PREVALENCE OF HELMINTHIC INFECTIONS AND FACTORS ASSOCIATED WITH PERFORMANCE OF THE SCHOOL HEALTH DEWORMING PROGRAMME IN KOROGWE URBAN DISTRICT, TANZANIA

By

Msumanje Alex Salio

A dissertation Submitted in partial Fulfillment of the Requirements for the Degree of Master of Science in Tropical Disease Control

Muhimbili University of Health and Allied Sciences

July, 2010

CERTIFICATION

The undersigned certify that they have read and hereby recommend for acceptance by Muhimbili University of Health and Allied Sciences a dissertation entitled; **Prevalence of helminthic infections and factors associated with performance of the school health de-worming programme in Korogwe urban District, Tanzania** in partial fulfillment of the requirements for the degree of Master of Science in Tropical Disease Control (MSC TDC).

Prof. Killewo J.Z.J. (MBChB, DPH, MSc, PhD)

(Supervisor)

Date: 5th July 2010

Dr. Gasarasi D.B. (BSc, M SPH, ScD)

(Supervisor)

Date: 5th July 2010

DECLARATION AND COPYRIGHT

I **Msumanje Alex Salio**, 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 similar or any other degree award.

Candidate signature..... Date..5th July, 2010

This dissertation is copyright material protected under the Berne Conversion, the Copyright Act 1999 and other international and national enactments, in that behalf, on intellectual property. It may not be reproduced by any means, in full or in part, except for short extracts in fair dealing, for research or private study, critically scholarly review or discourse with an acknowledgement, without the written permission of the Director of postgraduate studies, on behalf of both the author and the Muhimbili University of Health and Allied Sciences.

ACKNOWLEDGEMENT

First and foremost I praise the Lord for enabling me to pursue this course successfully.

I am deeply grateful to all the staff members of the Departments of Epidemiology and Biostatistics, Parasitology and Medical Entomology and Behavioral sciences from whom the capability to do this work grew.

I am very much indebted to my supervisors Professor Killewo, J.Z.J. and Doctor Gasarasi, D.B. who gave me excellent advice and constructive criticism from the initial development of the proposal to the final completion of the work. I am also obliged to Dr. Tarimo D.T. the head of department and Mr. Kazonda P. for his assistance in designing the data capturing sheet (Template). Thanks to Dr. Mpembeni R. for her assistance in clarifying some statistical issues during data analysis. Thanks to laboratory technicians at MUHAS mainly Mr. Mahikwano L. for his technical advice. I am also grateful to the Korogwe town District Executive Director, Korogwe town District Medical Officer and Korogwe town District Education Officer for allowing me to do this study in the district. I am also greatly obliged to all teachers and pupils who agreed to participate in the study. I am very obliged to Dr. Judy and her family for their financial support during the first year of my study.

Lastly, but not least I wish to extend my heartful gratitude to my wife Secilia Msumanje and my son Derrick Msumanje for tolerating my long absence from home during the whole period of my academic pursuit and indeed, for their encouragement and moral support. Really I find it very difficult to mention the names of every individual who contributed to the success of this work, but to all I say thanks.

DEDICATION

This dissertation is dedicated to my late daughter Maurine Alex Msumanje.

ABSTRACT

Introduction

Shistosomiasis and soil transmitted helminth infections represent a major public health problem in developing countries. Currently the periodic large-scale de-worming programme administered to school-age children without prior diagnosis has been shown to reduce the prevalence and intensity of helminths among school age children.

Methodology

The study was conducted in Korogwe urban district which is located in Tanga region. The study was designed to determine the prevalence of helminthic infections and factors associated with performance of the school health de-worming programme. A cross-sectional study was carried out in the area using both structured and semi-structured questionnaires. The study population included pupils from public primary schools which were randomly selected. For parasitological studies stool and urine specimens were examined. Urine was microscopically examined using standard procedures while stool samples were examined using the Kato-Katz technique. Qualitative data was collected using in-depth interviews with key informants including; teachers, health workers, influencial people in the community and the national school health programme coordinator. Descriptive statistics was used to analyse quantitative data using Epi Info computer software while elaborate narratives was used to analyse most of the qualitative data.

Results

The overall prevalence of *Schistosma haematobium, Schistosoma mansoni*, *Ascaris lumbricoides*, *Trichuris trichiura* and hookworms was found to be 14.7%. The prevalence of *S. haematobium* and hookworm infections were found to be 8.3% and 5.9% respectively. The prevalence rate for other helminthic parasites identified were negligible (<0.1%). The overall prevalence of helminthic parasites in older children aged 13-17 were significantly higher (19.4%) compared to 12.6% in the age group of

6-12 years and the intensity threshold of all intestinal worms identified fell under the category of light infections. The coverage of albendazole from the National Schistosomiasis and Soil transmitted helminth Control Programme (NSSCP) reached 45.4% while that of albendazole from the parallel programme (National Lymphatic Filariasis Elimination Programme) was 12.6%. Despite the low coverage compared to the 1996 study in the area the prevalence of *S. haematobium* decreased from 59% to 8.3% and hookworm decreased from 61% to 5.3%. It is hypothesized that these decrease in the prevalence of the most common parasites are attributable to the community compliance with the programme objectives and the school participation in general as demonstrated in the in-depth interviews.

Conclusion

The school age de-worming programme which in most cases is implemented by school teachers is perhaps the most effective way to reduce helminthic infections among school children in Tanzania. Although helminthic infection was not eliminated by two rounds of deworming interventions all children who remain infected had a 'light infection'.

Recommendations

Realizing the effectiveness of de-worming intervention in school children it is recommend that additional rounds of de-worming treatment be planned for further reduction of helminthic infections in the area. Head teachers should also be included in the training seminar and teaching materials specific for the programme should be provided. It is further recommende that, community meetings be held to raise awareness of the community regarding the programme and the drug used with the aim of reducing the fear of adverse side effects believed to be associated with medication used in the programme.

TABLE OF CONTENTS **PAGE**

CERTIFICATION ii
DECLARATION AND COPYRIGHT iii
ACKNOWLEDGEMENT iv
DEDICATION v
ABSTRACT vi
TABLE OF CONTENTS viii
LIST OF ABBREVIATIONS/ACRONYMS xiii

CHAPTER ONE: INTRODUCTION 1

1.1: Statement of the problem 5
1.2: Research questions and objectives 6
1.3: Research questions 6
1.4: Objectives 7
1.4.1: Broad objective 7
1.4.2: Specific objectives 7
1.5: Rationale for the study 7

CHAPTER TWO: Literature review 8

2.1: Situation of helminthic infections 8
2.2: School based de-worming programmes 9
2.3: Mass administration of anthelmintics 9
2.4: Effectiveness of anthelminthic drugs 10
2.5: Problem facing de-worming programmes 12
2.6: Factors affecting administration of anthelmintic drugs 13
2.7: Monitoring of mass de-worming programme 14

CHAPTER THREE: Research methodology 16

3.1: Study area 16
3.1.1: District profile 16
3.2: Study design 17
3.2.1: Study population 17
3.2.2: Sample size determination 18
3.2.3: Sampling 18
3.3: Recruitment and training of research assistants 19
3.3.1: Pre-testing of research instruments 19
3.4.0: Data collection 20
3.4.1: Study instruments 21
3.4.2: Collection of stool and urine specimens 22
3.4.3: Collection of qualitative data 22
3.5.0: Stool examination 24
3.5.1: Urine examination 24
3.6.0: Data entry and analysis 25
3.6.1: Analysis of quantitative data 25
3.6.2: Analysis of qualitative data 25
3.7.0: Variables 26
3.7.1: Dependent variable 26
3.7.2: Independent variables 26
3.8: Study limitation 27
3.9: Ethical clearance 27

CHAPTER FOUR: Results 29

4.1: Location and distribution of the study population 29
4.2: Characteristics of the school children 30

4.3: Prevalence of schistosomiasis and soil transmitted helminth infection 31
4.3.1: Prevalence of infection with at least one helminthic infection by age and sex 32
4.3.2: Age and sex distribution of the common helminths 33
4.3.3: Prevalence of mixed infections 35
4.3.4: Intensity of intestinal worms 35
4.3.5: Mean intensity of intestinal helminths 35
4.4: Coverage of de-worming treatment 36
4.5.0: Factors associated with programme performance 37
4.5.1: Opinion of school children regarding the programme 38
4.5.2: Awareness of the de-worming programme 38
4.5.3: Source of information 39
4.5.4: Reasons for not taking treatment during the last de-worming round 41
4.5.5: Problems experienced after taking praziquantel 44
4.5.6: Risk factors for infection 45
4.5.6.1: Effect of exposure to risk factors on helminthic infections 47
4.6.0: Qualitative data results 48
4.6.1: Knowledge on the programme among teachers 48
4.6.2: Incentives in the school health de-worming programme 49
4.6.3: Attitude towards the school de-worming programme 50
4.6.4: Training seminar for teachers 52
4.6.5: Training children 53

CHAPTER FIVE: Discussion, conclusion and recommendations 54

5.1: Discussion 54
5.2: Prevalence of helminthic infections 54
5.3: Coverage of de-worming interventions 57
5.4: Knowledge of school teachers on school health de-worming programme 58
5.5: Factors associated with performance of the school health de-worming

programme 59
5.6: Conclusion 61
5.7: Recommendations 62

REFERENCES **64**

APPENDICES **78**

APPENDIX A: Definition of terms 78
APPENDIX B: Intensity threshold of helminths being light, moderate and heavy infections 80
APPENDIX C: Kato Katz technique 81
APPENDIX D: Sedimentation method for terminal urine collection 83
APPENDIX E: Map showing location of the Korogwe Town in Tanga Region 84
APPENDIX F: Map showing administrative boundaries of Korogwe town 85
APPENDIX G: Study questionnaire for school children 86
APPENDIX H: Study questionnaire: Kiswahili version for school children 97
APPENDIX I: Interview guidelines for primary school teachers 108
APPENDIX J: Interview guidelines for health workers 111
APPENDIX K: Interview guidelines for the key influencial people in the community 113
APPENDIX L: Interview guidelines for the national school health programme coordinator 114
APPENDIX M: Interview guidelines: Kiswahili version for primary school teacher 115
APPENDIX N: Interview guidelines: Kiswahili version for health workers 118
APPENDIX O: Interview guidelines: Kiswahili version for the key influencial people in the community 120
APPENDIX P: Interview guidelines: Kiswahili version for the national school health programme coordinator 121

LIST OF TABLES **PAGE**

Table 1: Location and sex distribution of the study population **30**
Table 2: Distribution of the study population by age and sex **31**
Table 3: Prevalence of schistosomiasis and soil transmitted helminth infections **32**
Table 4: Prevalence of infection with at least one of helminthic infection by age and sex **33**
Table 5: Prevalence of Schistosoma haematobium and hookworms according to age and sex **34**
Table 6: Mean intensity of intestinal helminth infections **36**
Table 7: Coverage of de-worming treatment by age and sex **37**
Table 8: Distribution of source of information among school children by sex **41**
Table 9A: Reasons for not taking treatment in the last de-worming cycle from NSSCP **43**
Table 9B: Reasons for not taking treatment in the last de-worming cycle from NLFEP **44**
Table 10: Risk factors for schistosomiasis and hookworm infections according to age and sex **46**
Table 11: Association between infection with *S. haematobium* and hookworms and exposure to risk factors **48**

LIST OF ABBREVIATIONS/ACRONYMS

BMJ – British Medical Journal

CDC – Center for Disease Control

DMO – District Medical Officer

DED - District Executive Director

FRESH – Focusing Resources on Effective School Health

MOHSW – Ministry of Health and Social Welfare

NSSCP – National Schistosomiasis and Soil Transmitted Helminth Control Programme

MUHAS – Muhimbili University of Health and Allies Sciences

NLFEP – National Lymphatic Filariasis Elimination Programme

PCD - Partnership for Child Development

STH – Soil Transmitted Helminth

UNESCO - United Nations Educations, Science and Culture Organization

UNDP- United nations Development Projects

UNICEF – United Nations Children's Fund

US$ - United State Dollar

WFP - World Food Programme

WHO – World Health Organization

CHAPTER ONE

1: Introduction

Helminthic infection is an ancient global problem representing a serious medical and health problem, particularly in tropical regions where hygiene and sanitation in the community is poor. It is also a silent disease that destroys the health, wellbeing and learning potential of millions of school children in many developing countries today (Amara et al., 2005). The parasites consume nutrients; destroy tissues and organs in which they live causing pain, diarrhoea, obstruction, anaemia, ulcers and various health problems (Luong, 2003).

The global estimates suggested that *A. lumbricoides* infects 1.221 billion people, *T. trichiura* 795 million, and hookworms 740 million (de Silva et al., 2003, 1997) while about 85% of the 200 million people infected with schistosomes live in the African continent (Chitsulo et al., 2000). School children, aged around 6 and 15 years have the highest infection rates as well as the highest worm burden, which contribute greatly to contamination of the environment with infective stages of the parasites (WHO, 1995a). It is well known that the greater the number of worms with which a school-age child is infected, the greater the impact on that child's health. Moreover, the damage caused by worm infections in this early life has been found to have indirect effect on productivity during adulthood (Guyatt, 2000).

It is becoming apparent that treating health and nutrition problems in school children is important for the betterment of their health and survival. Through World Health Organization's the Global School Health initiatives was launched in 1995 which seeks to mobilize and strengthen health promotion and education activities at the local, national, regional and global levels. Currently the school health program has shown a tremendous promise on the general wellbeing of school children in developing countries. Compared to other population groups in the community, school children are more easily reached with drug-treatment and health education (PCD, 1999).

De-worming school children by anthelmintic drug treatment is a curative approach to expelling the heavy worm load in children. Periodic mass drug administration is the most effective approach to reduce worm's morbidity. Currently there are three ways used to implement periodic mass de-worming program in which treatment can be given to whole population without regard to people's characteristics (blanket approach); the second approach which is commonly used is targeting to treat the high-risk groups in a community without identifying who is infected and the last approach is to treat people who are diagnosed with or has show signs of an infection (WHO, 1996).

