HEMATOLOGICAL PROFILE OF SCHOOL CHILDREN WITH AND WHITHOUT INTESTINAL PARASITIC INFECTIONS

IN FIK DISTRICT, ERER ZONE, ETHIOPIAN-SOMALI REGION

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LIST OF ABBREVIATIONS AND ACRONYMS

CDC	Central for Disease Control and Prevention
Hb	Hemoglobin
HLA	Human Leukocyte Antigen
IPIs	Intestinal Parasitic Infections
NGOs	Non Governmental Organizations
PCV	Packed Cell Volume
RBCs	Red Blood Cells
Rh	Rhesus factor
STH	Soil Transmitted Helminthes
WBCs	White Blood Cells

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HEMATOLOGICAL PROFILE OF SCHOOL CHILDREN WITH AND WITHOUT INTESTINAL PARASITIC INFECTIONS IN FIK DISTRICT, ERER ZONE ETHIOPIAN- SOMALI REGION.

ABSTRACT

Parasite infections are a disease conditions associated with the presence of parasite in a host's body. And It is believed that infections caused by parasites have an effect on hematological parameters. Hence this study was designed to investigate the effect of intestinal parasites infections on Packed Read Cell Volume (PCV), Hemoglobin (Hb) concentration, and blood groups frequencies as well as to investigate the intestinal parasite prevalence among school children. Stool and blood samples were collected from 420 students which 239 were males and 181 were females in five selected Schools at Fik District, Erer Zone of Ethiopian-Somali Region. Regarding the age categories of the study participants,107 were 7-10 years old, 192 were 11-14 years old and 121 were 15-18 years old. Stool samples were examined using direct wet mount and Formal-ether concentration methods. It was obtained 178 students were positive with intestinal parasites and 242 students were without intestinal parasite infections. Furthermore, in order to determine hematological blood difference of infected students with the non-infected students, blood samples were examined using haematocrit, haemometer and ABO blood grouping techniques for the determination of packed red cell volume (PCV) value (%), hemoglobin (Hb concentration (g/dl) and blood group, respectively. It was revealed that the mean PCVand Hb blood groups were not significantly different between the infected and non-infected individuals; for blood group frequencies O+ and A+ were the most frequent blood groups among the intestinal parasite negative and positive students, respectively. Age and sex infection rate, were not seen significant difference, it was also observed that males had higher PCV with (32.0%) and Hb with (10.6g/dl) than the females with (31.0%) and (10.3 g/dl), respectively regardless of infections. In conclusion, this study shows that there was slight difference in relationship between intestinal parasites and sex difference in their hematological parameters (PCVand Hb) but the different was not statistically significant both p values (p>0.05) and frequency rate.

Key words: *Hematological profiles, intestinal parasites, Fik*

1. INTRODUCTION

Intestinal parasite infections are group of infections caused by one or more species of protozoa, cestodes, trematodes and nematodes. Parasitic infections are responsible for some of the most frequent disease conditions in tropical and sub-tropical communities (Orji *et al*., 2012).

Ethiopia is one of such areas where infection caused by intestinal parasites is a public health hazards due to the poor socio-economic conditions which are the major associated factors among those affected peoples (Orji *et al*., 2012).

These parasites are responsible for the major share of morbidity and mortality in those communities where there is over-crowding, poor environmental sanitation and personal hygienic practice, which make them a great concern for the developing countries.). Numerous studies have shown that the prevalence of intestinal parasites may approach up to 89% in developing countries (Adeyaba and Akinlabi, 2001)..

Parasitic infections caused by helminths and protozoa are the major causes of human diseases in most countries of the tropical region. It is estimated about 3.5 billion people in the world are infected with intestinal parasites, of whom 450 million are ill (Keiser and Utzinger, 2010).

Extensive studies shown that Components of natural immunity of which blood cells are involved provide an important defense mechanisms (Baker and Silverton,1985). Hematological parameter such as hemoglobin (Hb), packed cell volume (PVC), white blood cell count (WBC) and platelets are very vital in the diagnosis of diseases (Dage et al.,1984) .

It is believed that intestinal parasitic infections may affect hematological parameters such as hemoglobin concentration. Blood parameters help in the evaluation of the health condition of the individual to detect disease and also assess the patient's response to treatment (Uzoaru,2007). Anemia in children is defined by the World Health Organization as a hemoglobin concentration below 11 g/dl for children (0.5 - 5.0 yrs) and 12 g/dl for teens (12 - 15 yrs) (WHO 2008). It can denote decreased oxygen binding ability of each hemoglobin molecule due to deformity or lack in numerical development as in some types of hemoglobin deficiency (Saimak,2009). High parasitic load affects hemoglobin level in the blood of individuals (WHO, 1987). Most available literatures on intestinal parasites in Ethiopia lack information about effect of parasite infections on hematological values of affected individuals. It was observed that a decrease in the hemoglobin concentration of children infected with intestinal parasite from single to multiple infections. These may be due to the number of intestinal parasite present in the intestine; and the metabolic process of the parasite reduces the immune response as a result of malnutrition or change in the life style of the infected person.

The association between low hemoglobin and parasite positivity seems possible because intestinal parasites are lodged in the duodenum and jejunum, the site of iron absorption (Shamari; Khaja,Khawasky 2001). Hookworm infection is known to result in anemia due to chronic blood loss.The relationship between parasite infection and anemia is a pathogenic-physiologic type, it is recognized that certain factors play an important role. They include the speciesand number of the parasite, the size and site, metabolic process of the parasite, particularly the nature of waste products, age and level of immunity at the time of infection or presence of co-existing condition which reduce immune responses, malnutrition and the life style of the person infected(Shamari; Khaja,Khawasky 2001).

Anemia caused by parasitic infections with nutritional deficiencies is due to insufficiency of iron, folic acid, B-complex and protein (Blumenthal, and Scheltz, 1976). Mucosal changes have been reported in subjects infected with intestinal parasites. Gastric juices that facilitate iron absorption have been found to be reduced during ascariasis. Shortened gut transit time which accompanies intestinal infection can potentially reduce iron absorption from the gut.

Extensive studies during the last one to two decades conducted in different populations have worked out normal reference ranges for hematological parameters in adults and children and have reported significant differences in different population groups. Nutrition and physiology also influence hematological parameters (Evans, Frezer and Martin*et al*, 1999).The red blood cell count showed a statistically significant increase when compared infected with non-infected individuals by parasitic infections. This might be due to poor nutrition caused by the parasitic load, or may also be due to the presence of sub-clinical iron deficiency.

Fik district (wodeda) is one of the districts in Erer zone of Ethiopian-Somali Regional State which is included under the list of intestinal parasite endemic districts in Somali Region, although intestinal and blood parasites prevalence data are scanty for this district. So far there was no data on the relationship between intestinal parasites and hematological profiles have been generated for this area. Thus the purpose of this study was to generate baseline information on the relationship between intestinal parasitic infection and hematological profile of school children in Fik district, Erer zone, Ethiopian- Somali Region.

OBJECTIVES OF THE STUDY

General objective of the study was:

- To investigate the hematological profile of school children with and without intestinal parasite infection in Fik District, Erer Zone, Ethiopian-Somali Region.

Specific objectives were:

1. To analyze the prevalence of the major intestinal parasitic infections among school children in five selected primary schools in fik district.
2. To determine the Packed Red Cell Volume (PCV) and hemoglobin concentration of school children with and without intestinal parasitic infections in the study area.
3. To observe the ABO and Rh blood group frequencies of school children with and without intestinal parasitic infections in the study area.

2. LITERATURE REVIEW

2.1. Life Cycle of Intestinal Parasites and Pathogenesis

Intestinal parasite infection is a condition in which a parasite infects the gastro-intestinal tract of human and other animals. Such parasites can live any were in the body but most prefer the intestinal wall.

Giardia lamblia (protozoan) is a flagellate protozoa that exists in trophozoite and cyst form. The cyst form is resistance to drying and other environmental affects. Infection is limited to the small intestine and/or biliary tract. It is transmitted through food and water contaminated by sewage and food handling with poor hygiene, or through fecal-oral routes. Infection is more common in children than in adult. Patients with clinical illness may develop acute watery diarrhea with abdominal pain, or they may experience a protracted, intermittent disease which is characterized by passage of foul-smelling diarrhea or soft stool associated with flatulence, abdominal distention, and anorexia (Minnesota Refugee Health Provider Guide, 2013).

Entoamoeba histolytica does not require any intermediate host. Mature cysts are passed in the feces of an infected human. Another human can get infected by ingesting them in fecal contaminated water, food or hands. If the cysts survive the acidic stomach, they turn into trophozoites in the small intestine. Trophozoites migrate to the large intestine where they live and multiply by binary fission; both cyst and trophozoite are sometimes present in the feces. The cysts are usually found in a firm stool, whereas trophozoites are found in a loose stool. Only cysts can survive longer periods (up to many weeks outside the host) and infect other humans. If trophozoite are ingested, they are killed by the gastric acid of the stomach.

The *E. histolytica* cell differentiation takes place inside the colon, during this process the trophozoite stops its pseudopods formation, the nuclei starts division, the characteristically irregular shape is lost and the cell takes a spherical form at the time that a thick cystic wall appears. The trophozoite differentiation concludes with the tetra nucleated cyst formation (Martinez-palomo and Espinosa-cantellano.2003).

