2024-06

Distribution of Human Morphogenetic Traits and Blood Groups Among Students in Chandba Secondary and Preparatory School in Nebaru Chilga District, North West, Ethiopia

ZEWUDU, DAGNEW

BAHIR DAR UNIVRSITY

COLLEGE OF SCIENCE

DEPARTMENT OF BIOLOGY

PREVALENCE OF INTESTINAL PARASITIC HELMINTHIASIS AND ITS ASSOCIATED RISK FACTORS AMONG PREGNANT WOMEN ATTENDING ANTENATAL CARE AT ANDABET HEALTH CENTER, SOUTH GONDER, ETHIOPIA

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M.SC THESIS SUBMITTED TO THE DEPARTMENT OF BIOLOGY, BAHIR DAR UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR MASTER'S DEGREE IN BIOLOGY

BY

ZENAW ASSEFA ENINURE

ADVISOR: ABAINEH MUNSHEA (PH.D)

JANUARY, 2024

BAHIR DAR, ETHIOPIA

BAHIR DAR UNIVERSITY

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ACKNOWLEDGEMENTS

First and for most I praise the almighty God, who made my dreams true and for his blessings.

The authors gratitude acknowledge ministry of education to allowed the sponsor to learn without payment in free charge. My special and heartfelt gratitude goes to my advisor Abaineh Munshea (Ph.D) for his time, care and patience. Successful accomplishment of this research would have been very difficult without his giving time and care from early design of the topic, questionnaire development, data analysis and interpretation up to the final write up of the thesis by providing valuable, practical and useful comments.

May gratitude goes to acknowledge Bahir Dar University for giving clearance, Andabet Health Office for giving permissions to conduct this research, Andabet Health Center for allowing laboratory facilities, and the participants who voluntarily involved in this study. I would like to extend my thanks to my department for funding this research paper.

I would like to thanks the laboratory technicians in Andabet Health Center enrolment in stool sample collection and parasitological examination of the sample. in sincerely

I would also like to thanks pregnant women attending antenatal care at Andabet health center for their willingness to be a part of research investigation.

My deepest thanks goes to my best brother Getachew Kassia who encouragement, strong material and moral support, which the successful accomplishment of this work.I would like to thanks in extremely different biomedical researcher and authors being to give me source in pdf to show the way how to do this research. I would like to express my thanks to my best, friends Yabibal setie and Kifila Bihone who support how to do research and operate the application of software as well as SPSS.

I thank my mother W/or ,Teje Wubeta and my father Ato Assefa Eninur and my sisters Abebech Assefa unbound love and moral support.

I would also like to thank my love, Tihunie Kassia for her love, encouragement, tolerance and strong financial support, without her the successful accomplishment of this work would have been impossible.

Dedication

I dedicate this thesis to my love Tihunie Kassie, to my advisor Abaineh Munshea (Ph.D)) and my family for their love and care.

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List of abbreviations/acronyms

CDC: Center of disease control

HIPI: Human intestinal parasitic infection

IPI: Intestinal parasitic infection

SPSS: Statistical package for social science

STH: Soil transmitted helminths

WHO: World Health Organization

TH2 :Helper type2

HB: Hemoglobin

NCCLS: National Committee on Clinical Laboratory Standard

AWAO: AndabetWoreda administration office

CBC :Complete Blood Count

AOR-Adjusted Odd ratio

COR- Crud Odd ratio

ABSTRACT

Intestinal helminthic infections are highly prevalent throughout the tropics and sub tropics and affect millions of people especially in poor countries including Ethiopia. Pregnant women are one of the highly susceptible groups to these infections and that may lead to adverse maternal and fetal out comes. The present study was aimed to determining the prevalence of intestinal parasitic helminthiasis and its associated risk factors among pregnant women attending antenatal care at Andabet health center south Gonder. Therefore, to identification of its associated risk factors, were very important effective prevention and control measures intestinal helminthic infections are. Health center based cross-sectional study involving 384 pregnant women was conducted from October 2023to March 2023.Relevant information on potential risk factors associated with intestinal helminthic infections was gathered using semi structured questionnaire. Stool samples were collected and examined microscopically using wet mount and Formol-ether concentration techniques. Data collected were fed in to SPSS version 23 software. Univariate and multivariate logistic regression was used to evaluate the possible association between dependent and independent variables. The overall prevalence of helminthic infections was 57.8%. eight species of intestinal helminths were identified. Among those the most prevalent species were *Ascaris lumbricoides* (22.9%),followed by hookworm (15%),*Taenia species (14*.1%),*Trichuris Trichuria*(3.4%), *Schistosomes mansoni*(0.8%),*Strongloides stercoralis* (0.3%), *Enterobius vermicularis* (0.3%) and *Hymenolepis nana* (0.3%). The odds of intestinal helminthic infections were higher among those who were occupationally merchant (AOR = 6.38), who had the lowest monthly income earners (ETB) (AOR=3.98),did not take anti helminthic history drugs (AOR=3.32), and among those who did not practice hand washing after the use of toilet and before meal (AOR=4.89)($P < 0.05$). While, others factors were not found to be associated with the risk contracting parasitic intestinal helminthic infections ($P > 0.05$).Regular checkup during their ANC follow up are recommended to prevent possible adverse maternal and fetal effects from intestinal helminthic infections.

Keywords: Attending Antenatal Care, Intestinal Helminthic Infection, Pregnant women

1. INTRODUCTION

1.1 Background of the study

Intestinal parasitic infections (IPIs) are still a major global health concern, especially in developing countries (Taghipour *et al.*,2020). Approximately3.5 billion people are affected by IPIs worldwide. IPIs affect the world's most poorest and deprived communities especially in rural areas of Sub-Saharan Africa (SSA), Latin America, South East Asia and China **(**De Silva *et al,.*2003).*Ascaris lumbricoides, Ancylostoma duodenale &Necator americanus),Trichuris trichuria, Taenia species, Hymenolepis nana, Schistosoma mansoni, Enterobius vermicular* including Platy helminthes of (flatworms) Trematoda (flukes), Cestoda (tapeworms), Turbellaria (planarians), and Meneaonog are among the most common helminths infections in the world (WHO,2017).Ethiopia is one of developing countries where IPIs are major public health problems. Previous studies carried out in Ethiopia revealed a high prevalence of IPI (King *et al.,* 2013). The burden of intestinal parasites, particularly the soil-transmitted helminths (STHs)is often very high in school children and pregnant women (Worku *et a*l., 2014). Anemia is defined as a condition in which there is less than the normal hemoglobin (HB) level in the body, which decreases oxygen-carrying capacity of red blood cells to tissues. Anemia could be classified as mild, moderate and severe. It is more common in developing countries because of poor nutritional status and high prevalence parasitic infection, severe anemia during pregnancy is contributor to maternal mortality (Allen, 2007). Intestinal parasitic infections especially helminthiasis increase anemia in pregnancy women and this infection are low pregnancy weight and intrauterine growth retardation, followed by low birth weight. An estimated 44 million pregnant women have hookworm infections which can cause chronic loss of blood from the intestines and predisposes the women to develop iron deficiency anemia (Sackey *et al.,* 2003).Among others poverty-related factors (poor sanitation, scarcity of potable water, unsafe human waste disposal systems, open field defecation, conducive environmental conditions for the parasites, lack of adequate health services, and low level of awareness) are the contributing factors for the high rate of HIPIs (Palmeirim *et al.*,2018). Different studies showed that the prevalence of intestinal parasitic infections is very high in Ethiopia (Adane Derso *et al.,* 2016; Nebyat Yohannes *et al,* 2016). Although several studies were conducted on the prevalence of