Though mass chemotherapy will not always kill 100% of the worms but, because the few remaining worms will not replicate and because they usually pose only a minimal health threat, therefore repeated chemotherapy at regular interval (periodic de-worming) in high risk groups can ensure that the levels of infection are kept below those associated with morbidity and will frequently result in immediate improvement in child health and development (WHO, 1992). Drug therapy alone may only provide a short term measure for reducing worm infection in a target population. Re-infection is frequent within a short period therefore, control measures in schools and communities through improved sanitation and hygiene along with de-worming need to be ensured to prevent infection and re-infection.

The common helminths that infect school age children are *N. americanus, A. duodenale* (hookworms), *A. lumbricoides* (roundworms), *T. trichuris* (whipworm), *S. haematobium* and *S. mansoni* (World Bank, 1993). These worms can effectively be treated with single dose of Albendazole (400mg) or mebendazole (500 mg) targeting all the common intestinal worms (hookworms, roundworms, and whipworms) while praziquantel (40-60mg/kg) is used for the treatment of human schistosomiasis (*Schistosoma haematobium*, *Schistosoma mansoni* and *Schistosoma japonicam*). These drugs have been found to be highly effective (Awasthi et al., 2003). Unlike

albendazole and mebendazole, the number of praziquantel tablets has to be adjusted to the height of the child (WHO, 2002).

The challenges that face de-worming program for many of African countries is the limited access to drugs such as generic praziquantel which is not yet donated on a large scale and albendazole which in most cases is donated only for the control of lymphatic filariasis. Inadequate fund and limited access to anthelmintic drugs have been hampering national efforts to scale up and sustain de-worming treatment. It is likely that enhanced efforts will be required to expand national and global coverage and to integrate measures to control helminthic diseases.

Tanzania, being one of the resource limited countries in which the hygiene and sanitation condition are poor, clean and safe water supply is inadequate and the urban settlements are crowded, cannot escape the problem of helminthic infections (Mwaluko et al., 1991). The problem of schistosomiasis and soil transmitted helminths has been known since colonial era. To date, several fragmented surveys have explored the prevalence of disease in the country. One of these studies is the study on urinary schistosomiasis which reported the prevalence of *S. haematobium* infections to be greater than 50% in some ares of Tanzania mainland (Brooker et al., 2001). Another important study is the joint study between Tanzania and Ghana prior to the introduction of the school based de-worming program which revealed that the most intense worm infections and related illnesses occur in school age children (PCD, 1998b; Brooker et al., 2009). Using the available evidence based information and many other relevant sources of information the Ministry of Health and Social Welfare (MOHSW) recognized that helminthic infection is a public health problem in Tanzania. This led to introduction of National Schistosomiasis and Soil-transmitted Helminth Control Programme (NSSCP). The programme was officially launched in July 2005 by former Prime Minister the Honorable Fredrick Sumaye and the Minister of health Hon. Anna Abdallah.

NSSCP which is based within the Ministry of Health in collaboration with the Ministry of Education and Vocation Training jointly commenced de-worming treatment to primary school children in November and December, 2005. During the first de-worming round each child received appropriate single dosages of praziquantel for schistosomiasis (40 mg/kg body weight) and albendazole (400 mg) for intestinal helminths. During the first de-worming round in 2005 the programme planed to de-worm five million children but of them three million children (78%) were de-wormed while in 2007 the second de-worming round was carried out and achieved 83% coverage rate (MHSW, 2007 - unpublished).

During the second de-worming round the NSSCP distributed a single dose of praziquantel tablets alone while school children from Tanga, Pwani, Dar-es- Saalaam, Lindi and Mtwara regions where the National Lymphatic Filariasis Elimination Program (NLFEP) is running received albendazole which is co-administered with ivermectin under the blanket approach. Again in 2008 the programme scaled up de-worming treatment and covered six new regions that included; Arusha, Manyara, Kilimanjaro, Singida, Morogoro and Rukwa in which Praziquantel was distributed.

Together with many other activities the NSSCP has been working hard to ensure successful implementation of de-worming programme. However, reducing morbidity of helminthic infections among school age children will depend on the policy decisions taken by Ministers of Health, Ministers of Education and their advisers. Critically, it will depend also on the dedication of health professionals and the support of stakeholders who have committed time, money and resources to helminthic control and the involvement of communities.

Despite the programs effort to achieve the target there has been some reported shortfalls associated with minimal participation of regional health management team and in some cases school children, their parents and community in general were not prepared to support the programme. Also during the first de-worming treatment a few number of children developed an expected adverse drug events which created fear

among parents. Consequently this led to the notion that the affected children were overdosed (MHSW, 2005 - unpublished).

Under these circumstances there is a great need to assess the current de-worming status by determining the prevalence of helminthic infections, the coverage of the de-worming treatment, the acquired knowledge of school teachers on school health de-worming programme and factors associated with performance of the school de-worming programme. Such information will enable policy makers and programme managers to improve the school de-worming programmes.

1.1: Statement of the problem

Schistosomiasis and soil-transmitted helminths (STHs) are found countrywide. In some areas, the prevalence rate exceeding 80% was found (Ansel et al., 1997), making these diseases a primary public health concern. The prominence of infection is probably attributed to factors related to poor sanitation, overcrowding, bad hygienic habits, environmental contamination with infective stage of the parasite (Smith, 1993) and poor health education (Shubair et al., 2000). Fragmented surveys in different parts of the country provide the only evidence based data describing the prevalence of schistosomiasis and soil transmitted helminths in those areas. Though some of the surveys were done many years ago they give some clue on the magnitude of helminthic infections in the country.

Realizing the burden of helminths infections in the country the MOHSW introduced NSSCP which is now working hard to scale up the coverage. The programme is now facing problems relating to ineffective preparation and implementation of its activities. This was seen during the first and second de-worming campaign when school children, their parents and the community in general were not prepared for the programme activities (MHSW, 2005 - unpublished). In some cases teachers were blamed for harming children when they developed adverse drug effects following anthelmintic treatment (MHSW, 2005 - unpublished). This led to the notion that the affected children were overdosed. Apart from ineffective implementation of

programme activities the NSSCP has managed to distribute two rounds of praziquantel treatments in some parts of Tanzania mainland including Korogwe urban district and reached 78% and 85% de-worming coverage in 2005 and 2007 respectively.

The Ministry of Health and Social Welfare is satisfied with the outcome of the school health de-worming programme from seventeen regions of Tanzania mainland with a de-worming coverage of 78% in 2005 and 85% in 2007. Apart from the reported de-worming coverage there is no recent information on the actual consumption of either praziquantel or albendazole, and no study has been done to determine the current prevalence of helminthic infections subsequent to school health de-worming treatment. Moreover, it is not known exactly how effective the school health de-worming programme has been, in terms of de-worming coverage, the current prevalence of helminthic infections and factors associated with performance of the school health de-worming programme.

It is against this background that, this study was undertaken to examine the current prevalence of helminthic infections and factors associated with performance of the school health de-worming programme in Korogwe urban district.

1.2: Research questions and objectives

1.3: Research questions

1. What is the current prevalence of schistosomiasis and soil transmitted helminth infections among school children in Korogwe urban district?

2. What is the proportion of school children who received Praziquantel and Albendazole in the last de-worming treatment in Korogwe urban district?

3. What is the acquired knowledge of school teachers on school health de-worming programme in Korogwe urban district?

4. What factors are associated with performance of school health de-worming programme in Korogwe urban district?

1.4: Objectives

1.4.1: Broad objective

To determine the prevalence of helminthic infections and factors associated with performance of the school health de-worming programme in Korogwe urban district.

1.4.2: Specific objectives

1 To determine the current prevalence of schistosomiasis and soil transmitted helminth infections in school children in Korogwe urban district

2. To determine the proportion of school children who received praziquantel during the last de-worming treatment in Korogwe urban district

3. To determine the proportion of school children who received albendazole during the last de-worming treatment in Korogwe urban district

4. To assess the acquired knowledge of school teachers on school health de-worming programme in Korogwe urban district

5. To assess factors associated with performance of the school health de-worming programme in Korogwe urban district

1.5: Rationale for the study

Some progress has been made by the NSSCP towards attaining the national and international targets to de-worming school age children in Tanzania mainland. This study sought to contribute to the MOHSW efforts and those of other stake holders towards improving the ongoing school health de-worming programme.

CHAPTER TWO

2.0: Literature review

2.1: Situation of helminthic infections

Schistosomiasis is the second most prevalent tropical parasitic disease after malaria. It is a leading cause of morbidity in endemic areas of Africa, Asia and South America (WHO, 1995). In some parts of Africa the onset of haematuria due to urinary schistosomiasis is so common in adolescent boys that it is seen as normal (Desowitz, 1981). Of the intestinal parasites, the peak prevalence and intensities for trichurisis and ascarisis are in childhood, while for hookworm, the prevalence and intensity rises with age, reaching a plateau in late adolescence (Bundy et al., 1992).

Worldwide, more than 3.5 billion people are infected with intestinal worms, of which 1.47 billion are infested with roundworms, 1.3 billion with hookworms and 1.05 billion with whipworm (de Silva, 2003). Children aged 5–15 years make up the group with the highest infestation rate and highest worm burden, which contributes greatly to the contamination of the environment. It is estimated that about 400 million school age children are infested with the roundworms, whipworms and hookworms worldwide (Chan et al., 1994).

In Tanzania, there are several fragmented surveys that have measured the prevalence of helminths in school age children. One of these is a study in Dar es Salaam, which found the prevalence of 4% for *A. lumbricoides* (Killewo et al., 1994). Another study is a study in Kilimanjaro region in the lower Moshi rice irrigation scheme which revealed prevalence of *S. haematobium* and *S. mansoni* among children aged 3 to14 years to be 3% and 36.5% for *S. haematobium* and *S. mansoni* respectively (Kisanga, 1991). Another study done in Muheza district showed that, the overall prevalence of geohelminths in school children was 47.1% in which hookworm infection was reported to have the highest (45.0%) prevalence (Mtoi, 2003).

2.2: School based de-worming programmes

In contrast to all other infectious agents like viruses, bacteria, fungi and protozoa, the helminthic infections of interest such as ascariasis, trichuriasis, hookworms and schistosomiasis do not multiply in the human host. Therefore infection and re-infection will always results from external sources while the rate of re-infection will depend on many factors including the treatment efficacy and de-worming coverage. Generally de-worming school age children who are the most infected and source of environmental contamination in the community is critical in the reduction of transmission of helminthic diseases in the community. Therefore, treating only school age children can reduce up to 70% of the total burden of intestinal worms in the community (Bundy et al., 1990).

Evidence from existing de-worming programs that narrowed their intervention to school age children (a high-risk group) has shows that the treatment costs of chemotherapy for helminthic infections are quite low (well below US$1 per school age child). This finding is in part due to the easy accessibility of the target group and the cost savings of incorporating delivery into existing school and health programs. Indeed, evidence shows that mass treatment for these neglected diseases is both the most cost effective way to increase school participation and improving health status of children in endemic areas (PCD, 1997).

Fortunately, cost-effective measures based on highly efficacious anthelmintic drugs are now available to reduce and control disease caused by these infections. It has also been shown that anthelminthic drugs given to children significantly effect their rapid growth judged by weight gain, height increment, arm circumference and triceps and sub scapular skin-folds (Stephenson et al., 1993).

2.3: Mass administration of anthelmintics

Preventive chemotherapy interventions will be more effective, and compliance with subsequent rounds of treatment sustained, if communities are properly informed about the aims and objectives of the programme. Communities also need to be aware of the

purpose of drug administration, the timing and location of treatment rounds, and the measures to be taken if any adverse events should occur. Clear and concise messages to the community about preventive chemotherapy program should be delivered in a socially appropriate manner and in time to reach as many people as possible.

In many places, there may be opportunities to associate preventive chemotherapy interventions with existing health-care programmes that make use of different drug distribution channels, for example, campaigns targeting mothers and children, such as those involving antenatal services and other health intervention programmes may offer an inexpensive approach for regular anthelmintic drug administration (CDC, 2004). In most instances, interventions that are "packaged" in this way yield additional benefits (Curtale et al., 1995; WHO/UNICEF, 2004).

2.4: Effectiveness of anthelminthic drugs

Anthelmintic drug treatment is aimed at reducing morbidity by decreasing the worm burden. Repeated chemotherapy at regular intervals (periodic de-worming) in high-risk groups can ensure that the levels of infection are kept below those associated with morbidity. Currently there is not enough evidence of the emergence of drug resistance in human helminths. A number of reports have attested to the effectiveness of chemotherapy when treating helminths in China (Lin et al., 1997), Saudi Arabia (Ageel et al., 1997) and Kenya (Magnussen et al., 1997). The problem is the low efficacy of single-dose albendazole and mebendazole for the treatment of hookworm and trichuriasis, respectively (Adams et al., 2004; Albanico et al., 1994) and high rates of post treatment re-infection for soil transmitted helminths in areas of high endemicity (Albanico et al., 1995).

Drug resistance should be suspected if high coverage, high-frequency anthelmintic treatment is found to have less than the expected effect on the target helminths. Since we adopted regular mass chemotherapy to control helminths in endemic countries there has been increasing pressure for anthelmintic drugs which might create chances for anthelmintic drug resistance (Albanico et al., 2003). Hookworms are known to be

at higher risk than other helminths for developing drug resistance. Therefore, a long term preventive chemotherapy must be accompanied by collection of baseline data on drug efficacy at the beginning of the intervention, followed by regular monitoring (Geerts et al., 2000; Albanico et al., 2004).

Millions of doses of praziquantel and albendazole have been used since registration of these drugs for human treatment was approved (Stephenson et al., 2000). Each drug has an excellent safety record; adverse reactions are minimal and transient, and serious adverse experiences are extremely infrequent. In practice, both infected and uninfected people are treated in community program. Temporary minor reactions following treatment occurs mainly in infected people and usually result from the body's response to the dying of worms. Heavily infected people are more likely to experience such reactions (Weekly Epidemiological Records, 2003; Loukas et al., 2006). Generally, the number of people reporting adverse reactions is highest at the first round of treatment and tends to decrease during subsequent rounds (de Rochars et al., 2005).

