SOIL-TRANSMITTED HELMINTHS INFECTIONS, MALNUTRITION AND ANAEMIA AMONG PRIMARY SCHOOL CHILDREN IN SAME DISTRICT

By

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A Dissertation Submitted in (Partial) Fulfillment of the Requirements for the Degree of Master of Science in Parasitology and Medical Entomology of Muhimbili University of Health and Allied Sciences

Muhimbili University of Health and Allied Sciences
October, 2012

CERTIFICATION

The undersigned certifies that he has read and hereby recommend for acceptance the dissertation entitled "***Soil-transmitted helminths infections, malnutrition and anaemia among primary school children in Same district"*** in fulfillment of the requirements for the degree of Master of Science in Parasitology and Medical Entomology of Muhimbili University of Health and Allied Sciences.

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Prof. C. M. Kihamia

(Supervisor)

Date: ______________________________

DECLARATION

AND

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I, **David Zadock Munisi**, declare that this **dissertation** is my own original work and that it has not been presented and will not be presented to any other university for a similar or any other degree award.

Signature.. Date....................................

ACKNOWLEDGEMENT

I would like to express my heartfelt gratitude to my God who offered me good health and an opportunity to study.

In a unique manner I would like to extend my sincere appreciation to my Supervisor Prof. Charles Kihamia who has also been my course coordinator for his valuable, tireless and fatherly guidance, ideas, and constructive criticism during the whole period of my study and during the development of the proposal for, and the conduct of this research project.

I am further grateful to my sponsor, the Ministry of Health and Social Welfare, for sponsoring me to undertake a Master degree at the Muhimbili University of Health and Allied Sciences.

My sincere appreciation goes to the District Executive Director, District Education Officer and the District Medical Officer of Same District for the permission to conduct a research in their district and the support that enabled me accomplish my data collection activity in the district.

I am also very thankful to all the Ward Education Officers and head teachers of all the wards and schools that I visited for their support during data collection in their respective wards and schools.

My well-expressed thanks goes to all the primary school children who participated in this study, together with their parents and guardians who allowed them to participate in this study and make it a success.

Lastly but not least, I would like to express my heartfelt gratitude to my wife and my children for their support during the entire period of my study.

DEDICATION

This work is dedicated to my wife Kunegunda Angelo Sanga, my daughter Sasha and my son Maximillian.

ABSTRACT

Introduction: Soil-transmitted helminths (STHs) are major public health problems in several tropical and subtropical developing countries with poor socio-economic status. In Tanzania published data suggest that all regions have some level of infection with some areas having prevalence of up to 100%. Children are found to have the highest prevalence and infection intensities and are also very vulnerable to the effects of worm infection which includes nutritional deficiencies which aggravate malnutrition and worsening the rates of anaemia. Prior to the implementation of any control programme, WHO recommends a baseline survey in school children to determine the prevalence and intensity of infections as governments need to target treatment appropriately, based on reliable and up-to-date information on the geographical distribution of infection . Currently there are no data on the extent of these problems in Same district. Therefore this study was designed to determine the prevalence and intensity of STH infections, malnutrition and anaemia among priamary school children in Same district

Objective: This study aimed at determining the prevalence and intensity of STH infections, malnutrition and anaemia among primary school children in Same district.

Materials and Methods: A descriptive cross-sectional study was carried out in Same district. A stratified multistage cluster sampling was applied to obtain 10 schools for the study. A minimum of 61 children were sampled from each school. A total of 579 school children were recruited. Stool specimens were obtained from 549 children. Kato-katz technique was used to determine status and intensity of STH infection. Body weight and height were determined by using a weighing scale and height pole respectively. Anthropometric measurements were analyzed using z- scores of height-for-age and BMI-for-age (BMIA) indices. Hemoglobin levels were determined using HemoCue photometer. Data analysis was done using SPSS software version13. Ethical clearance was obtained from the MUHAS Ethical Review Board and permission to conduct the research was obtained from the district authorities.

Results: The overall prevalence of STH was found to be 0.9% (5/549). The prevalence of light and moderate intensity infections were 0.5% (3/549) and 0.4% (2/549) respectively. The prevalence of stunting was 42.3% with 11.1% being severely stunted. Prevalence of stunting was more in male (48.6%) than in female (37.8%) (*P*=0.015). Pupils in the upland plateau zone were more stunted than children in the middle plateau zone and lowlands zone with prevalence of 48.4%, 38.6% and 38.5% respectively (*P*=0.029). The overall prevalence of thinness was 11.7%. The prevalence of thinness was highest in the lowlands zone (15.8%) compared to the middle and upland plateau zone 14.6% and 5.9% respectively (*P*=0.013). The mean Hb level was 13.4g/dl [95%CI (13.2g/dl, 13.5g/dl)]. The overall prevalence of anaemia was 3.1%. There was no difference in the prevalence of anaemia by age-group, sex and topographical zone.

Conclusion: This study revealed that STHs is not a problem in Same district. The mass chemotherapy conducted by NSSCP in 2008, and the ongoing provision of antihelminthic drugs to children under the age of five has achieved to maintain the prevalence of STH in the district at low levels. However malnutrition has been observed to be a problem in the district with nearly half of the children being stunted.

Recommendations: With the observed low prevalence of STH in Same district, selective treatment is recommended as a chemotherapeutic method of controlling STH in the district. Studies that are going to establish the cause of the observed prevalence of malnutrition are also recommended.

LIST OF ABBREVIATIONS:

Al	–	*Ascaris lumbricoides*
APOC	–	African Programme for Onchocerciasis Control
BMC	–	BioMed Central
BMI	–	Body Mass Index
BMIA	–	Body Mass Index-for-age
BMIAZ	–	Body Mass Index-for-age Z score
CI	–	Confidence interval
DED	–	District Executive Director
DEO	–	District Education Officer
DMO	–	District Medical Officer
EPG	–	Eggs per gram of feces
H/A	–	Height-for-age
H/A	–	Height-for-age
HAZ	–	Height-for-age z scores
Hb	–	Hemoglobin
Hw	–	Hookworm
NBS	–	National Bureau of Statistics
NSSCP	–	National Soil-transmitted helminths and Schistosomiasis Control Programme
NTD	–	Neglected Tropical Disease
NTDCP	–	Neglected Tropical Diseases Control Programme.
SCI	–	Schistosomiasis Control Initiative
STH	–	Soil-Transmitted Helminth
Tt	–	*Trichuris trichiura*
W/A	–	Weight-for-age
WHO	–	World Health Organization

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CHAPTER ONE

1.0. INTRODUCTION

Soil-transmitted helminths are major public health problems in several tropical and subtropical developing countries with poor socio-economic status. In Tanzania published data suggests that all regions have some level of infection which can go up to 100% in certain ecological settings (MoHSW, 2009). The three major Soil-Transmitted Helminths (STH), *Ascarislumbricoides* (roundworm), *Trichuris trichiura* (whipworm) and *Necator americanus/Ancylostoma duodenale* (the hookworms) are amongst the most widespread parasites worldwide (Vercruysse *et al.*, 2011). Children are the group with the highest prevalence and infection intensities and are also very vulnerable to the effects of worm infection including nutritional deficiencies which aggravate malnutrition and worsen the rates of anaemia and impaired physical and mental development contributing significantly to school absenteeism (WHO, 2010, Saathoff *et al.*, 2004).

Periodic treatment of the endemic population with a broad spectrum antihelminthic drug has been advocated as a cheap and effective mean of reducing the worm burden and its related morbidity (Andrade *et al.*, 2001). Before the implementation of a treatment programme, the World Health Organization (WHO) recommends a baseline survey in school children to determine the prevalence and intensity of infections (Montresor *et al.*, 1998). This is because the implementation of treatment programme requires reliable and up-to-date information on the geographical distribution of infection in order to (i) guide control to areas in greatest need and (ii) estimate drug requirements **(**Brooker *et al.*, 2009).

WHO recommends that in high-risk communities, which are communities with prevalence of any STH infection among school-aged children being more or equal to 50%, all school-age children (enrolled and not enrolled) should be treated twice each year. In these communities preschool children, women of childbearing age, including pregnant women in the 2nd and 3rd trimesters and lactating women, and adults at high risk in certain occupations (e.g. tea-pickers and miners) should also be treated. In low-risk communities, that is communities with prevalence of less than 50% but more or equal to 20% ($\geq$20% and <50%) WHO recommends that all school-age children (enrolled and not enrolled) should be treated once each year. Preschool children, women of childbearing age, including pregnant women in the 2nd and 3rd trimesters and lactating women and adults at high risk in certain occupations (e.g. tea-pickers and miners) should also be treated in these communities. When prevalence of any STH infection is less than 20%, large-scale preventive chemotherapy interventions are not recommended. Affected individuals should be dealt with on a case-by-case basis (WHO, 2006). The first round of school deworming treatment campaign in Kilimanjaro Region including Same district was done in August 2008 under the Mainland's National Schistosomiasis and Soil-Transmitted Helminths Control Programme (NSSCP), with reported coverage of 76.76% in Same district (SCI, 2009).

Tanzania had embarked on an integrated approach to Neglected Tropical Diseases (NTD) (Including STH infections) control. The NTD control programme was designed to limit duplication, maximize use of resources and work by and with the community, in a holistic approach. It is increasingly being recognized that, co-occurring diseases need to be tackled in an integrated manner since the interaction between co-existing pathogens, affect the transmission of individual diseases and the overall morbidity, caused to the community (MoHSW, 2009). Then the NSSCP was combined with other tropical disease control programme to form the (Neglected Tropical Diseases Control Programme) NTDCP (MoHSW,2009).

The Tanzania Ministry of Health and Social Welfare (MoHSW) started to implement the phase 1 of the Neglected Tropical Disease Control Programme (NTDCP) in January 2009 in five regions, namely Ruvuma, Mbeya, Morogoro, Iringa and Tanga . The second phase started in 2010 in three regions namely Mtwara, Lindi and Coast. In 2011 the Ministry of Health and Social Welfare (MoHSW) started a third phase of the NTDCP in four regions which were

Dodoma, Tabora, Singida and Rukwa. Mara, Shinyanga, Kagera,Mwanza and Kigoma are in the fourth phase. Kilimanjaro (Including Same district), Manyara, and Arusha are within the fifth Phase of the NTDCP in Tanzania (MoHSW, 2009) which is yet to be implemented (Appendix 7).