intestinal helminthes infections across different segments of the community in Ethiopia, documented information about the prevalence of intestinal helminthes among pregnant women in Andabet district was not available. World Health Organization recommends a baseline survey in pregnant women to determine the prevalence and intensity of infections before the implementation of a treatment program(WHO, 1993). In Amhara region, although several studies revealed that intestinal helminthiasis are widely distributed with high prevalence rates, there was no previous research conducted at Andabet district, health center concerning intestinal helminthes infection. Therefore, this study aimed at assessing the status of these parasites and associated risk factors among pregnant women in the district.

1.2. Statement of the problem

Intestinal helminths infections are major public health problems in several tropical and subtropical developing countries (WHO, 2018).Ethiopia is one of the countries with high burden of intestinal parasitic infections, particularly parasitic helminths and protozoan infections (Abraraw Abate *et al.*, 2013).Pregnant women are the segments of a community affected by parasitic helminths that directly or indirectly lead to spectrum of adverse maternal and fetal effects. some the most common intestinal helminthic species affecting pregnant women are *Ascaris lumbricoides, Hookworm (Ancylostoma* duodenale *&Necator americanus),Trichuris trichuria, Taenia species, Hymenolepis nana, Schistosoma mansoni, Strongloides stercoralis and Enterobius vermicular* helminths ,including Platy helminthes (flat worms) of Trematoda (flukes), Cestoda (tapeworms), Turbellaria (planarians) *(*WHO,2017*).*

According to personal observation and communication to health officials in the study area were low latrine coverage, inadequate water supply, habit of open defecation, lack of personal and environmental hygiene, walking bare-footed ,consumption of fruits ,vegetables without washing, crossing, river on bare foot, low monthly income, not hand washing before meal and after toilet use, summing in rivers, unaware of helminthes and would not keep themselves from any risk like close contact with infected factors of helminthiasis, because of this and other risk factors could be common ways infected among pregnant women(Bethony *et al.* 2006).

Although several studies have been conducted on the prevalence of intestinal helminthic parasites in Ethiopia, there are still several places for which epidemiological information helminths among pregnant women and in Amhara region, although several studies revealed that

intestinal helminthiasis are widely distributed with high prevalence rates but in Andabet district is not available(Andabet Woreda Health Office., 2015) .To fill gap in the district the present study is planned to generate data about the prevalence of helminthic infections and assess associated risk factorsamong pregnant women who hadfollw- up at ANC of Andabet district south Gonder Ethopia.

1.3 Objectives of the Study

1.3.1 General Objective

The general objective of this study was to determine the prevalence and associated risk factors of intestinal helminthiasis among pregnant women attending ANC in Andabet health center South Gonder Ethiopia.

1.3.2 Specific Objectives

The specific objective of the present study was to:

- Determine the prevalence of intestinal helminthic parasitic infections among pregnant women in the study area.
- Identify the common intestinal helminthic parasitic species infecting pregnant women in the study area.
- Assess the major associated risk factors accounting for the prevalence of parasitic helminthic among pregnant women in the study area.

1.4. Significance of the Study

This study may provide information about the current status and possible risk factors of intestinal helminthic infections among pregnant women attending antenatal care in the study area. It might also be helpful for effective planning and designing prevention, control, and intervention strategies against intestinal helminthic infections. Moreover, it might serve as baseline information for further studied on the prevalence of intestinal helminthic infection because this parasite infections are common health problems especially among pregnant women and community with poor hygiene and low economic status. Then, to give the fact that intestinal helminthic were widespread in Ethiopia in squalid conditions, assessment of its prevalence is the first step for its management and subsequent practical intervention.

1.5. Limitations of the study

This study was limited to onlypregnant women ANC in Andabet health center locality.Therefore, to get better result on the prvalence of intestinal helminthes, the present study could have included other health center in the district. Besides, parasite load was not quantified, which might show the intensity of infectionamong infected pregnant women.

2. LITERATURE REVIEW

2.1. Intestinal Parasites

Intestinal parasite infections have a wide global distribution. They are estimated to affect an estimated of 3.5 billion people, most of whom are pregnant women and young residing in developing countries *(*Bethony *et al.,* 2006). The major intestinal parasitic infections of global public health concern are the protozoan species such as *E.histolyca,* Giardia species, and intestinal helminths; *A. lumbricoides, T.trichuria,* hookworms, *(Ancylostoma duodenale &Necator americanus) S. stercolaris, Hymenolepis nana, Schistosomes-Schistosoma mansoni ,Enterobius vermicularis* including Platy helminthes, group worms of Trematoda (flukes), Cestoda (tapeworms), Turbellaria (planarians), and Meneaonog (WHO, 2017).Cestoda are commonly known as tapeworms and about 4,000 species have been describe. Almost all vertebrate species may function as potential hosts. Tapeworms usually require at least two hosts, and humans represent the primary host of several species, with infestation occurring through uptake of uncooked meat such as pork (*Taenia solium*), beef (*Taenia saginata*),or fish(*Diphyllo bothrium* spp.).Adult tapeworms are parasitic in the digestive tract of vertebrates, and often one of the intermediate hosts is an invertebrate. Tapeworms usually have long flat bodies composed of many reproductive units or proglottids. This represents a specific trait of Cestoda, since each proglottide contains the male and female reproductive structures and can reproduce independently; therefore, it could be considered that a tapeworm is actually a colony of proglottids they are more dangerous to humans is the species *Taenia solium,* or pork tapeworm, because humans can act also as secondary hosts. Cysticercoids can move from the muscle to the brain and cause cysticercoids, which can be that Embryogenesis of *Taenia*an (Hartenstein and Jones ,2003).Trematodes are all parasitic flukes, and as adults they are almost all found as end parasites in vertebrates and have a complex life cycle. The intermediate host is a mollusk, and the definitive host is a vertebrate. In some species, a second and sometimes even a third intermediate host is involved. The genus *Schistosoma* has been the subject of several studies, since it is the causative agent of schistosomiass, Cercariae swim actively and penetrate the definitive host, again through the skin to enter blood vessels, where they develop into adults (Jurberg et al. 2009).