Many individuals in endemic countries are often infected with multiple worms, making it justifiable to co-administer anthelmintic drugs targeting more than one helminthic infection in order to reduce helminth morbidity. Praziquantel and Albendazole have been shown to be safely co-administered for schistosomiasis and soil-transmitted helminth infections (Olds, 2003) while mebendazole and praziquantel have been widely co-administered in many countries and reported to be safe (Engels et al., 1993, 1994; WHO, 2002). Again albendazole plus ivermectin can be safely used for the treatment of lymphatic filariasis (Awadzi et al., 2003; Horton et al., 2000; Simonsen et al., 2004).

A sustainable anthelminthic treatment for helminths may be disrupted if serious adverse drug events occur as a result of the inadvertent treatment of certain concurrent infections that have not been recognized. For instance, praziquantel can exacerbate central nervous system pathology due to schistosomiasis or *Taenia solium* cysticercosis. As a general rule this drug should not be administered in large-scale

interventions to individuals reporting a history of epilepsy and/or other signs of potential central nervous system suggestive of cystercosis (Mehta et al., 2004).

2.5: Problem facing de-worming programmes

Helminthic diseases are largely neglected by the global health community as the people most affected are among the most impoverished. Helminthic infections are of major public health importance in most of the resource limited countries. Despite of its high morbidity helminthic infections receive less than 1% of the global research dollars (Hotez et al., 2008).

Helminthic transmission is a result of environmental contamination with human excreta, therefore chemotherapy control approach can provide a short term interventions because their effect is quickly hampered by re-infections. Studies have shown that haphazard handling and disposal of human and animal excreta together with inadequate water supply contribute to high levels of helminthic infections (Bundy, 1995). Therefore improvements in hygiene, sanitation and water supply are the most beneficial approach in the control of helminthic infections in the community.

It is predicted that more than half of the global human populations live in urban areas where most of them are in the rapidly growing cities of Africa, Asia and Latin America (United Nations, 2003). Rapid urbanization in most African countries often go with lack of adequate water and sanitation which further increases transmission of schistosomiasis and soil transmitted helminth infections (Crompton et al., 1993.).

Health education is another control strategy that has not been effectively integrated in de-worming programmes. Since health education aims at reducing transmission and preventing re-infection by encouraging healthy behaviors, it can help also reduce environmental contamination by promoting use of latrines and increasing level of knowledge which further reduces chances for re-infection (Lansdown et al., 2002).

Community perceptions towards de-worming programmes may affect anthelmintic administration. A study in Turkey determined community perception of school-based

de-worming programme. Result shows that, 99% of the parents and 98.4% of the teachers approved of the teacher's role in this program. Nearly all of the teachers and parents showed willingness to continue the program in the future and 75% of the parents indicated willingness to pay for the drugs. The study also highlighted the need of educating illiterate mothers and overcoming the prejudice against externally funded measures, which are perceived by some of the members of the community as an experiment run by foreigners on the local population and the concern of some parents that anthelmintic drug (mebendazole) might cause sterility (Ulukanligil, 2006).

2.6: Factors affecting administration of anthelmintic drugs

Effective community involvement in any of the health intervention programmes has a positive impact in terms of programme implementation and sustainability. One study which determined community perception relating to school de-worming was carried out in two countries before they commence de-worming programme. Result shows that, most teachers (96% in Ghana and 98% in Tanzania) were positive about their role in the program, including acceptance of anthelmintic drugs and over 90% of parents in both Ghana and Tanzania were willing to pay for the continuation of drug treatment (Brooker et al., 2001). Similar findings were also observed in a local community where school age de-worming was being conducted and parents were willing to pay for a school-based chemotherapy program (Lwambo, 2005).

The cost of de-worming drugs may also affect administration of anthelmintic treatments. When the price of Praziquantel and Albendazole drugs was high, each person was screened for infection and then treated accordingly. Today individual diagnosis for helminthic infections is nearly four to ten times as expensive as the treatment itself. Reduced price of anthelmintic drugs and the use of school system for delivery of de-worming treatment has make de-worming programme to be the cost effective helminthic control approach as the cost for praziquantel is now less than 0.50 US$ per year and less than 0.25 US$ per child per year for treating common intestinal worms. More over, these tablets are heat stable and require no cold chain for delivery.

With a shelf life of up to four years, they can be purchased in bulk to reduce costs and to ensure uninterrupted supply (WHO, 2002).

Successful distribution of anthelmintic drugs will depend on effective cascade training of regional and district school health officers and thus the school teachers. Before commencing de-worming programme the MOHWS conducted three de-worming training workshops in 2004. The training workshops were the footstep for school health de-worming programme. Each workshop lasted for 4 days, covering epidemiology, transmission, diagnosis and treatment of schistosomiasis and STH. The workshops were very successful having a100% attendance from the District and Regional School Health officers both from the Ministry of Health and Ministry of Education. These Regional and District School Health officers were responsible for cascading de-worming training to primary school teachers in their districts (MOHSW, 2006 - unpublished).

According to WHO and other international agencies a one day training seminar should be conducted for selected personnel from the Ministry of Health and Ministry of Education and it should cover the following subjects; Negative effects of intestinal helminths on health and educational outcomes; justification for a school based de-worming programme; characteristics of the drugs and treatment schedule and prevention of intestinal parasitic infections through improvement of water and sanitation facilities as well as hygiene practices (WFP/UNESCO/WHO, 1999).

2.7: Monitoring of mass de-worming programme

Monitoring of helminthic morbidity subsequent to mass chemotherapy treatment is an important component in the control of schistosomiasis and soil transmitted helminths. In order to determine progress of the programme it is important to understand that, clinical, nutritional and parasitological assessment can equally be carried out to determine worms' morbidity (Montresor et al., 2002). Also a study on the impact of school age de-worming exercise will discover trends of de-worming effects such as;

the improved iron stores and haemoglobin levels, improved growth and improved food intake (Crompton et al., 2002; Stephenson et al., 1993).

Normally the first sign of improvement is the reduction of heavy infection, then nutritional, with an increase in iron stores, followed by an increase in haemoglobin level and finally by an increase in growth. At least two years of intervention are normally required before an increase in haemoglobin becomes evident while more time is required to show an improvement in growth (WHO, 1996).

There are several monitoring indicators but the most important indicators are parasitological changes and reduction in morbidity. In practice it is not necessary for all these indicators to be collected in each of the control programmes. However, there is a core set of indicators which should always be measured and other indicators which may be considered at particular times or when additional resources are available.

Usually once the control programme has been initiated, the first monitoring activity will involve estimation of number of participating schools, the number of teachers trained, the distribution and quantity of drugs administered and the number and type of health education activities conducted. Among these, the most important indicator is the estimation of drug coverage (proportion of the school children received the drug). The number of variables to be studied will depend on the amount of resources available though, in many cases the coverage estimated using either Forms B-C which is routinely filled in by the teachers after each drug distribution in the school or the coverage determined from a specially organized survey in which the coverage teams randomly select schools and ask children if they have received de-worming drugs provide sufficient approximation of coverage in the whole school-age population (Montresor et al., 1998).

CHAPTER THREE

3.0: Research methodology

3.1: Study area

This study was conducted from January to November 2009 in Korogwe Urban district which lies in the central part of the Tanga region, surrounded by Korogwe rural, Handeni and Kilindi districts. The district was selected because of two major reasons; it is one of the districts where the two de-worming interventions targeting school age children had been undertaken. Secondly, it is a district where baseline results from a study done in 1996 prior to commencement of the national school de-worming intervention was accessible. The 1996 study examined 466 primary school children in Muheza, Tanga urban and Korogwe districts (WHO, 2001).

3.1.1: District profile

With its central location, Korogwe urban district is well connected to the rest of Tanga region. It is about 93 kilometers away from Tanga city, 344 kilometers south of Arusha and 305 kilometers north of Dar es Salaam city. It is located within the latitudes 5^0 and $5^0$14' south and in the longitudes $38^0$23' and $30^0$33' east. The climate is closely associated with the topography and ranges from tropical to sub tropical with a mean annual rainfall of 950 mm. There are two rainfall seasons: the long rains ("*Masika*") fall during February to May and the short rains ("*Vuli*") fall during September to November. The average temperatures during hot months (October – March) usually range between 30—32^0C. In the cooler season from May to October, the temperatures range from 23—28^0C. Humidity is generally high and ranges between 65% —100% during the hot season. The major occupation in the area is agriculture where people engage in sisal production as the main cash crop. They also grow beans and maize as food crops and keep livestock such as goats, cows and sheeps. Other occupations include trade and employments from the public and private sectors.

According to the National Population and Housing Census held in 2002, Korogwe urban had a total population of 53,986 people of whom 28.8% were school age children aged between 5 and 14 years. The current data shows that the Korogwe urban has a total number of 26 public and private primary schools enrolling about 12473 children, of these 6311 are males and 6162 are females.

The Korogwe Town has 8 wards namely Manundu, Kilole, Kwamsisi, Mtonga, Magunga, Old Korogwe, Kwamndolwa and Ngombezi (Appendix F). The town has one government district hospital which is located in Magunga ward. There are five dispensaries and several small privately operated clinics. Three out of the five dispensaries are located in Manundu ward, one dispensary in Ngombezi ward, and another one in the Kwamndolwa ward. The main sources of water used by people is piped water, protected and unprotected wells, protected and unprotected springs, rivers, streams and rainwater. There was no urban system to collect and recycle waste water and sewage which are either discharged into soak pits or into open gutters.

3.2: Study design

A cross-sectional study that involved primary school children was done in Korogwe urban area using structured and semi-structured (guideline) questionnaires. Results from a study done by the Tanzania Partnership for Child Development (PCD) published by Bulletin of the World Health Organization (WHO, 2001) were available to compare the current findings to those of the previous study done in 1996.

3.2.1: Study population

The target population was the school children from the public primary schools. However, to obtain detailed information about the programme the study interviewed key informants from the school teachers, health workers, national school health programme coordinator and influential people in the community.

3.2.2: Sample size determination

The sample size was estimated basing on the previous prevalence of hookworm infections (61%) from the study area (WHO, 2001). The study randomly sampled one third of the public primary schools in the area. Therefore eight primary schools were randomly sampled from a list of 24 public primary schools in the district. Recruitment of school children from the chosen primary schools was also done. The minimum sample size required was arrived at by using the following formula (Petrie et al., 2005);

$$n = (1.96/ w)^2 * p(1-p)$$

Where: n = sample size (minimum sample size)

w = margin of error on P (4%) = 0.04

1.96 = Is the percentage point of normal distribution corresponding to a two sided significant level.

p = Is the expected proportion (in percentage) of school children reported to have hookworm infestations in the study areas (61%) = 0.61.

Therefore: $n = (1.96/0.04)^2 * 0.61(1-0.61) = 571.2$.

This formula was taken to give a rough estimate of the minimum sample size required for the purpose of the study in order to detect an estimate of the true prevalence rate.

When 5% was added to take into account for attrition the study recruited 600 children. However, 21 pupils were excluded from the study because they did not collect both the stool and urine specimens therefore, the study managed to recruit 579 primary school children in the study area.

3.2.3: Sampling

1. Probability sampling.
2. Purposive sampling (Non probability sampling).

The target population in the study was the public primary school children which were randomly selected. At each school children were drawn up in a chronological order from a list of class enrollment register book. Systematic sampling was applied in which every fourth pupil in a class was sampled from this list. About 75 children were systematically sampled from each school with an average sampling of 11 children from each class.

Purposive sampling was applied to select key informants from the school teachers, health workers, influential people in the community and the national school health programme coordinator. Selection of the primary school teachers was based on those who attended de-worming seminars to distribute the de-worming drugs and selection of influential people based on those who have the primary school age children. Selection of key informants from the medical field targeted the District Medical Officer, Reproductive and Child Health Coordinator and the District School Health Coordinator. Information about the influencial people in the community was obtained through asking different people during the first few days of the sampling process.

3.3: Recruitment and training of research assistants

Research assistants were obtained by announcing a vacancy for the research assistants. The announcement briefly describes qualification for the post. One of the requirements was; the applicant must be a resident in the study area and should have secondary school education with at least a certificate in medical fields, teacher or community worker. Three research assistants were recruited. Of these two were primary school teachers and one had certificate in medical laboratory technology. These research assistants were trained in the techniques for data collection, handling of specimens, mobilize and calming children during the survey. Furthermore, the three recruited research assistants participated in one day pilot study.

3.3.1: Pre-testing of research instruments

Pre-testing of research questionnaires (structured and guidelines) was done in the field in which five children were chosen randomly and two school teachers were chosen

purposively from one primary school in the study area. More over, two health workers from one dispensary in the area and two influential peoples in the community were chosen purposively for in-depth interview. Pre-testing was successfully done and all questions were clearly understood to participants. In order to reduce bias the study did not include school or any participant who was interviewed during the pre-testing session.

3.4.0: Data collection

Data collection included two methods: one is the collection of stool and urine specimens for laboratory examination and the second source of data was obtained from the interviews in which a questionnaire was used. Data collection was done after the researcher had received permission from the District Executive Director who introduced him to the District Education Officer, District Medical officer, Local leaders and the head teachers in the study area. The District Education Officer made available the list of all primary schools in his district. Using the list, schools were selected by sampling method described above. Selected schools were informed about the study at least two days before commencing of data collection procedure. Children were also informed by teachers about the study and were invited to pass along this information to parents/guardian.

Just before we began the sampling procedure pupils were educated on the causes of schistosomiasis and soil transmitted helminth infections and they were convinced that every child ought to be free from such infections, thus the necessity of participating in the research work was appreciated by them. Sampling of children was done using the enrollment register book. Sampling ensured equal participation of males and females from each class. Selected children were given wide mouthed corked sterile bottles and were taught how to collect stool and urine samples at school toilet on the same date and with the aid of the research assistants the specimens were properly collected.

A child who managed to collect both the stool and urine samples was requested for the interview. The questionnaires were developed in English Version and later translated

into Kiswahili Version by translator. During the time of the interviewing the questionnaires used were the Kiswahili version because most of the people use Kiswahili. The type of questions was open and closed ended type of questions as described in Appendix H. With the aid of research assistants and school teachers pupils were comfortably interviewed and all questions were correctly filled.

In-depth interview was used to collect qualitative information from four groups of key informants namely; the primary school teachers, the national school health programme coordinator, the influential people in the community and key informants from the medical field. Detailed information about the interview will be explained below.

