INTESTINAL PARASITIC INFECTIONS IN PATIENTS ATTENDING MOI TEACHING AND REFERRAL HOSPITAL ELDORET, KENYA

BY

KIMOSOP JEPKOSGEI ROSE

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN ZOOLOGY (PARASITOLOGY) OF THE UNIVERSITY OF ELDORET, KENYA

OCTOBER, 2017

DECLARATION

This thesis is my original work and has not been submitted for any Degree or any other award in any other University or Institution. No part of this thesis may be reproduced without the prior written permission of the author and/or the University of Eldoret.

Candidate: Kimosop Jepkosgei Rose **Sign…………………**

Date…………………

Regn. Number: SC/PGB/028/08

This Thesis has been submitted for examination with our approval as the University supervisors.

Dr. Moses M. Ngeiywa **Sign………………………**

Date………………………

Department of Biological Sciences, School of Science, University of Eldoret.

P.O. Box 1125, ELDORET.

Prof. Chrispinus S. Mulambalah. **Sign………………………**

Date………………………

Department of Medical Microbiology and Parasitology, School of Medicine, Moi University.

P.O. Box 4606, ELDORET.

DEDICATION

This work is dedicated to my loving husband Joseph, children Nordia , Bilha, Immaculate and all the members of my entire family for their support , patience and co-operation that they have tirelessly accorded me.

ABSTRACT

Intestinal parasitic infections are major public health problems in developing countries. The distribution of these infections is mainly associated with poor personal hygiene, environmental sanitations and limited access to clean water. Intestinal parasitic infections (IPIS), in patients attending Moi Teaching and Referral Hospital Eldoret (MTRH), Kenya has not been studied although they present serious public health problem nationally and worldwide. The aim of the study was to determine the prevalence and distribution of intestinal parasites in patients referred to the laboratory from the outpatient clinics and the wards at MTRH. The demographics and social – economic variables of 185 patients investigated were done between April-December 2015. Direct saline and formal - ether sedimentation techniques were used for detection and identification of the protozoan and helminth parasites in stool samples while air dried fresh stool smears were stained with modified acid fast stain for identification of the coccidian parasites. Preliminary macroscopic assessment of fresh stool specimens was performed for identification of helminthic segments, larvae and/or adult stages. The results revealed an overall prevalence of 86 (46.5%) of intestinal parasites while 99 (53.5%) were negative. The specific parasites prevalence and distributions were *Entamoeba histolytica* 43 (23.9%), *Cryptosporidium parvum* 24(13%), *Entamoeba coli* 12(6.5 %), *Giardia lamblia* 12 (6.5%), *Iadomoeba butschlii* 12 (6.5%), *Ascaris lumbricoides* 3 (1.6 %), *Hymenolepis nana* 1 (0.5%), *Trichuris trichiura* 1 (0.5 %), and Hookworm species 1 (0.5%). The most prevalent parasitic infections encountered were amoebiasis and cryptosporidiosis. Study participants of all ages were susceptible to parasitic infections with varied magnitudes in the study population and both genders were found to be susceptible to both protozoal and helminth infections. The high prevalence of IPIS among the patients attending MTRH indicates that parasitic infections should be considered a public health problem.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS AND ACRONYMS

CDC	Center for Disease Control and Prevention
DALYS	Disability Adjusted Life Years
GNNTD	Global network for neglected tropical diseases
IPIs	Intestinal Parasitic Infections
IREC	Institutional Research and Ethics Committee
MTRH	Moi Teaching and Referral Hospital
PI	Principal Investigator
SES	Socio-Economic Status
Spp	Species
SPSS	Statistical Package for Social Sciences
STHs	Soil Transmitted Helminthes
UK	United Kingdom
USA	United States of America
WHO	World Health Organization
Z-N	Ziehl- Nielsen

ACKNOWLEDGEMENT

I sincerely thank the Almighty God for guidance and good health to perform my work with sound health. I am humbled in expressing my sincere gratitude to my thesis supervisors: Dr M. Ngeiywa and Prof. C. S. Mulambalah for their guidance, encouragement and tireless support in the entire writing up of the proposal and the thesis.

My Sincere gratitude also goes to the department of Biological sciences, University of Eldoret for offering me all the support I needed in order to accomplish the course work. Appreciation also goes to Dr. A. Obala, Department of Medical Microbiology and parasitology, Moi University for assisting me with all the required laboratory equipment used for the study and my former HOD, Prof. H. Nyamogoba for allowing me the opportunity and time to collect and analyze the data for the study.

Iam indebted to VLIR OUS Programme which funded the study and clearing the fee balance at the University. My gratitude also goes to Moi Teaching and Referal hospital (MTRH), Uasin gishu County hospital for allowing me to use their staff and facilities during this study. Finally, I wish to appreciate my entire family, friends and colleagues for their constant love, prayers, cooperation and support they gave me during the course and all those who assisted me in one way or another.

CHAPTER ONE

INTRODUCTION

1.1 Background Information

Parasitic infections are endemic worldwide and have been described as constituting the greatest single worldwide cause of illness and disease (Lwambo *et al*., 1999). These infections are associated with poor sanitary habits, lack of access to safe water and improper hygiene, thereby occurring wherever there is poverty (Mbuh *et al*., 2010). The prevalence of infections varies from one region to another (Mazigo *et al.,* 2010). Contaminated environment and the socio-cultural habits of communities could be the contributing factors for the high prevalence of intestinal parasitic infections in the developing countries (Abbosie *et al*., 2014 and Mbanugo *et al.,* 2002). Therefore, intestinal parasitic infections in humans are important threats to healthy living in many developing countries (Kia *et al.,* 2008).

Intestinal parasitic infections are amongst the most common worldwide. It is estimated that some 3.5 billion people are affected, that 450 million are ill as a result of these infections, the majority being children (WHO, 2003). One fourth of the known human infectious diseases are caused by the helminthes and protozoan species known to infect humans since prehistoric times and have evolved with man throughout history (Cleaveland *et al.,* 2001). The World Health Organization estimates the global prevalence of intestinal geohelminth infections to be over 1 billion cases of *Ascaris lumbri*co*ides,* 740 million cases of *Necator americanus* and *Ancylostoma duodenale,* and 795 million cases of *Trichuris trichiura* (WHO, 2010a).The four intestinal geohelminth nematodes sometimes occur concurrently in the same community, resulting in multiple infections in an individual at a time (Ruto and Mulambalah 2016). Current estimates show that at least one-quarter of the world's population is infected with intestinal geohelminth nematodes with about 90 million school-aged children and the poor being infected in Africa (WHO, 2010a).

This relationship has been influenced by global changes in the human socio-cultural spectrum. The highest rates of ascariasis infection have been reported in China, Southeast Asia, coastal regions of West Africa, and Central Africa (Ortega *et al.*, 1997). However, trichuriasis infection is at its highest rate in Central Africa, Southern India, and Southeast Asia while hookworm infections are most common in Sub-Saharan Africa, South China, and Southeast Asia (Meyer,1985).

In industrialized countries, the prevalence of intestinal protozoan parasites such as Giardia infection ranges from 2% to 5%, whereas in developing countries it ranges from 20% to 40% (Ali and Hill, 2003). *Giardia lamblia*, causing giardiasis, is the most prevalent protozoan parasite worldwide with about 200 million people being currently infected (Minenoa and Avery, 2003). *Blastocystis hominis* whose parasitic status is under debate (Pillai and Kain, 2003) is also another common protozoan affecting the human. Parasitic infections caused by helminths and protozoa are the major causes of human diseases in most countries of the tropical region. It is estimated that about 3.5 billion people in the world are infected with intestinal parasites, of which 450 million are ill (Keiser and Utzinger, 2010; WHO, 2003). Majority of these cases are children (Brooker *et al*., 2009). About 1.45 billion people in the world were infected with Soil-Transmitted Helminthes (STHs) and 5.19 million showed associated morbidity in 2010 (Pullan *et al.*, 2014). Out of 1.45 billion infections due to STHs, 438.9 million people were infected with hookworm, 819.0 million with *A. lumbricoides* and 464.6 million with *T. trichiura* (Pullan *et al.*, 2014). STHs are the second leading cause of mortality in children aged less than 6 years who live in Africa (WHO, 2010b) while the estimated disease burden due to schistosomiasis was 3.31 million during 2010 (Hotez *et al*., 2014).

Intestinal parasites are among the major contributors to the global infectious disease load. A wide variety of intestinal parasites are prevalent in different parts of the world. Parasite species in the genera: Ascaris, Entamoeba, Toxoplasma, Cyclospora, Giardia, and Cryptosporidium are among the major contributors to the global intestinal parasitic disease burden. Intestinal parasitic infections have serious consequences on human health, such as hepatomegaly, splenomegaly, esophageal varices and bleeding (WHO, 2010b).

Prevention of intestinal parasitic infections usually involves treatment of cases with appropriate drugs. However, infection with these parasites remains a major public health problem in most of the endemic areas due to continued exposure (Nacher, 2011). Therefore, there is need to undertake integrated control strategies involving improved sanitation, health education and chemotherapy to effectively control intestinal parasitic infections in endemic African countries (WHO, 2013b).Intervention against intestinal helminthic infections is based on regular anti-helminthic treatment, improved water supply and sanitation and health education (Belayhun *et al*., 2010). In developing countries, however, control measures are difficult to implement due to lack of clean water, sanitation and education problems. As a result, intestinal helminths infection remains a significant health problem in these regions.

1.2 Statement of the Problem

Growth and development disabilities due to frequently undetected health problems are prevalent in developing countries such as Kenya. Intestinal parasitic infections are prevalent in all age-groups who visit the MTRH and most of these patients present with nonspecific clinical manifestations have their diagnosis based on clinical observations and it is often misleading and may lead to wrong treatment. However, there is growing need for targeted approach for treatment based on evidence-based diagnostic tests results. This will go a long way in improving patient treatment outcome, rational use of drugs and preventive measures.

1.3 Justification of the Study

Intestinal parasitic infections are endemic world-wide and are responsible for the greatest cause of illnesses and disease. The prevalence of intestinal protozoal and helminthic infections varies with location even within a region in the country (Gunawardena *et al*., 2004, Thiongo *et al*., 2001). Prevalence studies provides basis for design of appropriate and specific intervention programs in the community. If not diagnosed and appropriately treated, the outcome of intestinal protozoal and helminthic infections lead to adverse consequences in specific population segments for instance school children and pregnant women. In women of child- bearing age, infections are associated with adverse pregnancy outcomes (Wekesa *et al*., 2014). It has been observed that children living in less developed countries are likely to be infected with one or more STH which may affect their physical and cognitive development (Bethony *et al.,* 2006).

The findings of the study therefore forms a valuable basis for further epidemiological studies on intestinal parasitic infections and formulation of better informed policy on disease(s) prevention and control by public health sector. For instance, age group and gender-related prevalence findings will enable targeted investigations for risk factors and prevention/control.

1.4 Objectives of the Study

1.4.1 General Objective of the study

To investigate the prevalence, distribution and risk factors for intestinal parasitic infections among patients referred to the laboratory for stool analysis at the MTRH, Eldoret, Kenya.

1.4.2 The Specific Objectives of the study:

1. To identify parasite species associated with intestinal infections in referred patients.

2. To determine the prevalence of intestinal parasitic infections amongst different age groups.

3. To determine the prevalence of gender-related intestinal parasitic infections.

4. To determine the possible socio-economic risk factors associated with the intestinal parasitic infections distribution amongst referred patients.

1.5 Hypothesis

1.5.1 Null-Hypothesis

Ho: There is no significant difference in the species distribution, prevalence and socio- economic factors of intestinal parasitic infections among the children, teenagers, adults and between genders in patients referred to the laboratory at MTRH, Eldoret, Kenya.

CHAPTER TWO

LITERATURE REVIEW

Intestinal parasitic infections (IPIs) are globally endemic and have been described as constituting the greatest single worldwide cause of illness and disease (Sketetee, 2003*).* IPIs are linked to lack of sanitation, access to safe water and improper hygiene; therefore they occur wherever there is poverty (Bethony *et al.*, 2006). Intestinal parasitic infections deprive the poorest of the poor of health, contributing to economic instability and social marginalization (Garson, 2003). The poor people of under developed nations experience a cycle where under nutrition and repeated infections lead to excess morbidity that can continue from generation to generation.

Intestinal parasitic infections are particularly rampant in areas of the world where climate and poor sanitary conditions promote their survival, reproduction and transmission (Alum *et al.,* 2010). People of all ages are affected by this cycle of prevalent parasitic infections; however, children are the worst affected (Curtale *et al.*, 1998). About one third of the worlds, more than two billion people, are infected with intestinal parasites WHO, (2006).

IPIs rarely cause death but because of the size of the problem, the global number of related deaths is substantial (WHO, 2006). About 39 million Disability Adjusted Life Years (DALYs) are attributed to IPIs and these infections thus represent a substantial economic burden (Stephenson *et al.*, 2000). These infections have a worldwide distribution, being present in almost all geographic and climatic regions, except for those with extremes of cold or heat where survival of infectious stages in the environment is impossible. Prevalence tends to be highest in warm, moist climates and is closely correlated with poor environmental hygiene such as lack of adequate excreta disposal facilities and access to health services. Whipworm (*Trichuris trichiura*) and hookworm account for 604–795 and

576–740 million infections respectively and the highest incidence was discovered in the Sub-Saharan Africa and East Asia (Bethony *et al*., 2006).

In a recent study done by (WHO, 2002), DALYs lost due to Ascaris, whipworm, and hookworm infections were estimated to be 1.2, 1.6, and 1.8 million, respectively. These DALY estimates were significantly lower than those of previous reports: 10.5, 6.4, and 22.1 million, respectively studied by (Chan *et al.*, 1994). Soil-transmitted helminthiasis is a major public health problem in low and middle-income countries affecting about 2 billion people across the globe, WHO, (2010b).

2.1 Intestinal helminthiases

The common geohelminth infections are caused by *Ascaris lumbricoides*, *Trichuris trichiura* and hookworm (*Ancylostoma duodenal*e and *Necator americanus*). The estimated global prevalence of *A. lumbricoides*, *T. trichiura* and hookworm are 1.5 billion, 1.3 billion and 900 million, respectively, and have more than 2 billion humans are infected with at least one of these parasites (Hotez *et al*., 2006).

The chief form of morbidity caused by intestinal geohelminth nematodes is the negative effect on nutritional status that includes malabsorption of nutrients, loss of appetite and reduction of food intake (WHO, 2010a). Soil-transmitted helminthiasis (STH) and schistosomiasis are the most important helminthiases, and are among the neglected tropical diseases (CDC, 2011). This group of helminthiases have been targeted under the joint action of the world's leading pharmaceutical companies and non-governmental organizations through an ambitious project launched in 2012 called the London Declaration on Neglected Tropical Diseases which aims to control or eradicate certain neglected tropical diseases by 2020 (London Declaration, 2012). Transmission of intestinal geohelminth nematode infections is predominantly related to human behavioral habits with regard to cleanliness, personal hygiene.

2.1.1 Ascariasis

Ascariasis is the most common helminth infection, with an estimated worldwide prevalence of 25% (0.8-1.22 billion people) (Bethony *et al.,* 2006). This infection is caused by the parasitic roundworm *Ascaris lumbricoides* which is usually asymptomatic usually in more than 85% of cases, especially if the number of worms is small. The Center for Disease Control and Prevention (CDC), estimated the worldwide ascariasis rates in 2005 and found the following: 86 million cases in China, 204 million elsewhere in East Asia and the Pacific, 173 million in sub-Saharan Africa, 140 million in India, 97 million elsewhere in South Asia, 84 million in Latin America and the Caribbean, 23 million in the Middle East and North Africa. About 0.8 to 1.2 billion people globally have ascariasis with the most heavily affected populations being in sub-Saharan Africa, Latin America, and Asia (Keiser and Utzinger, 2010). Ascariasis still remains the most common intestinal parasite with 807–1221 million infections globally (Senior, 2008).

2.1.2 Trichuriasis

Trichuriasis, also known as whipworm infection, is caused by the parasitic worm *Trichuris trichiura* (whipworm) (CDC, 2014). The global prevalence of trichurisias is estimated as 795 million cases representing about 31.36% of the total worldwide infection by intestinal geohelminth nematodes and Africa takes the second largest burden of infection with 162 million cases reported WHO, (2010a). It is most common in tropical countries and the developing world, thus those infected with whipworm often have hookworms and ascariasis infections (Bethony, 2006). In spite of its classification as one of the neglected tropical disease (CDC , 2013) its effects on the economy of many countries is enormous (Jamison, 2006).