Helminths is associated with poverty conditions such as reduced access to safe drinking water, poor environmental sanitation and personal hygiene, inadequate access to health care, poor nutritional status, prevailing climatic and environmental conditions (Tsehay*et al.,* 2009).

Pregnancy is a physiological state which is often associated with changes in disease susceptibility. The change in immunity during pregnancy induces tolerance to fetal implantation and also associated with decreased immunity to various infections such as helminths, HIV, hepatitis C and B . The immune modulation by helminths combined with the progressive immunodeficiency by HIV may have deleterious effects on both HIV acquisition and disease progression and on increased susceptibility to parasitic infections (Tian *et al.,*2012*).*People of all ages are affected by this cycle of prevalent parasitic infections; however pregnant women are the worst affected (CDC, 2013). Intestinal parasitic infections especially helminthes increase anemia in pregnant women . The results of this are low pregnancy weight and intrauterine growth retardation, followed by low birth weight, with its associated greater risks of infection and higher prenatal mortality rates. An estimated 44 million pregnant women have hookworm infections which can cause chronic loss of blood from the intestines and predisposes the women to develop iron deficiency anemia (Sackey.,2003). Women of childbearing age, especially those living below the poverty line in low-income countries, are at a higher risk of morbidities related to IPIs(Mpairwe H., 2014).It is well-documented that the immunological effects of intestinal parasites, mainly helminthes infections, have adverse outcomes for both pregnant women and their fetuses(Petersen E, 2007).Intestinal helminths are associated with a strong polarization of T helper type 2 (Th2) cells because it should be noted that type 2 immunity is dominant during a normal pregnancy (except at early stages of pregnancy and around the time delivery) to prevent fetal loss .Transmission of intestinal helminths usually conducted through directly or indirectly fecal contamination, but their distribution in different geographical location may vary depending on many factors involved in the maintenance of life cycle of each parasite and the majority did not require intermediate hosts and have a wider distribution, while other need obligatory hosts, climatic condition and habitat requirement naturally found or modified by human activities. Although investigators have reached various conclusions regarding pregnancy groups at greatest risk and the effect of helminths on pregnant women and their fetuses (Kwabena *et al.*, 2015).

2.2. Intestinal Helminthic Infection

The parasitic helminths or worms of humans grouped in to round worms and flatworms, these groups of parasites are among the most medically important and diverse groups of parasites of human beings, Cestodes or tapeworms are flat and have a ribbon-like chain of segments containing male and female reproductive structures. At the anterior end of an adult tapeworm is the scolex, which is often elaborated with muscular suckers, hooks, or structures that aid in its ability to attach to the intestinal wall (Sakanari and McKerrow., 2012).Enteric helminthes are parasites that colonize the human gastrointestinal tracts and are one of the most prevalent forms of parasitic disease causing organisms (Alamneh Abera and Endalkachew Nibret., 2014). Soil transmitted nematode worms infect humans and transmitted through inadequate sanitation or where practices such as open defecation persist the eggs contaminate the soil and parasitize humans when they are ingested in different food stafe with contaminated hands (WHO, 2018).

2.3. Clinical Manifestation[sign] of Intestinal Helminthic Infections

The clinical manifestations produced by infections with pathogenic intestinal helminths include abdominal discomfort, vomiting, diarrhea, loss of weight, allergic skin reaction, general malaise, anemia, screen of helminths with faces and stomach pains. Morbidity (unpleasant) and mortality caused by intestinal helminthic infections' are usually more pronounced in children and pregnant women compared to other human groups due to less mature& amount immune systems (Bahador *et al.*, 2016).Anemia is a frequent manifestation brought in heavy infections with *A.duodenale, N.americanus, T.trichiuria*and in some instances, highest infections with *S.stercoralis*. Acute bloody diarrheic episodes are common in intestinal infections with, for example, *T.trichiuria*and in certain severe infections with *S.stercoralis*. Fatty steatorrhoeic stools are also passed in acute infections with (CDC, 2013).

Generalized malaise often accompanied by nausea and abdominal pains are a condition frequently associated with many helminthic infections, especially when the infections are heavy and in a chronic state. It occurs in ascariasis, trichuriasis, strongyloidiasis and taeniasis. stercoralis impairs fat digestion and also causes defective absorption of protein and fat-soluble vitamins, specifically vitamins A, D, E and K and Folic Acid. Hookworm *(Ancylostoma duodenale &Necator americanus* both associated with the loss of Iron, Folic Acid (vitamin B12) from the bowel/ intestinal and then the lack of folic acid during pregnancy is occur for anemia and

increase the risk for the fetal to have birth defect spinal cord, brain, urinary tract and heart malformation low birth weight, low pregnancy weight , prenatal mortality, preterm birth, poor fetal growth, and poor cognitive and gross motor out came in infants (WHO, 2017).

2.4. Global prevalence of intestinal parasitic infections

Intestinal parasitic infections are widely distributed throughout the tropics and sub tropics. The major intestinal parasitic infections of global public health concern are the protozoan species such as *E.histolytica,* and *G.lambilia,* and intestinal helminthes; *A.lumbricoides, T.trichiuria,* hookworms and tapeworms (WHO, 2018). The majority of these infections are associated with poverty conditions such as reduce access to safe drinking water, housing and inadequate access to health care or sanitation practices (Stephenson *et al.,* 2015). Intestinal parasitic infections especially helminths increase anemia in pregnancy. The results of this are low pregnancy weight and intrauterine growth retardation, followed by low birth weight, with its associated great risks of infection and higher prenatal mortality rates. An estimated 44 million pregnant women have hookworm infections which can cause chronic loss of blood from the intestines and predisposes the women to develop iron deficiency anemia and faced to double burden for pregnant women in affecting their health and their offspring (Sackey *et al.*,2003).In the terms of pathology, helminthic infections in pregnancy have been associated with iron deficiency anemia and impaired nutritional status, as well as preterm birth, low birth weight, poor iron status in the infant and adverse birth outcomes(Petersen E, 2007).Helminthic can cause chronic illnesses, such as iron deficiency anemia and growth retardation, as well as digestive disorders, including diarrhea, flatulence, anorexia, nausea, vomiting and abdominal pain *(*Mahmud *et al.,* 2020).

