Prevalence and risk factors of intestinal schistosomiasis and soil transmitted helminthiasis and their association to nutritional status among school going children in Kilombero district of Morogoro region, Tanzania

By

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A dissertation submitted to the University of Zambia in partial fulfilment of the requirements of the degree of Master of Science in One Health Analytical Epidemiology

The University of Zambia

LUSAKA

DECLARATION

I, **Maro Mwikwabe Chacha**, do hereby declare that the contents of this dissertation submitted herein are my original work and have not been submitted previously to any university for the award of Master's degree or any other qualification.

Signature ……………………………….

Date ……………………………….

CERTIFICATE OF APPROVAL

This dissertation submitted by **Maro Mwikwabe Chacha** is approved as fulfilling the requirements for the award of the degree of MASTER OF SCIENCE IN ONE HEALTH ANALYTICAL EPIDEMIOLOGY (OHAE) of the University of Zambia.

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ABSTRACT

Intestinal Schistosomiasis (SCH) and Soil Transmitted Helminithiasis (STH) are among the major public health problems in the world, especially in Sub-Saharan Africa. About 2 billion people are affected and that 300 million are ill as a result of these infections, the majority being children. In developing countries like Tanzania, poverty, poor nutrition, inadequate sanitation, lack of clean drinking-water and minimal health care makes the situation worse. The highest rates of infection are often in school aged children (5-15 years). This study was conducted to determine the prevalence and risk factors of intestinal SCH and STH and their association to nutritional status among school going children in Kilombero District of Tanzania.

A cross-sectional study was conducted involving 403 school going children in Kilombero district, Tanzania. A structured questionnaire was used to collect demographic information and risk factors. Stool samples were collected and analyzed for worm eggs using Kato-Katz technique for quantification of the eggs. Anthropometric data were collected and entered into the WHO AnthroPlus program to obtain nutritional status based on Z-scores while demographic information and risk factors were entered in an excel data sheet. Data was analyzing in STATA. Chi-square or F-test was used where appropriate to measure the association of hookworm worm infections and risk factors, also association of demographic information and nutritional status. Furthermore, simple logistic regression was used to measure the strength of association.

The prevalence of hookworm infection, wasting, underweight and stunting was 1.5%, 16.8%, 24.2% and 46.1% respectively. Eggs of *Schistosoma mansoni*, *Trichuris trichiura* and *Ascaris lumbricoides* were not detected. Children without toilets at their homes were 7.3 times more likely to be infected with hookworm than those with toilets (OR = 7.3, 95% CI = 1.4 - 37.1, p = 0.017), also participants who had not received anthelminthitic drugs (Albendazole, Mebendazole, Praziquantel or Ivermectin) in the last Mass Drug Administration were 7.6 times more likey to be infected with hookworm than those who received (OR = 7.6, 95% CI = 1.5-38.9, p = 0.015). Males had 2.43 times higher odds of stunting than girls (OR = 2.43, 95% CI = 1.63-3.65, $p < 0.001$), however children aged from 5-9 years had 0.32 times less odds of stunting than children 10-15 years (OR = 0.32, 95% CI = 0.19-0.51), $p < 0.001$).

There is a substantially low prevalence of intestinal SCH and STH (predominantly hookworms), and therefore they do not have a public health impact in school going children in the study area. The observed high prevalence rates of under nutrition (stunting, underweight and wasting) may not be associated with helminths infection, signifying that it could be allied with other factors not investigated in this study such as malnutrition.

DEDICATION

This dissertation is dedicated to my dearest wife Caritas Wendelin Mlenge and my three children Pauline, Gratia and Gian. They are essence of love but also a cause of passionate commitment in accomplishing this study. May the almighty God bless them abundantly.

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LIST OF SYMBOLS AND ABBREVIATIONS

%	Percentage
<	Less than
=	Equal to
>	Greater than
±	Plus and minus
≤	less or equal to
≥	Greater or equal to
BAZ	Body Mass Index for Age Z-Score
BZAs	Benzimidazole Anthelminthics
CDC	Centre for Disease Control
CI	Confidence Interval
CLTS	Community Led Total Sanitation
DC	District Council
DED	District Executive Director
DEO	District Education Office
DMO	District Medical Officer
DNA	Deoxyribose Nucleic Acid
DOB	Date of Birth
ELISA	Enzyme-linked immunosorbent assay
GM-epg	Geometric Mean- Eggs per Gram
HAZ	Height for Age Z-Score
Kg	Kilogram
MDA	Mass Drug Administration

Mg	Milligram
MoHSW	Ministry of Health and Social Welfare
MUAC	Mid-Upper Arm Circumference
NIMR	National Institute of Medical Research
NTDs	Neglected Tropical Diseases
OR	Odd Ratio
PCR	Polymerase Chain Reaction
PQZ	Praziquantel
SCH	Schistosomiasis
SD	Standard Deviation
Sq	Square
STH	Soil Transmitted Helminthiasis
TANAPA	Tanzania National Park
TAZARA	Tanzania and Zambia Railway Authority
UNICEF	United Nation Child Education and Food
WAZ	Weight for Age Z-Score
WHO	World Health Organization

CHAPTER ONE

INTRODUCTION

Intestinal Schistosomiasis (SCH) is an acute and chronic parasitic disease caused by *Schistosoma mansoni* and other species like *Schistosoma japonicum*, *Schistosoma mekongi*, *Schistosoma quineensis.* In Africa, *Schstosoma mansoni* is the one which is mostly responsible for causing intestinal SCH (WHO, 2002). Intestinal SCH is transmitted when an infected person contaminate freshwater with excreta (faeces) containing parasite eggs which hatch in the water. A person becomes infected when the larval form of the parasite penetrates the skin during contact with infested water. The disease is associated with poverty and poor living conditions, inadequate environmental sanitation and water supply, development of water source without health impact being put into consideration and poor health awareness (Montresor *et al*., 1998; Tekeste *et al*., 2013).

Soil Transmitted Helminthiasis (STH), also known as intestinal worms is the most common type of parasitic infection in the world. Infection is caused by four main species of worms commonly known as roundworms (*Ascaris lumbricoides*), whipworms (*Trichuris trichiura*) and hookworm (*Ancylostoma duodenale* and *Necator americanus*) (Tchuente, 2011; WHO, 2012a). Warm climates and adequate moisture are essential for the hatching or embryonation of STH eggs in the environment or development of larvae. In such social-ecological systems, multiple species of STH infections are common (Anuar *et al*., 2014). Transmission of STH occurs via contact with contaminated soil (hookworm) or consumption of egg-contaminated foods (*A.*

lumbricoides and *T. trichiura).* An important epidemiological feature is their highly aggregated distribution; the majority of patients harbour low intensity infections, while only few individuals harbour very heavy infections (Anuar *et al*., 2014).

The burden of disease associated with helminths infections (SCH and STH infections) is enormous, with at least 2 billion people affected worldwide (WHO, 2006a). This is being increasingly recognized as a significant public health problem, particularly in developing countries, where poverty, poor nutrition, inadequate sanitation, lack of clean drinking-water and minimal health care prevail. The highest rates of infection are often in children between the ages of 5 and 15 (WHO, 2006a).

Soil transmitted helminthiasis rank highest among prevailing neglected tropical diseases in many developing countries particularly in slum dwelling or rural location in Africa, Asia and Latin America (Kaminsky, 2014) and they reduce appetite and food intake, causing mal-absorption and poor growth rate. Morbidity due to intestinal SCH and STH include impairment of cognitive development in young children resulting in poor educational outcome (Huat *et al*., 2012; Midzi *et al.*, 2014) and STH also causes anaemia due to worm induced blood loss and compromised nutrition, intestinal obstruction as well as reduced absorption of vitamin A, impacting on growth (Stoltzfus *et al* 1997; Stephenson *et al*., 2000). Intestinal helminths infection, malaria and poor nutrition are the main causes of iron deficiency anaemia and over 90% affected people live in developing countries (Uneke, 2010). Anaemia continues to be a major public health problem worldwide and is estimated to affect half of the school age children in developing countries (Akanni *et al*., 2014; Uneke *et al*., 2010).

1.0 Statement of the Problem and study justification

1.1 Problem statement

Poverty and inadequate water supplies and sanitation are important determinants of transmission of intestinal SCH and STH infections. In such conditions, soil-transmitted helminths species are commonly co-endemic (Bethony *et al*., 2006, WHO, 2002). In Tanzania, the prevalence of SCH infection on a national scale ranges from 12.7% to 87.6% and for that of STH infection could be up to 100% in certain ecological settings (Kabatereine *et al*., 2006). Poverty and inadequate water supplies and sanitation are important determinants of transmission of SCH and STH infections. In such conditions, soil-transmitted helminthiasis species are commonly co-endemic (WHO, 2002).

Despite numerous nutritional interventions that have taken place in Tanzania, the country still experiences a high rate of child malnutrition. Millions of children suffer from one or more forms of malnutrition resulting in stunting, underweight, wasting and anaemia (Muhimbula & Issa-zacharia, 2010), for instance the prevalence of stunting in Morogoro region goes up to 36.9% (Tanzania Food and Nutrition Centre, 2014).

1. 2 Study Justification

Kilombero district started the first round of Mass Drug Administration (MDA) for SCH and STH in 2008 (MoHSW, 2009) when the baseline data indicated the prevalence of *S. mansoni* and STH as 2% and 80%, respectively (Kilombero district, 2008). For under five aged children it has been done twice in each year while for above 5 years old it is regular done with a maximum interval of two years, up to now five rounds have been done since its commencement. For STH the age group of greater or equal to one year has been target while for SCH school children were targeted. Albenzazole, Mebendazole and Praziquantel are the anthelminthic drugs which are being used in MDA depend on the age group. In the control of STH for under five children Mebenzazole is being used, where greater than five years of age Albendazole is used. For schistosomiasis control Praziquantel is being used for school children which are the targeted group. The magnitude of intestinal SCH and STH in Kilombero district since the commencement of MDA remain unknown. There are no studies which have been carried out in the district to find out the prevalence of these infections, also their association with nutritional status among school going children.

Reliable data on the magnitude of intestinal SCH and STH is very important in order to plan for control measures and assessment of impact of MDA. The decision to treat all people or only school children and other high risk groups once or more times a year depends on the prevalence of the infection (Kaminsky *et al*., 2014; Tekese *et al.*, 2013). Therefore, this study was aimed at producing data on the prevalence and risk factors of intestinal SCH and STH among school going children in Kilombero District council and their associations to nutritional status. The findings can be used as baseline data for future impact assessment of various control and intervention measures which are currently undertaken including MDA and environmental sanitation.

The general objective of this study was to determine the prevalence and risk factors of intestinal SCH and STH and their association to nutritional status among school going children in Kilombero District.

Specific objectives were;

1. To determine the prevalence of intestinal SCH and STH among school going children in Kilombero District.

2. To assess whether nutritional status is associated with intestinal SCH and STH infections among school going children in study area.

3. To identify risk factors associated with intestinal SCH and STH among school going children in the study area.

CHAPTER TWO

LITERATURE REVIEW

2.1 Overview

Intestinal schistosomiasis and soil transmitted helminthiasis are among the most prevalent parasitic diseases in the world and they are classified by World Health Organization as neglected tropical diseases (NTDs). They are endemic in 76 countries and remain a public health concern in developing countries (Alemu *et al*., 2011). Globally over 237 million people required treatment for schistosomiasis in 2010, with estimates of up to an additional 779 million at risk (Steinmann *et al*., 2010; WHO, 2012b). Two major species are prevalent in Africa, *S. mansoni* and *S. haematobium* causing intestinal and urogenital schistosomiasis, respectively. Whereas, it is estimated that more than 1.5 billion people are infected with STH worldwide (Montresor, 1998). They are widely distributed and affect people living in areas with poor and limited access to safe water, sanitary facilities and inadequate health facilities (WHO, 2002). Intestinal SCH and STH remain common across the world, especially among poor population. The infections due to SCH are more than 187 billions in which *S. mansoni* account for 67 millions. On the other hand, infections caused by STH worldwide are more than 2 billion (de Silva *et al.,* 2003).

Intestinal SCH is caused by *S. mansoni*, and infections are acquired by contact with freshwater containing parasite larvae, on the other hand, STH infection occurs through faecal exposure, either through skin in contaminated soil (in case of hookworms) or ingestion of contaminated food (in case of roundworms and whipworms) (Gass *et al*., 2014; Weaver *et al*., 2010; WHO, 2012c). The impact that these infections have on health varies depending on the intensity of the infection.STH are regarded as the most important cause of physical and intellectual growth impairment. Children bear the highest burden of the disease caused by *Ascaris* and *Trichuris*, resulting in malnutrition, growth wasting and stunting, with cognitive and poor educational performance (Waever *et al.*, 2010).

2.2 Life cycle of Intestinal SCH and STH

2.2.1 Life cycle of *S. mansoni*

The life cycle of *S. mansoni* involve the snail as intermediate host (Figure 2.1). Transmission occurs when the cercaria penetrate the skin. It enters the circulation and migrates to portal blood in the liver and mature into adults. Paired adults migrate to mesenteric venule of bowel or rectum and lay eggs that circulate to liver and discharged in stools. Eggs of *S. mansoni* are passed in faeces while for *S. haematobium* are passed through urine. Eggs hatch releasing miracidia which penetrates the snail, (*Biophalaria* species for *S. mansoni* and *Bulinus* species for *S. haematobium*) and develop to the cercaria which is the infective stage (WHO, 2002; Hotez *et al*., 2006).