3.4.1: Study instruments

The following items were assembled for collection and processing of stool and urine samples while in the field; stool containers, applicator sticks, disposable gloves, marker pen, pipettes and 10% formaldehyde to fix intestinal worms before leaving the field for microscopic examination while urine containers, 37% formaldehyde, marker pen and pipettes were used to collect and preserve urine samples before leaving the field for microscopic examination. Other materials were used in the laboratory to process stool and urine specimens. These included; binocular microscope and laboratory reagents, whose echnical details and their use are given under Appendices C and D.

Other items that were used in the laboratory to examine specimens were as follows; 10% formaldehyde, microscope glass slides, applicator sticks, sodium hypochloride, disposable gloves, soap and the Kato-Katz technique items including templates, nylon mesh, glycerol, cellophane, spatula, absorbent tissue, microscope glass slides, 3% methylene blue, disposable gloves, marker for labeling and a form for recording results of stool examination. The items used to process urine samples by sedimentation method include; disposable gloves, centrifuge with head and cups to hold 15-ml tubes, centrifuge tubes, cover slips, microscopy glass slides, conical flask for urine collection, pipettes, and marker for labeling, pen and form for recording results.

3.4.2: Collection of stool and urine specimens

Each child was provided with two similar numbered screwed plastic containers, one for the stool and the other for the urine sample. The containers were numbered according to the same ID number used on the questionnaire. To collect stool specimens the researcher used mud and demonstrated in front of school children on how they could pick and fill the stool sample using an applicator stick in the provided containers. They were instructed to collect about a tea spoonful of stool on the same date of data collection and fill in the provided stool container. On receiving the stool specimen about 7 milliliters of 10% formaldehide was added by researcher or his research assistants to each of the stool specimen, thoroughly mixed to fix eggs of intestinal worms (Isenberg, 1998).

To collect urine specimens the researcher used water and demonstrated in front of school children on how they could collect their terminal urine into the provided containers. Children were instructed to collect their terminal urine on the same date of data collection and fill about three quarters of the urine container provided, that meant 15 milliliter of urine. On receiving the specimen researcher or research assistants added with 0.2 milliliter of 37% formaldehyde to preserve urine sample before leaving the field for microscopic examination. Bearing in mind that the number of schistosoma eggs varies throughout the day; collection of stool and terminal urine was carried out between 10hours and 14hours. This ensured the highest number of schistosoma eggs in the specimens (Piekarski, 1989).

3.4.3: Collection of qualitative data

Qualitative data was obtained using in-depth interviews in which an interview guide was used to obtain detailed information about the programme. Eighteen key informants were enrolled in the study namely; seven school teachers, three health workers; seven influential people in the community and the national school health programme coordinator.

Once the consent was obtained the key informant was asked to propose time and place that was convenient for in-depth interview. School teachers, national school health programme coordinator and the medical professionals were interviewed at their working places while the influential people in the community were interviewed at their home places. Researcher began by interviewing the key informants from the medical field followed by school teachers and influential people in the community. Lastly the researcher interviewed the national school health programme coordinator. Research assistants helped the researcher to have an access to the key influential people in the community who were already identified.

Discussions and documentation of the information obtained was done using Kiswahili language because most of the people in the area speak Kiswahili. Later during the analysis this information was translated into English. Each key informant was systematically interviewed to obtain detailed information about the programme. Most of the questions were open-ended and sought to explore the possible factors associated with performance of the de-worming programme and the level of understanding among teachers on school de-worming programme. The interview focused on the following key areas; community opinions, knowledge about the programme, whether there was any kind of incentive offered during the de-worming campaign, any participation of local leaders; health workers and other key stakeholders during the campaign.

Other questions focused on whether school children had been trained on issues relating to school health de-worming programme, the sudy also sought to identify areas where the programme need improvement and the way anthelminthic drugs were distributed. Detailed interview was made to each participant and documentation of the specific statements made by the key informants. Apart from documenting statements from the key informants, the researcher also wrote down observations he made during the interviews. Immediately after leaving the field, the researcher organized all the informations obtained.

3.5.0: Stool examination

Stool was collected from a labeled screwed plastic container then preserved using 10% formaldehyde and stored at room temperature before leaving the field for microscopic examination. Prior microscopic examination of specimen the stool samples were processed using the Kato-Katz technique (Montresor et al., 1998). Processing and examination of stool samples was done at MUHAS laboratory in the Department of Parasitology/Medical Entomology. Detailed procedure for the Kato-Katz technique is described in Appendix C. Using the Kato-Katz technique the eggs per gram of faeces was obtained by multiplying the number of eggs counted on the slide by the multiplication factor of 24. This was because the templates used hold 41.7 mg of faeces (WHO, 1987, 1993).

3.5.1: Urine examination

Filtration is the best method for the detection and quantification of *Schistosoma haematobium* eggs in urine. However, due to budgetary constraints the study did not carry out filtration method instead sedimentation method was applied by centrifuging terminal urine to concentrate schistosome eggs. Urine was collected from a labeled screwed plastic container then preserved using 0.2 mililliter of 37% formaldehyde and stored at room temperature before leaving the field. Processing and examination of urine was done at MUHAS laboratory in the Department of Parasitology/Medical Entomology. Before examination urine was centrifuged at 2000 revolution per minutes for two minutes to obtain sediments that was examined under the microscope for the presence of *Schistosoma haematobium* eggs (WHO, 1991). Detailed information on urine sedimentation is described in Appendix D.

3.6.0: Data entry and analysis

3.6.1: Analysis of quantitative data

With the assistance of an experienced research data clerk, the data capturing sheet (Template) was developed and the researcher started to enter data. Data was entered using EPI info computer software version 3.5.1 of August 13, 2008. Data were thoroughly cleaned and validated to determine coding errors in which frequency tabulation was applied for each of the study variables. Data analysis was carried out by running descriptive statistics and cross tabulations. Helminthic infection rates among the pupil were calculated, proportion of children received de-worming treatment during the last time round was also explored.

Chi square test was conducted to analyze the most prevalent worms (*S. haematobium* and hookworms) among school children in the area by comparing it with their age and sex. Similarly, proportion of pupils who received anthelmintic treatment during the last de-worming round was compared against their age and sex. Differences in proportion were evaluated using the Chi-square test. Statistical significance was achieved if $P < 0.05$.

3.6.2: Analysis of qualitative data

Qualitative data sought to explore two major aspects namely; the knowledge of school teachers on school de-worming programme and factors associated with performance of the school de-worming programme. Most of the factors associated with performance of the programme were analyzed through narratives while the knowledge of school teachers on issues relating to the programme was analyzed by determining the points scored from the question asked as described below.

Seven key informants, mainly teacher's in-charge of health education from different schools, were interviewed to determine their knowledge about the programme. Questions were designed based on different themes to determine teachers' knowledge about the programme. The first three themes assessed the aim of the programmes.

These include; reducing worm burden and transmission; improving sanitation and health education on positive hygienic behaviour. The last question had eight themes which were expected to be covered during the last de-worming seminar. These were the knowledge about common types of worms; understanding helminth preventive measures; drug distribution; health education; hygiene promotion; sanitation promotion; helminthic preventive measures through improving water and sanitation and solving problems related to side effects of the de-worming tablets.

Each theme assessed was regarded as question and was given a score; Questions that assessed knowledge on the aim of the programme was given 10 points to each of the correct answers and 0 point was given to the wrong answer. This was followed by computing the mean and mode for the points scored to determine the levels of knowledge in three equal categories as follows; the score points ranging from 23.4 to 30 and from 16.7 to 23.36 was regarded as "Very good knowledge" and "fairly good knowledge" respectively while the score points of 10.0 to 16.66 was regarded as "Low knowledge". Similarly the second question which had eight themes was scored as follows; the score for each of the correct answer was given 5 points while 0 point was given to the wrong answer. Similarly mean and mode was computed to determine the level of knowledge in three equal categories as follows; the score ranging from 28.5 to 40 was regarded as "Very good knowledge" while the scores ranging from 16.7 to 28.4 was regarded as "Fairly good knowledge" and those ranging from 5.0 to 16.66 was regarded as "Low knowledge".

3.7.0: Variables

3.7.1: Dependent variable

Helminthic infection status

3.7.2: Independent variables

1. The knowledge of teachers regarding the programme
2. Perceived adverse drug effect

3. Drug consumption status
4. Reasons for not taking treatment during the last de-worming intervention
5. Incentives given to school teachers
6. Involvements of key stakeholders during the campaign

3.8: Study limitation

This was a cross-sectional study therefore, it is important to note that the prevalence and characteristics of helminthic infections was given at that particular time and not for any other time.

The source of research fund was so limited to carry out anticipated laboratory procedures as the study intended to quantify helminthic eggs both from the urine and stool samples and compare findings to those of the previous survey done in 1996. Due to limited funds it was difficult to quantify helminthic eggs in the urine samples so long as the items for urine filtration such as polycarbonate membranes and filter holders were very expensive, instead a study used centrifugation technique in which terminal urine was centrifuged to concentrate schistosome eggs. Failure to quantify urine samples limits the findings to make a concrete comparison of urinary schistosomiasis to those of the previous study.

Despite the problem encountered the researcher managed to obtain useful information, reflecting the actual situation and magnitude of the problem in the area.

3.9: Ethical clearance

The protocol for this study was approved by the MUHAS ethical committee. The approval was on the agreement that; participation in the study must be voluntarily, evade deceiving and harming the participant. Permission to conduct study in Korogwe urban district was obtained from the District Executive Director who wrote letters to the District Education Officer, the District Medical Officer and head teachers for introduction. Through teachers children were informed about the study at least two

days before the actual day for data collection and were invited to pass over the information to their parents/guardians. On behalf of children, head teachers were requested to provide a written consent to interview and collect specimens from the school children.

All work was performed according to the MUHAS ethical committee. Risk to study participant was considered to be minimal, involving interview and specimen collection mainly stool and urine. Treatment of the infected pupils was arranged between the District Medical Officer (DMO), head teachers and the researcher. Laboratory results were communicated between the infected pupil and his/her parent or guardian through their teachers before treatment was given. Infected pupils including their parents/guardians all accepted an offer for the treatment and treatment was successfully provided at Korogwe district hospital.

CHAPTER FOUR

4.0: Results

The present survey determined the prevalence of helminthic infections and factors associated with performance of the school health programme. The following are findings from this study.

4.1: Location and distribution of the study population

Results show that eight primary schools were involved in the study which recruited a total of 579 pupils. The sampling gives an average of 72 children from each primary school. Of those sampled 50.3% were Males and 49.7% were females (Table 1).

Table 1: Location and sex distribution of the study population (N=579)

Name of the Ward	Name of school	Male	Female	Total
Mtonga	Kilimani	36	35	71
Kilole	Kilole	33	40	73
Old Korogwe	Kitopeni	35	37	72
	Old Korogwe	35	37	72
Magunga	Kwasemangube	40	33	73
	Zung'nut	39	34	73
Manundu	Mazoezi Manundu	37	35	72
	New Korogwe	36	37	73
Total		291	288	579

4.2: Characteristics of the school children

Table 2 shows distribution of the study population by age and sex. Males represented 50.3% of the population while females represented 49.7%. Children in the age group of 6-12 years represented 69.8% while those in the age of 13-17 represented 30.2% of the population. The differences between the sexes and between the age groups were not statistically significant ($p>0.05$).

Table 2: Distribution of the study population by age and sex (N= 579)

Age (Yrs)	Sex					
	Male	(%)	Female	(%)	Total	(%)
6-12	195	(48.3)	209	(51.7)	404	(69.8)
13-17	96	(54.9)	79	(45.1)	175	(30.2)
Total	291	(50.3)	288	(49.7)	579	

4.3: Prevalence of schistosomiasis and soil transmitted helminth infection

Table 3 shows the prevalence of schistosomiasis and soil transmitted helminth infections. Two species of schistosomiasis and three parasites for soil transmitted helminth infections were found to be prevalent in children in the study area namely; *Schistosoma haematobium*, *Schistosoma mansoni*, *Ascaris lumbricoides, Trichuris trichiura* and hookworms. *S. haematobium* and hookworms had the highest prevalence of 8.3% and 5.9% respectively.

Table 3: Prevalence of schistosomiasis and soil transmitted helminth infections (N= 579)

Helminthic parasites	No. Exam.	No. Positive	Prevalence (%)
S. haematobium	579	48	8.3
S. mansoni	579	1	0.2
A. lumbricoides	579	4	0.7
T. trichiura	579	2	0.3
Hookworms	579	34	5.9

4.3.1: Prevalence of infection with at least one helminthic infection by age and sex

Results shows that the overall prevalence of helminthic parasites namely; *Schistosoma haematobium*, *Schistosoma mansoni*, *Ascaris lumbricoides, Trichuris trichiura* and hookworms identified in the area was 14.7%.

Table 4 shows the prevalence of infection with at least one of the helminthic parasites by age and sex among the school children. The prevalence of infection with any of the five helminths namely; *S. haematobium*, *S. mansoni*, *A. lumbricoides, T. trichiura* and hookworms were found to be higher among females (16.0%) compared to males (13.4%). The difference was not statistically significant ($p>0.05$). Older children in the

age group of 13-17 years had the highest prevalence of infection with 19.4% compared to 12.6% in the age group of 6-12 years. The difference was statistically significant ($p<0.05$).

Table 4: Prevalence of infection with at least one of helminthic infection by age and sex (N=579)

Age (Yrs)	Sex						
	Male		Female		Total		
	No. exam.	No. pos. (%)	No. exam.	No. pos. (%)	No. exam.	No. pos (%)	P-value
6-12	195	20 (10.3)	209	31 (14.8)	404	51 (12.6)	0. 034
13-17	96	19 (19.8)	79	15 (19.0)	175	34 (19.4)	
Total	291	39 (13.4)	288	46 (16.0)	579	85 (14.7)	

No. Exam. = number examined: No. pos. = Number positive for parasites

4.3.2: Age and sex distribution of the common helminths

Two helminthic parasites were found to be the most prevalent in the study area namely *Schistosoma haematobium* (8.3%) and hookworms (5.9%). Results in Table 5 show that, the prevalence of *S. haematobium* was higher (12.6%) among children aged 13 – 17 years compared to 6.4% in those aged 6-12 years. The difference was statistically significant ($p< 0.05$). The prevalence of *S. haematobium* among males was 8.6% while 8.0% was among females. The difference was not statistically significant ($p> 0.05$). The prevalence of hookworms was 7.6% among females compared 4.1% among

males. The difference was not statistically significant (p>0 .05). The prevalence of hookworms was higher (7.6%) among children aged 13 – 17 years compared to 5.2% in those aged 6 – 12 years. The difference was not statistically significant (p> 0.05).

