EFFECTIVENESS OF INTERVENTION WITH MASS CHEMOTHERAPY FOR SOIL-TRANSMITTED HELMINTHS AMONG PRIMARY SCHOOL CHILDREN IN BAGAMOYO DISTRICT, TANZANIA.

Anence Josephath Kamasho, BSc.EHS

MSc. (Tropical Diseases Control) Dissertation
Muhimbili University of Health and Allied Sciences
November 2012

EFFECTIVENESS OF INTERVENTION WITH MASS CHEMOTHERAPY FOR SOIL-TRANSMITTED HELMINTHS AMONG PRIMARY SCHOOL CHILDREN IN BAGAMOYO DISTRICT, TANZANIA.

By

Anence Josephath Kamasho

A Dissertation Submitted in partial Fulfillment of the Requirements for the Degree of Master of Science in Tropical Disease Control of the Muhimbili University of Health and Allied Sciences.

Muhimbili University of Health and Allied Sciences

November, 2012

CERTIFICATION

The undersigned certifies that he has read and hereby recommends for acceptance by Muhimbili University of Health and Allied Sciences a dissertation entitled, **“Effectiveness of intervention with mass chemotherapy for Soil-transmitted helminthes among primary school children in Bagamoyo district, Tanzania”** as a partial fulfillment of the requirements for the degree of the Master of Science in Tropical Disease Control of the Muhimbili University of Health and Allied Sciences.

....

Prof. C. M. Kihamia
(Supervisor)

Date..............................

DECLARATION

AND

COPYRIGHT

I, Anence Josephath Kamasho, declare that this report is my own work and that it has not been presented and will not be presented to any other University for a similar degree or any other degree award.

Signature........................ Date…………………………..

ACKNOWLEDGEMENT

I thank Almighty God for giving me strength and ability to reach where I am now. Also I am very grateful to my supervisor Prof. C.M. Kihamia who gave me excellent, tireless and tremendous support.

My appreciation also goes to the technicians of the medical Parasitology Laboratory (MUHAS) who assisted me with the stool examination.

My sincere gratitude also goes to my husband Vicent Manyilizu for his tolerance and endless support and love.

Finally, I would like to thank the administration of Bagamoyo District Council, District Medical Officer, and District Education Officer for the cooperation they offered me during this study. As it is difficult to mention every individual who contributed to this work by name, to all of the unnamed benefactors and especially the teachers and pupils of the schools that I worked with, I give them my sincere gratitude.

DEDICATION

This dissertation is dedicated to my beloved son, Sixbert Vicent Manyilizu, may this work bring him encouragement and motivation to achieve great milestones in his life.

ABSTRACT

Background: In most countries where soil-transmitted helminths (geoheminths) are endemic, school-age children have the highest prevalence and bear the greatest intensity of infection. A deworming programme represents one of the most efficient and cost-effective means to improve child health and education.

Objective: The objective of the study was to assess the effectiveness of intervention with mass chemotherapy for soil-transmitted helminths among primary school children in Bagamoyo district.

Methodology: A cross-sectional study design, cluster sampling was used to obtain 300 children of standard I-V of Mlingotini and Pande primary schools. Questionnaires were administered to obtain demographic information, knowledge and factors related to soil-transmitted helminths infection. Fresh stool samples ($\leq$ 24 hours) were collected from every participant and examined by the Kato-Katz thick smear technique to determine infection status.

Results:

Proportion of the school children who received Albendazole during the last distribution was 97.7% and the prevalence of geohelminths was 0% based on microscopic examination. 63% of the children had poor knowledge regarding soil-transmitted helminths, 23% had adequate knowledge and 14% had moderate knowledge. It was statistically significant that the level of knowledge was increasing with age, Chi squire for age group with level of knowledge was 3.26 and p value <0.05. Some risk factors for having soil-transmitted helminths were high, 89% of the children were drinking untreated water at their home. Also 64% of the children mentioned sand as their toilet floor material and 0.3% reported never wearing shoes when visiting toilets.

Conclusion:

Health promotion activities to enhance awareness are important in ensuring that the risks for being infected with soil-transmitted helminths are minimal if not eliminated. Regular mass treatment should be maintained so as to ensure that the prevalence of soil-transmitted helminths remains zero.

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

ABBREVIATIONS

MDA	Mass Drug Administration.
MOHSW	Ministry of Health and Social Welfare
WHO	World Health Organisation
STH	Soil-Transmitted Helminths
TDHS	Tanzania Demographic Health Survey
KAP	Knowledge, Altitude and Practice.
MUHAS	Muhimbili University of Health and Allied Sciences.
NSSCP	National Schistosomiasis and Soil-transmitted helminths Control Program.
MSc TDC	Master of Science in Tropical Disease Control.
MMed	Master of Medicine
LFEP	Lymphatic Filariasis Elimination Program.

CHAPTER 1

1.1 INTRODUCTION.

Intestinal parasitic infections are highly prevalent in developing countries, mainly due to deficiency in sanitary facilities, unsafe human waste disposal systems, inadequacy and lack of safe water supply and low socio-economic status (Savioli, *et al.*, 1992). It is estimated that soil-transmitted helminthiasis and schistosomiasis represent more than 55% of the disease burden due to all tropical diseases, excluding malaria. Most morbidity is seen in pre-school children, school-age children and women of child-bearing age (WHO, 1999).

Soil transmitted helminths (STH) are intestinal nematodes whose part of their development takes place outside the body of the host. These organisms make soil as their intermediate host before they infect the individual (Grang, *et al.*, 2003). The three most common STH are the large intestinal roundworm (*Ascaris lumbricoides*), whipworm (*Trichuris trichiura*), and the anthropophilic hookworms (*Necator americanus* and *Ancylostoma duodenale*).

Trichuris and *Ascaris* infections often found together and they have similar mode of transmission. Adult worms live in the lumen of the small intestine. A female may produce eggs which are passed with the feces. Unfertilized eggs may be ingested but are not infective. Fertile eggs embryonate and become infective after several weeks, depending on the environmental conditions (optimum: moist, warm, shaded soil). After infective eggs are swallowed, the larvae hatch, invade the intestinal mucosa, and are carried via the portal, then systemic circulation to the lungs. Upon reaching the small intestine, they develop into adult worms. Between 2 and 3 months are required from ingestion of the infective eggs to oviposition by the adult female. Adult worms can live 1 to 2 years.

The life cycle of Hookworm is quite different from that of *Trichuris* and *Ascaris*. Eggs passed with the feaces develop to rhabditiform larva in moist shaded soil and it feeds on bacteria, moults to filariform larva. Under favourable conditions (shade, moist soil & warmth $25^0C – 35^0C$), filariform larva can survive for 3 – 6 weeks. Filariform larva ascend vertically 60 – 90 cm & laterally about 30 cm in sandy loamy soils. Therefore wet type earthen floor pit latrines or shallow pits for defecation allows penetration of Hookworm to the top. Filariform larvae penetrate human skin and are carried by blood circulation to the lungs. They travel and reach the trachea and through coughing they swallowed and reach the small intestine they develop to adult worms and female lay eggs.

Prevalence of these intestinal worms varies according to the hygienic conditions and socio-economic status of the area and occurs in all age groups and sex but is highest among children. In areas where feaces are used as agricultural fertilizer, infection is common in farm workers. It has been estimated that almost two billion people are infected with one or more of these soil-transmitted helminths which account for up to 40% of the universal morbidity (Hotez, *et al.,* 2003). STH infections rarely cause death. Instead, the burden of disease is related less to mortality than to the chronic on the hosts' health and nutritional status (Stephenson *et al.,* 2000). Hookworms have long been recognized as an important cause of intestinal blood loss leading to iron deficiency and protein malnutrition. The iron deficiency anemia that accompanies moderate and heavy hookworm burdens is sometimes referred as hookworm disease (Hotez *et al.,* 2004).

Historically Tanzania has been having high prevalence of soil-transmitted helminths infections. The first report of STH was published in Tanga in 1917 by the civil medical services. Since that time and subsequent years, the civil medical services continued to give information in the annual report of STH (Kihamia, 1977), and in 1998 the Tanzania Partnership for Child Development carried out an extensive operational research, training teachers to administer Albendazole to treat intestinal nematodes. The Government is committed to the control by setting up a National Schistosomiasis and STH Control Program (NSSCP). Since transmission is most common among school-age children who bear the heaviest burden of disease, the implementation strategy using large-scale mass drug administration (MDA) focused on them.

The immediate broad objective of the program was to reduce prevalence and intensity by 50% in 4 years in at least one third of the districts in Tanzania mainland. Intermediate objective was to set up a sustainable mechanism for delivery of Praziquantel and Albendazole to school-age children and other vulnerable age groups and to promote personal hygiene and sanitation. Development of a sustainable national control program to reduce morbidity due to schostosomiasis and STH to level where it is no longer a public health problem was taken as a long term objective.

Health education targeted school children through their teachers who were responsible for encouraging personal and environmental hygiene within the school and at home. Messages were designed based on evidence derived from KAP surveys on water supplies, latrines, hand-washing, beliefs, waste disposal, wearing of shoes, water contact and contamination of water and soil.

The Government also initiated LF Elimination Programme (LFEP) in 2000 and one of the objectives was to ensure that the whole country is covered by treatment with Ivermectin and Albendazole. Coastline regions covered are Tanga, Pwani, Lindi and Mtwara and coverage ranges between 50-65% of total population and the program has achieved 18% geographical coverage (Neglected Tropical Disease Control, Unpublished Report, 2011)

Work was carried out in primary schools, with the aim of improving children's personal hygiene in general, and with particular reference to the need to encourage aspects of personal hygiene relevant to the control of helminths infection for instance using latrines, hand-washing, keeping the latrines and the general school environment cleanliness, wearing footwear, and being aware of the dangers of contaminated water (Nyandindi, *et al.*, 1995)

According to Mlingotini primary school records, school children started to be given Albendazole regularly from 2006. However from June 2010 up to June 2011, twelve children of the age 7 up to 14years were diagnosed with intestinal worms at Mlingotini dispensary (Mlingotini Dispensary Laboratory Report, 2010-2011).

This study reports how effective chemoprophylaxis with Albendazole has been effective in mitigating soil-transmitted helminths infections amongst school children in selected villages in Bagamoyo district. The findings show the extent of STH prevalence post-intervention.