Same has implemented one round mass chemotherapy for soil-transmitted helminths and Schistosomiasis in 2008 (SCI, 2009). Howeve, since the last mass chemotherapy in Same district, there has been no study done to determine the prevalence and intensity of STH infections in the district though it is known that an important factor in STH treatment is reinfection, as it has been observed that after community-wide treatment, rates of hookworm infection reach 80% of pretreatment rates within 30–36 months. *A.lumbricoides* infection reached 55% of pretreatment rates within 11 months and *T trichiura* infection reached 44% of pretreatment rates within 17 months (Bethony *et al*, 2006). It is now four years after the last mass chemotherapy in Same district. Hospital laboratory records in the district show that the prevalence of STH was 15.4% in 2009 (Same District Hospital Laboratory Records, 2009). However hospital records do not truly represent the real infection status in the community. Before the implementation of the fifth phase of the NTDCP there is a need to have up-to date information with regards to the prevalence and intensity of STH in the district, this is because the implementation of treatment programme requires reliable and up-to-date information on the geographical distribution of infection in order to (i) guide control to areas in greatest need and (ii) estimate drug requirements **(**Brooker *et al.,* 2009). And this information may assist in monitoring and finally evaluation of the control programme.

The present study is going to provide data on the prevalence and intensity of soil-transmitted helminths infections, malnutrition and anaemia among primary school children in Same district. So as to determine the need for the scheduled mass chemotherapy for STH in the district.

1.1. STATEMENT OF THE PROBLEM

Poverty and inadequate water supplies and sanitation are important determinants of transmission of STH infections. In such conditions, soil-transmitted helminths species are commonly co-endemic (Bethony *et al.,* 2006, WHO, 2002).In Same district 734 out of 29360 households have no toilets. This constitutes 2.5 percent of the total households in the district. The percentage of households without toilet facility in Same district is above the average of the region**.** The most common source of drinking water is from unprotected wells **(**The united Republic of Tanzania, 2002).These conditions suggests that STH are endemic in Same district.

Periodic treatment of the endemic population with a broad spectrum anti-helminthic drug has been advocated as a cheap and effective mean of reducing the worm burden and its related morbidity (Andrade *et al.,* 2001). NSSCP implemented the first round of school deworming campaign in Kilimanjaro Region including Same district in August 2008 (SCI, 2009), the second round is scheduled in the fifth phase of the NTDCP which is yet to be done. It is also known that an important factor in STH treatment is reinfection, where rates of STH infection has been observed to reach between 44% to 80% of pretreatment rates, within a period of less than 36 months depending on the parasite species (Bethony *et al,* 2006). However since the last mass chemotherapy against STH in the district, no survey has been done to determine the prevalence and intensity of STH. As WHO recommends a baseline survey in school children to determine the prevalence and intensity of infections (Montresor *et al.,* 1998) as governments need to target treatment appropriately, based on reliable and up-to-date information on the geographical distribution of infection (Pullan *et al.,* 2011).

It has also been reported that in many tropical regions, anaemia, iron deficiency, malaria and multiple helminths (most importantly Geohelminths and Schistosomes) infections coexist and are interrelated (Stoltzfus *et al,*2000). There are limited information in Same district regarding the coexistance of soil-transmitted helminths, malnutrition and anaemia.

This study was then designed to provide data on the prevalence and intensity of STH infections, malnutrition and anaemia among school going children in Same district, based on which the need for the scheduled mass chemotherapy will be determined and data for monitoring and evaluating any intervention programme against STH, malnutrition and anaemia in the district will be availed.

1.2. RESEARCH QUESTIONS

1. What is the prevalence of STH infections among primary school children in Same district?
2. What is the intensity of STH infections among primary school children in Same district?
3. What is the prevalence of malnutrition among primary school children in same district?
4. What is the prevalence of anaemia among primary school children in Same district?

1.3. STUDY OBJECTIVES

1.3.1. Broad Objective

To determine the prevalence and intensity of soil-transmitted helminths infections, malnutrition and anaemia among primary school children in Same district.

1.3.2. Specific Objectives

1. To determine the prevalence of STH infections among primary school children in Same district.
2. To determine the intensity STH infections among primary school children in Same district.

3. To determine the prevalence of stunting and thinness among primary School-children in Same district.
4. To determine the prevalence of anaemia among primary school children in Same district.

1.4. RATIONALE OF THE STUDY

Health strategy for attainment of effective parasitic disease control programme demand knowledge of magnitude of the disease and their changes in course of time as related to ecological, cultural, behavioural and other factors (Legesse, 2008). This is more so in resource poor countries like Tanzania, with limited resources our implementation of treatment programme should base on reliable and up-to-date information on the geographical distribution of infection in order to (i) guide control to areas in greatest need and (ii) estimate drug requirements **(**Brooker *et al.,* 2009).

This study was then designed to provide current epidemiogical data with regards to prevalence and intensity of STH in Same district that could be used in determining the need for a mass chemotherapy and provide baseline data for monitoring and evaluation of control programme aimed at improving health, nutritional status and cognitive functioning of School-age children in Same district.

CHAPTER TWO

2.1. LITERATURE REVIEW

2.1.1. Overview

Soil-transmitted helminths (STHs) are among the most common of all chronic human infections, occurring predominantly in areas of poverty and inadequate hygiene and sanitation in the developing world (Brooker and Bundy, 2009). More than one dozen different species of soil-transmitted helminths infect humans, especially in the tropical and subtropical parts of the developing world. However, four nematodes in particular stand out because of their widespread prevalence and distribution that result in hundreds of millions of human infections. These include the large roundworm, *Ascaris lumbricoides*, the whipworm *Trichuris trichiura*, and two species of hookworm, *Necator americanus* and *Ancylostoma duodenale*. The WHO estimates that almost 2 billion people are infected with one or more of these soil-transmitted helminths, accounting for up to 40% of the global morbidity from infectious diseases, exclusive of malaria (Hotez *et al*., 2003). The greatest numbers of STH infections occur in the Americas, China and East Asia, and Sub-Saharan Africa (Hotez *et al*., 2006).

For all human soil-transmitted helminths studied to date, which so far includes *Ascaris lumbricoides, Trichuris trichiura*, and hookworms, worm burdens exhibit a highly over dispersed distribution so that most individuals harbor just a few worms in their intestines while a few hosts harbor disproportionately large worm burdens (Hotez *et al.,* 2003, 2006). As a rule, 20 percent of the host population harbors approximately 80 percent of the worm population. This over dispersion has many consequences, both with regard to the population biology of the helminths and the public health consequence for the host, because heavily infected individuals are simultaneously at highest risk of disease and the major source of environmental contamination (Hotez *et al.*, 2003).

STH are considered together because it is common for a single individual, especially a child living in a less developed country, to be chronically infected with all three worms. Such children have malnutrition, growth stunting, intellectual retardation, and cognitive and educational deficits (Bethony, 2006).

2.1.2. Prevalence and Intensity of STH infections in school children

In terms of the disease burden in school-age populations in developing countries in which Tanzania is included, intestinal helminth infections rank first among the causes of all communicable and noncommunicable diseases (Montresor *et al.,* 2002). Field studies of Schistosomes and the major intestinal nematodes *Trichuris trichiura* and *Ascaris lumbricoides* repeatedly demonstrate that the intensity and prevalence of infection exhibit marked dependency on host age. Peak levels of infection typically occur in hosts aged between 10 and 14 years in endemically infected communities (Galvani, 2005). Age-dependent patterns of infection prevalence are generally similar among the major helminth species, exhibiting a rise in childhood to a relatively stable asymptote in adulthood (Hotez *et al*., 2006). Epidemiological studies of STH infections have shown that the prevalence and intensity of infection are highest among children 4 – 15 years of age (Norhayati, 2003). In Tanzania much of these children are in primary schools as the official school attending age ranges from 7-13 for primary school education (The United Republic of Tanzania, 2010). Therefore school-age children are the group that bears the greatest prevalences and worm intensities. This was reported in a cross – sectional study carried out in school children in Zarima town, north west Ethiopia, where it was observed that 82.4% of the study subjects were infected with one or more parasites. From soil-transmitted helminths, *Ascaris lumbricoides* was the predominant isolate (22%) followed by Hookworms (19%) and *Trichuris trichiura* (2.5%) (Abebe *et al*., 2011).

Another study on school aged children in, Delta State, Nigeria, reported that 54.70% were infected by soil-transmitted helminths. Among these *A. lumbricoides* had the highest overall infection rate of 48.41%. Overall prevalence of other STHs were hookworm 29.76% and *T trichiura*17.39% (Andy and Palmer, 2005).

In Tanzania STH are quite prevalent among school-age children. Knopp and his colleagues conducted a study in Zanzibar archipelago in the United republic of Tanzania and they reported that almost half of the children surveyed were infected with at least one helminth (49.4%) and *T. trichiura* was the predominant helminth with an overall prevalence of 35.5%. The overall prevalence of *A. lumbricoides* infection was 12.2%. The overall hookworm prevalence was 11.9 (Knopp *et al.*, 2008).

Mazigo and his fellows observed that among primary school children in northwest Tanzania prevalence of hookworms was observed to increase with age reaching maximum at 44.8% (95% CI: 40-49.8) in the 14 -16 years age groups (Mazigo *et al.*, 2010).

Morbidity from soil-transmitted helminths infections and the rate of transmission are directly related to the number of worms harbored in the host i.e intensity of infection, which is the main epidemiological index used to describe Soil-transmitted helminth infection and it is measured by the number of eggs per gram of faeces, generally by the Kato-Katz faecal thick-smear technique (Bethony *et al.*, 2006). The resulting egg per gram of faeces obtained is presented in classes of intensity of infections (Table 1). Presentation of the results in classes of intensity allows the proportion of individuals suffering severe consequences to be quantified. Since the first objective of any control programme is the reduction of the proportion of highly infected individuals, this indicator is extremely important for the selection of the control measures, and in monitoring the results of the programme
(Montressor *et al.*, 1998). And normally the data collected from children attending schools are generally representative of the situation in the community (Montresor *et al.*, 1998).

