PREVALENCE, INTENSITY AND RISK FACTORS OF SOIL TRANSMITTED HELMINTH INFECTIONS AMONG KILLISO PRIMARY SCHOOL CHILDREN IN CHIRO TOWN, WEST HARARGHE, OROMIA REGION, ETHIOPIA

MSc. Thesis

By

Getaneh Abdi

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Haramaya University, Haramaya

Prevalence, Intensity and Risk Factors of Soil Transmitted Helminth Infections Among Killiso Primary School Children In Chiro Town, West Hararghe, Oromia Region, Ethiopia

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

By

Getaneh Abdi

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Haramaya University, Haramaya

APPROVAL SHEET

SCHOOL OF GRADUATE STUDIES

HARAMAYA UNIVERSITY

As thesis research advisors, we hereby certify that we have read and evaluated this thesis prepared, under our guidance, by **Getaneh Abdi**, entitled **"Prevalence, Intensity and Risk Factors of Soil Transmitted Helminth Infections among Killiso Primary School-Children in Chiro Town, West Hararghe, Oromia Region. Ethiopia".** We recommend that it can be submitted as fulfilling all the thesis requirements.

Sissay Menkir (PhD)	______________	_____________
Name of Major Advisor	Signature	Date
Ameha Kebede (PhD)	______________	_____________
Name of Co. Advisor	Signature	Date

As member of the board of the examiners of the M.Sc Thesis open defense examination of Getaneh Abdi, we certify that we have read and evaluated this thesis properly and examined the candidate .We recommended that the thesis can be accepted as fulfilling the Thesis requirement for the degree of Master of Science in Biology

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DEDICATION

This thesis manuscript is dedicated to my beloved wife and my friend Yirga Asfere for their persistent and boundless love, patience and strength that helped me to complete this work

STATEMENT OF THE AUTHOR

By my signature below, I declare and affirm that this thesis is my own work. I have followed all ethical principles of scholarship in the preparation, data collection, data analysis and completion of this thesis. All scholarly matter that is included in the thesis has been given recognition through citation. I affirm that I have cited and referenced all sources used in this document. Every serious effort has been made to avoid any plagiarism in the preparation of this thesis.

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Date: ______________________________

School of Biological Science and Biotechnology

BIOGRAPHICAL SKETCH

The author was born on January 21,1976 in Horo Guduru, Wollega Zone of Oromia Regional State. He started his elementary education at Hareto Elementary School and completed his secondary education at Hareto Comprehensive High School in 1994. He got diploma in Biology from Jimma College of Teachers Education in 2007 and then his Bachelor of Education Degree from Haramaya University in 2010. Following this, the author has been teaching Biology at Chiro General Secondary School until he joined the Department of Biology, Haramaya University, for his graduate studies in Biology in July, 2014.

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LIST OF ABBREVIATIONS AND ACRONYMS

CI	Confidence Interval
CWW	Children without Worm
DALY	Disability Adjusted Life Years
EPG	Eggs Per Gram of Stool
FEC	Formol Ether Concentration
ID	Iron Deficiency
KAP	Knowledge, Attitude and Practice
L_3	Third Stage Larvae
NTDs	Neglected Tropical Disease
OR	Odds Ratio
QC	Quality Control
SPSS	Statistical Package for Social Sciences
SSA	Sub Saharan Africa
STHs	Soil Transmitted Helminths
TDS	Trichuris Dysentery Syndrome
UNICEF	United Nations International Children Education Fund
WSHD	Water Sanitation Hygiene and De-worming
WFP	World Food Program
WHA	World Health Assembly
WHO	World Health Organization

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ABSTRACT

Soil transmitted helminth (STH) parasitic infections are one of the major public health problems in many countries including Ethiopia.The objective of the present study was to assess the prevalence of soil transmitted helminth parasitic infections and the associated risk factors among Killiso primary school children of Chiro Town, Oromia Region, Eastern Ethiopia. The design of the study was a cross-sectional survey involving 440 children aged 7-18 years old who were chosen using stratified random sampling technique from Killiso Primary School, Chiro Town, West Hararghe Zone, Oromia Region, Eastern Ethiopia during February-April 2017. Data were gathered using of questionnaire and laboratory parasitological examination procedures A structured and pre tested questionnaires were administered to gather information on socio-demographic characteristics and risk factors. Stool samples were examined using direct wet-mount and Formol-Ether concentration methods. Data were analyzed using the SPSS statistical software, version 20.0. of the total 440 study participants examined, 230(52.3%) were males and 210(47.3%) were female children. It was found that 44(19.1%) male and 38(18.1%) female children were infected with STH parasites. Thus, the overall prevalence of infections of STH parasites among school children was 18.6%. The major STH parasitic species identified in school children were Ascaris lumbricoides, Hookworm species and Trichuris trichuria with prevalence of 10.5% ,6.1% and 2% ,respectively. The prevalence of STH parasite infections among school children in age group 7-10, 11-14 and 15-18 were 20%, 17.2% and 15% respectively. The findings showed STH parasitic infections were significantly associated with factors like source of drinking water , eating unwashed vegetables, level of family education, absence of toilet facility drinking untreated water and absence of shoes ($P<0.05$)but no significant association was observed with occupation and finger nail cutting behavior ($P<0.05$). Local health sector should collaborate with school health program for delivering health education to increase the knowledge, attitude and practice of school children.

KeyWords/Phrases:-Chiro Town Intensity Parasitic Prevalence Risk Factors School Children.

1. INTRODUCTION

Intestinal helminths are multi-cellular pathogens that infect a vast number of people causing widespread chronic disease and morbidity (Crompton and Nesheim, 2002).Children and pregnant women are the main sufferers from these parasitic infections (WHO, 2003). Soil transmitted helminths (STH) refer to a group of parasitic diseases in humans caused by intestinal round worms such as hookworms (*Ancylostoma duodenale* and *Necator americanus*), Ascaris (*Ascaris lumbricoides*) and whipworm (*Trichuris trichiura*), collectively called STHs which are transmitted through contaminated soils.

Intestinal parasitic infection is one of the major health problems in developing countries. It has been estimated to affect nearly 3.5 billion people globally and of these 450 million are thought to be ill as a result of such infections, the majority being children (WHO, 2000). In some tropical areas, the prevalence reaches nearly100 percent (Uga *et al*., 2004).

The STHs are group of parasitic nematode worms causing human infections through contact with parasite eggs or larvae. The life cycles of *A. lumbricoides*, *T.trichiura* and hookworms follow a similar pattern. The adult parasite stages inhabit the gastro-intestinal tract (*A. lumbricoides* and hookworm in the small intestine, *T.trichiura* in the colon), reproduce sexually, and produce eggs, which are passed in human faeces and deposited in the external environment (Stephan and Richard, 2001). The STHs are one of the world's most important causes of physical and intellectual growth retardation in children leading to attention reduction, learning disabilities, school absenteeism and higher dropout rates (Stephenson *et al.,* 2000).

Despite their educational, economic, and public-health importance, they remain largely neglected by the medical and international communities. This neglect stems from three features: first, the people most affected are the world's most impoverished; second, the infections cause chronic ill health and have insidious clinical presentations; and third, quantification of the effect of STH parasitic infections on economic development and education is difficult (Jeffrey *et al*., 2006; WHO, 2002).

Current estimates indicate that an estimated 4.5 billion individuals are at risk of STH parasitic infections and the global estimate of number of cases of *A. lumbricoides* was 807 million, *T. trichiura* 604 million and Hookworm (*N. americanus and A. duodenale*) was 576 million (Hotez *et al*., 2008). Although estimates of disability-adjusted life years (DALYs) lost due to these STHs infections portray a more accurate picture of the disease burden caused by the infections, the estimates of DALYs lost differ greatly from one source to another (WHO, 2002; Van der Werf *et al.*, 2003; King *et al*., 2002; DCCP, 2008).

The public health importance of STHs has been well recognized and its disease burden has been acknowledged to be as great as that of tuberculosis [34.7 million disability adjusted life years (DALYs)] or malaria (46.5 million DALYs) (Hotez *et al*., 2006). About 39 million DALYs are attributed to STHs and these infections represent a substantial economic burden (Stephenson et *al*., 2000 a). Younger children are predisposed to heavy infections with STHs since their immune systems are not yet fully developed and they also habitually play on fecal contaminated soil. School age Children are one of the groups at high-risk for intestinal STH parasitic infections.

Several factors like climatic conditions, poor sanitation, unsafe drinking water, and lack of toilet facilities are the main contributors to the high prevalence of intestinal parasites in the tropical and sub-tropical countries (Mahfouz *et al*., 1997). Further, lack of awareness about mode of transmission of parasitic infections increases the risk of infection. Hence, a better understanding of the above factors, as well as how social, cultural, behavioral and community awareness affect the epidemiology and control of intestinal parasites may help design effective control strategies of these diseases (Pearce, 1996).

Most parts of Ethiopia are suitable for the transmission of STHs, except parts of Somali and Afar regions where the annual mean temperature is too high for transmission (Pullan and Brooker, 2012). The most important helminth parasites predominantly distributed in Ethiopia include *A.lumbricoides, hookworm, T. trichiura* and others; with varying prevalence in different areas. They are also the second most predominant cause of outpatient morbidity (Erko and Medhin, 2003).

In Ethiopia, hookworm is estimated to infect 11 million people, thus Ethiopia bears 5.6% of the hookworm burden in Sub Saharan Africa (SSA) and is the country with the third highest burden in SSA (Hotz and Kamath, 2009). Ethiopia also has the second highest burden of ascariasis in SSA: 26 million people are infected, which is 15% of the overall burden in SSA. and, Ethiopia has the 4th highest burden of trichuriasis, with 21 million people infected, which are 13% of the disease burden in SSA (Hotez and Kamath, 2009)

Prevalence of intestinal STHs and other intestinal parasites have been studied in different tropics and subtropics including Ethiopia. Most of the previous studies conducted in Ethiopia have focused on the prevalence and distribution of intestinal parasitic infections mainly among school children of the age 13-16, different community groups such as pre-school children and other groups confined to campus and refugees. However, still the prevalence of STH are not well addressed in different parts of Ethiopia including the present study area. In Chiro town and its surroundings there is a problem of sanitation, getting pure water, dietary habits. These problems are thought to cause danger on the health of human beings particularly on children that are known to be the most vulnerable. Therefore the purpose of this study is to assess the prevalence of STH infections and determine their association with risk factors among primary school children in Killiso Primary School, Chiro town.

General Objective:

The general objective of this study was to assess the prevalence and burden of STH parasitic infections and their associated risk factors among Killiso Primary School Children, Chiro Town, Oromia Region. Eastern Ethiopia.