Schistosoma species encompasses three distinct phases of clinical manifestation and on a world wide scale is one of the most common causes of hematuria. Individuals exposed to various *Schistosoma* species. The schistosome will initially produce a pruritic papupar dermatatis after penetration of the skin by cercariae. This referred to as "swimmer's itch" and can be contacted from fresh water. Human pathogenic species include the following:*S. mansoni*, *S. japonicum*, *S.heamatobium, S. mekongi, and S. intercalatum.*These species rely on the presence of fresh water snail as intermediate host and have various geographic distributions. The *S.mansoni* is found mainly in tropical Africa , Latin America, the Caribbean and the Arabian Peninsula. The *S. haematoobium* is found mainly in Africa and the eastern Mediterranean area. *S. mekongi and S. japonicum*, as their names reflect are found mainly in the Mekong river delta and in parts of China , the Philippines, and Indonesia, respectively.

After skin penetration, the organism migrates through the blood stream via the lungs before ultimately lodging in the venous plexus draining the bladder (*S. heamatobium*) or the colon. After four to six weeks an acute illness (characterized by fever, malaise, cough, rash, abdominal pain, nausea, diarrhea, lymphadenopathy and eosinophilia) ensues and is termed "Katayama fever" with heavy gastrointestinal infection, bloody diarrhea and tender hepatomegaly may occur.

Chronic disease reflects the worm burden and fibrosis with inflammation at the site of deposited eggs. Infected individuals may be asymptotic with light infestation. Heavy colon involvement may cause chronic bloody, mucoid diarrhea, abdominal pain, hepatosplenomegaly, ascites, and esophageal varices (due to portal hypertension).

Bladder symptoms related to inflammation and fibrosis may include dysuria, terminal hematuria (microscopic or gross), secondary UTIs, and pelvic pain (Minnesota Refugee Health Provider Guide, 2013).

Another important common helminth parasite of childen is *Hymenolepis nana,* in which their eggs are immediately infective when passed with the stool and cannot survive more than 10 days in the external environment. When eggs are ingested by arthropod intermediate host, they develop in to cysticercoids which can infect human or rodent upon ingestion and develop in to adults in the small intestine. A morphologically identical variants , *H nana var. fratena* , infects rodents and uses arthropods as intermediate host. When eggs are ingested in contaminated food or water or fromhands contaminated with feces, the oncospheres contained eggs are released. The oncospheres penetrate the intestinal villus and develop in to cysticercoids larvae. Upon rupture of the villus, the cysticercoids return to the intestinal lumen, evaginate their scoleces, attach to the intestinal mucosa and develop in to adults that reside in the ileal portion of the small intestine producing gravid proglotods. Eggs are passed in the stool when released from proglotods through its genital atrium or when proglotods disintegrate in the small intestine. An alternate mode of infection consists of internal autoinfection, where the eggs release their hexacanth embryo, which penetrate the villus continuing the infective cycle without passage through the external environment. The life span of adult worms is 4 to 6 weeks, but the internal autoinfection allows the infection to persist for years (CDC)

Ascaris lumbricoids (Helminths) is one of the most common and important soil transmitted helminthes parasites which has cosmopolitan distribution largely determined by the local habits in the disposal of the feces because its eggs reach the soil in the human feces and so contaminate the human environment (Kighlinger *et al.,* 1998). The parasite is the one of the major public health problems in the community where the prevailing social environment is characterizing by the poverty, poor housing and inadequate sanitary practices and overcrowding (chan, 1997 and chan *et al.*,1994). *A lombriciods* have been shown to play a significant role in childhood malnutrition which leads to growth retardation cognitive impairment and poor academic performance resulting in a poorer quality of life and les ability to contribute to society (Drake *et al.*,2000).

1. Adult worm 2. Unfertilized egg 3. fertilized egg become infective 4. infective stage swallowed 5.Larvae hatch

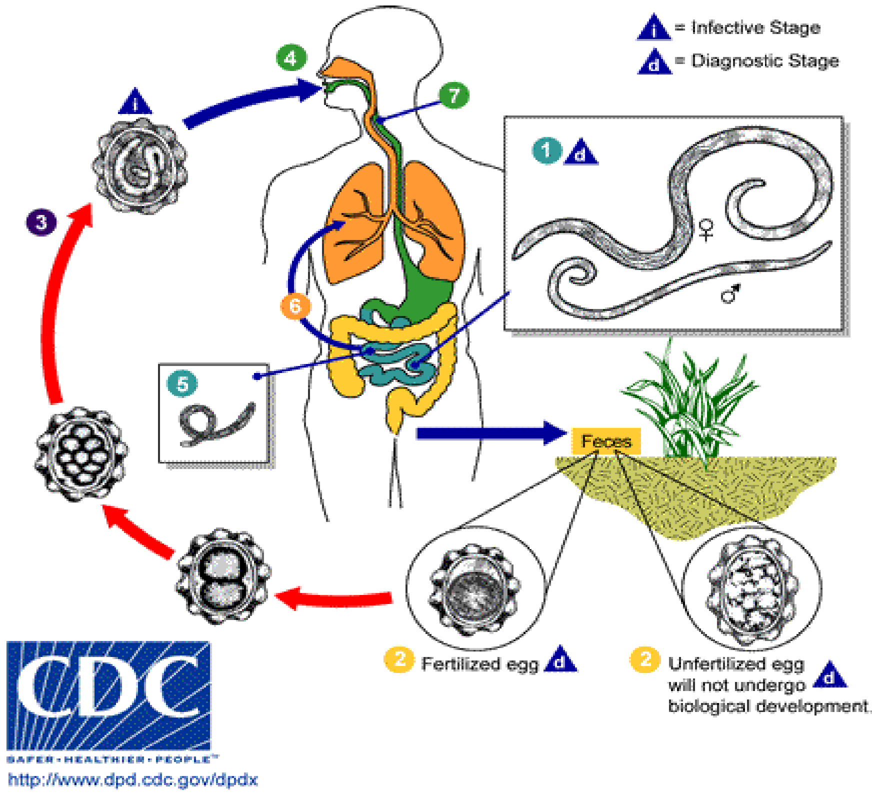


Figure 1 . Life cycle of *Ascaris lumbricoides* (source,CDC,2009)

Infection with *Trichuris tichiura*is the third most common helminthes infections of human (Peters and Pasvol, 2005). The distribution of tichuriasis is worldwide being most abundant in the warm moist regions of the world . it is spread via fecal-oral transmission and high prevalence occurs in areas with tropical weather and poor sanitation practices (Bethony *et al*., (2006). The parasite commonly occurs together with *A. lumbricoids* and likewise mainly affects children. Transmission may occur through the medium of food or water or directly from hands of individuals . Children may be heavily infected and constitute important reservoirs.

2.2. Epidemiology and Geographic Distribution of Intestinal Parasites

2.2.1. Global Epidemiology and Geographic Distribution of Intestinal Parasite

Intestinal protozoan parasite infections enjoy a wide global distribution. They are estimated to affect 3.5 billion people. Most of who are children and young residing in developing countries the major intestinal protozoan of global public health concern protozoan species are *Entoamoeba histolytica* , *Giardia lamblia* and *Cryptosoridium* species (WHO, 2000).

Intestinal protozoan parasitic infections are endemic worldwide and have been described as constituting the greatest single worldwide cause of illness and disease. Poverty, illiteracy, poor hygiene, lack of access to potable water and host and humid tropical climate are the factors associated with intestinal parasitic infections. Parasitic intestinal protozoa and helminthes are responsible for some of the most devastating and prevalent diseases oh humans. Intestinal protozoan parasitic infection constitute a global health burden causing clinical morbidity in 450 million people many of these women of reproductive age and children in developing countries (Quihii *et al.,* 2006) .

Intestinal parasitic infection are among the most common infectious in the world and are responsible for considerable morbidity and mortality (Kongs *et al*.,2001). The epidemiology of intestinal parasitic infections shows that these parasites are found in every group and in both sexes. However the incidence is high in some areas and in some age groups. Human intestinal parasitic infection has a worldwide distribution with greatest incidence and intensity occurring in developing countries (Mccarhty *et al*., 2004).

Invasive amoebiosis is prevalent in certain areas of the world including west and south-east Africa, China, and Mexico. In Tehran province, the highest infection rate (41.5%) was relatedto protozoan parasites. *Entomoeba histolytica* has been recovered worldwide and is more prevalent in the tropics and sub-tropics than in colder climates. However in poor sanitary conditions in temperate and colder climates, infection rates have been found to equal that seen in the tropics. In a related study in Ardabil Iran,a total of 10 species were identified with *Giardia lamblia* (14%), *Blastocystes homonis* (10%), and *Entoamoeba coli* (4.1%), being the most common parasites (Aksow *et al;* 2005).

Giardia lamblia also has a worldwide distribution with an incidence rate or between 11% and 30%. in the united states of America, it is now considered to be the most common intestinal parasite of man and the leading cause of diarrhea due to protozoan infection in human. It is also the most frequent reported intestinal parasite in peru (Beltran *et al*., 2004).

Intestinal infections in general affect more than two-thirds of the human population and mostly children. The intensity of the infection is a major determination of morbidity and approximately reflected in the number characteristics cysts passed out in a feces (Kongsw *et al*., 2001). *Giardiasis* is one of the most common parasitic infection having a worldwide distribution and according both in developed and developing nations. In Africa, Asia, and Latin America about 200 million cases have been estimated to occur annually.

