawema school. The greater percentage of boys involved in the present study are in the age group 5-6 years; from Kwawema school living at lowland plateau zone whose parents are uneducated. The greater percentage of girls involved in the present study are in the age group 5-6 years; from Bago school living at middle plateau zone whose parents are uneducated.

Table 1. Number and percentage of pre-primary school children by age group, zone of residence, parent education and children's school in Bagamoyo district, Tanzania

Variable	Number of participants and percentage (%)		
	Boys	Girls	Total
Age group			
3-4 years	13 (50)	13 (50)	26 (22.6)
5-6 years	47 (52.8)	42 (47.2)	89 (77.4)
Total	60 (52.2)	55 (47.8)	115 (100)
Zone of residence			
Across the river	5 (55.5)	4 (44.4)	9 (7.7)
Upland plateau zone	8 (47.1)	9 (52.9)	17 (13.4)
Middle plateau zone	20 (45.4)	24 (54.5)	44 (38.3)
Lowland plateau zone	27 (60.0)	18 (40.0)	45 (40.6)
Total	60 (52.2)	55 (47.8)	115 (100)
Parent education			
Non-educated	39 (53.4)	34 (46.6)	73 (63.5)
Educated	21 (50.0)	21 (50.0)	42 (36.5)
Total	60 (52.2)	55 (47.8)	115 (100)
Children's school			
Kiwangwa	13 (44.8)	16 (55.2)	29 (25.2)
Kwawema	19 (63.3)	11 (36.7)	30 (26.2)
Bago	12 (42.9)	16 (57.1)	28 (24.3)
Msinune	16 (57.1)	12 (42.9)	28 (24.3)
Total	60 (52.2)	55 (47.8)	115 (100)

Prevalence of soil-transmitted helminths

The overall prevalence of soil-transmitted helminths infection in the selected schools was found to be 3.8%. Among 115 pre-primary school children, 4 children were infected with soil-transmitted helminths. The specific soil transmitted helminths found were *Ascaris lumbricoides* and hookworm. Between the four infected children, one had single infection of *Ascaris lumbricoides*, two had infection of hookworm and one had co-infection of *Ascaris lumbricoides* and hookworm. All the four infected school children were from three different schools. The prevalence of soil transmitted helminths according to demographic characteristics is shown table 2.

Table 2. Prevalence of soil-transmitted helminths among the participant by sex, age group, parent education, zone of residence and type of helminths in Bagamoyo district, Tanzania

Variable	Positive /Total	Prevalence (%)
Sex		
Boys	2/60	3.4
Girls	2/55	3.6
Age group		
3-4	2/26	7.7
5-6	2/89	2.2
Parent education		
Educated	0/42	0
Non-educated	4/73	5.5
Zone of residence		
Across the river	1/9	11.1
Upland plateau zone	0/17	0.0
Middle plateau zone	1/44	2.3
Lowland plateau zone	2/45	4.4
Type of helminthes		
Ascaris lumbricoides	1/115	0.90
Hookworm	2/115	1.74
Both helminths	1/115	0.90

Intensity of *Ascaris lumbricoides* and Hookworm

The intensity of helminths infection in the pre-school children was characterized based on the World Health Organization grouping system of soil-transmitted helminths infection intensities (Montresor et al., 1998). Among the four children found positive, one student who had co-infection of *Ascaris lumbricoides* and hookworm was found to have the intensity of 1344 EPG for *Ascaris lumbricoides* and 888 EPG for hookworm. Both of the intensities are light intensities. Two children had moderate intensity infection of hookworm (206400 EPG and 232800 EPG). One child had moderate intensity infection of *Ascaris Lumbricoides* (13600 EPG).