The Specific Objectives of the Study were:

1. To identify the major STH parasitic species in the study population
2. To determine the prevalence of STH parasitic infections in the study population
3. To determine the intensity of STH parasitic infection in the study population
4. To examine the association between risk factors and STH parasitic infections in the study population

2. LITERATURE REVIEW

2.1. Soil-Transmitted Helminths (STHs)

STHs are caused by a group of parasitic worms, most commonly hookworms, roundworms (*A. lumbricoides)* and whipworms (*Trichuris trichiura*) that are either transmitted through contaminated soils or by ingesting parasite eggs. Infection occurs when vegetables and fruits, contaminated with soil infested eggs, are consumed; or when hands or fingers have been contaminated with dirt carrying eggs are put in the mouth (Hotez 2006).

Human hookworm infection is caused by the helminthes nematode parasites *Necator americanus* and *Ancylostoma duodenale* and is transmitted through contact with contaminated soil with third-stage infective larvae, which either penetrate the skin (as do both *N. americanus* and *A.duodenale*) or when they are ingested (*A. duodenale* only) (Hotez, 2006).*Trichuriasis* or whipworm infection is caused by *Trichuris trichiura.* Humans are the primary host for infections caused by *Trichuris trichiura.*

Ascariasis is caused by the intestinal roundworm, *Ascariasis lumbricoides*. Humans become infected by ingesting eggs from contaminated soil. The eggs release larvae in the small intestine which bore through the intestinal wall and circulate through the lymphatic system, ultimately reaching the lungs. Over a period of 2-3 months larvae mature through a process that involves coughing up and swallowing larvae from the lungs. Once swallowed, the worms return to the small intestine, were the adult female worm burrows through the mucosa and begins producing about 200,000 eggs per day. The eggs are shed into the feces allowing the infection to propagate. Most infections with ascariasis are asymptomatic, but moderate to heavy worm burdens can cause malabsorption of nutrients or obstruction of the intestine (Hotez, 2006).

2.2. Life Cycle of Major STH Parasites

2.2.1. Life Cycle of *Ascaris lumbricoides*

The adult ascaris worms reside in the lumen of the small intestine where they feed on predigested food. The adult worms are covered with a tough shell composed of collagens and lipids. They also produce protease inhibitors that help to prevent digestion by the host. The adult female worm can produce 200,000 eggs per day (Satoskar *et al*., 2009).The eggs that pass out of the adult worm are fertilized, but not embryonated. Once the eggs exit the host via feces, embryonation occurs in the soil and the embryonated eggs are subsequently ingested. Within the embryonated egg, the first stage larva develops into the second stage larva. This second stage larva is stimulated to hatch by the presence of both the alkaline conditions in the small intestine and the solubilization of its outer layer by bile salts.

The hatched parasite that now resides in the lumen of the intestine penetrates the intestinal wall and is carried to the liver through the portal circulation. It then travels via the blood stream to the heart and lungs by the pulmonary circulation. The larvae molt twice, enlarge and break into the alveoli of the lung. They then pass up through the bronchi and into the trachea, are swallowed and reach the small intestine once again. Within the small intestine, the parasites molt twice more and mature into adult worms (Satoskar *et al*., 2009).

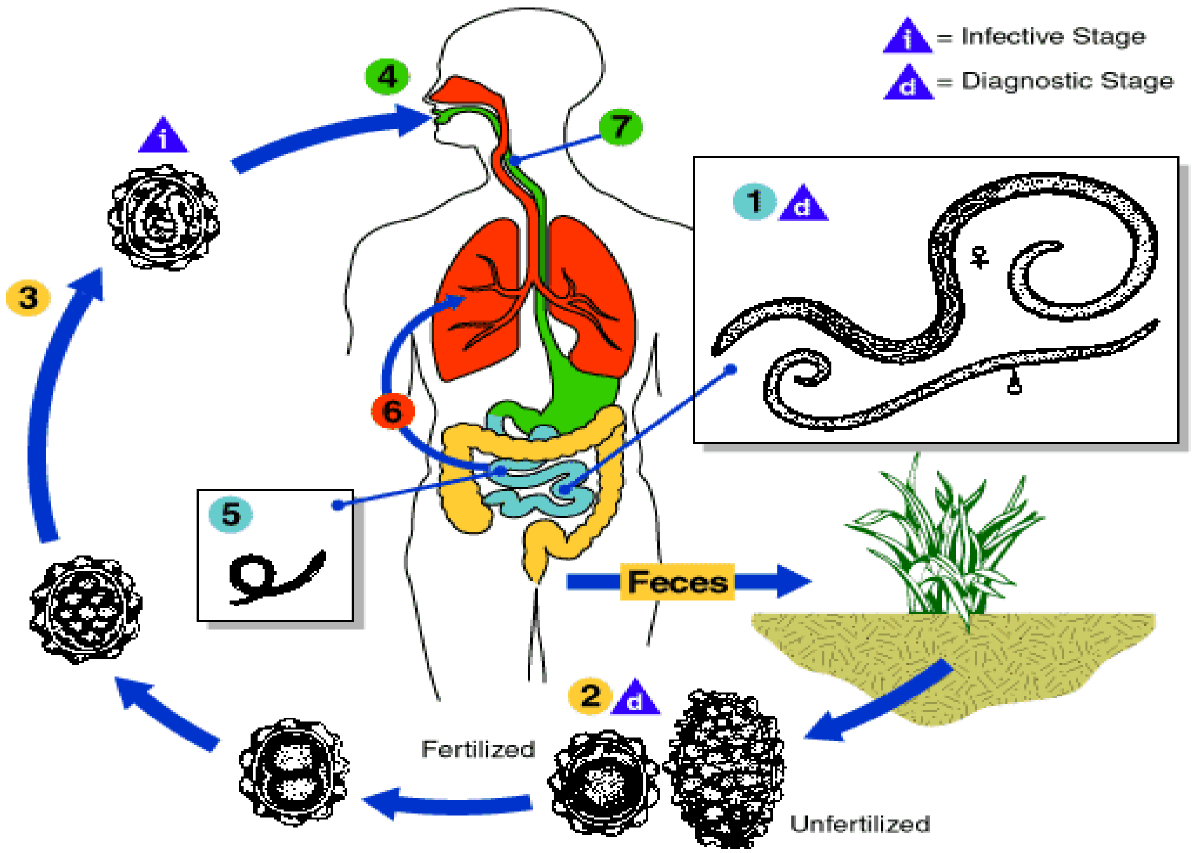

Figure 1. Life cycle of *Ascaris lumbricoides* (Source: CDC, 2012)

1=Adult Male and Female Ascaris .2= Fertilized egg .3= Advanced Cleavage .4=Embryonated eggs are ingested .5=Larvae hatch in small intestine .6=The Larvae molt twice enlarge and break into the alveoli of the lung .7=The Larvea pass up through the bronchi and into the trachea are swallowed and reach the small intestine once again.

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2.2.2. Life Cycle of Trichuris (Whipworm)

Adult female whipworms shed between 3000 - 20000 eggs per day, which are passed with the stool. In the soil, the eggs develop into a 2-cell stage, an advance cleavage stage and then embryonate. It is the embryonated egg that is actually infectious. Environmental factors such as high humidity and warm temperature quicken the development of the embryo. This helps explain the geographic predilection for tropical environments. Under optimal conditions, embryonic development occurs between 15-30 days. Infection begins when these embryonated eggs are ingested (Satoskar *et al*., 2009**)**

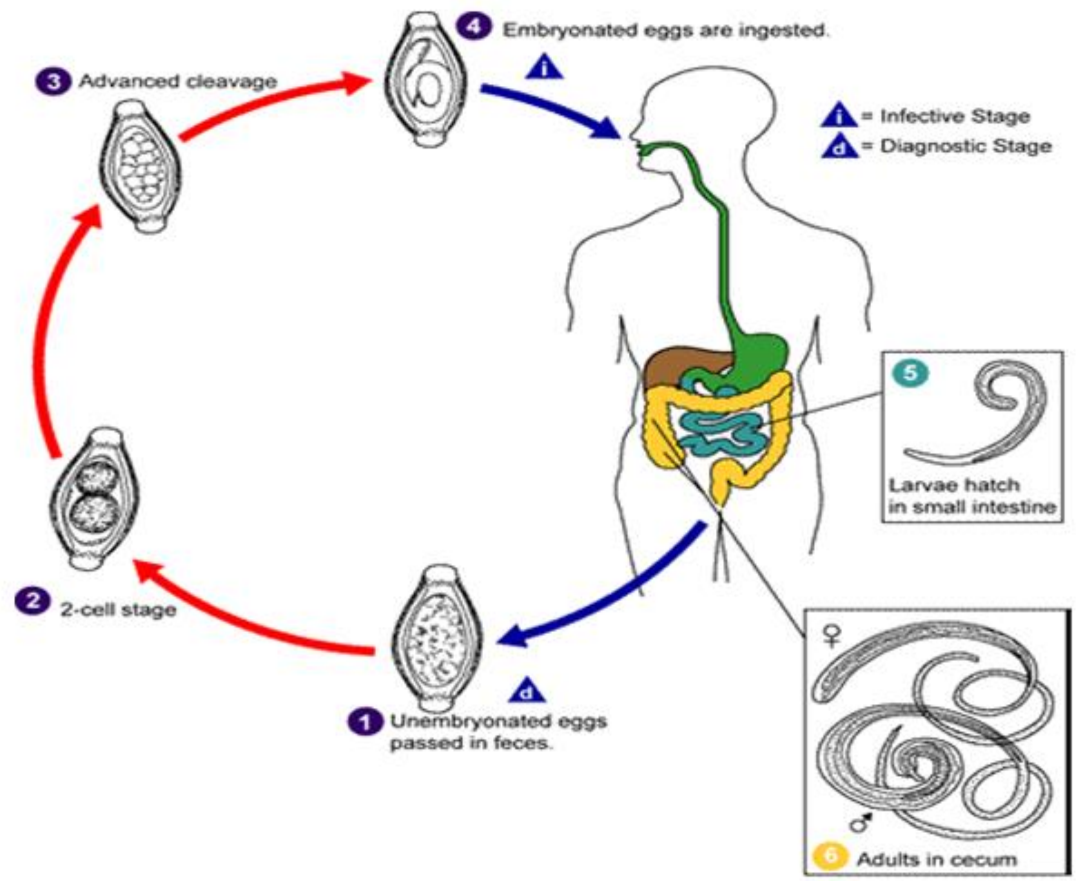

Figure 2. Life cycle of *Trichuris trichiura* (Source: USAID 2010)

2.2.3. Life Cycle of Hookworms

Hookworm larvae have the ability to actively penetrate the coetaneous tissues, most often those of the hands, feet, arms and legs due to exposure and usually through hair follicles or abraded skin. Following skin penetration, the larvae enter subcutaneous venues and lymphatic's to gain access to the host's afferent circulation. Ultimately, they enter the pulmonary capillaries where they penetrate into the alveolar spaces, ascend the brachial tree to the trachea, traverse the epiglottis into the pharynx and are swallowed into the gastrointestinal tract (Satoskar*et al*., 2009). Larvae undergo two molts in the lumen of the intestine before developing into egg-laying adults approximately five to nine weeks after skin penetration.