When infection is associated with only a few worms, there are often no symptoms and in those who are infected with many worms, there may be abdominal pain, tiredness, diarrhea which may be blood stained (WHO,2014). Infections in children may cause poor intellectual and physical development due to low red blood cell counts according studies done by (CDC and WHO, 2014). Young children playing in the soil and putting their fingers in the mouth also become infected easily (WHO, 2014). Whipworm infection affects about 600 to 800 million people worldwide (Fenwick, 2012).Trichuriasis is associated with poverty, inadequate sanitation and hygiene, and certain sanitary behaviors such as defecating in the open fields (Ezeagwuna *et al.*, 2010).

The prevalence of trichuriasis increases during childhood and maintains a relatively constant value in adulthood (Bundy *et al.*, 1987). Children below 10 years of age tend to have higher intensity of trichuriasis than older age groups (Thiongo *et al.*, 2001). In Kenya, variable prevalence have been reported in the arid, semi-arid, highlands and Lake Region (Otieno *et al*., 1985). The prevalence of 21.85% and 24% in the Bondo then Kisumu districts was recorded respectively (Olsen *et al.*, 1998; Thiongo *et al*., 2001). In other studies, prevalence rates of 3.6%, 30.6% and 55.2% were reported among schoolchildren in southwestern Kenya (Peterson *et al.*, 2011), Nairobi city (Mwanthi and Kinoti, 2008) and Busia (Brooker *et al.*, 2000) respectively.

2.1.3 Hookworm disease

Hookworm infection in humans is caused by two species, namely *Ancylostoma duadenale* which is more prevalent in the Middle East, North China, Europe and South East Asia; and

Necator americanus which is prevalent in Central and South America and Tropical Africa (WHO, 2010b). Globally, the prevalence of hookworm disease is estimated as 740 million cases of *N.americanus* and *A.duodenale*, with Africa harboring the largest disease burden of 198 million cases (WHO, 2010a). It was previously estimated that these hookworm infections annually account for 65,500 human deaths and 22.1 million disabilities adjusted life span years (WHO, 2002; De Silva *et al*., 2003.

In Kenya hookworm infection was found to be more prevalent in the coastal region and western Kenya (Olsen *et al.,* 1998; Thiongo *et al*., 2001). Other studies reported different percentage prevalence of 36% (Thiongo *et al.,* 2001) and 63% (Oslen *et al.,* 1998) in Bondo and Kisumu districts respectively. Booker *et al*., (2000) estimated the percentage prevalence and intensity of infection of hookworm infection among schoolchildren in Busia District at 77.5% and 8.6% respectively. In southwestern Kenya and Nairobi city, prevalence of 9% and 1.6% was registered respectively (Mwanthi *et al*., 2008; Peterson *et al.,* 2011). Hookworms contribute significantly to iron deficiency (Olsen *et al.,* 1998) and impair the intellectual, cognitive and physical development of infected children (Stephenson *et al.,* 2000).

2. 2 Intestinal protozoal infections

The most important intestinal protozoan pathogens are Entamoeba histolytica, Giardia lamblia, Balantidium coli, Cryptosporidium parvum, Cyclospora cayetanensis, Isospora belli and members of the phylum Microsporidia (Hague *et al.,* 2007).Infections with pathogenic intestinal protozoa (e.g. Entamoeba histolytica and Giardia intestinalis) result in considerable gastrointestinal morbidity, malnutrition and mortality worldwide, particularly among young children in developing countries (Feng and XiaoL, 2011). It has been estimated that *E. histolytica*, the causative agent of amoebiasis, kills between 40,000 and

100,000 people each year; hence, is one of the deadliest parasitic infections worldwide (Stanley, 2003). In the People's Republic of China alone, *G. intestinalis* affects an estimated 28.5 million people every year (Lozano *et al.,* 2010).The prevalence of *G. intestinalis* has been estimated at 2–3% in the industrialized world and 20–30% in developing countries (Jex *et al.,* 2011). *Blastocystis hominis* is a common additional anaerobic intestinal protozoan and its pathogenicity is still under debate (Stensvold *et al.*, 2009). Lack of access to clean water, sanitation and hygiene are strong drivers for infection with intestinal protozoa (Yonder *et al.,* 2010).

2.2.1 Cryptosporidiosis

Cryptosporidiosis has a worldwide distribution and in most surveys is among the four major pathogens causing diarrheal diseases in children. It has major public health implications because infections can result from exposure to low doses of Cryptosporidium Oocysts (Xiao *et al.,* 2000).In developing countries, Cryptosporidium is responsible for 8–19% of cases of diarrheal disease, with a significant effect on mortality (Molbak *et al.*, 1993). A recent study on cryptosporidiosis conducted in Egypt examined 1,275 children attending two hospitals and found a prevalence of 17% (Abdel-Messih *et al*., 2005).

2.2.2 Giardiasis

Giardiasis is popularly known as beaver fever and it is a Zoonotic parasitic disease caused by the flagellate protozoan *Giardia lamblia* (formerly called *Giardia intestinalis* / *Giardia duodenalis*) (Esch *et al.,* 2013).There are three identified species of Giardia: *Giardia lamblia, Giardia muris,* and *Giardia agilis*. *Giardia lamblia* is the only species of three known to infect humans. It is the most common pathogenic parasitic infection in humans worldwide. In 2013, there were about 280 million people worldwide with symptomatic giardiasis (Barry *et al.*, 2013).

Giardiasis usually represents a zoonosis with cross-infectivity between animals and humans and is believed to play a role in keeping infections present in an environment (Auerbach *et al.,* 2012). It is a cosmopolitan parasite with an overall prevalence rate of 20–30% in developing countries, higher numbers of infections are seen in the late summer months. Travelers to regions of Africa, Asia, and Latin America where clean water supplies are low are at increased risk of contracting the infection (Savioli *et al.,* 2006). Children, seniors, and people with long-term illnesses may be more prone to contracting the infection as the risk of transmission is higher in day care centers and seniors' residences and may become opportunistic infection (WHO, 2000a).

2.2.3 Intestinal Amoebiasis

Amoebiasis is the third most important reason for death from parasitic diseases worldwide, with its further most impact on the people of developing countries (Wang *et al.,* 2009). The (WHO, 2012) estimates that approximately 50 million people worldwide endure insidious amoebic infection each year, resulting in 40–100 thousand deaths yearly. Out of the 50 million symptomatic cases occurring each year, up to 100,000 are fatal (Stanley, 2001).There is three species of intestinal amebae with identical morphologic characteristics: *E. histolytica*, *E. dispar*, and *E. moshkovskii* (Peterson *et al.,* 2011). Most symptomatic disease is caused by *E. histolytica* while *E. dispar* is considered nonpathogenic. Approximately 10 percent of the world's population is infected, yet 90 percent of infected persons are asymptomatic (Reed *et al*., 2001). Reported infections with *E. moshkovskii* are becoming more frequent but its pathogenic potential remains unclear (Heredia *et al.,* 2012). Globally, approximately 50 million people develop colitis or extra intestinal disease, with over 100,000 deaths annually (Haque *et al.,* 2007).

2.3 Social economic factors associated with intestinal parasites

Age is an important risk factor for IPIs and the pre-school and school going children have been reported to be at highest risk for IPIs (Bethony *et al.,* 2002). Lower socioeconomic status (SES) is a risk factor for IPIs (Nematian *et al.,* 2004).The effect of SES on risk of infectious diseases in general, and parasitic infections in particular, is complex in nature and could be attributed to several other factors such as lack of access to clean water, poor hygienic environment, lack of access to education due to financial constraints and overcrowded conditions (Houweling *et al.,* 2003). Local conditions such as quality of domestic and village infrastructure; economic factors such as monthly income, employment and occupation and social factors such as education influence the risk of infection, disease transmission and associated morbidity and mortality (Wang *et al.,* 2009). STHs is enhanced by favourable natural factors such as temperature, humidity and socioecological factors, structure of dwelling, life style, and habits of food consumption. However, the construction of latrine and improvement of education might contribute to the decrease of infection rate of STHs (Toma *et al*, 1999).

According to (WHO, 2012) estimates, developing countries are the most affected, majority being school children because of their typical hand-mouth activity, uncontrolled fecal activity and their immature immune systems. The climatic conditions in this part of the world favor the development and survival of these parasites. The high prevalence is as a result of infection and diseases that may lead to malnutrition and death in young children. Intestinal parasitic diseases constitute a global health burden in numerous developing countries mainly due to fecal contamination of water and food (Odu *et al.,* 2011). sympathetic climatic, and environmental and sociocultural factors enhancing parasitic transmissions (Mordi and Ngwodo 2007, Alli *et al.*,2011). These parasites dwell in the gastrointestinal tract in humans and other animals (Loukopoulos *et al.*,2007). In urbanized countries, protozoan parasites commonly cause gastrointestinal infections in contrast to helminthes as reported by (Haque, 2007).

Intestinal parasite prevention methods are not isolated to specific geographical areas however, many of the research-based interventions have primarily taken place in underdeveloped countries and regions, where sanitation is a large concern for the spreading of diseases (Birn and Armando ,1999). Current best practice behaviors that prevent intestinal parasites include: using proper hand washing practices, using correctly-built latrines with ample ventilation, having a piped water source, and wearing shoes (Abossie and Seid, 2014).Currently, in some parts of Ethiopia where IPIs prevalence is high, up to 80% of people in a population lack access to washing facilities and 93% did have access to a latrine, but only 29.2% of those latrines had proper construction to decrease parasitic infections (Abossie and Seid, 2014). Behavioral interventions have been focused on promoting washing, sometimes with soap, in context of education at schools and child care facilities and the best interventions following multidisciplinary health approaches (Ejemot *et al.*, 2015). The factors influencing.

2.4 Gender- related issues versus intestinal parasitic infections

Parasitic infections caused by protozoa and helminths are major global health problems. The prevalence of parasitic infections varies with the level of sanitation and is generally higher in the tropics and sub-tropics than in more temperate climates Singh *et al.*, (2010). In addition, poverty, malnutrition, high population density, the unavailability of potable water, low health status and a lack of personal hygiene provide optimal conditions for the growth and transmission of intestinal parasites. Other barriers which are likely to increasing the rates of parasitic infections include insufficient parasitic disease research, neglect of the problem in developing countries and lack of follow-up treatment Sayyari *et al.,* (2005).

According to a study of the Tribhuvan University Teaching Hospital recorded from 1985-1992 revealed that the positive rates of the intestinal parasites were 29.1% - 43% and higher prevalence was found in children and some of the study also revealed that the prevalence of parasitic infection is more common in girls in comparison to boys Rai *et al.*, (1993). Another study done in Nepal also revealed that the prevalence of parasitic infection is more common in girls in comparison to boys (Sherchand *et al*, 1997).

CHAPTER THREE

MATERIALS AND METHODS

3.1 Study Site and Setting

This study was conducted among patients seeking treatment at MTRH who were referred to the Medical Laboratory for stool analysis. Moi Teaching and Referral Hospital is the second largest National Referral Hospital after Kenyatta National Hospital in Kenya. It is located along Nandi Road in Eldoret town, which is 310 kilometers Northwest of Nairobi, the capital city of Kenya. It is in Uasin Gishu County in the North Rift region of Western Kenya.

The Hospital has an 800 bed capacity and receives patients from Western Kenya, parts of Eastern Uganda, and the Southern Sudan. It offers a wide range of services both out-patient and in-patient. The services are supported by modern state of the art clinical and diagnostic equipment manned by trained and qualified medical, para-medical and support staff of different cadres both from the hospital and the college of Health Sciences administered through various clinical departments in the hospital.

Eldoret's altitude is about 2100 meters above sea level (7,000-9,000 feet) and Uasin Gishu is a cosmopolitan County.

3.2 Study Design, Sample Size and Population

This was an analytical cross-sectional, health facility-based study. The study was conducted between April and December 2015. Informed consent was obtained from each individual before the study (Appendix 6).

Demographic details were obtained using a questionnaire which was administered to the participants (Appendix 5). Fresh stool specimen was collected from each individual who were also interviewed on their social - economic status such as their toilet and water facilities, hand washing habits, level of education, the presence of pets in the homes and previous parasitic infections. The study population consisted of all consenting age groups (in case of children, consent was obtained from their parents/guardians) and both sexes who were referred to the laboratory for stool analysis at MTRH. The sample size was calculated basing on a previous study done by Wekesa *et al.*, (2014) on intestinal helminth infections, which showed an overall prevalence of 13.7% and was used as the standard. The calculation was done basing on 95% confidence level and 5% marginal error. The sample size (n) was estimated using modified Fischer's formula as described by Mugenda and Mugenda, (1999).

$n=z^2pq/d^2$

n=desired sample size

z= standard normal deviate (1.96)

p= Prevalence of intestinal parasites from previous study of 13.7%.

q=1.0-p

d= degree of accuracy

$n = (1.96)^2 (0.14) (1.0-0.14)/ (0.05)^2$

n=185 patients. Therefore, the minimum sample size aimed at was 185 patients.

The participants were separated and recorded according to the following age groups; below 9, 10-19, 20-29, 30-39, 40-49, 50 and above years (age was rounded to the nearest year). Through the hospital management team, the clinicians working in the outpatient clinics and the wards were informed about the ongoing study so that willing patients could be recruited and thus benefit from the study.

A questionnaire (Appendix 5) was used to obtain demographic data and the variables of the suspected risk factors. The two Senior Laboratory Technologists who were trained by the Principal Investigator for this purpose to collect the data took charge from the reception to the processing of the specimens. To ensure the reliability of the information, the patients were interviewed in the language they understood best. The interview included information on several factors such as age, hand washing habits, housing status, level of education and the source of drinking water. Those patients who were willing to participate and were unable to get stool specimen during request, were provided with the polypots and advised accordingly so that they would deliver it the following day or at any convenient time of the day. All the questionnaires were checked regularly for accuracy and completeness.

3.3 Inclusion and Exclusion criteria

All patients who were sent to the laboratory for stool analysis and consented by signing the provided form were included in the study.

Patients of unsound mind and those whose parents/ guardians did not consent were excluded from the study.

3.4 Collection of Stool Specimens

At the time of interview, the patients were given a dry, clean, leak proof container labeled with the serial code for identification in the collection of stool specimen. They were guided on how to collect the specimen appropriately. In the case of small children, either the stool was to be collected directly as the child defecates or a small piece of the feces was to be put into the sample bottle after the child defecates, through the help of a sterile wooden scoop which was provided with the collecting container.

A small screw capped leak-prove plastic container, wooden scoop and a tissue paper was provided to each participant. They were advised to fill half the container and safely discard the scoop after use. The stool specimens were collected and brought to the laboratory for processing.

All the containers along with specimen were properly labeled with the respective individual code, date, age, time and gender. The stool specimens was examined macroscopically for the adult and the larval stages of helminth parasites and microscopically for trophozoites, ova and cysts of parasites using both direct saline and iodine mounts on clean grease-free slides in the laboratory. Slides were then prepared directly for wet mount in saline as well as in iodine and then were microscopically examined initially under low power (10×=100 times magnification) bright field then under high power (40×=400 times magnification) bright field for helminth cysts or eggs and at oil immersion power (100x = 1000 times magnification) for protozoan parasites.

Laboratory examinations was conducted at the Department of Parasitology MTRH, by the Principal Investigator and two other experienced laboratory technologists .Therefore, every patient who was recruited signed the consent form. In the case of children and minors the parents/guardians were informed verbally before appending their signatures on the medical consent form (Appendix 6) for the purpose of authorization. The two technical staff at the laboratory's specimen collection room were responsible for delivering this information. Patients, who were referred from other hospitals or clinics to the laboratory for stool analysis outside MTRH, also had a chance to be recruited into the study.

3.5 Preservation of specimens

Once the specimen was received in the laboratory, saline and iodine wet mount techniques were immediately performed. The remaining specimen was preserved in 10% formalin until formal ether concentration technique was performed. Preservation of the specimens was essential for maintenance of protozoal morphology and also to prevent further development of helminthic eggs and larvae and thus render the specimens safe.

3.6 Microscopic examination-staining methods

The recognition of intestinal parasites was achieved by using a binocular microscope under 10x and confirmed by observing under 40x objectives.