1.2 PROBLEM STATEMENT.

Historically Bagamoyo district has been having high prevalence of soil-transmitted helminths. This is due to poor sanitation, favorable climatic and soil conditions. The mass chemotherapy intervention started in 2006 and the implementation was administration of Ivermectin and Albendazole twice per year to primary school children. This intervention has been carried regularly but in some years not biannual but at least once a year. Additionally, every year new pupils start primary school, thus it is important that these new pupils are also given the intervention. Thus it is important to evaluate whether the prevalence of soil-transmitted helminths has decreased with time. This study addresses that since the intervention strategy has not been systematically evaluated.

Moreover pupils are given the intervention at school but return to the same environment and practice unhealthy behaviors which are the risk factors for having soil-transmitted helminths infections. This study also assesses these risk factors and gives recommendations on possible ways to invert the factors.

1.3 RATIONALE

Intervention with mass chemotherapy is costing in terms of money, resources and time therefore it was important to evaluate its effectiveness. NSSCP may use this findings to know whether intervention is successful or not and put corrective measures or maintain the available method.

The findings may also inform the Government of its achievements in health sector especially at this point in time where the MOHSW is struggling to meet Millennium Development Goals. The generated information may also be helpful to bilateral donor funding for soil-transmitted helminths and filariasis control program.

1.4 OBJECTIVES

1.4.1 BROAD OBJECTIVE.

To assess the effectiveness of intervention with mass chemotherapy for soil-transmitted helminths among primary school children in Bagamoyo district.

1.4.2 SPECIFIC OBJECTIVES.

1. To determine the prevalence of soil-transmitted helminths among primary school children in Bagamoyo district.
2. To determine the proportion of school children who received Albendazole during last distribution among primary school children in Bagamoyo district.
3. To determine knowledge of school children on soil-transmitted helminths in Bagamoyo district.
4. To identify the risk factors associated with soil-transmitted helminths infection among primary school children in Bagamoyo district.

1.5 LITERATURE REVIEW.

1.5.1 SITUATION OF SOIL-TRANSMITTED HELMINTHS WORLDWIDE.

The updated global distribution of soil-transmitted helminths revealed that the tropics and subtropics have widespread infection of all three soil-transmitted helminths. Estimates suggest that *A. lumbricoides* infects 1.221 billion people, *T. trichiura* 795 millions, and hookworms 740 millions world wide (Silva, *et al.,* 2003).The greatest numbers of geohelminths infections occur in the Americas, China and East Asia, and Sub-Saharan Africa. *Strongyloides stercoralis* is also a common STH in some of these regions, although detailed information on the prevalence of strongyloidiasis is lacking because of the difficulties in diagnosing human infection. Also it has been estimated that over one billion people who are infected with *Ascaris lumbricoides* worldwide the school children are being the mostly affected (Ogbe, *et al.,* 2002). Also the WHO (2006) report shows that the prevalence of STH is high among children in rural areas of developing countries where 400 million school-age children who are infected are physically and intellectually affected by malnutrition, leading to cognitive deficits, learning disabilities and high school absenteeism (WHO, 2006).

In most countries where soil-transmitted helminths are endemic, school-age children experience the highest prevalence and intensity of infection, particularly with *Ascaris lumbricoides* and *Trichuris trichiura* (Hall, *et al.*, 1997). Morbidity has been traditionally considered a result of heavy geo-helminth infections; children with light infections were thought to suffer no ill effects. There is increasing evidence however, that even low or a moderate intensity infection significantly retards childhood growth and development (Hall, 1993; Stephenson, 1994).

Chronic STH infections resulting from *Ascaris, Trichuris,* and hookworm can dramatically affect physical and mental development in children (WHO, 2002). Studies have also shown that the growth and physical fitness deficits caused by chronic STH infections are reversible following treatment with anthelmintic drugs (Stephenson, *et al.*, 2000).

The effects on growth are most pronounced in children with the heaviest infections, but light infections may also contribute to growth deficits if the nutritional status of the community is poor. Soil-transmitted helminths infections rarely cause death thus, the burden of STH disease is related less to mortality than to the chronic effects on the hosts' health and nutritional status (Stephenson, *et al.,* 2000). Hookworms have long been recognized as an important cause of intestinal blood loss leading to iron deficiency and protein malnutrition. The iron deficiency anemia that accompanies moderate and heavy hookworm burdens is sometimes referred to as hookworm disease (Hotez, *et al.,*2004).

Soil-transmitted helminths infect more than one third of the African continent's population at any one time and the prevalence of *A. lumbricoides* and *T. trichiura* is greatest in equatorial, central, and west Africa, eastern Madagascar, and southeast Africa, whereas hookworm is more widely distributed across the continent (Brooker, *et al.,* 2006). Study done by (Brooker, *et al.,* 2000) among school children in Busia district Kenya showed that 91.7% of children were infected with hookworm or *Ascaris lumbricoides* or *Trichuris trichiura.* They concluded that helminth infections were exceptionally common among school children in Busia district, thus confirming the good sense of the school-based approach adopted by the control programme. The study also showed that there was an association between concurrent infection and the intensity of infection, which mighty have consequences for nutritional and educational status.

(Chukumwa, *et al.,* 2009) in Nigeria showed that 53.6% soil and 87.7% stool samples were positive. The recovery rates from stool samples were; eggs of Ascaris lumbricoides (54.1%), Hookworm (45.5%), and Trichuris trichiura (18%). Prevalence from soil samples showed (24.0%) of Ascaris eggs, (25.9%) of hookworm eggs. The wide and unrestricted spread of the infection was attributed to failure to wear footwear in school, lack of functioning toilet facilities, geophagia and preference of the pupils to defecate in the bush leading to indiscriminate defecation in and around the school yard (Chukumwa, *et al.,* 2009).

Associated factors for soil-transmitted helminthic infection usually related to hygiene, sanitation and environmental conditions. In a study done in Uganda, having a pit latrine or toilet versus no toilet showed a protective effect against some hygiene-related helminthic infection (Woodburn, *et al.*, 2009).Use of unprotected water source, such as river water and the lack of drinking water treatment were seen to be associated with at least one soil-transmitted helminth species (van Eijk, *et al.*, 2003). Geophagy, is also associated with infection with *Ascaris lumbricoides* and *Trichuris trichiura* (Luoba, *et al.*, 2005). The absence of clean water to wash vegetables and fruits properly and the lack of knowledge on intestinal helminthic infection may increase the infection rate in rural and poor community. Eating without washing hands and not washing hands after using toilets are also the risk factors for having geohelminths.

Soil contamination with soil-transmitted helminths eggs worldwide is the problem due to the fact that an area where the soil is mostly contaminated with geohelminth the problem also is endemic. Study done by Wong (1990) in Jamaica showed that household which had high level of geohelminth had high density of eggs of helminth in the soil.

1.5.2 SITUATION OF SOIL-TRANSMITTED HELMINTHS IN TANZANIA

The effect of soil-transmitted helminths was seen in Tanzania since colonial government (Kihamia, 1977). The first report of intestinal helminthes was published in Tanga in 1917 by the civil medical services which showed that soil-transmitted helminths are prevalent in Tanzania. Since that time and subsequent years, the civil medical services continued to give information in the annual report of STH (Kihamia, 1977).

Prevalence of soil-transmitted helminths in Tanzania is high in some of the regions with favorable environmental conditions for growth and multiplication. In some parts where regular chemoprophylaxis admission has being done the prevalence has being decreasing day after day. Study done by Kihamia, (1977) in four communities in Kilimanjaro region showed that the prevalence of A. lumbricoides was 27.8%, T. trichuris 23.1% and Hookworm 3.8%. Killewo*, et al.,* (1991) studied patterns of Hookworm and Ascaris infection in Dar es Salaam and they reported the prevalences of 4% and 7.1% for Ascaris and Hookworm respectively.

Prevalence of soil-transmitted helminths is also high among primary school children. This has being revealed by several studies, Senkoro (1999) did the study among school age children in rural areas of Kinondoni district Dar es Salaam and found the prevalence of Hookworm, Ascaris and Trichuris to be 25.8%,4.8% and 3.5% respectively. Another study by Tarimo (1999), who studied the prevalence and intensity of soil-transmitted helminths among primary school children and related factors in Temeke district showed that the prevalence of Hookworm was 22.4%, Ascaris 4.1%, Trichuris 0.7%, Strongloides and E.vermicularis 1.7%. Also study by Dahoma (2000) in Zanzibar showed the prevalence of at least one species of soil-transmitted helminths infection before treatment was 62%. Study done by Tatal*, et al.,* (2008) in Tanga region shows that the prevalence of Hookworm in school children to be 68%. Another study by Mazigo, *et al.,* (2010) who studied co-infections with *Plasmodium falciparum*, *Schistosoma mansoni* and intestinal helminths among schoolchildren in endemic areas of northwestern Tanzania found the prevalence of hookworm infection to be 38%.

Jukes*, et al .,* (2002) did the study among primary school children in Bagamoyo and Kibaha district to find if heavy schistosomiasis is associated with poor short term memory and slower reaction times. Among other things they also examined the prevalence of Hookworm and other helminthes. The prevalence of Hookworm was found to be 12.4%.

Tarimo (1999) examined the soil samples in Temeke district and among 60 samples 45% were found with STH larvae. The same study assessed knowledge of the children, 72.4% of them knew at least one transmission mode of soil-transmitted helminths. Awareness increased with age, and it was not statistically significant difference between male and female school children in the awareness of geohelminths transmission.

1.5.3 CONTROL OF SOIL-TRANSMITTED HELMINTHS

Among the strategies of integrated control of neglected tropical diseases, deworming programme represents one of the most efficient and cost-effective means to improve child health and education, pregnancy outcome, reducing anemia, improve worker productivity, prevent blindness and skin diseases. Single-dose anthelminthic treatment, usually without prior diagnosis administered to high-risk groups, is the strategy of choice. This approach has been termed preventive chemotherapy (Knopp, *et al.*, 2007).

Chemotherapy with single dose, broad- spectrum, safe and low cost antihelminthic drugs is the mainstay of programmes aimed at the control of morbidity due to intestinal nematodes (Savioli, *et al.*,1992). Chemotherapy targeted at school children has been considered one of the most cost effective strategies to control helminthic infections in endemic areas (Anderson, *et al.*, 1985), (Bundy, *et al.*,1990).

