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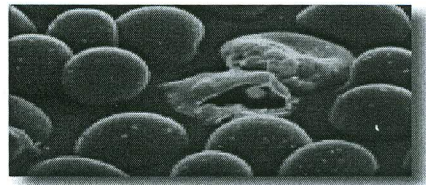
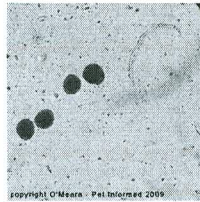
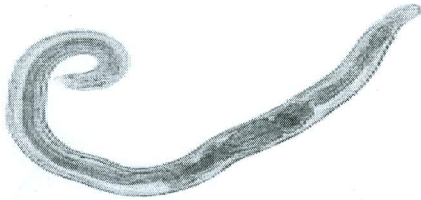
prevalence of intestinal parasites among students of elementary and junior secondary schools in dembecha north west ethiopia

Melikte, Yacob

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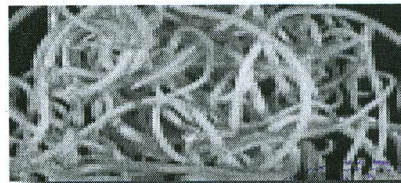
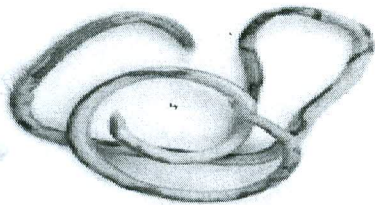
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**PREVALENCE OF INTESTINAL PARASITES
AMONG STUDENTS OF ELEMENTARY AND
JUNIOR SECONDARY SCHOOLS IN DEMBECHA,
NORTH WEST ETHIOPIA**

**BY
MELIKTE YACOB**



**DEPARTMENT OF BIOLOGY
COLLEGE OF SCIENCE
BAHIR DAR UNIVERSITY**



MAY, 2010



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PREVALENCE OF INTESTINAL PARASITES AMONG
STUDENTS OF ELEMENTARY AND JUNIOR
SECONDARY SCHOOLS IN DEMBECHA, NORTH
WEST ETHIOPIA

THESIS

Submitted in partial Fulfillment of the requirements for the degree
of master of science in biology

By
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Advisor

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May, 2010



The thesis titled "Prevalence of intestinal parasites among students of Elementary and Junior Secondary Schools in Dembecha, North West Ethiopia" by Melkite Jacob is approved for the degree of "Master of Science in Biology"

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TABLE OF CONTENTS

Page

<i>Acknowledgments</i>	i
<i>Table of contents</i>	ii
<i>List of Tables</i>	iv
<i>List of Figures</i>	v
<i>List of Appendixes</i>	vi
<i>Abstract</i>	vii
1 Introduction	1
1.1 Background of the study.....	1
1.2 Objectives of the study.....	4
1.2.1 General objective of the study.....	4
1.2.2 Specific objectives of the study.....	4
2 Literature Review	5
2.1 Intestinal parasitic infections.....	5
2.1.1 Protozoan infections.....	5
2.1.2 Helminthic infections.....	8
2.2 Public health importance of intestinal parasites.....	12
2.3 Intestinal parasitic infection in Ethiopia.....	13
2.4 Transmission and risk factors.....	15
2.5 Control measures.....	16
3 Materials and Methods	19
3.1 Study area.....	19
3.2 Study population.....	19
3.3. Study Design.....	20
3.4 Sample Size.....	20
3.5 Sampling techniques.....	21

3.6 Sample preparation and identification.....	21
3.6.1 Direct wet mount.....	21
3.6.2 Formal ether concentration.....	22
3.7 Ethical consideration.....	22
3.8 Data analysis.....	22
4. Results.....	24
4.1 Socio-demographic and other characteristics of schoolchildren.....	24
4.2 Prevalence of intestinal parasites.....	26
4.3 Parasitic species verses socio-demographic characters.....	32
5. Discussion.....	35
6. Conclusion and Recommendations.....	40
<i>References</i>	42
<i>Appendices</i>	50

List of Tables

Page

Table 1: Association between rates of parasitic infection and socio- demographic characteristics of study subjects..... 25

Table 2: Mean number of children infected by the nine intestinal parasites, Dembecha West Gojam in 2009..... 26

Table 3: Association between rates of infection and some socio-economic factors... 33

Table 4: Influence of grade level and type of parasite on the prevalence of intestinal parasitic infections at Dembecha in 2009..... 34

List of Figures

Page

Figure 1: Proportion of students infected by various intestinal parasitic species.....27

Figure 2: The relationship between infection rate and sex 28

Figure 3: The relationship between infection rate and hand washing 29

Figure 4: The relationship between infection rate and fingernail neatness..... 30

Figure 5: The relationship between infection rate and family size 31

Figure 6: The relationship between infection rate and mothers education 32

List of Appendices

Page

Appendix I. Questionnaire used for socio- demographic data and history of
Students..... 50

Appendix II. Map of study area..... 51

ABSTRACT

*Intestinal parasitic infections are among the major diseases of public health problems in developing countries, where the rate of mortality and morbidity is very high. As in many other developing countries, intestinal parasitic diseases in Ethiopia are among the top 10 leading causes of patient morbidity. The present study was conducted to determine the prevalence of intestinal parasites and risk factors among elementary and junior secondary schools of Dembecha, Ethiopia from December 2009 to February 2010. A total of 320 students were included in the study from whom stool samples were taken and analyzed with standard procedures. Structured questionnaire was used to collect socio-demographic data of students. Data collected were statistically analyzed using χ^2 -test and (Analysis of Variance) ANOVA. The result indicates that one or more intestinal parasites were isolated with an overall prevalence rate of 82%. Grade levels (age) and sex did not show significant association with prevalence of intestinal parasites. Hand washing before and after meal, toilet availability, water supply source, shoe-wearing habit, finger nail cleanliness, family size and the education level of mothers showed significant association with the prevalence of intestinal parasites ($p < 0.05$). Shoes had a significant contribution to the low prevalence of hookworm. High infections of intestinal parasites especially *E. histolytica/dispar* were recorded from the study groups with unclean fingernails and from those who did not wash hands regularly. The high prevalence rate of intestinal parasites observed in this study is a reminder for concerned bodies to launch regular monitoring activities and invest in the area of personal hygiene and sanitation and medication.*

1. Introduction

1.1. Background of the study

Intestinal parasites live in their host's intestine and take up the nutrition from the host, and cause abdominal discomfort, dysentery, irritation of intestinal mucosa, malabsorption syndromes and obstruction. They can be transmitted by faecal-oral route (Ichhpujani and Bathia, 1998).

The impact of parasitic diseases on people is enormous. The protozoan and helminth organisms, which cause these diseases, are ubiquitous and are particularly prevalent in the vast tropical regions. These infectious agents particularly hit children hard. About 75% of the global population is in the developing world and approximately 50% of this, which is more than 3 billion people, is under 15 years of age; 15% is in the age group 0-4; 97% of all infant and child deaths occur in this age group of 0-4, and most of these fatalities are due to intestinal parasitic infections (Englund and Sher, 1988).

At a global scale, over 30 species of protozoans, trematodes, cestodes and nematodes parasitize humans. Out of these, seven intestinal parasites are widely distributed and cause severe pathogenesis (Gebreyesuse Kidane, 1986).

The World Health Organization estimates 250 million people infected with round worms (*Ascaris lumbricoides*), 46 million with whipworm (*Trichuris trichiura*) and 151 million with hookworms (*Ancylostoma duodenale* and *Necator americanus*) with associated morbidity (WHO, 1996a).

Young children have a high infection rate and suffer with a heavy worm burden of *A. lumbricoides*, *Trichuris trichiura* and/or schistosomes. These parasitic infections manifest themselves as reduced growth rates of children through impaired nutrient utilization. Consequently, children are not able to achieve their full potential physically and educationally. Heavy hookworm burden is the major etiology for iron deficiency (anemia) in young children (WHO, 1996b).

Intestinal parasitic infections are among the major diseases causing public health problems in sub-Saharan Africa. Apart from causing mortality and morbidity, infections with intestinal parasites have been associated with stunting of linear growth, physical weakness and lack of fitness (WHO, 1996b). They also affect the students' survival, appetite, school attendance and cognitive performance and educational achievement (Mengistu Legesse and Berhanu Erko, 2004).

As in many other developing countries, intestinal parasitic diseases in Ethiopia are among the top 10 leading causes of patient's morbidity. Currently, helminthiasis ranks second from the out-patient morbidity. The very few studies done in rural communities indicated parasitization of the population by multiple parasites of up to 13 species. *Ascaris* creates surgical complications by obstructing the intestine and the bile duct and depletes the nutrition of the host (Gebreyesuse Kidane, 1986).

In Ethiopia, parasitism is caused mainly through the ingestion of faecally contaminated food or water. Poverty and poor environmental sanitation are the driving forces. Most intestinal parasites in Ethiopia thrive with specific climatic and geographical conditions. In Jimma zone, Surafel Kebede *et al.* (1995) reported an overall intestinal parasitism of 91.2%.

Intestinal helminthes are more prevalent throughout the tropics, especially among poor communities (Girum Tadesse, 2005; Amare Mengistu *et al.*, 2007). Records show increasing trends in helminthes infections particularly in developing nations.

Parasitic infections exacerbate child malnutrition and micronutrient deficiency through subtle reduction in digestion and absorption, chronic inflammation and loss of nutrients. Parasites may affect the intake of food, its subsequent digestion and absorption, metabolism and the maintenance of nutrient pools. The most important parasites related to the nutritional status are intestinal parasites especially soil-transmitted helminthes (Hashem *et al.*, 2004).

The level of helminthic infections can be viewed as an index of a community's progress towards a desirable level of sanitation (WHO, 2000). The low economic standard, poor sanitation and ignorance of health promotion practices favor the wide distribution of

intestinal helminth in Ethiopia. Of all types of diseases in the country, helminthiasis is the second most common cause of outpatient morbidity next to malaria (Yared Merid *et al.*, 2001).

A.lumbricoides was more severe in younger children than older ones. This indicated that younger children were more exposed to infections, which could be transmitted through the contamination of the environment, especially the soil where the children usually play in the open fields and eat food without washing hands. Thus, as age increases, susceptibility to intestinal nematode infection decreases possibly due to improved personal hygiene (Teklehaimanot Alemayehu *et al.*, 1998).

In Ethiopia, annually more than half a million visits of the patient services of health institutions are caused by intestinal parasitic infections (Ministry of Health, 1996). However, this number of visits may be underestimated, because most of the health institutions lack appropriate diagnostic facilities to detect low levels of parasite burden.