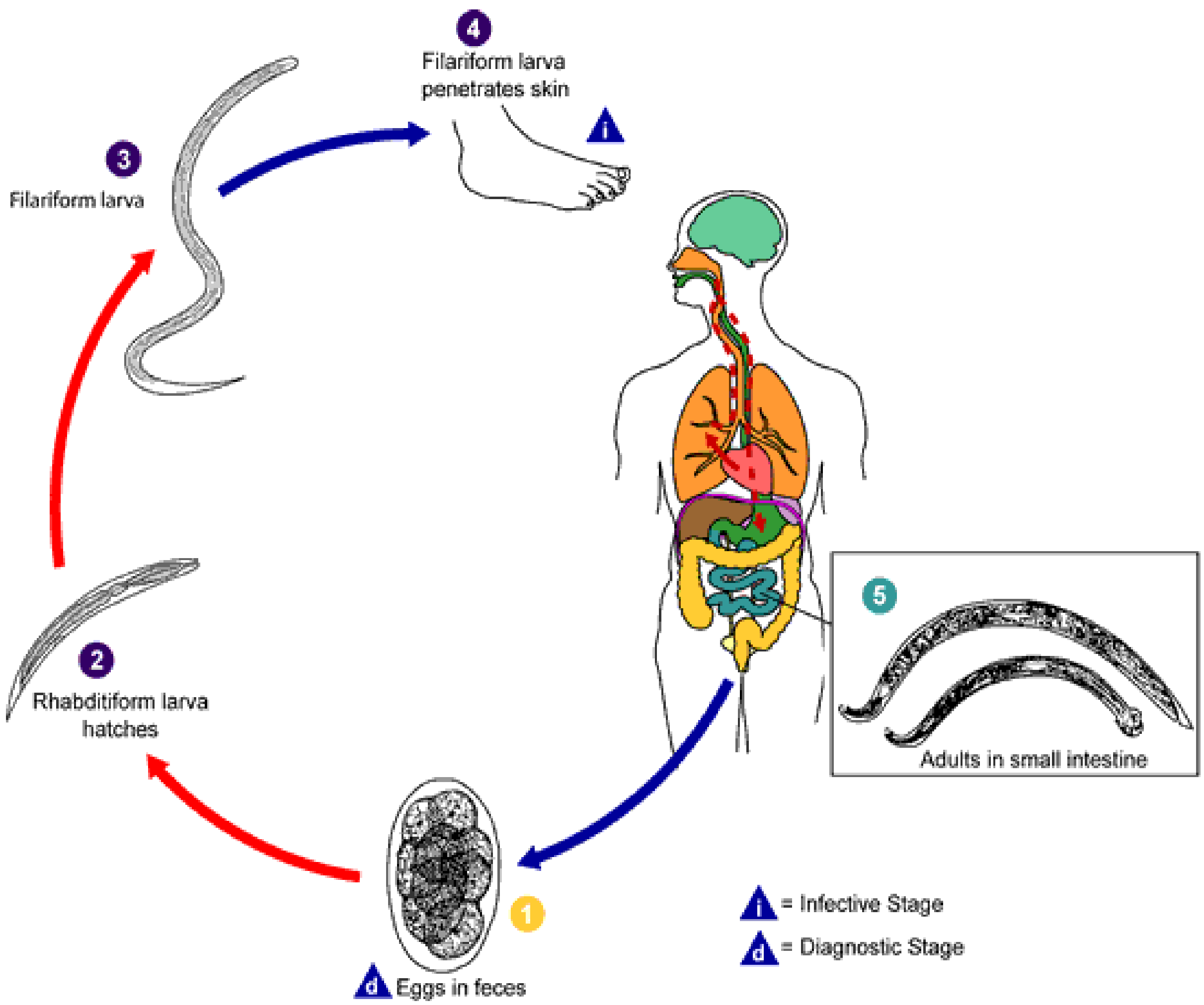

Figure 3. Life cycle of Hookworm infections (Source ;http;//www.dpd.cdc.gov/dpdx**)**

2.3. Pathogenesis and Clinical Manifestation of STH Parasite

Soil-transmitted helminths (STHs), such as hookworms (*Necator americanus* and *Ancylostoma duodenale*) and whipworms (*Trichuris trichiura)*, contribute to iron-deficiency anaemia by ingesting blood and by damaging the intestinal mucosa during feeding (Brooker *et al*, 2010). The manifestations of severe disease include fatal, intestinal obstruction or pulmonary allergic reactions in the case of ascariasis, severe anaemia in hookworm infections and chronic dysentery and rectal prolapsed in trichuriasis (Crompton and Nesheim, 2002). Chronic and intense STH infections can contribute to malnutrition and iron-deficiency anemia, and also can adversely affect physical and mental growth in childhood (Drake *et al.*, 2000, Stephenson *et al*.,2000) Hotez *et al.*, 2004).Much of the pathophysiology of these parasites is nutritional in nature, and their geographic distributions overlap with those of the four most common forms of malnutrition. The four most important forms of malnutrition worldwide (protein-energy malnutrition, iron deficiency and anemia's, vitamin A deficiency, and iodine deficiency disorders) affect hundreds of millions of people, especially children and women and girls of childbearing age.

Deficiencies of vitamin B12 and other nutrients are also important in a number of areas.

A.lumbricoides is a well-known cause of malnutrition, intestinal obstruction, biliary colic and pancreatitis estimated to infect a quarter of the world's population (Hall, 2000). The most severe manifestation, include chronic dysentery, rectal prolapse, anemia, and growth stunting (Stephenson *et al.*, 2000). Intellectual and cognitive impairments and delays are also associated with chronic heavy infections causing TDS (Partovi *et al.*, 2007). . STH is most often associated with malnutrition, to the point of life threatening, because the worms negatively affect the nutritional status as they induce intestinal bleeding, competition for nutrients, frequent anemia and diarrhea.

Hookworm infections insinuate a skin reaction (dermatitis), increased white blood cells (eosinophil's), a pulmonary reaction (pneumonitis), and skin rash. Iron deficiency an anemia due to blood loss is a common symptom (WHO, 2008).Symptomatic disease is usually related to either the larval migration stage or manifests as pulmonary disease, or to the intestinal stage of the adult worm (WHO, 2008).

2.4. Epidemiology of STH Parasites

STHs infections are widely distributed throughout the world. *N. americanus* is the most prevalent hookworm worldwide, with the highest rates of infection in sub-Saharan Africa, the tropical regions of the Americas, south China and southeast Asia, whereas *A. duodenale* is more focally endemic in parts of India, China, sub-Saharan Africa, North Africa and a few regions of the Americas. Climate is an important determinant of hookworm transmission, with adequate moisture and warm temperature essential for larval development in the soil. An equally important determinant of infection is poverty and the associated lack of sanitation and supply of clean water (Satoskar *et al.*, 2009).Hookworm eggs hatch in the soil, releasing larvae that mature into a form that can actively penetrate the skin. People become infected with hookworm primarily by walking barefoot on the contaminated soil. There is no direct person-to-person transmission, or infection from fresh feces, because eggs passed in feces need about three weeks to mature in the soil before they become infective. Since these worms do not multiply in the human host, re-infection occurs only as a result of contact with infective stages in the environment (Hall, 2000).

The most severe manifestation, include chronic dysentery, rectal prolapsed, anemia, and growth stunting (Stephenson *et al*, 2000). Intellectual and cognitive impairments and delays are also associated with chronic heavy infections (Partovi *et al.*, 2007).There is no reservoir host for *Trichuris*. Transmission occurs when contaminated soil reaches the food, drink, or hands of a person and is subsequently ingested. Therefore, poor sanitary conditions are a major risk factor. It is noteworthy that patients are often co-infected with other soil-transmitted helminthes like *Ascaris* and hookworm due to similar transmission modalities (Satoskar *et al.*, 2009).

2.4.1. Prevalence of the Three Major STH infections Globally

Soil-transmitted helminthes infections are among the most common infections worldwide and affect the poorest and most deprived communities (WHO, 2008). Approximately 2 billion People in the world are infected with one or more of these STHs, accounting for up to 40% of the global morbidity from infectious diseases (De Silvia *et al.*, 2003). As of 1990, an estimated 29% of the world's preschool age children (158 million) and 35% of school-age children (320 million) were infected with *A.lumbricoides* (WHO, 1996). Hookworm infection is considered to be a major health threat to adolescent girls and women of reproductive age, with adverse effects on the outcome of pregnancy (Bundy *et al.*, 1995). An estimated 44 million pregnant women are infected with hookworm worldwide, with 7.5 million in Sub-Saharan Africa alone (Crompton, 2000). As of 1990, an estimated 7% of the world's preschool age children (41 million), 26% of school age children (239 million), and 44.3 million of the developing world's 124.3 million pregnant women harbored hookworm infection (WHO, 1996). At least 50% of pregnant women and over 40% of preschool-age children in developing countries are likely to be clinically anemic (DeBenoist, 1999).

N. americanus is the most common hookworm worldwide, whereas *A. duodenale* is more geographically restricted. It is one of the most common chronic infections, with an estimated 740 million cases in areas of rural poverty in the tropics and subtropics (De Silva *et al*., 2003). The fecal oral route is significant in the transmission of parasitic infections to humans via poor personal hygiene, as a result is very common in people who live in areas whose environment is contaminated with contaminated soil and water sources with human feces or indirectly by fecal contaminated irrigation water. When the soil or water becomes contaminated, the eggs can be transferred onto vegetables then onto the hands and transferred directly into the mouth or ingested by eating raw vegetables (Satoskar *et al*., 2009).

2.4.2. Prevalence of the Major STH infections in Ethiopia

In Ethiopia, hookworm is estimated to infect 11 million people, thus Ethiopia bears 5.6% of the hookworm burden in Sub Saharan Africa (SSA) and is the country with the third highest burden in SSA (Hotez andKamath , 2009).