Table 5: Prevalence of Schistosoma haematobium and hookworms according to age and sex (N= 579)

Age (Yrs)	Sex						
	Male		Female		Total		
	No. exam	No. pos (%)	No. exam.	No. pos (%)	No. exam	No. pos (%)	P-value
***S. haematobium* infection**							
6-12	195	10 (5.1)	209	16 (7.7)	404	26 (6.4)	
13-17	96	15 (15.6)	79	7 (8.9)	175	22 (12.6)	0. 014
Total	291	25 (8.6)	288	23 (8.0)	579	48 (8.3)	
Hookworm infection							
6-12	195	8 (4.1)	209	13 (6.2)	404	21 (5.2)	
13-17	96	4 (4.2)	79	9 (11.4)	175	13 (7.4)	0. 29
Total	291	12 (4.1)	288	22 (7.6)	579	34 (5.9)	

No. Exam. = number examined: No. pos. = Number positive for parasites

4.3.3: Prevalence of mixed infections

The study identified four cases (0.7%) of mixed infection. Three of these cases were co-infections of *S. haematobium* and hookworms while one case was infected with *S. mansoni* and hookworms infection.

4.3.4: Intensity of intestinal worms

According to WHO recommendations (Montresor et al., 2002) the intensity of helminth infection threshold as expressed by egg count per gram of faeces should be ranked as light, moderate and heavy infections as described in Appendix B. Results for the intensity of intestinal helminths show that, the number of eggs per gram of faeces from children infected with hookworms ranged from 24 to 432 eggs per gram of faeces while for *Ascaris lumbricoides* and *Trichuris trichiura* the egg count ranged from 48 to 888 and 48 to 72 eggs per gram of faeces respectively. Only one case was found for *Schistosoma mansoni* having 24 eggs per gram of faeces. This means that according to WHO recommendations, results for the intensity threshold for *S. mansoni*, hookworms, *A. lumbricoides* and *T. trichiura* in this study fell under the "light infection" category.

4.3.5: Mean intensity of intestinal helminths

Out of 579 children who were enrolled for the study 34 were infected with hookworms with an average intensity of 7 eggs per gram of faeces. There were 4 cases for *A. lumbricoides* with an average intensity of 2 eggs per gram of faeces and 2 cases of *T. trichiura* with an average intensity of 0.2 eggs per gram of faeces while one case of *S. mansoni* was found with an average intensity of 0.04 eggs per gram of faeces.

Table 6: Mean intensity of intestinal helminth infections (N= 579)

Helminth infections	No. infected	No. of epg	Average epg
A. lumbricoides	4	1320	2
T. trichiura	2	120	0.2
S. mansoni	1	24	0.04
Hookworms	34	3864	7

No. of epg = Number of eggs per gram of faeces

4.4: Coverage of de-worming treatment

Praziquantel and albendazole de-worming drugs are dispensed by two independent national programmes namely; NSSCP and NLFEP respectively. Results show that out of 579 children who were recruited 45.4% took praziquantel and 12.6% took albendazole tablets. The coverage of praziquantel and albendazole by age and sex are shown in Table 7 below. Of all who took praziquantel tablets for schistosomiasis females represented 47.2% coverage compared to 43.6% of males. The difference was not statistically significant ($p> 0.05$). However, the coverage of those who took praziquantel tablets was higher (62.3%) among children aged 13-17 years compared to 38.1% in those aged 6-12 years. The difference was statistically significant ($p< 0.05$).

Proportion of children who took abendazole tablets from the NLFEP during the last de-worming round was higher (13.5%) in females compared to 11.7% among males. The difference was not statistically significant ($p> 0.05$). There was high coverage of albendazole (19.4%) among children aged 13-17 years compared to 9.7% in those aged 6-12 years. The difference was statistically significant ($p< 0.05$).

Table 7: Coverage of de-worming treatment by age and sex (N= 579)

Age (Yrs)	Sex					
	Male		Female		Total	
	No. of part.	No. trd. (%)	No. of part.	No. trd. (%)	No. of part.	No. trd. (%)
*PDC						
6-12	195	62 (31.8)	209	92 (44.0)	404	154 (38.1)
13-17	96	65 (67.7)	79	44 (55.7)	175	109 (62.3)
Total	291	127 (43.6)	288	136 (47.2)	579	263 (45.4)
**ADC						
6-12	195	16 (8.2)	209	23 (11.0)	404	39 (9.7)
13-17	96	18 (18.8)	79	16 (20.3)	175	34 (19.4)
Total	291	34 (11.7)	288	39 (13.5)	579	73 (12.6)

***PDC = Praziquantel de-worming coverage; **ADC = Albendazole de-worming coverage**

No. of part. = Number of participant; No. trd. = Number treated during the campaign

4.5.0: Factors associated with programme performance

Several factors were studied to determine their influence on the programme performance. These included the opinions and awareness of school children about the programme, sources of information about the de-worming campaign and reasons for

not receiving treatment during the last de-worming round. Other reasons included; perceived adverse drug events, risk behaviors associated with helminthic infections, knowledge of teachers on school health programme and incentives offered during the last de-worming campaign.

4.5.1: Opinion of school children regarding the programme

Results show that among 579 children recruited for the study 95.3% reported having positive opinion about the programme.

4.5.2: Awareness of the de-worming programme

Results show that of 579 children studied 93.3% reported to be taught about health issues related to school health programme as part of their syllabus. Among the areas reported to be covered during health education lessons were as follows; the importance of participation in the programme (36.8%), how children get infected with worms (45.1%) and general hygiene including; house cleaning (0.3%), personal hygiene (11.6%), environmental hygiene (0.2%), hand washing before meals (88.6%), hand washing after meals (38.2%) and environmental sanitation (44.0%).

Results show that, parents/guardians were aware of the programme objectives and were reported to participat in the implementation of the programme by taking stool or urine specimen of their school age children to the near by health care unit for identification of helminthic infections. Among children who participated in the study 46.2% of females and 45.4% of males reported having at least one round of stool examination for intestinal helminths infections. However, the difference was not statistically significant ($p>0.05$). Likewise 29.2% and 27.8% of males and females children respectively reported having urine examination outside the programme initiatives for identification of *S. haematobium* infections. The difference was not statistically significant ($p> 0.05$).

Among those who had stool examination 15.5% reported to be examined at school while 82.1% were examined at hospital and 2.3% were examined at home. Those who

reported having stool examination at home, 0.8% were examined by medical practitioners while 1.5% reported that their parents/guardians took the specimen for examination at hospital or nearby laboratory centers. Moreover, it was reported that out of 265 children who were examined for intestinal worms in the last one year 201 (75.9%) were examined once while 51 (19.2%) were examined twice at two different occasions and 13 (4.9%) were examined at three different occasions.

Similarly out of 165 children who reported having urine examination 35 (21.2%) were examined at school, 127 (77.0%) were examined at hospital and 3 (1.8%) were examined at home. Result shows that children who had urine examination at home, the specimens were sent to the nearby hospital or laboratoty center by parents/guardians. Majority of those who had urine examination in the last one year were examined once 129 (78.2%) while 34 (20.6%) were examined twice and 2 (1.2%) were examined at three different occasions.

4.5.3: Source of information

Children were interviewed to determine ways to which information about the school health programme was obtained. Out of 579 children who were recruited 423 reported to have access of information about the programme from five different sources. These include information obtained through school teachers, through parents/guardians, information obtained at hospital when a child goes to the hospital for treatment and information obtained through media including television and radio. Table 8 shows the sex distribution of children by different source of information about the school de-worming programme. Results show that, higher proportion (89.1%) of children reported to receive information from school teachers. However, information received from teachers did not significantly differ in sex as 40.8% of males and 88.9% of females received information from school teachers. There was a slight difference in the proportion of males and females who depend on the other sources of information including information received at home, at hospital, through television and through

radio. However, the differences from these sources of information were not statistically significant ($p>0.05$).

Table 8: Distribution of source of information among school children by sex (N= 423)

Source of information	Sex								
	Male			Female			Total		
	No. of part.	No. rec.	(%)	No. of part.	No. rec.	(%)	No. of part.	No. rec.	(%)
Teachers	206	84	(40.8)	217	193	(88.9)	423	377	(89.1)
Home	206	33	(16.0)	217	39	(18.0)	423	72	(17.0)
Hospital	206	5	(2.4)	217	9	(4.1)	423	14	(3.3)
Television	206	7	(3.4)	217	5	(2.3)	423	12	(2.8)
Radio	206	17	(8.3)	217	14	(6.5)	423	31	(7.3)

No. of part. = Number of participant; No. rec. = Number receiving information

4.5.4: Reasons for not taking treatment during the last de-worming round

Results in Table 9A and 9B show that, children in the area did not participate in the NSSCP and the parallel programme (NLFEP) respectively due to the following reasons; absent from school (53.1%) during the campaign, forbidden by parents (26.3%), afraid of taking the drug due to their perceived side effects (5.1%) and others with no reason refused taking the treatment (12.3%). Reasons for those who did not participate in the parallel programme (NLFEP) did not differ from the reasons of those

who did not participate in both programmes and included; absent during the campaign (12.5%) refused to take the treatment (26.5%), forbidden by parents (21.5%), afraid of taking the drug due to their perceived side effects (11.3%) and 25.3% of children did not know about the de-worming campaign.

Table 9A: Reasons for not taking treatment in the last de-worming cycle from NSSCP (N = 316)

Reasons for not Taking treatment	No. not treated	Percent (%)
Absent from school	168	53.1
Refused treatment	39	12.3
Forbidden by parents	83	26.3
Forbidden by other children	1	0.3
Fear of adverse drug effects	16	5.1
Did not know about the campaign	6	1.9
Sick from other infections	3	1.0

Table 9B: Reasons for not taking treatment in the last de-worming cycle from NLFEP (N = 506)

Reasons for not Taking treatment	No. not treated	Percent (%)
Absent from home	63	12.5
Refused taking the drug	134	26.5
Fear of adverse drug effects	57	11.3
Forbidden by parents	109	21.5
Did not know about the campaign	128	25.3
Sick from other infections	8	1.6
Children do not suffer Elephantiasis	7	1.4

4.5.5: Problems experienced after taking praziquantel

Out of 579 children who were recruited in the study 263 (45.4%) took praziquantel tablets during the last de-worming campaign in 2007. Of these 46 (17.5%) experienced symptoms that were considered to be associated with adverse drug effects. Of those affected 26 (20.6%) were males and 20 (14.8%) were females. However, the difference between the affected males and females was not statistically

significant ($p>0.05$). Seven different symptoms associated with praziquantel side effects were observed in which some pupils reported having more than one symptom. Among the reported side effects were dizziness 18 (3.1%), abdominal pain 9 (1.5%), nausea 8 (1.4%), headache 7 (1.2%), general body weakness 7 (1.2%), vomiting 4 (0.7%) and diarrhoea 2 (0.3%).

4.5.6: Risk factors for infection

Exposure to risk factors for *S .haematobium* and hookworm infections were identified in which washing clothes in the river, swimming in the river, swimming in the irrigation canals and swimming in the swamps were the risk factors for *S. haematobium* infections while walking barefoot for different occasions including at school, at home and when the child goes to the place of worship were the risk factors for hookworm infections. These risk factors were identified through the interviews then it was combined to form one overall risk factor known as "exposure to potentially contaminated water bodies" and "irregular use of footwear" which was the risk factors for *S. haematobium* and hookworm infections respectively.

Out of 579 children recruited for the study 48 reported being in regular contact with potentially contaminated water bodies while 555 reported being in irregular use of footwear. Table 10 shows the risk factors for infections with *S. haematobium* and hookworms according to age and sex. Results showed that a higher proportion (12.6%) of older children aged 13-17 years reported being in regular contact with potentially contaminated water bodies compared to 6.4% for younger children aged 6-12 years. The difference was statistically significant ($p<0.05$). The proportion of males who reported being in regular contacts with potentially contaminated water bodies was 8.6% compared to 8.0% for females, the difference was not statistically significant ($p>0.5$).

The proportion of children who reported being in irregular use of footwear was higher (96.8%) among younger children aged 13-17 years compared to older children (93.7%) aged 6-12 years. The difference was not statistically significant. Likewise the

proportion of children who reported being in irregular use of footwear did not differ among males (95.9%) and females (95.8%).

Table 10: Risk factors for schistosomiasis and hookworm infections according to age and sex (N=579)

Characteristics	No. of participant	No. with risk factor	Percent (%)	P- value
S. haematobium				
Age (Years)				
6-12	404	26	6.4	0.02
13-17	175	22	12.6	
Sex				
Male	291	25	8.6	0.79
Female	288	23	8.0	
Hookworms				
Age (Years)				
6-12	404	391	96.8	0.89
13-17	175	164	93.7	
Sex				
Male	291	279	95.9	0.98
Female	288	276	95.8	

4.5.6.1: Effect of exposure to risk factors on helminthic infections

The risk factors for infection with *S. haematobium* were washing clothes in the river, swimming in a river, swimming in irrigation canals and swimming in a swamp while the risk factors for hookworm infection were regular walking barefoot at school, at home and when the child goes to the place of worship. These risk factors were combined to form one overall risk factor known as "exposure to potentially contaminated water bodies" and "irregular use of footwear" as risk factors for *S. haematobium* and hookworm infections respectively. Table 11 shows the association between infection with *S. haematobium* and hookworms and exposure to risk factors. The finding showed that exposure to potentially contaminated water was not associated with *S. haematobium* infections, OR = 0.89 (CI; 0.44, 1.73). Similarly with regard to hookworm infection there was no association between irregular use of footwear and hookworm infections, OR =1 (CI; 0.24, 9.26).