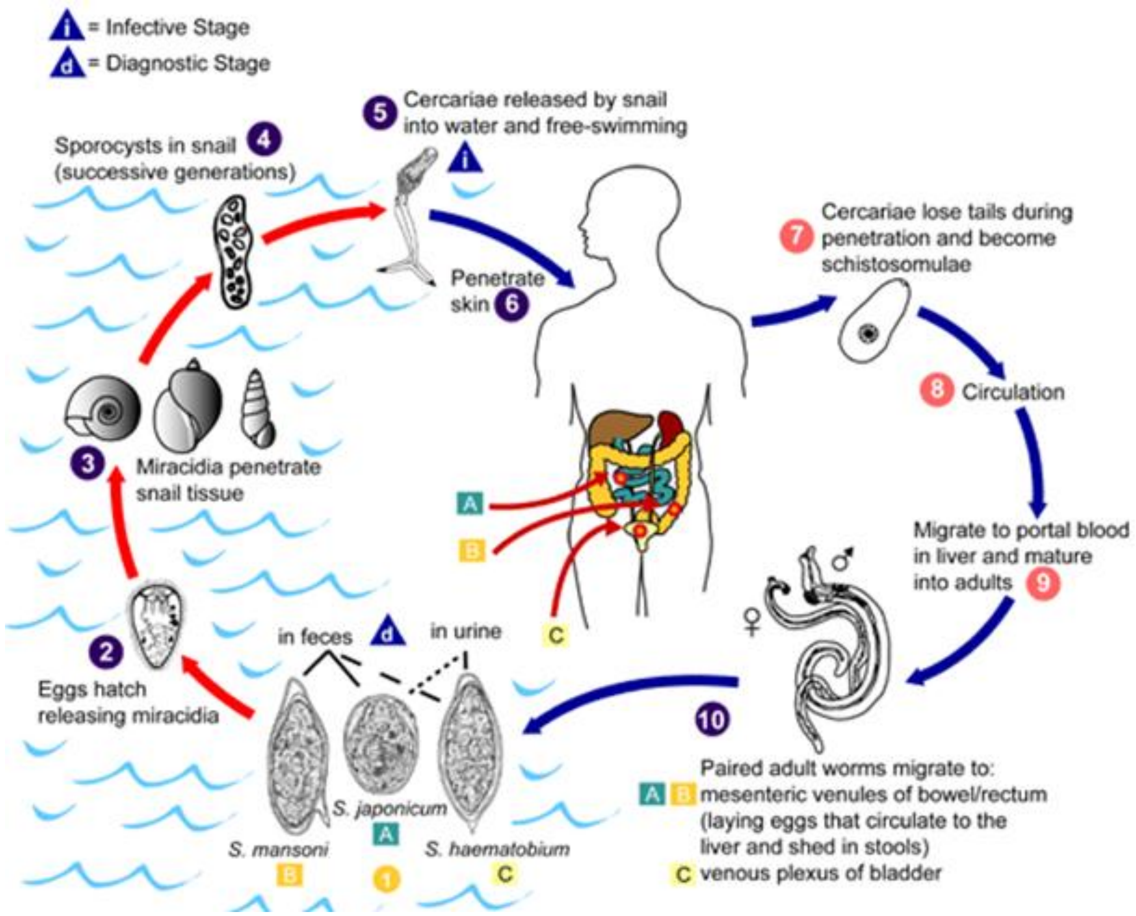

Figure 2. 1: Life cycle of *Schistosoma mansoni*

Source: http://www.cdc.gov/parasites/schistosomiasis/biolobgy.html

2.2.2 Life cycle of Hookworm

The life cycle of Hookworm (Figure 2. 2) is the same for both *A. deodenale and N. americanus.* Transmission is through skin penetration of the filariform larvae and they enter the blood circulation, then to the lungs where they ascend to the trachea and pharynx, from there swallowed and become attached to small intestine where the adult worms live. Eggs in stool are released to the environment and develop to rhabditiform larvae which hatch to Filarifrom larvae (Stephenson *et al*., 2000)**.**

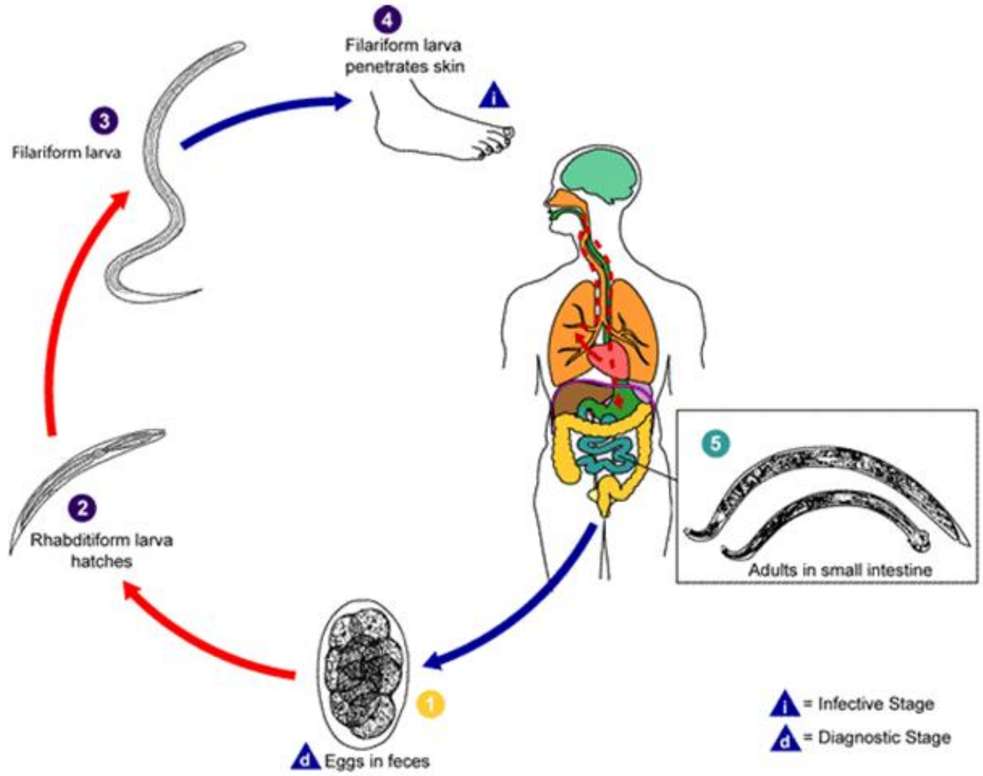

Figure 2. 2: Life cycle of hookworm

Source: http://www.cdc.gov/parasites/hookwom/biolobgy.html

2.2.3 Life cycle of *Ascaris. Lumbricoides*

The adult *A. lumbricoides* lives in the gastrointestinal tract (Figure 2. 3). The immature ovum is passed in stool into the soil. Fertilization or development of embryo takes place within 2-4 months. A person becomes infected when the ova with the second stage is ingested. It penetrates mucous membrane of the stomach; enter the circulation up to the lungs and burrows through the alveoli and passes up the respiratory tract. Swallowed a second time and enters oesophagus reaching intestine where become adult worm (Stephenson *et al*., 2000)

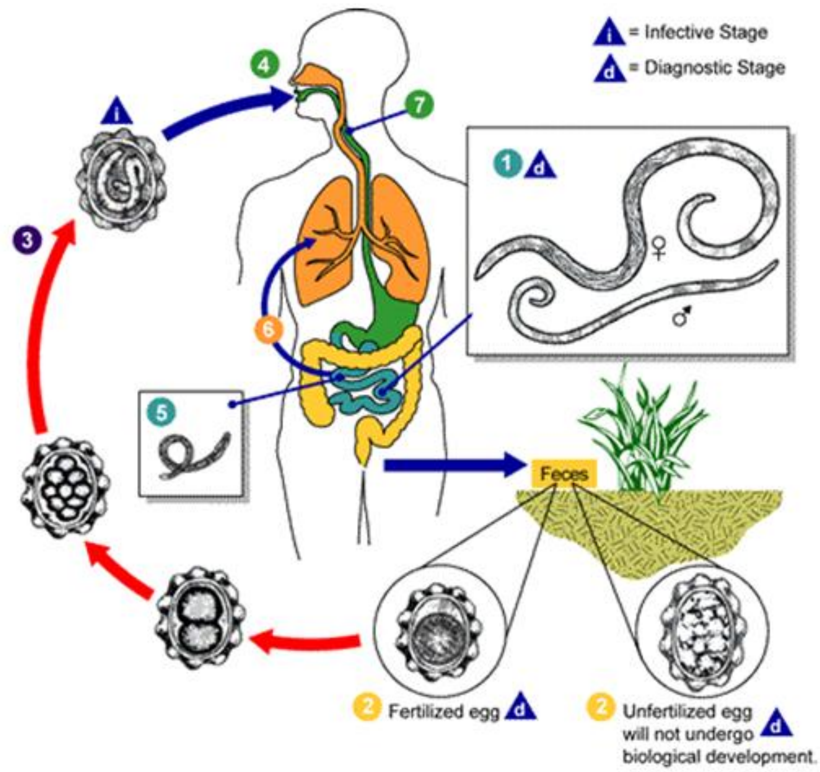

Figure 2. 3: Life cycle of *Ascaris lumbricoides*

Source: http://www.cdc.gov/parasites/ascariasis/biolobgy.html

2.2.4 Life cycle of *Trichuris trichiura*

Adult worms live in the cecum or appendix. Eggs which are unembryonated pass in faeces to the environment. They become embryonated in 21 days and they cannot tolerate drought conditions. Transmission of *T. trichiura* occurs by ingestion of food or drinking water contaminated with embryonated eggs. In the small intestinal they hatch and the larvae emerge in the small intestine where it penetrates the villi and develop for a week and re-emerge, attaches itself to mucosa and become adult (Stephenson *et al*., 2000) (Figure 2.4).

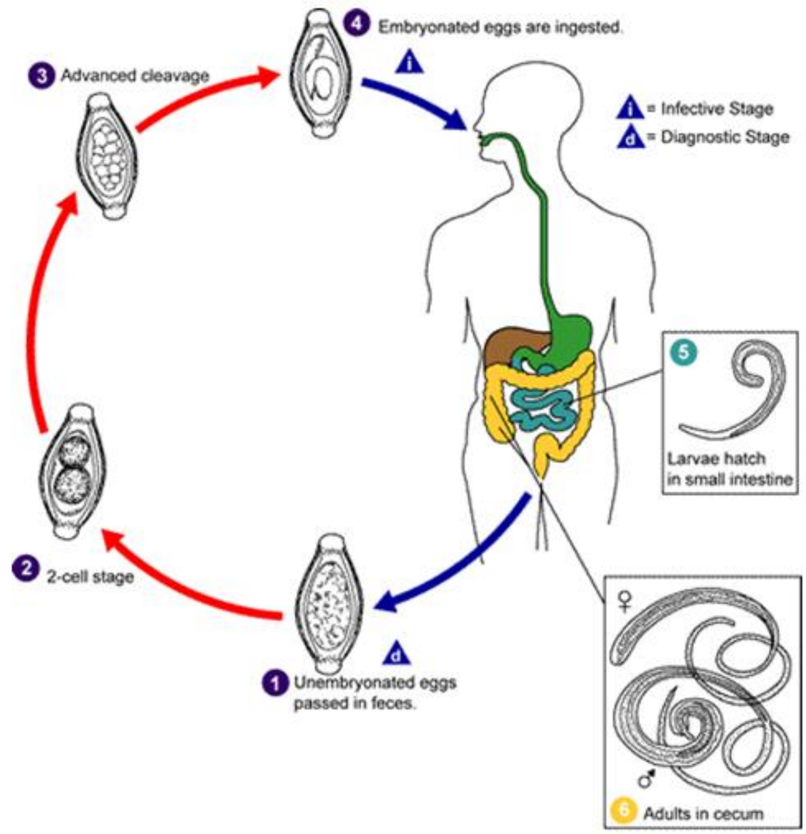

Figure 2. 4: Life cycle of *Trichuris trichiura*

Source: http://www.cdc.gov/parasites/whipworm/biolobgy.html

2.3 Risk factors associated with helminths infections among school aged children

2.3.1 Poverty

Poverty is one of the factors associated with helminths infections (Montresor, 1998; Brooker, 2006). Poor communities are usually faced with poor living conditions; inadequate water supply and sanitation, unsafe disposal of human excreta and poor health awareness are associated with helminths infections, also development of water resources without considering impact is a risk factor for Schistosomiasis (Montresor, 1998).

2.3.2 Poor sanitation and poor personal hygiene

Inadequate sanitation at household level and personal hygiene predict helminths infections. Absence of toilets at a home has been reported as the most important risk factor for these infections (Hesham Al-Mekhlafi *et al*., 2008). Practices like swimming in the river, playing barefooted, eating unwashed vegetables and fruits and eating without washing hands have be reported as risk factors for STH (Nishiura *et al*., 2002; Nematian *et al*., 2004). Knopp *et al*. (2009) also reported that people who eat raw vegetables and salads are more likely to be infected with *A. lumbriocides* whereas eating unpeeled fruits was reported as a protective factor against hookworm infection.

2.3.3 Gender and age

Studies have reported that gender and age are associated with helminths infections. A study conducted in Ethiopia by Mekonnen *et al*. (2014) indicated that gender and age are among factors associated with intestinal SCH among school going children. Males have an increased risk of being infected with *A. lumbricoides* and hookworm (Knopp *et al*., 2009; Gabrie *et al*., 2014). On the contrary, Hesham Al-Mekhlafi *et al*. (2008) stated that females have higher risk of being re-infected by STH than males because of their responsibilities of cleaning and washing the ground and floor. Increase in age by one year was reported as a protective factor for *A. lumbricoides* and *T. trichiura* (Knopp *et al*., 2009).

