INFECTION RATE OF INTESTINAL PARASITES AMONG DENEBA GENERAL PRAMIRY SCHOOL CHILDREN IN DENEBA TOWN, CENTRAL ETHIOPIA

M.Sc. THESIS

BY

TEKLESLASSIE TEKA

A THESIS SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES OFADDIS ABABA UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE MSc IN GENERAL BIOLOGY

ADVISOR: HAILEEYESUS ADAMU (PhD)

ASSOCIATION PROFESSOR

INSTITUTION: BIOTECHNOLOGY

ADDIS ABABA UNIVERSITY

ADDIS ABABA

ETHIOPIA

AUGUST, 2018

INFECTION RATE OF INTESTINAL PARASITES INFECTION AMONG DENEBA PRAMIRY SCHOOL CHILDREN IN DENEBA TOWN, SIYADEBIR AND WAYU DISTRICT NORTH SHOA, AMHARA REGION, CENTRAL ETHIOPIA

MSc-THESIS

A Thesis Submitted to Zoological Science Department, College of Natural and Computational Science School of Graduate program

ADDIS ABABA UNIVERSITY

In Partial Fulfillment of the Requirements for the Degree of Master of Science in General Biology

By
Tekleslassie Teka

August, 2018

APPROVAL SHEET

SCHOOL OF GRADUATE STUDIES

ADDIS ABABA UNIVERSITY

As thesis research advisors, we hereby certify that we have read and evaluated this thesis prepared, under our guidance, by Tekleslassie Teka, entitled "Infection rate of Intestinal Parasites among Deneba Primary School Children in Deneba Town, Central, Ethiopia". I recommend that it can be submitted as fulfilling all the thesis requirements.

Haileeyesus Adamu (PhD)	_____	_____
Name of Advisor	Signature	Date

As member of the board of the examiners of the open defenses of the examination, we certify that we have read and evaluated this thesis properly which was prepared by Tekleslassie Teka. We recommended that the thesis can be accepted as fulfilling the Thesis requirement for the degree of Master of Science in General Biology.

_____	_____	_____
Name of Chair person	Signature	Date
_____	_____	_____
Name of Examiner	Signature	Date

DEDICATION

This thesis is dedicated to my beloved mother w/ro. Etete Mekasha for her continual and unbound love, patience and strength that helped me to complete this work.

ACKNOWLEDGEMENT

First and fore most I praise the Almighty God, who sustained me to bear the rigorous of academic life and research work and made my dreams come true. My special and heartfelt gratitude goes to my advisor Dr. Haileeyesus Adamu for his whole hearted effort in advising and providing me valuable information, comments as well as continuous follow up of the research. I would like to extend my thanks to my Department of Biology. My sincere appreciation is also extended to the School of Graduate Studies of Addis Ababa University for their arrangement of such program. I would also like to thank Yeshigeta Tadesse and other Deneba health center laboratory technician. I am deeply grateful to his patience and kind words of advice. Special thanks also go to my friend Habtu Getaneh whose wise counsel, patience and spiritual strength helped me through the tough days. My great gratitude also goes to Deneba General Primary school children who volunteered to participate in the study and their teachers, school directors and those who helped me in coordinating them. I would like to express my thanks to all persons who were directly or indirectly involved to add their efforts to the accomplishment of this study.

Last but not least, I am extremely thankful to my mother, W/r Etete Mekasha for her love and encouragement since my childhood and contribution the opportunities her never hand last.

LIST OF ABBREVIATIONS AND ACRONYMS

ASL	Above sea level
AIDS	Acquired immunodeficiency syndrome
CDC	Center for Disease Control
CSAE	Central Statistical Agency of Ethiopia
IPI	Intestinal Parasitic Infections
MOH	Ministry of Health
NaCl	Sodium chloride
NCCLS	National Committee Clinical Laboratory Standard
SPSS	Statistical Package for Social Science
STH	Soil Transmitted Helminthes
WHO	World Health Organization

TABLE OF CONTENTS

LIST OF TABLES

Page

LIST OF FIGURES

Page

LIST OF APPENDICES

Pages

ABSTRACT

Intestinal parasitic infections (IPIs) are one of the major public health problems in many countries including Ethiopia. They are mostly associated with poor quality of drinking water, poor personal and environmental sanitation. The objective of this study were to determine the intestinal parasites infections among Deneba General primary school- aged children in Deneba town, Central Ethiopia. The study was conducted at Deneba primary school and its design was descriptive cross-sectional survey. Stool samples were collected from September, 2017 – January, 2018. Structured questionnaire was used to gather data on environmental, socio-demographic and behavioral variables. Data analysis was done using chi-squared test. From the total of 384 study participants, 188 (49%) were males and 196 (51%) were females. The results showed that 111 (28.9%) males and 100 (26.04%) females were infected with one or more intestinal parasites. The total infection rates with IPIs was 211 (54.94%). Multiple infection with two or more parasites were found in 74 (19.5%) of the positive stool samples. The infection rates of protozoan parasites, E.histolytica/dispar and G.lambia, was 10.2%, and 4.4%, respectively. Similarly, the infection rate of helminthes infection, Hookworm spp, A. lumbricoides, H.nana T.trichiura and T.saginata were 10.4%, 4.4%, 3.6%, 1.8% and 0.8%, respectively. Infection rate of intestinal parasitic infections was significantly associated with some of risk factors, such as family's job, family's education level, source of water and its handling, function of toilet, hand washed practice and eating habits (p=0.0398, p=0.049, p=0.030, p= 0.050, p=0.009 and p=0.0015 respectively). Even though there were high parasitic infections, they were not statistically associated with some socio-demographic factors, such as sex, age group, family's dwelling area, sanitation of nail and wearing shoe habits.

Key words: *infection, infection rate, intestinal parasites, school children, Deneba town*

1. Introduction

1.1. Background of the study

Parasites are defined as organism that obtain food and shelter from other organism, the host. For parasitic to be defined as intestinal, it must have an intestinal life cycle stage. Moreover, it may have life stage in the heart, circulation, lung, tissue and other animals on the environment (Bethony et al., 2006). Intestinal parasites are found in the gastrointestinal tract of humans and other animals and include protozoan and helminthes. The common intestinal protozoan parasites of human are *Entamoeba histolytica/dispar, Giardia lamblia/intestinalis, cryptosporidium* and *cyclospora* species. Parasitic helminthes (worms) that infect humans belong to two phyla, *platyhelmiths* and *nematode*. The medically important helminthes are *nematodes* (roundworms), *cestodes* (tapeworms) trematodes (flukes) (*WHO, 2009*). Intestinal parasites which are among the common infections in the world have been responsible for considerable morbidity and mortality (*WHO, 1991*). According to the World Health Organization (*WHO*), more than 3.5 billion people (the majority children) around the world are affected by intestinal parasitic infection (IPI) (*WHO, 1991*). Besides causing morbidity intestinal parasites have been associated with malnutrition growth retardation, physical weakness and poor school performance among school children (*Cooper et al, 1992; Desilva et al. 2003).*

The degree of harm caused by intestinal parasitic infections to the health of individuals and communities depends on the parasite species, the intensity and course of infection, the nature of interactions between the parasite species and concurrent infection, the nutritional and immunological status, and numerous socioeconomic factors of the populations. Thus, it is generally extremely difficult to measure the suffering caused by intestinal parasitic infections because so many cases of the diseases are asymptomatic and therefore remain undetected (*WHO, 1987*). Another study which was done in children of aged 17 years and below from East African countries showed 50% prevalence rate and all infected children were asymptomatic at diagnosis (*Rice et al., 2003*). Intestinal helminthes are more prevalent throughout the tropics, especially among poor communities that is often neglected.

In these parts of the world the high prevalence rate of intestinal parasites is attributed largely to socioeconomic status, poor sanitation, and inadequate medical care and absence of safe drinking water supplies.

Records show increasing trends in helminthiasis infections, particularly in developing nations (*WHO, 2002*). Regarding to intestinal protozoan infections, Giardiasis caused by *Giardia lamblia/intestinalis*, is the most predominant protozoa infection with an estimated prevalence rates ranging from 2.0 to 7.0% in developed countries and 20.0 to 30.0% in most developing countries, affecting approximately 200 million people worldwide (*Mineno and Avery, 2003*).

School children carry the heaviest burden of the associated morbidity *(Nematian, 2004*), due to their dirty habits of playing or handling of infested soils, eating with soiled hands, unhygienic toilet practices, drinking and eating of contaminated water and food (*Opara et al., 2012; Tadesse , 2005).* Parasite infections are highly prevalent in sub Saharan African countries due to factors like poverty, malnutrition, poor sanitary condition and suitable tropical climate for maturation of the various parasites to their infective stage (*WHO, 2000 and 2002*).

The distribution of IPI depends on many factors. These includes socio-demographic variables associated with poverty such as reduced access to adequate sanitation the prevailing climatic and environmental condition (*Petri and Sing, 1999; WHO, 2002*). School aged children are one of the groups at high risk for intestinal parasite infections. The adverse effects of intestinal parasites among school children are diverse and alarming. Intestinal parasites infections have reduced appetite, growth and physical fitness, school attendance, and cognitive performance of age children (*Gad and Ahmed, 2011).* Protozoan parasites are one of the causative agents of intestinal parasites. The main clinical manifestation of the disease caused by these parasites is diarrhea (*Chacon-Cruz, 2003*). The importance of parasites is due to its distribution in large population especially in children in most of the developing and poor countries, possibly because these parasites have easy way of transmission, such parasites are; *Entamoeba histolytica/dispars*, *Giardia lamblia* and *Cryptosporidium* infection happen via faecal contaminated food and water in most regions of the world.

According to WHO (*2004)* estimates indicates that approximately 1,472 million people have roundworm infection; 1289 million people have hookworm infection and 1049 million people have whipworm infection (*Cropmpton, 1999*). *Entamoeba histolytical/dispa,* the cause of *amoebiasis,* is estimated to inflict severe disease in 48 million individuals around the globe (*Sehgal and Reddy, 2010*). The worldwide prevalence of giardiasis is assumed to be in the million.

The best global indicates of a child's wellbeing is growth and irregular growth patterns in children are kwon to be indicative of underlying risks factors including low household income and resources inadequate food consumption increased burden of disease particularly communicable disease that results from inadequate sanitation and poor hygiene condition (*Assis et al., 2004*).

A study conducted by the Central Statistical Agency of Ethiopia *(CSAE*) in 2005 found that underweight wasting and stunting in children aged under five years in Ethiopia was 36% and 51%, respectively (*CSAE, 2005*). Epidemiological surveys have indicated that the most important source for human infection is contaminated drinking and recreational water, food, household animals and infected people in our country high prevalence of intestinal protozoan parasites infection is attributable to factors associated with low socio-economic status. Such factors include poor personal hygiene, environmental sanitation, low household income, low level of education, improper sanitation of dining utensil, resident areas of parents, toilet facility and lack of clean water supplies. For instance, our country has one of the lowest quality drinking water supply and latrine coverage's (*Mengistu et al., 2007*). This was related to lack of proper hygiene prevalence of parasitic infection, low accessibility of food and low parental income (*Adamu et al., 2006*).

Intestinal parasites are widely distributed in Ethiopia largely due to low level of environmental and personal hygienes contamination of food and drinking water that result from improper disposal of excreta (*Teka, 1984; WHO, 1993*). Ethiopia has one of the lowest quality of drinking water supply and latrine coverage in the world (*Amare et al., 2007; Abera et al., 2005*).

The distribution and prevalence of various species of intestinal parasites differs from region to region because of several environmental, social and geographical and other factors mentioned above. Hence, study on the prevalence of various intestinal parasitic infections is a prerequisite not only for formulation of appropriate control strategies but also to predict risk for communities under consideration. In Ethiopia intestinal parasitic infection is sixth of the top ten causes of morbidity amongst children (*Markup et al., 2009*).

Different studies conducted in different regions depicted that the prevalence and possible associated factors are different (*Tadesse, 2005; Amare et al., 2007*). For instance *Tadesse et al.(2005)* in Babile town indicated that the overall prevalence of intestinal parasites was 27.2% and the predominant parasites were *Hymenolopsis nana* (10.1%), *hookworm* (6.7%) and poor personal hygiene and children who eat food items sold on the street where the possible associated factors(4.3%) (*Kebede et al., 2011*). Moreover, *Asrat et al.* (2011) in North Gonder showed that the overall prevalence of intestinal parasite was 79.8%. The most prevalent intestinal parasites identified were *Ascaris lunbricoides* (48%), *Giardia lambilia* (41.9%). *Entamoeba histolytica/dispar* (27.3). *Schistosoma mansoni* (15.9) and *hookworm* (11.5%). Intestinal parasites was higher in children with less educated mother, in children who have habit of eating raw /unwashed vegetables, drinking unprotected well/spring water and who do not have hand washing practice before meal (*Asrat ,et al., 2011*).

Deneba town is located in *Amhara reginal state*. The predominant inhabitants are mixed economy (farmers and trader). It has one health center, one hospital and two primary school. According to the woreda health office report (*2016*), intestinal parasitosis has been one of the common infection disease. Hence, the prevalence of intestinal parasitic infection is different among various communities there is a need for the periodical prevalence evaluation for the future prevention and control programmer. So that the aim of the present study was to assess the infection rate of intestinal parasitic among primary school children in *Deneba town, Central Ethiopia.*

1.2. Statement of the problem

Human intestinal parasites are identified as causes of morbidity and mortality throughout the world particularly in developing countries including Ethiopia. They are more prevalence throughout the tropic, especially among poor communities. Record show that increasing trends of intestinal parasites infection in developing countries. A high infection rate of intestinal parasites in human are positively correlated with poverty and poor personal hygiene, lack of safe water, supply and contamination of the environmental by human excreta and animals wastes (WHO, 2009).