Field experiences in different countries confirmed the mathematical models predictions that relatively short intervals between treatments (i.e. 2-6 month) are required in areas of moderate to high transmission in order to reduce the prevalence of helminthic infections to very low levels (Anderson, 1989).

STH infections can be controlled cost effectively using anthelminthics (World Bank, 1993). Albendazole has been found to be most appropriate for mass chemotherapy however its efficacy against different geohelminths has been variable (Ismail, *et al.*, 1991; Albonico, *et al.*, 1994). Study done by Elmar, et al., (2004) in Kwazulu-Natal South Africa showed that single dose treatment with Albendazole was very effective against hookworm and *A. lumbricoides* with cure rates (CR) of 78.8 and 96.4% and egg reduction rates (ERR) of 93.2 and 97.7%, respectively however it was exceptionally ineffective against *T. trichiura* (CR = 12.7%, ERR = 24.8%).

The integrated method of controlling soil-transmitted helminths is an effective measure in control programs, Chemotherapy must be accompanied with health education to ensure good health practices. Sufiyan, *et al.*, (2011) did the study in Nigeria to evaluate the effectiveness of deworming and participatory hygiene education strategy in controlling anemia among children aged 6-15yrs . They concluded that including participatory hygiene education to deworming programmes is an effective approach to improve the hemoglobin level of children in areas where there is a high prevalence of hookworm infections, especially as a short-term preventive measure for anemia in children.

Deworming at Mlingotini started in 2006 where primary school children were given single dose drug (Albendazole). The aim of this study was to assess the effectiveness of intervention with mass chemotherapy for soil-transmitted helminths among primary school children in Bagamoyo district. NSSCP and LFEP may use the findings to know whether intervention is successful or not and put corrective measures or maintain the available method.

CHAPTER 2

2.1 METHODOLOGY.

2.1.1 Study area.

Bagamoyo district is one of the six districts in the Coast region. Bagamoyo was selected because it was among the districts in Tanzania with history of high prevalence of soil-transmitted helminths. Also, pupils in this area were receiving Albendazole from 2006 to reduce the infection of STH. Since then there were no any scientific data to see if the prevalence and intensity has declined or not. Doing this study in this area provides the picture of the effectiveness of the mass drug administration (MDA) program.

The district is located between Longitude 37^0 and 39^0 East of Greenwich Meridian, and between latitude 6^0 and 7^0 south of the equator. It is boarded by Morogoro district to the west, Mvomero, Kilindi, and Handeni districts on the north, Indian ocean on the east and Kibaha district on the south.

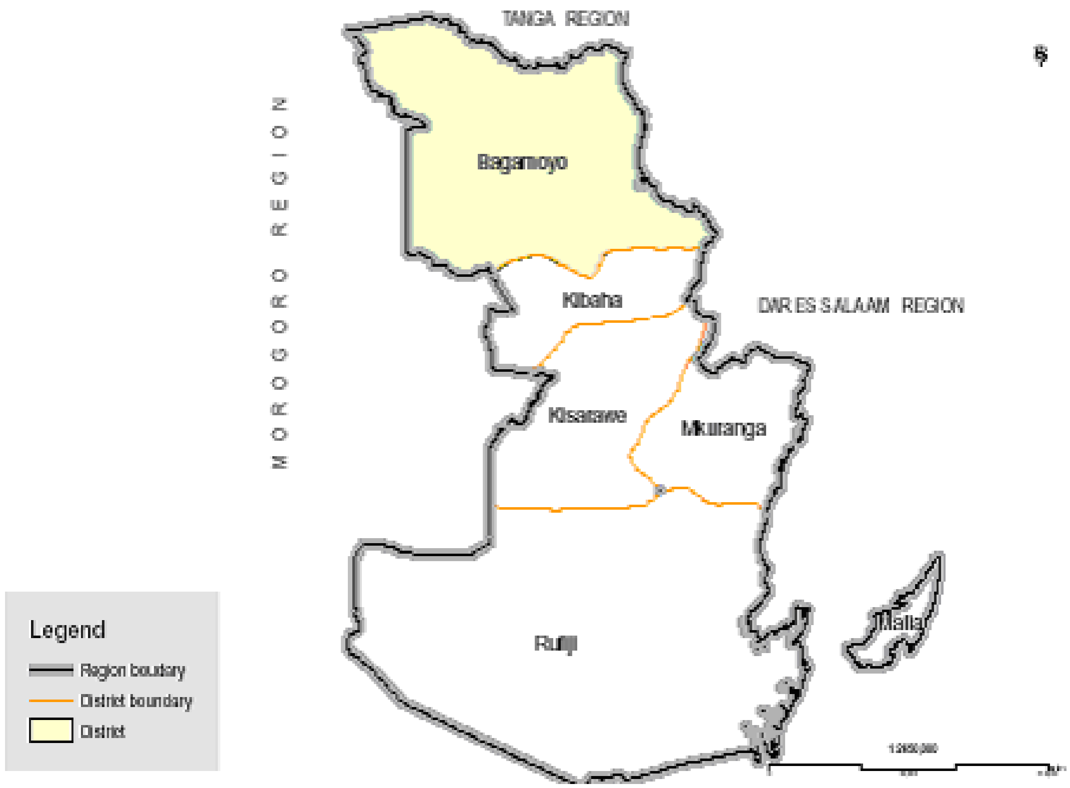
The district has an average temperature of about 28 ^{0}C. It also experiences dual rainfall. The shorter rains start in October to December and long rains from March to June. The average annual rainfall is between 800-1000 mm. The main economic activities in Bagamoyo district are fishing, agriculture, pastoralism and small scale mining

According to the 2002 census, Bagamoyo district has a population of 228,967 people with an annual growth rate of almost 2%. The district is relatively large covering an area of 9,847 sq.kms and has 6 divisions, 16 wards and 78 villages. Among sixteen wards, Magomeni and Zinga wards have the highest population densities. Mlingotini and Pande villages are found within Zinga ward and are among the nine coastal villages, they have a population of 2,291 and 1,591 respectively according to 2002 census. This study was carried out in Mlingotini and Pande villages.

Artisanal fishing is by far the most important economic activity for the people in these villages and 70-80% of the men and women are to some extent involved in the fishing industry. Other occupations include but not limited to farming, boat building and charcoal making. Women traditionally play a role in fish processing and do little fishing individually but boys sometimes help their elders with fishing.

Bagamoyo district is covered by sand loam soil and heavy clay waterlogged soils which are suitable for paddy production and coconut trees. Water coverage within the district was high; in 2005 rural coverage was 73% and urban coverage was 50%. Additionally, 64% of the households had toilets (National bureau of statistics, 2007).

Figure 1. Map showing location of Bagamoyo district



2.1.2 Study population

The study population consisted of standard I-V primary school children in Bagamoyo district. Standard I-V children were chosen because of their age since soil-transmitted helminths reach its maximum intensity at the age of 5-10 years (Grang et al, 2003) and from school records most of the children falling in that range are those in standard I-V.

2.1.3 Study Design

A cross-sectional study design was used to determine the prevalence and assess the risk factors associated with soil-transmitted helminths intervention respectively.

2.1.4 Sample size Estimation

The sample size for this study was estimated using the formula below by Hirji (2010);

$$n = \left(\frac{z}{d}\right)^2 \Pi(1-\Pi)f$$

Where:

n= sample size

d= 0.05 = margin error

f =1.5 =inflation factor (design effect)

z=standard normal deviate set at 1.96 for 5% significant level

Π = estimated proportion of school children with geohelminths was about 12.4% according to the study done by Jukes et al (2002)in Bagamoyo and Kibaha district.

$$n = \left(\frac{1.96}{0.05}\right)^2 0.124(1-0.124)1.5$$

n = 250

Add non participation rate= 10%

$n = (10/100 \times 250) + 250$

$= 275$

$\approx 300.$

2.1.5 Sampling Procedure

Cluster random sampling technique was used, where by classes were clusters of school children. This sampling was conducted in 3-stage cluster sampling method, the 1st stage a simple random sample of villages, 2nd stage selection of schools, 3rd stage selection of classes.

1st stage; selection of villages

The study randomly selected 2 villages out of nine coastal villages which are Dunda, Magomeni, Kaole, Pande, Mlingotini, Kondo, Mapinga, Buyuni and Saadani. A piece of paper was taken and divided it into nine equal pieces. The names of the villages were written in each small piece of paper where by each paper was folded and then assembled together in a box. The box was shaken and one piece of paper was picked from the box at random and a name of the village was identified and noted. Then the box was shaken again and the name of the second village was selected. The villages selected were Mlingotini and Pande.

2nd stage; selection of schools

Each village had one primary school, therefore all the schools were taken.

3rd stage; selection of classes

In this stage classes I-V from each school were involved purposively because of their age. Soil-transmitted helminths infection reach its maximum intensity at the age of 5-10 years(Grang et al, 2003) and from school records that range from standard I-V. All pupils from standard I-V who were eligible were involved in the study.

2.1.6 Study Variables.

Independent variables:

These included STH chemotherapy, socio-demographic characteristics of the primary school children (e.g. age, sex) knowledge on STH infection (knowing STH worms, type of STH worms, potential sources of STH infection, transmission ways and risk factors of STH infection i.e. source of water, water treatment method, type of sanitation facilities, availability of water for hand washing, availability of soap for hand washing, house walls material, house floor materials, wearing of footwear).

Dependent variable:

Prevalence of soil-transmitted helminths.

2.1.7 Inclusion criteria:

Students whose parents/guardian/schoolteacher were willing to participate in the study and living in the study area for at least three months preceding the study were included in the study.

2.1.8 Exclusion criteria:

Primary school children who were serious ill and not attending school at the time of the study were not included in the study.

2.1.9 Recruitment and training of research assistants

Two primary school teachers were recruited prior to the study as research assistants. To ensure quality data collection, one day training was offered to research assistants about the study and on how to administer and fill the questionnaire, collection, handling and storage of stool specimen.

2.1.10 Pretesting of research tools.

Prior to the data collection, pre-testing of questionnaires was done at Mbezi Luis primary school in Dar es Salaam to check if the questions were well understood and was suitable for collecting the required information. Thereafter, amendments of the questionnaire were made this was to remove some questions which appeared not to be well understood and add some new questions with easier language to the children.