Globally, millions of people suffer from a parasitic infection such as *A.lumbricoides* (1billion), *T.trichiuria* (500 million), hookworm (700-900 million), *E.histolytica* (50million), and *G.lambilia* (2.8million) (CDC, 2013). The recent global prevalence estimate shows that *S. mansoni* infect 67 million and *Tania species* 16 million people worldwide. *T .saginata,* affecting people in beef-eating countries, specifically causes a disease called *taeniasis* (Chiodini *et al.,* 2011).

2.5. Ways of transmission and life cycle of intestinal helminthes

2.*5.1* Roundworms *(A. lumbricoides)*

Adult worm live in the lumen of the small intestine. A female may produce up to 200,000 eggs per day, which are passed with the feces. Fertile eggs embryonate and become infective after 18 days to several weeks depending on the environmental conditions (optimum: moist, warm, shaded soil). After infective eggs are swallowed the larvae hatch ,invade the intestinal mucosa, and are carried via the portal, then systemic circulation to the lungs . The larvae mature further in the lungs (10 to 14 days), penetrate the alveolar walls, ascend the bronchial tree to the throat, and are swallowed. Upon reaching the small intestine, they develop into adult worms between 2 and 3 months are required from ingestion of the infective eggs to oviposition by the adult female. Adult worms can live 1 to 2 years(CDC, 2019 a).

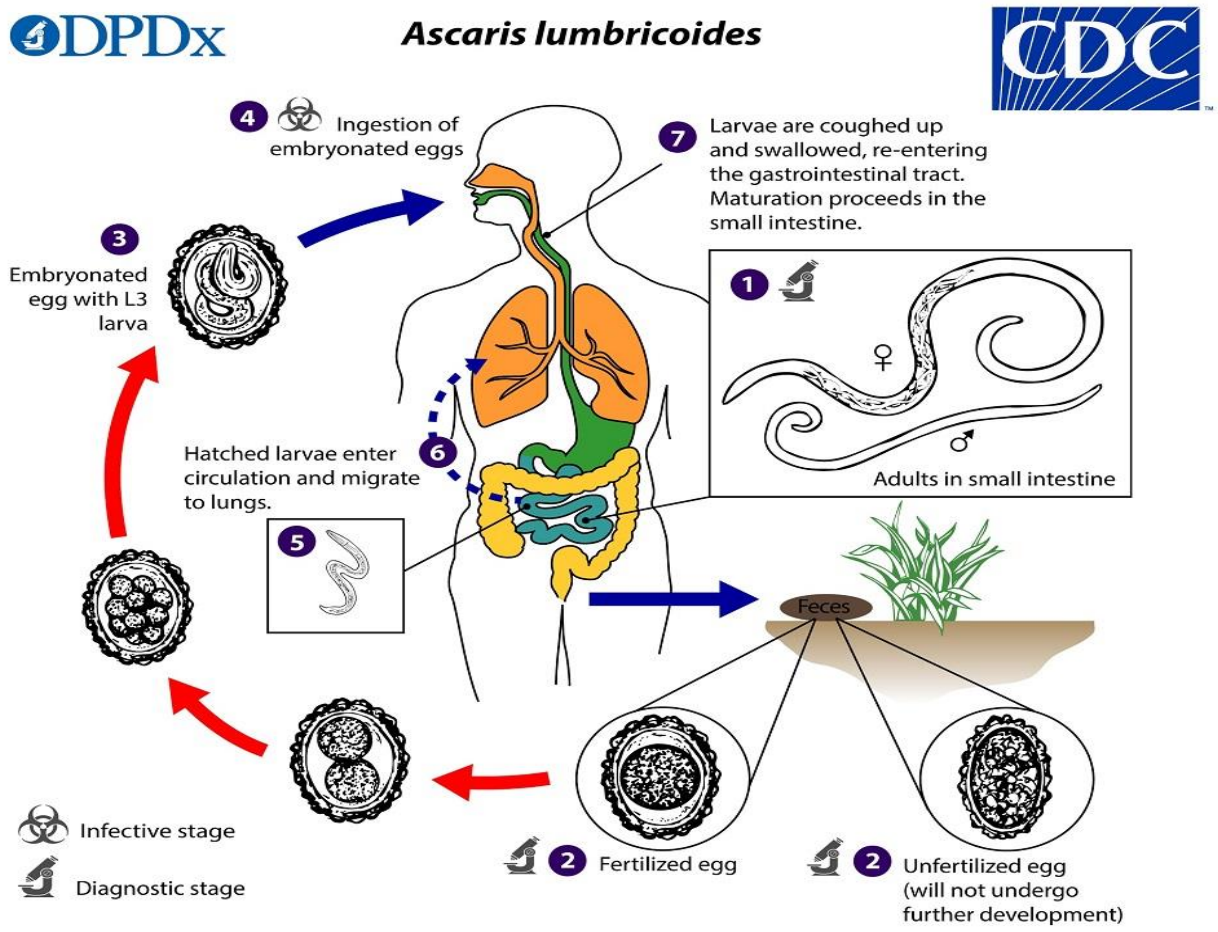

Fig 2.**1** .life cycle of A .lumbricoides (2019**).**

2.5.2 Whipworms (*T. trichuria*)

The unembryonated eggs are passed with the stool in the soil, the eggs develop into a 2-cell stage an advanced cleavage stage and then they embryonate eggs become infective in 15 to 30 days. After ingestion (soil-contaminated hands or food), the eggs hatch in the small intestine, and release larvae that mature and establish themselves as adults in the colon . The adult worms (approximately 4 cm in length) live in the cecum and ascending colon. The adult worms are fixed in that location, with the anterior portions threaded into the mucosa. The females begin to oviposit 60 to 70 days after infection. Female worms in the cecum shed between 3,000 and 20,000 eggs per day. The life span of the adults is about 1 year(CDC .2013 b)