Haile et al. (1994) and Jemaneh (1998) show that high prevalence and distribution of intestinal parasites in Ethiopia may be due to the effect of altitude, urbanization, irrigation and resettlement with the country. Mengistu et al.,(2007) reported that parasitic helminthic infection the second most predominant cause of outpatient morbidity in the country several factors such as climates, humidity ,socio-economic status customary of nutrition and water reservoir etc. play an important role in the distribution and frequency of intestinal parasites (Asrat et al. 2007).

On the other hand, Ethiopia like any other low income country in the tropics is heavily affected by IPIs due to very poor personal and environmental hygiene, poor water quality and toilet coverage. Studies on the prevalence of intestinal parasites in different parts of country and identifying high risk group in the community are important to design appropriate intervention strategies. Instead this, in Deneba town like any other town the people socio-economic status low, poor personal and environmental hygiene, poor water quality and toilet coverage. The people use spring and depth water. Therefore, the purpose of this study is to obtain information about the prevalence or distribution of intestinal parasites among school children in Deneba town Siyadebr and Wayu wereda. Generally the present study was conducted to find out water quality and stool examination to determine the infection rate of intestinal parasite infection among school children in Deneba town, central Ethiopia.

1.3. Significance of the study

The study provided current epidemiological information on the infection rate of human intestinal parasitic infections among primary school children in Deneba town. The findings of the study would be significant primarily for health care workers and other health institutions in understanding the infection rate of intestinal parasitic infections and in giving emphasis for those parasitic infections most prevalent in the study area. This research finding would also serve as a starting point to enable other researchers to conduct further studies on the epidemiology of intestinal parasitic infections in the study area.

1.4. Scope of the study

The study was emphasizes on the infection rate of intestinal parasites among primary school children in Deneba town. It was more concerned on the personal, and environmental hygiene, nutritional sanitation, water resource quality, and other factors that contribution to the distribution of intestinal parasites infection. The study area has two primary school in the town. However, due to time resource constraints, it is difficult to study all school. As a result this study was delimited to purposively select one school, namely, Deneba General Primary School. Methodologically, the study was on descriptive research approach and undertaken from September 2017 to May 2018.

2. Literature Review

2.1. Human Intestinal Parasites

Intestinal parasites infections (IPIs) are globally endemic and have been described as constituting the greatest single worldwide cause of illness and disease (*Curtale et al., 1998; Steketee, 2003*). IPIs are estimated to affect 3.5 billion people, most of whom are children residing in developing countries (*WHO, 2006*). The major IPIs of global public health concern are the protozoa species Entamoeba histolytica/dispar, Giardia lamblia, cryptosporidium, and cylospora specie. Parasites helminthes (worms) that infect humans belong to two phyla, Platyhelminthes and nematode. The medically important helminthes are nematodes (roundworm), cestodes (tapeworm), trematodes (flukes) (*WHO, 2009*). IPIs are linked to lacks of sanitations, lack of access to safe water and improper hygiene; thus occurring wherever there is poverty. People of all age are affected by the cycle of prevalent parasitic infections; however, children are the worst affected (*Steketee, 2003; Garzon, 2003*).

The majority of infection are associated with poverty conditions such as reduced access to safe drinking water, adequate sanitation and hygiene, housing, and inadequate access to health care (*Mata, 1982; Montresor et al,. 1998).* They are also affected by poor family and community hygiene and sanitation practices and prevailing climatic and environmental conditions (*Jemaneh, 1998*). These conditions lay the stage for the continuous transmission of the IPI's (*Mata, 1982; Montresor et al., 1998; Crompton, 1999).* In developing countries, particularly those with tropical climates and at low altitudes, such infections remain a serious medical and public health among the poor, who are negatively affected by low socio-economic conditions, poor personal and environmental hygiene, overcrowding, and limited access to clean water (*Mengistu et al., 2007; Obeng et al., 2007*).The main transmission route for most intestinal parasites is fecal-oral, through contaminated food or water (*Marshall et al., 1997*). Young children are reported to be disproportionately affected by IPI's compared to adults due to their increased nutritional requirements and less developed immune systems (*Scrimshaw, 1994*).

Intestinal parasite infection (IPI) and helminthes in particular, are associated with increased risks for nutritional anemia, protein energy malnutrition and growth retardation in children, poor increase in body weight in pregnancy, intrauterine growth retardation, and low birth weight (*Rodriguez-Morales et al., 2006*).

Children infected with soil-transmitted helminthes (STHs) have poor educational level and performance at school and a high level of truancy, thus impacting on their future earnings and productivity (*Miguel, 2004; Hotez, 2004*). Intestinal parasitic infections are among the most common health problems generally in global level, in Ethiopia in particular (*Mengistu et al., 2007*). Similar to other developing countries, wide distribution of intestinal parasites in Ethiopia is due to low level of environmental sanitation, personal hygiene, food and water contamination with human excreta (*WHO, 1981*) and unaware of simple health promotion practices such as personal hygiene, food hygiene, etc.(*Zein, 1988; Kloos and Tesfayohannes, 1993*).

2.2. Intestinal protozoan parasites infections

The protozoa are an extremely diverse group of unicellular organisms occurring in almost all of the ecological niches known to humans, including the bottom of hot springs and the edges of ice flows. Even though the majority of protozoa occur as free-living organisms in the soil, moist, marine or freshwater environments, a substantial number also exist as mutualisms, commensals or parasites *(Melhorn, 1988; Katz et al., 1989*). Most of these have evolved a totally parasitic existence. The enteric protozoa that cause human illness are usually transmitted by the consumption of food and drink, or through environmental contamination and poor hygiene. Some of these can cause substantial illness, and have economic consequences (*Buzby and Roberts, 1997*).

The common protozoan parasites include *Entamoeba histolytica/dispar, Giardia lamblia/intestinalis, Cryptosporidium* and *Cyclospora* (*Neva and Brown, 1994*). Intestinal protozoal diseases are caused by unicellular microorganisms which invade the wall of the intestine such as *Amebiasis, Giardiasis,* and *Cryptosporidiosis.*

Numerous protozoa inhabit the gastro-intestinal tract of humans. The majority of intestinal protozoa is non-pathogenic commensals, or only result in mild disease. Some of these organisms can cause severe disease under certain circumstances. *Apicomplexa* and *microsporidia* species, which normally do not evoke severe disease, can cause severe and life-threatening diarrhea in AIDS patients and other immune-compromised individuals (*Adamu, et al, 2006*). Intestinal protozoan parasite infections are a significant problem with more than 58 million cases in children each year. Pathogenic intestinal protozoa are especially important in the developing world where they may cause death.

Most intestinal protozoan parasites are spread by faecal–oral contact or contamination of water or food. Poor sanitation and poverty are contributory factors in many low income countries. Symptoms of intestinal protozoan parasite infections include diarrhea, abdominal pain, and nausea, vomiting and weight loss (*Marshall et al, 1997*).

2.2.1. Entamoeba histolytica/dispar

Entamoeba histolytica/dispar is an intestinal parasite that characterized by possessing clear protoplasm which form pseudopodia. These pseudopodia are the means by which the organisms move and use for feeding purposes. The two species *Entamoeba hitolytica* and *Entamoeba dispar* are morphologically identical but pathologically distinct (*WHO, 1997*). However, only *Entamoeba hitolytica* is capable of causing disease (medically important). 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 *Entamoeba histolytica* or *Entamoeba dispar* and in many tropical countries the prevalence may approach 50%. It is also estimated that about 100,000 deaths and 50 million cases of amoebiasis occur per year in the world and humans are the only host of *Entamoeba histolytica* and there are no animal reservoirs (*Haque et al., 2003*). The majority of amoebic infections are reported to occur in Central America, South America, Africa and Asia. These are often associated with poor water and food hygiene and sanitation practices. In the study of *Tikur Anbessa Hospital* shown that *Entamoeba histolytica* trophozoite was the most commonly reported parasite, which was seen in 13.6% of the patients over the five years study period (*Petri and Singh, 1999*).

2.2.1.1. Life cycle of Entamoeba histolytica/dispar

The life cycle of *Entamoeba histolytica*/dispar includes the infective cyst and the invasive trophozoite forms. Infection is acquired by ingestion of infectious cyst through water or undercooked food contaminated by human faeces. After ingestion of the cyst, which is resistant to gastric acids and enzymes, excystation occurs in the ileoceacal area of the intestine to form trophozoites. The trophozoites are larger in size and actively motile organisms. According to the bind-lyse-eat model, the trophozoites bind to the large intestine and invade the wall releasing amoeba pores and phospholipidases, causing ulceration of the mucous membrane (called flask shaped ulcers), and sometimes large vessels may be eroded and severe intestinal hemorrhage result (*Petri and Singh,1999).*

The trophozoites are typically found in the periphery of the necrotized tissues. Reproduction is by binary fission or the formation of cysts. These pass out with the stool and are immediately infective (*Neva and Brown, 1994*). In the extra-intestinal invasion no cysts are formed and trophozoites proliferate solely by binary fission (*Katz et al., 1989*).

Asymptomatic infection with *Entamoeba histolytica* is defined as the presence of cysts in stools in the absence of colitis or extra-intestinal infection. These healthy carriers may pass millions of cysts in the stool per day as the trophozoites multiply in the intestinal lumen (*Petri and Singh, 1999; WHO 1997; Neva and Brown, 1994*). Approximately, 90% of all intestinal *Entamoeba histolytica* infection is asymptomatic. However, even asymptomatic infection is associated with a small but significantly increased risk for developing invasive amoebiasis (*Petri and Singh, 1999; Mohamed et al., 2000*). Clinical symptoms of acute intestinal amoebiasis include diarrhea, bloody stool that may contain necrotic mucous, abdominal pain, tenderness and fever *(Petri and Singh, 1999*). Symptoms of amoebic liver abscess usually involve fever, right upper abdominal tenderness/ pain, weight loss and colitis (*Katz et al.1989; Neva and Brown, 1994; Petri and Singh, 1999*). Amebic liver abscesses 7-10 times more common in men than women but this sex difference in risk has not been reported for children (*Petri and Singh, 1999*).

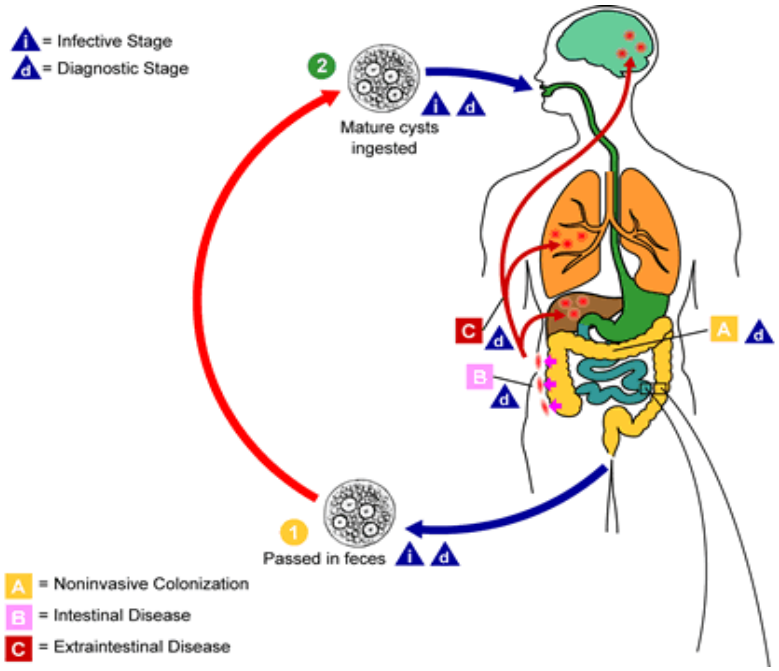

Figure 2.1 The life cycle of Entamoeba histolytica (from Parasite image library of CDC, USA)

2.2.3. Giardia lamblia/intestinalis

Giardia lamblia/intestinalis (also known as *Giardia duodenalis* or *Giardia intestinalis*) is a unicellular flagellated intestinal protozoan parasite of humans isolated worldwide and ranked among the top 10 parasites of man (*Wolfe, 1992*). Giardiasis is caused by infection with the enteric pathogenic intestinal flagellate, *Giardia lamblia*. It is considered the most common human intestinal protozoan infection. Humans are the preferred host but morphologically identical organisms have been isolated in dogs, beavers, ungulates and other mammals (*Katz et al., 1989*). The frequent availability of hosts and reservoirs for the protozoan has contributed to the high prevalence of this infection in many industrialized countries (*Juckett, 1996*). The transmission of the parasite is mainly by the fecal-oral route but also occurs by human-to-human transmission (*Mata, 1982; Garcia, 1999*). *Giardia lamblia* is the most common Protozoan intestinal parasite isolated worldwide as causative agents of diarrhoea.

Epidemiological studies suggest that the parasite is responsible for about 5% of acute diarrhea and 20% of chronic diarrhoeal illness in the world (*Thompson et al., 2005*). Giardia exists in two forms: the infective cyst and the not invasive trophozoite which typically inhabits the duodenum and upper jejunum of humans (*Neva and Brown, 1994*).