Intestinal parasitism is also closely associated with low household income, poor personal and environmental sanitation, overcrowding, limited access to clean water, tropical climate and low altitude. Amoebiasis, ascariasis, hookworm infection and trichiuriasis are among the 10 most common infections. A previous study indicated up to 95% parasitism in Bahir Dar caused by open air defecation and vegetables growing in polluted gardens (Berhanu Erko *et al.*, 1995).

Intestinal parasitic diseases pose medical and public health problems (Gebreyesuse Kidane, 1986). Because of the high prevalence of these diseases, their implication for health and economic development is enormous. The economic consequences in terms of days of productivity lost, working years lost through premature death, or the value of expenditure incurred in treating a specific episode of illness is so high that it constrains the economic growth of a country.

As elsewhere in Ethiopia, intestinal parasites are anticipated to be important in Dembecha area west Gojam zone of the Amhara region. However, there is no information on the extent and severity of the disease in this area. This study was conducted to determine the prevalence of intestinal parasitic infections in school children in Dembecha town.

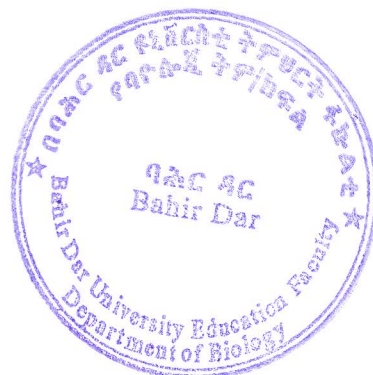
1.2. Objectives of the study

1.2.1. General objective of the study

- To quantify the prevalence of intestinal parasites among elementary and junior secondary school students of Demebecha.

1.2.2. Specific objectives of the study

- To assess the prevalence of intestinal parasites in the area
- To determine the species composition of the intestinal parasites in the study area.
- To determine the pattern of intestinal parasitic infections in relation to socio- economic and demographic circumstances of the community.



2. Literature Review

2.1. Intestinal parasitic infections

Intestinal parasitic infections are widely distributed in the world. They are estimated to affect 3.5 billion people, most of whom are children residing in developing countries (WHO, 2000). The major intestinal parasites of global public health concern are the protozoan species such as *Entamoeba histolytica* and *Giardia intestinalis*, and the soil transmitted helminthes *Ascaris lumbricoides*, *Trichuris trichiura*, and hookworm (WHO, 1999a; WHO, 2000). The incidence and prevalence of these parasitic pathogens varies between and with in the countries.

Epidemiological research carried out in different countries has shown that the social and economic situation of the individuals is an important factor in the prevalence of intestinal parasites. In addition, poor sanitary and environmental conditions facilitate the propagation of these infectious agents (WHO, 2000).

2.1.1. Protozoan infections

Protozoans are one- celled eukaryotic organisms that belong to the kingdom Protista. Protozoans are classified into phyla on the basis of their motility. Phylum Sarcodina consists of amoebas. The amoebas move by extending projections of cytoplasm called pseudopodia. Mastigophora possess flagella, which are capable of whip like movement. *Giardia lamblia* belongs to phylum Mastigophora (Tortora *et al.*, 1989).

Giardia lamblia. *Giardia lamblia* is a flagellated, binucleated protozoan that inhabits the upper part of the small intestine of its host and reproduces by binary fission. This is a type of reproduction in which one cell divides into two new cells by mitosis. During a growth cycle, the components of the cell multiply so that each daughter cell is a complete copy of the parent cell. The cells then pinch off from each other, and a complete reproduction cycle occurs. This parasite has a simple direct life cycle consisting of an infective cyst and a vegetative trophozoite.

The cyst of *Giardia lamblia* is elliptically shaped, ranges in size from 6 to 10 μm and contains two to four nuclei (Heresi and Cleary, 1997). The cysts possess a thin, protective wall that allows them to survive in faeces for weeks or in cold water for months (Ortega and Adam, 1997). In addition, the cyst wall makes the organism very resistant to environmental factors and disinfection. The transmission of giardiasis is through ingestion of cysts that contaminate water or foods. The cysts pass through the stomach and enter the small intestine. The protective wall allows the cyst to survive the acidic conditions of the stomach until the cyst reaches the small intestine, where the conditions are alkaline. The alkaline environment triggers excystation. During excystation, the cyst wall ruptures at the pole opposite to the nuclei, so that flagella and other projections emerge from the rupture point. The cyst wall is then completely shed and the microbe enters the trophozoite stage of its life (Ortega and Adam, 1997).

The trophozoite stage is approximately 12 to 15 μm by 6 to 8 μm . The organism has a pointed elongated median body with two symmetric nuclei and four pairs of flagella. It resembles human faeces on stained preparations (Heresy and Cleary, 1997). The trophozoite is the reproducing and motile form of *Giardia* that attaches to the intestinal wall via its ventral disc and causes the symptoms of giardiasis (Ortega and Adam, 1997). In severe cases, the trophozoites can become so numerous along the intestine that they cover it as a "carpet." While the trophozoite is attached, it not only absorbs but also blocks nutrients from transporting across the epithelial lining of the intestine. It inhibits the absorption of fats, carbohydrates, vitamins and folic acid. Trophozoites are rarely infective because they are not resistant to gastric acid and die rapidly outside the body. The trophozoite then undergoes encystations to complete its life cycle.

Entamoeba histolytica/dispar. *Entamoeba histolytica* belongs to the phylum Sarcodina class Rhizopoda. The members of this order are characterized by having lobe like pseudopodia. *E. histolytica* is by far medically the most important species that causes invasive amoebiasis (Diamond and Clark 1993 cited in Dawit Ayalew, 2006). It is considered as pathogenic and causes a disease called amoebiasis or amebic dysentery. It

causes amebic colitis and liver abscess. It exists in two forms: the motile and invasive trophozoite and an infective cyst. The trophozoites measure 10-50 μm in diameter and contain a single nucleus, whereas the cyst contains four nuclei when matured. The cyst stage of *E. histolytica* is resistant to acidification, chlorination and desiccation, and capable of surviving in a moist environment for several weeks, is spread via the ingestion of faecally contaminated food or water (Martinez-Palomo and Espinosa-Cantellano, 1998 cited in Dawit Ayalew, 2006).

E. dispar is morphologically identical to *E. histolytica* and the two were previously considered to be the same species. However, genetic and biochemical data indicate that the non-pathogenic *E. dispar* is a distinct species. The two species are found throughout the world, but like many other intestinal protozoa, they are more common in tropical countries or other areas with poor sanitary conditions. It is estimated that up to 10% of the world's population may be infected with either *E. histolytica/dispar* and in many tropical countries the prevalence may reach 50%. There are an estimated 50 million cases of amoebiasis per year and up to 100,000 deaths (Wiser, 2000).

Cysts and trophozoites are passed in faeces. Cysts are typically found in stool, and trophozoites found in diarrheal stool. Infection by *E. histolytica* occurs by ingestion of mature cysts in faecally contaminated food, water, or hands. Excystation occurs in the small intestine where trophozoites are released, and then they migrate to the large intestine. The trophozoites multiply by binary fission and produce cysts, and both stages are passed in the faeces. Because of the protection conferred by their walls, the cysts can survive days to weeks in the external environment and are responsible for transmission. Trophozoites passed in the stool are rapidly destroyed once outside the body, and if ingested would not survive exposure to the gastric environment. In many cases, the trophozoites remain confined to the intestinal lumen (noninvasive infection) of individuals who are asymptomatic carriers, passing cysts in their stool. In some patients, the trophozoites invade the intestinal mucosa (intestinal disease), or through the bloodstream, extraintestinal sites such as the liver, brain, and lungs (extraintestinal disease), with resultant pathologic manifestations. It has been established that the



invasive and noninvasive forms represent two separate species, respectively *E. histolytica* and *E. dispar*. These two species are morphologically indistinguishable unless *E. histolytica* is observed with ingested red blood cells (Center for Disease Control and Prevention, 2000).

2.1.2. Helminthic infections

The common intestinal helminthes include *Ascaris lumbricoides*, *Trichuris trichiura*, hookworm, and *Strongyloides stercoralis*. Similar to protozoan infections, helminth infections are enhanced by poor socio-economic conditions, lack of sanitary facilities, improper disposal of human faeces, insufficient supplies of potable water, poor personal hygiene, poor housing conditions and lack of education (WHO, 1996a).

Soil-transmitted helminthiasis is the third most prevalent infection worldwide, second only to diarrheal diseases and tuberculosis, and is ranked 10th among the world's top 10 infectious and killer diseases (National Objectives for Health, 2004). No wonder that the transmission of helminthes from the soil persists in abundant proportions even to this day, especially in developing countries. Soil-transmitted helminthiasis is the most important disease burden among those 5 to 14 years old (National Objectives for Health, 2004).

This age group has the highest prevalence rate and the greatest source of transmission. It is also considered number one health intervention priority in this age group because of the disease burden, and because mass deworming in this age group is a cost-effective intervention to dramatically bring down the prevalence in the community by as much as 70%. The prevalence of soil-transmitted helminthiasis among those two to five years old is lower, but they suffer the greatest impact from the disease when they are infected. Malnutrition, anemia, stunted growth in height and body size, decreased physical activity, impaired mental development and poor school performance are among the extensive results of parasitism (National Objectives for Health, 2004).

The three major soil transmitted helminthes considered to be of global public health concern are *Ascaris lumbricoides*, *Trichuris trichuria*, and hookworms. Over one billion of the world's population is estimated to be infected with these parasites and over two billion people are at risk (Montresor *et al.*, 1998).

These parasites largely affect school age children although they can be controlled via promoting hygiene in schools. Global prevalence of helminthic infections in school age children are estimated at about 320 million (35%) caused by ascaris, 233 million (25%) by trichuris and 239 million (26%) by hookworm. These parasitic infections consume nutrients from the children and bring about or aggravate multinutrition and retard children physical development. This leads to stunted growth, weight loss and anemia (International Water and Sanitation Center, 2004)

As numbers of worms build up over time, many of the health problems caused by these worms are chronic and can be long-lasting. The worms can cause malnutrition, as they rob the body of food through loss of appetite so the children eat less, or through interfering food absorption once it has been eaten. Children with chronic worm infections and large numbers of worms may be stunted and underweight. Heavy infections with roundworm can also cause bowel obstruction. Intestinal worms can also contribute to anaemia, especially hookworm, which causes bleeding in the intestines and loss of blood. The larger the number of worms, the more likely they are to make the children ill, which can also lead to the children missing school, and doing less well when they are at school. Chronic infections can lead to long-term retardation of mental and physical development, and in very severe infections, even death (WHO, 1996b).