Knowledge on soil-transmitted helminths

The administered questionnaire to the study population also covered awareness of the disease, type of worms with which they were familiar with and sources of worms. Only 4.4% of the children were aware of soil-transmitted helminths and mentioned hookworm and *Ascaris lumbricoides*. 8% of the children who were aware of *Ascaris lumbricoides* and hookworm had knowledge on at least one of source of soil-transmitted helminths. The Level of knowledge was measured by answering three questions that covered the following aspects: awareness of the disease, type of worms and source of worms. The level of knowledge was categorized as high, moderate and low when the child answered all the three questions correctly, two questions correctly and only one question, respectively. From the table 3, it was observed that the prevalence of soil-transmitted helminths was found to be higher in children who had low level of knowledge about the soil-transmitted helminths.

Table 3. Knowledge of pre-primary school children on soil transmitted helminthes in Bagamoyo district, Tanzania.

Level of knowledge	Number of children	Percentage (%)	Prevalence (%)
High	13	11.3	0
Moderate	19	16.5	3.6
Low knowledge	83	72.2	5.3

Risk factors associated with soil-transmitted helminths

Source and treatment methods for drinking water

Majority of the children (47.2%) mentioned tap water as the source of water for domestic use, 2.7% reported to use spring water and water from shallow wells, 9.2% used river as the source of water for domestic use and the remaining percent (40.9%) reported to buy water from street vendors. The prevalence of soil-transmitted helminths was found to be higher in families who bought water from water venders than those who had at least one source of water (Table 4).

With regard to the treatment of drinking water, 61.7% of the children reported to drink untreated water, 26.1% drink boiled water, 2.6% drink filtered water, 9.6% drink water treated with chemicals such as water guard as summarized in the table 4. The prevalence of soil-transmitted helminths was found to be higher in children who come from families that did not use any method of treating water.

Type of toilet facilities used at home

Pre-primary school children who participated in this study were asked to mention the types of latrines they used at home. In this regard, 86.9% of the children reported to use pit latrine, 9.6% were using flashing toilets, 0.9% used neighbor's toilet and 0.9% used bush as toilet. The prevalence of soil-transmitted helminths in children who came from families with no toilet facilities was found to be higher than those who owned toilet (Table 4).

Hand washing facilities

59.1% of the children reported having hand washing facilities at their home and availability of soap was very easy for 9.3% of children, easy for 22.2%, difficult for 24.3% and very difficult for 3.3% of them. 40.9% reported washing hands before eating, after eating and after visiting toilet. Others reported washing hands only before going to school or for prayers (2.2%), only before and after eating (27.7%), and only after toilet (11%). The prevalence of soil-transmitted helminths among preprimary school children who come from families with no hand washing facilities in toilet was found to be higher (Table 4).

Frequency of using footwear

Hookworm infection can be prevented by wearing shoes. In this study, 50.4% of the children reported that they wore shoes outside the house throughout and 49.6% seasonally (Table 4). The prevalence of soil-transmitted helminths among preprimary school children who wear footwear seasonally was found to be higher (Table 4).

Table 4. Risk factors associated with the prevalence of soil-transmitted helminths among the pre-primary school children in Bagamoyo district, Tanzania

Factors	Number of children	Percentage (%)	Prevalence (%)
Source of water for domestic use			
River/Wells/Tap water	68	59.1	2.9
Buy water from vendors	47	40.9	4.2
Treatment of water for domestic use			
Yes	44	38.3	2.3
No	71	61.7	4.3
Toilet ownership			
Own toilet	113	98.3	2.6
No toilet	2	1.7	50.0
Hand washing facilities			
Yes	68	59.1	1.5
No	47	40.9	6.4
Frequency of using footwear			
Throughout	58	50.4	1.8
Seasonally	57	49.6	5.3

DISCUSSION

A cross-sectional descriptive study was undertaken to establish the prevalence and intensity of soil-transmitted helminths infections among pre-primary school children in Kiwangwa ward, Bagamoyo district, Tanzania. The study has shown that the overall prevalence of soil-transmitted helminths is 3.8%. The results of intensity of soil transmitted helminths showed that among the 115 school children, four children were found to be positive.