The round or oval shaped cysts, which are the infective form of the protozoan, are approximately 11-14μm long and 7-10μm wide (*Garcia, 1999*). Although symptomatic infection causes a broad spectrum of clinical manifestations, Giardia results in asymptomatic carrier state in a majority of cases. The asymptomatic infections are most common in children and people with prior exposure to a source of infection, Clinical symptom of giardiasis includes diarrhea, epigastric pain, wasting and impaired absorptions (*Orteg and Adam, 1997*).

2.3. Human intestinal parasitic helminthes infections

Parasitic helminthes (worms) that infect humans belong to two phyla, Platyhelminthes and Nematode. The common intestinal helminthes are trematodes (flukes) includes Schistosomia mansoni), nematodes (round worms) includes *Ascaris lumbriicoide, Trichuris trichiura* and hook worms (*Necator americanus* and *Ancylostoma duodenale*) and cestodes (tape worms) includes *Hymenolepis nana, Taenia saginata* and *Taenia solium*.

Helminthic infections are enhanced by poor socio-economic conditions, lack of sanitary facilitates, improper disposal of human feces, insufficient supplies of potable water, poor personal hygiene, poor housing conditions and lack of education (*WHO, 1996*). According to *Montresor et al.* (1998), at global burden, over one billion of the world's population is estimated to be infected with helminthes parasites and over two billion people are at risk. Intestinal helminthes are common parasitic infectious agents of humans in the world mainly in developing countries (*Hotez et al., 2008).* More than 2,000 million people are infected by soil transmitted helminthes (STH) worldwide, of which more than 300 million suffer from associated severe morbidity. STH infections are widely distributed in tropical and subtropical areas, especially in poor populations (*Montresor et al., 2002 as cited in Abahussain, 2005*). *Ascaris lumbricoides, Trichuris trichiura* and hookworms, collectively referred to as soil-transmitted helminthes (STHs), are the most common intestinal parasites (*Bethony et al., 2006*).

Human hookworm infection is a leading cause of anemia and protein malnutrition, afflicting an estimated 740 million people in the tropics. The largest numbers of cases occur in impoverished rural areas of sub-Saharan Africa, Latin America, South-East Asia and China (WHO, 2005).

The major pathology of hookworm infection results from intestinal blood loss as a result of adult parasite invasion and attachment to the mucosa and submucosa of the small intestine (*Hotez et al.,* 2004). Hookworm transmission occurs by skin contact with infective third-stage larvae (L3) that have the ability to penetrate through the skin, frequently entering the body through the hands, feet, arms, or legs (*WHO, 2005).*

Ascaris lumbricoides infections is in humans occur when an ingested infective egg releases a larval worm that penetrates the wall of the duodenum and enters the blood stream. From here, it is carried to the liver and heart, and enters pulmonary circulation to break free in the alveoli, where it grows and molts. In 3 weeks, the larvae pass from the respiratory system to be coughed up, swallowed, and thus returned to the small intestine, where they mature to adult male and female worms. Fertilization can now occur and the female produces as many as 200,000 eggs per day for a year. These fertilized eggs become infectious after two weeks in soil; they can persist in soil for 10 years or more (*Murray et al., 2005*).

Ascaris lumbricoides is the largest and the most common helminthes parasitizing the human intestine and currently infects about 1 billion people worldwide (*CDC, 2006*). It is estimated that 25% of the world population harbors the parasite. Hand to mouth transmission is most common; it is found in association with poor personal hygiene, poor sanitation, and in places where human feces are used as fertilizer. Consumers of uncooked vegetables and fruits grown in or near soil fertilized with sewage are most at risk for acquiring infection. Water is rarely implicated as a source of *Ascaris* (*Bogitsh et al., 2005*).

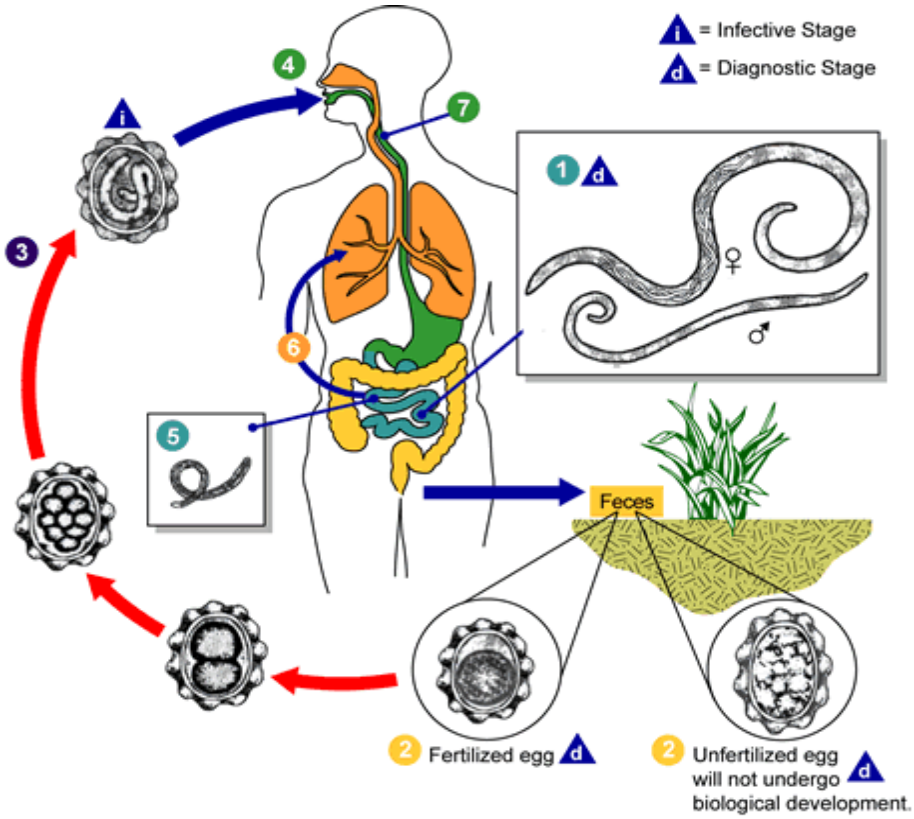

Figure 2.2. Life cycle of Ascaria lumbricoides (from Parasite image library of CDC, USA)

Trichuris trichiura infection is endemic in tropical and subtropical countries, but few sporadic cases have occurred in none endemic areas, mainly as a result of immigration. It is rare or nonexistent in arid, very hot, or very cold regions (*Bogish et al., 2005*). It is estimated that over 40.1 million African school-aged children are infected with *Trichuris* trichiura (*Brooker et al., 2006*) Intestinal trichuriasis is diagnosed by detecting Trichuris eggs in the feces. Prevention of zoonotic trichuriasis depends on the treatment and prevention of Trichuris infections in animals, the removal of feces before the eggs can become embryonated, good hygiene and public education *(Guyatt*, 2000).

Cestodes are tapeworm, specialized flatworms, looking very much like a narrow piece of adhesive tape. Tapeworms are the largest, and among the oldest, of the intestinal parasites that have plagued humans and other animals since time began.

The most important cestodes affecting humans and animals in Ethiopia are Taenia saginata, and Hymenolepsis nana, the former due to the custom of eating raw meat and the later due to unhygienic food consumption with contaminated hands and fingers that allow the ingestion of eggs from the faeces of an infected person (*Belete and Kloos, 2006*).

The adults of Taenia saginata and Taenia solium live in the intestine and are very large worms, i.e. several meters in length. Proglottids as well as eggs appear in faeces. The eggs of the two species are identical; they are round to oval in shape, measuring 35-43 μm in diameter and have a thick, radially-striated shell. The egg contains a 6-hooked embryo called an oncosphere or hexacanth. These eggs must be handled with extreme care because the egg of Taenia solium is infective to humans and produces cysticercosis (*WHO, 2004*). The adult worm of Hymenolepis nana found in the intestine. It is very small, only a few centimeters long. The egg is unique in its appearance. It is small, measuring 30-47 μm in diameter with a thin, colorless shell. The membrane surrounding the hexacanth embryo has 4-8 filaments arising from each pole that fill much of the space between the embryo and the shell (*WHO, 2004*).

2.4. Epidemiology of Human Intestinal Parasitic Infections

Intestinal parasites are present throughout the world in varying degrees of prevalence. The burden of the infection remains one of the greatest health problems in the developing world, with over one billion people estimated to be infected (*Cook, 1986*). While most infections remain asymptomatic, the clinical spectrum of disease widespread, ranging from mild gastrointestinal symptoms to death from disseminated infection. In East Africa including Somalia, Ethiopia, Eritrea, Kenya and Sudan more than 50% of people are at risk of illness from parasitic diseases.

This is due to deteriorated health service, armed conflict, famine and economic hardship (*Berger et al., 1989*). School age children are one of the groups at high risk for intestinal parasitic infections. The adverse effects of intestinal parasites among children are adverse and alarming. Intestinal parasitic infections have a great effect on the survival, appetite, growth and physical fitness, school attendance and cognitive performance of school age children *(Nokes and Bundy, 1993*). Intestinal protozoan infections are endemic worldwide.

In developed countries the prevalence of human intestinal parasitic protozoan infection is estimated to be between 1-7%, but it may be as high as 50% in developing countries. All age groups are equally affected during epidemics, but both subclinical infection and clinical disease are more common in children in endemic areas. Outbreaks occur regularly in childcare facilities. Immuno-compromised individuals are also more commonly affected than members of the general population. Giardia is also a cause of "travelers' diarrhea, in which the disease is sometimes also called beaver fever. *Entamoeba histolytica* infection is common in most developing countries. It is reported to be responsible for approximately 50 million cases of invasive *Amoebiasis* and upwards of 100,000 deaths each year. Thus, it is second only to malaria as the cause of mortality due to protozoan infection (*WHO, 1997*). Soil transmitted helminthes, *Trichuris trichiura, Ascaris lumbricoides* and hookworm (*WHO, 2000*). The incidence and prevalence of these parasitic pathogens vary between and within the countries. This is due to ecological and socio economic factors and difference in human behaviors and sanitations. Over population deficient sanitary facilities and shortage of potable water are the major risk factors particularly in the tropics and sub tropics (*WHO, 2000*).

2.5. Global distribution of human intestinal parasitic infections

Intestinal parasites are top global health problem with prevalence of about 67% (*Espinoza et al., 2003*) and are distributed virtually throughout the world, with high infection rates in many regions (*WHO, 2006*); whereas amoebiasis, ascariasis, Hookworm and trichuriasis are among the ten most common infections (*WHO, 2009*). Global prevalence of helminthic infections in school age children is estimated at about 35% caused by ascaris, 25% caused by trichuris and about 26% are caused by hookworms. Heavy infection of intestinal parasite can cause malnutrition, loss of appetite, interfering food absorption and weight loss. Majority of intestinal parasites are more likely to make the children ill. And, this can lead to the children's missing of school (*Nokes and Bundy, 1993*).

2.6. Intestinal parasites in Ethiopia

Different researchers have reported that intestinal parasitic infection is widely distributed in Ethiopia *(Erko and Medhin 2003; Andargie et al., 2008; Mengistu et al., 2007; Gebeyehu et al., 2011; Eleni, 2012; Negase, 2014; Melesse, 2017, etc.*).

Both geohelminthiasis and schistosomiasis are common in the country (*Erko* and *Medhin, 2003*). Studies by *Gebeyehu et al*. (2011) and *Eleni* (2012) showed that the high prevalence and distribution of intestinal parasites in Ethiopia may be due to the effect of altitude, urbanization, age, sex, and resettlement within the country.

Mengistu et al. (2007) reported that parasitic helminthic infections are the second most predominant cause of outpatient morbidity in the country. Several factors such as climate, humidity, socioeconomic status, customary of nutrition, wars, immigration and water reservoir, etc., play an important role in the distribution and frequency of intestinal parasites (*Amare et al., 2007*).

Parasite helimithic infections are the second most predominant causes of outpatient morbidity in the country. Several studies stated that, Ethiopia has one of the lowest qualities of drinking water supply and latrine coverage in the world. According to ministry of health (1996), more than half a million annual visits of the outpatients' services of the health institutions are caused by intestinal parasitic infections. This estimate is inaccurate, because most of the health institutions lack appropriate diagnostic tools to detect low level of parasite burden. Still data on intestinal parasites in Ethiopia is inadequate (*Hailu and Brhanu, 1995*).

The most important intestinal parasites predominantly distributed in the country include: *Ascaris lumbricoides, Giardia lamblia, hookworm, Hymenolepis nana, Trichuris trichiura, Entamoeba histolytica/dispar,* and *Entamoeba vermicularis;* with varying prevalence in different areas of the country. For example, Mengistu et al. (2007) showed that *Trichuris trichiura, Ascaris lumbricoides, Entamoeba histolytica/dispar, Giardia lamblia, Strongyloides stercoralis, Hymenolepis nana, intestinal schistosome, Taenia saginata, Entamoeba vermicularis* and hookworm with prevalence of 60.9%, 40.9, 17.1% 13.9%, 17.5%, 2.1% 5.0%, 2.3%, 14.8% and 1.1% respectively were diagnosed from study groups in Jimma, south-western Ethiopia.

In addition, Legesse and Erko (2004) reported that stool diagnosis from 259 surveyed students for intestinal parasites, 83.8% had one or more intestinal parasites which include hookworm (60.2%), *Trichuris trichuria* (14.7%), *Taenia* species (13.9%), *Entamoeba histolytica/dispar* (12.7%), *Ascaris lumbricoides* (6.2%), *Giardia lamblia* (6.2%) in descending order of prevalence.