WHO grouped soil-transmitted helminths infection status into three categories i.e light/moderate / heavy infection with thresholds (Montresor *et al.*, 1998) (Table 2).

Table 1 : Intensity thresholds for STH

Helminth species	Intensity threshold		
	Light	**Moderate**	**Heavy**
A. lumbricoides	1–4999epg	5000–49999epg	≥50000epg
T. trichiura	1–999epg	1000–9999epg	≥10000epg
Hookworms	1–1999epg	2000–3999epg	≥4000epg

Source: Montresor *et al*., 1998

The results obtained from a school survey can be used to classify the community into categories for diagnosis and treatment (Montresor *et al*., 1998) (Table 2).

Table 2: Community classification based on prevalence and intensity of STH in school-age children

Community category	**Cumulative prevalence**	**Percentage of heavy intensity infections**
I. High prevalence high intensity	ANY	10%
II. High prevalence low intensity	50 %*	< 10%
III. Low prevalence low intensity	< 50 %	< 10%

Source: Montresor *et al*., 1998

The most striking epidemiological features of human helminth infections are aggregated distributions in human communities and predisposition of individuals to heavy (or light) infection (Hotez *et al.*, 2006). Abebe and his fellows observed that from the infected children, 38.5%, 53.6% and 7.9% of the infected children harbored low, moderate and heavy infection, respectively for different STH (Abebe *et al*., 2011).

Knopp and his colleagues conducted a study in Zanzibar archipelago in the United Republic of Tanzania and they reported that the large majority of infections (95.7%) were of light intensity with EPGs below 1,000. The remaining 4.3% had moderate infection intensity. Also they observed that most infections with *A. lumbricoides* (80%) were of light intensity with epg below 5,000. The remaining 20.0% had moderate infection intensity. And all infections with hookworms were of light intensity with epgs below 2,000 (Knopp *et al*., 2008).

In endemic communities, infection by more than one soil-transmitted helminths species is also a common phenomenon. Abebe and others observed that among the infected children in school children in north west Ethiopia, 45.5%, 43.7% and 10.8% harbored single, double and triple parasites, respectively (Abebe *et al*., 2011). In another study it was reported that among school aged children 12.88% were infected by two or more soil-transmitted helminths. Of these 97.7% had double infections and 2.3% had triple infections (Andy and Palmer, 2005). Another study done on primary school children in Zanzibar archipelago reported that almost half of the children surveyed were infected with at least one helminths. Moreover, 28.3% children harbored two or more helminth species concurrently (Knopp *et al.*, 2008).

These findings show that school-age children in most developing countries including Tanzania are highly infected with soil-transmitted helminths. However few studies with regards to prevalence and intensity of STH infections in school-age children have been done in certain parts of Tanzania including Same district. This study is going to provide information regarding the prevalence and intensity of STH in Same district as an important requirement to the design of an appropriate control approach.

2.1.3. Relationship between STH infections and anthropometric indices of school children

Soil-transmitted helminths infections rarely cause death. Instead, the burden of disease is related less to mortality than to the chronic and insidious effects on the hosts' health and nutritional status (Stephenson *et al.,* 2000). Chronic STH infections resulting from *Ascaris lumbricoides*, *Trichuris trichiura*, and hookworm can dramatically affect physical and mental development in children (WHO, 2002). There is now a substantial body of research that clearly demonstrates how STH infections impair healthy nutrition (Stephenson *et al.,* 2000). STH impair the nutritional status of the individuals they are infecting in multiple ways, by:

- Feeding on host tissues, including blood, which leads to a loss of iron and protein;
- Malabsorption of nutrients;
- Competing for vitamin A in the intestine in particular roundworm;
- Causing inflammatory responses that may affect appetite and food intake, or substances that modify the metabolism and storage of key nutrients such as iron (WHO, 2012).

The three most frequently used indicators of nutritional status of children i.e. height-for-age, weight-for-age and weight-for-height are based on weight and height measurement (FAO, 2012). Based on these, a child is considered stunted if the child is too short for his/her age. Stunting reflects failure to receive adequate nutrition over a long period of time and is affected by recurrent and chronic illness. Height-for-age, therefore, represents the long-term effects of malnutrition in a population and is not sensitive to recent, short term changes in dietary intake (National Bureau of Statistics, 2010). The weight-for-height data assesses whether or not the child is wasted. A child is considered wasted if the child is too thin, that is, weighs too little for his/her height. Wasting is an indicator of acute or recent nutritional deficits and is closely tied to mortality risk. The weight-for height indicator also can be used to assess the extent to which children are overweight or obese, which is an increasing problem among children worldwide. Finally, the weight-for-age indicator provides an assessment of whether a child weighs too little for his/her age. A child can be underweight for his/her age because the child is stunted, wasted, or both (National Bureau of Statistics, 2010). However, WHO recommends that acute malnutrition among children and adolescents 5-19 years be assessed by calculating *Body Mass Index* (BMI), and then adjusting for age to generate *BMI for- age*. BMI is calculated based on the weight (in kg) divided by the square of the height (in m) of the individual. BMI-forage should be presented as Z-scores based on the 2007 WHO Growth Reference (WHO GR) for children and adolescents 5 to 19 years of age (Holland, 2011).

Several studies have established an association between intensities of STH infections and stunting or wasting. For instance, in a study done on school children in Ecuador it was observed that children with high intensity of infections were more stunted than the other children. Linear regression analysis confirmed a significant relationship ($p < 0.05$) between total worm burden, *A. lumbricoides* burden and degree of stunting, while no relationship could be found with wasting (Andreade *et al*.,2001). Almost similar findings were reported by Andy and Palmer in a study done in Nigeria , where anthropometric measurements indicated that 17.84% of the subjects were below the third percentile of weight (wasted) and 28.28% were below the third percentile of height (stunted). The data further revealed that there was no relationship between intensity of infection and wasting since among the uninfected group more underweight subjects 21.03% were recorded than moderately infected subjects (12.5%). However children with high intensity of infections were more stunted than the other children (Andy and Palmer, 2005).However slightly different results were found by Adefioye and his associates in a study done in Nigeria where it was observed that 17% of the children were below the third percentile for weight (wasted) while 14% were below the third percentile for height (stunted), and analysis showed that there was a relationship between intensity of infection and wasting since there were fewer underweight pupils (13%) with normal stool than those moderately infected (35%) (P<0.05) (Adefioye *et al*., 2011).

In Tanzania including Same district, little is known on the extent to which STH infections and malnutrition coexist.among primary school children. This study was therefore designed to assess the prevalence and severity of malnutrition among primary school children in Same district.

2.1.4. Effects of STH infections on Hemoglobin levels of school children

Anaemia is defined as a clinical condition characterized by reduction in hemoglobin (Hb) concentration of blood below the normal for the age, sex, physiological condition and altitude above sea level of that person (Viteri., 1998). It is a public health problem that affects populations in both rich and poor countries. Although the primary cause is iron deficiency, it is seldom present in isolation. More frequently it coexists with a number of other causes, such as malaria, parasitic infection, nutritional deficiencies, and Hemoglobinopathies (WHO, 2008). The World Health Organization estimates that two billion people suffer from anaemia in the world (WHO, 2000) and iron-deficiency anaemia affects about 1.3 billion people, with the highest prevalence and morbidity being in young children and pregnant women (Gillespie *et al*., 1991).

Normal Hb distributions vary with age, sex, and physiological status, e.g., during pregnancy. WHO Hb thresholds were used to classify individuals living at sea level as anaemic (Table 3) (WHO, 2008).

Table 3: Levels of HB signifying Anaemia according to age, sex and physiological status

Age or gender group	**Hemoglobin threshold (g/l)**
Children (0.50–4.99 yrs)	110
Children (5.00–11.99 yrs)	115
Children (12.00–14.99 yrs)	120
Non-pregnant women (≥15.00 yrs)	120
Pregnant women	110
Men (≥15.00 yrs)	130

Source: WHO, 2008

Soil-transmitted helminth infections cause malnutrition, anaemia and growth retardation as well as higher susceptibility to other infections (Montresor *et al*, 1998). Hookworms have long been recognized as an important cause of intestinal blood loss leading to iron deficiency and protein malnutrition *hookworm disease* (Hotez *et al*., 2006). In fact, hookworm infections are recognized as the leading cause of pathologic blood loss in tropical and subtropical countries (Pawlowski *et al.*, 1991). The mechanism by which hookworm infection leads to iron deficiency anaemia is chronic intestinal blood loss. Adult hookworms attach to mucosa in the upper small intestine, ingesting tissue and blood and changing their feeding site every 4–6 hours. Blood is primarily lost when it passes through the hookworm's intestinal tract and is subsequently expelled during feeding, but secondary loss also occurs from bleeding of the damaged mucosa (Stoltzfus *et al*., 1997). *Trichuris trichiura* causes inflammation at the site of attachment due to large numbers of whipworms resulting in colitis. Longstanding colitis produces a clinical disorder that resembles inflammatory bowel disease, including chronic abdominal pain and diarrhoea, as well as the sequel of impaired growth, anaemia of chronic disease, and finger clubbing (Bethony *et al*., 2006).

Several studies have shown that there is a relationship between STH infections particularly Hookworms and *Trichuris trichiura* and hemoglobin levels in school children. Among these is a study on hemoglobin concentrations and concomitant infections of hookworm and *Trichuris trichiura* in Panamanian primary school children. The results showed that 22·3% of the children had hemoglobin concentrations indicative of iron-deficiency anaemia. In addition to that, blood hemoglobin concentrations were significantly lower in children with heavier *Trichuris trichiura* infections (>5000 eggs/g) (P = 0·014), and in children with dual infections of both hookworm and *T. trichiura* (P = 0·005). Children with concomitant *T. trichiura* and hookworm infections were also significantly more likely to have blood hemoglobin levels indicative of anaemia than children who were uninfected or had single infections with either of these helminths (P < 0·005) (Robertson *et al.*,1992). Related findings have been reported in Tanzania in a study which was done to determine the risk factors for anaemia in school children in Tanga region. It was found that the prevalence of anaemia was 79.6%. Intestinal helminths were also highly prevalent; 68% of children had hookworm. It was observed that Vitamin A deficiency and infections with hookworm and schistosomiasis were the most significant factors predicting for anaemia (r=0.318 and r2=0.101) (Tatala *et al*., 2008).