3.6.1 Saline and iodine wet mount

Approximately 2 mg of stool specimen was picked up using a wooden stick and mixed with a drop of normal saline (0.9%) on a glass slide with applicator stick. For the formed stool, materials were taken from well inside the specimen to look for parasite eggs. The preparation was covered with a cover slip and observed under the microscope. For iodine wet mount preparation, approximately 2 mg of stool specimen was picked up using a wooden stick and mixed with a drop of dilute Lugol's iodine. It was covered with a cover slip and observed under the microscope.

3.6.2 Formal-ether concentration

One (1) g of stool specimen was fixed by emulsifying in 7 ml of 10% formal saline and left to stand for 10 min. It was then strained through a wire gauge and the filtrate was collected in a centrifuge tube. Three (3) ml of ether was added to it and the mixture was shaken vigorously for 1 min. It was then centrifuged at 3,000 rpm for 2 min and then allowed to settle. The debris was loosened with a stick; the upper part of the test tube was cleared of fatty debris and the supernatant fluid was decanted, leaving 1 or 2 drops. The deposit, after shaking by use of vortex, it was poured on to a glass slide, and a cover slip placed over it and examined. This process was suitable for both protozoal cysts and helminthes' eggs which are examined microscopically (Cheesbrough, 2000).

3.6.3 Modified Ziehl-Neelsen stain (acid fast staining technique)

Stool smears were prepared from the concentrated stool specimen; air dried and stained by the Modified Ziehl–Neelsen (Z-N) staining technique for identification of oocysts of *Cryptosporidium* species, *Isospora belli*, *Cyclospora cayetanensis* as described by Cheesbrough (1985). The smears were fixed with methanol for 10 min and 7 drops of carbol fuchsin were flooded for 3 minutes. Decolourization was done with 5% sulphuric acid for 30 seconds. Then, it was counter-stained with methylene blue for a minute. The smear was rinsed, drained, air-dried, and examined under oil immersion power. This diagnostic technique is the most suitable for demonstration of oocysts of the protozoans. Microscopy was done first with medium power (x40=400 times magnification) to determine the distribution then high power (x100=1000 times magnification) bright field for identification. For each batch of smears which was processed through the Modified Z-N stain, positive control was included for quality assurance. Each sample was observed microscopically by two other technologists for confirmation and verification before declaring the final result. The colored charts published by Cheesbrough, (1987) were used in differentiations of various trophozoites, cysts and ova in the faecal specimens. The identification of the various intestinal parasites species was achieved through the identification criteria summarized in a table (Appendix 7).

3.7 Data management

Demographic data and personal information on residence, housing, sanitation and socio-economic characteristics which were obtained by use of structured questionnaires were entered in the study register identified by specific codes to ensure confidentiality. The results were stored in a soft copy and the password was retained only by the PI.

The data collection was performed by the PI and the trained investigators who recorded first the coded information in a book/file as the raw data and then these were transferred into the soft copy. During the data collection, completed questionnaires were checked regularly in order to rectify any discrepancy which could have caused possible logical errors or missing values. The responsibilities of each person in the study research team was to make sure that at every step, good clinical practice was maintained in supervision, quality control, and protocol procedures for the effective production of valid and interpretable results.

3.7.1 Data Entry and Analysis

The data entry was carried out using Excel spread sheets ® 2007 template, cleaned and coded before exporting to statistical package for social sciences (SPSS) Version 16.0 for analysis.

The data analysis was performed using SPSS version 16.0 SE. Descriptive and inferential statistics such as mean median, standard deviations and ranges were carried out for continuous data while frequency listing and percentages were used to explore categorical data. The prevalence was calculated directly for the identified parasites and their respective percentages were obtained. Association between categorical variables like the gender status was assessed using Pearson's Chi Square test. In all analyses, a p-value of less than 0.05 was considered statistically significant. Data collected was presented in tables and graphs.

3.8 Ethical Considerations

The proposal for this study was submitted to the Institutional Research and Ethics Committee (IREC) of the School of Medicine – Moi University and Moi Teaching and Referral Hospital (MTRH), Eldoret, for scientific merit and ethical review (Approval Number: 0001601- Appendix 8). The purpose and benefit of the study was explained to the patients through informed verbal consent before signing the consent form followed by a structured questionnaire. For those below the age of 18 years, consent was obtained from their parents / guardians before recruitment. The participants were identified by specific codes and none of them was identified by name. Therefore all the results were coded and recorded in a soft copy and the principal investigator kept the secret code for confidentiality. There was no monetary or any form of inducements benefits for taking part in the study. However, those patients found with intestinal parasites were treated and were advised on prevention and control of those specific intestinal parasites for future protection. All individuals in the population were recruited regardless of age, ethnic origin, education, marital status, or social status so long as consent was obtained.

3.9 Limitations of the study

This study did not assess opportunistic intestinal parasitic infections since it required specialized serological techniques to be performed. Although important risk factors such as age, sex and gender were considered, some other risk factors were not evaluated like the handling and cooking of food stuffs in the current study.

This was a health facility based study which might have missed out those in the population who did not seek for medical treatment. Apart from these limitations the study had the following strengths; it is the first of its kind in the area, that is, the pattern of intestinal parasitism had not been studied earlier than this current study in the region. Moreover, all the participants at MTRH were sampled at one specific time during the sampling period to avoid seasonal biases.

In addition, the sample represented the entire population both urban and rural dwellers hence giving equal probability for each individual in which is a reflection of the real prevalence of IPIs in the region.

CHAPTER FOUR

RESULTS

4.1 Identified intestinal parasite species

The total number of patients who were found to have parasitic infections was 86 (46.5%) and the negative were 99 (53.5%). This is shown in Figure 4.1 which depicts most prevalent being *E. histolytica* 43 (23.2 %), followed by *C. parvum* 24 (13.0%) , *E. coli* 12 (6.5%), *G. lamblia* 12(6.5%), *I. butschlii* 12(6.5%), *A. lumbricoides* 3(1.6%), *A. duodenale* 2(1.1%), *H. nana* 1(0.5%), and *T. trichura* 1(0.5%) being the lowest.

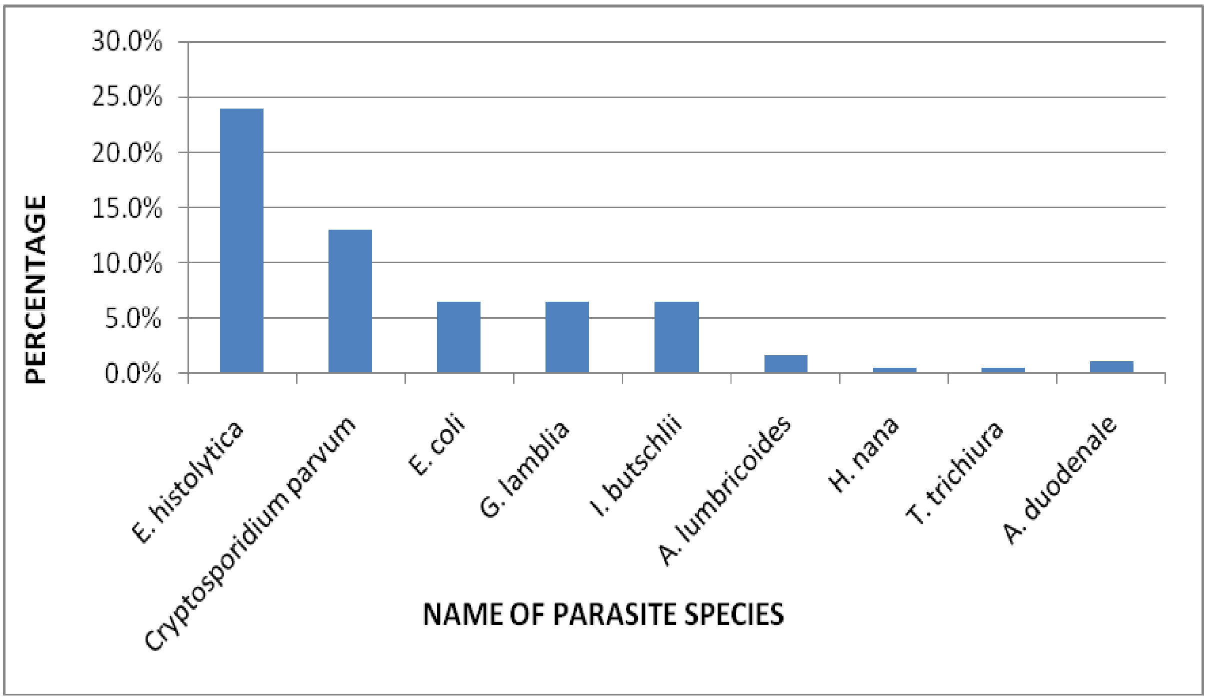


Figure 4.1 Identified parasite species and relative prevalence

4.2 Intestinal parasitic infections distribution according to specific age groups

The participants of the study in context had an age range of between 2 and 70 years with mean age of 24. The most prevalent parasitic intestinal infection in all age groups affecting mostly >9 years 24 (12.9%) and 20-29 years 24(12.9%) was amoebiasis. The second most prevalent was Cryptosporidiosis, followed by Giardiasis, Ascariasis, Hookworm disease, Trichuriasis and cysticercosis as depicted in Table 4.1.

Table 4.1 Parasitic infections Distribution, Prevalence and Absolute values by age group

Parasitic infection	**prevalence of parasitic infection in age groups in (%)**					
	<9yrs	10-19yrs	20-29yrs	30-39yrs	40-49yrs	>50yrs
Amoebiasis	24(12.9%)	22(11.8%)	24(12.9%)	21(11.4%)	7(3.7%)	20(25%)
Cryptosporidiosis	10(5.4%)	6(3.2%)	9(4.8%)	3(1.6%)	8(4.3%)	0%
Giardiasis	1(1.8%)	1(1.8%)	2(3.7%)	2(3.7%)	1(1.8%)	0%
Ascariasis	0%	1(1.8%)	1(1.8%)	1(1.8%)	0%	0%
Hookworm disease	0%	1(1.8%)	1(1.8%)	1(1.8%)	0%	0%
Trichuriasis	0%	0%	0%	1(1.8%)	0%	0%
Cysticercosis	0%	1(1.8%)	0%	0%	0%	0%
Absolute Totals	35	32	37	29	16	20

4.3 Intestinal parasitic infections distribution by gender

The total number of females who participated in the study was 104 while the males were 81 totaling to 185 participants. Amoebiasis was the most identified parasitic infection in the both genders; 67(36.2%) in males and 51(27.6%) in females. Cryptosporidiosis had a higher prevalence in females 27(14.6%) than males 10(5.4%). The helminthic infections were generally very low in both genders 1(0.5%). The least prevalent in the males was trichuriasis (0%) and in the females cysticercosis (0%) as depicted in Table 4.2.

Table 4.2 Intestinal infections in relation to Gender and Absolute values

Parasitic infection	**Percentage prevalence in gender status**	
	Males	Females
Amoebiasis	67(36.2%)	51(27.6%)
Giardiasis	3(1.6%)	4(2.2%)
Ascariasis	1(0.5%)	2(1.1%)
Trichuriasis	0%	1(0.5%)
Hookworm disease	1(0.5%)	1(0.5%)
Cysticercosis	1(0.5%)	0%
Cryptosporidiosis	10(5.4%)	27(14.6%)
Absolute Totals	83	86

4.4 Socio-economic risk factors associated with intestinal parasitic infections

4.4.1 The effects of domestic water used, faecal disposal facility and presence of pets

The majority of the participants used tap and borehole water 88 (47.8), and the least used borehole 6 (3.3%). Pit latrine was mostly used 140 (76.1%) with only 14 (7.6%) using flash toilets. Possesion of pets was found in 119 (64.7%) while those without pets were 66 (35.7%) as depicted in Table 4.3

Table 4.3 The water source, faecal disposal and presence of pets

Utility Factor	Percentage found
• Using tap water only	48(22.8%)
• Using tap and borehole	88(47.8%)
• Using borehole and river	42(22.8%)
• Using borehole only	6(3.3%)
• Using pit latrine and flash toilets	30(16.3%)
• Using pit latrine only	140(76.1%)
• Using flash toilets only	14(7.6%)
• Sharing toilet more than five persons	133(72.3%)
• Using toilet less than five persons	5(27.7%)
• Possessing pets	119(64.7%)
• Do not have pets	65 (35.3%)

4.4.2 The effects of Education level , Occupation and Residence

The study results showed a p-value of 0.180 (Education level), 0.15 (Occupation) and 0.61 (Residence) respectively which is greater than the threshold value of (0.05). This means therefore that the study findings accepted the null hypothesis that there is no significant difference in the prevalence, species distribution and the socio-economic factors of intestinal parasitic infections among the children, teen's, gender and adult patients referred to the laboratory at MTRH.This is as depicted in Table 4.4.

Table 4.4 Test of Hypothesis on Education, Occupation and Residence

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
E.LEVEL	Between Groups	14.040	3	4.680	1.647	.180
	Within Groups	511.612	180	2.842		
	Total	525.652	183			
OCCUPATION	Between Groups	37.595	3	12.532	1.796	.150
	Within Groups	1255.774	180	6.977		
	Total	1293.370	183			
RESIDENCE	Between Groups	1065.831	3	355.277	.592	.621
	Within Groups	108056.729	180	600.315		
	Total	109122.560	183			

CHAPTER FIVE

DISCUSSION

The present study was undertaken to investigate the prevalence of intestinal parasitic infections, its relationship with age, gender and the association with specific socio-economic factors. A total of 185 stool samples were analyzed for intestinal parasites. The residential areas varied from urban estates to the rural villages in all over the Western region of Kenya. In this study the total number of protozoans identified were 103 (55.1%) while the helminths were 7 (3.8%). It was in agreement with Ashtiani *et al.*, (2011) who found parasitic infection in Iran at (33%) and (4.8%) by protozoa and helminths respectively. On the other hand, it was in disagreement with Gelaw *et al*., (2013) who reported infection of (13.2%, 26.9%) with protozoa and helminths, respectively in Ethiopia. Inadequate sanitary measures and problems of drainage may have contributed to this high prevalence of protozoan parasitic infection in the study area. However, out of the total number of the identified parasites, 110 /185 some of the patients were found to have more than one parasite.

The general prevalence of parasitic infections in this study of 86 (46.5%) was lower than previous report from Karachi in India that had observed 52.8% (Mehraj *et al.*, 2003), and higher than similar studies done in Nigeria that observed a prevalence of 34.6% (Nduka *et al.*, 2006) and 30.6% (Mbanugo *et al.*, 2002) respectively. The difference could have been attributed to the type of patients used. For instance, in this study, both the in and out-patients, and those from the tertiary hospitals with signs and symptoms of diarrhea and abdominal pains were recruited. The studies mentioned previously used subjects from rural community (Nduka *et al.*, 2006) or those from the general population (Mbanugo *et al.*, 2012). It is possible that the patients in the current study may have not been treated at the available primary healthcare facilities where they lack diagnostic facilities This may explain the higher prevalence in this study.

The prevalence of *E. histolytica* among males and females below 9 years was 30.0% and 26.3%, respectively indicating that both genders are equally susceptible to infection ($p>0.05$). These results are not in agreement with many studies done in Thailand, where the prevalence was 18.5% (males), 16.1% (females) (Wongstitwilairoong *et al.,* 2007), in Italy 17.1% (males), 12.7% (females) (Manganelli *et al.*,2012). The higher standard of living in both Thailand and Italy could be the possible reason for the lower prevalence's in comparison to developing country like Kenya. Previous similar studies showed even higher rates in Morocco 63.5% (males), 60.4% (females), (El Fatni *et al*., 2014) and in Nairobi, Kenya 51.6% (males), 48.4% (females) (Mbae *et al*., 2013). However, it was not in agreement with the study that was done in Nepal where the prevalence was (16.9%, 22%), (Mukhiya *et al*., 2012), in Brazil (26.1%, 30.3%), (Nobre *et al*., 2013), in northwest and southern Ethiopia (32.1%, 35.9%) (Gelaw *et al.,* 2013), (80.6%, 81.4%) (Abossie and Sied, 2014) representing the males and females respectively. This varied difference could have been attributed by the improper disposal of the sewage refuse and lack of treated water for domestic uses.