Roundworm infection (*Ascaris lumbricoides*). *Ascaris lumbricoides* is a nematode that can infect the human small intestine, causing a condition called ascariasis, or roundworm infection. Ascariasis is asymptomatic in about 85% of cases. If present, symptoms are generally mild, but may be severe if the worm burden is high, for example, heavy transmission of the organism because of a seasonal pattern (Arfaa, 1984).



A. lumbricoides is distributed worldwide. It is the world most common intestinal parasite, and is more prevalent in tropical and subtropical areas, especially those with soil pollution (e.g. human excreta) and poor personal hygiene. It is estimated that 700 million to 1.3 billion people are infected worldwide. There is a high degree of association between infection by this organism and large households, overcrowded areas, poverty, and poor hygienic conditions. In a study in Addis Ababa, Ethiopia, researchers found a clear increase in the incidence of ascaris infection with decrease in family socioeconomic status (Montresor *et al.*, 1998).

Annual morbidity associated with the parasite has been estimated by the WHO (1999b) at 60,000 with another 250 million people said to be at risk of acquiring the infection (Montresor *et al.*, 1998).

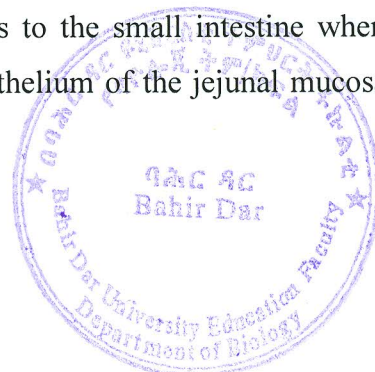
Adult worms live in the lumen of the small intestine. A female may produce approximately 200 thousand eggs per day, which are passed with the faeces. Unfertilized eggs may be ingested but are not infective. Fertile eggs embryonate and become infective after 18 days to several weeks, depending on the environmental conditions (optimum: moist, warm, shaded soil). After infective eggs are swallowed, the larvae hatch, invade the intestinal mucosa, and are carried via the portal, then systemic circulation to the lungs. In 10 to 14 days, larvae mature further in the lungs, penetrate the alveolar walls, ascend the bronchial tree to the throat, and are swallowed. Upon reaching the small intestine, they develop as adult worms. Between two and three months are required from ingestion of the infective eggs to oviposition by the adult female. Adult worms can live one to two years (Center for Disease Control and Prevention, 2000).

Hookworm infection. The two major species of hookworm known to infect humans are *Necator americanus* and *Ancylostoma duodenale*. Eggs of both species are identical and morphological identification can be done on the basis of the adult morphology (Katz *et al.*, 1989; Pawloski *et al.*, 1991) or by the study of the larval stages cultured from eggs by the Harada-Mori method (Pawloski *et al.*, 1991). In this report, the common name hookworm was used because it was technically impossible to identify the two hookworm species (*N. americanus* and *A. duodenale*). Hookworms are estimated to infect 151 million people worldwide and cause mortality in another 65,000 (Montresor *et al.* 1998).

Mature hookworms typically inhabit the jejunum where they attach to the intestinal mucosa with their ventral teeth (*A. duodenale*) or cutting plates (*N. americanus*). The worms derive their nourishment by feeding on the villous tissue and sucking blood at the point of attachment (Katz *et al.*, 1989).

Cutaneous larval migrans (also known as creeping eruption) is a zoonotic infection with hookworm species that do not use humans as a definitive host, the most common being *A. braziliense* and *A. caninum*. The normal definitive hosts for these species are dogs and cats. The cycle in the definitive host is very similar to the cycle for the human species. Eggs are passed in the stool, and under favorable conditions (moisture, warmth, shade), larvae hatch in one to two days. The released rhabditiform larvae grow in the faeces and/or the soil, and after five to ten days (and two molts), they become filariform (third-stage) larvae that are infective. These infective larvae can survive three to four weeks in favorable environmental conditions. On contact with the animal host, the larvae penetrate the skin and are carried through the blood vessels to the heart and then to the lungs. They penetrate into the pulmonary alveoli, ascend the bronchial tree to the pharynx, and are swallowed. The larvae reach the small intestine, where they reside and mature into adults. Adult worms live in the lumen of the small intestine, where they attach to the intestinal wall. Some larvae become arrested in the tissues, and serve as source of infection. Humans may also become infected when filariform larvae penetrate the skin. With most species, the larvae cannot mature further in the human host, and migrate aimlessly within the epidermis, sometimes as much as several centimeters a day. Some larvae may persist in deeper tissue after finishing their skin migration (Center for Disease Control and Prevention, 2000).

Strongyloidiasis. Strongyloidiasis occurs in various forms, depending on the species (*Strongyloides stercoralis* or *Strongyloides fuelleborni*), geographical location, and age of the host. *Strongyloides stercoralis* is widely distributed in the tropics and subtropics in areas of poor sanitation. Infection occurs when third-stage larvae, which have developed in soil contaminated by human defecation, penetrate the skin. The larvae migrate first through the tissues and then via the lungs to gain access to the small intestine where parthenogenetic adult females develop and live in the epithelium of the jejunal mucosa.



The females penetrate deep into the mucosal glands and begin to release eggs from which larvae emerge while still in the intestine. Larvae reach the external environment in the stools and some develop into infective, skin-penetrating, third-stage larvae, while some others grow into free-living adult male and female worms. Sometimes, the larvae become infective before they are passed out. This leads to auto-infection, and explains how some people have remained infected with *S. stercoralis* for more than 30 years after leaving an endemic area (WHO, 1987).

2.2. The public health importance of intestinal parasitic infections

Intestinal parasitic infections are considered a public health problem of worldwide importance for reasons of high prevalence, widespread distribution, and effects on health (Montresor *et al.*, 1998; WHO, 1999a; Stephenson *et al.*, 2000). Infants and children's are susceptible to intestinal parasitic infections compared to other age groups. In addition, they are reported to suffer from the nutritional health and developmental consequences (Sakti *et al.*, 1999).

Intestinal parasitic infections are more important particularly in developing countries, where the humid climate, the in- sanitary environment, and poor socioeconomic conditions contribute to the problem. Chronic infections impair physical and mental growth and development of children in general. Furthermore, intestinal parasites may increase susceptibility to infections with other intestinal pathogens. It is therefore important to identify the problem and tackle it in the interest of public health (Stephenson *et al.*, 2000).

The World Health Organization (WHO, 1996a) promotes the use of presumptive anti helminth treatment as the foundation of intestinal parasitic infections control activities in endemic populations (WHO, 1996b; Montresor *et al.*, 1998) while still recognizing the need for longer-term economic, social, behavioral and environmental solutions to reduce or eliminate sources of re-infection (WHO, 1996; Montresor *et al.*, 1998; WHO, 2000).

Given the importance of intestinal parasites in the overall development of school children, chronic intestinal parasitic infections have become the subject of speculation and investigation in relation to the spreading and severity of other infectious diseases of viral origin, tuberculosis and malaria. However, the role of intestinal parasites in causing morbidity and mortality as well as pathogenesis of other infectious diseases differs from species to species. (Mengistu Legesse and Berhanu Erko, 2004).

2.3. Intestinal parasitic infections in Ethiopia

In Ethiopia, nearly 80% of the rural and 20% of urban population have no access to safe water (Ministry of Health, 1997). Three-fourth of the health problems of children in Ethiopia are communicable diseases arising from the environment, especially unsafe water and lack of sanitation. A lot of mortality in under five years children is due to diarrhea in which water related diseases occupy a high proportion.

Like in many other developing countries, intestinal parasites are widely distributed in Ethiopia largely due to the low level of environmental and personal hygiene, contamination of food and drinking water that results from improper disposal of human excreta (WHO, 1987). According to Ministry of Health (1996), more than half a million annual visits of the outpatient services of the health institutions are caused by intestinal parasitic infections. This estimate is far from accurate, because most of the health institutions lack appropriate diagnostic tools to detect low levels of parasite burden. Data on intestinal parasites in Ethiopia is inadequate (Hailu Birrie and Berhanu Erko, 1995).

Based on variation in climatic and geographic zones in Ethiopia, it should be evident that there are macro and micro- environmental factors contributing to the differences in the distribution and prevalence of intestinal parasites (Shibru Tedla and Teklemariam Ayele, 1986).

It was also reported that intestinal helminthiasis is either the first or the second (Shibru Tedla and Teklemariam Ayele, 1986) reason for hospital visits in Ethiopia. Furthermore, varying degrees of prevalence rates of intestinal parasites have been reported depending

on the climatic, altitudinal and the microenvironmental factors of different ecological zones in different communities.

The two soil-transmitted intestinal parasites, *Ascaris lumbricoides* and *Trichuris trichiura* are frequently reported as co-existing and are highly prevalent in Ethiopia. Their prevalence increases with altitude, the highest was recorded at an altitude more than 2400 m above sea level, commonly affecting children of school age (Leykun Jemaneh, 1998).

Another study on intestinal parasitic infection was conducted in Finchae Sugar Project among residents of the sugar plantation. The results showed that *Ascaris lumbricoides* was found to be the most prevalent with an average of 28% followed by hookworm (20%) among the population living in seven camps. Other parasites, which were present at lower prevalence, were *Trichuris trichiuria*, *Tinea suginata*, *E.vermicularis*, *Faciola lipatica* and *H.nana* (Hailu Birrie *et al.*, 1997).

In 2001, a cross sectional study was conducted in Babile town, eastern Ethiopia from 415 school children found nine species of parasites with over all prevalence of 27%. *Hymenolepis nana* was the most common parasite found in this study followed by hook worm (Girum Tadesse, 2005).

In 2003, 259 schoolchildren were studied in southeast of Lake Langano. Nearly 84% of the children carried one or more parasites. Hookworm was the highest (60.2%), followed by *Schistosoma mansoni* (21.2%), *T. trichuria* (14.7%), *Taenia spp.* (13.9%), *E. histolytica/dispar* (12.7%), *A. lumbricoides* (6.2%), *G. intestinalis* (6.2%) and *S. stercoralis* (5.8%) (Mengistu Legesse and Berhanu Erko, 2004).

According to the Ministry of Health (1997), nearly 80% of the rural, and 20% of urban population have no access to safe water. The same mechanism is responsible for the health problems of majority of Ethiopia's children.