2.1.11 Data collection Techniques.

An interview schedule consisting of semi-structured questions with open and closed- ended questions was administered to every study participant. Each day 50 school children were interviewed using a questionnaire so as to cope with the collection of stool specimen for worm identification. The questionnaire had 15 questions developed in English and then translated to Swahili. It was designed to obtain information on socio-demographic characteristics, factors that can expose an individual to soil-transmitted helminths infection. Each study participant was asked for a fresh stool (≤ 24 hours) sample for a parasitological work one day before the interview. Each was given a special sealed and labeled container with an identification number corresponding to that on the questionnaire. Total number of containers given to the children was 309. Children, who failed to provide stool specimens on the day of interview, were requested to bring fresh stool on the following day where the research team was picking at the same school. 9 (3%) children failed to bring it on the requested day therefore were classified as non-respondents.

2.1.12 Parasitological work

Stool parasite status whether positive or negative for any STH determined from a stool sample using Kato–Katz technique. Laboratory work for stool analysis was done at the department of Parasitology and Entomology at Muhimbili University of Health and Allied Science (MUHAS) by the principal investigator and a laboratory technician. In dispatching of stools, a formaldehyde 10% solution was used as preservative.

Procedure for Kato Katz technique;

- A small amount of faecal material was placed on scrap paper and small screen was pressed on top of the faecal material so that some of the feaces could be sieved through the screen and accumulated on top of the screen.
- Flat sided spatula was scraped across the upper surface of the screen so that the sieved feaces accumulate on the spatula.
- A template with a hole was placed on the centre of a microscope slide and fecal matter was added from the spatula until the hole was completely filled. The

side of the spatula was passed over the temperate to remove excess feaces from the edge of the hole.

- Template was removed carefully from the slide so that the cylinder of feaces was left completely on the slide.
- Fecal material was covered with the pre-soaked cellophane strip
- Microscope slide was inverted and the fecal sample was pressed firmly against the hydrophilic cellophane strip on another microscope slide . With that pressure the fecal material was spread evenly between the microscope slide and cellophane strip.
- Slide was removed carefully by gently sliding it sideways to avoid separating the cellophane strip or lifting it off. Slide was placed on bench with the cellophane upwards. Water evaporates while glycerol clears the feaces.
- Slides were examined twice by two observers after preparation. Time was considered, since hookworm eggs clear rapidly within 30-60 minutes after slides preparation.

2.1.13 Data processing and analysis

Data was edited during and after collection, coded, classified to adjust for any missing information, entered and analyzed using SPSS Version 15.0 program by principal investigator.

Frequency tables and cross tabulation were produced for each study variables. Data analysis was carried out by running descriptive statistics and cross tabulations. Chi–square test was used to compare proportions. In order to conclude whether results are statistically significant or not, the cut-off point for p-values was set at 0.05.

2.1.14 Ethical consideration

Ethical clearance was obtained from the Research and Publication Committee of the Muhimbili University of Health and Allied Science. Permission to conduct the study at Bagamoyo District Council was obtained from District Executive Director, the District Medical Officer (DMO) and District Education Officer.

Parent permission was obtained by sending informed consent form through their children, and directed to sign if they accepted involvement of their children. 330 informed consent forms were given to 330 children, 21 (6%) children did not bring back the signed forms within the time therefore were not recruited into study. All information obtained from the participants was treated confidentially.

CHAPTER 3

3.1 RESULTS

3.1.1 DEMOGRAPHIC INFORMATION.

Among 300 school children who were enrolled in this study 51.3% were male of whom 68.8% were from Mlingotini primary school and 31.2% from Pande primary school. Female children were 48.7%, of whom 71.2% were from Mlingotini primary school and 28.8% from Pande primary school. The mean age of the children was 9.3 years.

Generally there were more male children in the higher age groups as compared to female children as it can be seen in the table below.

Table 1: Demographic characteristics of interviewed children by sex and age.

	Sex		
Age group(years)	**Female**	**Male**	**Total**
5-7	37(52.9%)	33(47.1%)	70(100%)
8-10	65(47.4%)	72(52.6%)	137(100%)
11-13	44(48.9%)	46(51.1%)	90(100%)
14-16	0 (0%)	3(100%)	3(100%)
Total	**146**	**154**	**300**

3.1.2 PROPORTION OF CHILDREN WHO RECEIVED ALBENDAZOLE DURING LAST MDA DISTRIBUTION.

Majority of school children reported to have received Albendazole in the last distribution (97.7%). Among those who took drugs, males had slightly higher proportion as compared to females 98.1% and 97.3% respectively although the difference of Albendazole intake between sex was not significant (Chi square= 0.21, p value= 0.65). Considering age groups, children of age group 11-13 and 14-16 had reported higher intake in the last distribution, and the difference between the groups was statistically significant.(Table 2)

Table 2: Proportion of Children received Albendazole during last MDA distribution according to their sex and age.

Children who received Albendazole during last distribution						
Sex	**Yes**	**No**	**Total**	χ^2	**P value**	**df**
Female	142 (97.3%)	4(2.7%)	146(100%)			
Male	151 (98.1%)	3(1.9%)	154(100%)	0.21	0.65	1
Age group						
5-7	65(92.9%)	5(7.1%)	70(100%)			
8-10	135(98.5%)	2(1.5%)	137(100%)			
11-13	90(100%)	0(0%)	90(100%)			
14-16	3(100%)	0(0%)	3(100%)	9.79	0.02	3

3.1.3 PREVALENCE OF SOIL-TRANSMITTED HELMINTHS.

The prevalence of geohelminths was 0% based on microscopic examination.

3.1.4 KNOWLEDGE ON SOIL-TRANSMITTED HELMINTHS.

The administered questionnaire to the study population, amongst other details, covered also awareness of the disease, type of worms which they were familiar with and sources of worms. Only 37% of the children were aware of STH and mentioned hookworm and soil as the type and source of worms they knew respectively. It was statistically significant p value (0.039) that Male children had high level of knowledge regarding STH compared to females i.e. 29.2% versus 17.1%.

It was also statistically significant that the level of knowledge was increasing with age, as it was noted that 66.7% of the children in the age group of 14 -16 years had high level of knowledge while only 17% of the children in the age group of 5-7 had high level of knowledge.

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 when the child answered all the three questions correctly; Moderate when the child answered two questions correctly and low when the child answered only one question.

Table 3: Level of knowledge on soil-transmitted helminths with respect to age group.

	Level of knowledge on STH			
Age group	Low	Moderate	High	Total
5-7yrs	49(70%)	9(12.9%)	12(17.1%)	70(100%)
8-10yrs	91(66.4%)	21(15.3%)	25(18.2%)	137(100%)
11-13yrs	48(53.3%)	11(12.2%)	31(34.4%)	90(100%)
14-16yrs	1 (33.3%)	0 (0%)	2(66.7%)	3(100%)
Total	**189**	**41**	**70**	**300**

Chi square 13.26 df = 6 P value = 0.039

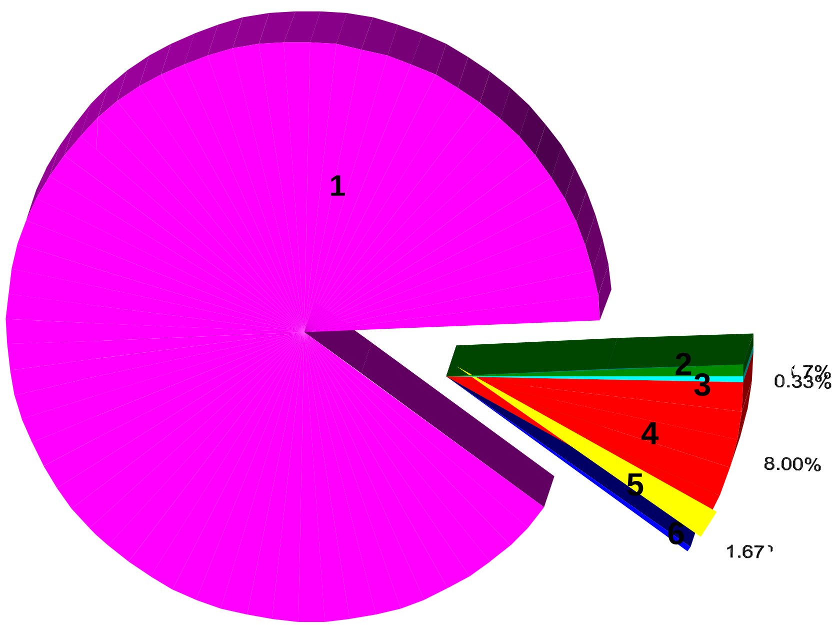
3.1.5 RISK FACTORS FOR HAVING SOIL-TRANSMITTED HELMINTHS

3.1.5.1 Source and treatment methods for drinking water

Majority of the children (55.7%) mentioned tap water as their source of water for domestic use, 33.3% reported to use both tap water and water from shallow wells. The remaining percent reported to be using water from springs or street venders or both of them.

With regard to the treatment of drinking water, 89% of the children reported to drink untreated water, 8 % reported to drink boiled water, 1.63% drink just filtered water, 0.63% drink both untreated and boiled water,0.33% drink boiled and filtered water and 0.33 drink water treated with chemicals such as Water Guard as summarized in the figure below.

Figure 2. Methods for treating drinking water as reported by the interviewed children.



Key;

1. Drink untreated water (89.00%)
2. Sometimes drink untreated and sometimes boiled water (0.67%)
3. Drink boiled and filtered water (0.33%)
4. Drink boiled water (8%)
5. Drink filtered water (1.67%)
6. Use chemicals like Water Guard (0.33%)

3.1.5.2 Use of toilet and hand washing

Children who participated in this study were asked to mention the types of latrines they use. In this regard, 95.3% of the children reported to use pit latrine as a type of toilet at their homes, the remaining 4.7% were using flashing toilets, and none reported unavailability of toilet at his/her home. However 49.7% of the children reported having hand washing facilities (Tap, jags) at their home and availability of soap was very easy for 11.3% of the children, easy for 61%, difficult for 24.3% and very difficult for 3.3% of them. 54.3% reported to be washing hands before eating, after eating and after toilet. Others reported to be washing hands only before going to school or for prayers (1.3%), only before and after eating (21.7%), and only after toilet (10%).