2.7. Prevention and Control of Intestinal Parasitic Infections

According to World Health Organization guidelines (*WHO, 2002*), any health program aiming at controlling morbidity of intestinal parasitic infections should have evidence based estimates of this problem. Human intestinal parasitic protozoan infections can be controlled through proper treatment and disposal of row swage and maintaining clear water supply including the protection of open wells, springs and rivers from contamination with swage and faces. The risk for infection can also be reduced via the adequate boiling of drinking water or treatment of water with chlorine or iodine. The exterior of row vegetables and fruits should be washed with soup and soaked in vinegar for some minutes before conception (*Petri and Singh 1999*). There are three types of basic control programs, those oriented to treating patients, those oriented to cutting the oral-fecal exposure i.e. sanitation and education.

2.7.1. Health education

Health education and promotion of healthy behaviors can play a key role in reducing the incidence of human intestinal parasitic infections. However, the effectiveness of those activities in reducing transmission of infection varies according to different reports. In some cases, health education can decrease costs, increase levels of knowledge, and decrease reinfection rates. Health education efforts can build trust and engage communities in aspects that are crucial to the success of public health initiatives (*Lansdown et al., 2002*).

2.7.2. Improved sanitation

The most important community control measure is reduction of the source of infection through the sanitary disposal of human feces. It is important to treat all infected persons, even if they are asymptomatic, in order to reduce the possibility of contaminating the environment. The only way to completely prevent 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 protozoan parasites are killed by chlorine; therefore, those organisms can exist in the water supply. Complete elimination can only be achieved by boiling (for a few minutes), filtering with a one micron filter, or drinking distilled water (*WHO, 1999*). 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 habit in the population (*Sackey et al., 2003*).

2.7.3. Treatments

Know a days, different groups of drugs are available that control intestinal protozoan parasites infections. Based on different age group, endemicity of the parasite and use of antimicrobial therapy vary. Recommended drugs used in the treatment of soil-transmitted helminths are albendazole, mebendazole and older drugs including pyrantel, tiabendazole and niclosamide (*Heelan, 2004*). Piperazine citrate is also used to paralyze the worm and rendering them unable to resist the peristalsis action of the host intestine. So are expelled in the feces. This drug is highly effective and was once the drug of choice for treating intestinal obstruction however, it can be neurotoxic and hepatotoxic and is no longer widely available. In cases of intestinal obstruction, surgery may be necessary if the obstruction persists and in specific cases of obstruction of certain body sites (*Maguire, 2005*).

3. Objectives of the Study

3.1. General Objective

The general objective of this study is to determine intestinal parasitic infections among Deneba General Primary School children in Deneba town, Central Ethiopia from September 2017-May 2018.

3.2. Specific Objectives

More specifically, this study intends to:

- assess intestinal parasitic infections and the level of awareness towards them among primary school children in the study area.
- To assess knowledge, attitude and practice of the school children towards intestinal parasites in the study area
- Identify intestinal parasites species among primary school children in the study area.
- Identify the dominant intestinal parasite among school children in the study area.

4. Materials and Methods

4.1. Description of the Study Area

The study area was Siyadebr and Wayu woreda, Deneba town, North Shoa Zone which is located 117 Km away from the capital city of Ethiopia, Addis Ababa, 742 Km away from the capital city of Amhara region, Bahir Dar, and 42Km from North Shoa Adminstive Zone, Debre Berhan town. Siyadebr and Wayu woreda covers a total area of 43073.72 Hectare and has 15 kebeles with total population of 72,544. The altitude ranges 679-2600m ASL at the highest peak. The annual minimum and maximum temperature ranges from 6 to 24℃, respectively. The mean annual temperature is 15℃. The rainfall is bimodal pattern occurring during mid-February- May (small rains) and June-Mid September (main rainy season).The mean annual rainfall is about 995.6mm. Most of the area is known to have fertile soil, which is suitable for agricultural activities.

The livelihood of the communities is based on mixed farming (cultivation of crop and raring animals), Merchant and Employers. The area experiences *''daga*" (51.54%) and "*woina dega*" (48.01%) and "*qola*" (0.45%) Climates (*Woreda communication office, 2017*). The town is divided into six sub-kebeles with total households of 7,195. Most of the dwellers of Deneba town are merchants, urban farmers and employers. There is one Hospital, one health center and each kebele has at least two health extension worker who is assigned to provide home-to-home health service to the community. There are two primary schools, one Secondary and preparatory school and Technical and vocational college in Deneba town. This study was conducted in Deneba General Primary School (*woreda education office and woreda health office, 2017*).

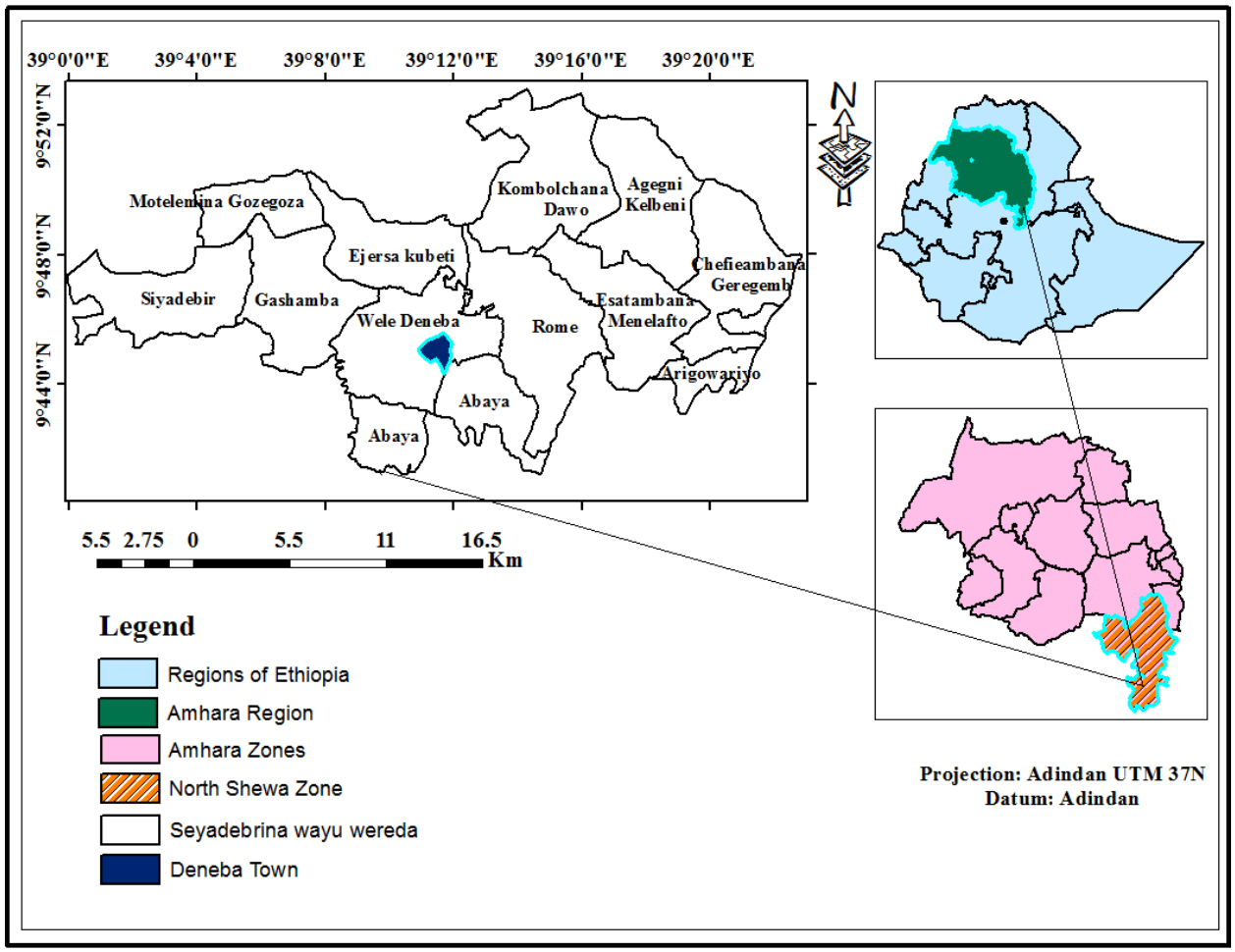

Figure 3.1 Map of Siyadebir and Wayu *Wereda* .

4.2. Research Design

A descriptive cross-sectional survey design was used to determine the infection rate of intestinal parasites infection among primary school children in Deneba town. Laboratory examination of stool sample was carried out using direct wet mount. In addition structural and pre-tested questionnaire were used collect data regarding to socio-demographic characters, environmental related factors, sanitary indicators, water source, toilet facility, habit of eating unwashed fruit and vegetables and resident areas. Among 1286 (male, 630 and female, 656) children in Deneba General Primary School, 384 (male, 188 and female, 196) respondents were taken as a sample for this study. This survey was conducted from September 2017 to May, 2018 among school children in Deneba General Primary School, Central Ethiopia.

4.3. The Study Population

All students from grade 1 to 8 in the selected schools, who are volunteers to participate and complete and signed the consent form by their parents were included in the study. According to the data obtained from the one primary schools of Deneba town, the total number of students from grade 1 up to grade 8 that were enrolled in the 2017/2018 academic year was 1286. Of these 639 and 656 are males and females, respectively. These constituted the study population of the present study.

4.4. Sample Size Determination and Sampling Methods

Students from Deneba General Primary School, who were volunteers to participate and complete and signed the consent form by their parents were included in the present study. The sample size (n) was determined using the following statistical formula ((Daniel, 1999 as cited by Naing et al., 2006).

$$n = \frac{Z^2 P(1-P)}{d^2}$$ Where n = Sample size

p = 0.5 (prevalence value)

Z=1.96 (score corresponds to 95% confidence interval.)

d= 0.05 (margin of error)

$$n = \frac{(1.96)^2 0.5(1-0.5)}{(0.05)^2}$$

n=384

Since the overall infection rate of intestinal parasites is not known for the study area, infection rate was taken to be 50%. Hence, the required sample size was 384. To select the sample children, the students were first stratified according to their educational level (grade 1 to 8).

Proportional sample number was then allocated for each grade and each section. Finally, the sample children were selected using systematic random sampling technique by using list of students as sampling frame.

4.5. Method of Data Collection

In this study questionnaire survey was conducted to assess the infection rate of intestinal parasite among primary school children in the study area. In addition, stool sample were collected to assess and determine the infection rate of intestinal parasites infection.

4.5.1. Questionnaire survey

The questionnaire was constructed in English and then translated into local language (Amharic) for parents or care takers for asking them standardized question in their mother tongue. A total of 384 respondents were involved in filing the question. This standardized questionnaire was used to gather the relevant general information on demographic and socio-economic data of the school children in the study area. Information about age, sex, source of water and its handling, presence or absence of toilet in their homes, parents' education level, life skills, personal hygiene, level of awareness to parasitic infection and wearing shoes or not were gathered using structured questionnaire after pre-test in the study area. The questionnaire was administered for each parent of selected primary school children in Deneba General Primary School.

4.5.2. Clinical examination

Each study participant was examined by health professional, physically and clinical condition was recorded appropriate format developing for their purpose. Weather they have or not clean water and clothing, hygienic condition and environmental sanitation source of water, place of toilet for anybody abnormality by the investigator.

4.5.3. Stool sample collection

Fecal sample specimen of 2-3gm of fresh stool was collected from primary school children then after kept in a plastic container and transported to the laboratory for examination within five to six hour after collection and examined by the use of microscopy. At the time of sampling; date of sampling, age, sex, presence or absence of intestinal protozoan parasite infections and code number was recorded for each children on the record format. In addition data were collected from primary school children. Two data collectors and three assistants (health workers of health center and community member of respective town) were involved in the data collection.

Stool Samples were collected from faeces of 384 children individuals from Deneba General Primary School children, in Deneba town September, 2017 – January, 2018. The staining techniques and the stool smear examination for intestinal protozoan parasite like *Giardia lamblia*, Cryptosporidium species and *Entamoemba histolytica* and helminthes are nematodes (roundworms) cestodes (tapeworms) trematodes (flukes) were conducted in Deneba town Health Center.

4.5.4. Direct microscopy or Wet mount method

A direct wet mount with normal saline (0.85% NaCl solution) was prepared at study site laboratory and observed for the presence of motile intestinal parasites infection like trophozoites, cyst and oocyst under low objective power at 10X and 40X magnification. Lugol's iodine staining was also used to observe cysts of protozoan parasites (WHO, 1991). Stool samples were diagnosed for the presence of intestinal parasites using direct wet-mount method. The processed stool samples were checked for the presence of intestinal parasite ova or cysts under light microscopy using objectives 10 x and 40 x. Identification of the parasite species was done on the basis of morphology and size by the principal investigator assisted be experienced laboratory technicians and referring the parasitological laboratory manual (*Cheesbrough, 1990*). Direct wet mount technique was used to assess the overall prevalence of IPI in the study area. The direct wet mount was processed by conventional iodine to identify the presence of motile intestinal parasites, cysts, egg and trophozoite under light microscope at 10X and 40x magnification. Saline was used to observe cysts of intestinal parasites (*Singh et al., 2004*). About 2g of stool samples was emulsified with 3-4 ml normal saline, and then a drop of emulsified sample placed on a clean microscopic glass slide, then a few drops of iodine solution was added and it was covered with a cover slip. The presence of intestinal parasites ova and cyst was observed under the microscope (*Lindo et al. 1998*).