As a result of low level standards of living, poor environmental sanitations and ignorance of simple health promoting factors, intestinal parasitism is very high. Even though the prevalence of individual parasites varies in different parts of the country, *A. lumbricoides* is the most prevalent parasites (Shibru Tedla and Teklemariam Ayele, 1986). In a study



conducted in South Western Ethiopia, the prevalence of Giardiasis was 13.7% though the rate is lower than, *A. lumbricoides* (Ibrahim Ali *et al.*, 1999). According to Hailu Birrie and Berhanu Erko (1995), based on a countrywide survey of giardiasis, the overall prevalence among school children and residents were 8.9% and 3.1% respectively and that of non- school children were 4.4%.

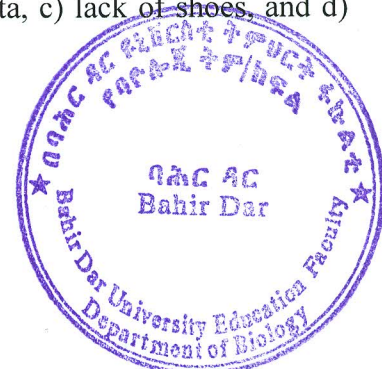
2.4. Transmissions and Risk factors

Most intestinal parasites are transmitted through contact with faecal matter. The organisms themselves or their cysts are expelled through the rectum of their host and find their way in some fashion to the mouth of their next host. This faecal-oral route of transmission can occur in several ways.

The only way to completely prevent exposure to parasites from food and water is by cooking. Food prepared by individuals infected with parasites who have not thoroughly washed their hands after using the bathroom may pose a risk. Not all water-borne intestinal parasites are killed by chlorine. Therefore, these organisms can exist in the water supply. Complete elimination can only be achieved by boiling (for at least 5 minutes), filtering with a one micron filter, or drinking distilled water. Bottled spring waters can vary greatly in their preparation methods but are usually safe (Integrative Health Consulting, 2007).

Helminthes are transmitted by the ingestion of the infective eggs from contaminated food, hands, and water. Hookworm infestation and strongyloidiasis are transmitted through the percutaneous route when the infective larva in the contaminated moist soil penetrates the skin, especially that of the foot. It is prevalent in the areas of poor sanitation coupled-with the habit of walking barefoot as seen in the rural farming community (WHO, 2000).

According to WHO (1999b), a high prevalence of intestinal parasitic infections is closely correlated with poverty and poor environmental hygiene, namely: a) lack of safe water supply, b) contamination of the environment by human excreta, c) lack of shoes, and d)

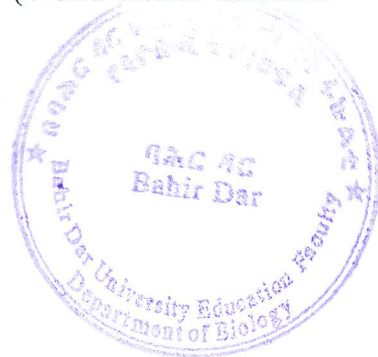


poor environmental or personal hygiene. In the long run, worm infections increase susceptibility to other infections and diminish learning ability and growth in children.

Intestinal parasitic infections negatively affect the health status of a high proportion of school-age children in developing countries, giving rise to general discomfort and acute symptoms such as abdominal pain, nausea and coughing. These symptoms are closely correlated with the “intensity of intestinal parasitic infections” (commonly called “worm burden”): the greater the worm burden, the more severe are the symptoms. In addition, hookworm infections give rise to blood loss, as the worms suck blood from the intestinal wall. This may cause iron deficiency (anemia) and reduced work capacity and fitness (WHO, 1999a).

2.5. Control Measures

Resources for controlling intestinal parasites are severely limited in developing countries, where intestinal parasitic infections are among the most common infections of humans. Controlling measures should be carefully evaluated to ensure cost-effectiveness. This requires an understanding of the different epidemiological patterns of the two groups of parasites, i.e., helminthes and protozoa. The transmission dynamics and morbidity associated with the major helminth infections depend on the size of the worm burden. Thus the important parameter for evaluating the impact of control on morbidity and transmission is the intensity of infection, which can be assessed by determining the mean density of parasite eggs in faecal specimens. Intensity is exceptionally sensitive to the populations size and demographic structure that is selected for assessment. With the major protozoan infections, an estimate of intensity is of little value and the central parameter for evaluation is prevalence. Prevalence exhibits age and spatial heterogeneity, which may be species-specific, so there remains a need to ensure a consistent sample structure, although this is less critical than for the helminthes (World Health Statistics Manual, 1988).



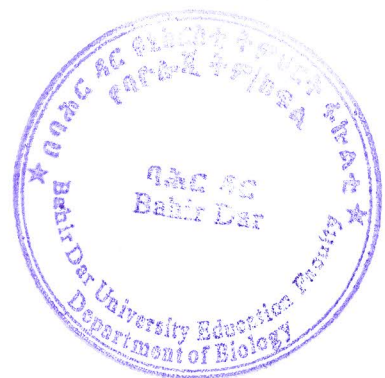
The most important community control measure is reduction of the source of infection through the sanitary disposal of human faeces. It is important to treat all infected persons, even if they are asymptomatic, in order to reduce the possibility of contaminating the environment. As with ancylostomiasis, wearing shoes provides good protection in endemic areas because it prevents larvae from penetrating the skin of the foot. Since strongyloidiasis can be acquired by the oral route, good personal hygiene habits, such as washing one's hands before eating, are also important (WHO, 1999b).

In several industrialized countries, the prevalence rate of the parasitosis has been significantly reduced as a result of improved standard of living, without the adoption of specific control measures. The principal measures that should be included in a control program consist of massive and periodic treatment of the human population to prevent environmental contamination, sanitary excreta disposal, provision of potable water, and health education for the purpose of instilling personal hygiene habits in the population (Stanley, 2003).

Health education should stress the danger of drinking water or eating raw vegetables that might be contaminated, as well as the importance of washing one's hands after defecating and before preparing food about shoe wearing and generally personal hygiene (Integrative Health Consulting, 2007).

According to Stanley (2003), prevention and control measures are similar to other diseases transmitted by the faecal-oral route. The major difference is that humans are the only host for *E. histolytica* and there is no possibility of zoonotic transmission. Control is based on avoiding the contamination of food or water with faecal material. Health education in regards to improving personal hygiene, sanitary disposal of faeces, and hand washing are particularly effective. Protecting water supplies will lower endemicity and epidemics. Like *Giardia*, *Entamoeba* cysts are resistant to standard chlorine treatment, but are killed by iodine or boiling. Sedimentation and filtration processes quite effectively remove *Entamoeba* cysts. Several drugs are available for the treatment of amebiasis and the choice of drug(s) depends on the clinical stage of the infection.

Metronidazole or tinidazole is recommended for all symptomatic infections. Albendazole or Mebendazole is recommended for helminthic infection. This drug kills several species of intestinal worms at the same time (Stanley, 2003).



3. Materials and Methods

3.1 Study area

A study of the prevalence of intestinal parasites and associated risk factors was conducted in a small town, Dembecha, located in West Gojam at 210 km south east of Bahir Dar. Dembecha is one of the 105 woredas in the Amhara Region of Ethiopia. It is bordered in the West by Bure Wenberma, in the North West by Jabi Tehnan, in the north by Bibugn, and in the east and south by East Gojam zone. Dembecha town has altitude and longitude of 10°33'N 37° 29'E with an elevation of 2083 meters above sea level. Dembecha has an estimated total population of 15,008, of whom 7,384 are men and 7,624 are women. The 1994 census reported this town had a total population of 8,663 of whom 3,885 were men and 4,775 were women (Free encyclopedia). There are three elementary and junior secondary schools in the town. The great majority of children attending school in Dembecha elementary and junior secondary school come from the inhabitants of the town who earn their living as merchants, government employees, farmers, daily laborers, "Tella and Araki" brewers (local alcoholic beverages), and a few tanners and weavers.

3.2 Study population

The study was conducted from December 2009 to February 2010 in Dembecha town, West Gojam. The data were collected from elementary and junior secondary school students from age group 7-14.

A total of 326 school children were included in the study among which 320 of them provided proper stool sample and filled the questionnaire, which was intended to determine socio-demographic data and history of students. These are variables that greatly influence parasitic infection.

3.3. Study design

A cross sectional study was conducted. Before the start of the study, the director, teachers, and students were informed about the objective of the study, its relevance, importance, and benefits of the outcome. Health education about the transmission of intestinal parasites and personal hygiene and sanitation was given for participants in the study.

A questionnaire was prepared and administered to sample students. The questionnaire touched up on socio-demographic and other issues to gather information including sex, age, grade, and hand washing habit, source of drinking water, toilet availability, family size, and the level of mother's education.

3.4. Sample size

A systematic random sampling technique using roster as a sampling frame was used to select 326 school children. Sample size was determined by the following formula (Bland, 1989):

$$n = \frac{(Z_{\alpha/2})^2(P)(1-P)}{E^2}$$

Where

n =is total sample size

Z =confidence level at 95 % (standard value of 1.96)

P =estimated prevalence of intestinal infection in the schools from previous studies in this case 0.694 (Lopiso Erosie *et al.*, 2002).

E = margin of error at 5% (standard value of 0.05)

$$n = \frac{(1.96)^2 \times 0.694(0.306)}{(0.05)^2} = 326$$

3.5. Sampling techniques

Socioeconomic data of each participating student were recorded before stool sample collection by using structured questionnaires focusing on sanitation. These included presence/absence of toilets, type of water supply, shoe wearing habit, family size, hand washing habit, and educational status of the mothers. Fingernails were also inspected for cleanliness.

Fresh stool sample was collected in labeled cups from each student in the laboratory at Dembecha Health Center. The samples were processed and examined for the presence of ova, cysts, larva, and trophozoites of parasites by using direct wet mount with in one hour. The remaining stool samples were preserved by formalin for concentration technique.

3.6. Sample Preparation and Identification

Standard laboratory techniques that are commonly used in most Ethiopian ordinary health facilities were used.

3.6.1. Direct wet mount

A direct wet mount was used to observe the motile trophozoites and larval stages of intestinal parasites. One or two drops of normal saline solution were placed at the center of a clean slide and mixed with about 2 mg stool samples with stick applicator. The suspensions were covered with cover slip and examined under light microscope at 10X and 40X power objectives for the presence of motile and non-motile stages of intestinal parasites (protozoa and helminths). The remaining samples or around 5 g were preserved with 10 ml 10% formalin solution for formal ether concentration techniques (WHO, 1991).