In this study 43(23.9%) were infected with *E. histolytica* which was in agreement with related study done in Iraq which showed that *E. histolytica* was the most common protozoan infection with a prevalence rate of 24.0% (Abbas, 2012). The frequency of the parasitic infestations was slightly higher among males 67 (36.2%) than females 51 (27.6%), but this difference was not statistically significant ($p>0.05$)

The high prevalence rate of *Entamoeba spp*. 43 (23.9%) in the current study showed that the infection transfer between persons probably through food or water is high and this may indicate that there is likelihood of contamination by human faeces (Fernandez *et al.*, 2002). The infections are likely to be linked to the everyday activities of the individuals rather than gender. The present study findings showed an equal exposure of both genders to parasitic infections due to sharing almost the same environmental conditions therefore gender did not influence the prevalence of the intestinal parasitic infections. The high prevalence of *E. histolytica* could be due to the existence of resistant cysts of the parasite as reported by Mbuh *et al.*, (2010) in Cameroon. Nevertheless, children most often have a tendency of eating food without hand washing unless reminded or may lick their contaminated fingers. This age group fall within the period when children are increasingly involved with outdoor activities, including an increased chance of handling fecal contaminated materials, which predispose them to parasitic infections. Among the non-pathogenic protozoa found in all age groups, was *Entamoeba coli* 12 (6.5%) and *iodamoeba butschlii* 12 (6.5 %).

Infection with *Ascaris lumbricoides* and *Hymenolepis nana* which had the lowest prevalence-one case of each 2 (1.6 %), was comparable with similar studies of 1(0.5%) by (Patel and Khandekar, 2006; Al-Braiken, 2008; Al-Megrin, 2010; Sharif *et al*., 2010). The ova of the two mentioned helminths have a tough outer coat that enables them to resist adverse external environmental conditions which enhance their survival and higher probability of transmission (Bhutta *et al.,* 2014). Indeed, earlier studies in the Magu district in Tanzania, reported a prevalence of <1% of *A. lumbricoides, Trichuris trichiura* and *E. vermicularis* (Lwambo *et al.,* 1999) while another previous study done in Sengerema District in Tanzania did not detect any *A. lumbricoides, T. trichiura or E. vermicularis* (Mazigo *et al.,* 2010). However, it was not in agreement with other studies done in Nicaragua (12%) (Munoz-Antoli *et al.,* 2014) and in Malaysia (Sinniah *et al.,* 2014). The low prevalence of the helminths in this study is an indication of effective regular intermittent treatment with anthelminthic drugs in the primary health facilities. However, the drug mass administration with albendazole could explain the low rate of helminthes infection as previously reported by (Supali *et al*., 2013).

The prevalence of *Cryptosporidium parvum* was 20 (13%), and it was comparable with several other studies (12%) (Yilmaz *et al.,* 2008; Dogan *et al*., 2012; Vahedi *et al*., 2012). The high prevalence rate of cryptosporidiosis recorded in the females could been attributed by other underlying medical conditions that may have weakened the immune system hence giving a chance to the opportunistic infections like cryptosporidiosis (Herwaldt *et al.*, 2000). In some areas of the studies, the water pipes are passed through drainage pathways and, in some instances, the pipes are broken and left unattended, which eventually may contaminate the drinking water (Lopez *et al.,* 2003). Nevertheless, with the suitable temperature range, humidity, and other environmental factors sporulation and endurance of oocysts in the water may be enhanced.

However, since modified Z-N test is not employed as a routine stool test in most of the hospital laboratories, some cases of cryptosporidiosis are missed out therefore it is possible that many healthy carriers exist in the communities. Such cases can only be detected when patients are referred to facilities with modern diagnostic techniques like MTRH.

Out of the infected patients 46.5 % (86/185) who were infected by the intestinal parasites, 6.4% (12/185) had multiple infections. In the multiple infection groups, the most common combinations were *Entamoeba histolytica* and *E. coli, Entamoeba histolytica* and *I. butschlii* followed by *hookworm spp* and *I. butschlii*. There was no statistically significant difference (*P* value of 0.562). The multiple infections were not specific to a particular age nor gender. For the case of small children the outdoor activities including handling of feacal contaminated materials could have predisposed them to parasitic infections.The sharing of the toilet facility by many people as shown in the current study may have lead to high chances of contamination 133 (72.3%). Polyparasitism was common within the protozoa than in the helminthic infections, and this could probably be due to the more hostile weather to the mode of transmission of the helminths. *Ascaris lumbricoides* and *Trichuris trichiura* is feco-oral requiring suitable environment for egg maturation, survival and transmission. The accessibility of improved hygiene, sanitation and awareness of the infection associated with lack of access to potable water could be one plausible explanation for low STH prevalence within these patients.

In the current study, relationships were evaluated between intestinal parasitic infections and socio-demographic factors. The level of education was one factor with no significant difference ($p < 0.210$) in this study. This was not in agreement with a study done by Abossie and Sied (2014) whereby majority of patients who had low level of education had their children infected with intestinal parasitic infections in comparison with other household heads who had higher level of education ($p < 0.001$). This current study indicates that there are no significant differences in all the identified parasites.

This current study was in agreement with a comparative study on prevalence of intestinal parasites in low socio-economic areas from South Chennai, India. Jeevitha *et al.*, (2014) which obtained the following results; *E. coli* (23%), *Cyclospora spp* (22.2%), *E. histolytica* (21.8%), *G. lamblia* (14.4%), *A. lumbricoides* (6.2%), *T. trichiura* (1.1%), and *H. nana* (2.7%). The data on the prevalence of parasites with respect to sex and age showed that the females harbored more numbers of parasites when compared to males. Further, with respect to age, children and teenagers had polyparasitism as compared to old age groups and the high percentage of educational status showed a reduction in the number of parasitic infections.

Conclusively, these IPIs could be prevented by possible grouping of better ecological designs, examination of personal hygiene as well as routine medical examination and treatment should be strongly recommended in the low socio-economic areas in the current study region.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

Based on the present study findings, *Entamoeba histolytica* and *Giardia lamblia* were the most prevalent pathogenic intestinal protozoa while *A. lumberciodes, Encylostoma duodenale* and *T. trichiura* were less common in the patients observed.

Study participants of all ages were susceptible to parasitic infections with varied magnitudes in the study population. The most prevalent parasitic infections encountered were amoebiasis and cryptosporidiosis.

Both genders were found susceptible to both protozoal and helminth infections though cryptosporidiosis was more prevalent in females than males.

Effects of education level, source of domestic water, residence and fecal disposal facility did not show a significant influence on intestinal infections among the patients referred to the laboratory at MTRH. The high prevalence rate of intestinal parasitic infections among the patients attending MTRH indicates that parasitic infections should be considered as a public health problem.

6.1 Recommendations

As this is the first study in the region to provide comprehensive information related to prevalence of intestinal parasites in patients attending MTRH, the given recommendations from the study will assist Government health officials in policy development. Interventions such as deworming and health education programs will provid proper mechanism to be put in place through the public health department in liaison with the County health authorities. For this reason, preventive measures should be implemented by adhering to the following;

1. Community-based health promotions including regular checkups and treatment.

2. Adequate treatment of domestic water for the community to reduce the incidences of IPIs.
3. Modified Z-N technique to should be included as a routine test for stool analysis in the health facility Laboratories.
4. Research is needed to elucidate why amoebiasis is higher in the males and cryptosporidiosis in the females.

REFERENCES

Abbas, Obaid, Farhan. (2012). Prevalence of Intestinal Parasitic Infestations in Al-Anbar Province, West of Iraq. *J. of university of anbar for pure science*: **Vol.6: NO.1.**

Abdel-M, I., A., Wierzba, T., F., Abu-Elyazeed, R., Ibrahim, A., F., Ahmed, S., F., Kamal, K., Sanders, J., Frenck, R. (2005). Diarrhea Associated with *Cryptosporidium parvum* among young Children of the Nile River Delta in Egypt. *J Trop Pediatr* 51*:*154–159.

Abossie, A. and M. Seid.(2014). Assessment of the prevalence of intestinal parasitosis and associated risk factors among primary School Children in Chencha town, Southern Ethiopia. *BMC Public Health*, **Vol. 14.** 10.1186/1471-2458-14-166.

Al-Braiken, F., A. (2008). Is intestinal parasitic infection still a public health concern among Saudi children? *Saudi Med. J.*, 29: 1630-1635.

Al-Braiken, F., A., A., Amin., N., J., Beeching., M., Hommel., and C., A., Hart. (2003). Detection of Cryptosporidium amongst diarrhoeic and asymptomatic children in Jeddah, Saudi Arabia. *Ann. Trop. Med. Parasitol*., 97: 505-510.

Ali, S., A. and Hill, D., R. (2003*).Giardia intestinalis. Curr Opin Infect Dis*.; 16: 453–460.

Alli, J., A., A., F., Kolade. I., O., Okonko. *et al*., (2011). "Prevalence of intestinal nematode infection among pregnant women attending antenatal clinic at the University College Hospital, Ibadan, Nigeria," *Advances in Applied Science Research*, **vol. 2, pp. 1–13.** View at Google Scholar.

Al-Megrin, W., A., I. (2010). Intestinal parasites infection among immunocompromised patients in Riyadh, Saudi Arabia. *Pak. J. Biol. Sci.,* 13: 390-394.

Alum, A., J., R., I., jaz, M., K. (2010). The global war against intestinal parasites— should we use a holistic approach? *Int J. Infect Dis*.14:e732–e738.

Ashtiani, M., T., H., M., Monajemzadeh., B., Saghi., S., Shams. and S, H., Mortazavi. (2013). Prevalence of intestinal parasites among children referred to Children's Medical Center during 18 years (1991-2008), Tehran, Iran. *Ann. Trop. Med. Parasitol*., 105: 507-513.

Auerbach, Karp., S. (2012).Intestinal parasites in Cambodia .Chronic *Strongyloides stercoralis* in Loatian immigrants .CDC 27/7: Saving Lives. Protecting people.

Barry, M.,A., Weatherhead J., E., Hotez, P., J., Woc-Colburn , L. (2013). "Childhood parasitic infections endemic to the United States". *Pediatrics Clin. North Am* 60 (2): 471–85. doi : 10.1016 /j. pcl. 2012.12.011 PMID 23481112.

Belayhun Y., Medhin G., Amberbir, A. (2010). Prevalence and risk factor for geohelminthic Infection in infants in Butajera Ethiopia, a population based study. *BMC Public Health 10: 21*. doi: 10.1186/1471-2458-10-21.

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

Birn, Anne, Emanuelle, Armando, Solórzano. (1999). "Public health policy paradoxes: science and politics in the Rockefeller Foundation's hookworm campaign in Mexico in the 1920s". *Social Science & Medicine*. 49 (9): 1197–1213. PMID 10501641. doi:10. /S0277-9536(99)00160-4.

Bhutta, Z., A., Sommerfeld, J., Lassi , Z., S., Salam ,R., A., Das, J., K.(2014).Global burden, distribution, and Interventions for infectious diseases of poverty. *Infect Dis poverty;* 3:21.

Brooker , S., Kabatereine, N., B., Smith, J., L., Mupfasoni, D., Mwanje, M., T. (2009). An updated Atlas of human helminth infections: the example of East Africa. *In.* J. *Health Geogr 8:* 42. doi: 10.1186/1476-072x-8-42.

Brooker, S., Michael., E. (2000).The Potential of Geographical Information Systems and Remote Sensing in Epidermiology and control of Human Helminth Infections. *Anvances in Parasitology* ; 47:254-87. (PubMed)

Bundy, D., C., T, Cooper, R., S., Thomson, D., Didler, M, and Simmons., S. (1987).Epidemiology and population dynamics of *A. lumbricoides* and *Trichuris trichiura* infections in the same community. Trans roy. Soc. *Trop. Med. Hgy*. 81:987-994

CDC. (2014). Centre for disease control and prevention.

http://www.cdc.gov/parasites/children.html.

CDC. (2013). "Parasites - Trichuriasis (also known as Whipworm Infection)" Retrieved 5 March2014.

CDC. (2013). "Giardiasis". *Cdc.gov.* Retrieved 26 February 2015.

Chan, M., S. (1997). The global burden of intestinal nematode infections—fifty years on. *Parasitol Today*. ; 13: 438–443.

Chan, M., S., Medley, G., F., Jamison, D. and Bundy, D., A. (1994). The evaluation of potential Global morbidity attributable to intestinal nematode infections. *Parasitology.* 1373–387

Cheesbrough, M. (1987).Medical Laboratory Manual for tropical Countries. **VOL 1. ELSB Ed.** 1989. Pitkanen Y., T., Petonen., M. Published 1995.

Cheesborough, M. (1987). Medical Laboratory Manual for Tropical Countries. **Vol. 1. 2nd Edition** Pgs 181-186, 204-205, 217.

Cheesbrough, M. (1985). Parasitological Tests. In: District Laboratory Practice in Tropical Countries, Chessbrough, M. (Ed.).*Tropical Health Technology,* World Health Organization, Geneva, Switzerland, pp: 184-235

Cleaveland, S., Laurenson, M., K. and Taylor, L., H. (2001). Diseases of humans and their domestic mammals: pathogen characteristics, host range and the risk of emergence. *Phil Trans R Soc Lond B.*; 356: 991– 999.

Curtale, F., Pezzotti. P., Sharbini. A., L., AlMaadat. H., Ingrosso. P. (1998). Knowledge, Perceptions and behavior of mothers towards intestinal helminths in Upper Egypt: Implication for control. *Health Policy Plan.*

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

Dogan, N., Y., O., Z., N., U., Kocman. and A , F., Nursal. (2012). [Comparison of individual differences in the direct microscopic examination in the diagnosis of intestinal parasites]. *Turkiye Parazitolojii Dergisi*, 36: 211-214, (In Turkish).

Ejemot, Nwadiaro, Regina, I., Ehiri, John, E., Arikpo, Dachi, Meremikwu, Martin, M., Critchley, Julia, A. (2015). "Hand washing promotion for preventing diarrhoea" . *The Cochrane Database of Systematic Reviews* (9): 1–95. ISSN 1469-493X.

El Fatni, C., F., Olmo., H., El Fatni., D., Romero. and M , J., Rosales.(2014). First genotyping of Giardia duodenalis and prevalence of enteroparasites in children from Tetouan (Morocco). *Parasite*, **Vol. 21. 10.1051/parasite/2014049.**

Esch, Thimothy, M., Goater., Cameron., P., Goater., Gearal., W., Esch.(2013).Parasitism In human. **2nd edition.** The diversity and ecology of animal parasites.

Ezeagwuna, Okwelogu, Ekejindu, Ogbuagu. C. (2010). The Prevalence and Socio-Economic Factors Of Intestinal Helminth Infections Among Primary School Pupils In Ozubulu, Anambra State, Nigeria. *The internet Journal of Epidemiology.* **Vol. 9 No 1.**

Feng, Y., Xiao, L. (2011). Zoonotic potential and molecular epidemiology of Giardia species and giardiasis. Clin Microbiol Rev.24:110–140. doi: 10.1128/CMR.00033-10.

Fenwick, A. (March 2012). "The global burden of neglected tropical diseases" Public health 126(3):233–6.doi:10.1016/ *j.puhe.*2011.11.015. **PMID 22325616.**

Fernandez, M., C., S., Verghese. , R ., Bhuvaneswari (2002). "A comparative study of the intestinal parasites prevalent among children living in rural and urban settings in and around Chennai," *Journal of Communicable Disease.* **vol. 34, no. 1, pp. 35–39**.

Garson, M. (2003). Capital University of Intergrated Medicine. Parasites- A Holistic Approach. In: *Associates NIH,* editor.

Gelaw, A., B., Anagaw., B., Nigussie., B., Silesh. and A, Yirga.(2013) . Prevalence of intestinal parasitic infections and risk factors among schoolchildren at the University of Gondar Community School, Northwest Ethiopia: A cross-sectional study. *BMC Public Health,* **Vol. 13. 10.1186/1471-2458-13-304.**

GNNTD, (2009). "Global network for neglected tropical diseases receives $34 million from Gates Foundation: IDB leads campaign to greatly reduce the burden of most neglected Diseases by 2020 in Latin America and the Caribbean. "*Press Release.Global Network for Neglected Tropical Diseases.*

Gunarwardena, C., Jennings. , B., Ortegano-Layne. L., Freehette. C., Carbajal

K., Linderrmann. K.(2004).Building an on line wisdom community: A transformation Design model. *Journal of computing in Higher Education* 15(2), 40-62.

Haque, R., (2007).“Human intestinal parasites,” *Journal of Health, Population and Nutrition*, **vol. 25, no. 4, pp. 387–391.** View at Google Scholar · View at Scopus.