The prevalence of hookworm among school age children in Ethiopia was reported to be 38% in Jimma (Demissie *et al*, 2009), 26.8% in Boloso Sore (Erosie *et al.*,2002), 53% in central Ethiopia , 20.6% in Southwest Ethiopia and 19% in northwest Ethiopia (Alemu *etal.*,2011)and there was no significant gender difference. According to a study conducted in southwest Ethiopia, 92% of the hookworm infections were due to *N. Americanus* and 8% were due to *A. duodenale*. None of the cultures showed mixed infection (infection by two or more species).

Ethiopia has the second highest burden of Ascariasis in SSA 26 million people are infected, which is 15% of the overall burden in SSA (Hotez and Kamath, 2009). The prevalence among school age children was recorded at 28.9% in northern Ethiopia (Jemaneh,2000), 83.4% in southern Ethiopia (Erco and Medhin,2003), 22% in northwest Ethiopia (Alemu *etal.*,2011), and the national average is estimated at 37% (Kolaczinski, 2008). Similarly, Ethiopia has the 4th highest burden of trichuriasis, with 21 million people infected, which are 13% of the disease burden in SSA (Hotez andKamath, 2009). The national prevalence is estimated at 30% (Kolaczinski, 2008).

2.4.3. Factors Affecting the Epidemiology and Transmission of STH Parasites

Large-scale environmental sanitation programs are complex, making interventions directly aimed at the transmission of STHs challenging to implement (Barreto *et al*,2007). These interventions directly affect the transmission of several diseases in both the public and private domains(Cairncross *et al.*,2000). Several factors need to be operative for an intervention to be successful. Amongst these are public investment in sewage networks and a collective will on the part of individual households to invest in a toilet and connect it to this network (Barreto *et al*,2007).

A high prevalence of STHs, when combined with poor hygiene and malnutrition, is an indicator of a country's future problems, indicating that priority be given to eradicating STHs worldwide.(De Siliva,1998). STHs are considered together since it is common for an individual, especially a child living in a less developed country, to be chronically infected with all three worms. Such children experience malnutrition, stunted growth, mental retardation, as well as cognitive and learning deficiencies (WHO, 2005),WHO, (2005) has recommended three interventions to control morbidity due to STH infections: regular drug treatment of high-risk groups for reduction of the worm burden over time, health education and sanitation supported by personal hygiene aimed at reducing soil contamination Environmental factors such as water supply for domestic and personal hygiene, sanitation and housing conditions; and other factors such as socioeconomic, demographic and health related behavior are known to influence this infection. Two principal factors in maintaining endemicity of these helminthes are favorable qualities of the soil and the frequent contamination of the environment by human feces. Their transmission within the community is predominantly related to human habits with regard to eating, defecation, personal hygiene and cleanliness.

Sanitation factors such as the reliability of water supply, frequency of rubbish collection and proximity to overflowing or visible sewage are not under the control of individual households. These do not reflect personal hygiene, and their significance suggests that the impact of environmental sanitation on health could have been greater if the governmental systems had been properly operated and maintained. Improved disposal of excreta offers a more sustainable method of control, among many other benefits (UNICEF, 1999).Since domestic risk factors assume greater importance after public domain transmission is controlled, the environmental sanitation creates opportunities for synergy with other inputs, such as hygiene promotion, which are aimed at such domestic risk factors(Moraes *et al.*,2004).The effect of improved sanitation is slow to development and may take decades to achieve a measurable impact. Often, the high costs involved prevent the provision of sanitation to the communities most in need, and sanitation does not become effective until it covers a high percentage of the population (Ofoezie, 2003).

2.5. Diagnosis of STH Parasites

For basic diagnosis, specific helminthes can be generally identified from the feces, and their eggs microscopically examined and enumerated using fecal egg count method (Hall, 2000). *Ascaris* eggs are easily recognized, although if very few eggs are present the diagnosis may be easily missed. Techniques for concentrating the stool specimen will increase the yield of diagnosis through microscopy. Occasionally an adult worm is passed via rectum.

If an Ascaris worm is found in the feces, a stool specimen can be checked for eggs to document whether or not additional worms are present prior (WHO, 1991). Other forms of diagnosis are through eosinophilia ,imaging, ultrasound, or serological examination which are not considered by this study .Adult *Ascaris lumbricoides* lives in the small intestine. Female worms measure as much as 35 cm in length, males are smaller. Eggs may be found easily in direct smears (2 mg) of faeces. The fertile un embryonated egg measures 55-75µm by 35-50 µm. It is brown in color and the surface of the shell has conspicuous "bumps" called mamillations. The egg contains a single cell ovum. Eggs may vary slightly in their appearance but key features (size, mamillations) are always evident.

The examination of human stool samples for the presence of hookworm eggs remains the most reliable means of diagnosis. The adult worms are small and live in the small intestine. They measure about 1.0 to 1.5 cm in length. Although the adult worms of these two species are easily identified on the basis of presence of cutting plates (*N. americanus*) or teeth (*A. duodenale*) around the mouth, the eggs they produce are nearly identical. The typical hookworm egg measures 60-75µm by 36-40µm. It has a clear, thin shell and the ovum is usually in the 4 or 8 cell stages or sometimes more advanced (WHO, 1987).

2.6. Prevention and Control of STH Parasites

2.6.1. Treatments

Recommended drugs used in the treatment of soil-transmitted helminths are albendazole, mebendazole; older drugs including pyrantel, tiabendazole and niclosamide (Heelan, 2004). Piperazine citrate is also used to paralyze the worms (Mazigo *et al*., 2010) rendering them unable to resist the peristalsis action of the host's intestine and 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 in specific cases of certain body sites.

Growth stunting is sometimes reversible with specific anti-helminthic treatment and supplemental oral iron. Intellectual and cognitive impairments and delays are also associated with chronic heavy infections (Darke *et al.*, 2000). These deficits sometimes reverse following anti-helminthic therapy, particularly when treatments are linked to psychological support (Stephenson *et al.*, 2000).

2.6.2. 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 re-infection 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).

2.6.3. Environmental Sanitation

Control programs based on sanitation aim to reduce or interrupt transmission, prevent re-infection and gradually reduce worm loads (Bundy, 1995). However, to be effective in a short period of time they need to be combined at their first stage with chemotherapy. Long term sanitary control programs need to add elements to improve the economic conditions of a region, to ensure a reliable and permanent sanitation system and have permanent health education programs (Gillespie,2001).School age children harbor the most intestinal parasitic infections with roundworm, hookworm and whip worm. Therefore, treatment of this age group which is easily accessible through the school system achieves optimal improvements in health status and educational performance. 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).

3. MATERIALS AND METHODS

3.1. Description of the Study Area

The study was conducted in Killiso Primary School in Chiro town of western Hararghe Zone, Oromia Region ,Eastern Ethiopia. Chiro town is located 326 km east of Addis Ababa.

The annual rain fall ranges from 600-800mm and the mean annual temperature 20^{o}C. Khat is the main trade activity while the other common trade activities include vegetables, bananas, orange, and coffee. Chiro town has one hospital and two health centers and also eight Primary Schools in the town ;although there are no published reports on the relative prevalence of parasitic infectious disease, the occurrence of STH infections and high malnutrition rate among school age children, are the major health problems in the study area.(ARC; GIS 2016).

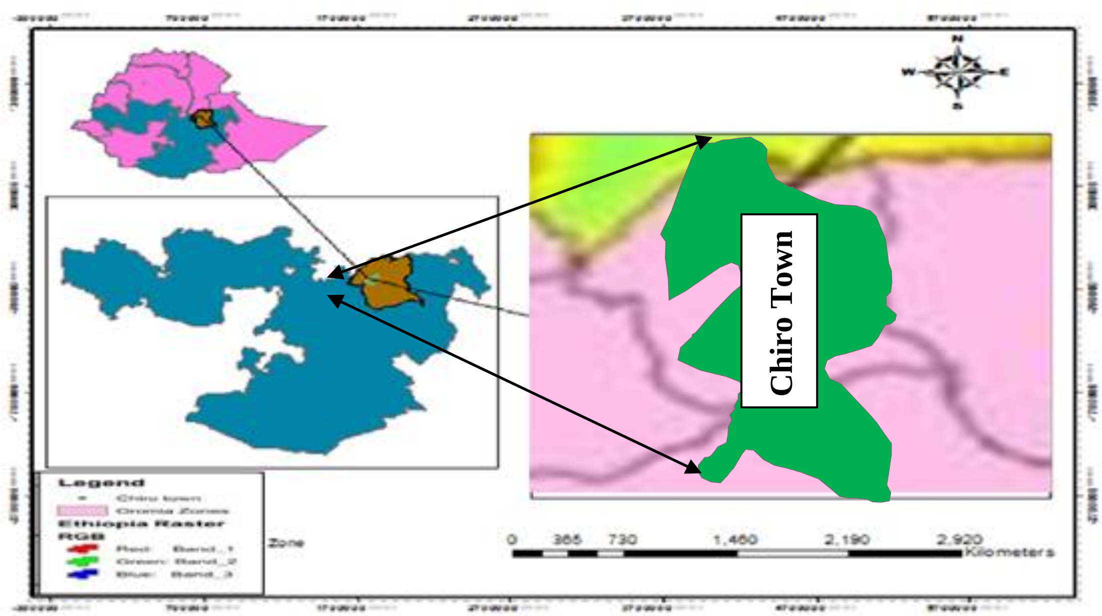

Figure 4: Map of the Study Area.

ARC; GIS 2016. Geographical Information System Ministry of Education AA.

3.2. Study Design

A cross- sectional study was conducted in School Children to determine the prevalence and risk factors of human intestinal parasitic infections among the primary school children who were attending Killiso Primary School in 2016/2017 academic year. Stool samples were collected from the study population, and pre-tested and structured questionnaires were used to determine the Prevalence and intensity of STH infections as well as to collect data regarding demographic characteristics, environmental related factors, sanitary conditions and dietary habits of the study participants.

3.3. Study Population

According to the data obtained from Killiso Primary School, the total number of students enrolled in 2016/2017 academic year were 996 (520 males and 476 females). This constituted the study population (Table 1).

Table 1.Total student population and sample size of the study participants from Killiso Primary School

School name	Grade	Student population			Sample population		
		Male	Female	Total	Male	Female	Total
Killiso Primary School	1-4	284	284	568	120	115	235
	5-8	236	192	428	110	95	205
Total		520	476	996	230	210	440

3.4. Sample Size Determination and Sampling Method

The sample size for this study was determined by using the following statistical formula (Hassan, 1999)

$n = t^2 . \frac{p(1-p)}{m^2}$, Where,

n = Required Sample Size

t = Confidence Level at 95 % (Standard value of 1.96)

p = Estimated Prevalence

m = Margin of error at 5% (Standard value of 0.05)

$$n = (1.96 \times \frac{0.5(1-0.5)}{(0.05)^2} = \frac{3.8416 \times 0.25}{0.0025} = \frac{0.9604}{0.0025} = 384.16 \approx 384.$$

Therefore, the calculated size was 384 and with the addition of 56 Students as contingency the study sample population was 440. In this formula, p (1-p) is maximized when p = 0.5, which ensures a sample size large enough to satisfy the precision and confidence constraints. But, if there was sufficient evidence to believe that $p \neq 0.5$, substitution of the best estimate can result in a significant reduction in the required sample size (Hassan, 1999).