2.4 Impact of SCH and STH infections on human health

Schistosoma mansoni transmission is associated largely with water contact behaviour which increases the risk to skin penetration with cercaria. Chronic infections of *S. mansoni* may lead to bloody diarrhoea, diarrhoea, abdominal pain, and gastric and oesophageal varices due to portal hypertension which when ruptured results in severe bleeding with vomiting (haematemesis) (Hotez *et al*., 2009). Moreover, in advanced stages, there may be development of hepatomegally splenomegally and ascites due to fibrosis of the liver (Steinman *et al*., 2006). Acute infection is rare in endemic areas and may present with skin rashes (Mazigo *et al*., 2012). The development of Schistosoma into adults may cause marked eosinophilia and a febrile syndrome known as Katayama fever. *Schistosoma haematobium* affects the bladder, genital tract and urethras which lead to urogenital Schistosomiasis (Montresor *et al*., 1998). A study revealed that visible haematuria, microhaematuria and urinary and genita tract pathology are associated with infections with *S. haematobium* (Savioli *et al*., 2004).

Studies have reported that morbidity due to STH may lead to nutritional impairment caused by intestinal bleeding due to hookworm infections (Stoltzfus *et al*., 1997), mal-absorption of nutrients, competitions for micronutrients and impaired growth (Crompton and Nesheim, 2002). According to Stephenson *et al*. (2000) *A. lumbricoides* is associated with loss of appetite and reduction of food intake and *T. trichiura* causes diarrhoea or dysentery. Furthermore, it has been reported that STH can impair cognitive development which can lead to reduction in fluency and memory (Nokes *et al*., 1992) and sometimes STH can lead to conditions requiring surgical intervention for example, *A. lumbricoides* may cause intestinal obstruction (de Silva *et al*., 1997) while *T. trichiura* causes rectal prolapse (WHO, 1981).

Malnutrition which means deficiencies, excess or imbalances in a person's intake of energy and/or nutrients, is associated with more than half of children deaths in developing countries and causes negative impact on physical, mental and children development (Chopra, 2006). Globally, it has been reported that about 100 million people developed stunting or wasting due to helminths infections. People affected by helminths have their nutritional status becoming impaired due to a decline in food intake and an increase in nutrient wastage through blood loss, vomiting or diarrhoea (Brooker *et al*., 2010). These effects can lead to protein energy malnutrition, anaemia and other nutrient deficiencies. Francis *et al*. (2012) in Uganda reported an association of stunting, underweight and wasting with intestinal helminths infections. A study done in Tanzania by Mwaniki and Makokha (2013) reported that malnutrition is associated with a combination of inadequate dietary intake and infections. Despite the high prevalence of under nutrition (mainly stunting) in Morogoro region of 36.9% (Tanzania Food and Nutrition Centre, 2014), but no studies which have been carried out in Kilombero district to see whether under nutrition is associated with helminths infections among school going children in the study.

2.5 Distribution of intestinal SCH and STH

2.5.1 Global distribution of intestinal SCH and STH

Globally, intestinal SCH is prevalent in tropical and subtropical areas of Sub-Sahara, Middle East, South America and Caribben (Hotez *et al*., 2007). The distribution of SCH is subjected to the distribution of the intermediate host which is the snail (Morgan *et al*., 2001). The tropics and subtropics have wide spread infection of STH, and it was reported that *A. lumbricoides* infects 1.221 billion people, *T. trichiura* 795 million, and hookworms 740 million, worldwide (de Silva, *et al*., 2003). The most number of STH infections occur in the Americas, China and East Asia, and Sub-Saharan Africa (Table 2.1). It has been reported by Ogbe *et al*. (2002) that over one million people are affected by *A. lumbricoides* and that school children are the mostly affected. In addition, prevalence of STH is high in children in rural area of developing countries, where 400 million school going children who are infected are physically and intellectually affected (WHO, 2006a).

Table 2. 1: Global distribution of intestinal SCH and STH

Helminthic Infection	**Total Cases**	**Major geographical area**
STH infection	$\geq$ 2 billions	Sub Sahara Africa, India, China and East Asia
Ascaris	1.221 billions	Sub Sahara Africa, Americas, China and East Asia
Trichuriasis	795 million	Sub-Saharan Africa, India, China and East Asia
Hookworm	740 million	Sub-Saharan Africa, Americas, China and East Asia
Schistosomiasis	187 million	
S. mansoni	67 million	Sub-Saharan Africa, Americas

Source: de Silva *et al*. (2003)

2.5.2 Distribution of intestinal SCH and STH in East Africa and Tanzania

The incidence and degree of helminths infections in East Africa is determined by geographical variations existing in a particular region (Brooker *et al*., 2009a). The distribution of SCH is influenced by the distribution of its snail intermediate hosts (Morgan *et al*., 2001), while geographical variations in temperature and humidity determine the distribution of STH (Brooker *et al*., 2009a) (Figure 2.5).

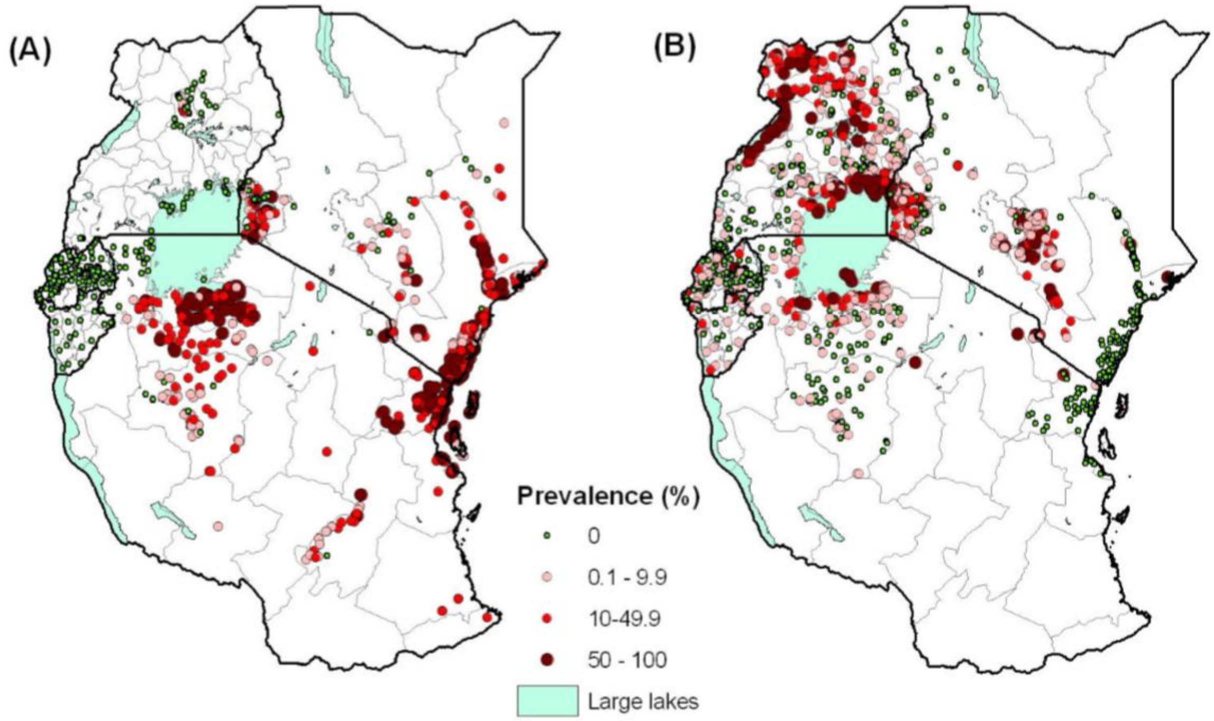

Figure 2. 5: Map East Africa showing distribution of schistosomiasis (Adopted from Brooker *et al*., 2009b) **(A:** *Schistosoma haematobium* B**:** *Schistosoma mansoni)*

S. haematobium and *S. mansoni* show differences in incidence in East Africa countries. In Kenya the prevalence of *S. haematobium* is greater around Tana River and *S. mansoni* is not present, while in Rwanda and Burundi greater than 99% of Schistosomiasis is caused by *S. mansoni* (Brooker *et al*., 2009b). In Tanzania SCH is endemic, and is considered a major public health problem (Hotez *et al*., 2008). The coast belt of Tanzania is highly endemic for SCH caused by *S. haematobium*, whereas intestinal SCH due to *S. mansoni* is absent due to absence of the snail intermediate host (Mazigo *et al*., 2012). The prevalence of intestinal SCH in Tanzania ranges from 12.7% to 87.6% (Kabatereine *et al*., 2006). For instance Mugono *et al*. (2014) reported a prevalence of 63.9% of *S. mansoni* in North-western Tanzania. However, it was reported by Mazigo *et al*. (2012) that the prevalence of SCH could be up to 100% depending on environmental settings (Figure 2.6).

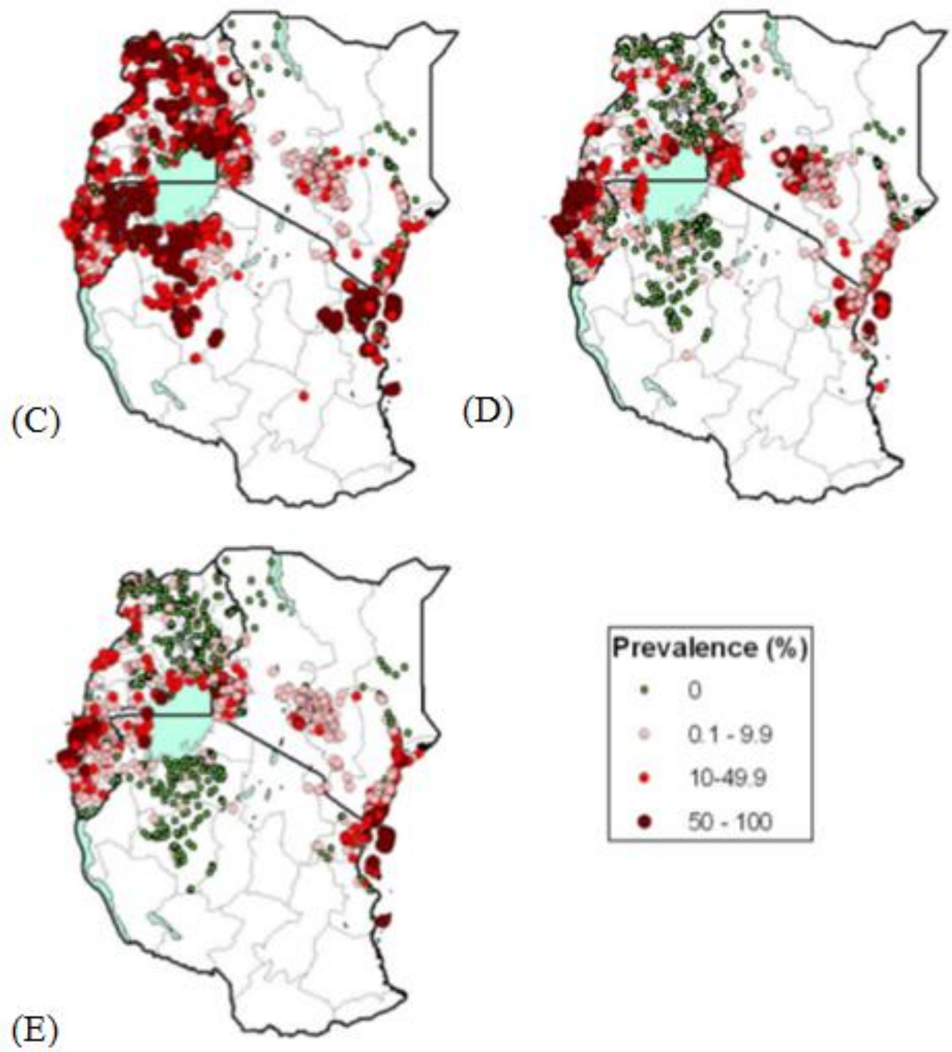

Figure 2. 6: Map of East Africa showing distribution of soil transmitted helminths **(Adopted from Brooker *et al*., 2009b)** (**C**: Hookworm **D**: *Ascaris lumbricoides* **E**: *Trichuris trichiura)*

2.6. Diagnosis of Intestinal SCH and STH

Reliable, sensitive and practical diagnostic tests are essential tools in the disease control programme including those for neglected tropical diseases. The diagnostic test should be moderately sensitive, easy to use and cost effective. The currently available diagnostic tools can be classifies as parasitological test, serological and molecular tools (McCarthy *et al*., 2012).

2.6.1 Parasitological tests

The methods involve taking of samples from specific tissue or body fluid which are directly visualised using a microscope. For quantitative parasitological tests, WHO recommends the use of Kato-Katz method for detection of human STH species and intestinal SCH, and in order to increase the sensitivity of the test duplicate slides are required (Montresor, 1998). The test involves the examination of eggs from fresh faeces under a light microscope. It is simple to use, low cost and equipments can be recycled. The technique allows on-site examination of specimens. However the sensitivity is good only for moderate and heavy intensity infection, but the sensitivity can be improved by duplicate samples (preparation of more than one slide) or repeatedly collection of specimens (WHO, 2002). Another disadvantage of the Kato-Katz technique is that it cannot distinguish the eggs of *A. deodenale* and *N. americanus* (Pawlowski *et al*., 1991). Further, Hookworm eggs are only visible within an hour of slide preparation.