In Tanzania, little has been done to determine coexistence of STH infections and anaemia among primary school children. which is important information when it comes to the control of anaemia in school-age children. The little information which is available is derived from area wise studies, which leave a bigger part of the country (Same being included) unstudied. This study was going to determine the extent to which STH infections and anaemia coexists among primary school children in Same district.

2.1.5. Control of Soil-Transmitted Helminths

The burden of disease associated with helminth infections (schistosomiasis and soil-transmitted helminth (STH) infections) is enormous, with at least 2 billion people affected worldwide. 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 (WHO, 2004). Soil-transmitted helminths infections cause morbidity, and sometimes death, by:

- Affecting nutritional status
- Affecting cognitive processes and
- Causing complications that need surgical intervention (Montresor, 2002).

Although these helminths can infect all members of a population, the most vulnerable groups i.e. those who are at most risk, and who would benefit most from preventive interventions are ; pre-school (age 2–5 years) and school-age children, adolescent girls, and women of childbearing age (WHO,2004).

Morbidity due to soil-transmitted helminths can be alleviated through effective control measures, of the three measures needed for effective control of STH infections i.e. good environmental sanitation, health education and chemotherapy, improving environmental sanitation and health education are preventive and has a long term impact. Good environmental sanitation and a high standard of living have resulted in a reduction in the prevalence of intestinal parasites in developed countries (Ananthakrishnan and Das, 2001).

Anthelmintic drug treatment ("deworming") is aimed at reducing morbidity by decreasing the worm burden. Repeated chemotherapy at regular intervals (periodic deworming) in high-risk groups can ensure that the levels of infection are kept below those associated with morbidity (Hotez, 2006). Improved sanitation is aimed at controlling *transmission* by reducing soil and/or water contamination and health education is aiming at reducing *transmission* and *reinfection* by encouraging healthy behaviors (Montresor, 2002). Anthelminthic treatment can be dispensed through health services (maternal and child health and antenatal clinics), school health programmes, and community interventions directed at other vulnerable groups (such as adolescent girls) (WHO, 2004).

Since higher prevalence and burden of worm infestation is seen among the school-age children, treatment of this age-group is expected to reduce transmission and therefore prevalence in the entire community (Ananthakrishnan and Das, 2001). However it is known that an important factor in STH treatment is reinfection, as it has been observed that after community-wide treatment, rates of hookworm infection reach 80% of pretreatment rates within 30–36 months. *A.lumbricoides* infection reached 55% of pretreatment rates within 11 months and *T trichiura* infection reached 44% of pretreatment rates within 17 months (Bethony *et al*, 2006). The first round of mass chemotherapy against soil-transmitted helminths was carried out in Same district in 2008. Hospital laboratory records in Same district shows that the prevalence of STH was 15.4% in 2009,with the parasites reported being *Ascaris lumbricoides* and hookworm (Unpublished Same District Hospital Laboratory

Records, 2009). It is now three years after the last mass chemotherapy in Same district. However hospital records based prevalence do not truly represent the real infection status in the community due to their incompleteness and bias. School based survey are thus required to provide reliable and up to date data on the prevalence and intensity of STH in the district.

The present study is going to provide data on the prevalence and intensities of soil-transmitted helminths infections. So as to determine the need for the scheduled Mass chemotherapy in the district.

CHAPTER THREE

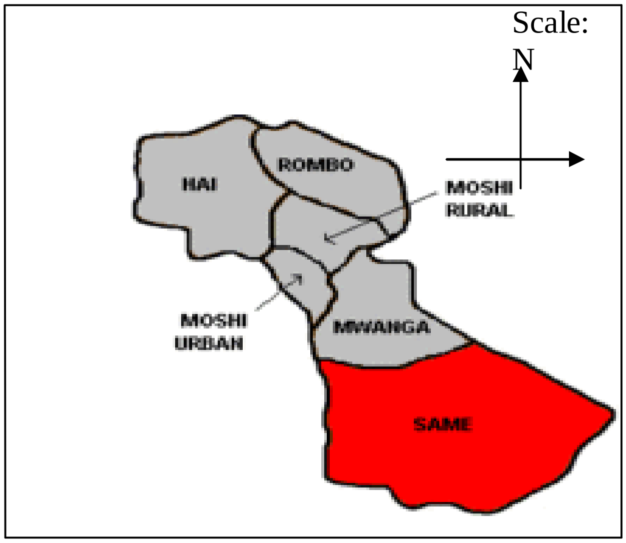
3.0. METHODOLOGY

3.1. Description of the study Area

Same is one of the six districts of the Kilimanjaro Region in Tanzania. It is bordered to the north by Mwanga district, to the northeast by Kenya, to the south and southeast by Tanga region, and to the west by Manyara region. According to 2002 census the district has a population of 212,325 people (103,520 males and 108,805 female). Administratively the district is divided into 6 divisions and it has 31 wards with the total area of 5,152sq.km which is 39% of total area of Kilimanjaro region making it the largest district in the Kilimanjaro region. Topographically the area is divided into three main zones namely; the Upland plateau zone which lies between an altitudes of 1100-2462m above the sea level with temperature which ranges between 15^0C-25^0C, The Middle Plateau zone which lies between 900-1100m above sea level with temperature which varies between 25^0C-30^0C and the lowlands zone which rises from 500-900m above the sea level. The area is dominated by major ethnic group which is composed of Wapare who speaks Kipare as their mother language of communication and Kiswahili being the official language. The area has a temperature range of 15^0C – 30^0C and receives rainfall ranging from 500 to 2000mm per annum. The rural population coverage with safe drinking water (1997) - 44% and urban population coverage 38% (The United Republic of Tanzania, 1998).

The district has a total of 184 primary schools, of which 178 (96.7%) are government schools and 6 (3.3%) are private schools (District education statistics – 2012). Same district has the lowest literacy rate in Kilimanjaro region which is 84.8%(The United Republic of Tanzania, 1998).

Figure 1: A map of Kilimanjaro region showing Same district (Deep grey).



3.2. Study Design

A cross-sectional descriptive study was undertaken to establish the prevalence and intensity of soil-transmitted helminths infections, malnutrition and anaemiaamong primary school children in Same district.

3.3. Study population

The study population was the primary school children in Same district who were present during the study period.

3.4. Sample size estimation

In this study, the sampling units were pupils of selected schools. In estimating the sample size, I used a 61% prevalence of hookworm, obtained in Tanga by Guyatt and his fellows (Guyatt *et al*, 2001). The minimum number of study subjects was estimated by using minimum sample size determination technique.

$$n = \left(\frac{1.96}{d}\right)^2 \Pi(1-\Pi) f$$

Where;

- n= The estimated sample size
- d= 0.05 = Is the margin of error
- f= Inflation factor = 1.5
- *f* = Estimated proportion of school children with soil-transmitted helminths infection from previous studies. In this study i used the prevalence of61.0 % which was the prevalence of hookworm in school children obtained by (Guyatt *et al.,* 2001) in school children in Tanga region, Tanzania.

$$n = \left(\frac{1.96}{0.05}\right)^2 0.61(1 - 0.61)1.5$$

Therefore:

n = 548 by, adding a 10% non – participation rate, i.e. 548 x 0.1 = 54.8 ≈ 548 + 54.8 = 602.8 ≈ 603. Therefore, the minimum number of school children in Same district to be included in this study was 603 school children.

3.5. Sampling procedure

A stratified multistage cluster sampling technique was used to obtain the sample for this study. There were 31 wards in the 6 divisions of Same district. Some of these wards fall in the upland plateau zone, a few in the middle plateau zone and others in the lowlands zone; these zones comprised strata for the study. Two wards were randomly selected from 14 wards in the upland plateau zone and one ward from 3 wards in the middle plateau zone and another two wards from the 14 wards in the lowlands zone. Random selection was done by writing the name of each ward on a separate piece of paper then put in one box and thoroughly mixed before sapling. A simple random sampling was applied by blindly picking one paper from the box, the selected name of the ward was written in a note book and the selected piece of paper was returned back into the box, the box was shook again and another piece of paper was selected, the same procedure was used until all the five wards were selected. Two primary schools were selected from each of these wards, by writing the names of all primary schools within the wards on separate pieces of paper, put in a box, thoroughly mixed then blindly picked one piece of paper and wrote the name of the school in a note book, replaced the piece of paper, and did the same to select the second school. Before selection of study participants children were asked of a history of being clinically ill and/or having taken drugs within a period of the past one month, and those who reported to have been ill were not involved in the study. A minimum number of 61 children were selected from each school. To obtain this number of children, one class from each of the selected schools was randomly selected to be studied and all the school children in that class were included in the study, this was done by writing the class levels on separate pieces of paper, then put them in a box, shook the box and one paper was blindly picked and that class was taken for study. When one class did not have the minimum number of pupils required, a second class was selected, this was done until a minimum number of 61 children was obtained.

3.6. Inclusion criteria

All selected primary school children who were living in the study area for at least three months whose parents or guardians signed a written consent form and willing to participate in the study were included in the study.

3.7. Exclusion criteria

Primary school children who were having a history of being clinically ill and used drug within a period of one month before the study, and those whose parents and guardians refused to sign a written consent form were not included in the study.

3.8. Recruitment and training of research assistants

One research assistant was recruited from Same township and was trained on how to take measurement of weight and height before starting the data collection exercise. A day before data collection, a nurse from nearby dispensary was being recruited and trained on how to use a HaemoCue photometer for measuring Hb.