To select the sample children, the school children were first stratified according to their age levels. Sample number was then be allocated for each sex and age from each class room. Finally the sample children were selected using random sampling method. Hence, 440 sample students were participated in the present study.

3.5. Methods of Data Collection

3.5.1. Stool Sample Collection

All the study subjects were given appropriate information at the beginning of the data collection about the aim and significance of the study. An oral description and specific instruction for handling and avoidance of contamination of the stool specimen was given to all the subjects by the laboratory technician.

Disposable plastic cups with clean applicator sticks were given for the study participants by labeling their own unique codes to collect for each about 3g of fresh stool specimen. The collected stool samples were examined using standard parasitological laboratory procedures.

3.5.2. Questionnaire Survey

In order to identify the major risk factors for STH infection a structured questionnaires were prepared by the principal investigator. The contents of the questionnaire included demographic features of the children’s parents or caretakers .,hygienic conditions ,dietary conditions and status, presence or absence of toilet facilities ,source of water etc. Atotal of 440 respondents were participated in filling the questionnaires.

The respondents were the parents or caretakers of School Children. The questionnaires were translated into local language. The questionnaires were pre-tested using few respondents (30) outside of the study area.

3.6. Parasitological Examination Procedures

Stool specimens were processed by both direct smear (wet mount examination) and Formol Ether Concentration Methods. The procedures are described as follow.

3.6.1. Direct Wet Mount Method

A direct wet mount with normal saline (0.85%NaCl solution) was prepared at the laboratory and used to detect the presence or abscence of motile intestinal parasites and trophozoites under the compound light microscope at 10x and 40x magnification. Logo's iodine staining was used to observe eggs of helminthes (WHO 2000).

3.6.2. Formol Ether Concentration Method

Using an applicator stick about **1g** of stool sample was placed in a clean 15ml conical centrifuge tube containing 7ml formalin. The sample was dissolved and mixed thoroughly with an applicator stick.

The resulting suspension was filtered through a sieve (cotton gauze) into a beaker and the filtrate was poured back into the same tube.The debris trapped on the sieve was discarded. After adding 3ml of diethyl ether to the mixture and hand shaken ,the contents was centrifuged at 2000 rpm for 3 minutes. The supernatant was poured away and the tube was replaced in its rack. The sediment was stained with iodine. Finally the entire area under the cover slip was systematically examined using 10x and 40x objective lenses (Lindo, 1998)

3.7. Data Analysis

The prevalence and intensity of STH infections of examined School Children were analyzed by sex and age. Odd ratio and the EPG value of the stool samples was used to associate the prevalence and risk factors for STH infections. The data were entered into a computer using SPSS, version 20, statistical software. Statistical significance was determined using p-value obtained. Frequencies of dependent variables, percentage, mean, range and proportions were carefully examined.. The prevalence of STH was determined by Pearson chi-square (X^2) test verifying the relationship between independent factors and the outcome variables. Odds ratios (OR) was used to determine association of independent variables with the STH parasite infections. The 95% CI was used to show the accuracy of data analysis. Probabilities less than 5% ($P < 0.05$) was considered statistically significant.

3.8. Data Quality Control

The laboratory procedures including collection and handling of specimens were carried out in accordance with standard protocols (NCCLS, 1997).All the reagents were checked for contamination each time. The stool samples were also taken randomly from the samples recorded for quality assurance (Million *et al.*, 2012) in Chiro town Hospital laboratory.

3.9. Ethical Clearance

Ethical clearance was obtained from Chiro Hospital Ethical Board Chiro Town. Institutional consent was also obtained from Chiro town health office, before conducting the study .Additionally, the researcher briefly explained the importance of the study to all responsible bodies: including the parents, the school directors, teachers and the study subjects. Any one not willing to take part in the study was allowed to have full right, not to do so, and the investigation only proceeded with fully and confidentially accepted subjects.

4. RESULTS AND DISCUSSION

4.1. Socio-Demographic Characteristics of the Study Participants

As the result data shows in table 2 atotal of 440 school Children from Killiso Primary School were sampled to participate in the study. Of these, 230 (52.3 %) were male and 210 (47.7 %) female participants. The age range was from 7 to 18 years. These were divided into three age groups, 7-10 years old students were 240 (54.55 %), 11-14years old were 180 (40.9 %) and 15-18 years old were 20 (4.55 %).

Furthermore, 78.1% of the study participants were from urban (Chiro town) while the remaining 21.9% were from the rural areas. As shown in Table 2,pipe water supply was the major source (77.7%) of water for drinking purpose. Only 13.9 % of the study participants were using river water and 8.4 of the study participants were using well water. With regard to parents education level, 160 (36.4 %), 184 (41.8 %), and 96 (21.8 %) were illiterate, primary education complete, secondary education complete and above, respectively (Table 2).

The results showed that 245 (55.7 %) from urban, 45(10.2%) from rural and totally 290 (65.9 %) had training and information about personal hygiene from family, media, health extension and health center whereas 96 (21.8 %) from rural, 54 (12.3 %) from rural and totally 150(34.1%) study participants did not take any training and information about personal hygiene. In the present study, regarding family occupation, 163 (37 %) were farmers,83 (18.9 %) civil servants and 194 (44.1 %) were private workers or small business owners.

Table 2.Socio-demographic characteristics of the study participants (n=440)

Characteristics	Frequency	%
Sex		
Male	230	52.3
Female	210	47.7
Age group(in year)		
7-10	240	54.55
11-14	180	40.9
15-18	20	4.55
Residence		
Urban	344	78.1
Rural	96	21.8
Family educational level		
Illiterate	160	36.4
Primary	184	41.8
Secondary and above	96	21.8
Personal hygiene		
Yes	290	65.9
No	150	34
Water source		
Pipe	342	77.7
River	61	13.9
Well	37	8.4
Family occupation		
Farmer	163	37
Civil servant	83	18.9
Small Business Workers	194	44.1

4.2 Prevalence of Soil Transmitted Helminth Parasitic Infections among School Children

Prevalence of soil transmitted helminthes parasite infections among Killiso primary school children at Chiro town by age and sex is presented in Table 3. Of the total 440Children examined, 82 (18.6%) were positive for at least one STH (Table 3). Of these, 44 (19.1 %) and 38 (18.1%) werefor males and females, respectively. In the present study, male children showed a bit higher prevalence of STH parasite infection than females. However, the difference was not statistically significant (p=0.781) (Table3) (Wani *et al*., 2010).

As observed in Chiro town by the investigator during the study period, there was variations in prevalence between males and females due to the fact that male children were more active in outdoor activities such as walking in farm, playing football and walking in flood after rain fall, more frequently than female children. These activities, which are sometimes carried out bare footed, very likely predispose them to hookworm infections (WHO, 1987). This was in accordance with some previous works by Dakul *et al.*, (2004) but it was contrary to others (Odikamnoro *et al*.,2004).This finding was supported by a previous report from India (Naish *et al*.,2004; Oyewole,2007; Adeyeba and Akinlabi, 2002; Ukpai and Ugwu, 2003) who reported high prevalence of STH parasites among males than females due to their activities.

As shown in Table 3, the overall prevalence of STH parasitic infections among the study participants was 18.6 %. Of these, the prevalence of soil transmitted helminthes parasitic infection among the age groups ranging from 7-10, 11-14 and 15-18 years was 48(20%),31 (17.2 %) and 3 (15 %), respectively. In the present study, the prevalence of STH parasitic infection among the age group of 7-10 years (20%) was higher than the other age groups, but it was not statistically significant (P=0.948) (Table 3). The observed higher prevalence in 7-10 years age group might be due to the high risk of exposure for environmental contamination, especially ,contaminated soil where the children always play, immature immunity, lower awareness of personal hygiene, low behavior of washing hands before eating and after toilet. But, the prevalence of STH parasitic infection was comparatively very low in the 15-18 years age groups. In all age groups the prevalence of STH parasitic infection was relatively low compared to previous reports of similar studies in different parts of Ethiopia. but was considerably lower than the prevalence rates reported by a number of other studies including in Kenya(63%) (Handezel *et al*.,2003),Ecuador(65%).

(Andrade *et al*.,2001) in Kelatan (56%)(Zulkifli*et al.*, 1999),Western Nigeria(64%) (Adeyeba and Akinlabi, 2002) Gondar, North west Ethiopia (55.6) (Worku *et al*.2009), Eastern Ethiopia Girum (2005) and non School Children in Alaba Kulito Woreda, Southern Ethiopia (Degarege *et al*.,2009). These variable results in prevalence might be reflections of the local endemicity and sanitary standard, environmental condition,timing and seasonal difference in the area.

Table 3. Prevalence of STH parasite infections by age and sex among School Children of Killiso Primary School (n=440).

Age Group (years)	Male		Female		Both sex		X^2	p-value
	No. Exm.	No. Posi (%)	No. Exm	No. posi.(%)	No exm.	No. posi(%)		
7-10	126	25(19.8)	114	23(20.2)	240	48 (20)	0.004	0.948
11-14	93	17(18.3)	87	14(16.1)	180	31(17.2)	1.151	0.698
15-18	11	2(18.2)	9	1(11.1)	20	3(15)	0.194	0.660
Total	230	44(19.1)	210	38(18.1)	440	82(18.6)	0.078	0.781
X^2		0.091		0.86		0.47		
p-value		0.955		0.649		0.80		

Exm. = Examined, Pos. = positive , No.= Number

4.3. Major Soil Transmitted Helminth Parasitic Species Identified in School Childrn

As indicated in Table 4, the major soil-transmitted helminths identified in the stool samples of the school children were *A.lumbricoides*, hookworm, and *T.trichiura* with the prevalence of 46(10.5%),27(6.1%), and 9(2%), respectively .These three soil-transmitted helminth parasites were found with an overall prevalence of 18.6% (82 of 440 children). The predominant parasite was *A.lumbricoides* which was observed in 46 (10.5%) students followed by hookworm in 27 (6.1%) of the examined students. The high prevalence of *A.lumbricodes* infection in the present study was due to poor environmental sanitation, common practice of eating unwashed and un cooked vegetables and poor personal hygiene. The least prevalent parasitic species in the present study was *T.trichiura*, 9 (2%) (Table 4).