4.6. Data analysis

The infection rate of intestinal parasitic infections was analyzed using SPSS, window Version 23.0. A statistically significant difference in frequencies was tested using chi-square analyses. All statistics was set to the significance level of P value <0.05 to indicate statistical significant differences whereas p-value greater than 0.05 was insignificant. In this study the following data types were collected and analyzed.

These parents' educational level, availability of latrine, level of awareness towards intestinal parasitic infections, household sanitation, environmental and personal hygiene's, family resident, way of eating unwashed fruit and vegetables, family occupation, age, sex, source of water and handling practices, type of intestinal parasites species found in the stool sample of individual having intestinal parasitic infections among the total examined school children.

4.7. Data Quality Control

To ensure quality control, all the laboratory procedures including collection and handling of specimens was carried out in accordance with standard protocols (*WHO, 1991*). To ensure general safety, disposable gloves were worn and universal bio-safety precautions (*NCCLS, 2002*) was followed at all times.

4.8. Ethical considerations

The study was reviewed and approved by the higher management of Deneba town Health center office. The purpose of the study was explained to the school principal, other concerned authorities and students. The questionnaire concerning the infection rate study was filled during sample collection. Written consent was sought from parents of the selected study children. Ethical considerations were addressed by treating positive intestinal parasites using the standard drugs. Laboratory samples were taken from the pupils of the selected area and signed on consent form. Those individuals with positive results were treated with the required treatment and the drugs were administered by the sites health officers. The identity of the participants was confidential.

5. Results

5.1. Socio-demographic characters of study participants.

A total of 384 primary school children were participated in the present study area, from these, 188(49%) were males and 196(51%) were females (Table 1). Majority of study participants 250(65.1%) live in town while the rest 134(34.9%) live in surrounding rural place of the study area. The sample study subjects were divided into three age groups: 7- 9 years, 10-12, years, and 13 and above years. The mean age of the study population was 11 years, and the ages range from 7 to 20 years. 131 (34.1%) of the students were 7-9 years old, 159(41.4%) were 10-12 years old and 94(24.5%) were 13 and above years old. Nearly half, 41.4% of the sample of study population where in the age group of 10-12 year old (Table-1). With regard to families' job, 91 (23.7%), 78 (29.3%), 115 (29.9%) and 100 (26.1%) said that they were government worker, farmer, private worker and merchant respectively. With regard to families' education level, 70 (18.2%), 108 (28.2%), 109 (28.4%) 55 (14.5%) and 42 (10.9%) said that they were illiterate, completed primary education, Complete secondary education, diploma and degree above respectively (Table-1).

Table-1. Socio- demographic characteristics of study participants in Deneba primary school (n =384)

Variables	Characteristics	Frequency	Percent	X^2	p-value
	Male	188	49		
Sex	Female	196	51	0.057	0.811
	7-9 years	131	34.1		
Age group	10-12 years	159	41.4	0.877	0.645
	13 and above	94	24.5		
Family's dwelling	Town	250	65.1		
Area	Rural	134	34.9	1.421	0.0723
Family' job	Government worker	91	23.7		
	Farmer	78	20.3		
	Private worker	115	29.5	2.961	0.0398
	Merchant	100	26		
	Illiterate	70	18.2		
	Completed primary school	108	28.2		
Family's education Level	Completed secondary school	109	28.4	8.372	0.049
	Diploma	55	14.3		
	Degree and above	42	10.9		

X^2 =chi square

About 195(50.5%) used soap for the purpose of washed children's dinning utensils and the remaining 189(49.5%) of did not used soap for the purpose of washed children's dinning utensils. Based the questionnaire, 187 (48.7%) of the children washed their hand by soap after toilet, 197 (51.3%) of the children did not washed their hand by soap after toilet. From the total 384 of participants, 110 (28.6%) of parents feed their children fruit and vegetables can washed by detergents. However, 274 (71.4%) of parents feed children so fruit and vegetables cannot washed by detergents. Among the participants who owned toilet 100 (26.0%) and from those without toilet 284 (74.0%) were determined to possess intestinal parasites (x^2 =1.571, p =0.0507). The major of participants do not have their owned toilet. The major factors in the relation of soil transmitted helminthes. Other risk factors in relation to intestinal parasite infection were drinking water sources; running water, 24 (6.3%), spring water, 201 (52.3%) and pipe water 159, (41.4%). From this finding in the study participants were infected with intestinal parasites (x^2=2.281, p =0.0312). From the total 384 of participants, 31 (8.1%), 191 (49.7%), 161 (41.9%) and 1 (0.3%) said that they have eaten always, sometimes, never and not give response to the question, respectively. 100 (26%) participant were always cutting their children nail and 159 (41.4%), 124 (32.3%) and 1 (0.3%), did sometime, not and do not give response to the question cutting theirs children nail when growth, respectively. Cutting of nail was the risk of intestinal parasites infection (x^2 =3.452, p =0.0178). 302(78.6%) of the children wear shoes regularly. 82 (33.1%) participants of the study did not wear shoes regularly. From 384 of participants of the study, 248 (64.6%) washed their hand before eating and 136 (35.4%) of participants of the study did not regularly wash their hand before eating. Eating raw meat and practicing washing hand before eating, were not statically significant. However, eating raw meat and practice of washing hand before eating the factors of intestinal parasitic infection.

Table-2. Socio-demographic factors associated with intestinal parasites infections among school children of Deneba General Primary School, Deneba Town (n =384)

Variables	Characteristic	Frequency	percent	X^2	p-values
Use soap to wash dinning utensils	Yes	195	50.5		
	No	189	49.5	1.179	0.278
Washed their hand after toilet by soap	Yes	187	48.7		
	No	197	51.3	5.389	0.0328
washed fruit and vegetables by detergent	Yes	110	28.6		
				1.213	0.0151
	No	274	71.4		
Type of toilet condition	Private	100	26		
	Open field	189	49.3	1.571	0.0507
	Common	95	24.7		
Source of water	Pipe water	159	41.4		
	Spring water	201	52.3		
	Running water	24	6.3	2.281	0.0312
Eat raw meats	Always	31	8.1		
	Sometime	191	49.7		
	Never	162	42.2	1.295	0.7302
Cut your nail when it grow	Always	91	23.7		
	Sometime	169	44.0	3.452	0.0178
	Never	124	57		
Wear shoes while you walk	Usually	302	78.4	1.851	0.396
	sometime	82	21.6		
Wash your hand before eating	Usually	248	46.6		
	Sometime	136	35.4	5.678	0.0189

X^2: chi-squared

5.2. Behavioral Related Variables of the Respondents

The treatment of water were risk factors for intestinal parasites infection; by boiling 20 (5.2%), by filtering 82 (21.4%), without treatment 252 (65.6%) and other method 30 (7.8%). About 34.4% of them also indicated that they have protected water supply for domestic uses. However, 65.6% were using unprotected water(x^2=4.484, P=0.0344). A large number 165(43%) of the students did not get health education from either health extension workers or other concerned bodies.

219 (57%) of the students did get a good information and training about personal and environmental hygiene and sanitation. 23 (6.0%), 118 (30.7%), 76 (19.8%) and 2 (0.5%) got information from families, health extension personnel, health center and hospital respectively. From 118 of participants, 21 (5.4%) of the respondents said that they regularly followed the health extension education given by extension worker, 42 (11.0%) of the respondents said that they sometime followed the health extension education given by extension worker and 55 (14.3%) of the respondents said that they couldn't follow the health extension education given by extension worker.

Table-3. Behavioral variables of students in Deneba General Primary school, during September, 2017-May, 2018.

Variables	Characteristics	Frequency	Percent	X^2	P-value
Treatment of drinking water	By boiling	20	5.2		
	By filtering	82	21.4	4.484	0.0344
	Without treatment	252	65.6		
	Others	30	7.8		
Get information and training about hygiene	Yes	219	57	0.075	0.792
	No	165	43		
Where did get information	Families	24	6.2		
	Health extension worker	118	30.7		
	Health center	78	20.3		
	Hospital	3	0.8		
Follow health extension education	Usually	21	5.4		
	Sometime	42	11.0		
	Never	55	14.3		

X^2=Chi-square

5.3. The infection rate of intestinal parasites among study participants

The results of the infection rate of intestinal parasitic infections among the Deneba general primary school children in Deneba town the study subjects were summarized and presented type infection and none infection by sex in Table-4. Among the 384 students sampled, 211 (54.9%) were found to be infected with one or more intestinal parasites. From these, the infection rate of any intestinal parasitic infections for males and females was 28.9% and 26.04%, respectively. Male was more infected than to female. The infection rate of any intestinal parasitic infection for the age group 7-9 was 8.3% and 11.4 % in males and females, respectively. The age group 7-9 was females more infected. While, for the age group 10-12 was 13.2% for males and 9.9 % for females. From this the group age 10-12 was males more infected. For age group 13 and above was 7.4% for males and 4.74% for female. The infection rate of intestinal parasitic infection for the age group of 13 and above year was males more infected than females.

Table-4. The infection rate of intestinal parasites among study participants age group (n=384)

		Age of examining students			
Sex	Result	From 7-9 age	B/n 10-12 age	13 and above	Total
Female	Infection	44 (11.4%)	38 (9.9%)	18 (4.74%)	100 (26.04%)
	Non-infection	30 (7.8%)	38 (10%)	28 (7.4%)	96 (25.2%)
Male	Infection	32 (8.3%)	51(13.2%)	28 (7.4%)	111 (28.9%)
	Non-infection	25(6.6%)	32 (8.3%)	20 (5.2%)	77 (20.04%)
Total		131(34.1%)	159(41.4%)	94 (24.5%)	384 (100%)

Single and multiple parasitic infection rates were 35.5% and 19.4% respectively. But, 173 (45.1%) students were free from any infection parasites (healthy). There were seven different intestinal parasites identified from the stool sample.

There were *E.histolytica/dispar* 39 (10.2%), *G.lamblia* 17 (4.4%), *A.lumbericoid* 17 (4.4%), Hookworms 40 (10.4%), *T.saginata* 3 (0.8%), *T.trichuria* 7 (1.8%) and *H.nana* 14 (3.6%).

The most predominant protozoa parasites were *E.histolytica/dispar* 39(10.2%) and the most predominant helminthes were hookworms 40 (10.4%). The infection rate hookworms was more infected male than females (12.2%). Multiple and single parasite infection in male was greater than female.

Table-5. Distribution of IPIs identified among school-age children at Deneba town, Ethiopia, in the current cross-sectional, September 2017-May 2018 (n=384)

Variable	Type of parasites	Sex			
		Male		Female	
		frequency	percent	frequency	Percent
Protozoan parasites	*E.histolytica*	20	10.4	19	10.0
	G.lamblia	9	4.8	8	4.0
Helminthes	*A.lumbericiods*	7	3.7	10	5.1
Parasites	Hookworms spp	23	12.2	17	8.6
	T.saginata	1	0.5	2	1.02
	T.trichuria	3	1.6	4	2.04
	H.nana	10	5.3	4	2.04
Mixed parasites	*E.histolytica,G.lamblia*	11	5.8	13	6.6
	E.histolytica, Hook worms Spp	1	0.5	1	0.5
	G.lamblia				
	Hookworms *A.lumbericoids*	3	1.6	2	1.02
	E.histolytica, A.lumbericoids	8	4.2	7	3.6
	E.histolytica, Hookworms *spp*	9	4.8	10	5.1
	G.lamblia, A.lumbericoids	5	2.6	3	1.5
	Hookwormsspp,*A,lumbericoid*	1	0.5	0	0
	T.trichuria				
	None infection	77	40.9	96	49.0
Total		188	100	196	100

6. Discussion

Among the widely prevalent intestinal parasites in low-income countries (Rao et al. 2003), there were seven IPIs detected in the present study. The 17.8% total prevalence detected in the present study was lower than the average prevalence other studies conducted in different parts of Ethiopia. For example, Ashenafi *et al* (*2012*) had reported an infection prevalence of 72.9% among school children in Chencha town, Southern Ethiopia, Mulat *et al.* (*2013*) with 77.9% prevalence among Delgi primary school, Northern Ethiopia had reported higher prevalence than the present study, Mengistu (*2008*) had reported an infection rate were 72.9% among school children in Atse Fasil general elementary school Azezo, Northwest Ethiopia and Auta (*2013*) had reported an infection rate were 67.1% among Primary School Children in Gwagwada, Kaduna, North Western Nigeria. This difference might be, due to the geographical difference, the living and the socio-economic nature of the study subjects. But it was comparable to that reported by Tadesse *(2005*), Teklu et al *(2011*) and Melesse et al (*2017*) which were 27.2%, 39.9% and 40.2% lower than the present study area respectively. Reported by Mulusew (*2008*) 50.8% was nearly Similar to the present study area. This might be due to lack of awareness about the transmission and prevention ways of intestinal parasite which result in low sanitation practice in school children.