3.9. Data collection procedure

3.9.1. Collection of stool specimen

A day before collection of stool specimen, the research including its benefits was explained to the teachers and the selected school children. Then each selected school children was provided with a labeled clean plastic container, a piece of applicator stick, a plain paper and a consent form. The plastic containers had a code number, the code number of the container and the name of the children who took that particular container were recorded in a note book this was so as to avoid the accidental exchange of specimens among children. The children were instructed that, once they got home, they should give the consent form to their respective parents or guardians for them to read and then agree or disagree to allow them to participate in the study. The children were then instructed that if they were allowed to participate and themselves were willing to participate then in the morning of the next day, they should defecate on a piece of paper provided, to avoid contamination from the toilet environment, and then using an applicator stick they should pick up a portion of the stool on a piece of paper and put it into the clean plastic container provided and cover it, then come with it to school. On delivery, the next day, using a list of names with their corresponding code numbers, children were called one after the other by name for collecting the stool specimen, the number on the container were compared with the number recorded when they were provided the container to check if it was the right container for her/him, then the stool specimen were mixed immediately with 10% formalin to preserve the morphology of the eggs.

3.9.2 Measurement of height and body weight

After the collection of stool specimen, children were called one after the other, then the code number of the children and the name were recorded in a questionnaire form, then the children’s height were measured using a height scale, weight was measured by using a weighing scale, and each child was asked of his/her age. The children’s barefoot stature was recorded to the nearest 0.1 cm. For accurate measurement of height an assembled height scale had a metal block perpendicular to the vertical calibrated metal bar, that was flat on the lower side and it could be moved up and down the calibrated bar, then the child stood on the standing pan, and the block was adjusted to allow the flat surface to touch the head of the child, perpendicular to the calibrated surface of the height scale, then the height was read. Weight measures were taken to the nearest 0.5 kg without shoes and with minimum clothing. The resulting height and weight measurements were compared to a standard population of the same age to calculate height-for-age z scores and BMI-for-age z scores. These anthropometric indices were calculated using the new World Health Organization Child Growth Standards (WHO, 2007). Any child with height-for-age z scores (HAZ) and BMI-for- age z scores (BMIAZ) below or equal to -2 standard deviation (≤ -2SD) was classified as stunted and thinness respectively and children with HAZ and BMIAZ below or equal to -3 standard deviation (≤ -3 SD) were classified as severely stunted and severe thinness respectively.

3.9.3. Determination of hemoglobin levels

Blood collection was done by finger prick using disposable lancet, and a sample of blood (about 100µl) was collected and used to measures venous Hemoglobin (Hb), in a HemoCue photometer (HemoCue, Angelholm, Sweden) (von Schenck *et al*. 1986).

The tip of middle finger or ring finger was cleaned with alcohol pads and then pricked with a blood lancet, and then two drops of blood were wiped away with dry cotton. The next drop of blood was used to fill the microcuvette by touching the micro-cuvette tip into the middle of the drop of blood until completely filled by avoiding air bubble. The filled micro-cuvette were then put on the holder and pushed into the HemoCue photometer. After approximately 30 seconds Hb value displayed in g /dl were recorded.

Children found to had Hb level below <11g/dl were considered anaemic, with Hb concentrations of <7g/dl, 7.0 - 9.9g/dl, 10.0 - 10.9g/dl and ≥11g/dl indicating severe anaemia, moderate anaemia, mild anaemia and normal respectively (Mazigo *et al*,2010).

All children who were found to be anaemic were referred to a nearby clinic for further investigation and appropriate management.

3.10. Parasitological work

The stool specimen were fixed with formalin and taken to Muhimbili University of Health and Allied Sciences for laboratory analysis. The stool specimens were processed using Kato-Katz technique employing a 50 mg template. Standard operating procedures were used for stool collection and processing for maintaining a good quality study as described by the World Health Organization (WHO, 1991) (Annex I). To ensure quality control, examination of the specimen was being done by two observers for the same prepared slide.

3.11. Intensity of infection

The number of eggs of each species were recorded and converted into the number of eggs per gram of feces (EPG) in order to analyze intensity of infection. EPG were calculated by multiplying egg count by conversion factor i.e. 20. An infection status (light/moderate / heavy infection) created for the three common STH infections following the standard procedure used by WHO (Montresor *et al.*, 2002) (Table 1). The arithmetic mean egg intensity for each parasite was calculated by using the formula:

$$\text{Arithmetic mean} = \frac{\sum epg}{n}$$

Where $\sum epg$ = Sum of each individual *epg*, *n* = the number of subjects investigated (Montresor *et al.*, 1998).

3.12. Data processing

Data editing was done during and after data collection exercise. The primary data were entered by the principal investigator using SPSS version 13.0.

Frequency tables and cross tabulations were produced for each of the study variables. Data analysis was carried out by running descriptive statistics and cross tabulations. Confidence intervals for prevalences and mean were determined by using WinPepi statistical software. Graphs were drawn using Microsoft office excel 2007.

Anthropometric indices which were Height-for-age z scores and Body Mass Index-for-age z scores were calculated using WHO AnthroPlus Software 2009. BMI-for-age z scores (BMIZ) and height-for-age z scores (HAZ) were then categorized into normal, stunted and severely stunted for HAZ >-2, -2≥ HAZ <-3 and HAZ≤ -3 respectively and normal, thinness and severe thinness for BMIZ >-2, -2≥ BMIZ <-3 and BMIZ≤ -3 respectively.

Relationship between independent and dependent variables was assessed by chi-square test. Statistical significance was achieved if $P<0.05$.

In order to analyze the intensity of infection for STH parasites, the number of eggs per slide was converted into the number of eggs per gram of stool and arithmetic mean egg intensity was calculated. The intensities of *Ascaris lumbricoides* and Hookworm were categorized based on the WHO categories of intensities.(Table 1).

The resulting height and weight measurements were compared to a standard population of the same age by use of the WHO Anthroplus software to calculate, height-for-age and BMI-for-age Z scores.

3.13. Variables

3.13.1. Independent variables

Age, sex, topographical zone, Intensity of STH infection

3.13.2. Dependent variables

Height-for-age z scores, BMI-for-age z scores, Hemoglobin levels

3.14. Ethical consideration

Before commencement of the study, ethical clearance was obtained from the MUHAS Ethical Review Board. A consent form was provided to each study subject together with stool containers a day before the day of data collection. Parents were asked to sign the consent forms if they agreed on their children to be involved in the study. Verbal consent to collect stool sample from pupils were sought from the head teachers of the schools to be involved in the study and from the pupils themselves.

Laboratory samples were only taken from those children whose parents/guardians signed on the consent forms. No other investigations were done on the sample except those needed for the study objectives that were described in the consent form. Any information that was obtained during the study was to be kept confidential.

At the end of the study, a brief report was prepared and sent to the District Education Officer so that schools with infected children and children with anaemia, could liaise with dispensaries in their vicinity to provide the required treatment to the children.

CHAPTER FOUR

4.0. RESULTS

4.1. Demographic characteristics of the study participants

The schools that were sampled included; Bendera, Mgandu, Mferejini, Ruvu, Kiomande, Chani, Vuje, Mgambo, Mvaa and Mjema. Sampled school children were from standard two to standard seven. The study involved a total of 579 school children whose parents or guardians signed consent forms. Female participants were more in number than male, 338 (58.4%) and 241 (41.6%) respectively, this difference mostly was due to the fact that most of the pupils who refused to participate in the study were male as they felt shy of bringing stool specimens. The lowlands zone, Middle plateau zone and Upland plateau zone had 39.4%, 22.5% and 38.2%) of the study participants respectively. The mean age was 11.5 ± 1.66sd years, the age range was 7 – 17 years. Majority of the study participant (61.8%) were of the age group 11 – 14 years, the 15 – 18 age group comprised the lowest proportion (4.1%) of the study participants. Standard two and standard seven had the lowest proportions of study participants which were 2.4% and 4.8 respectively, with the highest proportion being in standard six (26.4%). The rest of the classes had almost similar proportions of the study participants (Table 4).

Table 4: Demographic characteristics of the study participants (N=579)

Variable	Male n (%)	Female n (%)	Total n (%)
Age-group			
7 – 10	76 (38.6)	121 (61.4)	197 (34%)
11 – 14	152 (42.5)	206 (57.5)	358 (61.8)
15 – 17	13 (54.2)	11 (45.8)	24 (4.1)
Total	**241 (41.6)**	**338 (58.4)**	**579 (100)**
Zone of residence			
Upland plateau zone	82 (37.0)	139 (63.0)	221 (38.2)
Middle plateau zone	60 (46.2)	70 (53.8)	130 (22.5)
Lowlands zone	99 (43.4)	129 (56.6)	228 (39.4)
Total	**241 (41.6)**	**338 (58.4)**	**579 (100)**
Children's class			
Standard two	9 (64.3)	5 (35.7)	14 (2.4)
Standard three	60 (48.4)	64 (51.6)	124 (21.4)
Standard four	54 (39.1)	84 (60.9)	138 (23.8)
Standard five	54 (44.3)	68 (55.7)	122 (21.1)
Standard six	51 (33.3)	102 (66.7)	153 (26.4)
Standard seven	13 (46.4)	15 (53.6)	28 (4.8)
Total	**241 (41.6)**	**338 (58.4)**	**579 (100)**

4.2. Prevalence of Soil-Transmitted Helminths

The overall prevalence of soil-transmitted helminths infection in the ten schools that were sampled was found to be 0.9% [95%CI (0.3, 2.1)]. Among all the school children who brought stool (549), 5 school children were infected with soil-transmitted helminths. The specific soil-transmitted helminths that were found were *Ascaris lumbricoides* and hookworm. Among the infected children, three had single infections of *Ascaris lumbricoides*, one had a single infection of hookworm, and another one had a co-infection of hookworm and *Ascaris lumbricoides*. All the five infected school children were from the middle plateau zone. Out of the 5 infected school children 4 were from one of the two schools which were studied in the zone, and 1 from the other school.

4.3. Intensity of *Ascaris lumbricoides* and Hookworm among School children

The intensity of infection in the school children who were found positive was characterized based on the WHO grouping system of soil-transmitted helminths infection intensities (Montresor *et al*., 1998). The arithmetic mean egg intensity for *Ascaris lumbricoides* was 42.0 epg and that for Hookworm was 0.2 epg. Three children (0.5%) had light intensity infection of *Ascaris lumbricoides* and/or hookworm and the other two children had moderate intensity infection of *Ascaris lumbricoides*. Of the three single *Ascaris lumbricoides* infection one had light intensity infection (1620 epg) and two had moderate intensity infection (12400epg and 9000epg). The single hookworm single infection was of light intensity (60epg), also the *Ascaris lumbricoides* and hookworm co-infection was of light intensity for both parasites, 80epg and 60epg respectively.