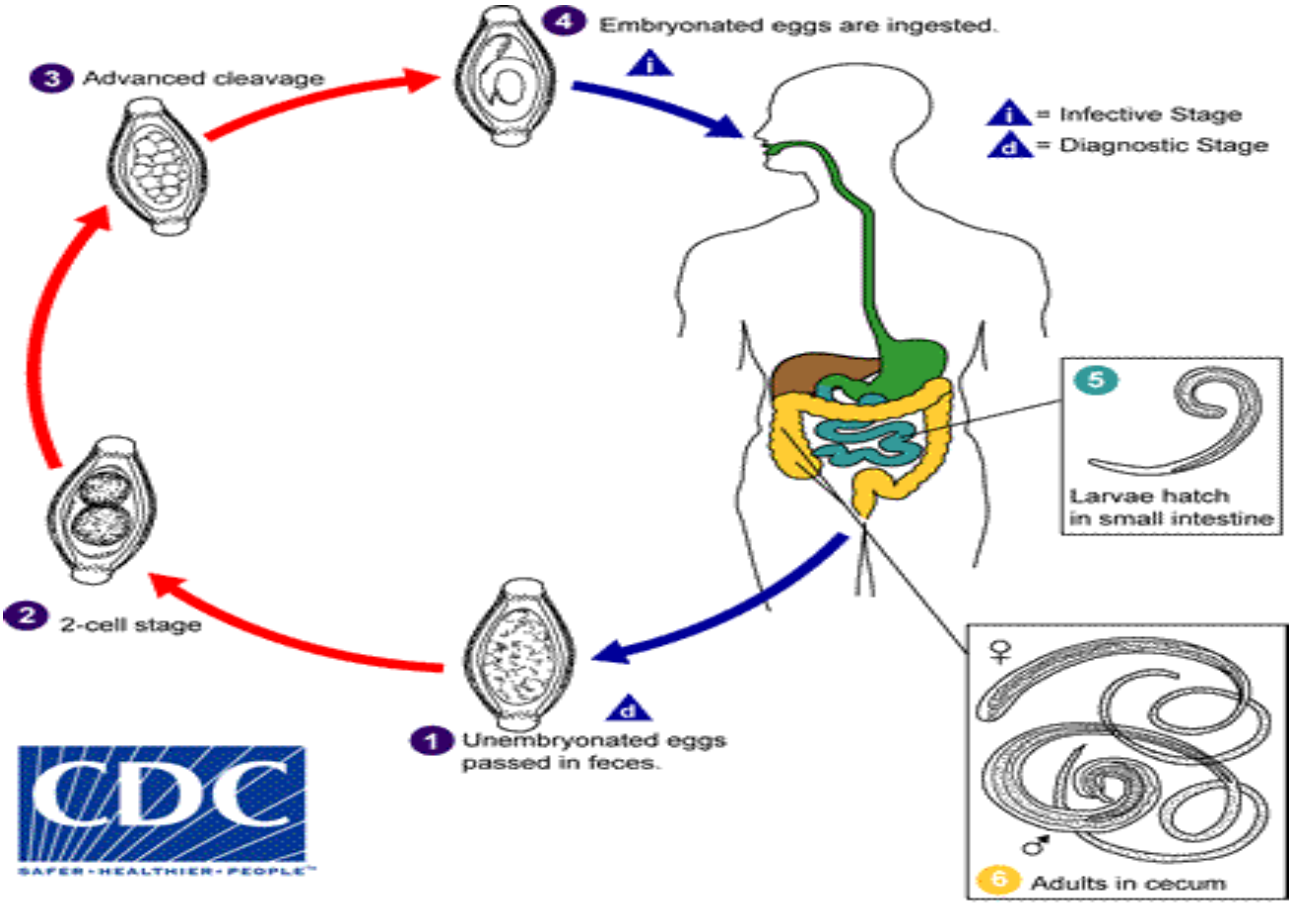

Figure 2.2. Life cycle of *T. trichuria* (CDC, 2013)

2.5.3. Hookworm (Necator americanus, and Ancylostoma duodenale)

Eggs are passed in the stool and under favorable conditions (moisture, warmth, shade), larvae hatch in 1 to 2 days. The released rhabditiform larvae grow in the feces or the soil and after 5 to

10 days, they become filariform (third-stage) larvae that are infective ,these infective larvae can survive 3 to 4 weeks in favorable environmental conditions. On contact with the human host, the larvae penetrate the skin and are carried through the veins to the heart and then to the lungs. They penetrate into the pulmonary alveoli, ascend the bronchial tree to the pharynx, and are swallowed then the larvae reach in the small intestine, where they reside and mature into adults. Adult worms live in the lumen of the small intestine, where they attach to the intestinal wall with resultant blood loss by the host and most adult worms are eliminated in 1 to 2 years, but longevity records can reach several years. Some *A. duodenale* larvae, following penetration of the host skin, can become dormant (in the intestine or muscle).In addition, infection by *A. duodenale* may probably also occur by the oral and transmammary route. *N. americanus*, however, requires a transpulmonary migration phase(CDC, 2019 b).