Soil transmitted helminthes infection are widely distributed in tropical and sub-tropical areas and since they are linked to lack of sanitation, occur where ever there is poverty, STH s are with the greatest public health burden occurring in developing countries particularly in sub-Saharan Africa (Bethony *et al*., 2006).

More than 1.5 billion people or 24% of the world's population are infected with STH infections worldwide. Infections are widely distributed in tropical and sub-tropical areas, with greatest number occurring in sub-Saharan Africa, Americans, China and East Asia. Over 270 million preschool age children and over 600 million school age children in areas where these parasites are intensively transmitted and one in need of treatment and preventive intervention (WHO, 2016).

2.2.2. Epidemiological and Geographical Distribution of Intestinal Parasites in Ethiopia

Nineteen communities located in the southern part of the Ethiopian Rift Valley were surveyed for soil-transmitted helminth parasites of man (Brrie *et al*., 1994). Parasites encountered included *A.lumbricoides* (1.2 %), *T. trichiura* (10.3%),hookworms *(*25.3%), *Taenia sp. (8.1%),E. vermicularis* (0.1%),*Strongyloids sp*.(2.9%)*and H.nana* (0.8%),In some communities the prevalence of hookworms, *A. lumbricoides* and *T. trichiura* reached 70%,66%, and 60% , respectively.According the study conducted in 6 districts in the south Gonder Zone of the Ahmara National Regional state, 2279 school children were examined for helminthes (Jemaneh,2000). The overall prevalence rates were 28.9%, 9.5%, and 12.9% for *A.lumbricoides*, *T.trichiura* and hookworms, respectively .

In 2002, a parasitological survey was made to determine the magnitude of soil transmitted helminthiasis inWondo genet area, southern Ethiopia. The prevalence of infection for

Ascarislumbricoides and *Trichuris trichiura* among school children was 83.4% and 86.4% respectively (Erko and Medhin, 2003). Ledesse and Erko (2004) also reported high helminthiasis prevalence in primary school children in southeast of Lake Langano.

Dawit Ayalew, (2006) showed that the higher prevalence of crytosporidiosis, giardiasis and amebiasis has been found among children below 14 years old with an average prevalence rate of 11.9%, 38% and 33.7% respectively in Dire Dawa.

2.3. Factors Influencing Human Blood Parameters

2.3.1. Effect of intestinal parasites on Hematological Profile

The values of hematological parameters are affected by a number of factors even in apparently healthy populations. These factors include age, sex, ethnic background, body build, social, nutritional, environmental factors and infections caused by parasites (Petrova ;1976). It has been demonstrated in several studies that some of the hematological parameters exhibit considerable variations at different periods of life. At birth, the total hemoglobin (Hb) level, red blood cell (RBC) count, and packed cell volume (PCV) are shown to be higher than at any other period of life,(Frerich, Wabber, Srinivasan , Berenson , 1977). The levels of these parameters then decrease during the next few months after birth, some more steeply than others, with the cells becoming hypochromic due to the development of physiological iron deficiency anemia.The Hb content and red cells then gradually rise to adult levels by the age of puberty.

Several studies have been carried out in children at various ages and in adolescents, and significant differences have been reported in different populations, seasons, racial and ethnic groups, and gender subgroups.(Taylor , Holand , Spencer , Jackson; Haematol 1997;). Genetic factors are shown to significantly contribute to all blood cells measurements accounting for between 61-96% of variance(Santiago Borrero; 1981). In almost all studies, the ethnic and gender differences are significant.

Systems of natural immunity have ability to provide significant defense mechanisms of which blood cells are involved (Baker and Silverton,1985). Hematological parameter such as hemoglobin (Hb), packed cell volume (PVC), White blood cell count (WBC) and platelets are very vital in the diagnosis of diseases (Dage *et al*; 1984). Intestinal parasites are microbial pathogen that cause fatal a disease conditions. It is understood that intestinal parasites affect hematological parameters.Intestinal parasitic infections (IPIs) are among the most prevalent diseases in Sub-Saharan Africa (SSA).

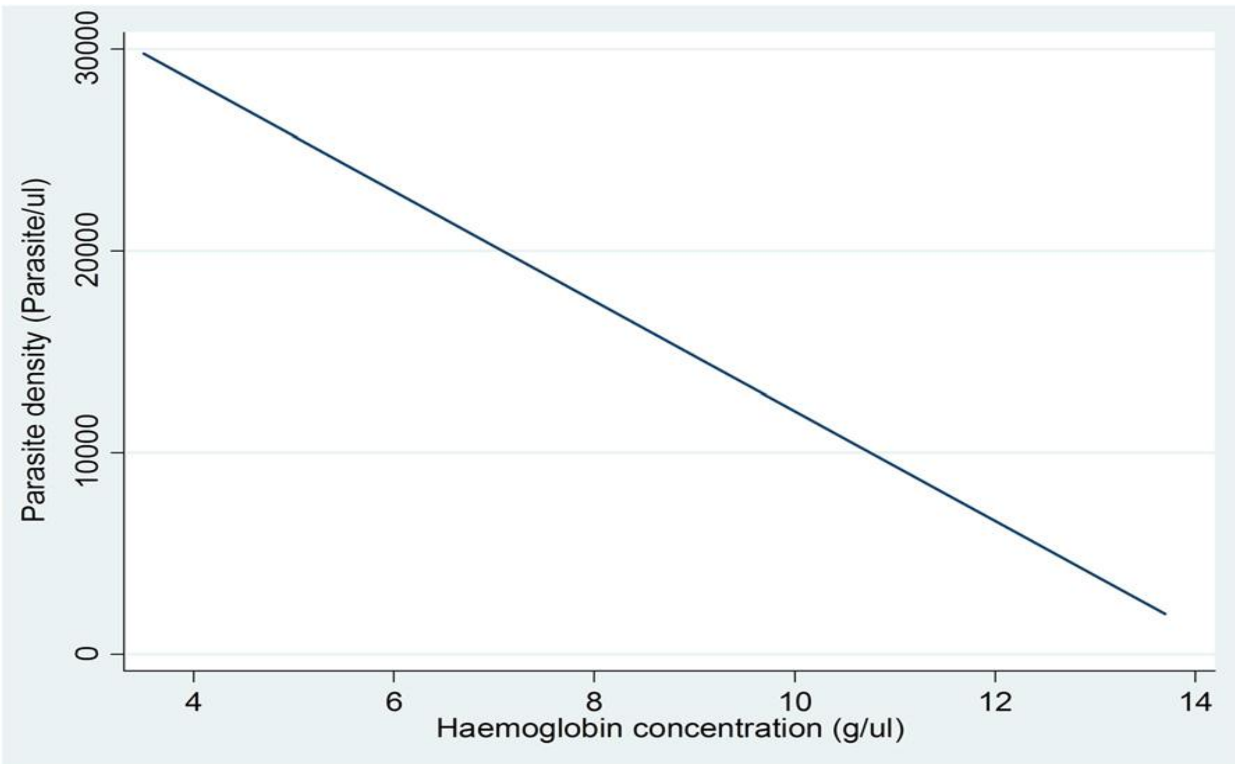


Figure 2. Relationship between Parasite Density and Hemoglobin Concentration

Although there has been a decline in the global prevalence of malaria (due to an increased number of funding bodies that have been contributing to the fight against the disease in the last decade), hundreds of thousands of people still die from the disease every year. The most vulnerable group is children (Central for Disease Control and Prevention and Malaria Worldwide, 2014). In 2013, 198 million cases of malaria and 584,000 deaths were reported (WHO; 2014). The majority of deaths from these parasitic infections occurred in children under 15 years of age (Murray senfeld; et al. 20120).

IPIs constitute a major public health problem, as these areas are often characterized by all the conditions favoring transmission of these infections, including a humid climate, unsanitary environments and poor socio-economic conditions. Helminths or protozoa, or both, cause IPIs. Neglected IPIs, particularly infection with helminths (helminthiasis), are a major cause of morbidity, especially in resource-limited settings (Zeukeng and Makoge; et al.2014].The incidence of IPIs is approximately 50 % in developed countries and reaches up to 95 % in developing countries. (Hotez, Fenwick, Savioli, and Molyneux; 2009). Due to malaria's and IPI's overlapping distribution, concomitant infection with malaria and intestinal parasites is common in developing countries, especially in low income countries . Co infection causes varying effects in the host. Concomitant infections in children have been shown to adversely affect their development and learning capabilities (Grantham-Gregor, Ani; 2001), and have been associated with increased susceptibility to other infections (Nacher, Singhasivanon, Yimsamran; *et al.,* 2002). Studies have shown that individuals co-infected with more than one parasite species are at risk of increased morbidity (Mwatha, jones, and Mohamad; *et al*., 2003), as well as an increased risk of developing more frequent and severe diseases due to interactions among infecting parasite species . Concomitant infection with malaria and intestinal parasites is also associated with anemia. Intestinal parasitic infections, especially those with hookworm and Trichuris trichiura, cause anemia by increasing blood and iron loss in the intestinal tract. Meanwhile, IPI is associated with a decrease in the amount of hemoglobin, increased destruction of parasitized red blood cells (RBCs), shortened lifespan of non-parasitized RBCs and decreased production of RBCs in the bone marrow, which eventually leads to anemia,(McDevitt, Xie; 2004). Little research has been done to investigate the association between malaria and IPI coinfection with anemia in children. Moreover, no study of this sort has ever been conducted in the health district of Fik,the current study area which is characterized by high intestinal parasitic infection . Therefore, this study was undertaken to determine the of intestinal parasites on hematological parameters.