4.4. Prevalence of Stunting in school children by Age, Sex and Topographical zone

The mean height-for-age z score was -1.813[95%CI (-1.896,-1.730)].The minimum z score was -4.57 and the maximum z score was 1.012. The overall prevalence of stunting (HAZ ≤ -2) was 42.3% [95%CI (38.3, 46.5)]. Severe stunting (HAZ ≤ -3) was observed in 64 (11.1%) [95%CI (,8.6 13.9)].

Height-for-age z scores were analyzed by age group, and it was observed that the 11 – 14 years age group had the highest rate of stunting which was 44.7%, [95%CI (39.5, 50.0)], The lowest prevalence of stunting was in the 15 – 17 years age group (33.3%) [95%CI (15.6, 55.3)]. However observed age group difference in the prevalence of stunting was not statistically significant ($\chi2$= 4.276, *P*=0.370) (Table 6).

Height-for-age z scores were also analyzed by sex and it was found that prevalence of stunting in male school children was 48.6%, [95%CI (42.1, 55.0)], and that in female 37.8%, [95%CI (32.7, 43.3)]. And the observed difference was statistically significant ($\chi2$= 8.384, *P*=0.015). It was further observed that female children had slightly higher prevalence of severe stunting (Table 6).

Height-for-age z scores were also analyzed by topographical zone of residence. It was found that school children in the upland plateau zone had the highest prevalence of stunting which was 48.4% [95%CI (41.7, 55.2)], and middle plateau zone had the lowest prevalence of stunting (38.5%) [95%CI (30.1, 47.4)]. This observed difference in the prevalence of stunting by topographical zone was statistically significant ($\chi2$= 10.829, *P*=0.029) (Table 6).

Table 5: Prevalence of stunting in school children by age, sex and topographical zone (N=579)

Variable	Stunting			Total	
	Normal n (%)	**Stunted n (%)**	**Severely stunted n (%)**	**N**	**P-value**
Age (Years)					
7 – 10	120 (61.0)	53 (26.9)	24 (12.1)	197	
11 – 14	198 (55.3)	121 (33.8)	39 (10.9)	358	0.370
15 – 17	16 (66.7)	7 (29.2)	1 (4.1)	24	
Sex					
Male	124 (51.5)	91 (37.8)	26 (10.8)	241	0.015
Female	210 (62.1)	90 (26.6)	38 (11.2)	338	
Topographical zone					
Upland plateau zone	114 (51.6)	72 (32.6)	35 (15.8)	221	
Middle plateau zone	80 (61.5)	37 (28.5)	13 (10.0)	130	0.029
Lowlands zone	140 (61.4)	72 (31.6)	16 (7.0)	228	

Stunted = **-2.99 ≤ Z score ≤-2**, Severely Stunted = **Z score ≤ -3**
P- value were calculated using **χ2**-statistic

4.5. Prevalence of thinness in school children by age, sex and topographical zone

The mean BMI-for-age z score was -0.8963, [95%CI (-0.9741,-0.8185)]. The minimum BMI-for-age z score was -6.71 and the maximum z score was 1.92. The overall prevalence of thinness (BMIAZ $\leq$ -2) was 11.7%, [95%CI (9.2, 14.7)], Severe thinness (BMIAZ $\leq$ -3) was observed in 1.7% [95%CI (0.8, 3.2)], of the school children (Table 8).

BMI-for-age z scores were analyzed by age groups and it was observed that the 11 – 14 years age group had the highest prevalence of thinness which was 14% , [95%CI (10.5,18.0)], this was followed by the 15 – 17 years age group which had 8.4% [95%CI (1.0,27.0)], and lastly the 7 – 10 years age group which had 8.1% [95%CI (4.7,12.9)], of the children having thinness . However the observed difference in the prevalence of thinness by age group was not statistically significant ($\chi2$= 5.945, *P*=0.203) (Table 7).

BMI-for-age z scores were also analyzed by sex, and it was found that male school children had slightly higher prevalence of thinness which was 13.3%, [95%CI (9.3, 18.2)], while females had 10.7%, [95%CI (7.6, 14.4)]. The observed difference was not statistically significant ($\chi2$= 1.177, *P*=0.555) (Table 7).

BMI-for-age z scores were further analyzed by topographical zone of residence, and it was observed that the prevalence of thinness varies significantly by topographical zone ($\chi2$= 12.679, *P*=0.013) (Table 7).Where the lowlands zone had the highest prevalence of thinness which was 15.8% ,[95%CI (11.3,21.2)], followed by middle plateau zone that had 14.6% [95%CI (9.0,21.9)], of the children having thinness and lastly the upland plateau zone whose prevalence of thinness was 5.9% [95%CI (3.2,9.8)].

Table 6: Prevalence of thinness in pupils by age, sex and topographical zone (N=579)

Variable	Thinness				
	Normal n (%)	**Thinness n (%)**	**Severe thinness n (%)**	**Total N**	**P-value**
Age (Years)					
7 – 10	181 (91.9)	14 (7.1)	2 (1.0)	197	
11 – 14	308 (86.0)	43 (12.0)	7 (2.0)	358	0.203
15 – 17	22 (91.6)	1 (4.2)	1 (4.2)	24	
Sex					
Male	209 (90.1)	28 (11.6)	4 (1.7)	241	0.555
Female	302 (89.3)	30 (8.9)	6 (1.8)	338	
Topographical zone					
Upland plateau zone	208 (94.1)	10 (4.5)	3 (1.4)	221	
Middle plateau zone	111 (85.4)	17 (13.1)	2 (1.5)	130	0.013
Lowlands zone	192 (84.2)	31 (13.6)	5 (2.2)	228	

Thinness = **-2.99≤ Z score≤-2,** Severe thinness = **Z score ≤ -3**
P- value were calculated using χ^2-statistic

4.6. Prevalence of anaemia in pupils by age, sex and topographical zone

The mean hemoglobin level was 13.4g/dl [95%CI (13.2, 13.5)]. The minimum hemoglobin level was 8.7g/dl and the maximum hemoglobin level was 17.3g/dl. The overall prevalence of anaemia (Hb < 11.0 g/dl) was 3.1%, [95%CI (1.9, 4.9)]. Out of these 9 (50%) [95%CI (26.0, 74.0)] had mild anaemia (Hb 10 -10.9 g/dl) and another 9 had moderate anaemia (Hb 7 – 9.9 g/dl). None of the school children had severe anaemia (Hb < 7 g/dl) (Table 8).

Hemoglobin levels were analyzed by age groups and it was observed that the 11 – 14 years age group had the highest prevalenceof anaemia which was 3.4% [95%CI (1.7,5.8)] followed by 7 – 10 years age group which had 3.0% [95%CI (1.1,6.5)]. Most importantly the 15 – 17 age-group had none of the children with anaemia. This observed difference in the prevalence of anaemia by age group was found not to be statistically significant ($\chi2$= 4.893, *P*=0.298) (Table 8).

Hemoglobin levels were also analyzed by sex and it was observed that male school children had higher prevalence of anaemia which was 4.1% [95%CI (2.0, 7.5)] than female who had 2.4% [95%CI (1.0, 4.6)] of the children with anaemia. And this observed difference was not statistically significant ($\chi2$= 2.399, *P*=0.301) (Table 8).

Hemoglobin levels were also analyzed by topographical zone of residence, and it was observed that lowlands zone had the highest prevalence of anaemia which was 4.8% [95%CI (2.4, 8.5)] followed by the upland plateau zone which had 2.7% [95%CI (1.0, 5.8)] and lastly 0.8% [95%CI (0.0, 4.2)] in the middle plateau zone. This observed topographical zonal difference in the prevalence of anaemia was not statistically significant, it could only have been by chance ($\chi2$= 5.675, *P*=0.225) (Table 8).

Table 7: Prevalence of anaemia in pupils by age, sex and topographical zone N=579

	Anaemia				
Variable	**Normal** n (%)	**Mild anaemia** n (%)	**Moderate anaemia** n (%)	**Total** N	**P-value**
Age (Years)					
7 – 10	191 (97.0)	1 (0.5)	5 (2.5)	197	
11 – 14	346 (96.7)	8 (2.2)	4 (1.1)	358	0.298
15 – 17	24 (100)	0	0	24	
Sex					
Male	231 (95.9)	6 (2.5)	4 (1.6)	241	0.301
Female	330 (97.6)	3 (0.9)	5 (1.5)	338	
Topographical zone					
Upland plateau zone	215 (97.3)	4 (1.8)	2 (0.9)	221	
Middle plateau zone	129 (99.2)	0	1 (0.8)	130	0.225
Lowlands zone	217 (95.2)	5 (2.2)	6 (2.6)	228	

Mild anaemia **= 10.0 – 10.9g/dl,** Moderate anaemia **= 7.0 – 9.9 g/dl**
P- value were calculated using $\chi 2$-statistic

CHAPTER FIVE

5.0. DISCUSSION

The overall prevalence of soil-transmitted helminths in Same district was found to be 0.9%, this observed relatively low prevalence of soil-transmitted helminths contradicts with similar studies done previously in primary school children in two villages in the neighboring Mwanga district where the prevalence of soil-transmitted helminths in their baseline survey in 1996 was found to range between 2.7% and 18.1% (Poggensee *et al*, 2005)., however the species of soil-transmitted helminths found in this study were similar to those reported in the laboratory records which are *Ascaris lumbricoides* and Hookworm (Unpublished Same district Laboratory Report, 2009).