3.1.5.3 House floor and toilet floor material

House floor and toilet floor materials mentioned by children included mud and cement. In this regard, 43.3% and 64% of the children mentioned mud as a house and toilet floor material respectively. Cement was mentioned by 56.7% and 36% of the children as a house and toilet floor material respectively.

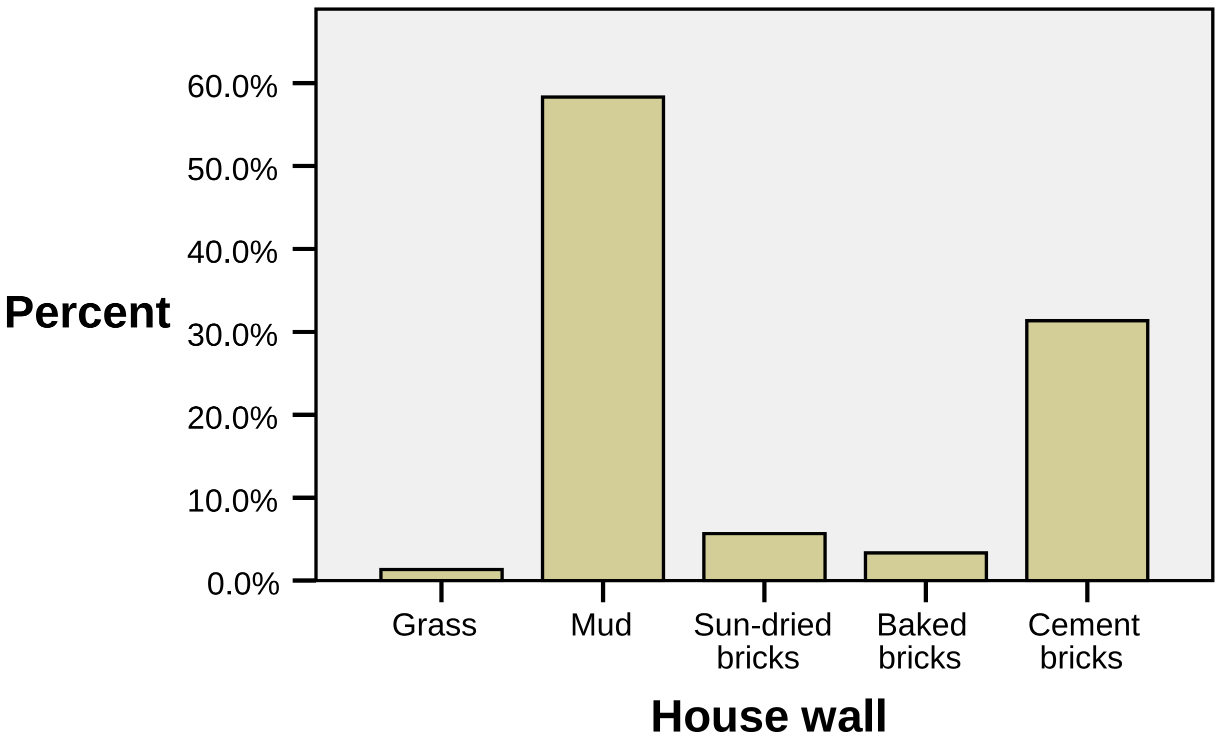
3.1.5.4 Shoe wearing

Wearing of shoes is an important aspect in avoiding hookworm infections. In this study, 43.3% of the children reported that they wear shoes outside throughout, 40% seasonally, 6.3% once in a while and 10.3% reported to never wear shoes when outside. Also majority reported wearing shoes throughout when going to toilet i.e. 72.3%, 24.7% seasonally, 2.7% once in a while and 0.3% reported to never wear shoes when going to toilet.

3.1.5.5 House wall material

Majority of children (50.8%) reported that their house walls were made up of mud while very few (0.2%) reported that their house walls were made up of grass (nyasi). Others mentioned cement bricks, baked bricks and sun-dried bricks. (Figure 3)

Figure 3. House wall material as reported by interviewed children.



CHAPTER 4

4.0 DISCUSSION

Demographic characteristics.

More than half of the children involved in this study were males. This differs from the study done by Kagya (2011) in Mkuranga district and study conducted in Nigeria which found that the majority of pupils who participated in their study were females (Adefemi, *et al.,* 2006). From school attendances most of the classes chosen in the study had many male children compared to females, hence a possible explanation as to why there were more males sampled compared to females. Soil-transmitted helminths reach its maximum intensity at the age of 5-10 years (Grang *et al.,*2003) and from the study the mean age of the children participated in the study was less than 10 which fall in that range.

Ant-helminth intake in the study area

This survey specifically intended to assess the effectiveness of soil-transmitted helminthes control using periodic chemotherapy. The school children were dewormed one month before the start of this survey. Additionally the chemotherapy was given to the school on regular basis. The coverage was acceptably high. More than 95% of the pupils were dewormed. Deworming is firmly on the international health agenda and increasing access to ant-helminth, particularly among school age children, is a key target of this program. Annual antiparasitic treatment is recommended for communities that contain moderate and low intensity (WHO 2002).

Prevalence of Soil-transmitted helminths.

This study found the prevalence to be zero percent for all the STH. This could be due mainly to two reasons. First the intervention over the years has reduced the burden significantly and this survey corresponded with the last round thus prevalence was zero. Secondly perhaps the Kato-Katz technique used did not show Hookworm because the glycerol used might have rendered the preparation to become transparent thus not showing the ova. The study area was endemic previously as shown by a number of studies; Jukes, et al., (2002) did the study in Bagamoyo and Kibaha district found the prevalence of Hookworm to be 12.4%. Study done in rural Dar es Salaam which has climatic conditions similar to Bagamoyo had the following findings; Senkoro (1999) in rural areas of

Kinondoni district found the prevalence of Hookworm, *Ascaris* and *Trichuris* to be 25.8%,4.8% and 3.5% respectively. Another study by Tarimo (1999) in Temeke district showed that the prevalence of Hookworm was 22.4%, *Ascaris* 4.1%, *Trichuris* 0.7%, *Strongyloides* and *Enterobius vermicularis* 1.7% .

It is very likely that the deworming intervention has been effective in reducing the prevalence of STH like it has been supported by several studies; Study done by Elmar, *et al.,* (2004) in Kwazulu-Natal South Africa showed that single dose treatment with Albendazole was very effective against hookworm and *A. lumbricoides* with cure rates (CR) of 78.8 and 96.4% and egg reduction rates (ERR) of 93.2 and 97.7%, respectively however it was exceptionally ineffective against *T. trichiura* (CR = 12.7%, ERR = 24.8%). Study done by Patrick *et al.* (2009) in Nigeria suggested that at baseline, the number of moderate infections was 6.2% and by the end of the follow-up after administration of Albendazole the number of moderate infections dropped to 1%. (Knopp, 2007,. Ismail, *et al.,* 1991 and Albonico *et al.,* 1994) supported the use of Albendazole for mass chemotherapy because of its effectiveness.

Knowledge regarding Soil-transmitted helminths

There was low knowledge regarding STH as more than half of the pupils had never heard about STH and only quarter of the pupils had high knowledge.

That may be due to several reasons; First the health education component of the control program may not be actively creating awareness amongst the pupils. Secondly it may be contributed by less focus of their training on intestinal worms at their schools. Study done by Tarimo (1999) among primary school children in Temeke district showed high level of knowledge regarding STHs where 72.4% of them knew at least one of its transmission mode.

Awareness in this study increased with age, this may be due to the fact that pupils of higher age are at higher classes and science subjects are taught from standard four, therefore it is possible that pupils of higher age were taught about intestinal worms by their teachers. Study done by Kagya (2011) among primary school children in Mkuranga district has the same observation, that knowledge was higher in higher age groups.

Risk factors for having Soil-transmitted helminths

Risk factors associated with infection of STH were high despite of the zero prevalence. More than 80% of the children were drinking untreated water from the tap and wells which were the main sources of domestic water. This may be contributed by parents' poor knowledge regarding STH.

STH require moist, warm and shaded soil for growth, development and transmission Grang, *et al*. (2003). More than 40% and more than 50% of the children mentioned sand as a house and toilet floor material respectively which is one of such conducive environments for the STH. Grang, *et al.* (2003) revealed that hookworm has the ability to ascend vertically 30-90cm and laterally about 30cm in sandy loamy soils. Therefore wet type earthen floor shallow pit latrine allows penetration of hookworm to the top. Hookworm enters human body through feet penetrations therefore not wearing of shoes when going to toilet as reported by some of the children was another risk factor. The condition of the toilet depends on the family income in the sense that 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 owners` attitude or awareness regarding the importance of using a better toilet. People with awareness and positive attitude will construct good toilets.

STH can also be spread by not washing hands with soap and clean water. If a person eats with contaminated hands he can be infected with STH. 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 (Borghi *et al.*, 2002 and Hoque, 2003). About half of the children reported to wash hands before eating and after toilet. These findings are in line with those of Kagya (2011) who did a study in Mkuranga district and found that many pupils wash their hands before eating and after using toilets.

Availability of soap for washing hands was easy for more than 50% of the children. Even though the quality of water used for washing hands was not investigated in this study, less than half of the pupils reported having hand washing facilities like tap and jags. These observations make signals that a reasonable number of children are still vulnerable to STH infection and they are in line with the observations made by Pawlos, *et al. (*2011) who highlighted that environment, hygiene and socioeconomic are major factors for the transmission of STH.

Chemotherapy must be accompanied with health education to ensure good health practices so as to reduce the observed risk factors. Sufiyan, *et al.* (2011) in Nigeria concluded that including participatory hygiene education to deworming programmes will greatly improve the hemoglobin level of children in areas where there is a high prevalence of hookworm infections.

CHAPTER 5

5.0 CONCLUSION

Mass Drug Administration had been a successful approach in the control of STH worms, therefore the program should be maintained to ensure that the prevalence remains low. Moreover MDA should be accompanied with health education because knowledge, altitudes and practices regarding STH infection were observed to be poor amongst the study population. Children are treated but return to the same environment and continue practicing in a way that makes them vulnerable to STH infections. Control programs should focus their efforts on environmental and hygiene factors to reduce the cost of carrying out regular treatment.