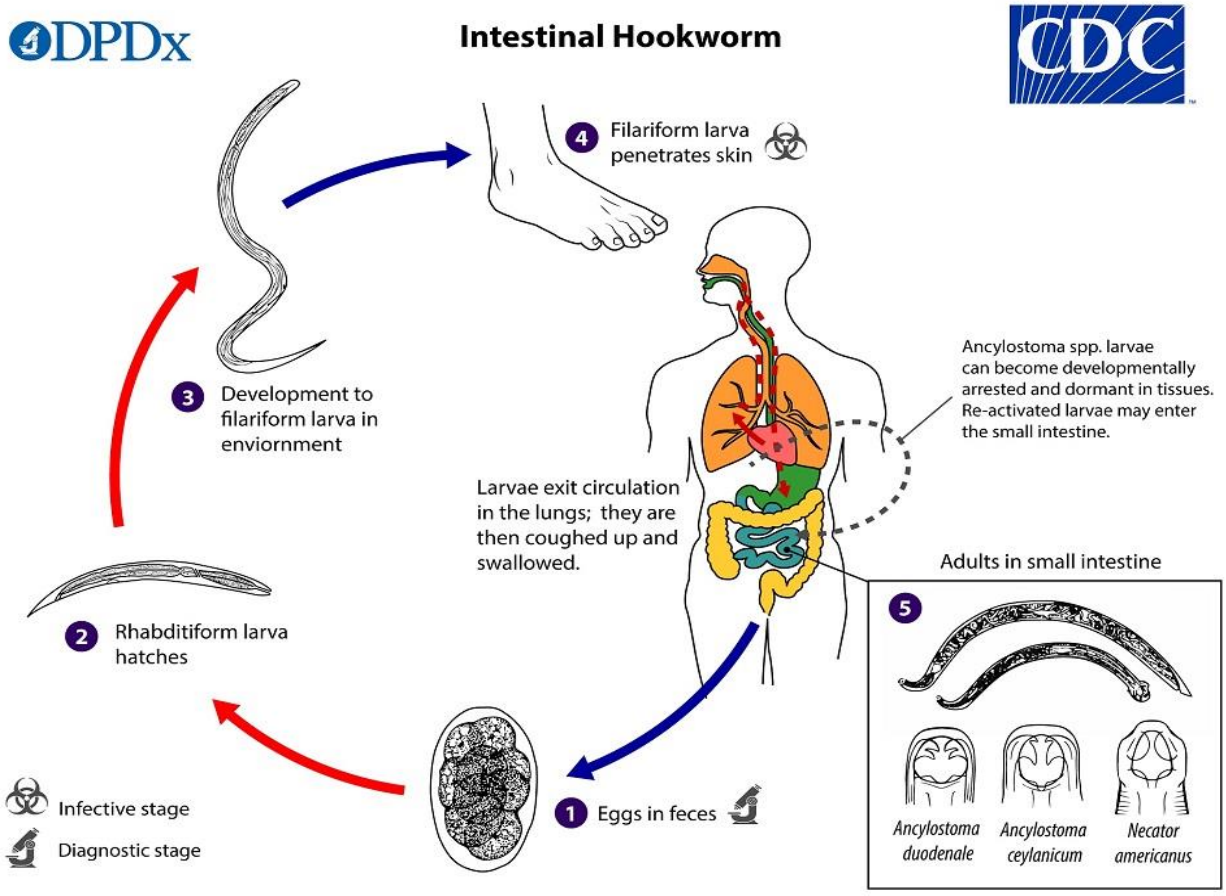

Figure 2.3.Life cycle of intestinal hook worm *A duodenale & N americanus*) (CDC, 2019).

2.5.4 Threadworm (*E. vermicularis* and *S. stercoralis*)

Gravid adult female *E. vermicularis* deposit eggs on per anal folds. Infection occurs via self-inoculation (transferring eggs to the mouth with hands that have scratched the per anal area) or through exposure to eggs in the environment (e.g. contaminated surfaces, clothes, bed linens, etc.). following ingestion of infective eggs, the larvae hatch in the small intestine and the adults establish them in the colon, usually in the cecum the time interval from ingestion of infective eggs to oviposition by the adult females is about one month. At full maturity adult females measure 8 to 13 mm, and adult males 2 to 5 mm; the adult life span is about two months. Gravid females migrate nocturnally outside the anus and oviposit while crawling on the skin of the per anal area. The larvae contained inside the eggs develop (the eggs become infective) in 4 to 6 hours under optimal conditions (CDC, 2019 c).

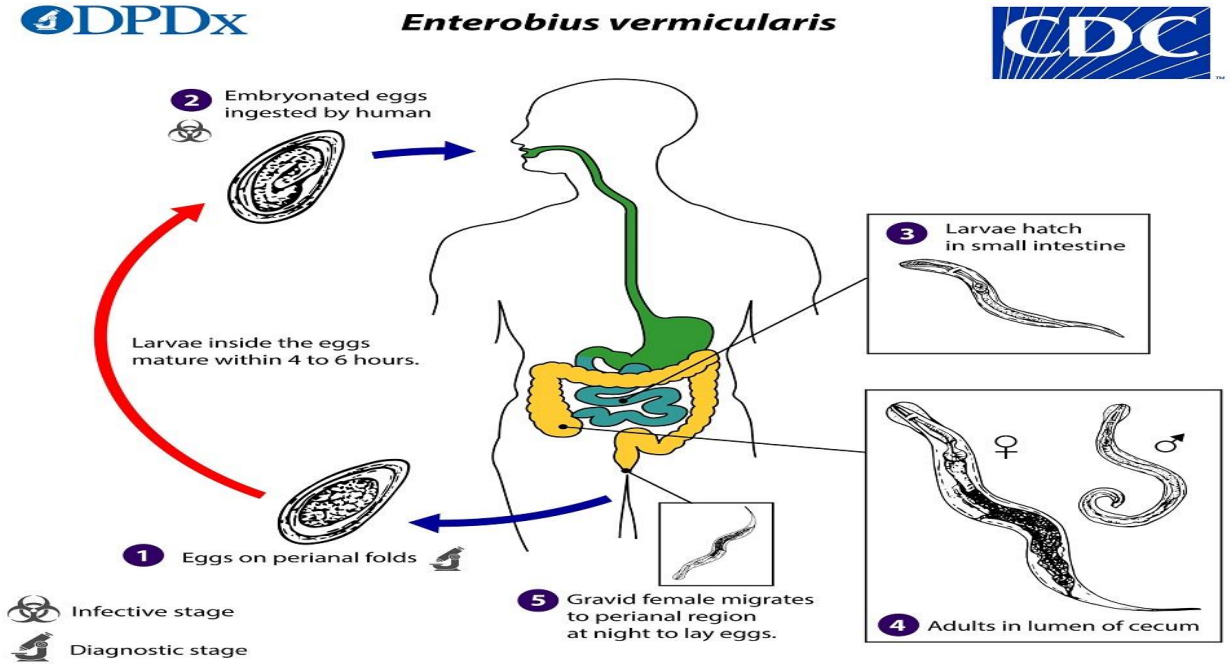

Figure 2.4. Life cycle of *E. vermicularis*(CDC, 2019)

4.5.5 .Schistosoma (Schistosoma mansoni*)*

The genus *Schistosoma* has been the subject of several studies, since it is the causative agent of schistosomiasis, Cercariae swim actively and penetrate the definitive host, again through the skin to enter blood vessels, where they develop into adults of Schistosoma .Eggs are expelled with faces (*1*). Under optimal conditions, miracidia (*2*) hatch from the eggs and swim and penetrate the snail intermediate host (*3*). The stages in the snail include two generations of sporocysts (*4*)

and the production of cercariae (*5*). Upon release from the snail, the infectious cercariae swim, penetrate the skin of the human host (6), and become schistosomulae (*7*). The schistosomulae migrate through several tissues and stages to their residence in the veins (*8, 9*). Adult worms in humans reside in the mesenteric venules in various locations, which seem to be specific for each species (*10*). The females deposit eggs in the small venules of the portal and perivesical systems. The eggs are moved progressively towards the lumen of the intestine (*S. mansoni*and *S. japonicum*) and are eliminated with faces (Jurberg et al. 2009).