In this study the prevalence of soil-transmitted helminths infection in Same district has been observed to be generally low, this may be as a result of the mass chemotherapy with mebendazole in school children which was carried out in 2008 with a reported coverage of 76.76% (SCI, 2009). This observed low prevalence of soil-transmitted helminths three years after school mass chemotherapy with mebendazole, is similar to what was observed in Kileo and Kivulini villages in Mwanga district, where the prevalence of soil-transmitted helminthiasis was significantly less seen in 2002 six years after mass chemotherapy compared to the baseline in 1996 (Poggensee *et al,* 2005). In naddition, antihelminthic chemotherapy has also been intergrated in the Martenal and Child Health services, where children under the age of five years are given antihelminthic drugs two times a year during the Martenal and Child Health clinic visits. This could be also one among the reasons for the observed low prevalence of STH infections in the district because treating this age group is of importance in reducing transmission intensities as it has been reported that high prevalence of *A. lumbricoides* (35%), *T.trichiura* (60%) and hookworm (40%) infections were found in pre-school children (0 – 4 years of age) on Pemba in a survey in 1991. Intensities, however, were quite low (Renganathan *et al*., 1995). However there could be environmental and/or behavioral factors that led to the sustained low prevalence of STH infections in school children as it has been reported that without environmental or behavioral changes the prevalence is likely to return to pre-treatment level if treatment is stopped (Olsen, 2003). All visited schools had pit latrines and shoe wearing has also become a tradition to most of the children, as on visual examination majority of the school children wore shoes, and for a few who did not have shoes had sandals (commonly known as yeboyebo) (Personal observation). This could partly explain for the observed low prevalence of STH in school children.

The five children who were positive for the soil-transmitted helminths were all found to be from the middle plateau zone, four of them from one school and another one from another school. The localization of STH infections in the middle plateau zone relative to the other zones could probably be because of some behavioral and environmental factors that favor transmission of STH in this Zone. This observation is inline with the known fact that there is considerable geographical variation in the occurrence of helminths infections in East Africa, and that geographically targeted control programmes are required to maximize the cost-effectiveness of chemotherapy (Brooker *et al*, 2009).

In this study, of the STH infected school children, 3 had light intensity of infection with either hookworm or/and *Ascaris lumbricoides* and two hade moderate intensity of STH infection. The absence of heavy intensity of infection and the relatively higher prevalence of light intensity of infection could be the result of the mass chemotherapy which was done in 2008, the ongoing treatment of under five years children twice a year during the and probably some other behavioral and environmental factors that discourages transmission of STH among school children in the district.

In this study, stunting (HAZ $\leq$ -2) was observed in 42.3% of the study participants. 11.1% of the study population was severely stunted. These results are almost similar to what has been reported by a study done in school going adolescents in India, where they reported an overall prevalence of stunting being 44.0% and severe stunting was observed in 14.0% of the study participants (Dey *et al*, 2011).

Male school children appeared to be more stunted than females with their respective prevalence being 48.6% and 37.8%. Stunting is an indicator of chronic malnutrition, and at school age, it may reflect malnutrition during the first years of life (Muller, 2005). Growth deficit tends to accumulate with age and particularly in boys, as observed in our study and in other studies of school-children in developing countries like what Anand *et al* reported, that the overall prevalence of stunting was 39% with a higher proportion in males (41%) than females (37%) among school children in Haryana (Anand *et al*,1999).The Tanzania Demographic and health survey observed the same trend in children under the age of five, as it was reported that, a higher proportion (46%) of male children were stunted compared with the proportion of female children (39%) (NBS, 2010). The predisposition of the male children to increased risk of stunting may be due to several reasons. One of the explanations could be that the boys are rarely at home. They tend to be active, running around in the neighbor hood as compared to the female children who probably eat whatever small feeds that their mothers got since they are always with them at home (Olwedo *et al*, 2008). There was also a significant relationship between Topographical zone of residence with stunting, with children in the upland plateau zone being more stunted (48.4%) than (38.6%) in the lowlands zone and (38.5%) in the middle plateau zone. In this study it was thus observed that the prevalence of stunting in the upland plateau zone was about 10% higher compared to the other zones. Almost similar results was obtained in a study done in Peru, Ecuador and Bolivia where there was a higher stunting prevalence in the highland area than in the remaining regions of each of the countries. In all three countries, highland prevalence rates were about 10% higher than those of the other regions (Larrea and Freire, 2002). As previously reported, the higher prevalence of stunting in the highlands besides inadequate nutrition could be attributed to the growth retarding effect of high altitude hypoxia (Frisancho, 1978) and the increased physical activity because of difficult terrain (Saxena and Saxena, 2010).

This Study also found the overall prevalence of thinness (BMIAZ ≤-2) to be 11.7% and 14.7% of the school children with thinness had severe thinness (BMI-for-age Z score ≤-3SD). This prevalence was slightly less than 13.7% which has been previously reported for school children in urban and peri-urban areas of Ouagadougou – Burkina Faso (Debone, 2011). Thinness, usually describes acute malnutrition. This prevalence of thinness could be as a result of the acute food scarcity which the district was experiencing during the study period as a result of the shortage of rainfall (drought) during the preceding farming season in the district (International Federation of Red Cross and Red Crescent Societies, 2011).

The present study observed that there was no significant difference in the prevalence of thinness between sex, results which are consistent with previous report by Mushtaq and his associates (Mushtaq *et al*, 2011). Further it was observed that the prevalence of thinness was similar between age groups and the lowlands zone had a significantly higher prevalence of thinness compared to the middle and upland plateau zone.

The prevalence of anaemia was observed to be 3.1%, significantly lower compared to previous study by Mazigo and associates who reported a prevalence of 20% (Mazigo *et al*, 2010). It is known that in many tropical regions, anaemia, iron deficiency, malaria and multiple helminths (most importantly Geohelminths and Schistosomes) infections coexist and are interrelated (Stoltzfus *et al*,2000).In this study it was found that the prevalence of soil-transmitted helminths in Same district was very low, less than 1% and it has previously been noted that the incidence of malaria was very low in the district (0.02 cases/child/year) (Masika *et al*, 2006), these could be possible explanation of the observed low prevalence of anaemia.

It has been observed that there were slightly more anemic children in the lowlands zone than in the other zones, this could partly be due to increased haematopoiesis with resultant increase in the concentration of haemoglobin in individuals at high altitude due to hypoxia resulting from low oxygen tension (Mason N.P., 2000). In this study it was also observed that there was no difference in the prevalence of anaemia between sex, age groups. This observation contradicted with previous studies which found that among female there were more anaemia (78.3%) than in male counterparts (52.3%) (Baral and Onta, 2009). Also Verma and associates found that the prevalence of anaemia among urban schoolchildren aged 5–15 years from Punjab was 51.5 per cent, and it was significantly higher in girls (Verma *et al,* 1998). Results in this study some how agrees with the findings by Gür and colleagues, that there was no significant relationship between the prevalence of anaemia and the students' age, gender (Gür *et al,* 2005).

5.1. STUDY LIMITATIONS

1. Financial constraints made it difficult to check for false negatives using a more sensitive method like formal-ether concentration technique as it is known that Kato-Katz technique tends to have low sensitivity in the diagnosis of intestinal helminths particularly in areas with high proportions of low intensity of infections (Knopp *et al.,* 2008). Therefore there could be some false negatives, thus underestimating the prevalence.

2. Baseline prevalence before the mass chemotherapy was not available, therefore it has been difficult to directly link the low prevalence with the mass chemotherapy that was applied.

3. Relationship between intensities of soil transmitted helminths and anthropometric indices and hemoglobin levels could not be done using statistical procedures because of the low prevalence of STH in the district

CHAPTER SIX

6.1. CONCLUSION AND RECOMMENDATIONS

6.1.1. Conclusion

The study showed that the prevalence and intensity of soil-transmitted helminths infections among primary school children in Same district is generally low. The observed low prevalence of soil-transmitted helminths could partly be explained by the mass chemotherapy which was carried out in the district in 2008 with a reported coverage of 76.76%, and the ongoing program of treating children under the age of five years with antihelminthic drugs two times a year during the routine Maternal and Child Health Clinics in the district.

However this study has observed that there is high prevalence of malnutrition among school children in Same district as 42.3% were stunted and 11.7% had thinness. This high prevalence of Stunting and thinness could not be associated with STH infections because of very few positive cases found, giving a clue that there are some other causes of malnutrition among school children in the district, probably nutritional, genetical and environmental factors. The existing school feeding Programme in the district need to be improved by providing children with variety of food types including protein rich food so as to reduce this prevalence of malnutrition in school going children. As the quality of future human resources depends on the present day children, improvement of the nutritional level of today's children should be given top priority (Som *et al*, 2007).

The prevalence of anaemia in the district was observed to be low (Less than 5%) signifying that anaemia in the district is not of public health importance (WHO, 2008). This low prevalence of could partly be because of the observed low prevalence of soil-transmitted helminths infections in the district and also because it has previously been noted that the incidence of malaria was very low in the district (0.02 cases/child/year) (Masika *et al.*, 2006) , as besides other factors STHs and Malaria have both been reported as important determinants of anaemia in school-age children (Robertson *et al.*,1992, Tatala *et al.*, 2008, Ronald *et al.*, 2006).

6.1.2. Recommendations

1. With the observed low prevalence of STH in Same district, selective treatment is recommended chemotherapeutic method of controlling STH in the district.

2. The factors which are associated with the sustained low prevalence of STH infections in the district three years after mass chemotherapy need to be thoroughly investigated, so that they can be positively reinforced.

3. Studies that will determine the factors which are associated with this observed prevalence of malnutrition among primary school children in Same district are highly recommended so that appropriate control measures could be initiated.

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6.3. APPENDICES

6.3.1. Appendix 1: Kato – Katz technique standard operating procedures

1. Soak the cellophane strip in the 50% glycerol – malachite green solution for at least 24 hours before use
2. Transer a small amount of faeces on to a piece of scrap paper (news paper is ideal)
3. Press the screen on top of the faecal sample
4. Using a flat – sided applicator stick, scrape across the upper surface of the screen to sieve the faecal sample
5. Place a template on a clean microscope slide
6. Transfer a small of sieved faecal material into the hole of the template and carefully fill the hole, level with the applicator stick
7. Remove the template carefully so that all the faecal material is left on the slide and none is left sticking to the template
8. Cover the faecal sample on the slide with a glycerol – soaked cellophane strip
9. If an excess of glycerol is present on the upper surface of the cellophane, wipe off the excess with a small piece of toilet paper or absorbent tissue
10. Invert the microscope slide and press the faecal sample against the cellophane on a smooth surface surface (a piece tile or flat stone is ideal) to spread the sample evenly
11. Do not lift the slide straight up. The cellophane may separate. Gently slide the microscope slide side ways holding the cellophane
12. The slide is placed on a microscope and examined for Soil-transmitted helminths eggs

6.3.2. Appendix 2: Informed Consent Form – English Version

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES
DIRECTORATE OF RESEARCH AND PUBLICATIONS, MUHAS
INFORMED CONSENT FORM

Consent to participate in study

I am David Zadock Munisi, a post graduate student from Muhimbili University of Health and Allied Sciences, School of Public Health and Social Sciences, Department of Parasitology and Entomology. I am here to study the STHs infection, anthropometric indices and anaemia of children in your school.