5.1 RECOMMENDATIONS

NSSCP and LFEP must be congratulated for elimination of STH infections among primary schools in Bagamoyo district. For ensuring eradication of this infection the following measures can be considered;

- Integrating methods of controlling soil-transmitted helminths which include health education so as to ensure health practices and to reduce risk factors for transmission of STH.
- The factors that do put these children at risk, needs to be further assessed and explored and more data needed so as to draw a reasonable conclusion.
- Further studies for assessing the effectiveness of STH intervention with chemotherapy are needed using the larger sample size and in different areas of the country so as to conclude nationally.

5.2 LIMITATIONS OF THE STUDY

- Some of the children failed to participate in the study because they felt shy of bringing stool samples, therefore reducing the number of participants and may resulted into miss of some information.

5.3 REFERENCES

Albonico, M., Smith, P.G., Hall, A., Chwaya, H.M., Alawi, K.S. and Savioli, L. (1994) A randomized controlled trial comparing mebendazole and albendazole against *Ascaris*, *Trichuris* and hookworm infections. *Trans R Soc Trop Med Hyg* ; 88: 585-9.

Anderson, R.M. and Medley, G.F., (1985). Community control of helminth infections of man by mass and selective chemotherapy. Parasitology 1985; 90:629-60

Anderson, R.M.(1989) Transmission dynamics of Ascaris lumbricoides and the impact of chemotherapy in Crompton, D.W.T., Nesheim, M.C., Pawlowski, Z.S. (eds). Ascariasis and its Prevention and Control. London and Philadelphia; Taylor and Francis,pp.44-54

Andy, E. and Palmer, A. (2005) Soil-transmitted helminthiasis among school-age children in Ethiope east local government area, Delta state, Nigeria. Afr J Biotechnol.

Bagamoyo District Council and Tanzania Coastal Management Partnership (2001). Integrated Coastal Management Action Plan. Bagamoyo, Bagamoyo District Council.

Borghi, J., Borghi, L., Guiness, J., Oudraogo, C. and Curtis, V. (2002). Is hygiene promotion cost-effective? A case study in Burkina Faso. Trop Med Int Health, 7:960-969.

Brooker, S., Miguel, E.A., Moulin, S., Luoba, A. I., Bundy, D. A. P. and Kremer, M. (2000) Epidemiology of single and multiple species of helminth infections among school children in Busia district, Kenya. *East African Medical Journal Vol.77 No.3*

Brooker, S., Clements, A. C. A. and Bundy, D. A. P. (2006). Global epidemiology, ecology and control of soil-transmitted helminth infections. *Adv Parasitol 62:* 221–26

Bundy, D.A.P., Wong, M.S. and Lewis, L.L. (1990). Control of geohelminths by delivery of targeted chemotherapy through schools. *Trans Roy Soc Trop Med Hyg 1990,84:115-20*

Chukumwa, M.C., Ekejindu, N.R., Agbakoba, D.A., Ezeagwuna, C., Anaghalu, D. and Nwosu, D.C. (2009) . The Prevalence and Risk Factors of Geohelminths Infections among Primary School Children Middle- East. *Journal of Scientific Research, 4*(3):211-215.

Connolly, K.J. and Kvalsvig, J.D. (1992) Infection, nutrition and cognitive performance in children. *Parasitol Today* 104: S187-S200.

Dahoma, M.J.U. (2000) A randomized community trial on safety and efficacy of co-administration of albendazole and ivermectin on lymphatic filariasis and its secondary effects on geohelminths in Zanzibar, Tanzania. Master of Science in Tropical Disease Control Dissertation, University of Dar es Salaam.

Daniel, W. (1995) Biostatistics: A foundation for analysis in the health sciences. *6th ed. New York: Willey.*

Elmar, S., Annette, O., Jane, DK. and Chris, C.A. (2004). Patterns of geohelminths infection, impact of albendazole treatment and re-infection after treatment in school children from rural Kwazulu-Natal South Africa. BMC Infectious disease 2004,4:27.

Gautum, A. (2009) . Profile of current coastal tourism in Bagamoyo district, Tanzania and opportunities for development ecotourism. *TCMP technical report.*

Grang, J. and Zumla, A. (2003). Protozoa and helminth infections. Manson’s tropical diseases. 21st ed. London: Elsevier Sciences, p. 1205–1527.

Hall, A. (1993). Intestinal parasitic worms and the growth of children. *Trans R Soc Trop Med Hyg*; 87: 241-2.

Hall, A., Orinda, V., Bundy, D.A.P. and Broun, D. (1997). Promoting child health through helminth control – a way forward? *Parasitol Today* 13: 411-3.

Hirji, K. (2010), Sample size estimation, Lecture/ Class, Muhimbili University, unpublished.

Hoque, B. A. (2003). Handwashing practices and challenges in Bangladesh. Int J Environmant Health Re, 13(1):81-87.

Hotez, A. (2003). Soil transmitted helminth infections: ascariasis, trichuriasis, and hookworm. *Lancet*, 367:1521-1532.

Hotez, P.J., Brooker, S., Bethony, J.M., Bottazzi, M.E., Loukas, A. and Xiao, S.H.(2004) Current Concepts: Hookworm Infection. *New England Journal of Medicine. 351:799-807.[Pubmed]*

Ismail, M.M., Premaratne, U.N. and Suraweera, M.G. (1991). Comparative efficacy of single dose anthelminthics in relation to intensity of geohelminth infections.*Ceylon Med J* ;36: 162-7.

Jukes, M.C.H., Nokes, C.A., Alcock, K.J., Lambo, J.K., Kihamia, C., Ngorosho, N., Mbise, A., Lorri, W., Yona, E., Mwanri, L., Baddeley, A.D., Hall. A. and Bundy D.A.P. (2002). Heavy schistosomiasis associated with poor short term memory and slower reaction times in Tanzania school children. Tropical Medicine and International Health. 7,104-117.

Kagya, N. (2011) Prevalence, Intensity and Factors Associated with Soil transmitted-helminths among primary school pupils in Mkuranga district, Coast region, Tanzania. Dissertation for Master of Science in Tropical Disease Control Dissertation, Muhimbili University of Health and Allied Sciences.

Khalid, M., Amir, S., Pascal, Robert, N., Benedict, N. and Annette, O. (2009) The combined effect of the lymphatic filariasis elimination programme and the schistosomiasis and soil transmitted helminthiasis control programme in school children in Tanzania. Transactions of the society of tropical medicine and hygiene.103:25-30.

Kihamia, C.M. (1977): Prevalence rates of Intestinal Parasites in Four Communities in Kilimanjaro, Tanzania. Master of Medicine Dissertation, University of Dar es Salaam.

Killewo, J.Z.J, Caincross, S., Smet, J.E.M., Mahikwano, L.F. and Van Aslen, H. (1991): Patterns of Hookworm and Ascaris infection in Dar es Salaam. Acta Tropica 48: 247-249.

Knopp, S., Mgeni, A.F., Khamis, I.S., Steinmann, P., Stothard, J.R., Rollinson, D., Marti, H., and Utzinger, J. (2007) Diagnosis of Soil-Transmitted Helminths in the Era of Preventive Chemotherapy: Effect of Multiple Stool Sampling and Use of Different Diagnostic Techniques. PloS Negl Trop Dis; 2 (11): e331

Legese, M. and Erko, B. (2004) Prevalence of intestinal parasites among school children rural area close to the southeast of Lake Langano, Ethiopia. *Ethiopian J of Health Dev.; 18:116–120.*

Luoba, A.I., Geissler, P.W., Estammbale, B., Ouma, J.H., Alusala, D., Ayah, R., Mwaniki, D., Magnussen, P. and Friis, H. (2005) . Earth-eating and re-infection with intestinal helminths among pregnant and lactating women in western Kenya. Tropical Medicine and International Health; 10 (3): 220 – 22

Mazigo, H. D., Waihenya, R., Lwambo, N., Mnyone, L. L., Mahande, A. M., Seni, J., Zinga, M., Kapesa, A., Kweka, E. J., Mshana, E. S., Heukelbach, J. and Mkoji, G.M. (2010) Co-infections with *Plasmodium falciparum*, *Schistosoma mansoni* and intestinal helminths among schoolchildren in endemic areas of northwestern Tanzania. *Parasites & Vectors 2010, 3:44*

National Bureau of Statistics and Coast Regional Commissioner's Office, (2007). United Republic of Tanzania, Coast Regional Social Economic Profile, Second Edition.

Neglected Tropical Disease Control program (2011). Unpublished report of MOH.

Nokes, C. and Bundy, D.A.P. (1993). Compliance and absenteeism in school children: implications for helminth control. *Trans R Soc Trop Med Hyg* 87: 148-52.

Nyandindi, U., Milen, A., Palin-Palokas, T., Robison, V., Mwakasagule, S. and Mbiru, F.(1995). Training teachers to implement a school oral health education programme in Tanzania. *Health Promotion International*, 10 :93-100.

Ogbe, M .N., Edet, E.E. and Isichel, N.N.(2002).Intestinal Helminth infection in primary School Children in areas of operation of shell petroleum development company of Nigeria (SPDC) western division in Delta State. *The Nig. J. Parasitiol,* 23:3-10.

Patrick, K., Samuel, O., Asaolu, S., Molloy, F., Titilayo, C.A., Andrew, L.J. and Celia, V.H.(2009). Patterns of soil-transmitted helminth infection and impact of four-monthly albendazole treatments in preschool children from semi-urban communities in Nigeria: a double –blind placebo-controlled randomized trial. *BMC Infectious Diseases,* 9(20): 1471-2334.

Pawlos, R., Getachew, B., Berhanu, E., Mengistu, L. and Mulugeta, B., (2011) Intestinal parasitic Infections and Malnutrition amongst first cycle primary school children in Adama,Ethiopia. *Africa Journ of Primary Health Care Vol 3, No 1.*

Phiri K., Whitty, C., Graham, S. and Ssembatya-Lule, G. (2000). Urban/rural differences in prevalence and risk factors for intestinal helminthes infection in southern Malawi. Ann *Trop Med Parasitol; 94:381–387.*

Savioli, L., Bundy, D.A.P. and Tomikins, A.(1992). Intestinal parasitic infections a possible public health problem. Transactions of the Royal Society of Tropical Medicine and Hygiene 86: 353-354.