Alternative stool examination techniques have been tested for the detection of STH infections. FLOTAC, a recent technique mostly used in veterinary field is suitable diagnostic tools particularly when the parasitic infection intensities are light (Cringoli, 2006). It has been recently reported that a single FLOTAC examination was more sensitive than triplicate Kato-Katz thick smears for the diagnosis of light intensity STH infections (Knopp *et al*., 2009). The FLOTAC technique improves the ability to diagnose human hookworms (Utzinger *et al.*, 2008), which is normally underestimated when using Kato-Katz thick smear due to a rapid disintegration of hookworm eggs, hence requires the reading of the slides in a short time (within 30min) after preparation (Dacombe *et al.,* 2007). Therefore, FLOTAC was suggested as a suitable method for accurate surveillance of helminths control programmes, monitoring of STH transmission and verification of local elimination (Knopp *et al*., 2009)

McMaster, a flotation technique commonly used in parasitological veterinary, despite the fact that McMaster is less sensitive than FLOTAC; the former technique was most feasible and easy to perform under field conditions. McMaster appeared as a promising technique of choice when using faecal egg counts for monitoring of drug efficacy against STHs (Levecke *et al*., 2009).

Overall, several techniques are available for the detection of STH infections, with significant difference in the cost, sensitivity, simplicity and field applicability. Though a true ‘gold standard’ test with 100% accuracy does not exist, Kato–Katz thick smears is so far commonly and widely used as the basic and ‘default’ technique for helminths epidemiology, despite some limitations. Further efforts should be made to validate other detection tools. The choice of a specific diagnostic assay should be governed by the objective of the activity, and according to the stage of helminth control (Berquist *et al*., 2009)

2.6.2 Serological tests

This method detects the parasite specific antibodies in a serum sample. Serological test in the form of an Enzyme-linked immunosorbent assay (ELISA) for diagnosis of helminths has reported higher sensitivity than Kato-Katz (Burlandy *et al*., 2003). The high difference between serological and parasitological prevalence data is undoubtedly due to the low diagnostic sensitivity of the parasitological methods, therefore microscopic method is not appropriate particularly when the intensity of helminths infection is low (Enk *et al*., 2008).

2.6.3 Molecular diagnosis

Deoxyribose nucleic acid (DNA) based method for diagnosis for a variety of intestinal helminths has shown excellent sensitivity and specificity (Esbroeck *et al*., 2009). Polymerase chain reaction (PCR) is used for identification and differentiation of parasite species; it involves the detection of the parasite nucleic acid both in human/animal and in arthropod vectors or snail or in any other intermediate hosts (Crigoli, 2006; McCarthy *et al*., 2012; Nikolay *et al.*, 2014). However, PCR is restricted in the number of parasites that can be detected concurrently. Therefore, a careful assessment is required for the choice of parasitic targets when PCR is used (Esbroeck *et al*., 2009). Cost hinders its wide use

2.7. Treatment, prevention and control of Intestinal SCH and STH

2.7.1 Treatment

There are varieties of drugs for treatment of intestinal worms which include Albendazole, Mebendazole, Pyrantel pamoate, Lavamisol, Ivermectin. However, at complicated stages Prednisoline therapy and supportive treatment with antispasmodics, nasogastric and IV fluids are required. The most common used drugs are Mebendazole and Albendazole (Helbig *et al*., 2012). While for the treatment of Schistosomiasi Praziquantel if the drug of choice

2.7.2 Preventive and control

School going children are targeted for anthelminthic drugs administration in order to control helminths infection in the community (Albinico *et al*., 1998). The control and treatment of helminths by using drugs has immediate impact on killing the adult parasite within the human but does not prevent re-infection if the host contacts an environment contaminated with infective stage of the parasites (Hesham Al-Mekhlafi *et al*., 2008). Chemotherapeutic interventions successfully operate to decrease morbidity caused by helminths in the short term, however, for long term control, de-worming interventions must be repeated periodically (WHO, 2011). Recommended drugs for use in public health programs to control STH infections are albendazole (400mg) or melbendazole (500mg) (WHO, 2002; Brooker *et al*., 2006) and in areas where STH infections are co-endemic with SCH, Benzimidazole Anthelminthics (BZAs) are co-administered with Praziquantel (PQZ) (40mg/kg). WHO (2006b) reported that evidence of drug resistance in human helminthiasis is not yet approved, but low efficacy with single dose of Albendazole for treatment of STH has been reported (Speich *et al*., 2016).

Adequate environmental sanitation and safe waste disposal play a major role in the control and prevention of intestinal helminths. In order to ensure long term sustainable de-worming, it is recommended to improve sanitation and person hygiene (WHO, 2004). Because it has been reported that anthelminthic in control of helminths are highly efficacious in short term, nearly 68% of people treated become re-infected with Ascaris, 67% with Trichuris and 55% with hookworm (Hesham Al-Mekhlafi *et al*., 2008; Jia *et al*., 2012). Improved sanitation which includes availability and proper use of toilets and adequate personal hygiene in homes may contribute to sustainable reduction of STH prevalence and transmission (Campbell *et al*., 2014). Therefore, in the absence of improved sanitation and personal hygiene, the prevalence of infection will return to pre-treatment levels within 6– 12 months of a single round of de-worming (Hesham Al-Mekhlafi *et al*., 2008).

Based on the prevalence of SCH and STH infections among school aged children, communities can be classified into categories of high-risk moderate-risk or low-risk (for SCH) and high-risk or low-risk (for STH) according to WHO thresholds. This determines appropriate treatment regime (WHO, 2006b). For SCH, in high-risk (prevalence ≥50% by parasitological method or ≥30 by questionnaire for visible haematuria), WHO recommends treating all school aged children (enrolled and not enrolled) once a year and treatment of those considered to be at high risk. In moderate-risk (prevalence ≥10% by parasitological method or <30 by questionnaire for visible haematuria) treat all school aged children (enrolled and not enrolled once every two years) while in low-risk (prevalence <10% by parasitological method) WHO recommends treatment of all school aged children (enrolled and not enrolled) twice during their schooling age (WHO, 2006b) (Table 2.2).

For STH, in high-risk communities (prevalence ≥ 50%) it is recommended to treat all school going children (enrolled and not enrolled) twice each year, while for low-risk communities (prevalence ≥ 20% and <50%) it is recommended to treat all school going children (enrolled and not enrolled) once each year (Table 2.3).

Table 2. 2: Recommended treatment strategy for schistosomiasis in preventive chemotherapy

Category	**Prevalence of infection among school-children**	**Action to be taken**	
High-risk community	≥50% by parasitological method (intestinal and urinary schistosomiasis or ≥30% by questionnaire for visible haematuria (urinary schistosomiasis)	• Treat all school aged children (enrolled and not enrolled) once a year	• Also treat adults considered to be at risk (from special groups to entire communities living in endemic areas)
Moderate- risk community	≥10% but <50% by parasitological method (intestinal and urinary schistosomiasis or <30% by questionnaire for visible haematuria (urinary schistosomiasis)	• Treat all school agedchildren (enrolled and not enrolled) once every two year	• Also treat adults considered to be at risk (special groups only)
Low- risk community	<10% by parasitological method (intestinal and urinary schistosomiasis	• Treat all school aged children (enrolled and not enrolled) twice during their primary schooling age	• Praziquantel should be available at dispensaries and clinics for treatment of suspected cases

Table 2. 3: Recommended treatment strategy for soil transmitted helminthiasis preventive chemotherapy

Category	Prevalence of infection among school-children	Action to be taken	
High- risk community	≥ 50%	Treat all school aged children (enrolled and not enrolled twice each year	Also treat: • Preschool children • Women with childbearing age, pregnant women and lactating mothers • Adults at high risk in certain occupations
Low- risk community	≥ 20% and <50%	Treat all school aged children (enrolled and not enrolled once each year	Also treat: • Preschool children • Women with childbearing age, pregnant women and lactating mothers • Adults at high risk in certain occupations

Note: Prevalence of soil transmitted helminthiasis < 20%, it is recommended to treat only positive diagnosed cases (WHO, 2006b)

CHAPTER THREE

MATERIAL AND METHODS

3.1 Description of the Study area

Kilombero District is one of the seven District Councils in Morogoro Region and lies along the Kilombero valley. Most of the area of the District extends below Udzungwa Mountains. Kilombero District is bordered by Ulanga District Council to the south; Kilosa District Council to the north, to the east is Morogoro District Council and Mufindi District Council to the west (Figure 3.1).

The District has the total population of 407,880 (Male 202,789 and Female 205,091) (National Census, 2012) with the average house hold size of 4.3 people. It has an area of 14,915 sq km divided in to 5 divisions, 23 wards, 98 villages and 365 hamlets with a total household of 104,600. There are 164 government primary schools in the district; number of schools in each ward ranges from 3-12, with a total 77,557 pupils (38,275 boys and 39,282 girls).

Kilombero district has a mild climate, with temperatures ranging from 20°C to 32 °C. The District has 2 rainy seasons; short rains start in early November and end in December, while the long rains start in March and end in May. Economic activities are mostly subsistence farming, fishing, animal husbandry, trading (wholesale and retailing). Few people however, have formal employment in Local Government, sugar cane factories, Tanzania and Zambia Railway Authority (TAZARA), Tanzania National Park (TANAPA) and Hydroelectric power plants. The main cash crop is sugarcane, while rice, maize and banana serve as both food and cash crops (Kilombero district, 2013).

Water sources in the District include 1,082 water points, 564 shallow wells, 410 deep wells and 32 rivers. About 60% of the inhabitants in the District get clean water (Kilombero district, 2013)

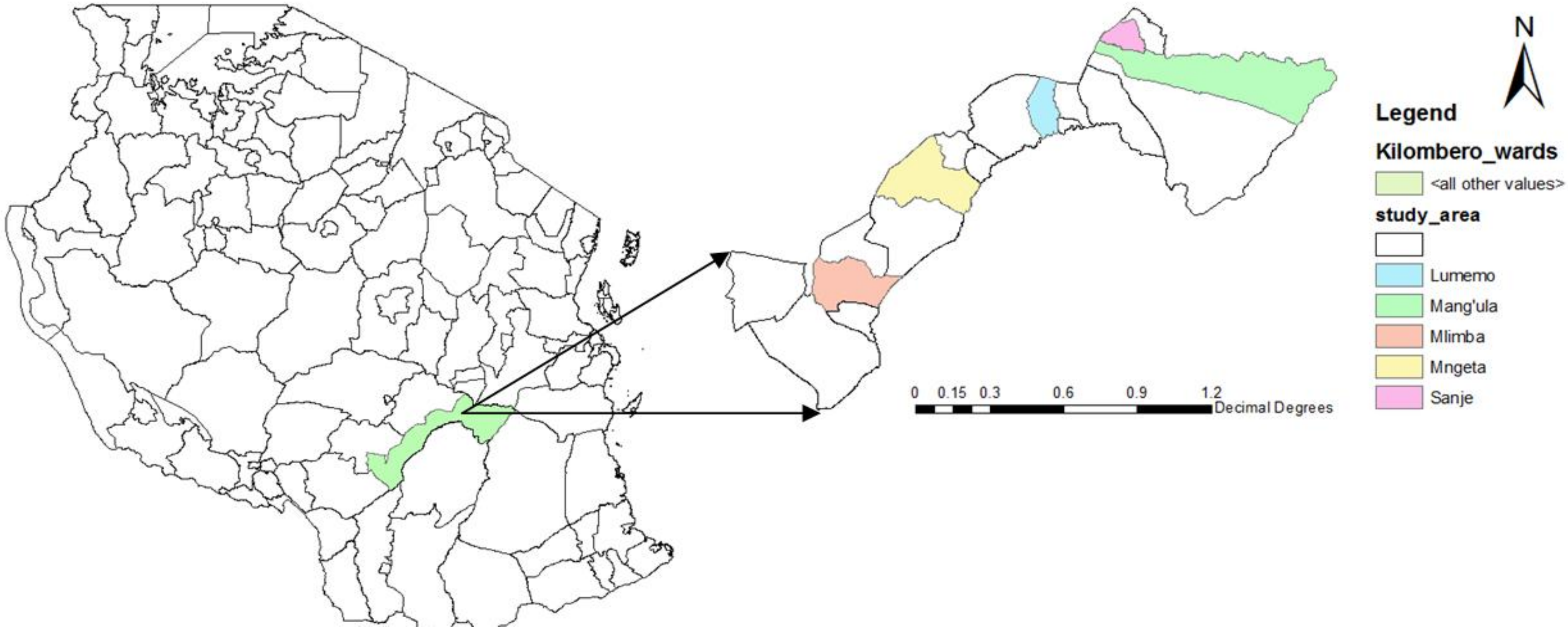

Figure 3. 1: Map of Tanzania showing Kilombero district and the wards where sampling was done (Drawn by using Arc GIS version 9.3 Tanzania administration shapefile of 2012)

3.2 Study design

A cross-sectional study was conducted from December 2015 to March 2016 in 403 school children from five primary schools namely Kigamboni, Tumaini, Miwangani, Jaribu and Ilungusha in Kilombero district to determine the prevalence and risk factors of intestinal SCH and STH and their association to nutritional status.

3.3 Target population

The target population were primary school children aged 5-15 years old.