IPI become a global public health problem affecting both developing and developed countries with Corresponding Author major consequences for human health as well as social and economic development (Worldwide prevalence of anemia 1993–2005, WHO Global Database on Anemia). In 2002, iron deficiency anemia (IDA) was considered to be among the most important contributing factors to the global burden of diseases (WHO. 2002). It is generally assumed that 50% of the cases of anemia are due to iron deficiency but more frequently it coexist with a number of other causes, such as malaria, parasitic infection, nutritional deficiencies and haemoglobinopathies. An estimated 30 per cent of the world's population is anemic, with the global prevalence of anemia among 6-12 yr old children to be 43 per cent and 77 per cent in developing regions respectively (Kumar, Sangwan ,and Peter; 2014). Ethiopia continues to be one of the countries to have highest prevalence of anemia because of low dietary intake, poor availability of iron and chronic blood loss due to hookworm infestation and malaria. Anemia is a serious concern for young children as it can adversely affect cognitive performance, behavioral and motor development, coordination and language development and scholastic achievement as well as increased morbidity from infectious diseases. School children who constitute a sizable segment of the population (about 20.25% of total population) many people are more vulnerable to this disease due to their rapid growth need of high iron (Agarwal, Upadhyay and . 1989). Anemia was defined using WHO criteria for different age groups. With these criteria, the hemoglobin cut off used to define anemia in children between age groups 6 to 12 years is < 12 gm / dl. Anemia was further graded as mild (Hb 9.0 - 11.9 g/dl), moderate (Hb = 6.0 -8.9 g/dl) and severe (Hb<6.0 g/dl) based on hemoglobin values.

Blood cells and their values are important indicators of disease conditions in individuals. A decrease or increase in their values gives an insight to the health condition of a person. Standard mean values and approximate ranges of blood parameters have been given (Dage *et al*., 1984). Results were revealed that there is a little differences in packed cell volume (PCV) and Haemoglobin concentration (Hb), between infected and non-infected individuals. Majority of those infected had their PCV and Hb levels a little below the normal range. This is similar to the findings of (Ameh *et al*., 2001) who stated from his observation that haematocrit result showed low PCV in more of the infected than non-infected people . According to the revealed results, there was no significant difference in the infection rate between male and female.

Packed cell volume was observed to be higher in males than in females regardless of intestinal parasitic infection. This was supported by Onwukeme, (1988) who stated that physiologically, packed cell volume is usually higher in males than in females. Nwabueze *etal.,* (2007), also agreed with his finding when he stated in his work that packed cell volume and Hemoglobin concentration were observed to be higher in males than in females regardless of infection.

2.3.2. Age

Comparative prospective study in RBC count and RBC indices indicates that there is significant decrease in hematological parameters in older age than adult due to decrease in bone marrow activity in aged participants (Dr Preeti. J, *et al*., 2013). Other study in aged population showed that significant decrease in hemoglobin, heamtocrit and red blood cell counts with aging (Caprari P, *et a.*, 1999).

2.3.3. Gender

Studies also shows variation in hematological parameters based on gender; a study of Jamaican population shows significantly higher white blood cell count in women than men, (Ne U, et al., 2008). Study conducted on healthy population of Pakistan shows significantly higher HGB, HCT, MCV, MCH, MCHC, and RBC in male than female but, WBC and platelet count were found significantly lower in male. The results when compared to different population indicates significant variations and reference range should be revised for accurate clinical interpretation of patients was recommended in this study (Khalid U, 2007). In the study conducted between Nigerian populations for establishing normal hematological profile it was reported that there was difference in hematological parameters between male and female population except MCH and WBC (Ah I, *et al.*, 2012).

Hematological reference values were determined among adult healthy blood donors for diagnosis and treatment decision purpose in Togo; this study indicates that platelet count was lower in male that female (Irenee M, *et al.,* 2011). Study in Bahir Dar town determine mean values for hematological parameters like HGB, HCT, WBC count and WBC differential; remarks there is higher WBC count in females than men (Bayeh A, *et al.*, 2012).

2.3.4. Dietary habit

A study conducted at Gondar, on children of age group up to 6 years reports low hematocrit value (38%) and higher prevalence of anemia (47.2%) despite the fact that Ethiopian diet is rich in iron content (Zein Z, *et al.*, 1991).

2.3.5 Altitude

Andean population shows hematocrit or hemoglobin concentration elevated over normal sea level values was long considered a hallmark of lifelong adaptation to high-altitude hypoxia. However, study in Ambaras region of north Gondar indicates adaptation of people; despite reduction in ambient oxygen at high altitude, people were having slight change in hemoglobin concentration compared with sea level natives 15.9g/dl in male and 15.0g/dl in female (Cynthia M, *et al.,* 2002). Study done to assess hematological variations with changein altitude. See level natives when exposed to high altitude shows increase in Hct and Hgb(Siques P, *et al.,* 2007).

2.3.6. Exercise

The effect of exercise on some blood parameters was seen in for example:- on cyclists hemoglobin and hematocrit values are higher than normal (Schumache Y, *et al.,* 2002). Comparative study conducted between exercising post-menopausal women and control groups shows that there is a significant decrease in total cholesterol and LDL level in highly exercising women than control groups (Boyden T, *et al.,* 1993). Study conducted in Switzerland had shown improved lipid profile in both men and women of physically active participants in comparison to sedentary ones (Dai S, *et al.,* 1990). Effect of yoga practice on blood parameters was assessed among yoga practitioners in Spain, a study carried out to compare yoga practitioner with those not practicing showed higher hemoglobin level in those who practice yoga than the control groups. So, it was concluded that yoga changes biochemical parameters (Gabriel A, *et al.,* 2012). Significant difference in hematological parameters between kick boxer and cartie professional was also observed (i.e Hemoglobin concentration was significantly lower among kick boxer than Caratie professionals (Violeta D, *et al.,* 2013) this study is evidence that type of exercise also influence blood parameters.

2.3.7. Ethnicity, race and genetics

Ethnicity is one factor for parameter variation (Mohsen A, 2001). Studies conducted in Indian showed that there is variation in lipid profile and mean corpuscular hemoglobin depending on ethnicity (Sundaram M, *et al.,* 2008). Genetic variation also contributes to change in lipid profile. A study shows that people with family history of CHD had lower HDL than those without family history of CHD and that lower HDL is mainly associated with history of CHD (Suenram A and Pometta D,1983). Influence of life-style change on blood parameters was observed in study conducted among Namibia subjects who had hunter-gathers way of life when moved to South Africa (towestern way of life) as shown by low hemoglobin level 14.7g/dl for male and 13.8gm/dl infemale and higher prevalence of anemia was observed (Coetzee M,1994).

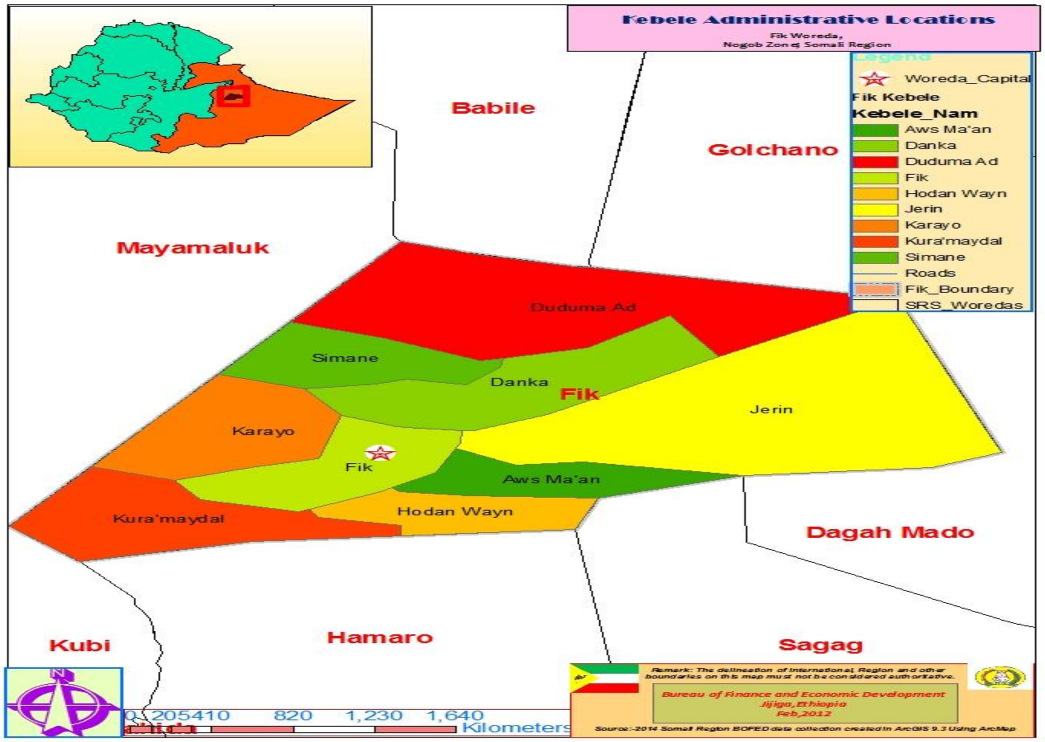
2.3.8. Blood donation

Study conducted in Nigeria shows significantly lower mean triglyceride, total cholesterol and low density lipoproteins in regular blood donors due to regular blood donation lower blood iron and lower lipid per oxidation donors tend to have lower lipid levels (Uche E, *et al.,* 2013). Similar study on blood donor shows lower hematological parameters including WBC, RBC count, HCT HGB, MC