Table 11: Association between infection with S. haematobium and hookworms and exposure to risk factors (N = 579)

		Infection status		Total	OR (95% CI)
		Infected	Not infected		
***S. haematobium* infections**					
	Exposed	15	180	195	
					0.89 (0.44, 1.73)
	Not exposed	33	351	384	
Hookworm infections					
	Exposed	32	512	544	
					1 (0.24, 9.26)
	Not exposed	2	33	35	

OR = Odds ratio; CI = Confidence interval

4.6.0: Qualitative data results

Qualitative data were obtained using interview guidelines. In-depth interviews were carried out with selected key informants from the medical professionals, primary school teachers, influential people in the community and the national school health programme coordinator. The interview aimed at exploring the level of knowledge among school teachers about the programme and factors associated with performance of the de-worming programme in the study area. The following findings were obtained from the discussion with key informants;

4.6.1: Knowledge on the programme among teachers

The knowledge among school teachers on the school health de-worming programme was assessed through qualitative study using in-depth interview. Two basic questions

were used to determine teachers' knowledge about the programme. The first question assessed the level of knowledge looking at the aim of the programme while the second question assessed the level of knowledge looking at other aspects of the programme particularly those related to topics covered during the training seminars involving school teachers.

Assessment of the knowledge on the aim of the programme showed that, out of seven key informants interviewed four of them scored 57 points each while three key informants who remained scored 43 points each. From these findings the key informants who scored 57 points were regarded to have "fairly good knowledge" while those scored 43 points were regarded to have "low knowledge". Assessment of other aspects of the programme including; the knowledge about the common types of worms; understanding helminth preventive measures; drug distribution; health education; hygiene promotion; sanitation promotion; helminthic preventive measures through improving water and sanitation and solving problems related to side effects of de-worming tablets showed that, four out of seven key informants interviewed scored 57 points each while 43 points was scored by each of the three remained key informants. From these findings those scored 57 points fall into a category of "fairly good knowledge" while those scored 43 points fall into a category of "low knowledge'. However, there was no key informant from the two basic questions who were found to fall under the category of 'very good knowledge' as per score ranked above.

4.6.2: Incentives in the school health de-worming programme

Incentive is any kind of motivating factors given to programme implementers for the success of the programme. This study explored if there was any kind of incentive for the programme as this could influence programme performance. Analysis of the findings showed that; key stakeholders like the local leaders, health workers and teachers complained of not being respected during the last de-worming campaign. For

instance one key informant who attended the last de-worming seminar complained of being deceived by the trainer during the seminar as indicated below;

> '.....*The bad thing I will never forget is that, they assured us to receive all kinds of incentives on the day of de-worming campaign but till now nothing has been received'*. (Key informant)

Further more, analysis of the finding shows that school teachers were willing to continue supporting the programme even though they were not given any kind of material incentives. Discussion with some influential people including the local leaders in the community revealed that, they were informed about the campaign but did not participate because they were not assured of any kind of material incentives, as reported by one of the key informants below.

> *'It is hard to find the local leaders' during the school de-worming campaign because our presence is not valued. How can I stay there for the whole day without even a cold drink.....I once participated in one of the malaria control programs where I came home with good money, how come this programme did not pay us anything'*. (Key informant)

One key informant supported the argument raised from other key informant and pointed out that; the school de-worming programme has been facing budgetary constraints. They had planned to hand over all the intervention activities to the district authorities. What they are doing is to advise the district medical officers (DMO) and the District Executive Directors' (DED) to set aside money from their health fund and take full responsibilities in running the school de-worming programme in their respective districts.

4.6.3: Attitude towards the school de-worming programme

Results from the in-depth interview showed that, community members including the school teachers had positive attitudes towards the programme. What was found to be

among the challenges was the fear among parents that the drugs could harm children as reported out by one of the key influential people in the community.

> *'I really accept the school de-worming programme but my doubt is on the type of drugs used during the campaign…… We are receiving the same kind of drugs from the hospital and pharmacy but we don't experience such kind of problems, how come the drugs affect our children'.* (Key informant)

Medical professionals on the other hand did not show their full participation during the campaign. One key informant argued that, the problem of negative rumors against the programme could have been eliminated if both the health workers and local leaders joined teachers during the de-worming campaign. The key informant stressed that, in the presence of medical personnel people would not shout against teachers that they were giving incorrect dose to school children as indicated below;

> *'……We dispensed the correct dose of de-worming drugs but some of the parents including health personnel complained that teachers were not giving the correct dose to children and associated it with those children who developed symptoms relating to adverse drug events'.* (Key informant)

Medical professionals were considered to be knowledgeable about the school de-worming programme including feasibility of using height pole as an alternative way to determine the correct dose of praziquantel tablets. The in-depth interview with one of the key informants from the medical professionals revealed that some of them were not aware that, a child's height could be used to determine the correct dose of praziquantel in places where weight measurements cannot easily be obtained as indicated below;

> *'……..I wonder how teachers were dispensing praziquantel tablets basing on the child height instead of using their body weight! This could end up into overdosing our children'.* (Key informant)

Another key informant from the medical profession pointed out that, there was no primary school child brought to their district hospital who complained of symptoms related to the adverse effect of praziquantel treatment during the last de-worming campaign.

4.6.4: Training seminar for teachers

During the in-depth interview it was established that, the training workshop on the de-worming programme for school teachers who were to conduct treatment was carried out for one day. Each school was invited to send one teacher. The invitation was mainly to teacher's in-charge of health education (*'mwalimu wa afya'*) or to teachers who attended the first training seminar. The training seminar in each district was organized by members of the District Health Management Team who conducted the training in one center. It was learnt during the interview, that the initial planning was to train two teachers from each school; one being the head teacher and the other being the teacher in-charge of health education. However, they managed to train one school teacher mainly *'mwalimu wa afya'* due to budgetary constraints. The time allocated for training was adequate as reported by one of the key informants.

> *'One day training was quite enough for us to understand delivery of the de-worming treatment. What we learnt was just about techniques for dispensing drugs based on child's height as well as the correct way to fill the report forms'.* (Key informant)

Another key informant compared the last de-worming seminar and the one held during the first de-worming campaign in 2005 and said that, the last training seminar was not well organized because the trainer assumed every participant knew the topics and thus it was like a repetition of what they were taught during the first de-worming round as reported by one of the key informants below;

> *'The last training workshop was somehow different compared to the one we had during the first de-worming campaign……we were trained as if we were experts for the programme. Towards the end the trainer told us to go back home*

insisting that we share our experience with those who attended the seminar for the first time'. (Key informant)

It was found during the interview that, all teachers from each school participated in the last de-worming campaign in spite of not attending the seminar. Furthermore it was learnt that there were little or no initiatives both from the head teacher and the trained teacher (mainly the in-charge of health education) to train their colleagues who did not have the chance to attend the seminar. Even those who were trained the training session occurred on the same date of the de-worming campaign as reported by one of the key informants below;

'.....I trained my fellow school teachers on how to dispense drugs including; height measurement and all other necessary information during the campaign, only a few hours before commencement of the de-worming treatment'. (Key informant)

4.6.5: Training children

The study also explored if children were trained on issues related to the school de-worming programme. Analysis of the findings showed that; primary school teachers trained children to cover the topics indicated in the curriculum. Teachers who teach science subjects were the ones responsible to teach health related topics which may not necessarily cover topics on de-worming as reported by one of the key informants.

'..... Science subjects teach everything about health and diseases. We do not have any specific subject teaching on worms. What is usually done is to teach them about environmental sanitation, HIV/AIDS and personal hygiene including; hand washing after visiting the toilet, oral health and wearing of shoes'. (Key informant)

CHAPTER FIVE

5.0: Discussion, conclusion and recommendations

5.1: Discussion

Infections with schistosomiasis and soil-transmitted helminths (STH) impose an unnecessary burden on many Tanzanian children. School children are the group most heavily infected with these helminths (Savioli et al., 1992). Local and international studies have demonstrated that synchronized and regular treatment of school-age children for schistosomiasis and STHs can reduce the morbidity associated with these infections (Beasley et al., 1999; Bethony et al., 2006). The present study was designed to assess the prevalence of helminthic infections and factors associated with performance of the school health de-worming programme in Korogwe urban district, Tanzania.

5.2: Prevalence of helminthic infections

The present study identified five different helminthic parasites that infect school children in the area. Of these two were schistosomes and three were STH infections namely; *Schistosoma haematobium*, *Schistosoma mansoni, Ascaris lumbricoides, Trichuris trichiura* and hookworms (Table 3). The prevalence of *S. haematobium* and hookworm infection were observed to be higher in the current study while the prevalence rate for *S. mansoni*, *A. lumbricoides* and *T. trichiura* were negligible (<1.0%). It is hypothesized that the dry environmental conditions encountered during data collection (May - June) aggravated by low rainfall in the last rain reason might have contributed to low positive rates for *T. trichiura* since the ova of this parasite was shown to be liable to destruction due to their fragility (Ukoli, 1984).

It was observed during the study that school children in the area were infected with helminthic infections with an overall prevalence rate of 14.7% both for schistosome and STH infections. This prevalence is almost six fold lower than that of the previous survey (87.0%) done in 1996 (WHO, 2001). It is likely that regular school de-

worming interventions, commitment of teachers on the programme and health education lessons taught to school children have contributed to the reduction in the prevalence of helminthic infections among school children in the area. This finding is unsurprising because praziquantel and albendazole drugs which are commonly used for the national de-worming programmes are effective and have a broad spectrum of activity, clearing most of the common helminthic infections (WHO, 2002). It was further observed that the overall prevalence of helminthic infections was significantly higher (19.4%) among older children aged 13-17 years than those aged 6-12 years. This could be explained by the higher proportion (12.6%) of older children aged 13-17 years who reported being in regular contact with potentially contaminated water bodies.

Though studies done elsewhere (Helmut et al., 1991; Barreto, 1991; Yuesheng et al., 2000) reported association between water contact behaviour and the incidence of *S. haematobium* infections among school children the current study observed that exposure to potentially contaminated water bodies which is the risk factors for schistosome infection was not associated with *S. haematobium* infection (OR = 0.89). This surprising result could be explained by the effectiveness of regular school de-worming intervention in which we can only see the effect of de-worming treatment rather than the effect of exposure to potentially contaminated water bodies.

Findings of the current study indicated a prevalence rate of 8.3% for *S. haematobium* and 5.9% for hookworms. However, these prevalence rates are lower than those found in the previous survey in 1996 in the same area (WHO, 2001). It was notable that the school de-worming interventions has dropped the prevalence of hookworm's ten folds from 61.0% in 1996 to 5.9% in the current study while the prevalence of *S. haematobium* dropped seven folds from 59.0% in the previous survey to 8.3% in the current study. The major possible reasons for the drastic fall in the prevalence of *S. haematobium* and hookworm infections can be explained by reduced sources of helminthic infection in the community as long as treating only school age children can

reduce helminthic infections by 70% in the community as whole (Bundy et al., 1990). Another possible reason could be due to access to health education lessons as children reported being trained on how helminths are transmitted as well as the general hygiene practices like personal hygiene and environmental sanitation. It is possible that putting into practices the knowledge from the programme may have complemented the treatment programme.

The current study observed that the prevalence of *S. haematobium* was significantly higher (12.6%) among older children aged 13-17 years compared to those aged 6-12 years. Age variation in the prevalence of *S. haematobium* was comparable to those in the previous survey done in 1996 as the prevalence and intensity of *S. haematobium* was reported to be higher among older children aged 11-14 years than those aged 8-10 years (WHO, 2001). Although studies done elsewhere reported that, the prevalence of *S. haematobium* differs by sex being higher in male than female (Atupele et al., 2009; Chigozie et al., 2009; Ross et al., 2002), the current study did not demonstrate the difference in the prevalence of *S. haematoium* between males (8.6%) and females (8.0%). However, authors from these studies did not indicate whether male and female children were equally recruited for the study therefore; the observed sex difference in the prevalence of *S. haematobium* cannot be compared to the findings in this study.

The intensity threshold for intestinal helminthic infections in the area namely; *S. mansoni*, *A. lumbricoides*, *T. trichiura* and hookworms fell from moderate and heavy infections during the previous survey (WHO, 2001) to light infections in the current study. Similarly the current estimates of the mean intensity of hookworm infections among those who were recruited was almost three times lower than the estimate of 18 eggs per gram of faeces in the previous survey done in 1996 (WHO, 2001). A fall in the worm load can be explained by the effort made by the community members following recognition of the public health significance for helminthic infections. This is demonstrated by the fact that, 75.9% of children reported having at least one round of stool examination, mainly to identify helminthic infections. This health seeking

behaviour which was shown by parents/guardians was reported to have been made outside the programme initiatives indicating that the communities are willing to support implementation of the programme objectives.

Althought the prevalence of hookworm infections was lower (5.9%) compared to the previous study (61.0%) done before commencing the national school de-worming intervention, it was observed that children wore shoes most frequently when they goes to school than when they are at home. Therefore, the prevalence of hookworm infections in the current study can probably be explained by irregular use of footwear among school children mainly at home. However, the current study did not find out any association between 'irregular use of footwear' and hookworm infections (OR = 1) which is contrary to elsewhere studies (Killewo et al., 1991; Lopiso et al., 2002). This finding could have resulted from the effectiveness of de-worming interventions which could downplay the effect of irregular use of footwear on hookworm infections.

5.3: Coverage of de-worming interventions

A single-dose anthelminthic treatment, usually given to children without prior diagnosis is the strategy of choice in the control of helminthic infections. The present study has attempted to evaluate school de-worming coverage for schistosomiasis and soil transmitted helminth infections focusing on the enrolled school children. It was observed that the NSSCP which distributed praziquantel tablets attained a coverage rate of 45.4% while the coverage rate for albendazole from the parallel programme (NLFEP) was 12.6%. These coverage rates are below the WHO recommendation which emphasize helminthic endemic countries to attain at least 75% de-worming coverage of all school age children (WHO, 2001). In the same way the global progress towards meeting this target is not impressive as the most recent data are for 2006 in which school age children in 64 countries Tanzania included were reported having 22% of school de-worming coverage (WHO, 2008).

The possible reasons for low coverage of praziquantel could be due to the low school attendance (53.1%) mainly during the campaign. May be children who reported

having urine examination few months before commencing the last de-worming treatment did not participate and take praziquantel because they knew enough about their infection status hence did not need treatment. Moreover, 26.3% of children reported being forbidden by parents from taking any kind of medication dispensed in the school premises while others with no reason refused (12.3%) taking the drug and 5.1% of children did not take the drug in fear of the adverse drug effects.