The higher prevalence in this study might be due to favorable climatic and environmental conditions coupled with poor water supply and other sanitary practices or facilities. The infection rate of protozoa parasites comparable to other reported was high (18%). For example, Negasse (*2014*) was reported an infection rate of 16.9% among school children in Gerbe Guracha. The infection rate of protozoa parasites comparable to other reported was low. For example, Mengistu et al (*2007*) with infection rate of 31.0% among urban dwellers in southwest Ethiopia and. *E. histolytica/dispar* with infection rate of 10.2% was the most prevalent protozoa parasitic infection in the present study which is relatively lower than the study reported by Eleni (*2012*) with prevalence of 23.2%, Mengistu et al. (*2007*) with infection rate 17.1% among urban dwellers in southwest Ethiopia and Tamirat (*2014*) with infection rate of 24.5% among Dona Berber primary school children, Bahir Dar; but much higher than that reported by Amare *et al*., (*2007*) with prevalence of 7.1%, from a study conducted in South west Ethiopia. However, it is nearly similar result was with that reported by Melesse (*2017*) was conducted on intestinal Parasitic Infection and Nutritional Status among Elementary School children in age between 7 - 14 in Enemorena-Ener District, Gurage Zone, Ethiopia infection rate of 12%, and Legesse and Erko (2004) with infection rate of 12.7% in

a study conducted among school children in a rural area close to the southeast of Lake Langano. This could be due to the study season, poor environmental sanitation, water source of the study subjects and the favorable environmental condition of the study area for the multiplication of these parasites. However, which need further investigation (x^2 =2.032, p=0.0113). The present finding showed that *E. histolytica/dispar* infection was strongly associated with drinking water source (x^2 =1.382, p =0.000), hand washing habit (x^2 = 2.045, p =0.0113), and unclean finger nail (x^2 =2.428, p =0.019). In line with the present finding, the association of *E. histolytica/dispar* with drinking water source and hand washing habit before meal was reported elsewhere (*Benettorra et al., 2004; Shahrul et al., 2012*). Contamination of drinking water source, poor personal hygiene and lack of regular hand washing habits are major contributing factors for high *E. histolytica/dispar* infection.

Results also showed that helminthes parasites infections (21%) were more common compared with protozoan infections (18%). Hookworms was the predominant helminthes parasite in this study with infection rate of 10.4% which is lower than that reported by several other investigators in Ethiopia. For example, Tamirat (*2014*) with reported the infection rate of 22% among school children Dona Berber primary school, Bahir Dar. Tilahun et al. (*2014*) recorded 71.2% infection rate among children at Debre Elias primary school, North West Ethiopia. On the other hand, the current study is similar with the finding of Dinku et al. (2015) from Adigrat town (10.03%). However, lower prevalence of hook worms (2.2%) than the present study was reported by Ashenafi (*2012*) among school children in Chencha town, southern Ethiopia. The most important determinant of hookworm infection in the present study was shoe wearing habit of the study participants. The likely same of being infected by hookworm was increased more among students who did not use protective shoe as compared with students regularly use protective shoe (x^2 =1.851, p =0.0344). The association of hookworm infection and shoe wearing habit is supported by several studies reported elsewhere (*Mengistu, 2008; Alemu et al., 2011*). Lack of regular shoe wearing habit is known to be the major contributing factor that leads to high hookworm infection. This finding indirectly indicates the contamination of locality and playground of students with human fecal matters. This finding directly indicates eating raw meat was associated with human intestinal parasites, *T.saginata*. The likely the same of being infected by, *T.saginata* was increased more among students who eat raw meat as compared with students did not regularly eat raw meats (x^2 =6.898, p=0.037).

Multiple infections occurred in 75 individuals making 19.5% of the total examined subjects and 19.6% of those who had intestinal parasites, which is in agreement with 18.5% (*Ahmed et al., 2010*) and 18.4% (*Andualem, 2014*) reported from Central Sudan and Motta Town, respectively. However, our finding is lower than other reports from Ethiopia, 28.5% (*Alamir et al., 2013*) and Burkina Faso, 53.5% (*Erismann, 2016*).

The difference in prevalence of multiple parasitic infections at a time might be varied in relation to level of environmental contamination, level of awareness about parasitic infection and socio-economic factors. This finding suggests that there might be low level of knowledge, attitude and practice towards intestinal parasitic infection in the study area. The level of double infections with intestinal parasites determined in the present study (18.8%) was much lower than what was reported from southwest Ethiopia portraying a double infection of 35.8% among urban communities (*Jemaneh*, 1998). The possible difference in the socio-demographic condition of the study population and the environmental condition might explain the observed difference in double infection in the two study places. Students from the rural areas were not significance to get intestinal parasitic infections compared with students from urban (P=0.0723). It is different from other evidence in Ethiopia, where residence showed no significant association with intestinal parasitic infection.

In the current study, the infection rate of IPIs in the infected children was 28.9% in males and 26.04% in females; the difference between the sex was statistically insignificant (x^2 =0.057, p = 0.811). Therefore sex difference did not affect the infection rate of IPIs. The finding of the study were inconsistent with those of Andualm in Motta town and Soheyli Azad et al. in Robat Karim, Iran (Andualm, 2014; Soheyli Azad et al., 2005). The result obtained from the extent of the outbreak in different age groups showed statistically insignificant (x^2 =0.877, p = 0.645). However, these results showed that all age group were not equally exposed to parasitic infection. Infection among the age group between 10-12 years more exposed than other age groups. This difference was probably due to more contact with parasitic infection sources. The infection rate of IPIs were higher among these age groups, because touching dirt, lack of personal hygiene, and dealing with the children in same age are more common among them; therefore, results of the current study were inconsistent with those of Saidi et al., and Tadese et al. that did not find significant difference among age group regarding the infection rate of IPIs (Saidi et al., 2001; Tadese et al., 2005).

There was significant relationship the level of education in parent and the infection rate of IPIs in children ((x^2 = 8.322, p = 0.049). In a study conducted by Asrat et al, (2011) and Ahmad-Rajabi et al (2003), in Bam, Iran, significance difference was association was observed between the parents' educational level and infection rate in children; same result in the current study may be result from the parents' educational level bellow guidance school. Finding of the current study was a significant relationship between the method of washing vegetables and fruits, and infection rate IPIs (x^2 =1.213, p = 0.01510); that is the infection rate of parasitic infection in children who consumed vegetables and fruits washed with water higher than washing by detergents (Atashnafas et al., 2005). In the study area, drinking water is provided in two ways, protective water and not protective water which distribute drinking water among village. The infection rate in children had a significant relationship with drinking water sources (x^2 = 2.281, p = 0.0312). Children who used the not protective water drinking water were more infected compared with the ones who used protective water. Probably, it was due to failure to assess the treatments of drinking water guidelines in the water purification and pollution distribution.

As a limitation of this study, identification of Hook worm's spp and the pathogenic *E.histolytica* from the enteric commensals *E.dispar* were not differentiated due to lack of laboratory facilities in the Deneba clinic. Although the potential risk factors for high burden of the disease were considered, some risk factors were not evaluated in the current study. Apart from this, it is a good reference study on risk factors leading to intestinal parasites infection. It is also the first study which indicates the consequence of social, local factors related to home and school duties, parents' behaviors and hygienic condition for the burden of disease in this study area.

7. Conclusion and Recommendation.

7.1. Conclusion

Based on the current data the study shows that the infection rate in the study area was 211(54.9%). From these, the infection rate of any intestinal parasitic infections for males and females was 28.9% and 26.04%, respectively. The infection of hookworm spp was predominant helminthes parasites 40 (10.4%), and followed *A.lumbericoid* 17(4.4%) and the predominant protozoa intestinal infection was *E.histolytica/dispar* 39 (10.2%), *G.lamblia*, 17 (4.4%) and mixed intestinal infection was 74(19.5%). The majority of the students were infected with one or more species of intestinal parasites. The results of this study indicated that intestinal parasitic infection were a common health problem varying environmental and personal condition among the school-aged children. Family's dwelling, family's job, family's education level were factors for the infection rate of intestinal parasites. This study also show the condition of toilet, source of water washed their hand after to toilet, eat unwashed fruit and vegetables, hygiene of nail, wear shoes while they walk and washed practice before meal of the children were the risk factor of intestinal parasites infection. The hygienic status of the dinning utensils (x^2=0.894, p=0.344) and eat raw meats (x^2=1.295, p=0.730) were insignificant statistically.

7.2. Recommendation

Based on the findings of the present study, about the infection rate of intestinal parasites among school children the following are recommended. There is a need to provide a well-protected and treated drinking water to the community. There is a need for intensive and habitual health education for behavioral changes related to mass treatment for the effective control of intestinal parasitic infections in the concerned area. Woreda health sector should collaborate with school health program for delivering health education to increase the knowledge and attitude of primary school children about personal hygiene, environmental sanitation, toilet facilities, proper waste disposal, transmission and preventions of human intestinal parasites.

8. References

Abera K., Verweij J.J., Endeshaw T., 2005. The use of real time PCR to identify Entamoeba histolytica and E. dispar infections in prisoners and primary school children in Ethiopia. Ann. Trop. Med. Parasit. 98(1):43-48.

Ahmed A, Afifi A, Malik E, Adam I., (2010). Intestinal protozoa and intestinal helminthic infections among school children in Central Sudan. Asian Pac Trop Med. 292–3.

Alamir M, Awoke W, Feleke A. (2013). Intestinal parasites infection and associated factors among school children in Dagi primary school, Amhara National Regional State. Ethiopia Health. 5 (10):1697–701

Alemu A, Atnafu A, Addis Z, Shiferaw Y, Teklu T, Mathewos B, Birhan W, Gebretsadik S, Gelaw B., (2011) Soil transmitted helminths and Schistosoma mansoni infections among school children in zarima town, northwest Ethiopia. BMC Infectious Disease. 11(189).

Amare M., Solomon G. and Tesfeye K., 2007. Prevalence of intestinal parasitic infections among urban dwellers in southwest Ethiopia. *Ethiop. J. Health Dev.* 21(1): 46-59.

Andargie G., Kassu A., Moges F., Tiruneh M., Huruy K., 2008. Prevalence of bacteria an intestinal parasites among food-handlers in Gondar town, northwest Ethiopia. *J Hlth Popu Nutr* 26:451-5.

Andualem M. (2014). Parasitic infection and associated factors among the primary school children in Motta town, western Amhara. Ethiopia Am J Public Health Res. 2(6):248–54.

Ashenafi A., Mohammed S., 2012. Assessment of the prevalence of intestinal parasites and associated risks among primary school children in Chencha town; *BMC Public Health, 14:166*

Asrat A., Tewodros D., and Alemayehu W., 2011. Prevalence and risk factors of intestinal parasites among Delgi school children, North Gondar, Ethiopia. *J. Para. And Vector Biology*, 3(5):75-81.

Assis AM., *Prado MS., Barreto ML.,Blanton RE., Reis MG. and Parraga IM.,* 2004. "Childhood stunting in Northeast Brazil: the role of *Schistosoma mansoni* infection and inadequate dietary intake". *Eur. J. Clin. Nutr.* 58.7, 1022-1029.

Auta T., Kogi E., Audu OK., 2013. Studies on the Intestinal Helminths Infestation among Primary School Children in Gwagwada, Kaduna, North Western Nigeria. J. Bio., Agri., and Healthcare. Vol. 3: 7, 2224-3208.

Belete H., and Kloos H., 2006. Intestinal Parasitism. In Yemane B., Damen H., and Helmut K. 2nd Ed. *The Epidemiology and Ecology of Health and Disease in Ethiopia. Shama Books*. Addis Ababa

Benettona M, Gonçalvesb A, Meneghinic M, Silvab E, Carneirob M.,(2012). Risk factors for infection by the Entamoeba Histolytica/E. dispar Complex: an epidemiological study conducted in outpatient clinics in the city of Manaus, Amazon region, Brazil. Trans R S Trop Med Hyg. 99(7):532–40.

Berger S.A., Schwartz T., Michael, 1989. Infectious diseases among Ethiopian Immigrants in Israel. *Arch. Intern. Med*. 149: 117-119.

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.

Bogitsh J., Carter, C.E. and Oeltmann, T.N., 2005. *Human Parasitology.* 3rd ed. Elsevier Academic Press. London. pp. 348-353.

Brooker S., Clements, A.C.A., and Bundy, D. A.P., 2006. Global epidemiology, ecology and control of soil- transmitted helminth infections. *Adv Parasitol* 62: 221–261

Buzby J.C., and Roberts T., 1997. Economic costs and trade impacts of Microbial food-borne illness. *World Health Stat Q:* 50- 57-66.CAB International: 15–37.

CDC, 2006. Laboratory Identification of Parasites of Public Health Concern. Atlanta: Center for Disease Control & Prevention, USA. (Source: - http://www.dpd.cdc.gov/dpdx) (Last modified: 12/05/2018).

Chacon-Cruz E., 2003.Intestinal Protozoan Diseases. *Medicine J.* 3(5):sec. 1-11.

Cheesbrough, M., 1998. Parasitological Tests: District Laboratory Practice in Tropical Countries, Part 1. Cambridge: Cambridge University Press. Pp.220–221.

Cook G.C., 1986. The clinical significance of gastrointestinal helminths – a review. *Trans. R. Soc. Trop. Med. Hyg.* 80: 675–85.

Cooper E, Bundy D., 1992. Parasitic helminth infection and cognitive function in school children. *Proc R Soc Lond. Biological Science*; 247:77-81

Crompton D. W. T., 1999. How much human helminthiasis is there in the world? *J Parasitol.* 85**:** 397 - 403.

CSAE. , 2005. Central Statistical Agency of Ethiopia. Ethiopia, Demographic and Health Survey.

Curtale, F., Pezzotti, P., Sharbini, A.L., al Maadat, H. and Ingrosso, P., 1998. Knowledge, perceptions and behavior of mothers toward intestinal helminths in Upper Egypt: implications for control. *Health Policy Plan* 13: 423–432.