Hellard, M., E., Sinclair, M., I., Hogg, G., G., Fairley, C., K. (2000). Prevalence of enteric pathogens among Community based asymptomatic individuals. *J Gastroenterol Hepatol.* ; 15: 290–293. doi: 10.1046/j.1440-1746.2000. 02089.

Heredia, R., D., Fonseca, J., A., López , M., C. (2012). *Entamoeba moshkovskii* perspectives of a new Agent to consider in the Diagnosis of amebiasis. *Acta Trop* 123:139.

Herwaldt, B., L. (2000).“Cyclospora cayetanensis: a review, focusing on the outbreaks of cyclosporiasis in the 1990s,” *Clinical Infectious Diseases,* **vol. 31, no. 4, pp. 1040–1057.**

Hotez, P., J., Alvarado, M., Basa'ñez, M., G., Bolliger, I., Bourne, R. (2014).The Global Burden of Disease Study 2010: Interpretation and Implications for the Neglected Tropical Diseases. *PLoS Negl Trop Dis* 8(7): e 2865. doi: 10.1371/ *journal.pntd*.0002865.

Hotez, P., J. (2009). One world health: neglected tropical diseases in a flat world. *PLoS Negl Trop Dis*.; 3: e405.

Hotez, P., J. (2008). Neglected infections of poverty in the United States of America. *PLoS Negl Trop Dis*.; 2: e256.

Hotez, P., J., Bottazzi, M., E., Franco-Paredes, C., Ault, S., K. and Periago, M., R. (2008). The neglected tropical diseases of Latin America and the Caribbean: a review of Disease burden and distribution and a roadmap for control and elimination. *PLoS Negl Trop Dis*.; 2 e300.

Hotez, P., J., Bottazzi. M., E.,Bethony. J., Buss., P. (2006). New technologies for the control of human hookworm infection *Trend Parasitol*. 22:327-331.

Hotez, P, J., Bethony, J., Bottazzi, M., E., Brooker, S., Buss, P. (2005). The Great Infection of Mankind.PLoS Med. 2 (3): e67. doi: 10.1371/journal.pmed.0020067PMC 1069663. PMID 15783256.

Houweling, T., A., Kunst, A., E., Mackenbach, J., P. (2003). Measuring health inequality among children in Developing countries: does the choice of the indicator of economic status matt . *Int J. Equity Health*. 2:8.

Jamison, Dean. (2006). "Helminth Infections: Soil-transmitted Helminth Infections and Schistosomiasis. “Disease control priorities in developing countries.” New York: *Oxford University Press. p.* **Chapter 24.** ISBN 9780821361801.

Jeevitha, D., Pradeep. Pushpara, j., Selvadoss. and Kanchana, Muthuswamy. (2014). Comparative Study of the Prevalence of Intestinal Parasites in Low Socioeconomic Areas from South Chennai, India. Research Article. *Journal of Parasitology Research.* **Volume 2014** , Article ID 630968, 7 pages. http://dx.doi.org/10.1155/2014/630968

Jex, A., R., Smith, H., V., Nolan, M., J., Campbell, B., E., Young, N., D., Cantacessi , C., Gasser, R., B. (2009). Cryptic parasite revealed improved prospects for treatment and control of human Cryptosporidiosis through advanced technologies. *Adv Parasitol*. 77:141–173.

Keiser, J., Utzinger, J. (2010). The drugs we have and the drugs we need against major helminth infections. Adv Parasitol73: 197–230. doi:10.1016/s0065-308x (10)73008.

Kia, E., B., Hossein,M., Nilforoushan, M.,R,, Meamar, A.,R., Rezaeian, M. (2008). Study of intestinal protozoan Parasites in rural inhabitants of Mazandaran Province, Northern Iran.*Iranian J Parasitol*; 3: 22–25.

Loukopoulos, P., A., Komnenou. E., Papadopoulos. and V., Psychas. (2007). “Lethal ozolaimus megatyphlon infection in a green iguana (Iguana iguana rhinolopa),” *Journal of Zoo and Wildlife Medicine,* **vol. 38, no. 1, pp. 131–134**. View at Publisher View at Google Scholar · View at Scopus.

Lozano, R., Naghavi, M., Foreman, K., Lim, S., Shibuya, K., Aboyans, V., Abraham, J., Adair, T., Aggarwal, R., Ahn, S.,Y. (2012). Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burd of Disease Study 2010 .*Lancet*.380:2095–2128. doi: 1016/S0140- 6736(12)61728-0.

Lwambo, N., J., S., Siza, J., E., Brooker, S., Bundy, D., A., P. & Guyatt, H. (1999).Patterns of concurrent hookworm infection and schistosomiasis in schoolchildren in Tanzania. *Transactions of the Royal Society of Tropical Medicine and Hygiene* 93, 497-502.

Manganelli, L., F., Berrilli., D., D., I., Cave., L., Ercoli., G., Capelli., D., Otranto. and A, Giangaspero. (2012). Intestinal parasite infections in immigrant children in the city of Rome, related risk factors and possible impact on nutritional status. *Parasites Vectors,* **Vol. 5. 10.1186/1756-3305-5-265.**

Mazigo, H., D., Waihenya, R., Lwambo, N., J., S., Mnyone, L., L., Mahande, A., M., Seni, J., Zinga, M., Kapesa , A., Kweka, E., J., Mshana S., E., Heukelbach, J., & Mkoji, G., M. (2010). Co-infections with *Plasmodium falciparum, Schistosoma mansoni* and in test helminth among school children in endemic areas of north western Tanzania. *BMC Parasites and Vectors 3:4.*

Mbae, C., K., D., J., Nokes., E., Mulinge., J., Nyambura. , A., Waruru, and S. Kariuki.(2013). Intestinal parasitic infections in children presenting with diarrhoea in outpatient and inpatient settings in an informal settlement of Nairobi , Kenya. *BMC Infect. Dis*., **Vol. 13. 10.1186/1471-2334-13-243.**

Mbanugo, J., I., Onyebuchi , C., J. (2012). Prevalence of intestinal parasites in Ezinifite Community, Aguata Local Government Area of Anambra State. *Nigerian J. Parasitol*.23:27–34.

Mbanugo, J., I., Abazie, O., C. (2002). A comparative study of intestinal parasite infections of pregnant and non-pregnant women in Nkpor , Anambra State. *Nigerian J Parasitol*. 23:19–26.

Mbuh, J., V., Ntonifor, H., N., & Ojong, J., T. (2010).The incidence, intensity and host morbidity of parasitic protozoan infections in gastrointestinal disorder outpatients in Buena Sub Division, Cameroon. *Journal of Infection in Developing Countries 4, 38-43.*

Mehraj, V., Hatcher, J., Akhtar, S., Rafique, G., Beg, M., A. (2008). Prevalence and factors associated with Intestinal parasitic infection among children in an urban slum of Karachi. *PLoS One.* 3(11):e3680.

Meyer, E., A. (1985). The epidemiology of giardiasis.*Parasitol Today.* (1985)1: 101–105.

Minenoa, M., and Avery, A. (2003). "Giardiasis: recent progress in chemotherapy and drug development," *Current Pharmaceutical Design*, **vol. 9, pp. 841–855.**

Molbak, K., Hojlyng , N., Gottschan. A., Sa., J., C., Ingholt, L., da Silva., A., P. and Aaby. , P. (1993).Cryptosporidiosis in infancy and childhood Mortality in Guinea Bissau, West Africa Br. *Medd. J. 307, 417-420.*

Mordi, R., M., and P., O., A., Ngwodo. (2007). "A study of blood and gastro-intestinal parasites in Edo state," *African Journal of Biotechnology*, **vol. 6, no. 19, pp. 2201–2207.** View at Google Scholar ·

View at Scopus.

Mugenda, O., M. and Mugenda, A., G. (1999). Research Methods: Quantitative and Qualitative approaches, African Center of Technology Studies, Nairobi, Kenya.

Mukhiya, R., K., S., K., Rai., A., B., Karki, and A. Prajapati.(2012). Intestinal protozoan parasitic infection among school children. *J. Nepal Health Res*. Council, 10: 204-207.

Munoz-Antoli, C., A., Pavon., A., Marcilla., R., Toledo. and J ,G., Esteban. (2014). Prevalence and risk factors related to intestinal parasites among children in Department of Rio San Juan, Nicaragua. *Trans. R. Soc. Trop. Med. Hyg., 108: 774-782*.

Mwanthi, M., A., Kinoti. (2008). Prevalence of intestinal worm infection among primary school children in Nairobi city. *East African Journal of Public Health,* **Vol. 5. No. 2**

Nacher, M. (2011). Interactions between worms and malaria: good worms or bad worms? *Malar J.10:259*.

Nduka, F., O., Nwaugo, V., O., Nwachukwu, N., C. (2006). Human intestinal parasite infections in Ishiagu, a leading mining Area of Abia State. *Animal Research International*; 3 (3):505–507.

Nematian, J., Nematian, E., Gholamrezanezhad, A., Asgari, A., A., (2004). Prevalence of intestinal Parasitic infections and their relation with socio-economic factors and hygienic habits in Tehran primary school students.

Acta Trop.92:179–186.

Nobre, L., N., R., V., Silva., M., S., Macedo., R., A., Teixeira., J., A., Lamounier. and S, C. , Franceschini.(2013). Risk factors for intestinal parasitic infections in pre-schoolers in a low socio-economic area, Diamantina, Brazil. Pathog. *Global Health*, 107: 103-10.

NYSDH. (2011). "Giardiasis (beaver fever)'' Retrieved 21 June 2015.

Odu, N., N., C., O., Akujobi. S., N., Maxwell, and A., R., Nte. (2011). "Impact of mass deworming of school children in rural communities in Rivers State, Nigeria: option for programme sustainability," *Acta Parasitologica*, **vol. 2, pp. 20–24.**
View at Google Scholar.

Ogbe , M., G., Odudu, L., A. (1990). Gastro-intestinal helminthiasis in Epe L.G.A., Lagos State, Nigeria. *Nigerian Journal Parasitol*. ; 9-11:95–106.

Olsen, A., Magnusen, P., Ouma, J., H., Anderso, J., Friis, H.(1998). The contribution of hookworm and other parasitic infections to haemoglobin and iron stsus among children and adults in Western Kenya.*Trans Roy Soc Trop Med Hyg.* Nov-Dec; 92(6):643-9.

Ortega, Y., R. and Adam, R., D. (1997). Giardia: overview and update. *Clin. Infect Dis*.; 25: 545–550.

Otieno, L., S., kamunui: F., j., Nyaga, D. and Nderitu , J., W. (1985). The intestinal parasitic characteristics in the rural health centres in Kisii District. In Recent advances in the management and control of infections in East Africa. Tukei P.M (ed) *East African Lit.Bureau*. Nairobi pp248-253.

Patel, P., K., and R., Khandekar. (2006). Intestinal parasitic infections among school children of the Dhahira Region of Oman. *Saudi Med. J., 27: 627-632.*

Peterson, K., M., Singh, U., Petri, W., A., Jr. (2011). Enteric Amebiasis. In: Tropical Infectious Diseases: Principles, Pathogens and Practice, 3rd ed, Guerrant R, Walker DH, Weller PF (Eds), *Saunders Elsevier*, *Philadelphia* p.614.

Pillai D., R., Kain ., K.,C. (2003). Common intestinal parasites. *Curr Treat Infect*. Dis 2003 ; 5: 207-17.

Pullan, R., L., Smith, J., L., I., Jasrasaria, R., Brooker, S., J. (2014). Global numbers of infection and disease burden of soil transmitted helminth infections in 2010. *Parasites & Vectors* 7: 37. doi: 10.1186/1756-3305-7-37.

Rai, S., K., Bajracharya. K., Shrestha. M., K. (1993). Status of intestinal parasites in Nepal. *J Nep Med Assoc* 31: 382-9.

Reed, S., L., (2012). Amobiasis and infections with free-living amoebas. In: Harrison T., R., Fauci A., S., Braunwald., E., *et al* ., Principles of internal medicine. **15 th ed. New York: McGraw-Hill; pg. 1199-2002.**

Ruto, J., Chrispinus. S., Mulambalah. (2016). Epidermiology of parasitism and poly-parasitism involving intestinal helminthes among school children from different residential settings in Nandi County,Kenya.

CHRISMED journal of Health and Research.

Sanad, M., M., and J., S., Al-Malki. (2007). Cryptosporidiosis among immunocompromised patients in Saudi Arabia. *J. Egypt. Soc. Parasitol*., 37: 765-774.

Sayyari, A., A., F. Imanzadeh, S., A., Bagheri, Yazdi, H., Karami, M., Yaghoobi. (2005).Prevalence of intestinal parasitic infections in the Islamic Republic of Iran *Eastern Mediterranean Health Journal*, 11 (3) (2005), pp. 377-383

Senior, K. (2008). Neglected tropical diseases affect thousands in the USA. *Lancet.* ; 8: 427.

Sharif, M., A., Daryani., F., Asgarian., and M., Nasrolahei. (2010). Intestinal parasitic infections among intellectual disability children in rehabilitation centers of northern Iran. *Res. Dev. Disabil*., 31: 924-928.

Sherchhand, J., B., Ohara, H., Cross. J., S., Shrestha, M., P., Sherchand. S. (1997). Intestinal parasitic infections in rural areas of southern Nepal. *J Inst Med* 1997; 19: 115-21.

Singh, C., S., A., Zargar, I., Masoodi, A., Shoukat, B., Ahmad. (2010). Predictors of intestinal parasitosis in school children of Kashmir: a prospective study .*Tropical Gastroenterology,* 31 (2) pp. 105-107

Sinniah, B., A., K., R., Hassan., I., Sabaridah., M., M., Soe., Z., Ibrahim. and O., Ali.(2014). Prevalence of intestinal parasitic infections among communities living in different habitats and its comparison with one hundred and one studies conducted over the past 42 years (1970 to 2013) in Malaysia. *Trop. Biomed*., 31: 190-206.

Stanley, S., L., Jr. (2001). Pathophysiology of amoebiasis. *Trends in Parasitology* 17280–285.285.

Steketee, R., W. (2003). Pregnancy, nutrition and parasitic diseases. *J. Nutr*. ;133:1661S– 1667S.

Stensvold , C., R., Lewis. H., C., Hammerum. A., M., Porsbo. L., J., Nielsen. S., S., Olsen. K., E., Arendrup. M., C., Nielsen. H., V., Mølbak. K. (2009). Blastocystis: unravelling potential risk factors and clinical significance of a common but neglected parasite. *Epidemiol Infect.*137:1655–1663. doi: 10.1017/S0950268809002672.

Stephenson, M. C., Latham. E., A., Ottesen. (2000). Malnutrition and parasitic helminth Infections .*Parasitology, 121 (Suppl.)* (2000), pp. S23-28

Supali, T., Djuardi, Y., Brabley, M., Noordin, R., Ruckert, P., Fischer., P. (2013). Impact of six rounds of mass drug administrationon Brugian filariasis and soil-tranmitted helminth infections in eastern Indonesia. *PLoS Negl Trop Dis.7 (12):e2586.*

Thiongo, F., W., Luoba, A. and Ouma., J., H. (2001). Intestinal helminths and schistosomiasis among school children in a rural district in Kenya. *East Africa Medical Journal 78(6): 279-282.*

Toma, T., Miyagi, I., Kamimura. K. (1999). Questionnaire survey and prevalence of intestinal helminthes infections in Barru, Sulawesi, Indonisia. *Southeast Asian J. Trop Med Public Health* 1999; 30 : 68-77.

Vahedi, M., S., Gohardehi., M., Sharif. and A., Daryani. (2012). Prevalence of parasites in patients with gastroenteritis at East of Mazandaran Province, Northern Iran. *Trop. Biomed., 29: 568-574.*

Wang, L., D, Guo., J., G., Wu., X., H., Chen., H., G., Wang., T., P., Zhu., S., P., Zhang., Z., H., Steinmann., P., Yang., G., J.,Wang., S., P. (2009). China's new strategy to block *Schistosoma japonicum* transmission:experiences and impact beyond schistosomiasis. *Trop. Med., Int. Health*. 14:1475-1483. 10.1111/j.1365-3156.02403.x.

Wekesa, A. W., Mulambalah, C., S., Muleke, C., I., and Odhiambo, R. (2014). Intestinal Helminth Infections in Pregnant Women Attending Antenatal Clinic at Kitale District Hospital, Kenya *Journal of Parasitology Research.*

WHO (2014). Soil- transmitted helminthiasis: number of children treated in 2010. Week Epidemio Rec.(3014), 87: 225-232).