Despite overall low coverage of praziquantel during the last de-worming round the study found that older children aged 13-17 years significantly had the highest coverage rate of 62.3% compared to those aged 6-12 years (Table 7). However, the age differences in the de-worming coverage are still below those of the international recommendation. It is likely that, the coverage rate among young children was low because the majority of younger children aged 6-12 years had been recently enrolled at school and did not receive medication during the last de-worming round in 2007 because at that time they had not reached the school age, which is the target group for de-worming intervention.

Similarly the possible reason for the low coverage of albendazole could be due to limited access to information (25.3%) about the campaign, while others with no reason refused (26.5%) taking the drugs and 11.3% of children did not take the drug in fear of adverse drug effects. Another interesting reason is that 1.4% of children reported having the notion that the targeted disease (elephantiasis) does not affect children and thus they did not see why they should take the drugs. Although the overall coverage of albendazole was low the study observed that, the coverage rate of albendazole was significantly higher (19.4%) in older children aged 13-17 years compared to those aged 6-12 years. It is likely that older children had access to information than young children.

5.4: Knowledge of school teachers on school health de-worming programme

Sufficient staffs that are well trained are required to run effective school health intervention programmes. For the last two rounds of praziquantel de-worming

interventions school teachers had been known to be the most potential implementers for the programme activities. In order to ensure the success of the programme activities teacher's in-charge of health education were trained from each school to cover topics related to school de-worming programme. The current study observed that, school teachers in the area had 'fairly good knowledge' about the school health de-worming programme. Having this good knowledge indicates ability of teachers to handle the de-worming campaign (Jamison et al., 2006; Alan et al., 2006). In the same way international experience has demonstrated that de-worming medication can safely be dispcnscd by people who are not health professionals, including school teachers (Awasthi et al., 2003). Likewise, a study in Vietnam showed that, even teachers that did not receive any specific training were able to distribute de-worming medication successfully following the page of written instructions accompanying the drug (Mondadori et al., 2006).

5.5: Factors associated with performance of the school health de-worming programme

In the past, the objective of helminthic control was to eradicate the infection. However, schistosomiasis and STH infections are extremely difficult to eradicate in communities where poverty and inadequate water and sanitation prevail, due to the high transmission potential of these parasites (Anderson, 1991). As a consequence, the current control strategies for schistosomiasis and STH have shifted from eradication to controlling morbidity and transmission using three main approaches mainly chemotherapy, supported by health education and improved water and sanitation (WHO, 1996).

The higher prevalence of *S. haematobium* and hookworms in the area were shown to be recognized by community members because these infections were reported to be among the most public health problems in the area. This could be the reason why children and key informants interviewed reported having positive attitude and thus accepted the programme. Moreover, parents/guardians were reported to be supporting

the programme objectives by taking stool or urine specimens from their school children to the near by hospitals or laboratory centers for diagnosis of helminths mainly hookworm and *S. haematobium* infections.

The current study observed that 17.5% of children reported having symptoms immediately after taking de-worming tablets. However, in-depth interview with key informants observed that although parents/guardians accepted the programme they feared taking the drugs mainly praziquantel due to their perceived side effects. They thought the drugs taken during the campaign could be different from those dispensed by medical professionals in hospitals. They believed that this could be the reason why children reported experiencing symptoms like dizziness, abdominal pain, nausea, headache and general body weakness. Similar complaints subsequent to school de-worming interventions were reported in Turkey (Ulukanligil, 2006) and Vietnam (Ehrhardit et al., 2006). It is likely that those who were heavily infected are the one who experienced symptoms associated with adverse drug effects (Loukas et al., 2006).

Despite of the reported adverse drug effects it was observed that teachers and parents/guardians adopted the international guidelines to provide food before children took the tablets. Moreover, 1.0% of children reported that they did not receive praziquantel tablets while 1.6% did not receive albendazole tablets during the last de-worming intervention because they were sick from other infections. Avoiding de-worming drugs incase of concurrent infections was not because of any danger of side effects, but to prevent the potential misconception that the drugs caused the illness (Montresor et al., 2002).

Apart from the programme achievements some shortcoming were reported indicating that the key stakeholders like teachers, medical professionals and local leaders who participated in the last de-worming campaign were not motivated as most of them expected to receive material incentives like money and lunch. Despite the lack of incentives teachers were still willing to continue supporting the programme. This willingness could be explained by acceptance of the programme among teachers.

Together with the fear of adverse drug effects lack of incentive is one among the major challenges for implementing future school de-worming interventions unless much effort is made to convince local leaders, villagers and other key stakeholders to contribute more time and efforts to the school de-worming activities.

Findings from in-depth interviews with key informants indicated that although pupils had health education lessons it was reported that, there was no special topic focused on the de-worming programme. It was further observed that teachers did not have teaching materials specific to the programme, yet efficient health education is an alternative control approach for de-worming programme (Lansdown et al., 2002; Asaolu et al., 2003). The study also observed that there were little initiatives from the teacher in-charge of health education that attended the seminar to distribute de-worming medication and requested to train their colleagues about the programme.

The current study recognizes difficulties of assembling teachers during the working days just to train them about the programme since the teacher in-charge of health education has no mandate to assemble and train fellow teachers. However, this could be feasible if the head teachers were trained and mandated to train other teachers in their respective schools.

It is likely that teachers who did not have the chance to attend the de-worming seminar could not gain knowledge about the programme because those who attended the training did not take initiatives to train their colleagues. However, this was not explored in this study since the study did not assess knowledge of those who did not attend the seminar. Further studies may be needed to verify this.

5.6: Conclusion

The school age de-worming programme which in most cases is implemented by school teachers is perhaps the most effective way to reduce helminthic infections among school children in Tanzania. A study was conducted in Korogwe urban district to determine the prevalence of helminthic infections and factors associated with performance of the school health de-worming programme.

5.7: Recommendations

From the study, the following recommendations are made:-

- The study found that de-worming interventions had reduced helminthic morbidity among school children in the study area. It is therefore recommend that additional rounds of de-worming treatment be planned for further reduction of schistosomiasis and soil transmitted helminth infections in the area.
- Since the study found that the teacher in-charge of health education was the only teacher who had been trained to distribute de-worming drugs, it is recommended that the head teacher be also included in the training seminar, as training of the head teacher will help to improve preparation and implementation of the programme activities.
- It was found that teachers did not have teaching materials for the programme.It is therefore recommended that teaching materials that are specific for the de-worming programme be provided to school teachers.
- Although the study found that children were regularly trained on health related issues, the training had no specific topics on helminthic infections. It is therefore recommended that the health education program incorporate topics on the de-worming programme.
- It was observed that pupils and the community in general feared taking de-worming medications during the campaign in fear of side effects. It is therefore recommended that the de-worming treatment be preceded with a community meeting. The discussions should focus but not limited to worm infections and nature of medical de-worming treatment including their possible adverse effects.
- It was found that key stakeholders complained of lack of provision of incentives during the last de-worming campaign. It is therefore recommended

to find out some form of incentive packages to encourage full participation of key stakeholders in the de-worming programme.

REFERENCES

Adams V.J, Lombard C.J, Dhansay M.A, Markus M.B. and Fincham J. E, (2004). Efficacy of Albendazole against the Whipworm *Trichuris Trichiura*—A Randomized, Controlled Trial. *South African Medical Journal*; **94**: 972 – 76.

Ageel, A.R and Amin, M.A, (1997). Integration of schistosomiasis control activities into the primary health care system in the Gizan region, Saudi Arabia. *Annals of Tropical Medicine and Parasitology*; **91**: 907–915.

Alan D. Lopez, Colin D. Mathers, Majid Ezzati, Dean T. Jamison, and Christopher J. L. Murray, (2006) eds. Global Burden of Disease and Risk Factors. New York: Oxford University Press.

Albonico M, Engels D, Savioli L, (1994). Monitoring drug efficacy and early detection of drug resistance in human soil-transmitted nematodes: a pressing public health agenda for helminth control. *International Journal of Parasitology*, **42**:277–341.

Albonico M, Smith P. G, Ercole E, Hall A, Chwaya H. M, Alawi K. S and Savioli L, (1995). Rate of Re-infection with Intestinal Nematodes after Treatment of Children with Mebendazole or Albendazole in a Highly Endemic Area. *Trans. R. Soc. Trop. Med. Hyg.* **89**: 538 – 41.

Albonico M, Bickle Q, Ramsan M, Montresor A, Savioli L. and Taylor M, (2003). Efficacy of Mebendazole and Levamisole Alone or in Combination against Intestinal Nematode Infections after Repeated Targeted Mebendazole

Treatment in Zanzibar. *Bulletin of the World Health Organization*; **81**: 343 – 52.

Albonico M, Engels D, Savioli L, (2004). Monitoring drug efficacy and early detection of drug resistance in human soil-transmitted nematodes: a pressing public health agenda for helminth control. *International Journal of Parasitology*, **42**:277–341.

Amara E.E, Jennifer F, Luz P. A, David C. B, Gretchen C. Langdon, Daria L. M, Remigio M. O, Jonathan D. K, and Stephen T. M, (2005). Helminth infection and cognitive impairment among Filipino children. *Am J Trop Med Hyg*. **72**(5): 540–548.

Anderson R.M, May R.M, (1991). Infectious Diseases of Humans: dynamics and control. Oxford: Oxford University Press.

Ansel J, Guyat H, Hall A, Kihamia C, Kivugo J, Ntibwa P, Bundy D, (1997). The reliability of self-reported blood in urine and schistosomiasis as indicators of Schistosoma haematobium infection in chool children: a study in Muheza District, Tanzania. *Trop Med Int Health*; **2** (12): 1180-9.

Asaolu S.O, Ofoezie I.E (2003). The role of health education and sanitation in the control of helminth infections. *Acta Tropica*; **86**: 283-294.

Atupele P. Kapito-Tembo, Victor Mwapasa, Steven R. Meshnick, Young Samanyika, Dan Banda, Cameron Bowie, and Sarah Radke, (2009). Prevalence Distribution and Risk Factors for *Schistosoma hematobium* Infection among School Children in Blantyre, Malawi; *PLoS Negl Trop Dis*. **3** (1): e361.

Awadzi K, Edwards G, Duke B.O, Opoku N.O, Attah S.K, Addy E.T, Ardrey A.E, Quartey B.T, (2003). The co-administration of ivermectin and albendazole – safety, pharmacokinetics and efficacy against *Onchocerca volvulus*. *Ann Trop Med Parasitol*. **97**:165–78.

Awasthi S, Bundy D.A.P and Savioli L, (2003). Clinical Review: helminthic infections. *BMJ*; **327**: 431-3.

Awasthi S, Bundy D.A.P, Savioli L, (2003). Helminthic infections. *BMJ,* **19**: 885-888.

Barreto M.L, (1991). Geographical and socioeconomic factors relating to the distribution of Schistosoma mansoni infection in an urban area of north-east Brazil. *Bulletin of the World Health Organization*, **69** (1): 93-102.

Beasley N.M.R, Tomkins A.M, Hall A, Kihamia C.M, Lorri W, Nduma B, Issae W, Nokes C. and bundy D.A.P, (1999) The impact of population level deworming on haemaglobin leves of school children in Tanga, Tanzania. *Trop Med Int Health*; **4** (11): 744-750

Bethony J, Brooker S, Albonico M, Geiger SM, Loukas A, et al., (2006) Soil-transmitted helminth infections: ascariasis, trichuriasis, and hookworm. *Lancet*; **367**: 1521–1532.

Bundy DAP, Wong M.S, Lewis LL & Horton J, (1990). Control of geohelminths by delivery of targeted chemotherapy through schools. *Trans. R. Soc. Trop. Med. Hyg*. **84:** 115-120.

Bundy D, Hall A, Medley G. F, and Savioli L, (1992). Evaluating measures to control intestinal parasitic infections. *World Health Statistics Quarterly*; **45:**168–179.

Bundy, D.A. (1995). "Epidemiology and Transmission of Intestinal Helminths." In Enteric Infection 2, Intestinal Helminths, ed. M. J. G.Farthing, G. T. Keusch, and D. Wakelin, 5-24. London: Chapman & Hall Medical.

Brooker S, Marriot H, Hall A, Adjei S, Allan E, Maier C, Bundy D.A.P, Drake L.J, Coombes M.D, Azene G, Lansdown R.G, Wen S.T, Dzodozmenyo M, Cobbinah J, Obro N, Kihamia C. M, Issae W, Mwanri L, Mweta M. R, Mwaikemwa A, Salimu M, Ntimbwa P, Kiwelu, V. M, Turuka A, Nkungu D.R, and Magingo J, (2001). Community perception of school-based delivery of anthelmintics in Ghana and Tanzania. The Partnership for Child Development, *Trop Med Int Health*; **6** (12): 1075 – 1083.

Brooker S, Narcis B Kabaterine, Jennifer L Smith, Denis Mupfasoni, Mariam T Mwaja, Onesime Ndayishimiye, Nicholas JS Lwambo, (2009). Deborah Mbotha, Peris Karanja, Charles Mwandawiro, Eric Muchiri, Archie CA Clements, Donald AP bundy and Robert W Snow. *International Journal of Health geographics*; **8**.

Simonsen P.E, Magesa S, Dunyo S, Malecela-Lazaro M, Michael E, (2004). The effect of single dose ivermectin alone or in combination with albendazole on Wuchereria bancrofti infection in primary school children in Tanzania. *Trans. R. Soc. Trop. Med. Hyg*. **98**:462–472.

Centers for Disease Control and Prevention, (2004). Distribution of insecticide-treated bed-nets during an integrated nationwide immunization campaign – Togo, West Africa, December 2004. *Morbidity and Mortality Weekly Report*; **54**: 994–996.

Chan, M.S., Medley, G.F., Jamison, D. and Bundy, D.A.P, (1994).The evaluation of potential global morbidity attributable to intestinal nematode infections. *Parasitology*; **109**; 373 – 87.