Purpose and Description of the Research

This study is going to determine the prevalence and intensity of STH and their relationship with anthropometric indices and hemoglobin levels in primary school children in Same district. The findings of this study will be used to initiate appropriate treatment for your child infections. The study findings would also be used to design and implement control strategies in this district in the future by concerned body or by any volunteer. The research results will be disseminated through publication and in a thesis for academic purpose.

Voluntary Participation

Please note that your participation in this study is entirely voluntary and you have a right to refuse to participate. If you agree to take part, you have the right to withdraw from study at anytime if you wish to do so, without giving a reason. Your decision to withdraw will not affect anything on the relationship between you and me or any other person who is involved in this study.

Benefits

If you agree to participate in this study there may be direct and indirect benefit to you. The direct benefit is that once your child is found either infected with any of the soil-transmitted helminth or having low hemoglobin levels that requires medical attention will be referred to the nearby dispensary for appropriate treatment. Also participating in the study assists in the determination of the level of infection in this community, this information will help in developing appropriate control measures for the parasites in the district.

Alternatives

The Alternative of participating in this study is to decline to take part.

Risks and Discomfort

There are no physical risks associated with this study but there is little pain that may be experienced during the taking of blood sample.

Confidentiality

All information collected from this study will be kept confidential and no one will be told on what you have said, your identity and laboratory findings of the sample taken from your child. Only people working in this study will have access to the information and laboratory findings.

Who to contact

If you happen to have questions about this study, you should contact,

David Zadock Munisi, The Principal Investigator**,** of MUHAS, P.O BOX 65001,Dar es Salaam.

Prof M. Aboud, The chairperson of the Research and Publication Committee at MUHAS (Tel :2150302); P. O. Box 65001, Dar-es-salaam.

Prof C. Kihamia, The study Supervisor. S.L.P 65001, Dar es Salaam. (Mobile: 0754-596775)

Signature

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 of participant..

If participant cannot read:

I was present while the benefits, risks and procedures were read to the volunteer. All questions were answered and the volunteer has agreed to allow his/her child to take part in the research.

Signature of Witness..

Signature of research assistant..

Date of signed consent...

6.3.3. Appendix 3: Informed Consent Form – Swahili Version

CHUO KIKUU CHA AFYA NA SAYANSI SHIRIKISHI MUHIMBILI (MUHAS)
KURUGENZI YA TAFITI NA MACHAPISHO
FOMU YA RIDHAA YA KUSHIRIKI KWENYE UTAFITI

Namba ya Utambulisho .... /....../......

Ridhaa ya kushiriki katika utafiti huu

Mimi naitwa David Zadock Munisi, ni mwanafunzi wa shahada ya uzamili kutoka chuo kikuu cha afya na sayansi shirikishi cha Muhimbili, shule kuu ya Afya ya uma na sayansi za jamii, Idara ya parasitolojia na entomolojia. Nimekuja hapa kufanya utafiti wa maambukizi ya minyoo ya tumbo na madhara yake katika ukuaji wa mtoto na kiwango cha damu kwa watoto wa shule za msingi.

Malengo ya utafiti

Utafiti huu una lengo la kuainisha kiwango cha maambukizi ya minyoo ya tumbo na athari zake katika ukuaji na kiwango cha damu kwa watoto wa shule za msingi za wilaya ya Same.

Ushiriki unahusisha nini?

Ushiriki wako katika utafiti huu ni wa hiari na una haki ya kukataa kushiriki ,na vilevile ukikubali kushiriki una haki ya kujiondoa katika utafiti muda wowote kama utapenda kufanya hivyo bila kutoa sababu yeyote,uamuzi wako wa kujito hautakuwa na madhara yeyote kwenye uhusiano kati yako na mimi au na jamaa wengine wanaohusika na utafiti huu.

Faida

Kumruhusu mtoto wako kushiriki katika utafiti huu kunaweza kukawa na faida za moja kwa moja na faida zisizokuwa za moja kwa moja. Faida za moja kwa moja ni pamoja na kama mtoto wako atakutwa na maambukizi ya minyoo au kiwango cha damu kidogo sana kinachohitaji tiba, basi akapewa rufaa ya kwenda kwenye kituo cha afya cha jirani yako na kupatiwa matibabu husika, na pia kushiriki kwa mwanao kwenye utafiti huu, kutasaidia upatikanaji wa takwimu za kiwango cha maambukizi ya minyooo ya tumbo na athari zake kwa watoto wa shule. Taarifa hizi zitatumika katika kupanga mpango mahsusi wa kudhibiti minyoo ya tumbo katika wilaya ya Same na hivyo kupunguza maambukizi si tu kwa watoto bali na watu wazima pia, na hivyo kupunguza athari za kiafya zitokanazo na maambukizi ya minyoo ya tumbo.

Haki ya kujitoa na mbadala wowote

Ushiriki wako katika utafiti huu ni wa hiari, kama utachagua kutokushiriki au utaamua kusitisha ushiriki wako hutapata madhara yoyote. Unaweza kusitisha kushiriki katika tafiti hii muda wowote hata kama ulisharidhia kushiriki. Kukataa kushiiriki au kujitoa katika utafiti hakukufanyi upoteze stahili yoyote unayotakiwa kuipata .

Madhara

Hakuna madhara yoyote makubwa ya kimwili isipokuwa kutakuwa na maumivu kidogo wakati wa kuchukua damu kidoleni, lakini tutajitahidi kutumia njia yenye maumivu kidogo iwezekanavyo.

Usiri

Nakuhakikishia kwamba taarifa zote zitakazokusanywa kutoka kwako zitakua ni siri, ni watu wanaofanya kazi katika utafiti huu tu ndio wanaweza kuziona taarifa hizi.Tutahakikisha ya kwamba taarifa zilizojumuishwa katika ripoti yetu hazitakuwa zinatoa utambulisho wako. Hatutaweka jina lako au taarifa yoyote ya utambulisho kwenye kumbukumbu za taarifa utakazotupatia.

Fidia ya muda

Hakutakuwa na fidia ya muda uliotumika wakati wa kufanya mahojiano au majadiliano katika utafiti huu, hata hivyo ushiriki wako katika utafiti huu utashukuriwa na kuthaminiwa.

Watu wa kuwasiliana nao

Kama una maswaIi kuhusiana na utafiti huu usisite kuwasiliana na:

David Zadock Munisi, Mratibu mkuu wa mradi, Chuo Kikuu Cha Afya Muhimbili, S.L. P 65001, Dar es Salaam (Simu. no. 0713-668857).

Prof M. Aboud, Mwenyekiti wa kamati ya chuo ya utafiti na machapisho, S.L.P 65001, Dar es Salaam. (Simu namba: 2150302-6) na

Prof C. Kihamia, Msimamizi wa utafiti huu. S.L.P 65001, Dar es Salaam. (Simu: 0754-596775)

Sahihi

Unamruhusu mtoto wako atolewe sampuli kwa ajili ya utafiti huu?

Mshiriki amekubali [__]

Mshiriki amekataa [__]

Mimi ____ nimesoma/nimeielewa hii fomu, maswali yangu yamejibiwa. Nakubali kushiriki katika utafiti huu.

Sahihi ya mshiriki ________________________

Kama hawezi kusoma na kuandika (Shahidi Asaini)

Nilikuwepo wakati faida, madhara na namna ya utafiti huu utakavyofanyika viliposomwa kwa mzazi huyu. Maswali yake yote yamejibiwa, na mzazi huyu amekubali kumruhusu mtoto wake ashiriki kwenye utafiti huu.

Sahihi ya shahidi ________________________

Sahihi ya mtafiti msaidizi________________________

Tarehe ya makubaliano ________________________

6.3.4. Appendix 4: Questionnaire (English version)

Date _____/____/ 2012

a) Student's Particulars

1.0. School's name ____

2.0. ID Number: ________

3.0. Name of the child:___________________-____________________-____________________

4.0. Sex: Male ☐- Female ☐, Age ☐ , Level of grade ☐

5.0. Place of residence________________________, Duration of stay____________________

Other data

Weight _____. ___ kg, Height ___ ___ . ___ cm

Last term's examinations average marks__, Grade__Position in class____Among___ Children

6.3.5. Appendix 5: Questionnaire (Swahili version)

FOMU YA USAILI

Tarehe _____/____/ 2012

Taarifa kuhusu mwanafunzi

Jina la shule ______________________________________

Namba ya utambulisho: ________

Jina lamwanafunzi_____________________-____________________-____________________

Jinsia: Me [ ] Ke [ ], Umri [ ], Darasa la [ ]

Eneo unaloishi________________________, Muda wa kuishi____________________

Taarifa nyinginezo

Uzito, kg _____. ___, Kimo, cm ___ ___ . ___

Wastani wa matokeo ya muhula uliopita________Daraja____Nafasi darasani____ kati ya wanafunzi______

6.3.6. Appendix 6: Stool analysis form

a) Student's Particulars

1.0. School's name ____

2.0. ID Number: _________

3.0. Name: ________________________-____________________-____________________

4.0. Sex: Male ☐ - Female ☐

b) Stool examination - Kato-Katz technique

Type of STH eggs seen and the number of egg per gram of stool

	Specie of STH	**eggs/slide**	**eggs/gram (epg)**
1	*Ascaris lumbricoides*		
2	*Trichuris trichiura*		
3	Hookworms		

Other parasites identified:

1. ___________________________________2. ___________________________________

Name of Principal investigator (P.I): ____

Signature _______________ Date ___/ ____/ _________

6.3.7. Appendix 7: A map of Tanzania Showing the NTD Implementation Plan