3.4 Sample size calculations

Since the prevalence of intestinal SCH and STH in Kilombero district 8 years after the commencement of MDA were unknown, the prevalence from a previous reported study was used in the estimation of the sample size of the current study. Since the current study was looking at the prevalence of more than one parasite (intestinal SCH and STH), therefore the prevalence of 54.5% co- infection *S. mansoni* and soil transmitted helminths among school children reported by Mazigo *et al.* (2012) in endemic areas of Western Tanzania, Therefore, the formula below was used to estimate the sample size.

$$n = (1.96/d)^2 * p * (1-p)$$ (Wayne, 2007)

Where n = Estimated sample size

d = 0.05 (Marginal error)

p = Prevalence of co-infection (54.5%)

$$n = (1.96/0.05)^2 * 0.545 * (1-0.545) = 382$$

To take account of possible non respondents during collection of specimen, an additional 38 pupils was added (10% of 382). Thus the sample size was 420 (382+38) school going children.

3.5 Sampling methods

A multistage sampling was used to get the study participants. Five wards were selected randomly from each division (the district has 5 divisions). From the five selected wards, one school was randomly selected from each ward. Systematic random selection was used to select 84 pupils from each school, where by all pupils eligible for the study were lined up starting from the lower to the higher class by order of their sex, t and the selection was done starting from a random selected point on a sampling frame at equal intervals depending on the total number of children who were included in the study from each school.

3.6 Data collection

3.6.1 Demographic characteristics and risk factors

A questionnaire was used to collect demographic information and risk factors among the study participants. The questionnaire was pre-tested to school children from one school which was selected from a ward not included in this study. Dates of birth of children were obtained from the school registers. The information collected through the questionnaire included, demographic information, environmental sanitation, and personal hygiene and water sources at the family level.

3.6.2 Stool samples

Stool specimens were collected using clean plastic containers from all the study participants. Each participant was given a container for stool collection early in the morning and was required to submit the specimen the same day. Duplicate Kato-Katz stool smears were prepared immediately after submission of the stool using template size of 41.7 mg stool from each child and microscopically examined for eggs of *S. mansoni* and STH. Examination of eggs was done on-site within 1 hour after preparation in order to capture eggs of hookworm before hatching. Eggs intensity was determined by multiplying egg count per slide by 24. Infected children were classified as having light, moderate and heavy infection according to WHO criteria (Table 3.1).

Table 3. 1: Intensity threshold for soil transmitted helminthiasis and *Schistosoma mansoni*

Parasitic infection	Intensity of infection threshold (epg- eggs per gram)		
	Light	**Moderate**	**Heavy**
A. lumbricoides	1 – 4,999epg	5,000 – 49,999epg	≥ 5,0000epg
T. trichiura	1 – 999epg	1,000 – 9,999epg	≥ 10,000epg
Hookworm	1 – 1,999epg	2,000 – 3999epg	≥ 4,000epg
S. mansoni	1 – 99epg	100 – 399epg	≥ 400epg

Source: Montresor, 1998; Tekeste *et al*., 2013; WHO, 2002

3.6.3 Anthropometric measurements

Weight and height were measured to the nearest 0.5kg and 0.1cm respectively by using standiometer. Date of birth (DOB) from each pupil was obtained from school registers. The Z-score values were calculated using WHO AnthroPlus software version 1.04 (WHO, Geneva, Switzerland) using the WHO international reference 2007 values (available at http://www.who.int/growthref/ tools/en/). Height for age Z-score (HAZ) was used to assess stunting; Weight for age Z-score (WAZ) was used to assess underweight for children < 10 years while Body Mass Index Z-score (BAZ) was to assess wasting or thinness. Based on Z-scores, the children were categorized as stunted, underweight and wasted or thin if HAZ < -2, WAZ < -2 and BAZ < -2 respectively. Z–score > -2 was considered as normal nutritional status. For the Mid-Up Arm Circumference (MUAC) the measurement was done using a measuring tape and the classification was categorized as normal nutrition, moderate and severe under nutrition. Mid-Upper Arm Circumference measurement for children from 5-9 years were classified as normal (>14.5cm), moderate (13.5cm - 14.5cm) and severe (<13.5cm), whereas for children aged from 10-14 years normal (>18.5cm), moderate (16cm - 18.5cm) and severe (<16.0cm).

3.7 Statistical analysis

Anthropometric data were entered into WHO AnthroPlus program to obtain nutritional status based on Z-scores while demographic information and risk factors were entered in the excel sheet before data were transferred to STATA. Chi-square or F-test were used where appropriate to measure the association of hookworm worm infections and risk factors, also association of demographic information and hookworm infection with nutritional status. Furthermore, univariate logistic regression model was used to determine factors associated with hookworm infection and nutritional status. The *p*-value < 0.05 threshold was used for statistical significance.

3.8. Ethical considerations

3.8.1 Ethical clearance

The study was carried out after obtaining Ethical Clearance from National Institute of Medical Research (NIMR) Reference No NIMR/HQ/R.8a/Vol.IX/2078 of 3rd December 2015. At the district level permission of doing the study was granted by District Executive Director (DED), District Medical Officer (DMO) and District Education Office (DEO). Parents consented for their children to participate in the study by signing informed consent form, only children who provided assent included in the study. Pupils who were found infected with hookworm were given anthelminthic drugs (Albendazole at 400mg) by a nurse at the nearest facility. Participants were assured confidentiality for the information they provided pertaining this study.

3.8.2 Recruitment of research team

A team composed of Principal Investigator (PI), 2 laboratory technicians and one teacher responsible for the school health program from each school and 1 auxiliary nurse was recruited for data collection. The team was oriented on the objectives of the study and every team members' responsibilities. The PI was overall in charge of the team, laboratory technician were responsible for demonstrating to pupils how to collect the sample, labelling stool collection containers, preparation and reading of the slides and recording the results. The auxiliary nurse ensured that the working environment was clean, slides and containers are cleaned and safe disposal of containers and the teacher was responsible for assisting in lining up pupils during sample selection and administering of questionnaires.

3.9 Inclusion criteria

School children aged from 5 to 15 years and who were present in school the day the study was conducted and who were not being used antihelminthic drug in the past six months. Only those pupils who were willing were selected to participant in the study.

3.10 Exclusion criteria

All pupils who were ill three weeks before the study and who used antihelminthic drugs within past six months were not included in the study. Pupils who were not willing were equally excluded.

CHAPTER FOUR

RESULTS

4.1 Demographic characteristics of the study participants

Participants were sampled from standard one to seven. Of 420 anticipated participants only 403 (96%) submitted stool for parasitic examination. However, this was as well as above the minimum sample size required in this study (382 school going children). Males were 51.1% (206/403) while females were 48.9% (197/403). The majority of the participants were from the age group of 11-15 years (63.3%). Parents or guardians of most of the participants (90.3%) were unemployed. Participants from standard one and standard seven contributed the lower percentage of the study participants 12.9% and 11.4%, respectively (Table 4.1).

Table 4. 1: Demographic characteristics of the study respondents

Parameters	Frequency (N)	Percentage
Sex		
Female	197	48.9
Male	206	51.1
Age Category (Years)		
5-7	28	6.9
8-10	120	29.8
11-15	255	63.3
Parents/Guardians employed		
Yes	39	9.7
No	364	90.3
School Name		
Kigamboni	81	20.1
Tumaini	84	20.8
Miwangani	83	20.6
Jaribu	78	19.4
Ilungusha	77	19.1
Class		
Standard One	52	12.9
Standard Two	55	13.6
Standard Three	64	15.9
Standard Four	62	15.4
Standard Five	63	15.6
Standard Six	61	15.1
Standard Seven	46	11.4

4.2 Prevalence of *Schistosoma mansoni* and soil transmitted helminths

From all the stool samples collected from school going children for analysis of *S. mansoni, A. lumbricoides,* hookworms and *T. trichiura,* 1.5% (6/403) were found positive for hookworms. Eggs of *S. mansoni, A. Lumbricoides* and *T. trichiura* were not detected, hence making their prevalence to be 0.0% (Table 4.2).

Table 4. 2: The prevalence and egg intensity of *S. mansoni*, *A. lumbricoides*, Hookworms and *T. trichiura* among respondents

Parameter	Parasite			
	S. mansoni	***A. lumbricoides***	**Hookworms**	***T. trichiura***
Number examined	403	403	403	403
Positive cases	0	0	6	0
Prevalence (%)	0.0	0.0	1.5	0.0
Egg intensity according to WHO guidelines				
% of Light infection	NA	NA	100.0	NA
% of Moderate infection	NA	NA	0.0	NA
% of Heavy infection	NA	NA	0.0	NA

NA-Not applicable

4.3 Prevalence of hookworm infection by demographic characteristic of study respondents

The prevalence of hookworm infection was higher in males 2.4% compared to 0.5% in females (Table 4.3). The prevalence of hookworm infection of participants in the age group of 5-7 years was 0.0% compared to other age groups. Ilungusha primary school indicated the highest prevalence of 2.6% (2/77) followed by Tumaini Primary school which had 2.3% (2/86) the prevalence of hookworm infection in Miwangani Primary School was 0.0%. Hookworm infection was only found in participants from class three, four and five (age ranges 8-15 years) with the prevalence of 4.7% (3/64), 1.6% (1/62) and 3.2% (2/63) respectively. Also, hookworm infections were found at 4 of the 5 schools, and the intensity of infection was 100 % light. However, the difference in prevalence of hookworm infections within parameters was not significant (Table 4.3).

Table 4. 3: Prevalence of hookworm infections by demographic characteristics and respondents' school

Parameter	Frequency (N)	% (n*)	*p*-value
Sex			
Female	197	0.5 (1)	0.216
Male	206	2.4 (5)	
Age Category			
5-7	28	0.0 (0)	0.622
8-10	120	1.7 (2)	
11-15	255	1.6 (4)	
Parents/Guardians employed			
Yes	39	0.03 (1)	0.459
No	364	0.01 (5)	
Name of Primary School			
Kigamboni	81	1.2 (1)	0.709
Tumaini	84	2.3(2)	
Miwangani	83	0.0 (0)	
Jaribu	78	1.3 (1)	
Ilungusha	77	2.6 (2)	
Class			
Standard 1-3	186	1.6 (3)	0.307
Standard 4-5	119	2.5 (3)	
Standard 6-7	98	0.0 (0)	

n* Number of hookworm positive cases in each category
Note: Fisher's exact test was used to compare the prevalence across variables

4. 4 Univariate risk factor analysis for hookworm infection

The prevalence of hookworm infection was significantly associated with participants without toilets at their homes (OR = 7.3; 95% CI = 1.4 - 37.1; p = 0.017). The odds of hookworm infection in participants without toilets at their homes were 7.3 times than those with toilets at their homes. Of 403 study participants, 49 did not get anthelminthic drugs in the last MDA implementation. The odds of hookworm infection was higher to participants who had not received Albendazole, Mebendazole or Praziquantel even once in the past year showed significant of hookworm infection (OR = 7.6, 95% CI=1.5-38.9,

p = 0.015) indicating that participants who had not receive anthelminthic drugs were 7.6 times more likely to be infected by hookworm infection than those who received. Other factors were not significant (Table 4.4).

Table 4. 4: Prevalence and univariate analysis of factors associated with hookworm infection by simple logistic regression

Parameters	n	Hookworm Infections		*p*-value
		% (n*)	**OR (95% CI)**	
Sex				
Female	197	0.51 (1)	1	0.15
Male	206	2.43 (5)	4.9 (0.6 - 42.1)	
Age category (Years)				
10 – 15	297	1.68 (5)	1	0.594
5 – 9	106	0.94 (1)	0.6 (0.1- 4.8)	
Employment status of parents				
Yes	39	2.56 (1)	1	0.566
No	364	1.37 (5)	0.53 (0.1- 4.6)	
Has toilet at home				
Yes	352	0.85 (3)	1	0.017
No	51	5.88 (3)	7.3 (1.4 - 37.1)	
Always wear shoes				
Yes	204	0.49 (1)	1	0.133
No	199	2.51 (5)	5.2 (0.6 - 45.2)	
Has taken anthelminthic drugs				
Yes	354	0.93 (3)	1	0.015
No	49	0.72 (3)	7.6 (1.5 - 38.9)	
Toilet floor material				
Cement or tiles	214	0.93 (2)	1	0.83
Muddy	138	0.72 (1)	0.8(0.07 - 8.62)	
Bathing habit				
Always home	221	0.90 (2)	1	0.30
Sometimes at the river	182	2.20 (4)	2.4(0.44-13.59)	

n* Number of hookworm positive cases in each category

4.5 Nutritional status of study participants

Anthropometric measurements of 403 participants were done. The mean age (±SD) was 11±2.2 years, ranging from 5 to 15 years. The mean weight (± SD) was 28.2 ± 7.6 Kg, ranging from 15.5 to 56.5 Kg. The mean height (± 2SD) was 132.4 ± 11.3 cm, ranging from 106.2 to 170.2cm (Table 4.5)

Table 4. 5: Anthropometric indicators for the participants

Parameter	**Mean ± 2SD**	**Minimum - Maximum**
Weight (Kg)	28.2 ± 7.6	15.5 – 56.5
Height (cm)	132.4 ± 11.3	106 – 170.2
Arm circumference (cm)	19.56 ± 2.56	14 – 30.3

Nutritional status results obtained from anthropometric indicators based on Z-scores showed that 46.1% of participants were stunted (HAZ indicator) which was highest when compared to underweight and wasting. The prevalence of underweight (WAZ indicator), wasting (BAZ indicator) and under nutrition (MUAC) were 24.2%, 16.8% and 14.1%, respectively (Table 4.6).