WHO (2013)."Soil-transmitted helminth infections Fact sheet N°366".Retrieved 5 March 2014.Wolfe MS (1975)."Giardiasis". *JAMA 233 (13): 1362–5.* doi:10.1001/jama.233.13.1362.

WHO (2013). Second report on neglected tropical diseases. Geneva: Sustaining the drive to Overcome the global impact of neglected tropical diseases. 9789241564540/en.

WHO (2012). The Use and Interpretation of Anthropometry. *Report of a WHO Expert Committee.* Geneva, Switzerland: 2012. pp. 2–5.

WHO (2010a). First report on neglected tropical diseases? Geneva: Working to overcome the Global impact of neglected Tropical disease who.int/publications/9789241564090.

WHO (2010b). Soil-transmitted helminthiasis. Number of children treated 2007–2008: update on the 2010 global target. *Wkly Epidemiol Rec 85: 141–8.*

WHO (2006). Preventive Chemotherapy in Human Helminthiasis: CoordinatedUse of Anthelminthic Drugs in Control Interventions: A Manual for Health Professionals and Programme Managers.

WHO (2003). The Global Burden of Intestinal Parasitic infections in man. www.E-mjm org/2003/v58n/ intestinal parasites.

WHO (2002). World health report. Annex Table 2: deaths by cause, sex, and mortality stratum In WHO regions and annex Table 3: Burden of disease in DALYs by cause, Sex and mortality stratum in WHO regions. *Geneva World Health.*

WHO (2000). Informal consultation on intestinal helminthes infection. Geneva, Switzerland: WHO; pp. 16–18. *Organization p. 186–93.*

Wongstitwilairoong, B., A., Srijan, O., Serichantalergs., C., D., Fukuda, P., McDaniel, L., Bodhidatta. and C., J., Mason.(2007). Intestinal parasitic infections among pre-school children in Sangkhlaburi, Thailand. *Am. J. Trop. Med. Hyg., 76: 345-350.*

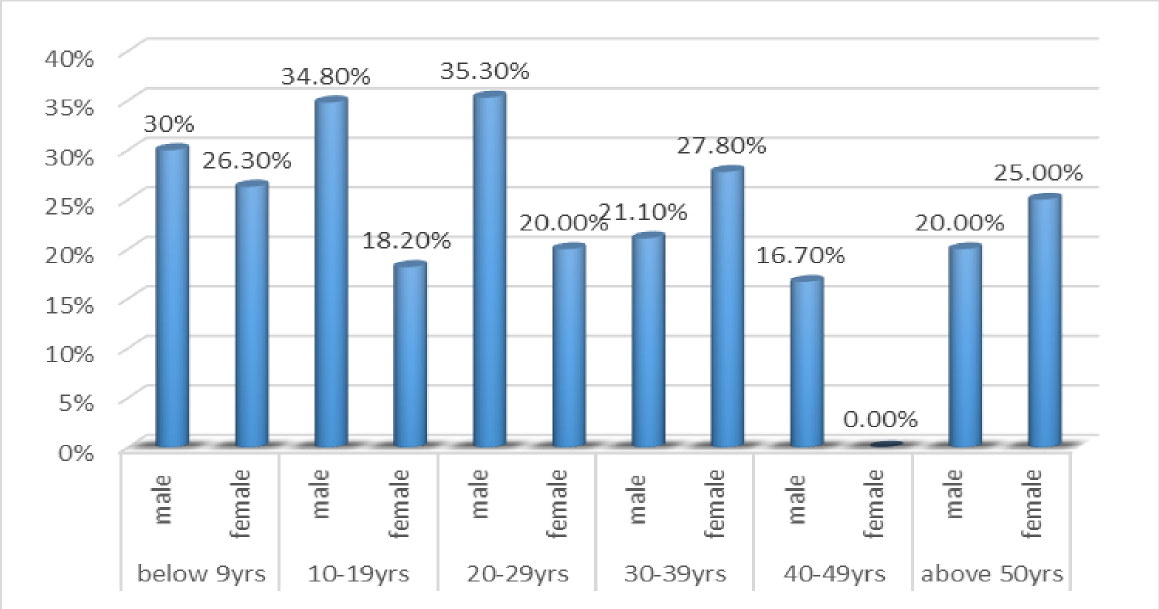
Xiao, L., Morgan, U., M., Fayer, R., Thompson, R., C., Lal, A., A. (2000). Cryptosporidium systematic and implications for public Health. *Parasitol Today16: 287–292.*

Yilmaz, H., Z., Tas, Cengiz, and M., Cicek. (2008). Investigation of cryptosporidiosis by enzyme-linked immunosorbent assay and microscopy in children with diarrhea. *Saudi Med. J., 29: 526-529.*

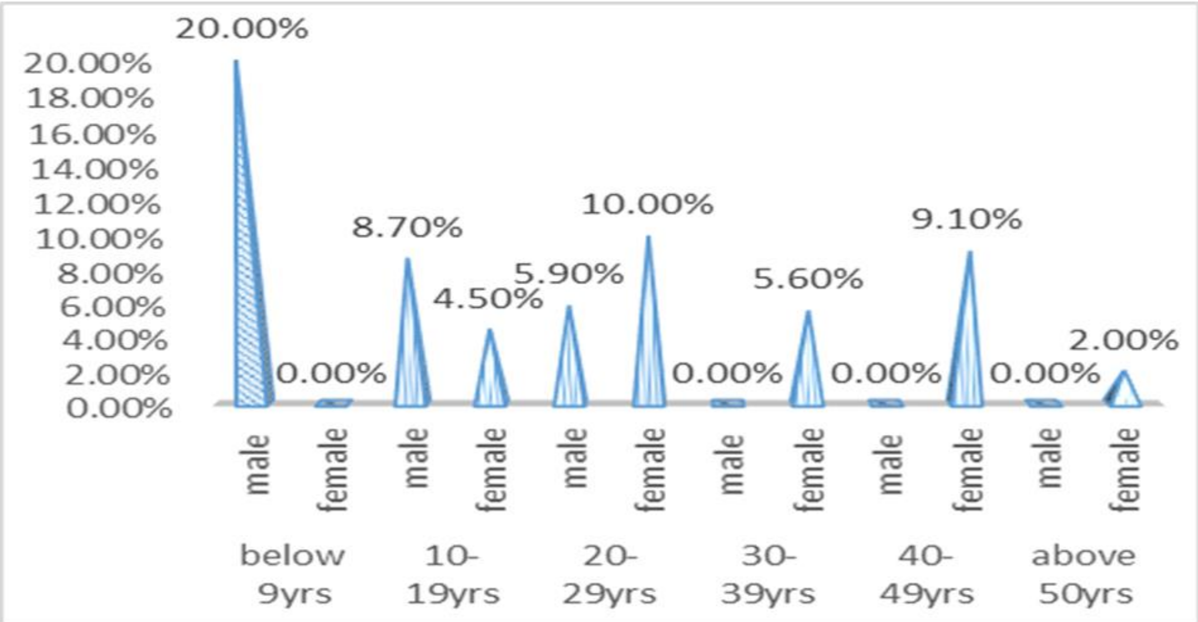
Yoder, J., S., Harral, C., Beach, M., J. (2010).Giardiasis surveillance-United States, 2006– 2008. *MMWR Surveillance Summit; 59:15–25.*

APPENDICES

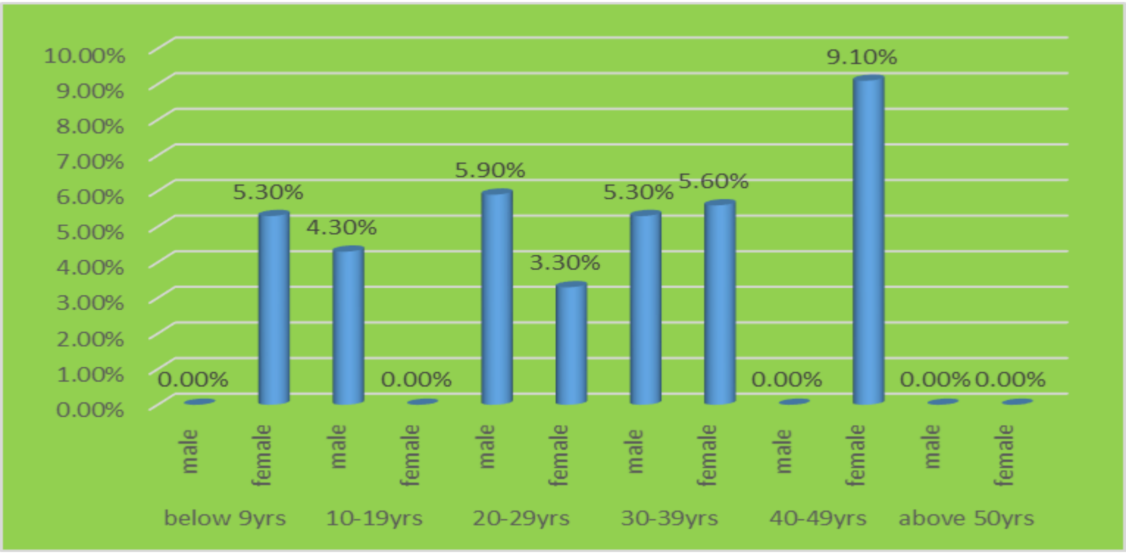
APPENDIX I (A-I): Parasite Genera / species associated with intestinal infection(s) among age groups



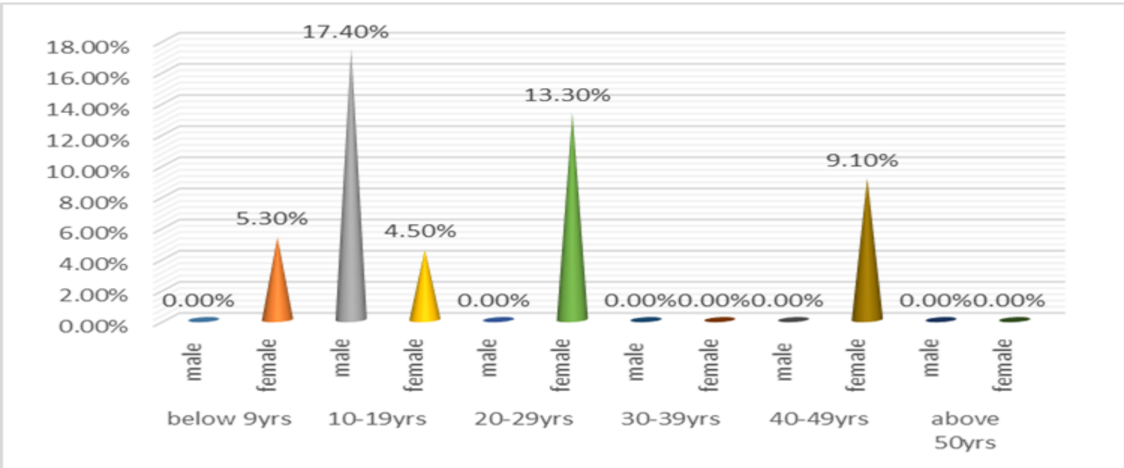
A. Prevalence (%) of *Entamoeba coli* amongst age groups and gender



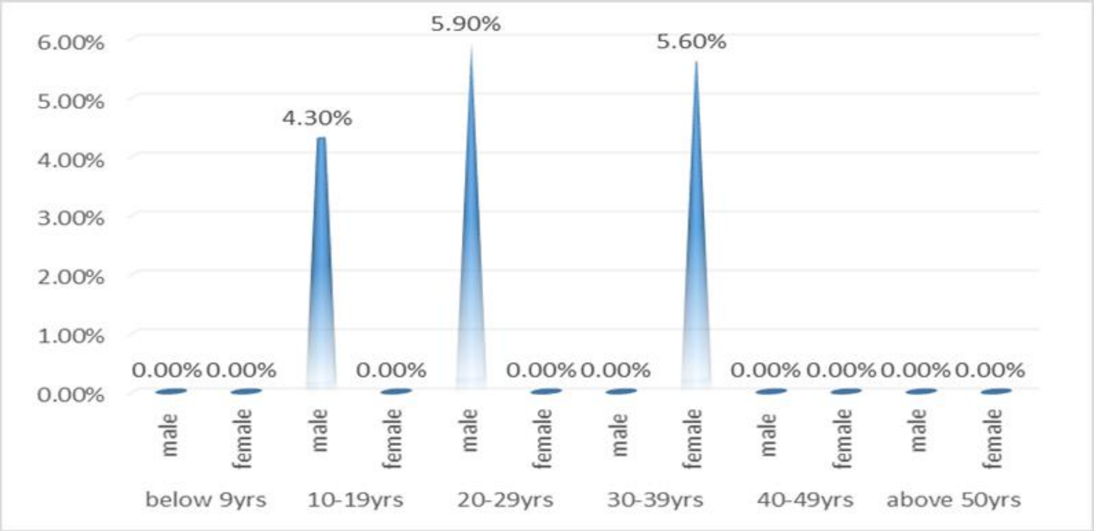
B. Prevalence (%) of *Giardia lamblia* amongst age groups and gender



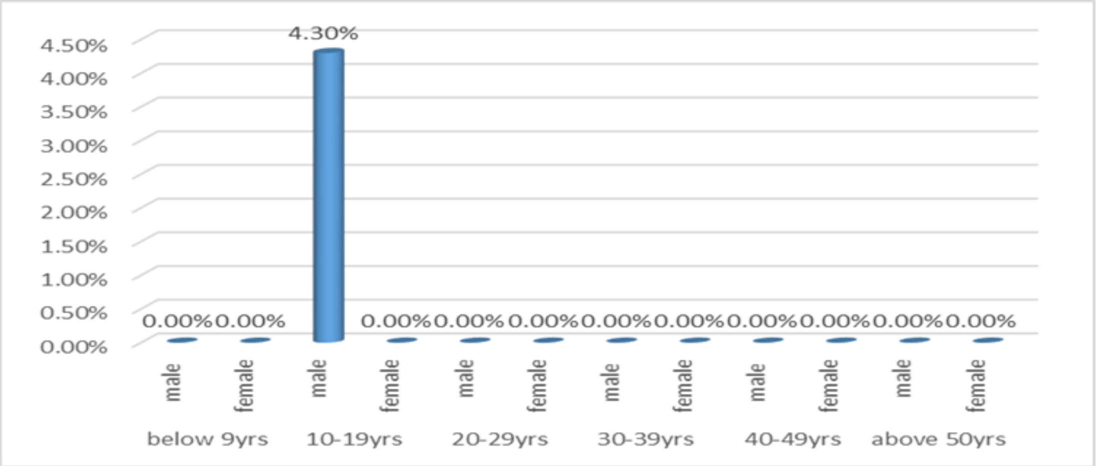
C. Prevalence (%) of *Iodamoeba butschlii* amongst age groups and gender



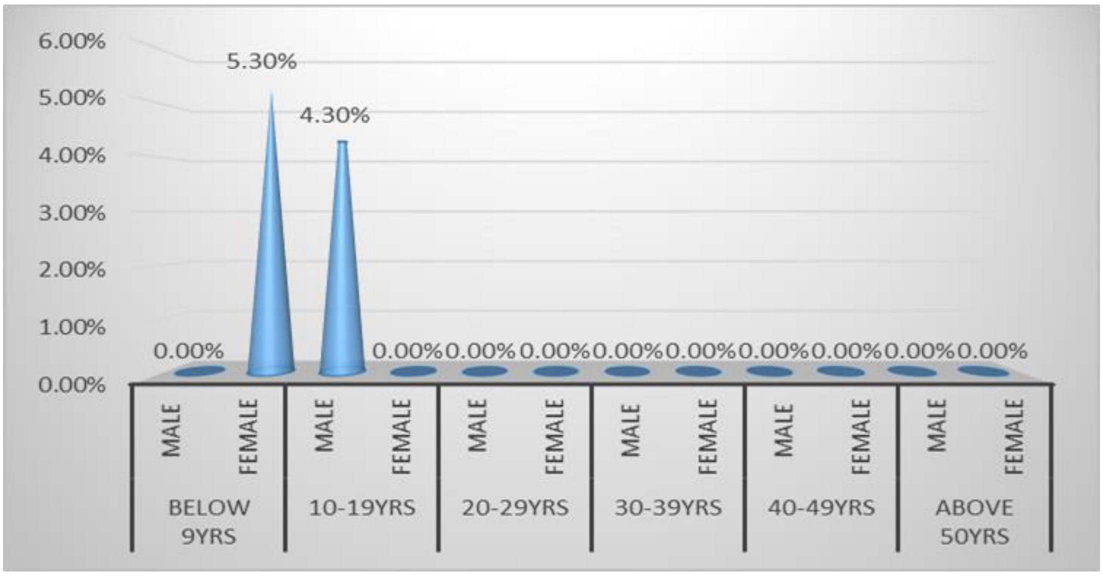
D. Prevalence (%) of Ascariasis amongst age groups and gender