Table 4: Major soil transmitted helminth parasitic species identified in School Children.

Age group(years) and sex	No Exam	AL No. pos(%)	HW No.pos(%)	TT No. pos(%)	X^2	P-Value
7-10						
Male	126	14(11.1)	8(6.3)	3(2.4)	0.158	0.984
Female	114	13(11.4)	8(7.1)	2(1.7)		
11-14						
Male	93	11(11.8)	5(5.4)	1(1.1)	0.779	0.854
Female	87	8(9.2)	4(4.6)	2(2.3)		
15-18						
Male	11	0	2(18.2)	0	2.88	0.236
Female	9	0	0	1(11.1)		
All age group						
Male	230	25(10.8)	15(6.5)	4(1.7)	0.432	0.934
Female	210	21(10)	12(5.7)	5(2.4)		
Total	440	46(10.5)	27(6.1)	9(2)		

AL=*Ascaris lumbricoides* HW=Hookworm TT=*Trichuris trichiura*

A.lumbricoides, hookworm and *T.trichiura* were the most prevalent helminth parasite worldwide (Crompton *et al*., 1998). In the present study, *A.lumbricoides* and hookworm were found to be the major prevalent STH parasites among the participants in the study area. A Similar study done on the prevalence of *A.lumbricoides*, hookworm and *T.trichiura* in Wolayta, Southern Ethiopia, showed that the prevalence was 40%, 25% and 14.7%, respectively (Lopiso *etal*., 2002). Another study done in Southern Nigeria showed that the overall prevalence fates were 76.89%, 54.60%, and 29.24% for *A. lumbricoides*, hookworm and *T.trichiura*, respectively (Nmor*et al*., 2009). From what Girum (2005) reported, the prevalence in Eastern Ethiopia was 6.7% for hookworm, 4. 3% for *A.lumbricoides* and 3.9% for *T.trichiura* infection. As compared to others the prevalence of *A.lumbricoides* infection in the present study was lower than that of the prevalence of the same parasite (20.9%) reported in South Ethiopia, Abosa around Lake Ziway by Gezahegn (2008). In contrary *A.lumbricoides* infection in the present study was higher than the prevalence reported by

Tesfamichael and Teklemariam (1983) found in Ziway Island (4.1%), Girum (2005) in Babile (4.3%) and Lemlem(2010) in Adwa(6.4%) .

The prevalence of hookworm infection was 6.1% in the present study participants. This was much lower than the 46.9 % prevalence reportedby Tilahun (2010), 33.3% by Mengistu (2010),14.3% by Gezahegn (2008). On the other hand it was higher than the 1.0% reported by Lemlem (2010), in North Ethiopia, and the 0.3 % reported from Adwa by Haile *et al*. (1994). Variability in prevalence of these infections might be due to variation in the degree of environmental contamination, inability of the helminth eggs to withstand diverse temperatures and low sensitivity of the diagnostic method as reported by Mazigo *et al (*2010). This variation could also indicate that infection rates depend on such factors as local personal hygienic and sanitary conditions.

The prevalence of *T.trichiura* prevalence in the school children of Killiso Primary School was 2%. This was relatively in agreement with the former report (3.6%) in Babile (Girum, 2005) and 2.5% in Zarima town, North west Ethiopia (Abebe *et al*.,2011). In contrary, the prevalence of T.trichiura infection in School Children was much lower than the previous prevalence reports of the same parasites in different parts ofEthiopia,57.4% in South West Ethiopia (Abraham,2005), 21.08% in South Gondar (Mengistu,2010),19.3% in South Ethiopia (Gezahegn.2008), 66.8 % Abosa, around Lake Ziway in Bachok was much higher than the prevalence of T.trichiura infection in the present study. The low prevalence of *trichiuriasis* in the present study area might be due to climatic conditions of the study area. Climate is an important determinant of transmission of STH parasites with adequate moisture and warm temperature are essential for larval development in the soil (Brooker and Michael,2000).

4.4. Intensity of Soil Transmitted Helminth Parasitic Infections among School Children

In the present study area more positive cases for STH parasitic infections were within the range of light and few moderate infections, and there were no cases with in heavy infection of STH (Appendix Table 1). The total egg count of *A.lumricoides*, hookwormand *T.trichiura* range from 240-5136,288-888 and 240-960, respectively (Table 5). The overall average egg burden for *A.lumbricodes*, hookworm and *T.trichiura* infections were 911.8 , 399.6 ,and 517.5, respectively (Table 5). The mean egg count of *A.lumbricoides*, hookworm and *T.trichiura*in all male students was 1140 , 443.2 and 582 , respectively and the total egg burden in male Children were 845.5 (Table 5). In the same way, the mean eggs of *A.lumbricoides*, hookworm and *T.trichiura* in female Students were 673.9 , 345.2 and 466 , respectively, and the total egg load were 542.7 (Table 5).

Many epidemiological research works have shown variations in the intensity of helminth infections by age (Chan *et al*., 1996). Changes in the average intensity of infection with age implies that there was rising trend in childhood and declining trend in adulthood. Children aged 5-15 years are most affected by *A. lumbricoides* and *T. trichiura*. However, the intensity and re-infection declines in adulthood (Gilles, 1996). In contrast, hookworm frequently exhibits a steady rise in intensity of infection with age, peaking in adulthood (Bethony *et al*., 2002).

In this study, the highest mean egg count (956.3) was recorded in the age group of 11-14 years, for *A.lumbricoides* and highest mean egg count for *T. trichiura*(656) in age group of 7-10years.This trend was also observed in other studies (Brooker *et al*., 2004). This could be because of high level of soil contact activity and low personal hygiene in the youngest age group. Similarly ,lower intensity of hookworm infection was observed in age group 15-18 with an increase in 7-10 years age group with mean egg count 312 and 528, respectively (Table 5).

In the case of *A. lumbricoides*, the mean egg count (1018.5 and 694) was recorded in 7-10 and 11-14 years age group, respectively (Brooker *et al*., 2004). On the other hand in case of female students no mean egg count was observed in 15-18 years age group (Table 5). This could be because of high level of soil contact activity and low personal hygiene in the youngest age group. As the result shown in (Table 5), the intensity of *A.lumbricoides* infection was found to be higher in females than male children and in case of T.t higher in males than females.

However, the intensity of eggs of hookworm in female children aged 11-14 years was Lower than the intensity of eggs in males.

In this study, the intensity of STH infection as measured by egg per gram of faeces is generally low. The overall intensity of STH infection among the present study subjects for *A.lumbricoides*, ,hookworm and *T.trichiura* were 911.8 ,399.6 and 517.5, respectively (Table 5). It is comparable with report from Abosa around Lake Zway, south Ethiopia (Gezahegn, 2008). The low intensity level of STH infection in the present study might be due to low humidity, unfavorable soil formation, and chance difference in exposure to infection.

Table 5: The mean and range of egg counts of STH parasites (epg) per gram stool of school children.

Age group(in years)and sex	No. Exam.	*A.lumbricoides*		Hook worm		*T.trichiura*		Total egg load	
		Mean±SEM	Range	Mean±SEM	Range	Mean±SEM	Range	Mean±SEM	Range
7-10									
Male	126	115.7±35.7[a]	240-5136	528 ±68.2[a]	288-888	656 ±215.2[a]	240-960	895.6±208.1[a]	240-5136
Female	114	838.1 ±189.3[a]	312-2832	355.7±52.6[a]	256-600	528 ±48[a]	480-576	643.4±117.1[a]	216-2832
11-14									
Male	93	956.3 ±356.8 [a]	408-5136	360±42.9[a]	240-480	360 ± 0[a]	360-360	808.9±278.5[a]	240-5136
Female	87	407±23[a]	280-480	324 ±72.3[a]	192-528	46.9 ±35[a]	434-504	392.1±264.2[a]	192-528
15-18									
Male	11	0		312 ±48	264-360	0	0	312±48	264-360
Female	9	0	0	0	0	33.6 ± 0	336-336	336±0	336-336
All age group									-
Male	230	1140±275.9[a]	240-5136	443.2±451.6[a]	240-888	582±169.2[a]	240-960	845.5±162.3[a]	240 -5136
Female	210	673.9±124.8[a]	280-2832	345.2 ±40.8[a]	192-600	466±397.8[a]	336-576	542.7 ±73.7[a]	192-2832
Total	440	911.8±157.3	240-5136	399.6±318.6.1	192-888	517.5±75.1	240-960	703.5±93.8	192-5136

SEM = Standard Error of Mean, epg= egg per gram,M = male,F =female. Similar superscript letters within each age group how no significant difference between male and female (sexes) whereas different superscript letters within each group show statistically significant difference between sexes.

4.5. Observed Clinical Signs and Symptoms among Examined Children and their Relationships with STH Parasitic Infections

The study participants were examined physically for variables such as stool type, nausea, and abdominal pain by the physician and investigator. The results of the clinical signs and symptoms interms of yes and no responses summarized in Table 6. The prevalence of STH parasitic infections and clinical manifestations like nausea and abdominal pain and cough were highly significantly associated (P = 0.001 and P=0.000), respectively (Table 6).

Table 6: Observed clinical signs and symptoms among examined children (n=440) and their relationships with STH parasitic infections

Clinical Manifestations	Number	STHs		OR (95%CI)	X^2	P-value
		No .Neg.(%)	No.pos(%)			
Nausea						
Yes	78	54(69.2)	24(30.8)	2.472	10.773	0.001
No	362	304(84)	58(16)	1.423-4.295		
Abdominal pain& cough						
Yes	63	34(54)	29(46)	5.214	36.393	0.000
No	377	324(86)	53(14)	2.936-9.260		
Stool Type						
Bloody	14	10(71.4)	4(28.6)	1.785	0.941	0.332
Non- bloody	426	348(81.7)	78(18.3)	0.546-5.838		

STH=Soil Transmitted Helminth, OR=Odds Ratio

As shown in Table 6 the prevalence of STH parasite infection in children at the study site in relation to the presence of abdominal pain was ,29 (46%),and to the absence of abdominal pain was 53 (14%) . High prevalence of STH infection was observed in those children whose response was yes. The clinical manifestation abdominal pain and cough was strongly associated with the prevalence of STH parasite infection ($p<0.05$).

4.6. Major Risk Factors that Predispose School Children to Soil Transmitted Helminth Parasitic Infections in the study area.

The prevalence of helminth parasitic infection was investigated in relation with risk factors such as, availability of toilet facility, hand washing practice before meal and after toilet, eating unwashed and uncooked vegetables, water treatment, finger nail cutting habit and shoe wearing habit.

Table 7: Major risk factors that predispose school children for infection with soil transmitted helminth.