3. MATERIALS AND METHODS

3.1. Description of the Study Area

Fik district is one of the districts in the Erer zone of Ethiopian-Somali Regional State. The district is located at 685 km east of Addis Ababa the capital city of Ethiopia, and 195 km south of Jigjiga, a capital city of Ethiopian- Somali region . Fik town has a latitude of $8^{o}8'N42^{0}18'E$ with an elevation of 1229 meters above sea level. Based on figures from the central statistic agency in 2005 Fik town has an estimated total population of 12,911 of whom 6,932 were men and 5,979 were women. The predominant ethnic group in Fik was the Somali (99.03%). It is bordered on the north to Babile district , south to Hamaro district, west to Mayu-Muluqe and east with Sagag district .The livelihood of the district population chiefly depends on animal and animal products. Fik district consists of 27 *Kebels* (villages) and has a health facility of 11 human health posts, 3 health centers and one zonal hospital. Also fik district has 11 schools, of which 5 of them was selected to this study.



(Figure 2.Map of Fik District : Source Ethiopian -Somali Region Administration Office)

3.2. Study Design

A cross sectional survey wasused to undertake the assessment of hematological parameters and intestinal parasitic infections among school children who are positive with one or more intestinal parasites and students who are not infected by parasitic infections .

3.3. Study Population

All school children enrolled in five primary schools of Fik district during the academic year of 2016/2017 were considered as the study population. Students who have been received anti-parasitic treatments and those who have sickle cell anemia were excluded from the study population.

3.5. Sample Size Determination and Sampling Techniques

Sample size for the study was estimated by using the following statistical formula used for determination of sample size in studies involving qualitative variables (Naing *et al*; 2006).

$$N = \frac{Z^2 p(1-p)}{d^2}$$

Where,N= required sample size

P= prevalence of the disease

Z= 95% confidence interval, which is standard value of 1.96

d= Absolute error or precision (Usually =0.05)

Since the overall prevalence of intestinal parasitic infections were not known for this study area, prevalence of 50% was taken in the estimation. insertion of the values in the formula gave the minimum sample of 384. The sampling techniques used was stratified sampling technique.

$$N = \frac{Z^2 p(1-p)}{d^2}$$

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

when a 10% contingency was added the total sample size was over 420 participants.

3.6.Methods of Data Collection

3.6.1. Blood sample collection

Blood sample was taken from forearm antecubital vein lying supine with appropriate aseptic technique. The 5 ml of blood from each study participant were emptied into Ethylene Diamine Tetraacetate (EDTA)-coated containers. It was analyzed using haematocrit, haemometer and ABO blood grouping techniques for the determination of PCV, Hb and blood group, respectively.

3.6.2. Stool sample collection

Stool samples was also collected from each participant and stored in air-tight container and taken to main laboratory section of Fik Hospital for analyses. The stool samples were analyzed in the laboratory by the concentration techniques as described by Cheesbrough; (2005).

3.6.3. Socio demographic data

Socio demographic data was collected through structured face-to-face interview (Appendix № 7.1). The questionnaire was developed in order to capture data on socio demographic characteristics of the individuals, history of intestinal parasitic infections and environmental information relevant to the disease. In addition to this stored information about prevalence of IPI in the district health office and health institution facilities were also used as secondary data.

3.7. Laboratory Investigations

3.7.1. Hematological analysis of blood samples

3.7.1.1. Determination of packed cell volume

The blood sample was gently mixed for 2 mn , and it was filled up in to a 75 X 1.5mm capillary tube up to $^3/_4$ of its length and one end sealed with sealant. Then, all of the blood filled tubes werecentrifuged at 12,00 rpm for 4 min using a micro-haematocrit centrifuge. Finally, each tube was placed in a micro-haematocrit reader, and determination of the percentage of packed cell volume (PCV) of each respondent was done, as described by Taylor and Spencer (1997).

3.7.1.2. Determination of hemoglobin concentration

Hemoglobin level was determined by using a portable battery-operated hemoglobinometer (HemoCue TM,Angelholm,Sweden) (Cohen and Seidi-Friedman,1988). According to the manufacturer instruction, each blood sample was used to fill cuvette by touching the cuvette tip into the middle of the drop of blood until completely filled. The filled cuvvete was placed on the holder and pushed into the HemoCue instrument. The hemoglobin value of the each participants is displayed in g/dl.

3.7.1.3. Determination of ABO and Rh blood group type frequencies

The ABO and Rh (D) blood Group were typed using commercial kits based on serological test of agglutination following the company's recommended procedure . The ABO blood group of each subject was determined using cell grouping antiserum (A, B, and D). Three drops of each subject sample is placed on separate points on sterile while tiles divided in to three cells. A drop of antiserumanti-A, anti-B, and anti- D was placed on the blood and thoroughly mixed to obtain a homogeneous mixture with the aid of a sterile rod and tile were rocked gently to ensure mixing. The mixture was carefully observed to determine blood groups by the presence of agglutination or not. Antiserum D is used to determine the Rhesus factor and the blood of the participants grouped in to A+, A, B+, B-, AB+, AB-, O+, and O- (Simon-Oke *et;al* 2016).

3.7.2. Parasitological examination of stool samples

3.7.2.1. Direct wet mount methods

It's the simplest way of examining a bacterial suspension. The basic types of wet mount that have been used for each faecal examination was saline, iodine, and buffered methylene blue. Stool samples were microscopically examined for motile organism by using 10X and the 40X objectives.

3.7.2.2. Concentration techniques

When the number of parasites in the stool is low, the examination of direct wet mount may not reveal them and it was used concentration techniques. The concentration procedure used was the formalin-ether (or formalin- ethyl acetate) concentration method. All types of worm eggs (roundworms, tapeworms,schistosomes, and other flihe eggs), larvae, and protozoan cysts were recovered by this method.

3.8. Data Analysis

Data was entered in to Microsoft Excel, checked for its correctness, and exported to and analyzed using SPSS version 20.Chi-squire test were used to assess the relationship between hematological profile and intestinal parasitic infections. Observed differences were considered to be significant for $P<0.05$. Summary statistics such as means, standard deviation, etc also were calculated for each quantitative variable. These summary statistics were presented in simple graphs and tables. Odds ratios (OR) were calculated with 95% confidence interval.

3.9. Ethical Clearance

Before starting data collection, explanation about the objectives and the procedure of the study were given by the researcher and a written informed consent was obtained from each participant (or from parents/caretakers in the case of children under 18 years).

4. RESULTS AND DISCUSSIONS

Knowing the hematological profile of school children with and without intestinal parasite infection in a given area and identification of the major difference between the range of packed cell volume, hemoglobin concentration, and the frequency of their blood group types are crucial to formulate appropriate interventions which are the main purpose of the present study. In line with this view also the present study attempted to high light the prevalence of intestinal parasite infections among school children in five selected schools at Fik District enrolled during 2016/217 academic year. There was 2118 students enrolled in those selected schools.

4.1. Scio-Demographic Characteristics of the Study Subjects

The socio-demographic characteristics of the school children are summarized and presented in Table 1. A sample population of 420 school children were participated in the present study, 239(57%) were males and 181(43%) were females. The minimum and maximum age of the study subjects was 7-18 years old, respectively. More than 71% of these students were in the age group 7-14 years old.

As shown in Table 1, 47.8 % and 52.2 % of the respondents said that they have family size of $\leq 4 \ and \ \geq 5$ persons. With the regard to their parent's educational level 47.3%, 31.9%, 12.8%, and 7.8% study participants said that they were illiterate, primary education, secondary education and above 12, respectively about 34% of them also indicated that they have protected water supply for domestic uses. However 66% were using unprotected water, majority of them use from ponds/berka, followed by uncovered wells, and hand pump. 48.9% of the study participants reported the presence of latrines in close vicinity of their homes. The remaining 51.1% did not have latrines at their homes. 41.9% and 58.1% of the respondents were with poor and good awareness to personal hygiene and environmental sanitation, respectively. The majority of participants (58.8%) were with poor and (41.2) were with good awareness to water-borne intestinal parasite.

Table 1: Some socio-demographic characteristics of the study participants in five selected schools at Fik District, Erer Zone, Ethiopian-Somali Region duringJanuary-February 2017.