The relationships with parasitism and socio-demographic characteristics such as sex, age, hand washing habit, toilet availability, water supply source, shoe wearing habit, cleanliness of fingernails, family size, and mothers' education were analyzed using χ^2 -test.

Descriptive statistics were used to present the relationship between socio-demographic factors and the intensity of intestinal parasite species.

4. Results

4.1. Socio-demographic and other characteristics of schoolchildren

The relationship between socio-demographic characteristics of students on parasitism is given in Table 1. Sex ratio of students was 1:1. Ages of students ranged from 7 to 14 years, which corresponds to grades 1 to 8. From each age (grade) group, 40 students were included in the study.

About 164(51.3%) of the 320 students did not practice hand washing before and after meals, while the rest practiced it regularly. Majority 259 (81%) of students included in the study used toilets, 238(74.4%) of them had running water (pipe water), 60(18.8%) used stream water, and 22(6.9%) used river water for drinking.

Slightly more than half of the students 172(53.8%) regularly wore shoes; the rest did not. As high as 144(45%) of them had unclean fingernails. Family size ranged from four to more than seven. Regarding family size 37(11.6%) had 4 family and below members, 87(27.2%) had 5 members, 106(33.1%), had 6 and 90(28.1%) had 7 and above family size.

More than half of the students 191(59.7%) had illiterate mothers, 103(34.1%) of their mothers could read and write, 13(4.1%) had certificates, 6(1.9%) had diploma and 1(0.3%) had degree.

The χ^2 - test indicated that association between intestinal parasitism and socio-demographic factors such as hand washing, toilet availability, water supply source, shoe wearing habit, fingernail neatness, family size, and mother education was significant. Sex and age/grade level were not significantly associated with parasitism (Table 1).

Table1. Association between rates of parasitic infection and socio- demographic characteristics of study subjects.

Socio-demographic characteristics	Status		χ^2	P-value
	Positive	Negative		
Sex				
Male	133	27	0.52	0.47
Female	128	32		
Age (grade)				
7 (Grade 1)	35	5	4.97	0.66
8 (Grade 2)	33	7		
9 (Grade 3)	36	4		
10 (Grade 4)	31	9		
11 (Grade 5)	30	10		
12 (Grade 6)	32	8		
13 (Grade 7)	31	9		
14 (Grade 8)	33	7		
Hand washing habit				
Always	106	50	37.51	<0.0001
Sometimes (or not at all)	155	9		
Toilet availability				
Available	202	57	11.52	0.0007
Not available	59	2		
Water supply source				
Tap water	184	54	11.91	0.0026
River water	22	0		
Stream water	55	5		
Shoe wearing habit				
Always	119	53	37.88	<0.0001
Sometimes (or not at all)	142	6		
Cleanliness of finger nails				
Clean	121	55	55.62	<0.0001
Dirty	140	4		
Family size				
4 and below	26	11	69.8522316	<0.0001
5 members	62	25		
6 members	91	15		
7 and above	82	8		
Mothers' education				
Could not read and write	175	16	75.52	<0.0001
Read and write	83	26		
Certificate	3	10		
Diploma	0	6		
Degree and above	0	1		

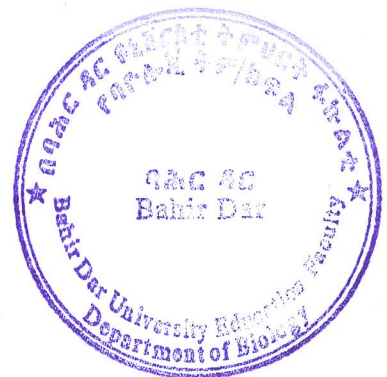
4.2. Prevalence of intestinal parasites

Microscopic stool sample examination showed that infections with various intestinal helminthes and protozoan parasites were common in Dembecha schoolchildren. Nine species of intestinal parasites were identified with an overall prevalence of 261(81.6%) .

The predominant parasite was hookworm which was observed in 111(34.7%) of the students followed by *E. histolytica/dispar* which occurred on 107(33.4%) of students. *G. intestinalis*, *A. lumbricoide*, *S. stercoralis*, *H. nana*, *Tricomonas*, *T. trichiura* and *E. vermicularis* followed in descending order (Table 2; Figure 1).

Table 2. Mean number of children infected by the nine intestinal parasites, Dembecha, west Gojam in 2009.

Parasite species	Mean no of children infected
<i>A. lumbricoides</i>	9.06bc
<i>G. intestinalis</i>	12.50b
<i>H. nana</i>	4.38bcd
<i>S. stercoralis</i>	5.00bcd
<i>Tricomonas</i>	1.56cd
<i>T. tricurua</i>	0.31d
<i>E. vermicules</i>	0.31d
<i>E. histolytica</i>	33.44a
Hookworm	34.69a



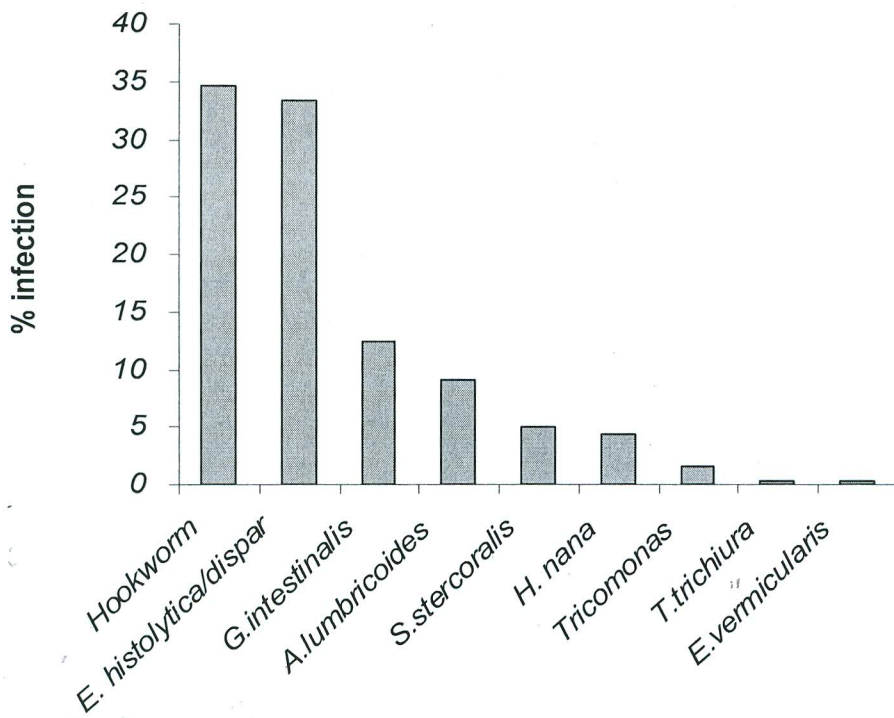


Figure 1: Proportion of students infected by various intestinal parasitic species.

Nearly equal numbers of male and female students were infected, which indicated the absence of significant difference in the rate of infection between sexes. Again, hookworm and *E. histolytica/dispar* were common parasites when observed based on sexes (Figure 2).

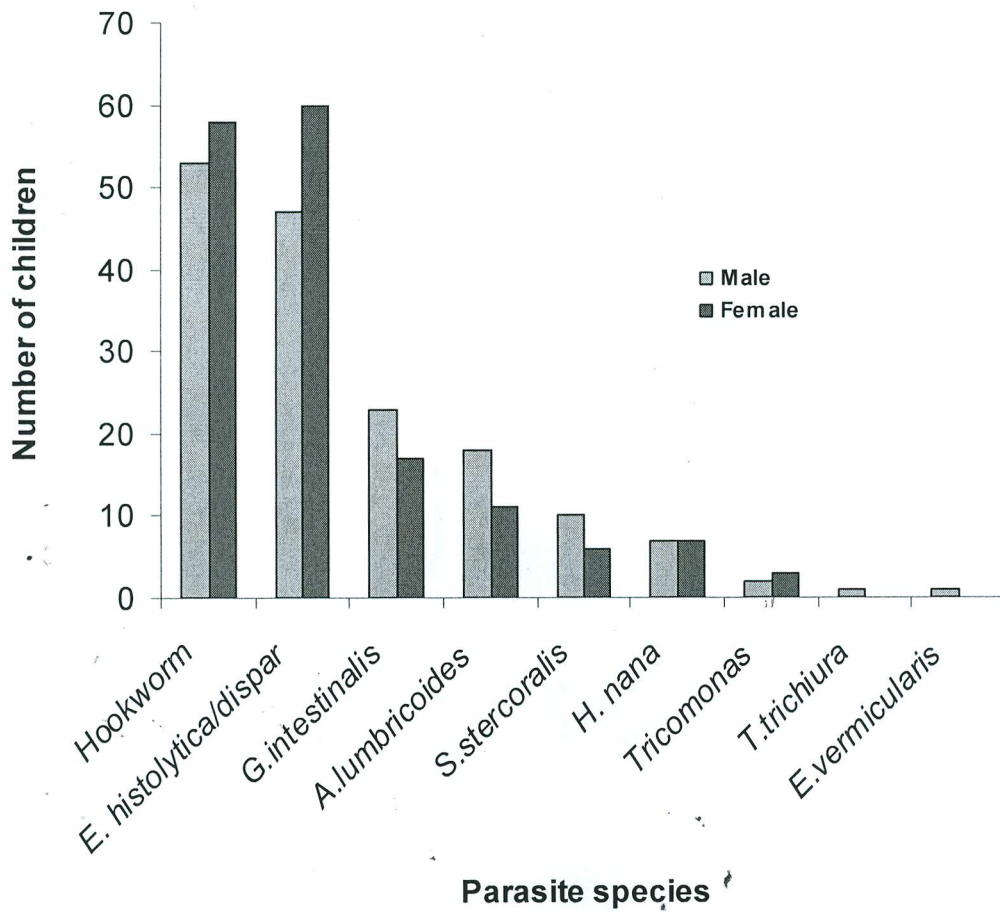


Figure 2 The relationship between prevalence and sex.

As to the effect of hand washing on parasitism, most infections were recorded to be caused by hookworm and *E. histolytica/dispar* followed, as before, by the rest of the parasites. Hand washing generally reduced prevalence significantly (Figure 3).