De Silva NR, Brooker S, Hotez PJ,Montresor A, Engels D,Savioli L., 2003. Soil transmitted helminth infections: updating the global picture. *Trends in Parasitology:* 19:547-551.

Dinku S., 2015. Prevalence of Intestinal Parasitic Infections and Associated Risk factors among School children in Adigrat town; *International Journal of Emerging Trends in Sciences and Technology: https://dx.doi.org/10.18535/ijetst/v4i1.03*.

Eleni K., 2012. Prevalence of intestinal parasitic infections and their associations with anthropometric measurements of school children in selected primary schools, wukro town, eastern Tigray, Ethiopia

Erismann S, Diagbouga S, Odermatt P, Knoblauch A, Gerold J, Shrestha A, Grissoum T, Kaboré A, Schindler C, Utzinger J., (2016).Prevalence of intestinal parasitic infections and associated risk factors among school children in the plateau Central and Centre-Ouest regions of Burkina Faso. Parasit Vectors; 9:554.

Erko B, Medhin M., 2003. Human Helminthiasis in Wondo-Genet, Southern Ethiopia with Emphasis on Geohelminthiasis. *Ethio Med J*; 41:333-34

Gad YZ., Ahmad NA., El-Desoky I., Arafa MM., Farag RE., 2011: Colorectal schistosomiasis: Is it still endemicin delta Egypt, early in the third millennium. Trop.

Garcia LS. , 1999. Practical Guide to Diagnostic Parasitology. Washington, D.C.: ASM Press.

Garzon M., 2003. Parasites: A Holistic Approach. Washington: Capital University of Integrative Medicine

Gebeyehu Y., 2011. Comparative assessment of malaria and intestinal parasite prevalence in Awramba and neighboring communities in Wojiarbamba kebele, south Gondar zone, Ethiopia**.**

Guyatt H., 2000. Do intestinal nematodes affect productivity in adulthood? *Parasitol Today* 16:153-158.

Haile G., Jirra C., Mola T., 1994. Intestinal parasitism among Jiren elementary and junior secondary school students, southwest Ethiopia. *Ethiop. J. Health Dev.* 8**:**37-41.

Haileeyesus A., Endeshaw T, Teka T., Achamyelesh K., and Beyene P., 2006. Prevalence of intestinal parasite. *Ethiopia J. of Health Division* 20**:** 1-32.

Hailu B. and Berhanu E., 1995. Giardiasis in Ethiopia. *Ethiop. J. Health Dev*. 9 (1): 77-80.

Haque R., Huston C. D., Hughes M., Houpt E. and Petri Jr. W. A., 2003. Amebiasis. *N Engl J Med* 348**:**1565–1573. Health Organization.

Heelan JS, 2004. *Cases in Human Parasitology*. ASM Press, Washington, DC. p. 129-131. Hookworm infection. *N Engl J Med* 351: 799–807.

Hotez P. J., Brindley, P. J., Bethony, J.M., King, C. H., Pearce, E. J., and Jacobson, J., 2008. Helminth infections: the great neglected tropical diseases. *J. Clin. Invest.* 118:1311–1321.

Hotez P. J., Brooker S., Bethony J.M., Bottazzi M. E., Loukas A. and Xiao S. H., 2004. Current Concepts: Hookworm Infection. *N Engl J Med*. 351: 799–807

Hotez P.J., Brooker, S., Bethony J.M., Bottazzi M.E., Loukas A. and Xiao, S., 2004. Hygiene practice in selected *woredas* of Ethiopia. A Systematic Review., PLoS Negl TropDis, pp.e291.doi:210.1371/journal.pntd.0000291.

Jemaneh, L., 1998. Comparative prevalence's of some common intestinal helminth infections in different altitudinal regions in Ethiopia. *Ethiop. Med. J.* 36**:**1-8.

Juckett G., 1996. Intestinal protozoa. *Ameri Family Physician; 53*: 2507-2516

Katz M.D., Despommier D. and Gwadz R.W., 1989.*Parasitic Diseases.* 2nd Ed. New York Inc: Springer-Verlag.

Kebede S., Yami A., Mamo Y., 2011. Prevalence and predictors of intestinal helminthiasis among school children in Jimma zone; a cross-sectional study. *Ethiop J Health Science 21:167-174.*

Kloos H., Tesfayohannes T.M., 1993. Intestinal parasitism. In Ecology of Health and Disease in Ethiopia, Vol. 3. 2nd edition. Edited by Kloos H, Zein AZ., 1988. Oxford: West View Press; 223–235.

Lansdown R., Ledward A., Hall A., Issac W., Yona E., Matulu J., 2002. Schistosomiasis, Helminth Infection, and Health Education in Tanzania: Achieving Behaviour Change in Primary Schools. *Health Edu. Rese.* 17: 425–33.

Legesse M., Erko B., 2004. Prevalence of intestinal parasites among school children in a rural area close to southeast of Lake Langano, Ethiopia. *Ethiop. J. Health Dev*.18:116-120.

Lindo F.J., Levy A.V, Baum K.M., and J.C Palmer, 1998. Epidemiology of giardiasis and cryptosporidiosis in Jamaica. *Am J Trop Med Hyg*; 59 (5):717-721.

Maguire J.H., 2005. Introduction to Helminthes Infections. In GL Mandell, JE. *Principles and* Practice of Infectious Diseases. 6th ed. Elsevier Academic Press. London. *pp*. 3258-3267.

Markou P., Chatzopoulos D., 2009 Yttrium-90 silicate radio synovectomy treatment of painful synovitis in knee osteoarthritis. Results after 6 months. Hell J Nucl Med 12: 33-36.

Marshall M. M., Naumovitz, D., Ortega, Y. and Sterling, C. R., 1997. Waterborne protozoan pathogens. *Clin Microbiol Rev* 10:67–85.

Mata L., 1982. Socio-cultural factors in the control and prevention of parasitic diseases. *Rev Infect Dis* 4:871-79.

Mehlhorn H., 1988. *Parasitology in focus: facts and trends.* Springer-Verlag, .Berlin, Heidelberg.

Melesse B., Kelebesa U., and Beyene P., 2017. "Intestinal Parasitic Infection and Nutritional Status of Elementary Schoolchildren Aged 7 - 14 in Enemorena-Ener District, Gurage Zone, Ethiopia". *EC Nutrition* 9.3: 129-141.

Mengistu A., Gebre-Selassie S. and Kassa T. 2007. Prevalence of intestinal parasitic infections among urban dwellers in southwest Ethiopia. *Ethiop J Health Dev* 21:12-17.

Mengistu E., 2008. Prevalence of Intestinal Parasitic Infections and Associated Factors among Primary Schools Children, in Azezo, *Ethiop. J. Health Biomed Sci., 2010. Vol.3, No.1*

Miguel E. and M.Kremer, 2004. Worms identifying impacts on education and health in the presence of treatment externalities. *Econometrica*; 72: 159–217.

Mineno T., Avery M., 2003 Giardiasis: recent progress in chemotherapy and drug development. Curr Pharm Design; 9(11):841-55.

MOH, Ministry of Health., 1996. Comprehensive health service directory, Addis Ababa, Ethiopia.

Montresor A., Crompton, D. W, T. Hall, A. Bundy, DAP. And L. Savioli, 2002. Guidelines for the evaluation of soil transmitted helminthiasis and schistosomiasis at community level. Geneva: World Health Organization; WHO/CTC/SIP/98.

Morales-Espinoza E.M., Sanchez-Perez H.J., Garcia-gil M.D.M., Vargas-Morales G., Mendez-Sanchez J.D. and Perez-Ramirez M., 2003.Intestinal parasites in children in highly deprived area in border region of Chiapas. *Salud Publica de Mexico* 45:1-10.

Mulatu A., Worku A., Amsalu F., 2013. Intestinal parasites infection and Associated Risk factors among School children; *Institute of Public health, College of Medicine and Health Sciences, University of Gondar, Gondar, Ethiopia*

Mulusew A., 2008. Prevalence of Intestinal Parasitic Infections and Associated Risk factors among School children in Motta town; *American Journal of Public Health Research, 2014, Vol. 2, No. 6, 248-254*

Murray R., Patrick, Rosenthal, S.Ken, P.faller and A. Michael, 2005. *Medical Microbiology*, Fifth Edition. United States: Elsevier Mosby.

N.Opara K, Udoidung NI, Opara DC, Okon OE, Edosomwa EU, Udoh AJ., 2012. The Impact of Intestinal Parasitic Infections on the Nutritional Status of Rural and Urban School-Aged Children in Nigeria. International Journal of MCH and AIDS; 1(1,):73-82

Naing, L., Winn, T. and Rusli, B.N., 2006. Practical Issues in calculating the sample size for prevalence studies. *Archiv Orofac Science* 1**:** 9-14

NCCLS, 2002. Protection of Laboratory workers from Occupationally Acquired Infections. Approved guideline M29-A2-NCCLS, Wayne, pa.

Negase A., 2014. Prevalence of intestinal protozoan parasites among primary school children: Haramaya, Ethiopia.

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 tropica; 92(3):179-86.

Neva F. A. and Brown H.W., 1994. Basic clinical parasitology Appleton and lange, press. U.S.A.

Nokes C. and Bundy D.A., 1993. Compliance and absenteeism in school children: Implications for helminth control. *Trans R Soc Trop Med Hyg*, 87:148-152.

Obeng, A.S., Kwakye-Nuako G., Asmah R.H. and Ayeh-Kumi P.F., 2007. Parasitic pathogen microbes associated with fresh vegetable consumed in Accra. *Ghana J Allied Health Sci* 2:11-5. Organization Technical Report Series. Geneva, 749: 121 - 130.

Ortega Y. and Adam R., 1997. Giardia: an overview and update. *Clin. Infect. Dis*.; 25(3):545-549.

Petri, W. A., and Singh U., 1999. Diagnosis and management of amebiasis. *Clin. Inf. Dis.* 29:1117 1125.

Rao VG., Sugunan AP., Murhekar MV., Sehgal SC., 2003. Malnutrition and high childhood mortality among the Onge tribe of the Andaman and Nicobar Islands.Public Health Nutr 9: 19-25.

Rice J, Skull S, Pearce C, Mulholland N, Davie G, Carapetis J., 2003. Screening for intestinal parasites in recently arrived children from East Africa. Journal of paediatrics and child health. 39(6):456-9.

Rodriguez-Morales, A.J., Barbella R.A, Case C, Arria M, Ravelo M, H.Perez, 2006. Intestinal parasitic infections among pregnant women in Venezuela. *Infect Dis Obstet Gynecol*; 23125. doi: 10.1155/IDOG/2006/23125.

Sackey M. E., Weigel M.M., and Armijos R.X., 2003. Predictors and nutritional consequences of intestinal parasitic infections in rural Ecuadorian children. *J. Trop. Pediatr.* 49**:** 17-23.

Scrimshaw NS., 1994. The consequences of hidden hunger for individuals and societies. *Food NutrBulletin* 15:3-24.

Sehgal R., Gogulamudi V., Reddy, Jaco J., Verweij Atluri V., Subba Rao, 2010. Prevalence of intestinal protozoa parasite.Iran J parasitol v. 12(1):108-116

Shahrul Anuar S, Al-Mekhlafi H, Abdul-Ghani M, Osman E, Mohd Yasin A, Nordin A, (2004). Prevalence and risk factors associated with Entamoeba histolytica /dispar/

moshkovskii infection among three orang Asli ethnic groups in Malaysia. PLoS One. 7(10):e48165.

Singh H.L., Singh N.D. and Singh Y.I., 2004. Helminthic infestation of the primary school going children in Manipur. *J Commun Dis.* 36:111–6.

Siyadebr and Wayu woreda, 2017.commomication offices report

Siydebir and Wayu Woreda, 2017. Education and Health offices report

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

Taddese, G., 2005. The prevalence of intestinal helminthic infections and associated risk factors among school children in Babile town, Eastern Ethiopia. *Ethiop J Health Dev* 19(2):140-7

Tamirat H., 2014. Prevalence of Intestinal Parasitic Infections and Associated Factors among Primary Schools Children, in Bahir Dar; *BMC Infectious Diseases 17:362 DOI 10.1186/s12879-017-2466-x*

Teka GA., 1984. Human waste disposal in Addis Ababa. Planning and programming Bureau, MoH, Ethiopia: 11-13.

Teklu W., Tsegaye T., Belete S., Takele T. 2013. Prevalence of intestinal parasitic infections among highland and lowland dwellers in Gamo area, South Ethiopia, BMC Public Health 13:151.

Thompson T., Sobsey M. and Bartram J. 2005. Providing clean water, keeping water clean: an integrated approach. *Inter. J. Med. Research*. 13Sup589-94.

Tilahun W., Ahmed E., 2014. Prevalence of Intestinal Parasitic Infections and Associated Factors among Primary Schools Children, East Gojjam Zone; *University of Debremarkose, College of Medicine and Health Science, Debremarkose Ethiopia*

WHO. 1981. Intestinal protozoan and helminthic infections. Report of WHO scientific groups. *Tech Rep Ser. No 666, Geneva: 7-86.*

WHO. 1987. Prevention and control of intestinal parasitic infections. WHO. Tech Rep Ser 749. Geneva: WHO.