Table 4. 6: Nutritional status of school children by Anthropometric measurements

Parameter	Frequency (%)	95% CI
HAZ		
Normal HAZ ≥ -2 SD	217 (53.8)	49.0 - 58.7
Moderate stunting (−3SD ≤ HAZ < −2SD)	117 (29.0)	24.6 -33.5
Severe stunting (HAZ<−3SD)	69 (17.1)	13.4 -20.8
WAZ**		
Normal WAZ ≥ -2	97 (75.8)	68.3 - 83.3
Moderate underweight (WAZ≥−3SD &<−2SD)	25 (19.5)	12.6 - 26.5
Severe underweight (WAZ<−3SD)	6 (4.7)	1.0 - 8.4
BAZ		
Normal BAZ (≥−2SD)	335 (83.1)	79.5 - 86.8
Moderate Wasting (BAZ≥−3SD &<−2SD)	61 (15.1)	11.6 - 18.7
Severe wasting (BAZ<−3SD)	7 (1.7)	0.5 - 3.0
MUAC		
Normal	346 (85.9)	82.4 - 89.3
Moderate under nutrition	57 (14.1)	10.7 - 17.6

** Weight-for-age was calculated to children from 5-10 years only
HAZ- Height for Age Z-score
WAZ-Weight for Age Z-score
BAZ-Body mass index for Age Z-score
MUAC-Mid Up Arm Circumference

The mean Z-score for stunting or chronic malnutrition (HAZ) for the participants was below WHO standard (Mean= - 1.86; 95% CI= -1.96 - -1.75). Furthermore, the mean HAZ score for boys was lower than that of girls, boys (Mean= -2.05; 95% CI=-2.21 - -1.89) while for girls was (Mean= -1.66; 95% CI= -1.82 - -1.51) (Figure 4.1a and Figure 4.1b).

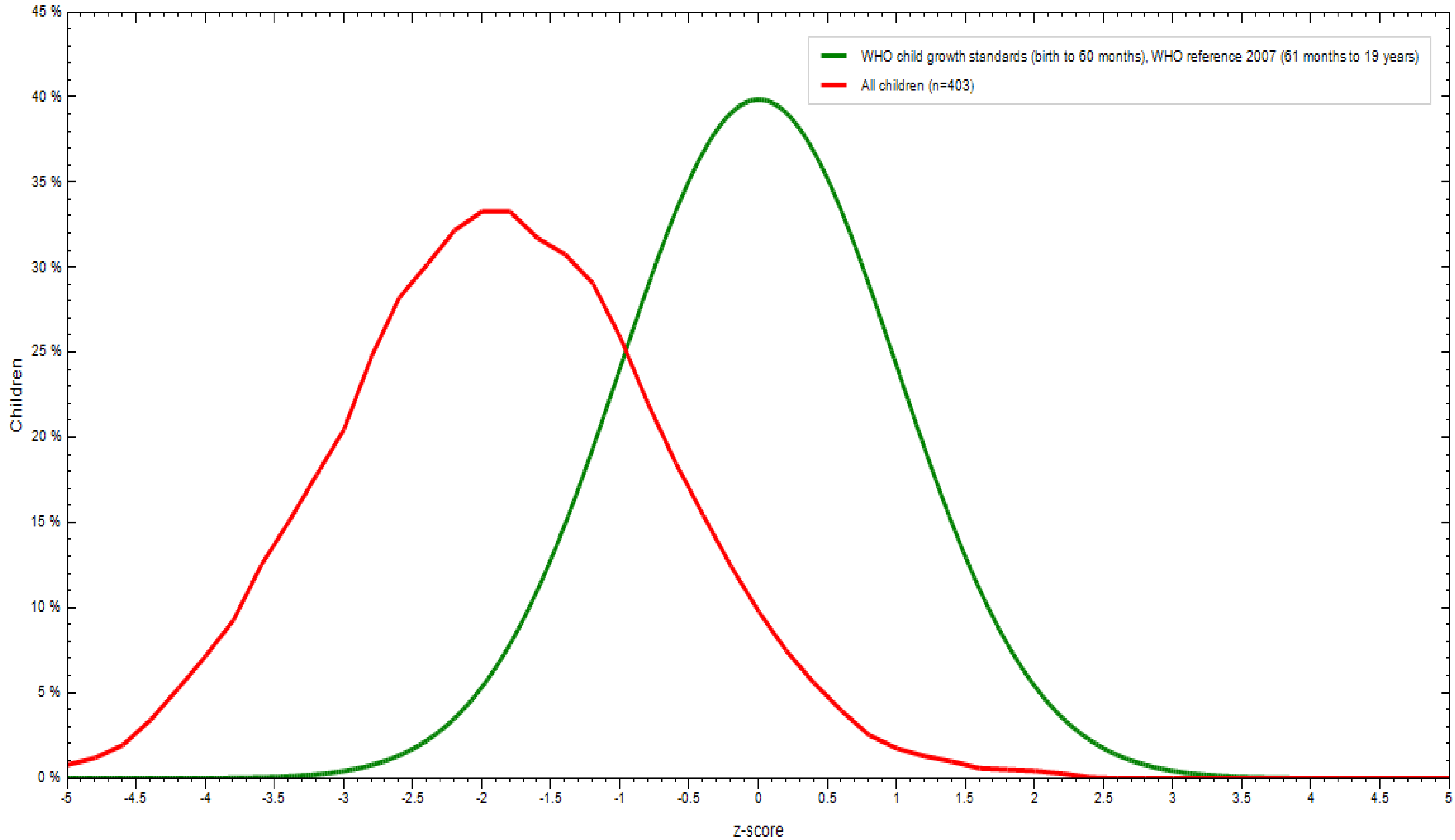

Figure 4. 1a: The distribution of HAZ of assessed school children compared to the WHO reference 2007 as a normal distribution

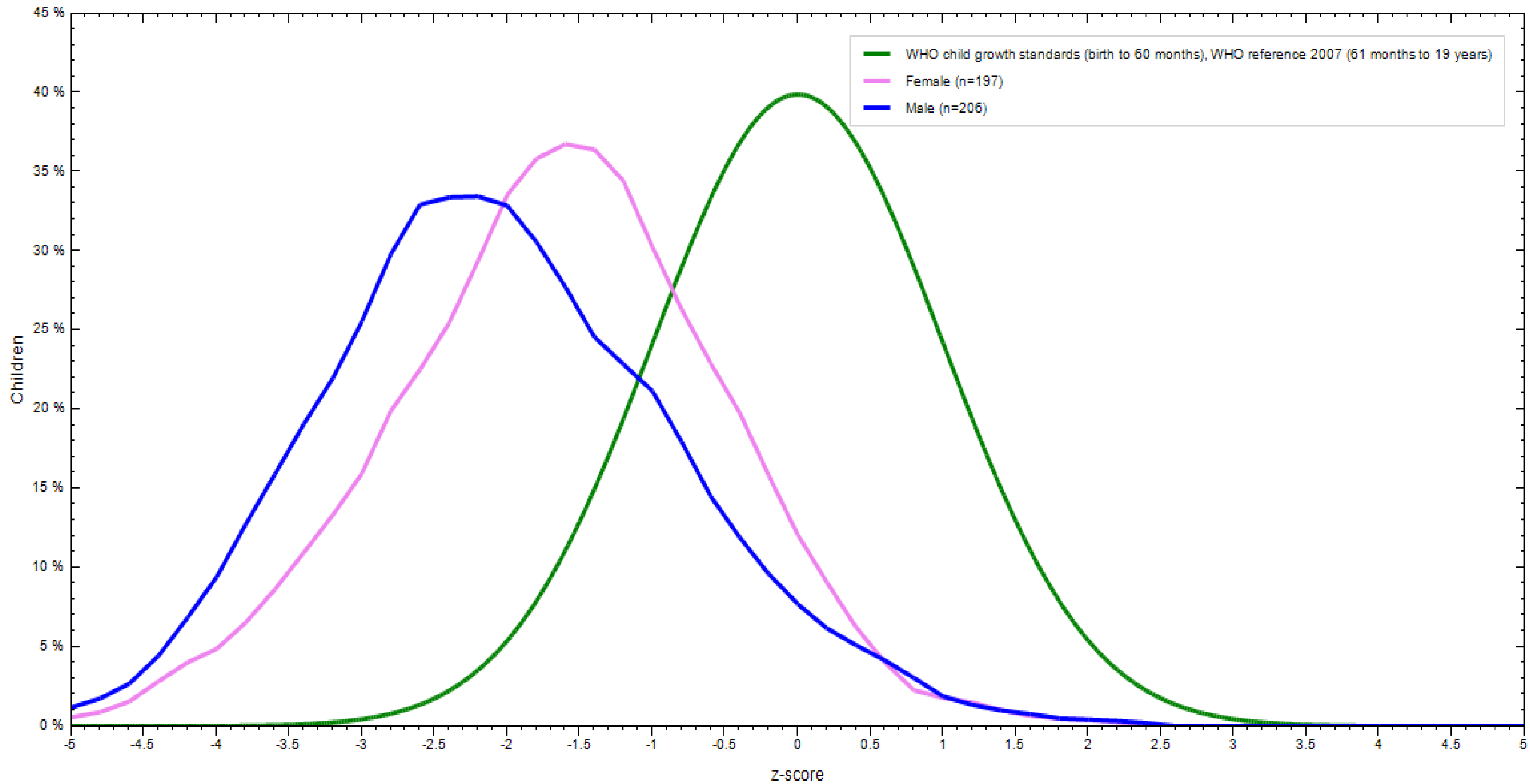

Figure 4. 1b: The distribution of HAZ of assessed school children between boys and girls compared to the WHO reference 2007 as a normal distribution

4.6 Factors associated with stunting, wasting and underweight among participants

By simple logistic regression sex and age category were significantly associated with stunting (OR = 2.43; 95% CI = 1.63-3.65; $p < 0.001$) and (OR = 0.32; 95% CI = 0.19-0.51; $p < 0.001$), respectively. This indicates the that male participants had 2.43 higher odds of being stunted than female participants; also age group of 5-9 years had 0.32 times lower odds of being stunted than the age group of 10-15 years. Sex, age group, employment status of parents or guardians and hook worm infection were not significantly associated with both wasting and underweight (Table 4.7)

Table 4. 7: Univariate logistic analysis of stunting, wasting and underweight by gender, age, employment status of parents/guardians and hookworm infection

Parameters	Stunting		Wasting		Underweight	
	OR (95%CI)	*p* - value	OR (95%CI)	*p* – value	OR (95%CI)	*p* - value
Sex						
Female	1		1		1	
Male	2.43 (1.63-3.65)	< 0.001	1.35 (0.79-2.29)	0.26	1.28 (0.57-2.88)	0.55
Age category (Years)						
5-9	1		1		1	
10-15	3.2 (1.94-5.16)	< 0.001	1.6 (0.58-4.36)	0.079	1.82 (0.93-3.55)	0.363
Employment status of parents/guardians						
Yes	1		1		1	
No	1.42 (0.72-2.79)	0.312	0.76 (0.33-1.75)	0.524	1.14 (0.34-3.75)	0.831
Hookworm infection						
No	1		1			
Yes	2.36 (0.43-13.05)	0.324	0.98 (0.11-8.57)	0.989	*	NA

* None of the school children was both hookworm infected and underweight
NA-Not Applicable

CHAPTER FIVE

DISCUSSION

This study was conducted to determine the prevalence and risk factors of intestinal Schistosomias and soil transmitted helminths and nutritional status among school going children in Kilombero District in Tanzania. The overall prevalence of STH established was 1.5% and was for hookworm only.

This study indicated zero prevalence of intestinal SCH (0.0%), comparable to previous studies done in Northern Tanzania by Poggensee *et al*. (2005) which revealed the prevalence of *S. mansoni* at 0.7% and in Malawi which showed the prevalence of 0.4% (Bowie *et al*., 2004). However, lower than those reported from earlier studies, the study done by Siza *et al*. (2015) in Lake Victoria basin of Tanzania indicated the prevalence of intestinal SCH at 14.8% as well as in Magu district in Tanzania which reported the prevalence of 39.7% in school children (Kinung'hi *et al*., 2014) and one more done in Western Kenya which indicated the mean prevalence of *S. mansoni* at 16.3% (Handzel *et al*., 2003). The absence of intestinal SCH may be attributable to ongoing de-worming interventions like preventive chemotherapy treatment strategy, environmental sanitation campaigns through CLTS and for intestinal SCH, may also have been attributable to the presence of many rivers in the study area do not favour the growth of the snail (*Biophalaria* species) which is the intermediate host for *S. mansoni.*

For STH, the current study also showed low prevalence hookworm at 1.5%. These findings are similar to an earlier study done, one done in Dar es salaam and Tanga regions in Tanzania reported less than 2% prevalence of hookworm infections

(Mwakitalu *et al*., 2014). Furthermore, comparable findings have also been reported in other countries like Zimbabwe which reported the prevalence of 5.5% for hookworm infections in school children (Midzi *et al*., 2014) and one more study in Malawi indicated the prevalence of less than 2.6% in the same group (Bowie *et al*., 2004). On the contrary, other studies reported high prevalence rate within and outside Tanzania. The study done in Magu district in Tanzania indicated the prevalence of 39.7% and 15.8% for *S. mansoni* and hookworms, respectively (Kinugh'hi *et al*., 2014). Furthermore, studies done in Kenya by Handzel *et al*. (2003); in South Nigeria by Akanni *et al*. (2014); in Northwestern Ethiopia by Abdi *et al*. (2016) and in Malaysia by Ahmed *et al*. (2012) as well as in Puducherry in South India by Ragunath *et al*. (2010) also indicated higher prevalence than the current study.