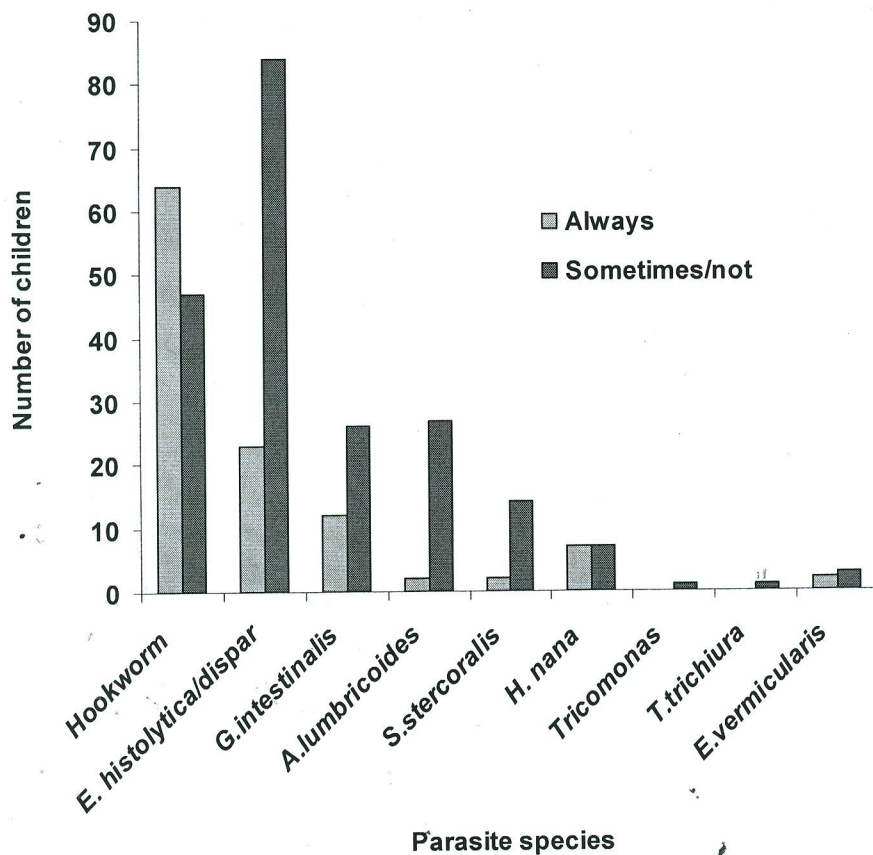


Figure 3. The relationship between prevalence and hand washing.

Looking at the effect of cleanliness of fingernails on the rate of infection, the most prevalent parasite was *E. histolytica/dispar* followed by hookworm and others. This was similar to hand washing, for example, where *E. histolytica/dispar* and hookworm were most important. Majority of students who did not keep their fingernails tidy were infected by *E. histolytica/dispar* (Figure 4).



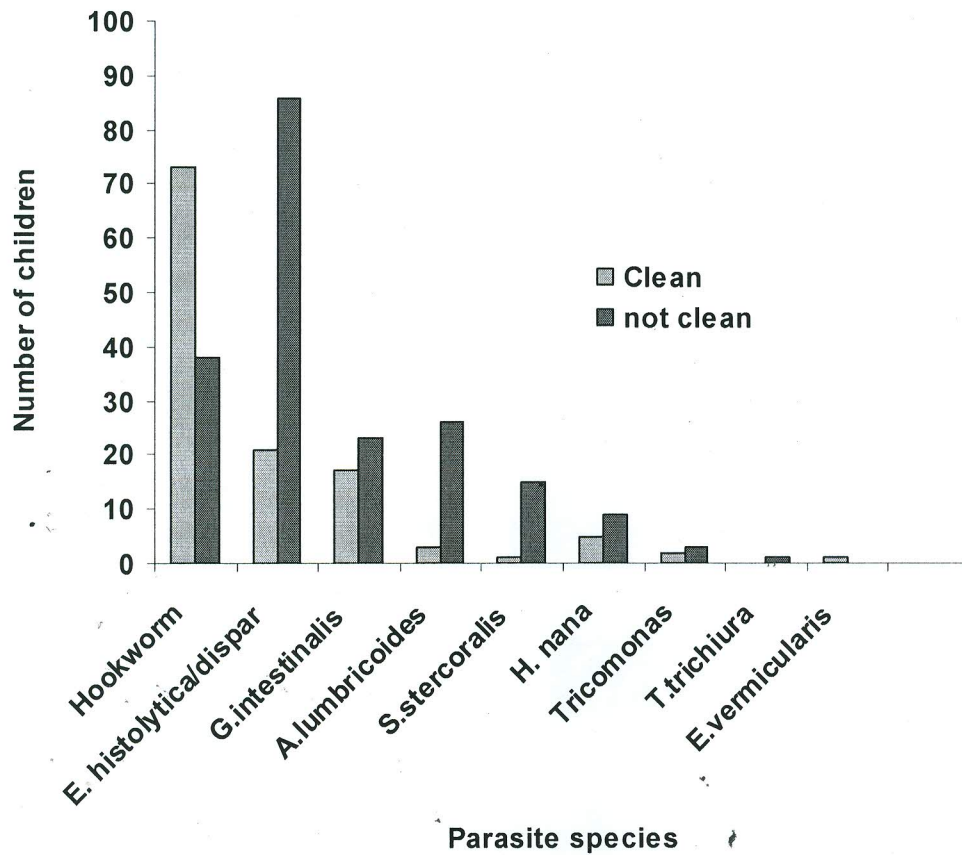


Figure 4. The relationship between prevalence and fingernail neatness.

In the case of family size, a clear pattern was observed where increase in family size increased the rate of infection (Figure 5), with *E. histolytica/dispar* and hookworm taking the largest share.

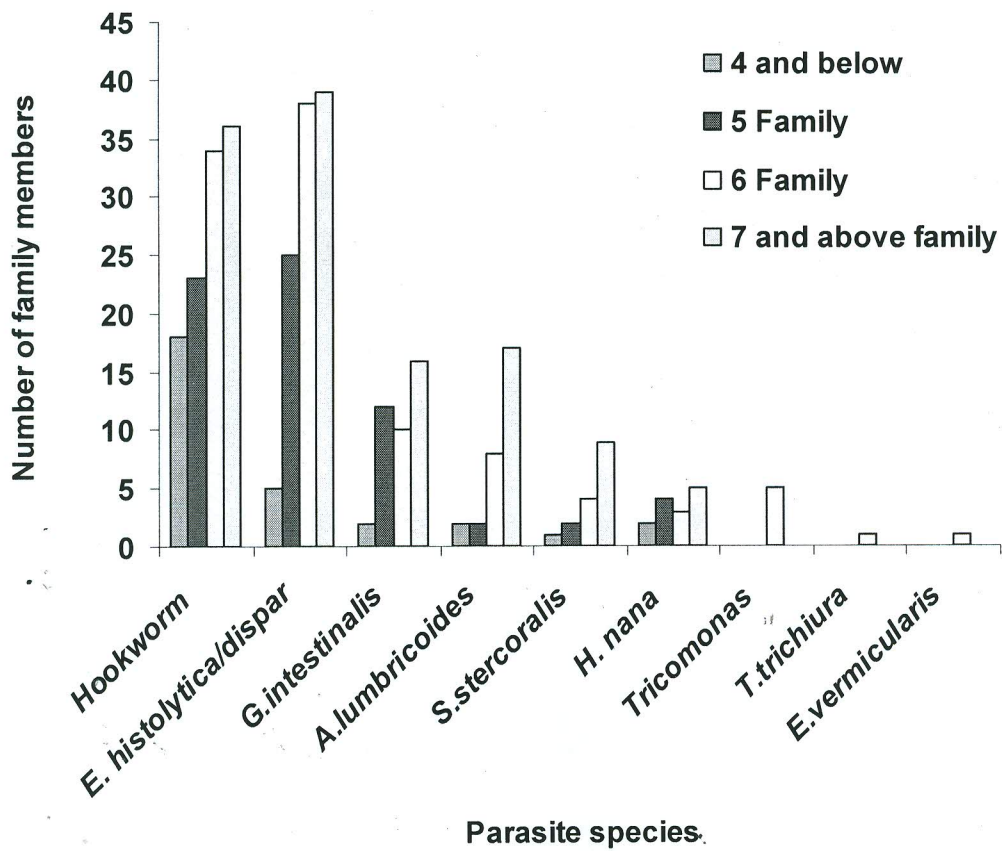


Figure 5. The relation ship between prevalence and family size.

Educational level of mothers had significant influence on child infection. Infection rate dramatically declined with the level of education increasing (Figure 6). Here too, hookworm and *E. histolytica/dispar* caused much of the infection.



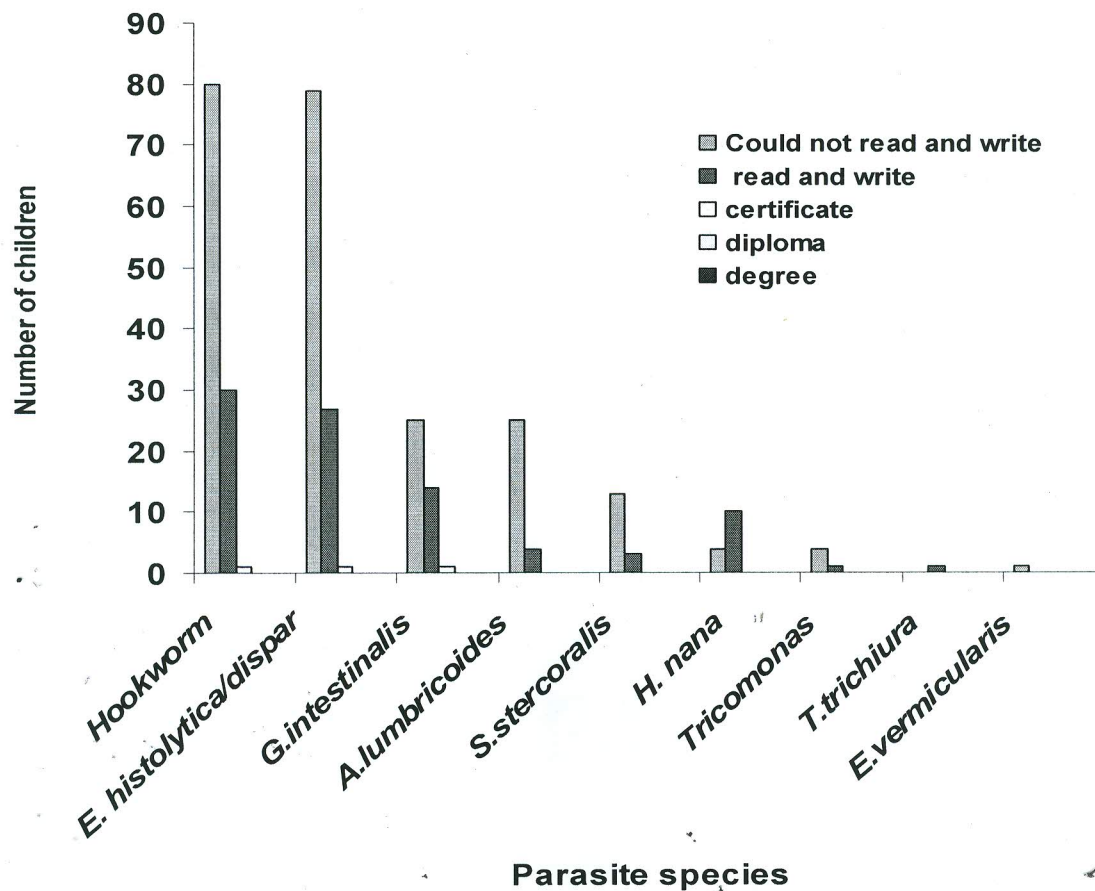


Figure 6. The relationship between prevalence and mothers education.