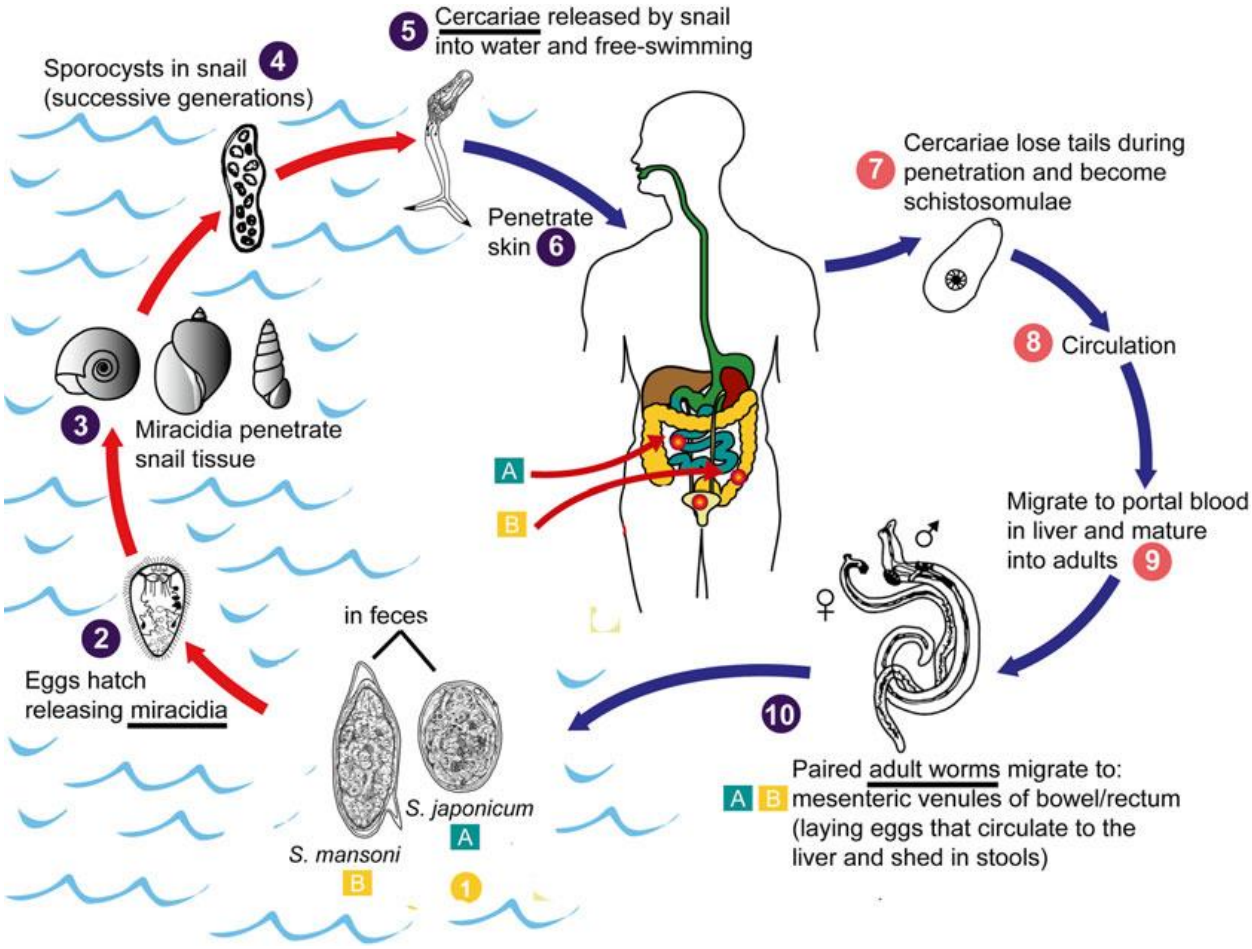

Figure 5:Life cycle of Schistosoma(*Schistosoma mansoni)*

2.6. Diagnosis of Intestinal Helminthes Infections

Direct microscopic stool examination for ova and parasites usually reveals oval eggs with thin, colorless shells. Concentrated techniques may be helpful for diagnosis of minimal infection (Gladwin and Trattler, 2004).Diagnosis of ascariasis, the diagnosis of ascariasis made through

microscopic examination of stool specimens. Ascaris eggs easily recognized, although if very few eggs are present the diagnosis may easily missed. Finding and identification of eggs in the stool by direct wet mount methods using adequately for detecting moderate to heavy infections and by concentration, technique may be used in light infection (Yetim *et al.,* 2009).See the worms' eggs and larvae in feces under a microscope. This way is the simplest and widely used in developing countries (Goodman *et al*., 2007).

The clinical examination of helminths to evaluate general condition dehydration and nutritional status and accompanied symptoms like fever ,lymphadenopathy, examination of respiratory and cardiovascular system ,examine abdomen tendemess ,ascites hepatosplenomegaly, enlarged intra-abdominal lymph nodes. The laboratory diagnosis of intestinal helminthes infections is done by the detection of their characteristic eggs and/or larvae for helminthes in stool samples collected from infected individuals to investigation stool microscopy for erythrocytes and white blood cell (invasive diarrhea) of the helminths parasitical stage, blood culture if febrile and septicemia associated diarrhea suspected also chest X ray sputum examination if having respiratory findings(TB) abdominal ultrasound is available to confirm hepatosplenomegaly abdominal lymphadenopathy and ascite .Trophozoite stages are most often found in watery or diarrheic fecal specimens. On the other hand, cysts are the stage typically found in formed fecal specimens. In direct smears of faces in saline, motile trophozoites may be found. Direct smears will often detect helminthes eggs; it is usually more efficient to do a simple concentration procedure to avoid overlooking parasites that may be present in very small numbers (Shirley *et a*l.,2018).Fecal concentration allows the detection of small numbers of organisms that may be missed by using a direct wet smear. This technique is required because it is rapid and can be used to concentrate a wide range of stool parasites from fresh or preserved stool. Sedimentation methods were used to concentrate the protozoan cyst, and helminths ova or larva in the bottom of the tube. In sedimentation technique, Formol is used to fix the parasite and ether will be used as an extractor of fecal debris and fat from the feces. Feces normally contain a great variety of materials, most of which are lighter or denser, smaller or larger than the cysts, eggs and larvae of parasites (Shirley *et a*l.,2018).

2.7. Prevention and treatment of Helminthes parasites

The problems of intestinal helminthes infection are very difficult for human beings especially for pregnant women then to need reduced such risk through the adequate treatment of drinking water with chlorine or iodine, The exterior of raw vegetables and fruits should be washed with soap and itself in vinegar for some minutes before conception, cooked raw meat & milk, wear shoes during farming activity, Safe disposal of human and animal wastes improved personal and environmental hygiene, proper use of latrine, early detection and treatment of drinking water are the major mechanisms of prevention and control of Human intestinal helminths infections, improved hygiene sanitation, and water have a positive and sustained impact on several diseases, including many of the neglected tropical diseases (Ziegelbauer *et al.*, 2012).There are many ways of prevention and control methods of intestinal helminths infections, among this are: washing hands regularly especially after defecation, cook food to its recommended internal temperature, drink clean water including bottled water, avoid drink water from river, well or ponds, avoid soil eating habit when they were pregnant, keep hands clean during and after discharging children and do not sucking fingers or scratching anal area, wear shoes when working in fields, avoid high-risk food like raw or under-cooked meat &milk, especially beef, pork and fish, clean and wash food thoroughly (WHO, 2017). Albendazole was a medication that specifically kills roundworms. It interferes with certain processes that the hookworm needs to perform in order to survive within the patient. By interrupting the parasite's metabolism, the drug kills it (Joseph., 2013).Anti-helminthic medications (drugs that avoid the body of parasitic worms), such as Albendazole and mebendazole, were the drugs of choice for treatment of helminthic infections were general treated for 3 days. Iron supplements may also be prescribed if the infected person suffers from anemia and male nutritional (CDC, 2013). The drug cures hookworm infection 96 percent of the time, Side effects of the Mebendazole include temporary abdominal pain, rash, convulsions, and liver damage. Albendazole is a medication that specifically kills roundworms (Joseph., 2013).