One student who had co infection of *Ascaris lumbricoides* and hookworm was found to have light intensities, two children had moderate intensity infection of hookworm and one child had moderate intensity infection of *Ascaris lumbricoides*. The prevalence of soil-transmitted helminths in Kiwangwa ward, Bagamoyo District was found to be high. This may be due to several reasons. The National School Health Program is undertaking deworming activities in schools and is giving albendazole or mebendazole for treatment and control of intestinal worms. This activity is carried out in collaboration with the Neglected Tropical Disease program. This deworming activity has been targeting primary school children. But schools now do enroll pre-primary children who do not receive albendazole and mebendazole.

The results showed that there was low knowledge regarding soil-transmitted helminths as more than half of the pre-primary school children had never heard about soil-transmitted helminths and only quarter of the pre-primary school children had high knowledge. This may be due to several reasons; first the health education component of the control program is not creating awareness amongst the pre-primary school children. Secondly it can be contributed by less focus of their training on intestinal worms at their schools where they are being enrolled as pre-primary school children. Study done by Tarimo (1999) among primary school children in Temeke district, Tanzania showed high level of knowledge regarding soil-transmitted helminths where 72.4% of them knew at least one of its transmission mode.

It was also statistically significant that the level of knowledge on soil-transmitted helminths was increasing with age. It was noted that 47.7% of the pre-primary school children in the age of 5 years and 60% of the pre-primary school children in the age of 6 years had a high level of knowledge. While only 11.1% of the children in the age of 3 and 23.6% in the age of 4 had high level of knowledge. This may be due to the fact that children of higher age have more knowledge and are exposed to different knowledge of intestinal worms given by educated parents and teachers at

school. Kagya reported the same kind of observation among primary school children in Mkuranga district, Coast region, Tanzania (Kagya, 2011).

Risk factors associated with infection of soil-transmitted helminths were high (Strunz et al., 2014 and Sobhana et al., 2015). With regard to the treatment of drinking water, more percentage of the children participated in the present study reported drinking of untreated water from the tap and wells which were the main sources of domestic water. This may be contributed by parents' poor knowledge regarding soil-transmitted helminths.

In the present study, the percentage of children reported to use pit latrine as a type of toilet at their homes is greater. For growth, development and transmission, soil-transmitted helminths require moist, warm and shaded soil (Grang and Zumla, 2003). More percentage of the children mentioned sand as a house (>40%) and toilet (>50%) floor material which is one of such conducive environments for the soil-transmitted helminths require moist. The hookworm has the ability to ascend vertically 30-90cm and laterally about 30cm in sandy loamy soils (Grang and Zumla, 2003). Therefore, wet type earthen floor and shallow pit latrine allows penetration of hookworm to the top. Hookworm enters human body through feet penetrations. Therefore not wearing shoes while going to toilet was another risk factor. The condition of the toilet depends on the family income. The families with higher income are capable of building a toilet with a good floor, protected walls and with water facility. The condition of the toilet also partly depends on the owner's attitude or awareness concerning the importance of using a better toilet. People with awareness and positive attitude will construct good toilets.

Soil-transmitted helminths can also be spread as a result of not washing hands with soap and clean water. This has been supported by the study done in Bangladesh and Burkina Faso where the results showed that there is a reduced risk for intestinal helminthic disease among children who wash their hands (Hoque, 2003). In the present study, 40.9% of pre-primary school children reported not having hand washing facilities in toilet.

Limitation of the study

Inability to attain the minimum required sample size was the major limitation of the study. Some pupils were reluctant to participate in the study and others were feeling shy to participate.

CONCLUSION

The study showed that the prevalence and intensity of soil-transmitted helminths infections among pre-primary school children in Kiwangwa rural ward, Bagamoyo district, Tanzania is generally high. This can partly be explained by mass chemotherapy which is not targeting pre-primary school children. The level of knowledge is generally low which is supposed to be provided with health education.

Recommendation

The deworming activities which are carried by The National School Health Program in collaboration with the Neglected Tropical Disease program should also target the pre-primary school children. Community participation in providing health education to children while at home should be improved. Risk factors for transmission of soil-transmitted helminths such as toilet facilities, hand washing facilities, water facilities should be reduced.

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