4.3. Parasitic species versus socio- demographic characteristics

Table 3 shows the relationship between the two major intestinal parasitic species and some of the socio- demographic characteristics. Hookworm infected 6.4% of students who regularly wore shoes and 67.6% of those who did not wear shoes.

E. histolytica/dispar infected 13.5% of students who regularly washed their hands and 52.4% of those who did not wash. This parasite attacked 11.4% of those students who kept their nails clean and 60.4% of them whose nails were untidy. Hookworm and *E. histolytica/dispar* significantly affected students who did not wear shoes, wash hands and kept fingernails clean (Table 3). The χ^2 - test showed that the two most common

parasites significantly affected students who did not wear shoes, washed hands, and kept their fingernails clean.

Table 3. Association between rates of infection and some socio-economic factors n=320

Socio-economic factors	Levels	Number of students		χ^2	P-value
		Infected(%)	Not infected(%)		
Hook worm					
Shoe wearing habit	Always	11(6.3)	161(93.6)	131.4	<0.0001
	Sometimes and/or not at all	100(67.6)	48(32.4)		
<i>E. histolytica/dispar</i>					
Hand washing habit	Always	21(13.5)	135(86.5)	54.6	<0.0001
	Sometimes and/or not at all	86(52.4)	78(47.6)		
Neatness of finger nails	Clean	20(11.4)	156(88.6)	85.6	<0.0001
	Dirty	87(60.4)	57(39.6)		

According to the ANOVA, infection was the same among the different age classes (F= 0.06, P=0.99) (Table 3). The most prevalent intestinal parasite was hookworm followed by *E. histolytica/dispar*. As mentioned above, close to 82% of students were infected by intestinal parasites, which ranged from a mean of 9 to 13 children (Table 4). Students sustained single or multiple species of parasites.

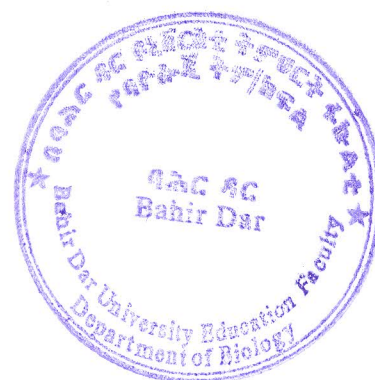


Table 4. Influence of grade level and type of parasite on the prevalence of intestinal parasitic infections at Dembecha in 2009.

Grade	Mean no of children infected
1	13.06a
2	11.94a
3	11.67a
4	10.00a
5	9.72a
6	10.28a
7	10.83a
8	12.50a

5. Discussion

This study has given a considerable insight into the scale of intestinal parasites in and around Demebecha area, where according to our knowledge, no similar work has ever been done. Intestinal parasitic infection has been a major public health problem in many communities of developing countries especially in Ethiopia. According to (Berhanu Erko *et al.*, 1995) the geographic climatic and microenvironment variation, varying degrees of prevalence of intestinal parasitic infections were reported in different places (Megambo *et al.*, 1988).

In this study an overall prevalence of parasitism was 82%. The prevalence is higher than reports from India (46.5%), and Nigeria (48.4%) (Kaur *et al.*, 2002; Awolaju and Morenikeji, 2008). The prevalence in this study is lower than the study conducted in Ecuador (Sackey, 2001). This could be due to variation in environmental, geographical, and socio-economic factors that determine the degree of distribution of parasites.

It is similar with the study done in neighboring country Kenya, where a similar survey of intestinal parasitic infection in a rural community, in Kiambu district, was carried out in 1985 by examining 1129 individuals from 203 households. It was followed by 3 more surveys in January, May and October 1986 in 5 families comprising 461 individuals who had also participated in the first survey. In the first survey 81.4% of the sample were positive for at least one intestinal protozoon and 72.7% of those infected had multiple species infection (Olarcaine and Hohand, 2000).

The prevalence rate of intestinal parasites in the present study was lower than a similar study conducted in 1993 in Bahir Dar. In the study conducted in Bahir Dar, 95% of the 528 children examined by formal ether concentration method, over 95% were found to harbor one or more intestinal parasites. The most common ones were Geohelminths, faeco-orally transmitted amoebae, and water-related schistosome parasites (Berhanu Erko *et al.*, 1995). Most children were found harboring more than one parasite, and it appears that double infections by *A. lumbricoides* and *T. trichiura* are most common.

The total prevalence of intestinal parasites in this study was higher than the findings of Hailu Birrie *et al.* (1997), but it was similar to other reports from South-western Ethiopia (Amare Mengistu *et al.*, 2007), and Wondo-Genet Zuria (Lopiso Erosie *et al.*, 2002), who reported a prevalence rates of 83%, and 89.4%, respectively. The high total prevalence in this study might be due to the climatic and environmental conditions of the area, which could be more favorable for intestinal parasites, along with poor water supply and sanitation facilities prevailing in the area.

In Bure area, Illubabor, intestinal parasites were studied on indigenous and new settlers. The predominant parasites in both population were *A. lumbricoides*, hook worm and *E. histolytica* multiple infections, comprising 48.2% in the indigenous and 53% in the settler population (Belay Roma and Worku Solomon, 1999). In a health survey in south western Ethiopia, 103 stool samples taken from randomly chosen individuals, 94 (91.2%) were found to be positive for either a single or multiple parasitic infection (Surafel Kebede *et al.*, 1995). A similar stool sample study conducted in Wondo Genet Zuria elementary school on 520 students indicated that 89.4% were positive for different intestinal helminthes while 30% were positive for *S. masoni* (Lopiso Erosie *et al.*, 2002).

Generally, the difference in prevalence of intestinal parasites in this study and other similar studies done in different places might be due to difference in geographic area, climatic condition, socio economic and other factors.

With respect to parasitic species, hookworm was the most prevalent parasite with a prevalence of 34.7%. This is higher than the study conducted in Asendabo Elementary and Junior Secondary school, South West Ethiopia. The prevalence of hookworm was 25.5% (Ibrahim Ali *et al.*, 1999) and 26.8% in the study conducted in Boloso Sorie woreda South Ethiopia (Lopiso Erosie *et al.*, 2002) but it is lower than reported by Mengistu Legesse and Berhanu Erko (2004), which was 60.2%. This difference could be due to behavioral, cultural and environmental differences of the communities and the time when the studies were carried out.



In the present study, hookworm was strongly associated with lack of shoe wearing habit. Similarly, in a study done by Lopiso Erosie *et al.* (2002), hookworm is significantly associated with shoe wearing. Poverty, improper human waste disposal and the custom of walking bare-foot enhance hookworm infection and result in widespread distribution in Ethiopia, especially among the adult agricultural population (Yemane Berhane *et al.*, 2006).

The second most common parasite in the current study *E.histolytica/dispar* with a prevalence rate 33.4%. This rate is higher compared to 12.7%, 2.1% was prevalence reported in South east of Lake Langano ,Ethiopia (Mengistue Legese and Berhanu Erko, 2004) and Gonder, North west Ethiopia (Nesamet Worku *et al.*, 2009). The third most prevalent parasite was *Gairdia lamblia* with the prevalence rate of 12.5%. This is higher compared to 10.7%, and 9% a study done in Kara and kwego semi- pastoralist tribes in lower Omo Valley, southwestern Ethiopia and in Gonder, North west Ethiopia (Tilahun Teklehaymanot , 2009; Nesamet Worku *et al.*, 2009).

In the present study, the prevalence rate of *Ascaris lumbricoides* was 9.1%. This is lower compared to a 17.8% prevalence reported in Gonder, North west Ethiopia (Nesamet Worku *et al.*, 2009). However, in other studies conducted in different parts of Ethiopia higher prevalence rates of *Ascaris lumbricoide* were reported which varied from 6% to 76% (Hailu Birrie *et al.*, 1997; Yared Merid *et al.*, 2001; Mengistu Legesse and Berhanu Erko, 2004; Girum Tadesse, 2005).

In this study, the prevalence of *Strongyloides stercoralis* was 5%. Mengistu Legesse and Berhanu Erko (2004) also reported low rates (5.8%). The other parasite identified in this study was *Hymenolepis nana* with prevalence rate of 4.5%. This was lower than reported by Girum Tadesse (2005), who reported 10.1%, but was the same as the one reported by Nesamet Worrku *et al.* (2009), which was 4.7%. Other minor parasites included *Trichostrongylus axei* (1.6%), *T. trichiura* and *E. vermicularis* (each 0.31%) prevalence.

Students in all grade levels may have similar exposure to intestinal parasites since grades did not significantly differ in parasitism. In this study age did not show statistically

significant difference. This corroborates studies done by Okyay *et al.* (2004); Haileyessus Adamu *et al.* (2005); Tilahun Teklehaymanot (2009). The rate of infection between age groups was not significant. In the same way the infection rate of worms in Ethiopia, and the infection of all age groups below 20 years old is 43.4% (Shibru Tedla, 1986). This may be caused by exposure to parasites and similar socio-economic background of students in the area, which is very common in the area.

In this study, slightly males were more infected than females (133 versus 128) but the difference was not statistically significant ($\chi^2=0.52$, $df=1$, $P= 0.66$). This indicates that there were no statistical difference between prevalence of intestinal parasites among males and females. The prevalence of intestinal parasites was not gender related. This study is similar to a study conducted in Nepal (Shrestha, 2001) and other countries (Okyay *et al.*, 2004; Uneke *et al.*, 2009). In contrast, Shibru Tedla (1986) has reported differences in rate of infection between sexes.