Senkoro, R.H. (1999) Health of school age children and factors associated with non-enrolment in school in rural areas of Kinondoni district Dar es Salaam. Master of Science in Tropical Disease Control Dissertation, University of Dar es Salaam

Silva N. R., Brooker S., Hotez P. J., Montresor A., Engles D. and Savioli L (2003). Soil-Transmitted Helminth Infections: Updating the Global Picture. *Trends in Parasitology* 19: 547–51. [PubMed]

Stephenson, L.S., Lantham, M.C., Kinoti, S.N., Kurz, K.M. and Brigham, H. (1990). Improvement of physical fitness of Kenyan schoolboys infected with hookworm, *Trichuris trichiura* and *Ascaris lumbricoides* following a single dose of albendazole. *Trans R Soc Trop Med Hyg* 84: 277-82.

Stephenson, L.S. (1994). Helminth parasites, a major factor in malnutrition *World Health Forum*; 15: 169-72.

Stephenson, L. S., Latham, M. C. and Ottesen, E. A (2000). Malnutrition and Parasitic Helminth Infections. *Parasitology*. 121(Suppl.): S23–28. [PubMed]

Sufiyan, M.B., Sabitu, K. and Mande, A.T. (2011). Evaluation of the effectiveness of deworming and participatory hygiene education strategy in controlling anemia among children aged 6-15 yrs in Gadagau community, Giwa LGA, Kaduna Nigeria. Annals of African Medicine Vol.10, No.1.1; 6-12

Tadesse, G. (2005). The prevalence of intestinal helminth infections and associated risk factors among school children in Babile town, Eastern Ethiopia. *Ethiopian J of Health Dev.; 19:140–147.*

Tarimo, A.M. (1999) Prevalence and Intensity of Geohelmiths among primary school children and related factors in Temeke district, Dar es Salaam. Master of Science in Tropical Disease Control Dissertation, University of Dar es Salaam

Tatala, S.R., Kihamia, C.M., Kyungu, L.H., and Svanberg, U. (2008).Risk factors for anaemia in school children in Tanga Region. *Tanzania Journal of Health Research Vol. 10 no.4*

van Eijk, A.M., Lindblade, K.A., Odhiambo, F., Peterson, E., Rosen, D.H., Karanja, D., Ayisi, J.G., Shi, Y.P., Adazu, K., and Slutsker, L.(2003)Geohelminth Infections among Pregnant Women in Rural Western Kenya; a Cross-Sectional Study: PloS Negl Trop Dis 3 (1): e370

WHO (1998). A global strategy for the control of soil transmitted
nematodes in high risk groups. *TAG Meeting World Health Organization*.

WHO (1999). Scaling up worm control: Reducing the public health impact Schistosomiasis and Soil-transmitted helminth infections. http://www.who.int/ctd/intpara.

WHO. (1999). Scaling up worm control: Reducing the public health impact Schistosomiasis and Soil-transmitted helminth infections. http://www.who.int/ctd/intpara.

WHO. (2002). Prevention and Control of Schistosomiasis and Soil-Transmitted Helminthiasis. *WHO Technical Series Report 912. Geneva.*

WHO. (2006). Schistosomiasis and soil-transmitted helminth infections- preliminary estimates of the number of children treated with albendazole or mebendazole, Soil-transmitted helminth infections: updating the global picture. *Wkly. Epidemiol. Rec.* 81, pp.

Wong, M.S. and Bundy, D.A.(1990). Quantitative assessment of contamination of soil by eggs of *A.lumbricoides and T.trichiura. Transaction of the Royal Society of Tropical Medicine and Hygiene,* 84(4):567-570

Woodburn, P.W., Muhang, L., Hillier, S., Ndibazza, J., Namujju, P.B., Kizza, M., Ameke, C., Omoding, N.M., Booth, M. and Elliot, A.M. (2009) . Risk Factors for Helminth, Malaria, and HIV Infection in Pregnancy in Entebbe, Uganda.PloS Negl Trop Dis; 3 (6): e473

World Bank: Appendix B. The global burden of diseases, 1990. In: World development report 1993.New York: Oxford University Press, 1993.

Zulkifli, A., Khairul, A., Anuar, Atiya. A.S. and Yano, A. (2000). Prevalence of malnutrition and geo-helminth infections among primary schoolchildren in rural Kelantan. *Chiba University, Chiba 26-8670, Japan*

5.4 APPENDICES.

5.4.1 INFORMED CONSENT ENGLISH VERSION.

CONSENT FORM

Introduction

My name is Anence Kamasho, The MSc. Student at the Muhimbili University of Health **a**nd Allied Sciences. I am conducting a research titled EFFECTIVENESS OF INTERVENTION WITH MASS CHEMOTHERAPY FOR SOIL-TRANSMITTED HELMINTHS AMONG PRIMARY SCHOOL CHILDREN IN BAGAMOYO DISTRICT.

Purpose of study

Soil-transmitted helminths are common health problems of children. Children at school age are at risk of developing clinical manifestation, because helminthic infections such as *Trichuris trichuria* and *Ascaris lumbricoides* reach maximum intensity at 5–10 years of age. Chronic STH infections resulting from *Ascaris*, *Trichuris*, and hookworm can dramatically affect physical and mental development in children.

This study will assess effectiveness of STHs intervention with chemotherapy and be used in control program to know if they apply the appropriate measure hence to maintain or modify it. Moreover it will assess factors associated with STHs intervention.

The study will recruit children with the following criteria

1. Standard I- V students from Mlingotini and Pande primary schools who will be willing to participate.
2. Who have leaved within the area at least three month preceding the study.
3. Primary school children who will be serious ill and not attending school at the time of the study will not be included.

Procedure

We will give the children stool containers one day before interview and ask them to bring stool samples on the next day and interviewed on certain issues which may be related to transmission of STH. Stool samples will then be taken at Muhimbili laboratory for examination of STHs.

Risk

The whole process is harmless apart from the time taken to complete the process.

Right to withdraw and alternative

Your child/children/students participation in this study is entirely optional. Once your child/children/students are recruited you will be free to pull them out of the study at any time or stage. Your right to any health services will continue to be independent of your recruitment status.

Benefits

There is no on spot benefit for the participating individuals, but study findings can help to modify the intervention measures and hence improve health situation of the children.

Confidentiality

The data which will be collected from the children may be published or accessed by external supervisors but will be treated as strictly confidential.

Who to contact

In case you have any questions regarding the procedure or participant's position in the study please contact the following people; Principal Researcher, Bagamoyo District Medical Officer, Bagamoyo District Education Officer or you may directly contact Prof C. Kihamia, Course Coordinator department of Parasitology and Medical entomology. Director of postgraduate studies Muhimbili University, Prof Z.Premji P.O.BOX 65001, TEL: (255-022)-2151378

We are therefore requesting you to allow your child/children be part of the participants who will be recruited for the study.

Consent

I (name of parent or guardian, school teacher in capital)……………………………………………………….have read/heard and understood the purpose/aim and all procedures involved in the study. I therefore willingly accept to let my children/child/students join the study.

Name of participant: ....

Signature of parent/guardian/ school teacher (or finger/thumbprint)………………….Date……………………

5.4.2 INFORMED CONSENT SWAHILI VERSION.

FOMU YA RIDHAA

Utangulizi

Naitwa Anence Kamasho, Mwanafunzi wa Shahada ya Pili katika Chuo kikuu cha Afya Cha Muhimbili . Nina fanya utafiti unaohusu; MAFANIKIO YA MPANGO WA KUDHIBITI MINYOO YA TUMBO KWA KUTUMIA DAWA KWA WATOTO WA SHULE ZA MSINGI WILAYA YA BAGAMOYO.

Dhumuni la utafiti

Minyoo ya tumbo ni moja ya tatizo la kiafya linalowapata watoto mara kwa mara. Minyoo hiyo ni Askari (Minyoo mikubwa ya tumbo), Safura na Minyoo ya mjeledi na inaweza kusababisha matatizo ya kimwili na ya kiakili. Watoto wenye umri wa kwenda shule wako katika hatari ya kupata ugonjwa wa minyoo ya tumbo kwani minyoo ya mjeledi na minyoo mikubwa ya tumbo ina tabia ya kujitokeza kwa kiwango kikubwa kwa watoto wenye umri kati ya miaka 5-10.

Utafiti huu utasaidia kujulisha kiwango cha ugonjwa wa minyoo ya tumbo kwa baadhi ya watoto wa shule za msingi katika wilaya ya bagamoyo ikilenga kwenye shule za Mlingotini na Pande baada ya kinga ya miaka mitano. Aidha utasaidia kujua uelewa wa wanafunzi na kujua hali ya vihatarishi vya kupata minyoo hiyo. Taarifa hizo zitakazopatikana zinaweza kutumika kujua mafanikio ya mpango wa kudhibiti minyoo ya tumbo kwa kutumia dawa kwa baadhi ya shule za msingi wilaya ya bagamoyo.

Utafiti huu utahusisha watoto wenye sifa zifuatazo:

1. Wanafunzi wa darasa la I- V kutoka shule za msingi Mlingotini na Pande ambao watakuwa tayari kujihusisha na utafiti.
2. Ambao wameishi katika maeneo hayo kwa muda usiopungua miezi mitatu kabla ya utafiti.
3. Wanafunzi ambao watakuwa ni wagonjwa sana na ambao hawatakuwepo shuleni kwa muda utafiti utakapofanyika hawataingizwa kwenye utafiti.

Utaratibu

Baada ya kukubali kuingizwa kwenye utafiti watoto watapewa vyombo maalumu vya kuhifadhia choo siku moja kabla ya kuhojiwa na watatakiwa kurudisha vyombo hivyo vikiwa na choo siku inayofuata. Sampuli za vyoo hivyo vitahifadhiwa kwa dawa maalumu inayopunguza harufu na kuzuia mazalia ya wadudu na baadae kupelekwa maabara maalumu Muhimbili kwa ajili ya usomaji wa minyoo ya tumbo.

Madhara ya kushiriki

Mbali na muda atakaotumia mshiriki kwenye utafiti, Zoezi zima halina madhara mengine kwa mshiriki.

Faida za kushiriki katika utafiti

Hakuna faida ya hapo kwa hapo kwa mshiriki, lakini matokeo ya utafiti huu yatasaidia kubuni mbinu mpya au kuboresha mbinu zilizopo za kupambana na magonjwa hayo hivyo kuboresha afya za watoto walioko shule.