The presence of only hookworm infection may be due to the presence of forest and humid atmosphere in the study area, also the probability of surviving to infectivity and finding a new host is enhanced for hookworm by its shorter time for larval development to infective stage in the soil of hookworm larvae (3-10 days) compared to that *Ascaris* 28-84 days and *Trichuris* 10-30 days (Clements *et al*., 2010).

The low prevalence of helminths infections indicated in this study may be attributable to bi-annual de-worming which is done to under-five children, annual MDA with Albendazole, Praziquantel and Ivermectin under the National Neglected Tropical Diseases program which have been conducted in the study area since 2008 (MoHSW, 2008). Five MDA rounds have been done to date, and the last MDA before this study was conducted in July, 2015. Also Community Led Total Sanitation (CLTS) campaigns which started in 2013 in the study area might have contributed to such low prevalence of helminths by reducing transmissions.

The present study indicated lack of association between helminths infections (hookworm) and nutritional indicators (HAZ, WAZ and BAZ). These findings are contrasting to previous studies (Montresor *et al*., 1998; Francis *et al*., 2012; Hürlimann *et al*., 2014) which reported significant association of stunting, underweight and wasting with helminths. Lack of association observed in the current study may be due to light intensity by 100% in all school children who were positive for hookworm and regular de-worming which prevent the infections becoming chronic.

For nutritional indicators, this study indicated that under nutrition is prevalent among school children. Prevalence of significant stunting, wasting and underweight was 46.1%, 16.8% and 24.2%, respectively. Findings from the current study indicated high prevalence of stunting at 46.1% which is comparable to other studies reported earlier. The study in Same district in Tanzania showed the prevalence of 42.3% in school children (Munisi, 2012), in Angola by Oliveira *et al*. (2015) reported a prevalence of 41.5%. But the prevalence from the current study was higher than those reported in Kenya by Suchdev *et al*. (2014) which indicated the prevalence of stunting at 16.9% and another study in Ethiopia reported the prevalence of 18% (Abdi *et al*., 2016) as well as a study in Malaysia by Ahmed *et al*. (2012) indicated the prevalence of 28%. The observed high prevalence of stunting in this study may be associated with possibility that those found stunted perhaps experienced chronic infections previously and may also be due to inadequate dietary intake since childhood. Furthermore, children greater than 9 years were the most affected by stunting and these findings are in agreement with those reported by Sanchez *et al*. (2013), Ahmed *et al*. (2012), Oliveira *et al*. (2015) and Papier *et al*. (2014), signifying that most children who were born subsequent to the commencement of MDA in 2008 in the study area might have been in a low risk of stunting because they are regularly protected against worms infection since their childhood. Stunting in boys was found to higher than in girls, this is consistent with previous similar studies in Malaysia (Ahmed *et al*., 2012) and in South Ethiopia (Asfaw *et al.,* 2015) but conversely to other studies in Northwestern Ethiopia (Degarege and Erko, 2013) and in Cambodia (Perignon *et al*., 2014). This could be attributed to socio cultural influences; that girls are culturally involved in cooking for family food and they have more access to food than boys.

This study showed that the prevalence of underweight was higher (24.2%) compared to that reported in other countries. Studies done by Sanchez *et al.* (2013) in rural community of Honduras, Suchdev *et al* (2014) in urban slum in Kenya and Francis *et al* (2012) in Wakiso district in Uganda indicated the prevalence of underweight of 1.3%, 1.4% and 5.3%, respectively, which is low compared to the present study. On the contrary, few studies showed higher prevalence of underweight than found in the current study. Studies by Ahmed *et al.* (2012) in Malaysia and by Sacko *et al.* (2011) in Mali reported prevalence of underweight of 29.2% and 96.7%, respectively. The differences in prevalence of underweight within sex, age and employment status of parents or guardians, were not significant. Despite the fact that the prevalence of STH found in this study is low, yet the prevalence of underweight is high, may imply that these infections may not be responsible for underweight in the children. Therefore, the high prevalence of underweight observed in this study may be attributed to other causes such as food insecurity. Moreover, this study indicated high prevalence of wasting of 16.8% comparable to other studies by Ahmed *et al* (2012) in Malaysia 12.5% as well as in Angolela, Ethiopia 19.6% (Nguyen *et al*., 2012) and in Southern Ethiopia 13.4% (Asfaw *et al*., 2015). In contrast, other studies reported low prevalence of wasting of 2.2% in rural community of Honduras (Sanchez *et al*., 2013), 9.0% in Niger River basin, Mali (Sacko *et al*., 2011) and 9.6% in urban slum of Kenya (Suchdev *et al*., 2014). The current study indicated that gender, age category, employment status of parents or guardians and hookworm infection were not significant for wasting among the participants.

The current study tried to find out how gender, age group, employment status of parents or guardians, presence of toilets at home, floor materials of toilets, bathing habit, wearing shoes and administration of anthelminthic drugs in school children is associated with hookworm infections. Only absence of toilets at homes and those who were not provided with anthelmithic drugs indicated significant associations with hookworm infections. The odds of hookworm infection were more to participants without toilet at their home than those with toilets. The findings coincide with other reports (WHO, 2008; Gabrie *et al*., 2014). The proposed reason for this is that, because of the absence of toilets at their homes, children return regularly to defecation site which is likely to have viable infectious hookworm larvae and therefore may become infected. Furthermore, the current study indicated that odds of hookworm infection were higher in children who were not administered with anthelminthic drugs during the last MDA than those who were administered. These findings are similar to those previously found in Muheza, Tanzania (Matata, 2014).

The results of this study indicated that poor faecal disposal (absence of toilet at home) and not taking anthelminthic drugs are strong determinants of hookworm infection.

5.1 Limitations of the study

- The low sensitivity of Kato-Katz technique, underestimates the prevalence of helminths especially when the intensity of infection is light and when a single collection of stool sample is used.
- The study was conducted at the time the study district was having an outbreak of cholera, therefore school children responses regarding sanitation issues at their homes could have been influenced by various operations which were undertaken in the control of the outbreak.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

In conclusion, there was a substantially low prevalence of intestinal schistosomiasis and soil transmitted helminths, and therefore they do not have a public health impact in school going children in the study area. The observed low prevalence of helminths may have been attained by preventive chemotherapy and improved environmental sanitation and personal hygiene, but high prevalence rates of under nutrition (stunting, underweight and wasting) may not be associated with helminths infection, but could be allied with other factors not investigated in this study such as malnutrition.

6.2 Recommendations and suggestions

1. For the control of Schistosomiasis, preventive chemotherapy strategy should be done to all school going children twice in their primary schooling age. However for STH it should be stopped and focus on the treatment of positive cases only.

2. The district should sustain efforts in environmental sanitation interventions for the control of helminths.

3. Large scale prospective study design is needed to find out the root causes of under nutrition among school going children in Kilombero district.

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APPENDIXES

Appendix 1(a): Informed Consent Form-English version

THE UNIVERSITY OF ZAMBIA

SCHOOL OF VETERINARY MEDICINE

INFORMED CONSENT FORM

Consent to participate in study

I am Maro Mwikwabe Chacha, a post graduate student at The Univesity of Zambia in School of Veterinary Medicines, Department of Disease Control. I am hereby doing a study on the ***Prevalence and risk factors of Intestinal Schistosomiasis and Soil Transmitted Helminthiasis and their associations to Nutritional status among school going Children in Kilombero District, Tanzania***

Purpose and Description of the Research

This study is aiming at determining the Prevalence and risk factors of Intestinal Schistosomiasis and Soil Transmitted Helminthiasis and their associations to Nutritional status among school going Children in Kilombero District, Tanzania. The finding of this research will ba used as the baseline data for future impact assessment of the current interventions against helminths and also will help to choose appropriate control measures to be taken. The results from this study will be published for academic purposes

Participation

Your participation in this study is entirely voluntary. So it is your decision whether to participant of not, and your refusal to participant in this research has no effect to you. Again you are free to withdraw from this research at any point. However your full participation will be highly appreciated because you will make possible for the purpose of this research to be meet.

Benefits

The direct benefit from this study is that all who are going to found infected with those helminths above are going to be treated. On the other hand, the indirect benefit of the research is that the findings will help the government in choosing appropriate control measure by knowing the prevalence and risk factors of these infections.

Data Collection

Participants will be required to submit a fresh tool sample earl in the morning and a questionnaire will be administered to them for identification of risk factors.

Risks of participating in the study

There is no risk of participating in study

Confidentiality

All information collected from this study will be kept confidential and shall be used only for the purpose of this study.

For inquiries communicated the following people

Chair, Medical Research Coordinating Committee,

2448 Ocean Road P.O. Box 9653 Dar es Salaam, Tanzania Tel: +255 22 2121400 Fax: 255 22 2121360 Website: www.nimr.or.tz

Maro Mwikwabe Chacha, the Principal Investigator, University of Zambia +260974306813

Dr C.S Sikasunge, Principal Supervisor, University of Zambia +260979878672

Dr Andrew.M.Phiri, Co-supervisor, University of Zambia +260971016370

Dr Khalid Massa, Co-supervisor, Ministry of Health and Social Welfare (MoHSW) +255713413699

Do you agree?

Participant agrees... Participant does NOT agree..........................

I .... have read the contents in this form.

My questions have been answered. I agree to participate in this study.

Signature/thumbprint of participant............................Date: ....

Signature/ thumbprint of a witness………………..Date………………………………

Signature of research assistant................................Date: ....

Appendix 1(b): Consent Form-Swahili Version

THE UNIVERSITY OF ZAMBIA

SCHOOL OF VETERINARY MEDICINE

Fomu ya Ridhaa kwa washiriki wa utafiti

Mimi Maro Mwikwabe Chacha ambaye ni mwanafunzi wa shahada ya udhamilikatika chuo Kikuu cha Zambia ninafanya utafiti juu ya Kiwango cha mambukizi ya minyoo yaKichocho cha tumbo na minyoo inayoambukiza kwa udongo na mahusiano yake hali ya lishe kwa watoto wa shule za msingi katika wilaya ya Kilombbero

Madhumuni na maelezo ya utafiti

Utafiti huu unalenga kutambua Kiwango cha mambukizi ya minyoo ya Kichocho cha tumbo na minyoo inayoambukiza kwa udongo na mahusiano yake hali ya lishe kwa watoto wa shule za msingi katika wilaya ya Kilombero.Matokeo ya utafiti huu yatatumika kama taarifa zitakozosaidia kupima mafanikio yafua mbalimbali zinazotumika katika kupambana na Minyoo, hatimaye kuweza kuchagua afua staki kulingano na kiwango cha mambukizi. Vilevile matokeo ya utafiti huu ya yatachapishwa katika kwa ajili ya malengo ya kitaaluma

Ushiriki

Kushiriki kwako katika utafiti huu ni wa hiara,kwa hiyo maamuzi ya kushiriki au kutoshiriki yapo juu yako, ila ushiriki wako katika utafiti huu utaweza kusaidia kupata matokeo yatakayosaidi katika kuboresha au kuimarisha afua katika kupambana na matatizo ya Minyoo

Faida

Kushiriki kwako katika utafiti huu kuna faida za moja kwa moja kama kutoa matibabu yasiyokuwa na malipo kiwapo utakutwa kuwa na maambukizi ya minyoo hii. Kwa upande mwingine matokeo ya utafiti huuyatasaidia katika kuchagua afua stahiki katika kupambana na maambbukizi ya Minyoo

Ukusanyaji wa sampuli na taarifa

Washiriki wataombwa kukusanya choo kwa kutumia kifaa maalum watakochopewa na kukikusanya mapema asubuhi na pia watatakiwa kuhojiwa kwa kutumia dodosa liliandaliwa ili kuwezza kujua mazingira hatarishi kwa mambukizi ya minyoo

Madhara ya kushiriki katika utafiti huu

Hakutakuwa na madhara yoyote yatakayotokana na kushiriki kwako katika utafiti huu.

Usiri

Taarifa zote zitakazotokana na utafiti huu zitatunzwa kwa usiri mkubwa sana na zitatumika kwa ajili ya malengo ya utafiti na si vinginevyo

Kama utahitaji ufafanuzi au maelezo zaidi tafadhali usisite kuwasiliana na wafuatao;

Mwenyekiti, Kamati ya Kuratibu Tafiti

2448 Ocean Road S.L. P 9653 Dar es Salaam, Tanzania Simu: +255 22 2121400 Fax: 255 22 2121360 Touti: www.nimr.or.tz

Maro Mwikwabe Chacha, Mtafiti mkuu, Chu Kikuu Zambia +260974306813

Dr C.S Sikasunge, Msimamizi Mkuu, Kikuu Zambia +260979878672

Dr Andrew.M.Phiri, MsimamiziMsaidizi, Kikuu Zambia +260971016370

Dr Khalid Massa, MsimamiziMsaidizi Wizara ya afya na Ustawi wa Jamii-Tanzania +255713413699

Mimi .... nimesoma na kuilewa hii fomu ya ridhaa hinyo basi nimekubali kushiriki katika utafiti huu.

Sahihi/alama gumba ya mshiriki...Tarehe: ....

Sahihi/alama gumba ya shuhuda………………………..

Tarehe…………………………

Sahihi ya mtafiti msaidizi..............................Tarehe: ....

Appendix 2 (a): Questionnaire- English version

Prevalence and risk factors of Intestinal Schistosomiasis and Soil Transmitted Helminthiasis and their association to Nutritional Status among School going Children in Kilombero District, Tanzania

Date of Interview: …/…/…

Section 1: Background Information.