Chigozie J. Uneke, Malachy U. Egede, (2009). Impact Of Urinary Schistosomiasis On Nutritional Status Of School Children In South-Eastern Nigeria. *The Internet Journal of Health*; **9** (1).

Chitsulo L, Engels D, Montresor A, Savioli L, (2000). The global status of schistosomiasis and its control. *Acta Tropica*; **77**: 41-51.

Crompton D.W.T and Nesheim M.C, (2002). Nutritional impact of intestinal helminthiasis during the human life cycle; *Annual Review of Nutrition*, **22**:35-59.

Crompton D.W. and Savioli L, (1993.) Intestinal Parasitic Infections and Urbanization. *Bulletin of the World Health Organizatio*; **71**:1-7.

Curtale F, Ram Prasad Pokhrel, Robert L. Tilden and Gene Higashi (1995). Intestinal helminths and xerophthalmia in Nepal. A case-control study. *Journal of Tropical Pediatrics,* **41**: 334–337.

de Silva N. R., Chan M. S., Bundy D. A. P, (1997). Morbidity and Mortality Due to Ascariasis: Re-estimation and Sensitivity Analysis of Global Numbers at Risk. *Trop Med Int Health*; **2**: 519–28.

de Silva N.R, Brooker S, Hotez P.J, Montresor A, Engels D, Savioli L, (2003). Soil-transmitted helminth infections: updating the global picture. *Trends in Parasitology*; **19**:547–551.

de Rochars MB, Kanjilal S, Direny AN, Radday J, Lafontant JG, et al. (2005) The Leogane, Haiti demonstration project: decreased microfilaremia and program costs after three years of mass drug administration. *Amer J Trop Med Hyg*; **73**: 888–894.

Desowitz, R. S, (1981). Controlling the schistosomiasis at a snail's pace. In Desowitz, R. S. (ed.), New Guinea Tapeworms and Jewish Grandmothers: Tales of Parasites and People. Norton, New York.

Ehrhardt A, Anh TL, Cong DT, Montresor A, (2006). Evaluation of coverage of deworming interventions in Vietnam. *Southeast Asian J Trop Med Public Health*; **37**(6):1091-4.

Engels D, Ndoricimpa J, Gryseels B, (1993). Schistosomiasis mansoni in Burundi: progress in its control since 1985. *Bulletin of the World Health Organization,* **71**:207–214.

Engels D, Ndoricimpa J, Nahimana S and Gryseels B, (1994). Control of Schistosoma mansoni and intestinal helminths: 8- year follow-up of an urban school programme in Bujumbura, Burundi. *Acta Tropica*; **58**:127–140.

Geerts S, Gryseels B, (2000). Drug resistance in human helminths: current situation and lessons from livestock. *Clinical Microbiology Reviews*, **13**:207–222.

Guyatt H, (2000). Do intestinal Nematodes Affect Productivity in Adulthood? *Parasitology Today*, **16** (4): 153-158.

Helmut Kloos, Gene I Higashi, Vernon D Schinski, Noshy S mansour, K Darwin Murrell and F DewolfE Miller, (1991). Water Contact and *Schistosoma*

Haematobium Infection: A Case Study from an Upper Egyptian Village. *International Journal of Epidemiology*; **19** (3): 749-758.

Horton J, Witt C, Ottesen E.A, Lazdins J.K, Addiss D.G, Awadzi K, Beach M.J, Belizario V.Y, Dunyo S.K, Espinel M, Gyapong J.O, Hossain M, Ismail M.M, Jayakody R.L, Lammie P.J, Makunde W, Richard-lenoble D, Selve B, Shenoy R.K, Simonsen P.E, Wamae and Weerasooriya M.V, (2000). An analysis of the safety of the single dose, two drug regimens used in programmes to eliminate lymphatic filariasis. *Parasitology*, **121**(Suppl.):S147–S160.

Hotez P, Brindley P.J, Jeffrey M, Bethony, et al., (2008). "Helminth Infections: The Great Neglected Tropical Disease," *The Journal of Clinical Investigation*; **118** (4): 1312.

Isenberg H.I. (ed), (1998). Essential Procedures in Clinical Microbiology Handbook. Washington; DC: ASM Press.

Jamison DT, Breman JG, Measham AR, Alleyne G, Claeson M, Evans DB, Prabhat Jha, Anne Mills, and Philip Musgrove, eds, (2006). Disease Control Priorities in Developing Countries, 2nd ed. New York: Oxford University Press.

Killewo J.Z.J; Caincross S, Smet J.E.M, Mahikwano L.F. and Van Asten, H, (1991). Pattern of hookworm and Ascaris infections in Dar es Salaam. *Acta Tropica*; **48**:247- 249.

Kisanga, F.S, (1991). Schistosomiasis and related transmission factors in the lower Moshi rice irrigation scheme. Dissertation for the degree of Msc Tropical

Disease Control at Muhimbili University College of Health and Allied Sciences, University of Dar es Salaam, Tanzania.

Lansdown R, Ledward A, Hall A, Issae W, Yona E, Matulu J, Mweta M, Kihamia C, Nyandindi U. and Bundy D, (2002). Schistosomiasis, helminth infection and health education in Tanzania: achieving behaviour change in primary schools. *Health Education Research*, **17**(4), 425-433.

Lin D, Zhang S, Murakami H, Wu, Z, Totsuya T, Gu X, Hu G, Chen T, Hu F. and Fei H, (1997). Impact mass chemotherapy with praziquantel on schistosomiasis control in Fanhu village, People's Republic of China. *Southeast Asian Journal of Tropical Medicine and Public Health*; **28**, 274–279.

Loukas A, Hotez P.J, (2006). Chemotherapy of helminth infections. In: Brunton LL et al., eds. Goodman and Gilman's The pharmacological basis of therapeutics, 11th ed. New York. McGraw-Hill.

Lopiso Erosie, Yared Marid, Ayele Ashiko, Mohamed Ayine, Ashenafi Balihu, Sultan Muzeyin, Shiferaw Teklemariam, Solomon Sorsa, (2002). Prevalence of Hookworm infection and haemoglobin status among rural elementary children in Southern Ethiopia, *Ethiop. J. Health Dev.* **16**(1) 113-115.

Luong T.V, (2003). De-worming school children and hygiene Intervention. *International Journal of Environmental Health Research*, **13**, S153 – S159.

Lwambo N.J.S, (2005). Community's willingness to pay for a school-based chemotherapy programme to control morbidity due to schistosomiasis and soil-

transmitted helminthiasis in children in rural Tanzania. *Tanzania Health Research Bulletin*; **7**(3)149-153.

Magnussen, P., Muchiri, E., Mungai, P., Ndzovu, M., Ourma, J. and Tosha, S, (1997). A school based approach to the control of urinary schistosomiasis and intestinal helminth infections in children in Matuga, Kenya: impact of a two year chemotherapy programme on prevalence and intensity of infections. *Trop Med Int Health*; **2**: 825–831.

Mehta D.K, Ryan R.S.M, Hogerzeil H.V, eds. (2004). World Health Organization Model Formulary. Geneva, World Health Organization.

Mondadori E, Ehrhardt A, Le anh Tuan, Dai Tran Cong, Sepe G, Van Huyen Nong, Montresor A, (2006). Appreciation of school de-worming program by parents in Ha Giang Province, Vietnam. *Southeast Asian J Trop Med Public Health*; **37**(6), 1095-1098.

Montresor A, Crompton D.W.T, Hall A, Bundy D.A.P and Savioli L, (1998). Guidelines for the evaluation of soil-transmitted helminthiasis and schistosomiasis at community level. A guide for Managers of Control Programmes WHO/CTD/SIP/98.1. Geneva.

Montresor A, Crompton D, Gyorkos T and Savioli L, (2002). Helminth Control in school-age children: a guide for managers of control programmes. World Health Organization.

Mtoi T.K, (2003). Assessment of the impact of periodic treatment of soil transmitted helminth infections on the health status of primary school children in Muheza

District. Dissertation for MPH, at Muhimbili University College of Health and Allied Sciences, University of Dar es Salaam, Tanzania.

Mwaluko, G.M.P; Kilama W.L; Mandara M.P; Muruu M, and Macpherson C.N.L, (1991). Health and Disease in Tanzania. London, England, HarperCollins Academic. Pg 289-95.

Olds G.R, (2003). Administration of praziquantel to pregnant and lactating women. *Acta Tropica*; **86**:185–195.

Partnership for Child Development, (1997). Better Health, nutrition and education for the school-aged child. Leading article, *Trans. R. Soc. Trop. Med. Hyg*. **91**: 1-2.

Partnership for Child Development (1998b). "The Health and Nutritional Status of School Children in Africa: Evidence from School-Based Health Programmes in Ghana and Tanzania." *Trans. R. Soc. Trop. Med. Hyg*. **92**: 254–61.

Partnership for Child Development (1999). "The Cost of Large-Scale School Health Programmes Which Deliver Anthelmintics to Children in Ghana and Tanzania." *Acta Tropica*. **73**: 183–204.

Petrie A and Sabin C, (2005). Medical Statistics at a Glace, second edition. Blackwell publishing Ltd, Massachusetts, USA.

Piekarski G, (1989). In "Medical Parasitology " Springer- Verlag Berlin Berlin Heidelberg. 168-169.

Ross A.G.P, Bartlet P.B, Sleigh A.C, et al., (2002). Current concepts: schistosomiasis. *New Engl J Med*; **346**: 1212–1220.

Savioli L., Bundy D.A.P., Tomkins A, (1992). Intestinal parasitic infections: a soluble public health problem. *Trans. R. Soc. Trop. Med. Hyg.* **86**:353-354.

Shubair M, Yassin M.M, Al-Hindi A.I, Al-Wahaidiv A.A, Jadallah SY and Abu Shaaban N.D, (2000). Intestinal parasites in relation to haemoglobin level and nutritional status of school children in Gaza. *J Egypt Soc Parasitol*; **30**(2):365–375.

Smith C.M.C, (1993). The effect of the introduction of piped sewerage on Ascaris infection and environmental contamination in a Gaza Strip refugee camp. Thesis submitted to the University of London in fulfillment of the degree of Doctor of Philosophy (Faculty of Medicine).

Stephenson L.S, Michael C.L, Elizabeth J.A, Stephen N.K and Anne P, (1993). Physical fitness, growth and appetite of Kenyan school boys with hookworm, Trichuris trichiura and Ascaris lumbricoides infections are improved four months after a single dose of albendazole. *Journal of Nutrition*; **123**:1036-46.

Stephenson L.S, Holland C.V and Ottesen E.A, (2000). Controlling intestinal helminths while eliminating lymphatic filariasis. *Parasitology,* **121**(Suppl.):S1–S173.).

Ukoli, F.M.A, (1984). Introduction to Parasitology in Tropical Africa, p: 464. John Wiley and Sons Limited.

Ulukanligil M, (2006). Community perception of school-based de-worming program in Sanliurfa, Turkey. *Am J Trop Med Hyg*; **75**: 1063–68.

United Nations, (2003). World Urbanization Prospects: The 2003 Revision. Department of Economic and Social Affairs, Population Division. New York: United Nations.

Weekly epidemiological records, (2003). Report on active surveillance for adverse events following the use of drug co-administrations in the Global Programme to Eliminate Lymphatic Filariasis. *Weekly Epidemiological Record,* **78**:315–317.

WFP/UNESCO/WHO, (1999). School feeding handbook. Rome, World food programme.

World Bank (1993). World Development Report 1993: Investing in Health. Oxford University Press, New York.

World Health Organization, (1987). Prevention and control of intestinal parasitic infections. Technical Report Series No 749 pp 7 – 23.

World Health Organization, (1991). Basic Laboratory methods in medical parasitology. Geneva, WHO.

World Health Organization (1992). Health of school children: treatment of intestinal helminths and schistosomiasis. WHO/CDS/IPI/CTD/92.1.

World Health Organization, (1993).The control of schistosomiasis. Second report of WHO Expert Committee. Geneva World Health Organization (WHO Technical report series No. 830).

World Health Organization, (1995). A Picture *of* Health? WHO, Geneva/UNICEF, New York.

World Health Organization (1995a). Health of School Age Children. Treatment of Intestinal Helminths and Schistosomiasis. WHO/SCHISTO/ 95.112. WHO/CDS/95.1, WHO.

World Health Organization (1996). Report of the WHO Informal Consultation on the use of chemotherapy for the control of morbidity due to soil-transmitted nematodes in humans. Geneva, World Health Organization, (WHO/CTD/SIP/96.2).

World Health Organization, (1996). World Health Organization Information Series on School Health – Document 1. Strengthening Interventions to Reduce Helminth Infections: An Entry Point for the Development of Health-Promoting Schools. Geneva: WHO.

World health Organization, (1998). Guidelines for the evaluation of soil-transmitted helminthiasis and Schistosomiasis at Community level.

World Health Organization, (2001). Evaluation of efficacy of school-based anthelmintic treatments against anaemia in children in the United Republic of Tanzania; *Bulletin of the World Health Organization*, **79** (8).

World Health Organization, (2001). World Health Assembly resolution WHA54.19 on Schistosomiasis and soil transmitted helminthiasis.

World Health Organization, (2002). Prevention and control of schistosomiasis and soil-transmitted helminthiasis. Report of a WHO expert committee. Geneva: (WHO Technical Report Series No. 912). pp. 1-57.

World Health Organization (2002). School Health at a Glance, World Bank, Washington DC.

World Health Organization, (2002). Prevention and control of schistosomiasis and soil-transmitted helminthiasis; report of a WHO expert committee. Geneva: World Health Organization. WHO technical report series no. 912, pg 63.

World Health Organization/UNICEF, (2004). How to add de-worming to vitamin A distribution. Geneva, World Health Organization, (WHO/CDS/CPE/PVC/2004.11).

World Health Organization, (2008). Soil-transmitted helminthiasis: progress report on number of children treated with anthelminthic drugs. *Weekly epidemiological record*; **83**: Nos. 27/28, 237-252.

Yuesheng Li, Adrian C. Sleigh, Gail M. Williams, Allen G. P. Ross, Y. Li, Simon J. Forsyth, Marcel Tanner and Donald P. McManus, (2000). Measuring exposure to *Schistosoma japonicum* in China. III. Activity diaries, snail and human infection, transmission ecology and options for control. *Acta Tropica*. **75**(3): 279-289