Educational level of children's mother had great impact to reduce prevalence of intestinal parasites, which corroborates reports from other countries (Okyay *et al.*, 2004; Kanoa and Al-Hindi, 2009). Educated people take maximum care to avoid contact to infectious routes (risk factors). Hence mothers/females education at schools and other places could be a powerful strategy for the control and prevention of intestinal parasites.

It was observed that regular hand washing before and after meals was associated with a reduction in intestinal parasites. However according to standards done in Nigeria it depends on the quality and quantity of water (Jombo *et al.*, 2007). Since the main route of intestinal parasites is faecal- oral, hand washing using soap and/or ash is the most appropriate measure to reduce prevalence of intestinal parasites (Fung and Cairncross, 2009).

Children that had toilet at their home were less prone to intestinal parasites as confirmed in this study. While acknowledging its importance, Ibrahim Ali *et al.* (1999) suggested that effectiveness of prevention depends on toilet quality and proper usage.



Similarly, source of drinking water had association with the rate of infection. This corroborates results of similar studies in Nigeria (Jombo *et al.*, 2007). River and stream water users were more affected than those using pipe water.

In Ethiopia, water supply and sanitation situation is inadequate. Most of the populations in urban and rural areas do not have access to safe and adequate water supplies and sanitary facilities. Food, water and personal hygienic practices are poor. As a result, three-fourths of the health problems in Ethiopia are due to communicable diseases attributable to unsafe/inadequate water supply, and unhygienic/unsanitary waste management, particularly excreta (United Nation Environment Programme, 2009).

The present study showed that shoes had a significant contribution to the low prevalence rate of intestinal parasitic infections. The prevalence of hookworm infection was high in students who did not wear shoes regularly. Shoes significantly reduced hookworm infection (Girum Tadesse, 2005). This is particularly true because transmission of infection is through skin penetration.

Children who did not cut their fingernail short had high infection rates. Fingernail is a potential source of infection and timely trimming and promotion of personal hygiene is very important to reduce the risk of infection. A number of studies have shown the presence of ova, larvae, and cysts of intestinal parasites under the fingernails of study participants. Ova larvae and cyst were found in fingernails of 149 of 564 subjects in a study conducted in Gonder (Okubaghzi, 1988).

Similar study carried out by Zewdneh Sahlemariam and Girma Mekete (2001) on food handlers in the cafeterias of three university and training colleges, in Jimma, Ethiopia, out of 101 fingernail contents examined, 11 (10.9%) were positive for one or more parasites which included *A. lumbricoides*, *Taenia spp.*, *G. lamblia* and *E. histolytica*. Infection prevalence tended to increase with increasing family size. Similar result was reported from many other countries (Rajeswari, 1994; Karrar and Rahim, 1995; Gunawardena, 2004).

6. Conclusion and Recommendation

The prevalence of intestinal parasites may vary temporally and spatially. The present study showed one of the highest prevalence rates (81.6%). The predominant parasite was hookworm followed by *Entamoeba histolytica/dispar* and *Giardia intestinalis* and the rest were minor parasites.

The high prevalence rate of intestinal parasites in the study area might be a reflection of unsafe and inadequate water supply system, poor sanitation of the environment, and poor personal hygiene. The highest prevalence of intestinal parasites was detected on students whose mothers were illiterate. Intestinal parasitism was lower on children whose mothers were educated. Education greatly contributes for the reduction of the prevalence of intestinal parasites in the society. Using pipe water for drinking, using toilets, washing hands, wearing shoes and small family size were important factors that greatly contributed for reduction of the prevalence of intestinal parasites.

Given the limited scope of the current study, the following recommendations are made.

- Health extension workers should encourage hand washing habit of the community for example by celebrating hand washing day. In many areas, hand washing after defecation or before preparing food seems like a luxury but it is not. Water may be fetched from a river/spring far away from home.
- Hookworm may be prevented significantly in the rural communities by encouraging wearing shoes. The plastic industry is now far advanced and plastic shoes are cheap, which may be tapped by the government and private business. Removing tax levies can tremendously lower price and encourage farmers to use footwear, which is also a part of government advocated program of preventive health strategies.
- The teachers should undergo inspection of their student's fingernail neatness ones a month or week.
- This study was conducted in brief period of the year. A more prolonged study and surveillance is required for a complete enumeration of the intestinal

parasitism and associated contributing factors. In so doing, the most favorable seasons for outbreak of intestinal parasites would be determined, which facilitate appropriate interventions

- The study tried to see the association of some socio-demographic variables including source of drinking water, toilet availability, shoe wearing habit, hand washing habit and others. However, there are not exhaustive lists of the factors that contribute to intestinal parasitism. Risk factors are by no means limited to these ones and thus further more elaborate research projects with a dependable funding source are required for through investigation. One aspect of the study may be determining whether or not parasitic infections result in changes in student physical growth, overall development, and academic performance.

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Appendices

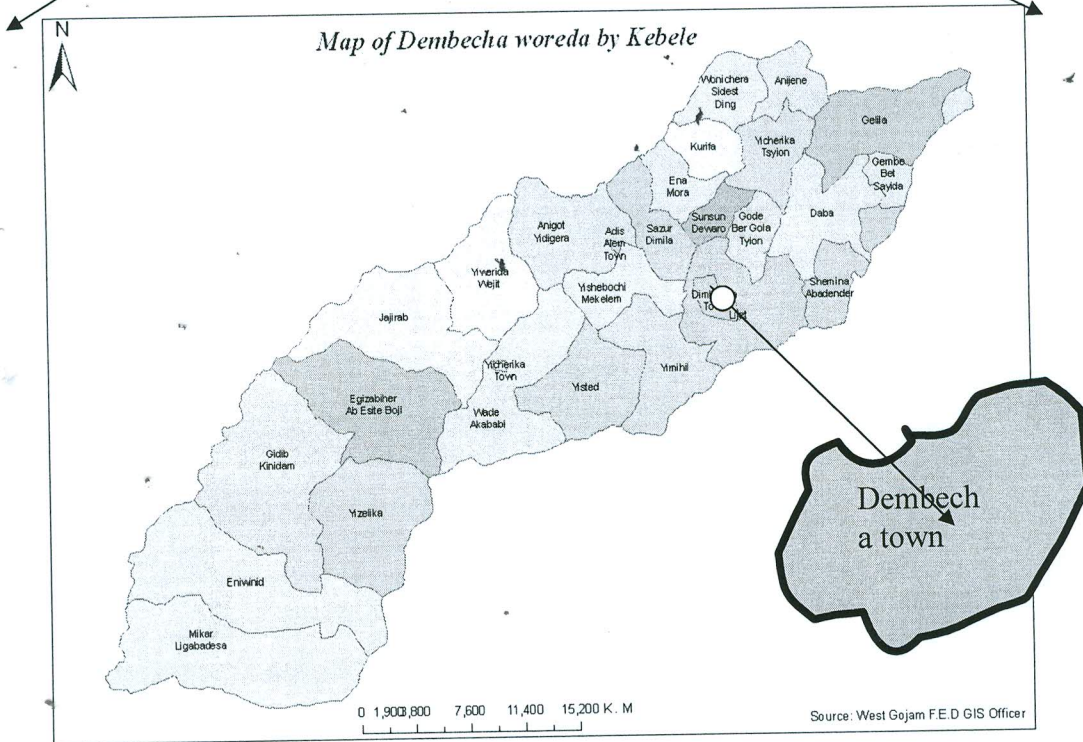
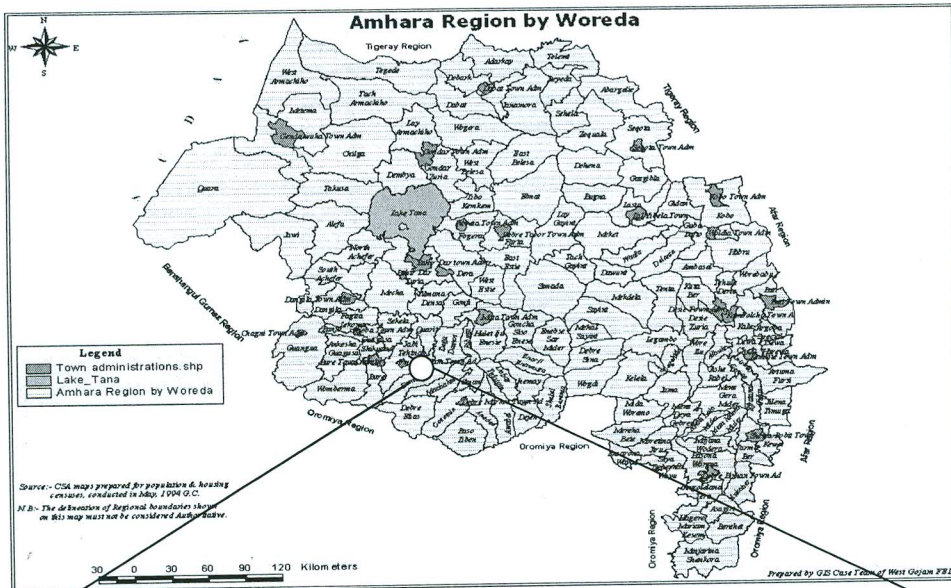
Appendix I

Socio-demographic data and history of students.

1. Code.....
2. Age.....
3. Sex a. Male b. Female
4. Grade a. 1 c. 3 e. 5 g. 7
b. 2 d. 4 f. 6 h.8
5. Source of drinking water a. Pipe c. Stream
b. River
6. Availability of toilets a. available
b. not available
7. Do you wash your hands before and after meal? a. Always c. not at all
b. Sometimes/ not at all
8. Educational status of your mother a. Could not read and write c. had certificate
b. Read and write d. had diploma e. Degree f. above degree
9. Do you wear shoe? a. Always
b. Sometimes/ not at all c. not at all
10. How many family members are in your home?
a. 4 and below b.5 c. 6 d.7 and above

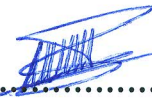
Appendix II

Study area



DECLARATION

I, the undersigned, declare that the thesis comprises my own work. In compliance with internationally accepted practices, I have duly acknowledged and referenced all materials used in this work. I understand that non- adherence too the principles of academic honesty and integrity, misrepresentation/fabrication of any idea/data/fact/source will constitute sufficient ground for disciplinary action by the University and can also evoke penal action from the sources which have not been properly cited or acknowledge.



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Signature

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