1.1 ID No... .. ..1.2. School Name: ……..…1.3.Village……….. 1.4 Street/Hamlet………..

1.5 Class……….1.6 Sex …. (M/F) 1.7 Age..........

1.8 Are your parents/guardians employed?

1.8.1 Father ….. Yes …...No (If yes where?....................................)

1.8.2 Mother ….. Yes …...No (If yes where?..................................)

1.9 What are activities does your family do for daily life?

…………………………………………………

…………………………………………………

…………………………………………………

Section 2.0: Environmental sanitation, Personal Hygiene and Water Supply

2.1 Is there a toilet at your home? Yes / NO

2.2 If yes above is of what type?

Pit Latrine ( )

Pour Flush latrine ( )

Water closet ( )

2.3 What type of materials is the toilet floor made of?

Cement ( )

Mud ( )

Tiles ( )

2.4 If no in question 2.1 where do you go for defecation?

To neighbors ( )

To the bush ( )

To the river ( )

Other places ( )

Specify……………………………………………………………………

2.5 Are there washing facilities near/within the toilet at your home?

Water only ( )

Water and Soap ( )

No ( )

2.6 Do you wash your hand after visiting toilet?

Always ( )

Sometimes ( )

Not at all ( )

2.7 Do you wash your hands before eating everything?

Always ( )

Sometimes ( )

Not at all ( )

2.8 Where does your family get water for domestic use?

Tap water	Always ( )	Sometimes ( )	Not at all ( )
Well	Always ( )	Sometimes ( )	Not at all ( )
River	Always ( )	Sometimes ( )	Not at all ( )
Spring	Always ( )	Sometimes ( )	Not at all ( )
Streams	Always ( )	Sometimes ( )	Not at all ( )
Buy from water vendors	Always ( )	Sometimes ( )	Not at all ( )

2.9 Where do you bath from?

At home:	Always ( )	Sometimes ( )	Not at all ( )
By the river:	Always ( )	Sometimes ( )	Not at all ( )
To neighbors	Always ( )	Sometimes ( )	Not at all ( )

2.10 Do you wear shoes when you walk out?

Always ( )

Sometimes ( )

No ( )

2.11 How frequently do you put footwear when going to the toilet?

Always ( )

Sometimes ( )

Observe the participant if she or he is wearing shoes………………..

2.12 Do you participate in the following activities? (*Tick all which are appropriate)*

Paddy production ( )

Fishing activities ( )

Cattle grazing ( )

Swimming ( )

Section 3.0: Health Services

3.1 Which is the nearest health facility to your home?

…………………………………………….

3.2 Have you ever received any medications for treatment of helminithiasis while at school?

Yes………….. No………………..

3.3 If yes when you received last? ………………………………..

Thank you so much for your Participation

Appendix 2 (b): Questionnaire- Swahili Version

Dodoso kwa ajili ya utafiti juu ya Kiwango na kiwango mambukizi ya Kichocho cha tumbo na minyoo inayoambukiza kwa udongo na mahusiano yake hali ya lishe kwa watoto wa shule za msingi katika wilaya ya Kilombbero

Tarehe ya mahojiona: …/…/2015

Sehemuya 1: Taarifa za awali .

1.1 Namba ya utambulisho... .. ..1.2. Jina la shule: ……..…1.3.Kijiji………..

1.4 Mtaa/Kitongoji………..1.5 Darasa……….1.6 Jinsi …. (Mvulana/Msichana

1.7 Umri..........

1.8 Je wazazi au walezi wako wameajiriwa?

1.8.1 Babba ….. Ndiyo …...Hapana (Iwapo ndiyo ameajiriwa wapi?....................................)

1.8.2 Mama ….. Ndiyo…...Hapana (iwapo ndiyo ameajiriwa wapi?..................................)

1.9 Je familia yako inajishughulisha na shughuli gani za kiuchumi za kila siku ?

…………………………………………………

…………………………………………………

…………………………………………………

…………………………………………………

Sehemu 2.0: Usafi wa mazingira, usafi wa mwili na upatikanaji wa maji

2.1 Nyumbani kwenu kuna choo? Ndiyo / Hapana

2.2 Iwapo ndiyo katika swali hapo juu je ni cha aina gani?

Choo cha shimo ( )

Choo cha kumwaga maji ( )

Choo cha kuvuta ( )

2.3 Je sakafu ya choo imetengenezwa kwa kutumia nini?

Saruji ( )

Udongo ( )

Vigae ( )

2.4 Iwapo hapana katika swali 2.1 huwa unajisaidia wapi?

Choo cha jirani ( )

Porini ( )

Mtoni ( )

Sehemu zingine ( )

Zitaje……………………………………………………………………………

2.5 Je karibu na choo cha nyumbani kwenu unapoishi kuna vifaa vya kuwezesha kunawa baada ya kutoka chooni?

Maji pekee ( )

Maji na sabuni ( )

Hakuna kitu ( )

2.6 Je huwa unanawa mikono baada ya kutoka chooni?

Wakati wote ( )

Wakati mwingine ( )

Sioshi kamwe ( )

2.7 Je huwa unanawa mikono yako kabla ya kula kitu chochote?

Wakati wote ( )

Wakati mwingine ( )

Sinawi kamwe ( )

2.8 Je familia yenu huwa inapata wapi maji kwa matumizi ya nyumbani ya kila siku?

Maji ya bomba Mara zote ( ) wakati mwingine ( )

Kisima Mara zote ( ) Wakati mwingine ( )

Mtoni Mara zote ( ) Wakati mwingine ( )

Chemchem Mara zote ( ) Wakati mwingine ( )

Mifereji Mara zote ( ) Wakati mwingine ( )

Kununua kutoka kwa wanaotembeza Mara zote ( ) Wakati mwingine ( )

2.9 Je huwa unaoga wapi?

Nyumbani:	Mara zote ( )	Wakati mwingine ( )
Mtoni:	Mara zote ( )	Wakati mwingine ( )
Kwa jirani	Mara zote ( )	Wakati mwingine ( )

2.10 Je huwa unavaa viatu kila unapotoka nje ya nyumba ?

Wakati wote ( )

Wakati mwingine ( )

Sivai viatu kamwe ( )

2.11 Ni mara ngapi huwa unavaa viatu au ndara wakati ukienda chooni?

Wakati wote ( )

Mara chache ( )

Tazama mshiriki kuona kama amevaa viatu………………..

2.12 Je huwa unashiriki katika shughuli zifuatazo? (*weka tiki kwa kila linalohusika)*

Kilimo cha mpunga ( )

Shughuli za uvuvi ( )

Kupeleka ng'ombe malishoni ( )

Kuogelea ( )

Sehemu 3.0: Huduma za afya

3.1 Kituo cha tiba kilichopo karibu na nyumbani kwenu kinaitwaje?

…………………………………………….

3.2 Je ulishawahi kupatiwa dawa za minyoo ukiwa shuleni?

Ndiyo………….. Hapana………………..

3.3 Kama ndiyo mara ya mwisho ulipewa lini? ………………………………..

Asante sana kwa ushiriki wako

Appendix 3: Laboratory Form

INTESTINAL SCHISTOSOMIAS AND SOIL TRANSMITTED HELMINTHIASIS
PREVALENCE SURVEY FORM FOR PUPILS

A: Person Data

ID No … … … School Name: …………………Village…………….. Street/Hamlet……….. ☐
Class………. Sex (M/F) Age......... Weight ……… (Kg) Height………. (cm)

B. Parasitological Data- Stool Examination

Ascaris lumbricoides Eggs/slide……………. Eggs/gram…………………..
Trichuris trichiura Eggs/slide……………. Eggs/gram…………………..
Hookworms Eggs/slide……………. Eggs/gram…………………..
Schistosoma mansoni Eggs/slide……………. Eggs/gram…………………..

Name of Lab Technician………………….. Signature…………….............Date…………………

Appendix 4: Proposal approval letter

THE UNIVERSITY OF ZAMBIA
SCHOOL OF VETERINARY MEDICINE
OFFICE OF THE ASSISTANT DEAN (POSTGRADUATE)

Telephone: 293727
Telegrams: UNZA LUSAKA
Telex: UNZALU ZA 44370
Fax: 293727/253952
School Fax: 293727
Vet. Clinic Telephone: 291515

P.O. Box 32379
Lusaka, Zambia

Your Ref:

Our Ref:

2nd September, 2015

Maro Mwikwabe Chacha
C/O Paraclinical Studies
School of Veterinary Medicine
University of Zambia
P.O. Box 32379
LUSAKA

Dear Mr Chacha,

RE: APPROVAL OF RESEARCH PROPOSAL

At the meeting of the School Board of Graduate Studies held on 31st August, 2015, your research proposal entitled ***'Prevalance and intensity of Intestinal Schistosomiasis and soil transmitted Helminthiasis and their association to Nutritional status among school-aged children in Kilombero District, Tanzania'*** was tabled and discussed. I am therefore pleased to inform you that the research proposal was subsequently approved by the Board.

On behalf of the Board, I wish you success as you apply for ethical approval and carry on with you research activities.

Yours sincerely

Prof. B. M. Hang'ombe
ASSISTANT DEAN (PG), SCHOOL OF VETERINARY MEDICINE

Cc *Director, DRGS*
Dean, School of Veterinary Medicine
Head, Paraclinical
Dr. C. S. Sikasunge, Paraclinical Studies Department
Dr. A. Phiri, Clinical Studies Department

Appendix 5: **Ethical Clearance Certificate**

THE UNITED REPUBLIC OF TANZANIA

National Institute for Medical Research
3 Barack Obama Drive
P.O. Box 9653
11101 Dar es Salaam
Tel: 255 22 2121400
Fax: 255 22 2121360
E-mail: headquarters@nimr.or.tz
NIMR/HQ/R.8a/Vol. IX/2078

Ministry of Health and Social Welfare
6 Samora Machel Avenue
P.O. Box 9083
11478 Dar es Salaam
Tel: 255 22 2120262-7
Fax: 255 22 2110986

03rd December 2015

Maro Mwikwabe Chacha
C/O Dr Khalid Massa
Ministry of Health and Social Welfare
P O Box 9083
DAR ES SALAAM

CLEARANCE CERTIFICATE FOR CONDUCTING MEDICAL RESEARCH IN TANZANIA

This is to certify that the research entitled: Prevalence and intensity of intestinal schistosomiasis and soil transmitted helminthiasis and their association to nutritional status among school aged children in Kilombero district in Tanzania (Chacha M M *et al*), has been granted ethical clearance to be conducted in Tanzania.

The Principal Investigator of the study must ensure that the following conditions are fulfilled:

1. Progress report is submitted to the Ministry of Health and the National Institute for Medical Research, Regional and District Medical Officers after every six months.
2. Permission to publish the results is obtained from National Institute for Medical Research.
3. Copies of final publications are made available to the Ministry of Health & Social Welfare and the National Institute for Medical Research.
4. Any researcher, who contravenes or fails to comply with these conditions, shall be guilty of an offence and shall be liable on conviction to a fine. NIMR Act No. 23 of 1979, PART III Section 10(2).
5. Sites: Kilombero District in Morogoro region.

Approval is for one year: 03rd December 2015 to 02nd December 2016.

Name: Dr Mwelecele Malecela

Signature
CHAIRPERSON
MEDICAL RESEARCH
COORDINATING COMMITTEE

Name: Prof. Muhammad Bakari Kambi

Signature
CHIEF MEDICAL OFFICER
MINISTRY OF HEALTH, SOCIAL WELFARE

CC: RMO
DED
DMO

Appendix 6: **Permission letter for conducting a research**

HALMASHAURI YA WILAYA YA KILOMBERO

(Barua zote zitumwe kwa Mkurugenzi Mtendaji wa Halmashauri)

Simu Na. 023 – 2931523
Fax Na. 023 – 2931513
Email-kilomberodc@yahoo.com

Ofisi ya Mkurugenzi Mtendaji wa Wilaya,
S.L.P. 263,
IFAKARA.

Unapojibu tafadhali taja;-

Kumb. Na. KDC/C.20/6/10

11/01/2016

Ndugu Maro Mwikwabe Chacha,
Idara ya Afya,
S.L.P. 47,
IFAKARA/KILOMBERO.

YAH:- KIBALI CHA KUFANYA UTAFITI KATIKA WILAYA YA KILOMBERO

Tafadhali husika na mada tajwa hapo juu pamoja na barua yako ya tarehe 05/01/2016 yahusika.

Napenda kukufahamisha kuwa kibali kimetolewa cha kwenda kufanya utafiti juu ya "kiwango cha maambukizi ya minyoo ya kichocho cha tumbo (**Intestinal Schistosmiasis**) na minyoo ienezayo kwa njia ya udongo (**Soil Transmitted Helminithiasis - STH**) na mahusiano yake kama ulivyoomba kwa Mkurugenzi Mtendaji Wilaya kuanzia tarehe 11/01/2016 hadi tarehe 25/01/2016.

Nakutakia kazi njema.

Benson Mihayo
Kny:- MKURUGENZI MTENDAJI WILAYA,
KILOMBERO.

Nakala:-	Mkurugenzi Mtendaji Wilaya, **Kilombero.**	- Aione kwenye jalada.
"	Mganga Mkuu Wilaya, **Kilombero.**	- Kwa taarifa
"	Afisa Elimu Msingi Wilaya, **Kilombero.**	- Kwa taarifa
"	Mwalimu Mkuu Shule za Msingi;- • Miwangani, Tumaini, Kigamboni, Ilungusha na Jaribu.	– Mpeni ushirikiano.