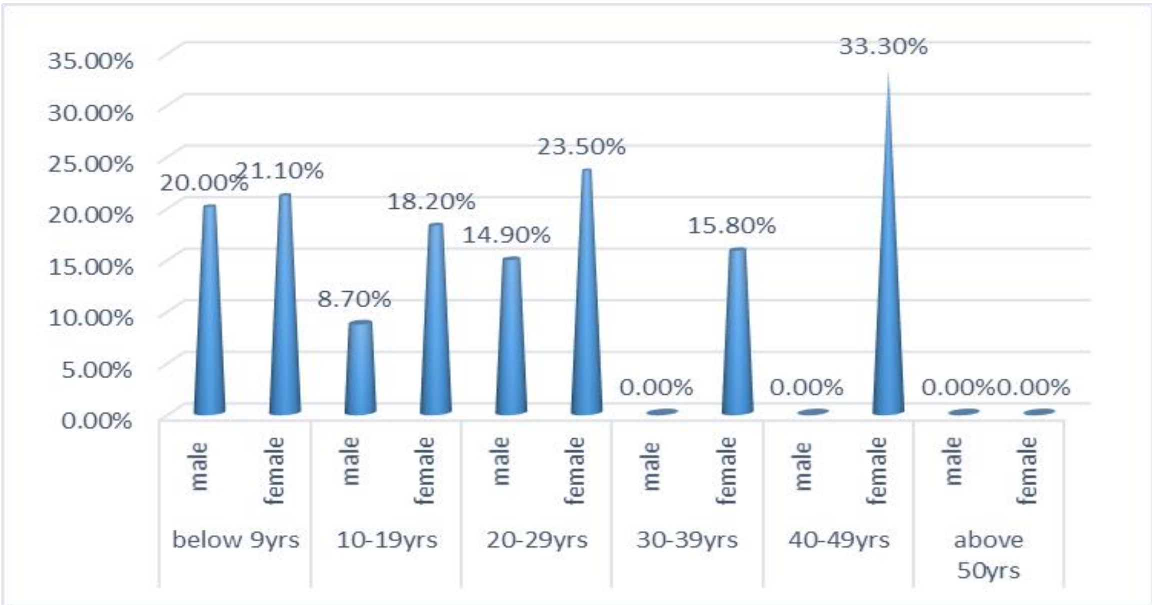
E. Prevalence (%) of *Hymenolepis nana* amongst age groups and gender



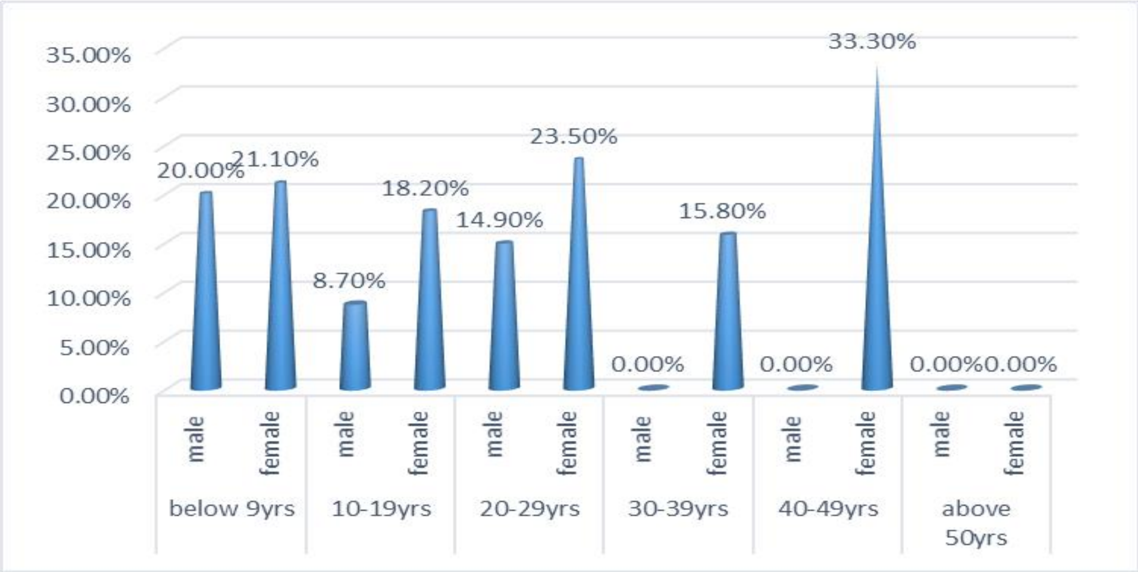
G. Prevalence (%) of Hookworm disease amongst age groups and gender



H. Prevalence (%) of Trichuriasis amongst age groups and gender



I. Prevalence (%) of Cryptosporidiosis amongst age groups and gender



APPENDIX II: Identified parasite species and the relative prevalence (%)

Name	Developmental stage	Classification	Associated infection	Technique used	(%)
E. histolytica	Cyst	sarcodina	Amoebiasis	Concentration	43(23.9%)
C. parvum	Oocyst	coccidia	Cryptosporidiosis	Mod.Z-N	24 (13%)
E. coli	Cyst	sarcodina	Amoebiasis	Concentration	12 (6.5)
G. lamblia	Cyst	mastigophora	Giardiasis	Concentration	12 (6.5%)
I. butschlii	Cyst	sarcodina	Amoebiasis	Concentration	12 (6.5%)
A. lumbricoides	Ova	Nematoda	Ascariasis	Concentration	3 (1.6%)
H. nana	Ova	Cestoda	Cysticercosis	Concentration	1 (0.5%)
T. trichiura	Ova	Nematoda	Trichuriasis	Concentration	1 (0.5%)
A. duodenale	Ova	Nematoda	Hookworm disease	Concentration	2 (1.1%)

APPENDIX III (A-I): Effects of the identified intestinal parasitic infections on age, level of education and gender

A. Effects of Amoebiasis on age, level of education and gender

The results showed that there was no significant difference of *E.histolytica* in age groups of the respondents (χ^2 = 3.525 and P-value of 0.620). The study findings showed that there was no significant relation between *E.histolytica* and Education (χ^2 = 7.143 and p-value of 0.210). There was no significant relationship between *E.histolytica* and sex (χ^2 = 1.820 and p-value of 0.177).

Variable	***E. histolytica***		
AGE	**Positive**	**Negative**	**Total**
Below 9 years	8	21	29
	18.20%	15.00%	15.80%
10-19 years	12	33	45
	27.30%	23.60%	24.50%
20-29 years	12	35	47
	27.30%	25.00%	25.50%
30-39 years	9	28	37
	20.50%	20.00%	20.10%
40-49 years	1	16	17
	2.30%	11.40%	9.20%
above 50 years	2	7	9
	4.50%	5.00%	4.90%
	χ^2 = 3.525	**Sig=0.620**	
EDUCATION LEVEL	**Positive**	**Negative**	
Primary	18	40	58
	40.90%	28.60%	31.50%
Secondary	4	13	17
	9.10%	9.30%	9.20%
O-level	6	44	50
	13.60%	31.40%	27.20%
A-level	0	3	3
	0.00%	2.10%	1.60%
College	13	33	46
	29.50%	23.60%	25.00%
University	3	7	10
	6.80%	*5.00%*	*5.40%*
	χ^2 = 7.143	**sig=0.210**	
SEX	**Positive**	**Negative**	
F	21	83	104

	47.70%	59.30%	56.50%
M	23	57	80
	52.30%	40.70%	43.50%
	χ^2 = 1.820	**sig=0.177**	

B. Effects of *E. coli* on age, level of education and gender

The results showed that there was no significant difference of *E.coli* in age groups of the respondents (χ = 1.521 and P-value of 0.911). The study findings showed that there was no significant relation between *E.coli* and Education (χ = 0.445 and p-value 0.994) and sex (χ = 0.017 and p-value of 0.896)

Variable	***E. coli***		
AGE	**Positive**	**Negative**	**TOTAL**
BELOW 9 YEARS	2	27	29
	16.70%	15.70%	15.80%
10-19 YEARS	3	42	45
	25.00%	24.40%	24.50%
20-29 YEARS	4	43	47
	33.30%	25.00%	25.50%
30-39 YEARS	1	36	37
	8.30%	20.90%	20.10%
40-49 YEARS	1	16	17
	8.30%	9.30%	9.20%
ABOVE 50 YEARS	1	8	9
	8.30%	4.70%	4.90%
	χ^2 = 1.521	**Sig=0.911**	
EDUCATION LEVEL	**Positive**	**Negative**	
PRIMARY	4	54	58
	33.30%	31.40%	31.50%
SECONDARY	1	16	17
	8.30%	9.30%	9.20%
O-LEVEL	3	47	50
	25.00%	27.30%	27.20%
A-LEVEL	0	3	3
	0.00%	1.70%	1.60%
COLLEGE	3	43	46
	25.00%	25.00%	25.00%
UNIVERSITY	1	9	10
	8.30%	5.20%	5.40%
	χ^2 = 0.455	**Sig=0.994**	
GENDER	**Positive**	**Negative**	
F	7	97	104
	58.30%	56.40%	56.50%
M	5	75	80

	41.70%	43.60%	43.50%
	χ^2 = 0.017	**Sig=0.896**	

C. Effects of Giardiasis on age, level of education and gender

The results showed that there was no significant difference of *G. Lamblia* in age groups of the respondents (χ^2 = 1.160 and P-value of 0.949). The study findings showed that there was no significant relation between *G. Lamblia* and Education (χ^2 = 2.140 and p-value of 0.829) and sex (χ^2 =0.001 and p-value of 0.973)

Variable	***G. lamblia***		
AGE	**Positive**	**Negative**	**Total**
below 9 years	1	28	29
	14.30%	15.80%	15.80%
10-19 years	1	44	45
	14.30%	24.90%	24.50%
20-29 years	2	45	47
	28.60%	25.40%	25.50%
30-39 years	2	35	37
	28.60%	19.80%	20.10%
40-49 years	1	16	17
	14.30%	9.00%	9.20%
above 50 years	0	9	9
	0.00%	5.10%	4.90%
	χ^2 = 1.160	**Sig=0.949**	
EDUCATION LEVEL	**Positive**	**Negative**	
Primary	2	56	58
	28.60%	31.60%	31.50%
secondary	0	17	17
	0.00%	9.60%	9.20%
O-level	2	48	50
	28.60%	27.10%	27.20%
A-level	0	3	3
	0.00%	1.70%	1.60%
College	3	43	46
	42.90%	24.30%	25.00%
University	0	10	10
	0.00%	5.60%	5.40%
	χ^2 = 2.140	**Sig=0.829**	
GENDER	**Positive**	**Negative**	
F	4	100	104
	57.10%	56.50%	56.50%
M	3	77	80
	42.90%	43.50%	43.50%

χ^2 =0.001	Sig=0.973

D. Effects of *I. butschlii* on age, level of education and gender

The results showed that there was no significant difference of *I. Butschlii* in age groups of the respondents (χ^2 = 5.213 and P-value of 0.390). The study findings showed that there was no significant relation between *I. Butschlii* and Education (χ^2 = 5.138 and p-value 0.399) and sex (χ^2 =0.017 and p-value of 0.896)

Variable	***I. butschlii***		
AGE	**Positive**	**Negative**	**Total**
below 9 years	1	28	29
	8.30%	16.30%	15.80%
10-19 years	5	40	45
	41.70%	23.30%	24.50%
20-29 years	4	43	47
	33.30%	25.00%	25.50%
30-39 years	0	37	37
	0.00%	21.50%	20.10%
40-49 years	1	16	17
	8.30%	9.30%	9.20%
above 50 years	1	8	9
	8.30%	4.70%	4.90%
	χ^2 =5.213	**Sig=0.390**	
EDUCATION LEVEL	**Positive**	**Negative**	
Primary	4	54	58
	33.30%	31.40%	31.50%
secondary	1	16	17
	8.30%	9.30%	9.20%
O-level	2	48	50
	16.70%	27.90%	27.20%
A-level	1	2	3
	8.30%	1.20%	1.60%
College	4	42	46
	33.30%	24.40%	25.00%
University	0	10	10
	0.00%	5.80%	5.40%
	χ^2 = 5.138	**Sig=0.399**	
GENDER	**Positive**	**Negative**	
F	7	97	104
	58.30%	56.40%	56.50%
M	5	75	80
	41.70%	43.60%	43.50%
	χ^2 = 0.017	**Sig=0.896**	

E. Effects of Ascariasis on age, level of education and gender

The results revealed that there was no significant difference of *A. Lumbricoides* in age groups of the respondents (χ^2 =1.348 and P-value of 0.930). The study findings showed that there was no significant relation between *A. Lumbricoides* and Education (χ^2 = 3.447 and p-value 0.631) and sex (χ^2 =0.667 and p-value of 0.414).

Variable	***A. lumbricoides***		
AGE	**Positive**	**Negative**	**Total**
below 9 years	0	29	29
	0.00%	16.00%	15.80%
10-19 years	1	44	45
	33.30%	24.30%	24.50%
20-29 years	1	46	47
	33.30%	25.40%	25.50%
30-39 years	1	36	37
	33.30%	19.90%	20.10%
40-49 years	0	17	17
	0.00%	9.40%	9.20%
above 50 years	0	9	9
	0.00%	5.00%	4.90%
	χ^2 =1.348	**Sig=0.930**	
EDUCATION LEVEL	**Positive**	**Negative**	
Primary	1	57	58
	33.30%	31.50%	31.50%
Secondary	0	17	17
	0.00%	9.40%	9.20%
O-level	0	50	50
	0.00%	27.60%	27.20%
A-level	0	3	3
	0.00%	1.70%	1.60%
College	2	44	46
	66.70%	24.30%	25.00%
University	0	10	10
	0.00%	5.50%	5.40%
	χ^2 =3.447	**Sig=0.631**	
SEX	**Positive**	**Negative**	
F	1	103	104
	33.30%	56.90%	56.50%
M	2	78	80
	66.70%	43.10%	43.50%
	χ^2 =0.667	**sig=0.414**	

F. Effects of *H. nana* on age, level of education and gender

The results revealed that there was no significant difference of *H. nana* in age groups of the respondents (χ^2 =3.106 and P-value of 0.684). The study findings showed that there was no significant relation between *H. nana* and Education (χ^2 = 9.877 and p-value of 0.079). There was no significant relationship between *H. nana* and sex (χ^2 =1.307 and p-value of 0.253).

Variable	***H. nana***		
AGE	**Positive**	**Negative**	**Total**
Below 9 years	0	29	29
	0.00%	15.80%	15.80%
10-19 years	1	44	45
	100.00%	24.00%	24.50%
20-29 years	0	47	47
	0.00%	25.70%	25.50%
30-39 years	0	37	37
	0.00%	20.20%	20.10%
40-49 years	0	17	17
	0.00%	9.30%	9.20%
above 50 years	0	9	9
	0.00%	4.90%	4.90%
	χ^2 =3.106	**sig=0.684**	
EDUCATION LEVEL	**Positive**	**Negative**	
Primary	0	58	58
	0.00%	31.70%	31.50%
Secondary	1	16	17
	100.00%	8.70%	9.20%
O-level	0	50	50
	0.00%	27.30%	27.20%
A-level	0	3	3
	0.00%	1.60%	1.60%
College	0	46	46
	0.00%	25.10%	25.00%
University	0	10	10
	0.00%	5.50%	5.40%
	χ^2 =9.877	**Sig=0.079**	
GENDER	**Positive**	**Negative**	
F	0	104	104
	0.00%	56.80%	56.50%
M	1	79	80
	100.00%	43.20%	43.50%
	χ^2 =1.307	**Sig=0.253**	

G. Effects of Hookworm disease on age, level of education and gender

The results revealed that there was no significant difference of *A. duodenale* in age groups of the respondents (χ^2=3.252 and P-value of 0.661). The study findings showed that there was no significant relation between *A. duodenale* and Education (χ^2 = 4.393 and p-value 0.494) and sex (χ^2=0.035 and p-value of 0.852).