Risk factors	Frequency	STH Parasite Infection				
		No. Neg.	No. Pos.	OR(95%CI)	X^2	P-value
Toilet Facility						
At home	385	345(89.6)	40(10.4)	0.036	1.38	0.000
Open field	55	13(23.6)	42(76.4)	0.018-0.72		
Near river	0	0	0			
HWM						
Always	377	319(84.6)	58(15.4)	0.29	18.36	0.000
Sometimes	63	39(61.9)	24(38.1)	0.165-0.528		
Never						
EUWFV						
Regularly	0	0	0	2.219	10.6	0.001
Sometimes	157	115(73.2)	42(26.8)	1.364-3.609		
Never	283	243(85.8)	40(14.2)			
Water treatment						
By boiling	30	22(73.3)	8(26.7)	0.000	1.781	0.000
By chemicals	352	325(92.3)	27(7.7)	0.000-0.007		
Untreated	58	11(19)	47(81)			
Finger nail Cutting habit						
Always	208	176(84.6)	32(15.4)		22.891	0.000
Sometimes	214	175(81.8)	39(18.2)	0.000		
Never	18	7(38.9)	11(61.1)	0.000-0.007		
Shoe wearing Habit						
Yes	335	289(86.3)	46(13.7)	3.305	22.27	0.000
No	105	69(65.7)	36(34.3)	0.183-0.508		

EUWFV=Eating of Unwashed Fruits and Vegetables, HWM=Hand Wash before Meal .No=Number ,Neg=Negative ,Pos=Positive .

The prevalence of STH parasite infection in children at the study site was evaluated in relation to the presence of clinical manifestations like nausea ,24(30.8%) and(absence of nausea) 58 (16%) High prevalence of STH parasitic infection was observed in those children who responsed yes. There was a significant association between the clinical manifestation nausea and the prevalence of STH ($p<0.05$). However, There was no significant association between the prevalence of STH parasitic infection and stool type (bloody or non-bloody) ($p>0.05$).

The association between STH parasitic infection and the availability of toilet facility was statistically significant (OR=0.036; χ^2=1.38, p=0.000). High prevalence of STH parasitic infection was found among children who had no latrine facility in the home vicinity (1.38 %) compared to those who had latrine facility in their home (10.4%). This finding was supported by previous report of Narain *et al*. (2000), Girum (2005) and Olsen *et al*. (2001) who had indicated that lack of latrine and/or even poor usage of toilets were persistent risk factors of having severe infections with intestinal parasites. This was probably due to contamination of their gardens or farm lands with fecal materials which enhance the rate of transmission as they contacted with polluted soil.

The prevalence of STH parasitic infection in relation to the methods of water treatment such as boiling, Chemicals and use of untreated water were 26.7 % ,7.7 % and 81 % respectively .High prevalence of STH infections was observed in untreated water users (81 %).and the association between the prevalence of STH infection and the method of water treatment was highly significant ($p<0.05$).This was in agreement with the previous study reported by (Olsen *et al*.(2001).

Table 7 showes that the prevalence of STH parasitic infections in school children in relation to eating of un washed fruits and raw vegetables regularly, sometimes and never were 0 (0%) ,42(26.8%) and 40(14.2%) respectively. The prevalence of STH parasitic infection was found to be statistically significantly associated with eating of unwashed fruits and vegetables ((OR=2.219; χ^2=10.6, P=0.001). A similar result was reported by Mohamed *et al .(*2009) in Nasiriyah. According to this research report, children who ate sometimes unwashed/uncooked vegetables were more likely to acquire parasitic infections 42(26.8%).

compared to those whonever ate unwashed vegetables regularly 40 (14.2%). This was probably due to contamination of vegetables by inappropriate handling mechanism or contamination with fecal material in the farm. Similar findings also found in other studies growing of vegetables in fecally contaminated or polluted gardens, These were all found to be conducive for transmission of helminth infections mainly due to direct contact and a long time staying of children in dirty areas with dust and mud and eating of unwashed fruits and raw vegetables there (Erko *etal*, 1995).

As shown in Table 7 the associations were significantly very high between soil transmitted helminth infections and shoes wearing habit ($P < 0.05$). The prevalence of STH parasite infections in school children who were wearing shoes was46 (13.7%) while in those who were not wearing shoes was,46(34.3%). Hookworm infections are normally correlated with habitual barefooted children (Rebholz *et al*.,2006).In this study the bare footed children were more infected with helminths. This study was similar with the study reported by Girum (2005) and Olsen *et al*. (2001).

4.7. Association of Intestinal Soil Transmitted Helminth Infections with Socio-demographic Characteristics of School Children

The results of the questionnaire surveys for socio-demographic characteristics and their association with the STH parasites of the school children were presented in Table 8. The risk factors explored in the present study were, residence, family occupation, Training and information about personal hygiene, water source, Family educational level, (Table 8).

Table 8: Association of soil transmitted helminth parasitic infection with socio-demographic characteristic.

Risk factors	Frequency	STH Parasite Infection				
		No.Neg (%)	No.pos (%)	OR(95%CI)	X^2	P-value
Residence				0.524	5.778	0.016
Urban	344 (78.1)	288 (83.7)	56 (16.3)	0.307-0.892		
Rural	96(21.9)	70 (73)	26 (27)			
Family Occupation						
Farmer	163 (37)	124 (76)	39 (24)	0.021	7.747	0.021
Civil servant	83 (18.9)	65 (78.3)	18 (21.7)	0.04-0.028		
Private	194 (44.1)	169 (87.1)	25 (12.9)			
Training&information About personal Hygiene						
Yes	290 (65.9)	238 (82.1)	52 (17.9)	0.874	0.279	0.597
No	150 (34.1)	120 (80)	30 (20)	0.530-1.441		
Family Education Level						
Illiterate	160 (36.4)	108(67.5)	52 (32.5)	0.000	32.04	0.000
Primary	184 (41.8)	163 (88.6)	21(11.4)	0.000-0.007		
Secondary&above	96 (21.8)	87 (90.6)	9(9.4)			
Water Source						
Pipe	322 (73.2)	290 (90)	32(10)	0.000	62.1	0.000
River	71 (16.1)	44 (62)	27(38)	0.000-0.007		
Well	47 (10.7)	24 (51)	23(49)			

STH =Soil transmitted Helminths No. =Number ,Neg=Negative,Pos =Positive

In table 8,the prevalence of STH parasite infections in rural area 26(27%) and in urban area 56(16.3%) with significant difference (p-value <0.05).The current result was supported by the study reported by (Mohamed *et al*.,2009) conducted in Sudan in Kassala town, the proportion of rural infection 22.2% was higher than the urban infection 12.9%.This might be improvement in sanitary conditions, personal hygiene and awareness in urban (Albonico *et al* .,1999).

The result from Table 8 showed that the prevalence of STH in accordance to children's family occupation were jobless, civil servant and private were 39 (24),18 (21.7) and 25(12.9) respectively. The association between the prevalence of STH infections and children family occupation and education level were statistically insignificant (p<0.05).The result of the present study was not statistically agreed (p<0.05) with the study reported by Quna (1994) in Portugal. It was found that higher parasite infection among children who had jobless and private worker families.

Table 8 showed that the prevalence of STH parasite infections in school children in relation to family education level were illiterate, primary and secondary and above were 52 (32.5),21 (11.4) and 9 (9.4) respectively. The association between the prevalence of STH infections with family education level were statistically significant (p<0.05).The result of the present study was statistically agreed (p<0.05) with the study reported by (Quana ,1994) in Portugal.

As shown in table 8, Significant associations were found between parasite infections and drinking water source as well (OR= 0.000; χ^2= 62.1, p=0.000). Children who drink water from well were more likely to acquire parasite infections (49%) compared with those who drink from pipe water (10%). This pattern of infection has been reported by (Narain *et al*, 2000). Children who drinking water from well, rivers or streams were found to harbor more parasite infections than those who had drinking from pipe water. This was probably due to from contamination of water with animals and human waste that flood into the river. The current result was supported by the study conducted by Girum (2005),in Babile Town.

5. SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1. Summary

The objective of the present study was to identify the prevalence ,intensity of soil transmitted helminths parasites specie. The design of the study was a cross-sectional parasitological survey involving a sample population obtained from 7-18 aged, Killiso Primary Shool.

A total of 440 stool samples were collected and examined by Direct Wet Mount and Formol-Ether concentration methods The study showed that infections with helminthic parasites were common in the study area. The over all prevalence of soil transmitted parasite infections was among 440 students 82 (18.6%) were infected.

The prevalence of STH parasites, *Ascaris lumbricoides,* Hookworm and *Trichuria trichuria* infections was 46 (10.5%), 27(6.1%) and 9 (2%), respectively. The prevalence of STH infection among school children both male and female in age group ,7-10, 11-14 and 15-18 was 48(20%), 31(17.2%) and 3(15%) respectively. The predominant helminth parasites involved in this study were *Ascaris lumbricoides,* 46 (10.5%), Hookworm, 27(6.1%) and *Trichuris trichiura,9* (2%) The mean egg count and range of *A. lumbricoides,* Hookworm and *T. trichiura* were 911.8 (ranged, 240 to 5136), 399.6 (ranged,192 to 888) and 517.5 (ranged, 240 to 960) egg per gram of feces, respectively.

The rates of prevalence of soil transmitted helminth infections in Killiso Primary School mainly due to drinking unsafe water, level of family education ,absence of toilet facility (defecting at open field),neglect hand wash before meal and after toilet ,drinking untreated water, absence of shoes and direct contact of children for long time in unclean areas with dust and unwashed fruits and uncooked or unwashed raw vegetables before eating. and was statistically significant ($p<0.05$).

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5.2. Conclusion

The common soil transmitted helminth species diagnosed among 7-8 aged children of Chiro town were *Ascaris lumbricoides*, Hookworm and *Trichiuris trichiura*. The finding reported in the present study was that soil transmitted helminths infections represent a health problem among under-fourteen aged school children of Chiro town. Most STH parasite infections represent a child health threat because of their contaminated water and food born transmission. *A.lumbricoides* and *Hookworm* were found as a dominant species helminth parasites infection diagnosed in the stool samples of the children and have a higher prevalence in the age group of 7-10 years old in the study area.

In this study risk factors associated with STH parasite infections were, toilet facility neglected hand wash before meal and after toilet, eating unwashed fruits and uncooked vegetables, the way of water treatment method and shoes wearing habit were significantly associated with STH parasite infections and plays a great role in the prevalence helminths parasites. Providing of washed fruits and cooked vegetables, proper toilet condition, well protected and treated drinking water, proper education on hygienic and environmental sanitation would help in reducing the prevalence of soil transmitted helminthes parasites infection.