Haki ya kujitoa katika utafiti

Kushiriki kwa mwanafunzi wako katika utafiti huu si lazima ila ni hiari. Hata baada ya kujiunga, iwapo hutapenda mwanafunzi aendelee kushiriki katika utafiti huu anaruhusiwa kujitoa. Haki ya kupata huduma ya afya ni huru haina uhusiano na utafiti huu.

Usiri wa taarifa za mgonjwa

Taarifa tutakazozipata kutokana na utafiti huu zinaweza kuchapishwa au kuangaliwa na wakaguzi ambao hawako katika utafiti huu. Kwa hali hiyo nitaheshimu usiri wa taarifa hizo na jina la mwanafunzi kamwe halitaonekana wala kuhusishwa na taarifa hizo.

Mawasiliano iwapo una maswali yoyote

Iwapo una maswali yoyote kuhusu utafiti huu au kushiriki kwa mwanafunzi tafadhali jisikie huru kabisa kuuliza kwa mtafiti mkuu, mganga mkuu wa wilaya ya Bagamoyo, Afisa Elimu wilaya ya Bagamoyo au wasiliana moja kwa moja na Prof C. Kihamia, mratibu wa masomo ya kuzuia magonjwa ya Ukanda wa tropika au Mkurugenzi wa masomo ya uzamili, Prof Z.Premji, S.L.P 65001 SIMU: (255-022)-2151378 Chuo cha Afya Muhimbili.

Hivyo basi, ninaomba wanafunzi/watoto/mtoto wako awe mmoja kati ya watoto ambao wanatarajiwa kushiriki katika utafiti huu.

Ridhaa

Mimi (Jina la Mzazi/mlezi/mwalimu kwa herufi kubwa)……………………. ....Nimesoma/nimesikia na kuyaelewa madhumuni na utaratibu wote wa utafiti huu. Kwa hiyo ninaruhusu bila kulazimishwa mwanangu/wanangu/wanafunzi kushiriki katika utafiti huu.

Jina la mtoto (kwa herufi kubwa)………………………………………………

Sahihi ya Mzazi/mlezi/mwalimu (au alama ya gumba)

……………………….Tarehe………………...

5.4.3 QUESTIONNAIRE ENGLISH VERSION.

Identification information.

Questionnaire on effectiveness of intervention with mass chemotherapy for soil-transmitted helminths among primary school children in Bagamoyo district.

PART ONE: BACKGROUND INFORMATION.

Name of School……………………………

Identification number………………………

Name of participant....................................

Age of participant…...................................

Sex of participant M ☐ F ☐

Date of interview……………………………

PART TWO: FACTORS OF SOIL-TRANSMITTED HELMINTHS INFECTION.

A: KNOWLEDGE ON STHs INFECTION

1. Have you ever heard about soil-transmitted helminths? *(circle where appropriate*)
   1) Yes
   2) No

   If **yes** go to qn. 2 and 3, if **no** go to qn 4.
2. What type of soil-transmitted helminths that you are aware of (*circle where appropriate)*
   1) Trichuris trichiura (whipworm)
   2) Ascaris lumbricoides
   3) Hookworm
   4) Others(specify)……………………………………………………………

3. What are the potential sources of STH infection (*circle where appropriate)*

1) Feces
2) Soil
3) Water
4) Food / vegetable
5) Don't know
6) Others (specify)……………………………………………….

B: RISK FACTORS ON SOIL-TRANSMITTED HELMINTHS TRANSMISSION

4. What type of water sources that you are using to collect water for domestic use? (*circle where appropriate*)

1) River
2) Streams
3) Wells
4) Spring
5) Tap water
6) Buy from water vendors
7) Others (specify)

....

5. How do you treat water for drinking? (*circle the appropriate*)

1) Boiling
2) Filtration
3) Use of water guard / chemicals
4) nothing
5) Others (specify)……………………………………………..

6. What type of toilet facilities do you normally use at home? (*circle the appropriate)*

1) Own pit latrine
2) Own flash toilet
3) Neighbour's toilet (shared toilet)

4) Bush / field
5) Others (specify)……………………………………………

7. Do you have water for washing hands in the toilet facility? *(circle the appropriate)*

1) No
2) Yes

9. When do you wash your hands? (*Circle the appropriate*)

1. Before eating
2. After eating
3. After toilet
4.Others (specify)…………….

10. How easy it is to have soap for washing hands in your toilet facility? (*Circle the appropriate)*

3) Very easy
4) Easy
5) Difficult
4) Very difficult

11. What is the main material of your house walls? (*circle the appropriate*)

1) Grass
2) Poles and mud
3) Sun dried bricks
4) Baked bricks
5) Timber
6) Cement bricks
7) Stones
8) Others (specify) ……………………………

12. What type of material is your house floor made of? (circle *the appropriate*)

1) Earth
2) Cement
3) tiles

13. What type of material is your toilet floor made of? (*circle the appropriate*)
    1) Earth
    2) Cement
    3) tiles
14. How frequently do you put footwear outside the house? (*circle the appropriate box*)
    1) Throughout (all the times)
    2) Seasonally (e.g. during going to the church or mosque)
    3) Once in a while (when traveling or off visiting)
    4) Never
15. How frequently do you put footwear when going to the toilet? (*circle the appropriate box*)
    1) Throughout (all the times)
    2) Seasonally (e.g during going to the church or mosque)
    3) Once in a while (when traveling or off visiting)
    4) Never

5.4.4 QUESTIONNAIRES SWAHILI VERSION.

DODOSO

Mafanikio ya mpango wa kudhibiti minyoo ya tumboni kwa kutumia dawa kwa watoto wa shule za msingi wilaya ya bagamoyo.

SEHEMU YA KWANZA : TAARIFA ZA UTANGULIZI.

Jina la shule……………………………………….

Namba ya mhojiwa……………………………….

Jina la mhojiwa..

Umri wa mhojiwa..

Jinsia ya mhojiwa **ME** ☐ **KE** ☐

Tarehe ya mahojiano..

SEHEMU YA PILI: VITU VINAVYOWEZA KUSABABISHA KUPATA MAGONJWA YA MINYOO YA TUMBONI.

A: ELIMU KUHUSU MINYOO YA TUMBO.

1. Je? Umewahi kusikia habari kuhusu minyoo ya tumboni? *(zungushia jibu husika*)

   a.Ndiyo

   b. Hapana

   Kama ndiyo nenda swali namba 2 na 3, kama hapana nenda swali la 4.

2. Ni aina gani ya minyoo ya tumbo ambayo umeshaisikia? (*zungushia jibu husika)*

   a. Minyoo ya mjeledi

   b. Minyoo mikubwa ya tumboni

   c. Minyoo ya Safura

   d. Mengineyo(taja)…………………………………………

3. Nini vyanzo vikuu vya minyoo ya tumboni? (*zungushia jibu husika)*

   a. Kinyesi

   b. Udongo

   c. Maji

   d. Vyakula

   e. Sijui

f. Mengineyo(taja)……………………………………………….

B: VIHATARISHI VYA KUPATA MINYOO YA TUMBO

4. Maji ya matumizi nyumbani mnayapata kwenye vyanzo gani? (*zungushia jibu husika*)
    a. Mto
    b. Mifereji
    c. Visima
    d. Chemichemi
    e. Maji ya bomba
    f. Tunanunua kwa wauza maji
    g. Vinginevyo (Taja)

    ....
5. Mnayaandaaje maji ya kunywa nyumbani? (*zungushia jibu husika*)
    a. Kuchemsha
    b. Kuchuja
    c. Kutumia water guard na kemikali nyinginezo
    d. Tunakunywa kama yalivyo/hayaandaliwi
    e. Mengineyo (taja)……………………………………………..

6. Unatumia choo cha aina gani nyumbani? (*zungushia jibu husika)*
    a. Choo cha shimo
    b. Choo cha kuvuta na maji
    c. Choo cha jirani
    d. Kichakani / porini
    e. Mengineyo (Taja)………………………………………….

7. Je nyumbani mna sehemu maalumu ya kunawia mikono mara baada ya chooni? *(zungushia jibu husika)*
    a. Ndiyo
    b. Hapana

8. Upatikanaji wa sabuni maalum ya kunawia mikono ni rahisi au ngumu kwa kiwango gani? (*zungushia sehemu husika)*

   a. Rahisi sana

   b. Rahisi

   c. Vigumu

   d. Vigumu sana

10. Unanawa mikono wakati gani? (*zungushia jibu husika*)

   a. Kabla yakula

   b. baada ya kula

   c. ukitoka chooni

   d. Mengineyo(taja)…………….

11. Kuta za nyumba unayoishi zimetengenezwa kwa vifaa gani? (*zungushia jibu husika*)

   a. Nyasi

   b. Matope

   c. Matofali ya udongo yaliyokaushwa kwa jua

   d. Matofali ya udongo yaliyochomwa

   e. Mbao

   f. Matofali ya simenti

   g. Mawe

   h. Mengineyo (taja) ……………………………

12. Sakafu ya nyumba yenu ni ya aina gani? (*zungushia jibu husika*)

   a.Udongo

   b.Simenti

   c.Vigae

   d.Zinginezo(taja)……………

13.Sakafu ya choo chenu ni ya aina gani? (zungushia jibu husika*)*

   a.Udongo

   b.Simenti

   c.Vigae

d.Zinginezo (taja)……………….

14. Ni kwa kiasi gani unavaa ndala/ viatu/sandozi ukiwa nje ya nyumba? (zungushia jibu husika)

a.Kila mara

b.Mara chache

c.Mara moja moja sana

d.Huwa sivai

15. Ni kwa kiasi gani unavaa ndala/ viatu/sandozi ukienda chooni? (zungushia jibu husika)

a.Kila mara

b.Mara chache

c.Mara moja moja sana

d.Huwa sivai

5.4.5 STOOL ANALYSIS FORM

Identification Number……………………………………………………

Date of examination…………………………………………………………

Parasitological findings of stool examination:

Kato-Katz technique

Intestinal worms	Positive	Negative	Intensity threshold (epg of feces)
1. Hookworm			
2. Ascaris lumbricoides			
3. Trichuris trichiura			

Other intestinal parasites identified

4.			
5.			
6.			
7.			
8.			
9.			
10.			