Variable	***A. duodenale***		
AGE	**Positive**	**Negative**	**Total**
below 9 years	1	28	29
	50.00%	15.40%	15.80%
10-19 years	1	44	45
	50.00%	24.20%	24.50%
20-29 years	0	47	47
	0.00%	25.80%	25.50%
30-39 years	0	37	37
	0.00%	20.30%	20.10%
40-49 years	0	17	17
	0.00%	9.30%	9.20%
Above 50 years	0	9	9
	0.00%	4.90%	4.90%
	χ^2=3.252	**sig=0.661**	
EDUCATION LEVEL	**Positive**	**Negative**	
Primary	2	56	58
	100.00%	30.80%	31.50%
Secondary	0	17	17
	0.00%	9.30%	9.20%
O-level	0	50	50
	0.00%	27.50%	27.20%
A-level	0	3	3
	0.00%	1.60%	1.60%
College	0	46	46
	0.00%	25.30%	25.00%
University	0	10	10
	0.00%	5.50%	5.40%
	χ^2=4.393	**Sig=0.494**	
GENDER	**Positive**	**Negative**	
F	1	103	104
	50.00%	56.60%	56.50%
M	1	79	80
	50.00%	43.40%	43.50%
	χ^2=0.035	**Sig=0.852**	

H. Effects of trichuriasis on age, level of education and gender

The results revealed that there was no significant difference of *T. trichiura* in age groups of the respondents (χ^2 =3.995 and P-value of 0.550). The study findings showed that there was a significant relation between *T. trichiura* and Education (χ^2 = 17.995 and p-value of 0.004) and sex (χ^2 =0.773 and p-value of 0.379).

Variable	***T. trichiura***		
AGE	**Positive**	**Negative**	**Total**
Below 9 years	0	29	29
	0.00%	15.80%	15.80%
10-19 years	0	45	45
	0.00%	24.60%	24.50%
20-29 years	0	47	47
	0.00%	25.70%	25.50%
30-39 years	1	36	37
	100.00%	19.70%	20.10%
40-49 years	0	17	17
	0.00%	9.30%	9.20%
Above 50 years	0	9	9
	0.00%	4.90%	4.90%
	χ^2 =3.995	**Sig=0.550**	
EDUCATION LEVEL	**Positive**	**Negative**	
Primary	0	58	58
	0.00%	31.70%	31.50%
Secondary	0	17	17
	0.00%	9.30%	9.20%
O-level	0	50	50
	0.00%	27.30%	27.20%
A-level	0	3	3
	0.00%	1.60%	1.60%
College	0	46	46
	0.00%	25.10%	25.00%
University	1	9	10
	100.00%	4.90%	5.40%
	χ^2 =17.995	**Sig=0.004**	
SEX	**Positive**	**Negative**	
F	1	103	104
	100.00%	56.30%	56.50%
M	0	80	80
	0.00%	43.70%	43.50%
	χ^2 =0.773	sig=0.379	

I. Effects of Cryptosporidiosis on Age, Level of Education and Gender

The results revealed that there was no significant difference of Cryptosporidiosis in age groups of the respondents (χ^2 =3.809 and P-value of 0.557). The study findings showed that there was no significant relation between the *C. Parvum* and Education (χ^2 = 4.764 and p-value 0.445), and sex (χ^2 =1.283 and p-value of 0.257).

Variable	***C. Parvum***		
AGE	**Positive**	**Negative**	**Total**
Below 9 years	6	23	29
	25.00%	14.40%	15.80%
10-19 years	6	39	45
	25.00%	24.40%	24.50%
20-29 years	7	40	47
	29.20%	25.00%	25.50%
30-39 years	3	34	37
	12.50%	21.20%	20.10%
40-49 years	2	15	17
	8.30%	9.40%	9.20%
Above 50 years	0	9	9
	0.00%	5.60%	4.90%
	χ^2 =3.809	**Sig=0.577**	
EDUCATION LEVEL	**Positive**	**Negative**	
Primary	10	48	58
	41.70%	30.00%	31.50%
secondary	2	15	17
	8.30%	9.40%	9.20%
O-level	4	46	50
	16.70%	28.80%	27.20%
A-level	0	3	3
	0.00%	1.90%	1.60%
College	8	38	46
	33.30%	23.80%	25.00%
University	0	10	10
	0.00%	6.20%	5.40%
	χ^2 =4.764	**Sig=0.445**	
SEX	**Positive**	**Negative**	
F	11	93	104
	45.80%	58.10%	56.50%
M	13	67	80
	χ^2 =1.283	**Sig=0.257**	

APPENDIX IV(A-B): Effects of water source, toilet type and presence of pets

A. Effects of water source, toilet type, housing and presence of pets

Variable	Category	Frequency	Percentages
Water Source	Tap/Borehole	88	47.8%
	Tap	48	26.1%
	Borehole/River	42	22.8%
	Borehole	6	3.3%
Toilet Type	Pit latrine/Flash	30	16.3%
	Pit Latrine	140	76.1%
	Flash	14	7.6%
No. of Users	>5	133	72.3%
	<5	51	27.7%
House Type	Permanent	109	59.2%
	Semi-Permanent	75	40.8
Any Pets	Yes	119	64.7%
	No	65	35.3%

B. Effects of Education level, Age and Sex in correlation with their X- and P-Values

Infection	Education level	Age	Sex	Comment
Amoebiasis	x-7.143 & p-0.210	x-3.525 & p-0.620	x-1.820 &p-0.177	No association
Giardiasis	x-2.140 & p-0.829	x-1.160 & p-0.949	x-0.001 & p-0.973	No association
Ascariasis	x-3.447 & p-0.631	x-1.348 & p-0.930	x-0.667 & p-0.414	No association
Trichuriasis	x-17.995 & p-0.004	x-3.995 & p-0.550	x-0.773 & p-0.379	No association
Hookworm disease	x-4.393 & p-0.494	x-3.252 & p-0.661	x-0.035 & p-0.852	No association
Cysticercosis	x-9.877 & p-0.079	x-3.106 & p-0.684	x-1.307 & p-0.253	No association
Cryptosporidiosis	x-4.764 & p-0.445	x-3.809 & p-0.557	x-1.283 & p-0.257	No association

APPENDIX V: Sample Questionnaire Form

Personal details

Age ……………………………………………………………………….

Sex ………………………………………………………………………..

Location/Residence ………………………………………………………

Occupation ………………………………………………………………..

Level of Education………………………………………………………...

Housing ☐ Permanent ☐ Semi-permanent ☐ Temporary

General Information

(a) Have you suffered from any stomach upsets in the last one year?

Yes ☐ No ☐

(b) How frequent do you wash your hands, fruits/ vegetables before eating?

☐ Always ☐ Frequently ☐ Rarely ☐ Never

(c) What is the source of your drinking water?

River ☐ Borehole ☐ Tap water ☐ Rain water ☐

(d) Do you treat your water before drinking? Yes ☐ No ☐

(e) If yes in (d) above, how?

Boiling ☐

Chlorinating ☐

Other specify ……………………………………………………………………

(f) Which type of latrine do you have for use? Pit latrine ☐ Flush toilet ☐

Portable toilet ☐ None ☐

(g) How many people use the same toilet? One only ☐ less than 5 ☐
More than 5 ☐

(h) How often do you clean the toilet? Once a day ☐ once a week ☐ once in a while ☐

(i) Who cleans your toilet? Cleaner ☐ volunteer ☐ landlord/ Landlady ☐

(j) Do you have any pet i.e. cat or dog or any domestic animal?

Yes ☐ No ☐

APPENDIX VI: Informed Consent Form

Title of the project proposal: Intestinal parasitic infestation in patients attending Moi Teaching and Referral Hospital, Kenya.

Patients Name…………………………………………………………………………

Date of birth……………………………..Age……………Sex…………………

Tel. /Mobile No……………………………Fax……………E-mail……………….

Purpose of the study

To determine the prevalence of intestinal parasitic infections and distribution among patients referred to the laboratory with request for stool analysis.

You are invited to participate in a research study conducted by investigators from Moi Teaching and Referral Hospital, to find out the prevalence, species distribution and the socio- economic factors of intestinal parasitic infections among the children, teens and adult patients referred to the laboratory with request for stool analysis.

Procedure to be followed

In this study the stool sample will be required from you for routine stool analysis for the diagnosis of various intestinal parasites. Therefore, if you accept to participate in this study, you will be requested to provide a small amount of faeces in a clean, dry, wide-necked container such as a polypot.

Benefits of Taking Part in the Study

There are no monetary benefits to you for taking part in this study. While there is no monetary, if any intestinal parasite will be diagnosed you will be treated.

Risks

This study will not expose you to unusual risks as trained hospital staff using approved methods will be handling the specimens for analysis.

Alternatives to Taking Part in the Study

It is import for you to know that you have the freedom to decline to participate in the study and your refusal will not affect relationship between you and those treating you and your caretakers. When not taking part in the study, you will continue with your usual medical care.

Confidentiality

Codes will be used to identify the samples in order to observe confidentiality. Your identity will be held in confidence in report in which the study may be published. Organizations that may inspect and/or copy your research records for quality assurance and data analysis include groups such as my academic supervisors, MTRH/Moi University (IREC). No identity of any specific patient in this study will be disclosed in any public reports or publication.

Costs/Compensation

There will be no cost to you to participate in this study.

Questions about the Study

You can ask the study staff any question that you may have about the study. They will be happy to answer any question at any time during the study. If you have any question regarding this study, your participation in it, or you develop any problem because of your participation in this study, you may contact the laboratory in-charge or the principal investigator using the following number: 0721-456-927.

Signature

I have read the above information and have had an opportunity to ask questions and all of my questions have been answered. I consent to participate in the study. I fully understand that there are no risks associated with the provision of the stool sample. I have been given a copy of this consent form.

Patient Signature………………………**Date**……………………………….....Parent or guardian **Signature**…………………….**Date**………………………..I, the undersigned, have fully explained the relevant details of this study to the patient named above and /or the person authorized to consent for the patient. I am qualified to perform this role.

Name: Rose Jepkosgei Kimosop

Signature……………**Date**……………...…

Investigator

Signature……………………**Name:**……………………………………**Date**……………

Witness

Address of Witness…………………………………………………………………

APPENDIX VII: Identification Criteria

Parasitic Species	Stage found	Size	Characteristics
Entamoeba histolytica	-Cyst -Amoeba	10-25 um 25*20um	-Have 1-4 nuclei -Have 1 nucleus, red blood cells and pseudopodia.
Entamoeba coli	Cyst	15-30 um	Have 1-8 nuclei
Entamoeba hartmanni	Cyst	7-9 um	Very small in size when compared with cyst of *Entamoeba* histolytica
Iodamoebabutschlii	Cyst	9-15 um	Have one nucleus with a compact mass of glycogen inclusion.
Endolimax nana	Cyst	7-9 um	Have 4 Hole-like nuclei
Giardia lamblia	-Cyst Trophozoite	10*6 um 10*12 um	Have 4 nuclei with the remains of Axoneme and flagella. -Have 8 flagella , 2 nuclei and Concavity at the anterior end.
Chilomastixmeslinii	Cyst	5-7 um	-Have one nuclei with remains of flagella and cystosome.(lemon shaped)
Balantidium coli	Cyst Ciliate	50-60 um 100*70 um	-Have a thick wall with a visible macronucleus. -Have beating cilia with a cytostome.Macronucleus and micronucleus can be seen.
Isosporabelii	Oocyst	32* 16 um	-Oval in shape and contains a central undivided mass of protoplasm (zygote).

Cryptosporidium parvum	Oocyst	7 um in diameter	-They are small, round to oval pink-red stained bodies with a single deeply stained dot.
Toxoplasma gondii	Oocyst	3*7 um in diameter	-Have small, crescent shapes with one end rounded and the other end pointed. The cytoplasm stains blue while the nucleus stains dark red and its position is towards the rounded end.
Sarcocystishominis	Sporocyst	20 um in diameter	Large in size and stain red.
Ascarislumbricoides	Ova Adult	60* 40 um 90*45 um 35cm long*3 mm wide	-Fertilized-is yellow-brown with uneven albuminous coat. -Unfertilized-is darker in color with more granular albuminous covering and a central mass of large retractile granules. -Is pink in color with a mouth which is surrounded by three lips.
Enterobiusvermicularis	Ova Adult	55*30 um 8-13mmlong	-Is oval in shape, with one side flattened. -Have cervical alae on each side of the head.
Strongyloidesstercoralis	Larvae Adult	300*15 um 2mm long	-Have bulbous esophagus (typical rhabditiform) shallow buccal cavity. -Have small buccal cavity surrounded by four lips
Trichuristrichiura	Ova Adult	50*25 um 50 mm long	-Has a barrel shape with colorless protruding mucoid plugs at each end and a central granular mass. -Is whip- like in shape, coiled and narrow at the anterior end and wide at the tail end.
Hookworm species	Ova Adult	65*40 um 15 mm long	-It is colorless, oval in shape with a thin shell and a segmented ovum. -Have a large mouth with teeth on its ventral surface and a smaller pair of teeth on its dorsal surface.

Taenia species	Ova Segments	33-43 um 15mm long *7mm wide	-It is round to oval in shape with radial striated wall which surrounds the embryo and hooklets are present in the embryo. -Have white and opaque. Has a uterus with a central stem with side branches.
Diphyllobothriumlatum	Ova	70*45 um	-It is pale yellow and oval in shape with an operculum (lid) and a mass of granulated yolk cells.
Hymenolepis nana	Ova	30-45 um in diameter	-It is round or oval with three pairs of hooklets in the embryo and polar filaments on each end of the egg.
Schistosoma mansoni	Ova	150*60 um	-It is large oval in shape with a lateral spine and contains a fully developed miracidium.
Fasciola hepatica	Ova	130*70 um	-It is large pale yellow with small operculum and contains unsegmented ovum

APPENDIX VIII : IREC Approval Letter

MOI TEACHING AND REFERRAL HOSPITAL

Telephone: 2033471/2/3/4
Fax: 61749
Email: director@mtrh.or.ke
Ref: ELD/MTRH/R.6/VOL.II/2008

P. O. Box 3
ELDORET

18th April, 2016

Rose Kimosop,
Moi University,
School of Medicine,
P.O. Box 4606-30100,
ELDORET-KENYA.

RE: APPROVAL TO CONDUCT RESEARCH AT MTRH

Upon obtaining approval from the Institutional Research and Ethics Committee (IREC) to conduct your research proposal titled:-

"The Intestinal Parasitic Infestation in Patients Attending Moi Teaching and Referral Hospital, Kenya during the Month of January to June 2014".

You are hereby permitted to commence your investigation at Moi Teaching and Referral Hospital.

18/04/2016

DR. WILSON ARUASA
CHIEF EXECUTIVE OFFICER
MOI TEACHING AND REFERRAL HOSPITAL

CC - Deputy Director (CS)
- Chief Nurse
- HOD, HRISM

INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE (IREC)

MOI TEACHING AND REFERRAL HOSPITAL
P.O. BOX 3
ELDORET
Tel: 33471//2/3

MOI UNIVERSITY
SCHOOL OF MEDICINE
P.O. BOX 4606
ELDORET

24th March, 2016

Reference: IREC/2014/74
Approval Number: 0001601

Rose Kimosop,
Moi University,
School of Medicine,
P.O. Box 4606-30100,
ELDORET-KENYA.

24 MAR 2016

Dear Ms. Kimosop,

RE: FORMAL APPROVAL

The Institutional Research and Ethics Committee has reviewed your research proposal titled:-

"The Intestinal Parasitic Infestation in Patients Attending Moi Teaching and Referral Hospital, Kenya during the Month of January to June 2014."

Your proposal has been granted a Formal Approval Number: ***FAN: IREC 1601*** on 24th March, 2016. are therefore permitted to begin your investigations.

Note that this approval is for 1 year; it will thus expire on 23rd March, 2017. If it is necessary to con with this research beyond the expiry date, a request for continuation should be made in writing to Secretariat two months prior to the expiry date.

You are required to submit progress report(s) regularly as dictated by your proposal. Furthermore must notify the Committee of any proposal change (s) or amendment (s), serious or unexpected outc related to the conduct of the study, or study termination for any reason. The Committee expects to re a final report at the end of the study.

Sincerely,

PROF. E. WERE
CHAIRMAN
INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE

cc	Director - MTRH	Dean - SOP	Dean - SOM
	Principal - CHS	Dean - SON	Dean - SOD