5. 3. Recommendation

- Regular deworming programme for school children should also be put in place to keep STH parasite infection intensities level low.
- High proportion of Soil Transmitted Helminth parasites in the present study indicates that more efforts are expected to be done in improving the health of the community from soil transmitted Helminth parasitic infections.
- This invites for the initiation of control measures to soil transmitted helimenth parasitic infections including health education concerning soil transmitted heliment parasites, treatment of infected individuals, improvement of sanitation etc.

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7. APPENDICES

Appendix I.

Appendix table 1

Intensity of soil transmitted helminths among school-children

Age in yrs/sex	No exam.	A. lumbricoides		Hookworm		T .trichiura	
		Light	Moderate	Light	Moderate	Light	Moderate
		1-4999(epg)	5000-49999(epg)	1-1999(epg)	2000-3999(egp)	1-999(epg)	1000-9999(epg)
7-10							
Male	126	13(10.3)	1(0.8)	8(6.3)	-	3(2.4)	-
Female	114	13(11.4)	-	8 (7)	-	2(1.75)	-
Total	240	26(10.8	1(0.4)	16(6.6)	-	5(2.1	-
11-14							
Male	93	10(10.7	1(1.1	5(5.4)	-	2(2.1)	-
Female	87	8(9.2)	-	4(4.5)	-	2(2.3)	-
Total	180	18 (10)	1(0.5)	9(5)	-	4(2.2)	-
15-18		-	-				
Male	11	-	-	2(18.2)	-	-	-
Female	9	-	-	-	-	1(11.1)	-
Total	20			2(10)		1(5)	

Appendix table 2

Major soil transmitted helminth parasite species identified in school children, Chiro Town Killiso Primary School, Eastern Ethiopia, February-April 2017

Age group (years&sexes)	No Exam	AL No. pos(%)	HW No.pos(%)	TT No. pos(%)	X^2	P-Value
7-10						
Male	126	14(11.1)	8(6.3)	3(2.4)	0.158	0.984
Female	114	13(11.4)	8(7.1)	2(1.7)		
11-14						
Male	93	11(11.8)	5(5.4)	1(1.1)	0.779	0.854
Female	87	8(9.2)	4(4.6)	2(2.3)		
15-18						
Male	11	0	2(18.2)	0	2.88	0.236
Female	9	0	0	1(11.1)		
All age group						
Male	230	25(10.8)	15(6.5)	4(1.7)	0.432	0.934
Female	210	21(10)	12(5.7)	5(2.4)		
Total	440	46(10.5)	27(6.1)	9(2)		

AL=*Ascaris lumbricoides* HW=Hookworm TT=*Trichuris trichiura*

Appendix II.

Written consent form

An ensuring format of parents whose children are not old enough to respond to questionnaires.

Part one: A format of gathering data for parents whose children are not old enough to response questionnaires.

My name is-- I am a post graduate student

in Haramaya University, Natural and Computation Sciences Collage, Biology Department and marking on a Thesis for masters' degree partial fulfillment

I am conducting a study to soil transmitted helminth infections and associated risk factors. You are being to participate in this study if you agree. I would like to obtain stool samples in a disposable spoon from your children, which will be used only to detect the presence of STH parasites. There is no serious risk in participating.

The objective of this study is intended to improve your and your family health. Hence, I honestly need your voluntariness and genuine information for it's of successful results.

Your name, special address, personality and information's you have provided are not indicated with what so ever ways explicitly. Despite your willingness, the researcher assures you have a right not to cooperated if you don`t want to do so. My respectful greetings go to you here.

I would like to thank you so much for your voluntariness to complete this Questionnaire.

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; -----------------

Signature of children parent's/care taker's: ------------------------ Date: -----------------

Date of the questionnaire held -------------------, starting time-----------------Ending time ------------

Appendix III.

Questionnaires used to be collect some demographic characteristics of the study participants

This is questionnaire to determine the prevalence of soil transmitted helminthsparasite infection and associated risk factor among Killiso primary school children Western Hararghe ,Oromia region, Ethiopia

Introduction :*My name is*_________________________. I am working as data collector in this research project run by Haramaya University, School of Graduate Studies, Department of Biology We are interviewing the community members to asses the prevalence of STH. I kindly request you to participate in the survey that will be appreciated and so mach useful for the region and country for future planning and evaluating the existing prevention and control measures of STHs.

Confidentiality and consent**: I am** going to ask you some questions that you are going to answer freely. your answer are completely confidential. You do not have to answer any question that you do not want to answer, and you may end this interview at any time you want to. However, you honest answer to these questions will help us better understand your knowledge of prevalence of STH. We will greatly appreciate your help in responding to this survey. The interview would take about 15-20 minutes.

Would you be willing to participate ?

If yes continue

If no, stop here

1. Child sex's Male ☐ Female ☐ Age ____ and Code no____

2. Residence: A. Rural ☐ B. Urban ☐

3. Occupation A. Jobless ☐ B. Civil servants ☐ C. Private ☐

4.Where do you defect and dispose the feces? A. At home ☐ B. Open field ☐ C. Near the river ☐

5. How often your child wash hands before eating meal? A. Always B. Som times C. Never

6.Where do you get drinking water from? A. pipe B. River C. well

7.How do you use drinking water? A. by Boiling B. by chemicals C Untreated

8. Do your child wear shoes? A. Yes B. No B No

9. How often you cut your child nail when grown? A. Always Some times C. never

10.Did you get information and training about personal and environmental hygiene and sanitation respectively so far ?A. Yes B. No

11.How often your child eat unwashed and uncooked fruits and vegetables? A) Always B) sometimes C) nev

12. Family educational states A. Illiterate B. Primary C. ndary and above

13.Does your child show a symptom of nausea? A .Yes B. No

14.Is there a symptom of abdominal pain and coughing on your child? A. Yes . No

15.Does your child's stool contain A. Blood B. No-blood

Questionnaire (Afan Oromo version)

Unka waliigaltee

Ani waa'ee dhukkuba raammolee maxxantuu biyyeetiin daddarbanii fi ka'msa isaanii maal akka ta'e qorannoo gaggeessan jira;atis qorannoo kana rratti qooda akka fudhattubarbaadnee yoo fedha qabaatte qo'annoo kanarratti hirmaadhu.jiraachuu raammolee maxxantuu kana beekuuf boolii xiqqoo barattoota irraa fudhadhee laaboraatooriitiin ilaala.Kun immoo rakkoo fidu hin qabu

Seensa

Maqaan kiyyaa____________________________jedhama.HaramayaaUnivarsiittii muummee Baayolojii keessattii digirii lammaffaa barachaa jirutti qoannoo fi qorannoo hojjechaan jira.kaayyoon qorannoo kanaas fayyuummaa keetiif maatiikee fooyyessa.Kanaaf odeeffanoo sirriif dhugaa ta,e akka naaf kennitu hayyama kee gaafadha.maqaa,teessoo fi waa'een dhuunfaa kee ibsuu hin barbaachisu.Akkasumas qoa'nnoo kanarratti hirmachuu dhiisuuf mirga akka qabdu qorataan kun si mirkaneessa.

Gaaffii kan jalqabdanii yoo isin nuffisiise addaan kutuu ni dandeessu waan ta,eef hin sodaatiinaa.Gaaffichi daqiiqaa 15-20 fudhachuu danda'a.haalli qorannoo kanaa naaf galeera.

-Yeroon fedhettis akkan hirmaacuu dand'us mirga koo naaf ibsameera.

kanaaf hirmaachuuf fedhii qabduu?

Eeyyee yoo ta'e ;itti fufi

Lakki yoo jette ;asumatti dhaabi

Guyyaa gaaffiin itti gaafatame_________ sa'aa itti jalqabame______sa'aa itti dhume______

Koodii _________________

Maqaa qoratamaa _________________mallattoo _______________Guyyaa __________

Maqaa qorataa _______________ Mallattoo ________________Guyyaa____________

Gaaffilee kana naaf guutuuf hayyamamaa ta'uu keetiif bay'een sigalateeffadha.

Mallattoo maatii/guddiftootaa ______________________Guyyaa ____________

1.Saala daa'imaa Dhi ☐ B.Dub ☐ umurii________koodii icciitii______

2.Bakka jireenyaa A.Baadiyaa ☐ B.Magaalaa ☐

3.Haala hojii A.Hojii dhabeessa ☐ B.Hojii mootummaa ☐ C.Dhuunfaa ☐

4.Boolii eessatti baata? A.Mana fincaanitti B.Dirreerratti ☐ C.Laga cinaatti

5.Daa'imni kee hammamif nyaata duraa harka dhiqata?A.Yeroo hunda ☐ B.Yeroo tokko tokko ☐ C.Homaa ☐

6.Bishaan dhugaatii eessaa argatta? A.Ujummoo ☐ B.Laga ☐ C.Boolla ☐

7. Bishaan dhugaatii akkamitti fayyadamta? A.Danfisuun ☐ B.keemikaalaan ☐ C.Akkasumatti ☐

8. Daa'imni kee kophee ni hidhataa ?A.Eeyyee ☐ B.Lakki ☐

9.Qeensi daa'ima kee yeroo guddatu hangamiif qorta? A.Yeroo hunda ☐ B.Yeroo ☐ tokko ☐Hin qoramu

10.Kana dura waa'ee qulqullina dhuunfaa fi naannoo kee odeeffannoo fi leenjii arggattee beektaa? A.Eeyyee ☐ B.Lakki ☐

11.Daa'imni kee kuduraa fi fuduraa hin dhiqamne hammamiif nyaata?A.yeroo hunda ☐ B.Yeroo tokko tokko ☐ C.Homaa ☐

12.Haalli barumsi maatii maal fakkata?A.Hin baranne ☐ B.Sadarkaa tokkoffaa ☐ C.Sadarkaa lammaffaa fi isaa ol ☐

13.Mallattoon dadhabbii daa,ima kee irratti ni mul,ataa? A .Eeyyee ☐ B.Lakki ☐

14.Malattoon garaa dhukkubbii fi qufaa irratti ni jiraa? A.Eeyyee ☐ B. Lakkii ☐

15.Booliin daa,imaa A.Dhiiga ni qaba ☐ B. Hin qabu ☐

Appendix IV

Laboratory data collecting format

Code	Sex	Age	Date/Month /Year	Presence/Absence	Parasites identified in the stool examination				Single infection	Double infections	k
					AL	**HW**	**TT**	**SS**			

Key :AL=*Ascaris lumbricoides*
HW= Hookworm
TT = *Trichiuris trichiura*
SS= Strongyloide stercolaris

Figure 5: During Stool examination at Chiro Hospital