Characters		Frequency	Percent (%)
Sex	Male	239	57
	Female	181	43
Age group	7-10	107	25.5
	11-14	192	45.7
	15-18	121	28.8
Family size	≤ 4persons	201	47.8
	≤ 5persons	219	52.2
Parent education level	Illiterate	199	47.3
	Primary education	134	31.9
	Secondary education	54	12.8
	Above 12	33	7.8
Source of water &its handling practice	Protected	278	66
	Unprotected	142	34
Source of water & its handling practice	Ponds/berka	95	22.6
	Open wells	183	43.5
	Hand pump	142	33.8
Use of water	Boiling	43	10.2
	Directly	284	67.6
	Filtering	9	2.1
	Chemical treating	84	20
Availability of latrine	Present	202	48.09
	Absent	218	51.9
Do you wash properly after toilet	Always	131	31
	Some times	264	62.8
	Never	25	5.9

Awareness to environmental sanitation and personal hygiene	Poor Good	176 244	41.9 58.09
Awareness to water-borne parasitic infections	Poor Good	247 173	58.8 41.1

4.2. Prevalence of Intestinal Parasite Infections among School Children

The overall prevalence of intestinal parasite infections among all age groups of the study participants was 42.3 % (table 2). The observed prevalence of intestinal parasite infections (42.3%) was lower compared to the report of some other similar studies which was 72.9% in Gonder, Azezo (Endries *et al.*, 2010), 83% in Jimma (Mengistu, 2007) and 47% in Merhabete (Demisew Gulilat; 2014). On the other hand, the prevalence of infections with intestinal parasites observed in this study was higher than the study conducted in Babile, which was 27.2% (Taddesse; 2005). The differences in findings of various studies can be explained by variations in geography, environmental sanitation, inadequate medical care, socio-economic conditions, drinking water sources, personal hygienic conditions of the study subjects, and health care as well as prevailing climatic and environmental conditions under consideration (WHO,1996).

The prevalence of intestinal parasite infections in this study area was 42.6% and 41.9 % in males and females respectively (table 2). In this study, intestinal parasite infections among males were higher than that of females children but the difference was not statistically significant ($p>0.05$). Similarly, the study conducted in school children at Babile town, eastern Ethiopia showed that the prevalence of intestinal protozoan parasites among males (28.8%) was higher than that of females (24.3%) (Taddesse; 2005). In contrast to this, a study conducted by shakya in Dhankuta and Sunsari, Nepal showed that the prevalence of intestinal parasite infections was slightly lower in males (65%) than females (66%) (Shakya,2003). This indicated that the gender may or may not play the role in parasitic infections, depending up on the region and other environmental or behavioral factors.

The prevalence of intestinal parasite infections in age group 7-10 years old was 45.9% and 45.6% in males and females, respectively (table 2). While, for the age group 11-14 years old the prevalence of intestinal parasite infections in male and female pupils was 43.1% and 43.3%, respectively. The prevalence of intestinal parasite infections for the age group of 15-18 years old was 39.1 % for male whereas it was 36.5 % for females. Generally, in each age group of the study participants there was no statistically significant difference ($p>0.05$ for each) in prevalence of intestinal parasite infections between males and females children (table 2).

The result shown in table 2 in both sexes, the prevalence of intestinal parasite infections decreased as the age of children increased. Accordingly, high prevalence of intestinal parasite infections was observed in age group 7-10 years old than older children (i.e., age groups 11-14 and 15-18). A similar study in Brazil also reported that high prevalence of *Entamoeba histolytica* infection and other intestinal parasites in the age group 5-10 years old children than older children (Fleming; 2006). The possible reason for the higher prevalence of intestinal parasitic infections in the younger age group (7-10 years old) in the present study may be due to low immunity in the younger children, low level of life skills such as practice washing hands and other personal hygiene measures in this age group. In addition to this, the younger children were more exposed to over crowed living conditions (school, play ground, nurseries etc). Higher prevalence of intestinal parasitic infections among school children may be due to poor sanitary conditions in the schools (Ogutibeju, 2006). However, the prevalence of intestinal parasite infections did not significantly vary among age groups in the present study (table 2)

Table 2. The intestinal parasite infections profile of examined school children (№=420) in five selected primary schools at fik district.

Age and Sex	No of Examined	Intestinal Protozoan Parasites infections		Intestinal Helminth Parasites Infection		Total Intestinal Parasite Infections	
		№ pos.(%)		№ pos.(%)		№ pos.(%)	
7-10							
Male	61	20(33.3)		8(13.1)		28 (45.9)	
Female	46	16(34.7)		5 (10.8)		21(45.6)	
Sub-total	107	36(33.6)		13 (12.1)		49 (45.7)	
11-14							
Male	109	35(32.2)		12(11)		47 (43.1)	
Female	83	27 (32.5)		9 (10.8)		36 (43.3)	
Sub-total	192	62(32.2)		21(10.9)		73 (38)	
15-18							
Male	69	20(28.9)		7 (10.1)		27 (39.1)	
Female	52	14(26.9)		5(9.6)		19 (36.5)	
Sub-total	121	34(35.5)		12(9.9)		46 (38)	
All Age Groups							
Male	239	75(31.3)		27(11.2)		102 (42.6)	
Female	181	57 (31.4)		19(10.4)		76 (41.9)	
Total	420	132 (34.4)		46 (10.9)		178 (42.3)	

4.3. Major Intestinal Parasites Species Identified in Examined School Children

In the present study, microscopic stool sample examinations were done using direct, formal-ether concentration techniques. Infection with various intestinal parasite species was common among the study school children. As shown in Table 3, eight common intestinal parasite species were identified in examined stools of school children. The detected parasite species and their prevalence arranged in their order of dominance were *Giardia lambia (*22.8%),*Entamoeba* *histolytica* (11.9%), *Ascaris lumbricoids* (3%), *Enterobius vermicular* (2.1) *Trichura trichiura (1.9%), Hookworm* (1.6), *Taeniaspecies (1.1%), and Strongloids stercoralis (0.7%)* (Table 3).

The overall prevalence of *Gardia lambia* among the study participants in the present study was 22.8% (Table 3). It was higher than report of previous study, 8.6% (Endeshaw *et al.*, 2004) and the study conducted in Cote d'Ivoire 13.9% (Quihii *et al.*, 2010). However, it was lower than 19.8% (Mehari; 2006). In current study, the prevalence of *Gardia lambia* (22.8%) was higher than the prevalence of infection with *Entamoeba histolytica* (11.9%),*Ascaris lumbricoids*(3%), *Trichuris trichiura* (1.9%), *Hookworm* (1.6),*Taenia (1.1%), and Strongloids stercoralis (0.7%)* The higher prevalence of *Gardia lambia* infection might be attributed to the fact that the most children in the rural areas were exposed to low level of environmental sanitation, high degree of food and water contamination with human excreta and lack of awareness in a simple health promotion practices such as personal hygiene and food hygiene (Endaeshaw; 2005).

The overall prevalence of *Entamoeba histolytica* infection among study participants in the present study was 11.9%. It was lower than report of previous study from Alemketema town, Central Ethiopia (Fetlework; 2010) which was 16.7%. And the one done in Dire dawa, Eastern Ethiopia, which was 38% (Ayalew; 2006). The prevalence of *Entamoeba histolytica* detected in the present study (11.9%) was higher than the study conducted on school children in Ginnir town, Bale zone which was 4.5% (Tadess; 2013).

However, is was a little near to the reported by Areda(2014) (9.1%) from the study done on school children in Grawa town, Eastern Ethiopia.

The overall prevalence of *Ascaris lumbricoides* in the present study was 3% (Table 3). Its prevalence (3%) was lower with previous report from Ginnir town., Bale zone (10.4%) by Tadesse (2013), and it was alsolower than the one reported from Lake Langano, (6.2) by Mengistu and Berhanu (2004), and a little similar from Babile town (3.9%) by Tadesse (2005). Moreover, the result of the present study was steamily lower than the prevalence reported in northwest Ethiopia, Chilga district, (42.9%) by Leykun (2001) and different parts of Ethiopia, (37%) by Gezahegn (2008). This variation in the prevalence of *Ascaris lumbricoides* infection most probably was an indication of the variation in the local environments with regard to water and food contamination, soil type, temperature, etc., that determine the transmission of the parasite. In addition, environmental sanitation and difference in exposure to infection probably play an important role in affecting prevalence rate of ascariasis (Gezahegn; 2008).

Inthe present study, the prevalence of *Trichuris trichiura* (1.9%) was slightly similar to the study reported in Mojo, (2.6%) by Alemnesh (2013) and Ara minch, (2.8%) by Walelign (2014). However, it was lower than the study conducted in Lake Lngano (14.7%)by Mengistu and Berhanu (2004), northwest Ethiopia, Chilga district, (14.8%)by Lykun (2001) and different parts of Ethiopia (30%) by Gezahegn, (2008). The observed differences in the prevalence of *Trichuristrichiura* infection in the present study from its reported prevalence might be due to differences in diverse environmental conditions of the study sites as epidemiology of parasite is highly affected by environmental sanitation and personal hygiene, surface temperature, altitude, soil type and rainfall (Brooker *et al.*,2003). The observed differences could also be explained by the fact that the prevalence and distribution of helminth parasite infections varies by place and with age in Ethiopia as reported by Yeshambel *et al.*, (2010).

In the present study, the overall prevalence of infection of school children with *Enterobius vermicular* was 2.1%, *Hookworm* was obtained to be 1.6%, *Taenia* 1.1%, *Strongloids stercolaris* 0.7% and *Enverobius Vermicular* was found to be 2.1%.