WHO. 1991. Control of tropical diseases. WHO: 25-26

WHO. 1991. Prevention and control of intestinal parasitic infections, World Health Organization, Basic Laboratory Method in Medical Parasitology. *Geneva*: WHO.

WHO. 1996. Report on the WHO informal consultation on the use of chemotherapy for the control of morbidity due to soil-transmitted nematodes in humans. Division of the control of tropical diseases, WHO, Geneva.

WHO. 1997. *Report of a Consultation of Experts on Amoebiasis* (WHO/PAHO/UNESCO). WHO Weekly Epidemiological recorded No.14. Geneva: WHO.

WHO. 1999. World Health Organization Definition of Child Abuse. Report on the Consultation on Child Abuse Prevention Geneva.

WHO. 2000. Control of tropical diseases. WHO, Geneva.

WHO. 2002. Prevention and control of schistosomiasis and soil-transmitted helminthiasis. *World Health Organ Tech Rep Ser. 912:1-57.*

WHO. 2004. Schistosomiasis and Intestinal Parasites Unit Division of Control of Tropical Diseases. Geneva: World Health Organization.

WHO. 2004. *Water Treatment and Pathogen Control: Process Efficiency in Achieving Safe Drinking Water*. Edited by Mark W LeChevallier and Kwok-Keung AuISBN: London, UK.

WHO. 2005. Interim WHO Clinical Staging of HIV/AIDS and HIV/AIDS Case Definitions for Surveillance.

WHO. 2006. Preventive chemotherapy in human helminthiasis: coordinated use of anthelminthic drugs in control interventions: a manual for health professionals and programmer managers. *Geneva*: World Health Organization.

WHO. 2009. Diagnosing Medical Parasites: A Public Health Officers Guide to Assisting Laboratory and Medical Officers. Retrieved Feb., 2017.

Wolfe M.S., 1992. Giardiasis. Clin. Microbiol. Rev. 5: 93-100.

9. Appendices

Annex-I. Questionnaire (English version)

Part one: A format of gathering data for primary school children parents.

The purpose of this questionnaire is to gather data on intestinal parasites in school age children in Deneba town. It is conducted with the aim of obtaining information to the research as the partial fulfillment for Master of Science in biology. To attain its objective you are kindly requested to give reliable information. The researcher assures you that your response will be confidential and only to be used for the purpose of the study; moreover, when filling this questionnaire you don't need to write your name.

Thank you in advance

Part two: An ensuring format for Volunteer parents.

1. I agree to participate in the study based on the above explanation; ----------
2. I disagree to participate in the study based on the above explanation; ----------

Questionnaire

Please, circle the letter of your choice, tick the boxes that are correct for you or write the figures

I. Research Site ----------

II. Code number of the children's ----------

Details about a child and family

1. children`s sex: A. Male ☐ B. Female ☐

2. Children's age: A. 7-9 years ☐ B. 10-12 years ☐ C. 13& above years ☐

3. Family`s dwelling areas; A. town ☐ B. Rural ☐

4. Job of family: A. government worker ☐ B. farmer ☐ C. private worker ☐ D. Merchant ☐

5. Family`s educational status; A. Illiterate ☐ .B. Complete primary education ☐ C. Complete secondary education ☐ D. Diploma ☐ E. Degree & above ☐

6. Do you always wash your child dinning utensils by soap? A. Yes ☐ B. NO ☐

7. Do your children always wash their hand by soap after toilet? A. yes ☐ B. No ☐

8. Do you always wash fruits and vegetables by detergent when you feed your children?

A. yes ☐ B. No ☐

9. What about Your toilet condition; A. private ☐ B. Open field ☐ C. common ☐

10. Your sources of water; A. pipe water ☐ B spring water ☐ C. running water ☐

11. How do you use drinking water?

A. By boiling ☐ B. By filtering ☐ C. Without treatment ☐ D. Other (specify)…..

12. Do your children eats raw meats? A. Yes ☐ B. No ☐

13. Do you cut your children nail when grown? A. Yes ☐ B. No ☐

14. Did you get information's and training about personal and environmental hygiene and sanitation before? A. Yes ☐ B. No ☐

15. If your answer for question 14 is "yes "where did you get? A. From families ☐

B. Health extension personnel ☐ C. Health center ☐ D. Hospital`s professionals ☐

16. Do you follow health extension education which is given by health extension workers?

A. Usually ☐ B. Sometimes ☐ C. Never ☐

17. Do you wear shoe while you walk?

A. Usually ☐ B. Sometimes ☐ C. Never ☐

18. Do you wash your hand before eating?

A. Usually ☐ B. Sometimes ☐ C. Never ☐

Annex-II. Questionnaire (Amharic version)

በመጀመሪያ ደረጃ ትምህርት ቤት የተማሪ ወላጆች የሚሞላ መጠይቅ

የመጠይቁ ዓላማ፡ የዚህ መጠይቅ ዋና አላማ "በደነባ ከተማ ውስጥ እየተከሰተ ያለዉን የአንጀት ጥገኛ ተህዋስያን ያላቸዉን ጉዳት እንዲሁም በምን ሁኔታ ላይ እንዳለ መጠቆም ሲሆን በተለይም የጥናቱ ዋና አላማ እድሜአቸዉ ለትምህርት የደረሱ ህፃናት ላይ ያለዉን የኢኮኖሚ፤ የማህበራዊ እና የስነ-ልቦና ጉዳት በአሁኑ ሰአት ያደረሰዉን ተፅእኖ እና የወደፊት የመፍትሄ አቅጣጫ ለማስቀመጥ ታስቦ የተዘጋጀ ነዉ፡፡ ስለዚህ የጥናቱን አላማ ለማሳካት እና ከግብ ለማድረስ ትክክለኛዉን መረጃ እንዲሰጡኝ በትህትና እየጠየቅሁ፤ መጠይቁን ሲሞሉ ስምዎትን መፃፍ አይጠበቅበዎትም፡፡

ስለ ትብብርዎ በቅድሚያ አመሰግናለሁ፡፡

ፍቃደኝነትን መጠየቂያ ቅጽ

ከላይ በተገለጸው መሰረት ለመሳተፍ ሀ. እስማማለሁ ☐ ለ. አልስማማም ☐

የ" X" ምልክት በማድረግ ይስጡ፡፡

I. የጥናት ቦታ----------

II. የተማሪው/ዋ መለያ ቁጥር----------

መመሪያ፡ ከዚህ በታች የቀረቡትን ጥያቄዎች በአግባቡ ካነበቡ በኋላ ከተሰጡት አማራጮች መካከል ትክክለኛውን መረጃ በሳጥኑ ውስጥ

የ" X" ምልክት በማድረግ ይስጡ፡፡

1. የተማሪው/ዋ ፆታ፡ ሀ. ወንድ ☐ ለ. ሴት ☐

2. የተማሪው/ ዋ እድሜ ሀ. 7-9 አመት ☐ ለ. 10-12 አመት ☐ ሐ. 13 አመት እና በላይ ☐

3. የሚኖሩበት ቦታ፡ ሀ. ከተማ ☐ ለ. ገጠር ☐

4. የስራ መስክ ሀ. መንግስት ሰራተኛ ☐ ለ. አርሶ-አደር ☐ ሐ .የግል ስራ ☐ መ. ነጋዴ ☐

5. የትምህርት ደረጃ ፡ ሀ. ያልተማረ ☐ ለ. የአንደኛ ደረጃ ☐ ሐ. ሁለተኛ ደረጃ ☐ መ. ድፕሎማ ☐ ሠ. ድግሪ እና በላይ ☐

6. የልጆችዎ የማብሰያ እና የመመገቢያ እቃዎች ሁልጊዜ በሳሙና ይታጠባሉን? ሀ. አዎ ☐ ለ. አይደለም ☐

7. ልጆችዎ ከሽንት ቤት በኋላ እጃቸውን በሳሙና ይታጠባሉን? ሀ. አዎ ☐ ለ. አይደለም ☐

8. ልጆችዎ ፍራፍሬ እና አትክልት በሚመገቡበት ጊዜ በሳሙና የታጠበ ነው? ሀ. አዎ ☐ ለ. አይደለም ☐

9. የሚጠቀሙበት ሽንት ቤት ምን አይነት ነው? ሀ. የግል ☐ ለ. በሜዳ ላይ ☐ ሐ. የማህበረሰብ ☐

10. የሚጠቀሙትን ውሀ ምን አይነት ነው? ሀ. ቧንቧ ውሀ ☐ ለ. ምንጭ ውሀ ☐ ሐ. ከወንዝ ውሀ ☐

11. የሚጠቀሙትን ውሀ በምን አይነት መንገድ ያክማሉ? ሀ. በማፍላት ☐ ለ. በማጥለል ☐

ሐ. ምንም ነገር አንጠቀምም ☐ መ. ሌላ ካለ----------

12. ልጆችዎ ጥሬ ስጋ ይመገባሉ? ሀ. አዎ ይመገባሉ ☐ ለ. አልፎ አልፎ ይመገባሉ ☐ ሐ. አይመገቡም ☐

13. የልጆችዎን የጥፍር እድገት እና ንጽህና ምን ያህል ይቆጣጠራሉ?

ሀ. ሁልጊዜ ☐ ለ. አልፎ አልፎ ☐ ሐ. አንቆጣጠርም ☐

14. ከዚህ ቀደም የግል እና የአካባቢ ንጽህና መረጃ እንዲሁም የተለያዩ አጫጭር ስልጠናዎች አግኝተዋል?

ሀ. አዎ ☐ ለ. አላገኘንም ☐

15. ለተራ ቁጥር 14 ምላሽዎ "አዎ" ከሆነ መረጃውን/ስልጠናውን ያገኙት ከማን ነው?

ሀ. ከቤተሰብ ☐ ለ. ከጤና ኤስቴንሽን ☐ ሐ. ከጤና ማእከል ☐ መ. ከሆስፒታል ባለሙያ ☐

16. የጤና ባለሙያዎች የሚያስተምሩትን ትምህርት በአግባቡ ይከታተላሉ?

ሀ. ሁል ጊዜ ☐ ለ .አልፎ አልፎ ☐ ሐ. አንከታተልም ☐

17. ልጆችዎ የእግር መንገድ በሚሄዱበት ጊዜ ጫማ ይጫማሉ (ያደርጋሉ)? ሀ. አዎ ☐ ለ. አልፎ አልፎ ☐

ሐ. አያደርጉም ☐

18. ልጆችዎ ምግብ ከመመገባቸው በፊት እጃቸውን ይታጠባሉ? ሀ. አዎ ☐ ለ. አልፎ አልፎ ☐

ሐ. አይታጠቡም ☐

አመሰግናለሁ::

Annex-III. Statement of the author

First, I declare that this thesis is my original work and that all sources of material used have been duly acknowledged. This thesis has been submitted in partial fulfillment of the requirements for the Degree of Master of Science in General Biology at the Addis Ababa University and is deposited at the University Library to be made available for borrower under the rule of the Library. I declare that this thesis is not submitted to any other institution anywhere for the award of any academic degree. Brief quotations from this thesis are allowable without special permission provided accurate acknowledgement of source is made. Requests for permission for extended quotation from or reproduction of this manuscript in whole or part may be granted by the major department or Dean of School of Graduate Studies in his or her judgment the proposed use of the material is in interest of scholarship.

Name: - Tekleslassie Teka Signature _____

Place: - Addis Ababa University, Addis Ababa

Date of Submission_____

Annex-IV. Data collection format for parasitological analysis, 2017/18

Nº	Lab Code	Sex	Age	**Parasite examination**		Remark
				Direct microscopy method	Concentration method	
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						

Annex-V. Written consent form

Code No _____

Name of the study participant----------Age ----------Sex----------

Name of Physician ----------Study site/Health center----------

I have been informed about a study that plans to investigate the "infection rate of intestinal parasites infection among Deneba primary school children in Deneba town" which helps in understanding the prevalence of parasitic infection in relation with knowledge, attitude and practice of different communities towards parasitic disease. At the same time, it enables concerned body in designing better control and preventive measures of parasitic diseases in the study. For this study, I was requested to give stool sample for intestinal parasites identification. I was informed that I will get proper therapy if I found to be positive intestinal parasites infection. The investigator has also briefed me that there would no health related risks associated with the sampling procedure. He also informed me that all laboratory results would be kept in secret. Moreover, I was clearly informed that my participation in this study is completely voluntary and I have right to withdraw from participating in this study and in so doing there will be no impact on the overall management of my conditions. Refusal to participate will not result in loss of medical care provided or any other benefits. I was given enough time to think over before I signed this informed consent. It is therefore; with full understanding of the situation that I gave informed consent and cooperate at my will in the course of the study.

Name (participant) _____Signature _____Date_____

Name (Wittiness) _____Signature _____ Date_____

Name (Investigator) _____ Signature _____ Date _____

Annex-VI. Biographical sketch

The author was born in Enewary Town, Amhara Regional state, Ethiopia on May 12, 1988. He attended Elementary school at Enewary primary school and completed his Senior Secondary school at Enewary Senior Secondary School in May 2004 and also he attended preparatory school at Haile Mariam Mamo preparatory school, Debre Berhan town in May 2006. After successful completion of his preparatory education, he joined Debre Berhan University as a regular student in October 2007, and graduated with a B.Ed. degree in Biology in July 2009. After the completion of B.Ed. studies, he was employed by Ministry of Education in Mida Senior Secondary School in August 2009. After five year service at Deneba Senior Secondary School, he joined the School of Graduate Studies of Addis Ababa University to pursue his M.Sc. study in General Biology in 2014.