Table 3. Major intestinal parasite species identified among examined school children (№ =420) in five selected primary schools

Age (year) and sex	№ Examined	Intestinal Protozoan Parasites		Intestinal Helminth Parasites						Multiple Infections
		G.I	***E.h./d.***	***A.I.***	***T.t.***	***E.v.***	***S.s.***	***HW***	***T.s***	№ pos. (%)
		№ pos. (%)	№ pos. (%)	№ pos. (%)	№ pos. (%)	№ pos. (%)	№ pos. (%)	№ pos. (%)	№ pos. (%)	
7-10										
Male	61	13 (21.3)	7 (11.4)	4 (6.5)	3(4.9)	2(3.2)	0(0)	2(3.2)		7(11.4)
Female	46	9(19.5)	7(15.2)	3(6.5)	1(2.1)	2(4.3)	1 (2.1)	1(2.1)		6(13)
Sub total	107	22 (20.5)	14(13.0)	7(6.5)	4(4.7)	4(3.7)	1 (0.9)	3(2.8)		13(12.1)
11-14										
Male	109	23(21.1)	12(11.0)	2 (1.8)	1(0.9)	2(1.8)	0	2(1.8)	2(1.8)	4(3.6)
Female	83	16 (19.2)	11(13.2)	1 (1.2)	0	1(1.2)	1(1.2)	1(1.2)	2(2.4)	5(6.0)
Sub total	192	39(20.3)	23(11.9)	3 (1.5)	1(O.5)	3(1.5)	1(0.5)	3(1.5)	4(2)	9(4.6)
15-18										
Male	69	13(18.8)	7 (10.1)	2 (2.8)	1(1.4)	1 (1.4)	2(2.8)	1 (1.4)	1(1.4)	3(4.3)
Female	52	8(15.3)	6 (11.5)	0 (0)	3(5.7)	1 (1.9)	0	0(0)	0	2(3.8)
Sub total	121	21(17.3)	13 (10.7)	2 (1.6)	4(3.3)	2 (1.6)	2(1.6)	1(0.8)	1(0.8)	5(4.1)
All Age Groups										
Male										
Female	239	49(20.9)	26(11.7)	8(3.3)	5(2.0)	5 (2)	2(0.8)	5 (4)	3 (1.2)	14 (5.8)
	181	33(17.6)	24(12)	4(2.2)	4(2.2)	4 (2.2)	2 (0.5)	2 (1.1)	2(1.1)	13 (7.1)
Total	420	82 (19.5)	50(11.9)	12(2.8)	9(2.1)	9 (2.1)	4 (0.9)	7 (1.6)	5 (1.1)	27(6.4)

(Key: *G.I=Gardia lambia, E.h=Entamoeba histolytica, A.l= Ascaris lumbricoides, T.t=Trichuris trichiura, E.v= Enterobius vermicular, S.s=Strongyloids stercoralis, Hw= Hookworm,T.s= Taenia species.*)

4.4. The Packed Red Cell Volume (PCV) Profile of School Children with and without Intestinal Parasite Infections

The results of Packed red cell volume are summarized and presented in table 4,as the result shown in table 4 the average PCVvalue for age group 7-10, 11-14, and 15-18 years old was 30%, 31.5%, and 33% respectively. It shows that a significant increase of the PCV with the increase of the age. As the age increases the PCV average range increases. In the present study the average PCV value of male and female with the age group 7-10,11-14, and 15-18 was found to be 30.5%, 29.5%, 31%, 30.5%, 32%, 33% respectively with regard to this observation it was seen a slight different for which the male students shown to have higher PCVvalue compared to the female students but the difference was not statistically significant ($p>0.5$). PCV values are higher in male and this complies with other studies (Blain H**,** et al., 2001 and Kibaya R, et al., 2008). Gender based variation in hematological parameters is suggestive of hormonal variation where androgen influences Erythropiesies (Aster T, et al., 1999). Similarly it was seen that the PCV average of infected children was 31.5% whereas non infected students was 33.1%, therefore non infected children have higher PCV then infected children but the difference was also not significant ($p>0.5$).

The mean PCV with positive individuals became 31.5%,and negative individuals was seen to be 33.1%. Majority of those infected had their PCV levels a little below the normal range. This is similar to the findings of Ameh et al. (2001) who stated from his observation that haematocrit result showed low PCV in more of the infected than non-infected people. However, the differences in PCV observed between infected and non-infected individuals in this study were not statistically significant. Also Packed cell volume was observed to be higher in males than female in the present study the average PCV of male and female and was observed to be 32%,and 31% .This was supported by Onwukeme, (1988) who stated that physiologically, packed cell volume is usually higher in males than in females. Nwabueze et al. (2007), also agreed with this finding when he stated inhis work that packed cell volume were observed to be higher in males than in females regardless of infection.

Table 4. Mean ± (std) average PCV value of school children in relation to age, sex and intestinal parasite infections

Age(year) and sex	№ Examined	Average of PCV Value (%)	Intestinal Protozoan Parasite Infections		Intestinal Helminth Parasite Infections		Intestinal Parasite Infections	
			№ Pos.(%)	*№ Neg.(%)*	*№ Pos.(%)*	*№ Neg.(%)*	*№ pos.(%)*	*№ Neg. (%)*
7-10								
Male	61	30.5	20(32.6)	41(67.2)	4(6.6)	57(93.4)	24(39.3)	37(60.6)
Female	46	29.5	16(34.7)	30(65.2)	2(4.3)	44(95.6)	18(39.1)	28(60.8)
Sub total	107	30	36(33.6)	71(66.3)	6(5.6)	101(94.3)	42(39.2)	65(60.7)
11-14								
Male	109	32	37(33.9)	72(66)	12(11)	97(88.9)	49(44.9)	66(55)
Female	83	31	30 (30)	53(63.8)	9(10.8)	74(89)	39(46.9)	44(53)
Sub total	192	31.5	67(34.8)	125(65.5)	21(10.9)	171(89)	88(45.5)	104(54.1)
15-18								
Male	69	34	24 (34.7)	45 (65.2)	9 (13)	60 (86.9)	33 (47.8)	36 (52)
Female	52	32	19 (36.5)	33 (63.4)	7 (13.4)	45 (86.5)	26 (50)	26 (50)
Sub total	121	33	43 (35.5)	78 (64.4)	16(13.2)	105 (86.7)	59 (48.7)	62 (51.2)
All age Groups								
Male	239	32	81 33.8)	158 (66)	25(10.4)	214 (89.5)	106(44.3)	133 (55.6)
Female	181	31	65 (35.9)	116 (64)	18 (9.9)	163 (90)	83 (45.8)	98 (54.1)
Total	420	31.5	146 (34.7)	274 (65)	43(10.2)	377 (89.7)	189 (45)	231 (55)

4.5. The Hemoglobin (Hb) Concentration Profile of School Children

The results of Hemoglobin concentration are summarized and presented in table 5 as the result shown in table 5 indicates the Hemoglobin concentration average (g/dl) for age group 7-10, 11-14, and 15-18 years old was 9.8(g/dl), 10.4(g/dl), and 10.9(g/dl) respectively. It shows that an increase of the Hemoglobin concentration as the increase of the age.

In the present study the average Hemoglobin concentration (g/dl) value of male and female with the age group 7-10,11-14, and 15-18 was found to be 10.0(g/dl),9.6(g/dl), 10.6(g/dl),10.2(g/dl), 11.2(g/dl),10.6(g/dl)respectively, with regard to this observation it was seen a slight different for which the male students shown to have higher Hemoglobin concentration value compared to the female students but the difference was not significant ($p>0.5$). Similarly it was seen that the Hemoglobin concentration average of infected children and non-infected students of the age group 7-10,11-14 and 15-18 in the present study as to be 9.05(g/dl), 9.8(g/dl), 10.05(g/dl),10.2(g/dl) and 10.4(g/dl), 10.9(g/dl) respectively, therefore non infected children have higher Hemoglobin concentration value then infected children but the difference was also not significant ($p>0.5$). Thus the result revealed from the present study states that there was little differences in Hemoglobin concentration between the positive students with intestinal parasite infections and negative students with intestinal parasite infections, the mean Hemoglobin concentration with positive individuals became 10.4 (g/dl) and negative individuals was seen to be 11.3(g/dl). Majority of those infected had their Hemoglobin concentration levels a little below the normal range. This is similar to the findings of Ameh et al. (2001) who stated from his observation that haematocrit result showed low Hemoglobin concentration in more of the infected than non-infected people. However, the differences in Hemoglobin concentration observed between infected and non-infected individuals in this study were not statistically significant. Also Hemoglobin concentration volume was observed to be higher in males than female in the present study the average Hemoglobin concentration of male and female was also observed to be 10.6(g/dl) and 10.2(g/dl) respectively .This was supported by Onwukeme, (1988) who stated that physiologically, Hemoglobin concentration is usually higher in males than in females. Nwabueze et al. (2007), also agreed with this finding when he stated in his work that Hemoglobin concentration were observed to be higher in males than in females regardless of infection.

Table 5. Mean ± hemoglobin concentration of school children in relation to age, sex and intestinal parasite infections.

№ Examined with Age and Sex		Average Hb Concentration (g/dl)	№ of students with intestinal parasite infection and their average of Hb conc.		№ of students without intestinal parasite infections And their average of Hb conc.	
			№	Hb(g/d)	№	Hb(g/d)
7-10						
Male	61	10.0	249.5		3710.2	
Female	46	9.6	188.6		28 9.5	
Sub total	107	9.8	42	9.05	65	9.8
11-14						
Male	109	10.6	49 10.2		6010.5	
Female	83	10.2	39 9.9		4410.0	
Sub total	192	10.4	88	10.05	104	10.2
15-18						
Male	69	11.2	33 10.6		36 11.2	
Female	52	10.6	2610.2		26 10.6	
Sub total	121	10.9	59	10.4	62	10.9
All age Groups						
Male	239	10.6	10610.6		133 11.2	
Female	181	10.2	8310.2		9810.0	
Total	420		189		231	
Mean Hb g/dl		10.8	10.4		11.3	

4.6. The Frequencies of ABO and Rh Blood Group Types of School Children with and without Intestinal Parasite Infections

The frequency of ABO and Rh blood group of the study participants was summarized and presented in the following table 5. As the table 5 indicated the blood group type of the 7-10, 11-14, and 15-18 aged students with the respect of infected and non infected students was that of 21(19.6%)A+, 14(13%)B+, 10(9.3%)O+, 7(6.5%)B^{-} for 7-10 students with infected, 19(17.7)A+,12(11.2%)B+,18(16.8%)O+, 6(5.6%)B+ and non infected children. 35(18.2%)A+,21(10.9%)B+, 7(3.6%)O+5(2.6%)B^{-}, for 11-14 students with infected, 17(8.8%)A+,43(22.3%)B+,49(25.5%)O+,15(7.8%)B^{-}, and non-infected children. 27(22.3%)A+,14(11.5%)B+,9(7.4%)O+, for 15-18 students with infected, 17(14%)A+, 12(9.9%)B+, 29(23.9%)O+, and 4(3.3%)B^{-} for non-infected students.

From the total of 178 positive students with intestinal parasite infections of the study participants 83 (46.6%) was A+, 49 (27.5%) was B+,26(14.6%) was B- and 20(11.1%) became O+ .In addition to that From a total of 242negative students with intestinal parasite infections of the study participants, 96 (39.6%) was O+, 67(27.6%) was B+, 53 (21.9%.) were A+ and 25 (10.3%) were B- blood Groups. According to the present study A+ is the most frequent number with the students of positive intestinal parasite infections following to B+.

This difference might be due to population racial distribution difference, or Genetic variation of the population. In this study, being blood group A and B has high likely to have intestinal parasite infections. Among all blood groups, blood group O is less likely to have intestinal parasite intensity of infection, which is similar with a study conducted in zimbabwe that shows blood group Children are less likely to have intestinal parasite infections, this might be due to the absence of A andB red cell antigens that can be used some intestinal parasites to mask their body and escape the human protective immune System or might be due to the presence of anti-a that may afford Partial protection against different disease

In most blood group frequencies of individuals without intestinal parasite infections is that of O+, and the most blood group frequencies of positive students with intestinal parasite infection is that of students who have A+.

Table 6: Age related blood group frequencies and it's corresponding individuals with intestinal and without intestinal parasite infections .

No Examined	**No of Blood Group types without Intestinal Parasites**				**No of Blood Group types with Intestinal Parasites**			
	A+	**B+**	**O+**	**B-**	**A+**	**B+**	**O+**	**B-**
	Freq.(%)	*Freq.(%)*	*Freq.(%)*	*Freq.(%)*	*Freq.(%)*	*Freq.(%)*	*Freq.(%)*	*Freq.(%)*
107	1917.7	1211.2	1816.8	65.6	2119.6	1413	76.5	109.3
192	178.8	4322.3	4925.5	157.8	3518.2	2110.9	63.1	63.2
121	1714	129.9	2923.9	43.3	27 22.3	1411.5	75.7	108.2
420	**5312.6**	**6715.9**	**9622.8**	**255.9**	**8319.7**	**49 11.6**	**204.7**	**266.1**

5. SUMMERY, CONCLUSSIONS AND RECOMENDATION

5.1. Summery

The objective of the present study was to determine the hematological profile of school children with and without intestinal parasitic infections in Fik district, Erer zone, Somali regional state. The design of the study was a cross-sectional and stratified sampling techniques was used, to undertake the assessment of Hematological parameters and intestinal parasitic infections among school children who are positive with one or more intestinal parasites and students who are no infected by parasitic infection in the study area.

Stool and blood samples was collected from 420 students which of 239 was male and 181 was female, they was selected from five primary schools in Fik District Erer Zone Ethiopian-Somali Region. The stool samples was examined using formalin-ether concentration techniques, and it was obtained that 178 students became positive with intestinal parasites were 132 (31.4%)of them infected by protozoan parasites, and 46(10.9%) of them infected by hilmenths parasitic infections. furthermore blood samples was examined using haematocrit, haemometer and ABO blood grouping techniques for the determination of PCV, Hb and blood group respectively. Result revealed from the study showed that there was little differences in packed cell volume (PCV) and Hemoglobin concentration (Hb), between infected and non-infected individuals. Most of the infected students had their PCV and Hb levels a little below the normal range. This is similar to the findings of Ameh et al. (2001) who stated from his observation that hematocrit result showed low PCV in more of the infected than non-infected people. However, the differences in PCV and Hb observed between infected and non-infected individuals in this study were not statistically significant.

According to the result, there was no significant difference in the infection rate between male and female. Both sexes were infected at almost the same rate. This finding is in consonance with the finding of Onwukeme (1988) who carried out a similar research and stated that there is no significant difference between male and female regarding parasitic infection.

Packed cell volume was observed to be higher in males (32.0%) than in females (31.0%), regardless of intestinal parasitic infection. The ABO and Rh blood group frequencies was obtained that O+ became the most frequencies in the students who are not infected by parasite infection, and A+ become the most frequencies ABO Blood group type in the students who was infected by parasitic infections.

5.2. Conclusions

The most common intestinal parasite detected was *Gardia lambia* 19.5%, followed by *Entamoaba histolytica* 11.9%, *Ascaris lumbricoides* 3%, *Enterobius vermicular* 2.1%,*Trichuris trichiura* 2.1%, *Hook worm* 1.6%, *Teania* 1.1%, and *Strongyloids strecorals* 0.7%. This shows that the most frequent intestinal parasite is that of *Gardia lambia* followed by *Entamoebahistolytica* which indicates that the study area have problems related with the sanitation, availability of portable and clean water, and socio-economic problems. The Intestinal Parasite Infection frequency and distribution is also consistent with the pattern reported for school age children in other part of the country.

The study also reveals that hematological parameters (PCV and Hb) are not highly or significantly affected by intestinal parasitic infection. The low packed cell volume observed among individuals who were infected, similarly there was slight different of PCV and Hb range in male and female, males had a little higher PCV and Hb than female.

According to Brabin (1985), Armon (1978), another factor that can cause low PCV and Hb is co-endemic malaria.

5.3. Recommendations

1. There is still need for improvement in sanitation and domestic hygiene in the Community.
2. Those infected students should be treated and finally, awareness should also be given so that people may know how to take care of themselves to avoid being infected.
3. Availability of clean and potable water, creating awareness of using water purification chemicals and the use of latrine should be improved.
4. Decreasing the proximity of domestic animal to homes and water sources in order to reduce contaminations.
5. Further investigation needs to be done to confirm effect of intestinal parasites to all hematological parameters.

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7. APPENDEX(CES)

7.1. Questioner Form of Socioeconomic Data Collection

1. Code ☐ 2. Sex ☐ 3. Age ☐

4. Parent's Educational Background :

Illiterate ☐ Primary school ☐ High school ☐ Degree ☐ Master ☐

5. Lifestyle :

Agricultural ☐ Pastoral ☐ Margent ☐ Government staff ☐ Other ☐

6. Monthly Income in Birr: ____

7. Family size in Number: ____

8. Type of your house and number of classes: ____

9. Do you have a latrine: ____

10. What kind of water source you use:____

7.2. Informed Consent:

My name is Dayib Ahmed Nur , I am student at Haramaya University in Biology department. I am here to carry out a research on Hematological profile of school children with and without intestinal parasitic infections in partial fill filament of my MSC in Biotechnology .

The objective of this study is to determine the Hematological profiles of school children with and without intestinal parasitic infections bytaking samples from blood and stool you donate. There is no direct benefit you obtained from this study, but indirectly the outcome of the result will be used to know either parasitic infection has affects on Hematological Parameters like PCV, Hb and Blood Groups frequency, therefore your participation is important for this research. The risk of this project is, you feel a mild painwhile blood samples are collected except that there will be no risk to participate in the study.Coding method will be applied in all the procedures, code will be given to the questionerform and also to blood and stool samples, the same code is use for both blood and stool samples and laboratoryresult and data is analyzed accordingly so your results will be kept confidential, and no oneknows your result.You are selected to participate in this research, using systemic sampling since this type ofsampling is thought to be most reliable for our study. And there is nothing you will loss ifyou are not willing to participate in the study or stop filling the questioner In between, so it isyour right to participate or not to participate in the study.

7.3. Consent Form

Code no___________________________

Information about the study has been explained to me by the investigator. I have understoodthat the objective of this study is to determine the Hematological Profile of School Children with and without Parasitic infections among school children in fik woreda , and the small amount of blood and stool that I will give will not hurt my daughter/son's health. It has also been explained to me that I have the right to stop participation at any time in between and there is nothing, I will loss if I refuse to participate.I agree to participate in the study and hereby approve my agreement with my signature.

Student's parent Signature______________________________ Date_______________________

Student's Signature: _______________________________Date ______________________

Investigator signature___________________________________ Date_______________________