Treatment of IPIs: that something is done (drug) to cure an illness of intestinal helminthic infections to make free from helminthiasis. The drug was not recommending pregnant women during in gestation period of first and second trimester due to side effect for feats.

3. MATERIALS AND METHODS

3.1 Description of the study area

The study was conducted at Aandabet health center located in Andabet district. Andabet district is located 150km from BahirDar and91km from Debre Tabor and covers 98,216 hectare. Itisbordered by Este district in the east and north, East Gojam (Hulet EjuEnese) in the South; Deara district in the west. The total population is 154,797, of these (51.2% are males while (48.8% are females) (AWAO, 2015). Andabet district has 24 rural and 2 urban kebele of administrations. The Astronomical location of this helminthic is 11° 10′ to 11° 30′ N latitude and longitude 37° 45′ to 38° to 00'E. and the topography of district is also comprises 41% plain , 47% plateau and 12% deep gorge and other features as according to District Agriculture office. It has wide variation in altitude ranging from less than 1500 to more than 2300 meter above sea level. The agro-climatic conditions have three agro-ecological zones, that include Dega with altitude more than 2300 meter above sea level ,Woina -degas with an altitude of 1500-2300 meter above sea level; and kolla with an altitude of less than 1500 meter above sea level. The average annual rainfall of the district is from 673.2 -1538 mm, and the average temperature is 11°-25°C (Andabet Woreda Administration Office., 2015). Majority (about 65%) of the residents are farmers; 15% merchant,15%, grow & sale livestock only,2% weavers and3% are others. About 95% of the town dwellers are orthodox Christian and 5% are Muslims (Andabet Woreda Administration office. 2015).The main economic activities of the rural population are mixed farming. Various types of crops and cereals, vegetables and fruits grow in the district. From crops and cereals, teff, maize wheat, barley pea, beans, chick peas, from vegetable and fruits, potato, tomato, lemon, cabbage are produced. The main livestock types are also cattle , sheep , goat , poultry , mule and donkey, then nearly 80% of the farmers are involved in both raise crops and livestock, while 15.4% grow crops only and 4.6% raise livestock only (AWAO, 2015).

The health center office also enrollment/ record number of peasants infected by IPs in a year to identify the difference magnitudes people who affected in IPs(Andabet WoredaHealth office, 2015).

3.2 Study Design

A health center based cross-sectional study was conducted from October 2023 to March 2023 to determine the prevalence of intestinal parasitic infections and associated risk factors among pregnant women ANC in Andabet Town, South Gondar Ethiopia.

3.3 Source population

The source of population of this study was all pregnant women attending antenatal care at Andabet health center.

3.4. The study population

Pregnant women who were willing to participate, consented to provide stool samples, socio-demographic and environmental sanitation related information and available during the study period were considered as the study population.

3.5. Inclusion criteria

Pregnant women who were willing to provide stool sample and fill out questionnaire on socio demographic and environmental sanitation related information at time of data collection were included in the study.

3.6. Exclusion criteria

Pregnant women who were taking history of anti helminthes drug within the past 2weeks and those seriously sick (unable to provide socio demographic and environmental sanitary related information) at time of data collection were excluded from the study.

3.7. Sample size determination

Sample size was determined using simple population proportion formula for sample size calculation (Naing T *et al.*, 2006) Since the overall prevalence rate (P) of intestinal parasites among pregnant women in the study area was not known, prevalence was taken to be 50%. In the calculation, 95% confidence level (z) and 5% sampling error (d) were used).

$n=Z^2P(1-p)/d^2$ Where **n**= required sample size

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

P= prevalence 50% (standard value of 0.5)

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

N = $(1.96)^2$ 0.5(1-0.5) / $(0.05)^2$=384.

Therefore, a total of 384Pregnant women were included in study.

3.8.Sampling technique

A purposive sampling technique was used to select the study participant of pregnant women who ANC in Andabet health center they were take consented to provide stool samples, socio-demographic and environmental sanitation related information during the study period and enrolled each until the calculated sample size was (384) achieved .Finally, 384 pregnant women were include for interview, the questionnaires and provide stool sample during the study period.

3.9. Methods of Data Collection

Questionnaires survey was conducted to assess the major socio-demographic and potential risk factors of intestinal helminthic infections among study participants. In addition stool samples were collected to assess the prevalence of intestinal parasitic helminthic infections, from pregnant women attending ANC.

3.9.1 Questionnaire Survey.

A structured questionnaire was developed first in the English language. Questionnaire incorporated issues about the sociodemography variables, water source, personal hygiene, latrine availability, residence, basic knowledge about transmitted and symptoms of intestinal helminthic infections, obstetric information of the respondents. Then; it was translated into the local language (Amharic) for interview. Before the interview, the questionnaire was pretested among pregnant women attending in the nearby health center, and then the necessary adjustments based on the feedback were done. The objective of the study was explained to the study participants and verbal consent was obtained, then trained data collectors interviewed the respondents using their local language, Amharic during stool sample collection and finally the questionnaire was translated back into English for data analysis**.**

3.9.2 Stool Sample collection procedures

After completing out the questionnaire, the pregnant women were briefed on how to collect sufficient amount and contamination free stool specimens. Each study participant was provided with a labeled disposable plastic cup and plastic spatula/applicator stick and was informed to put about 2-3 g of stool into the plastic cup using the plastic spatula/applicator stick. Then, fresh stool sample was collected in a labeled plastic cup from each consented subject, then the sample were examined in the health center using direct wet-mount andFormol-ether concentration procedures.

3.9.3 Laboratory Examinations of Stool sample

This is the way of microscopic review that used to examined stool specimen in the direct wet mount concentration and Formol-ether sedimentation method during the study period were bring concentrated fresh stool from individuals during the study period.

3.9.3.1 Direct-wet mounts procedures

In the direct wet mount, a fresh stool sample of each participant (about 2 mg) was placed on a glass slide with a wooden applicator, was emulsified with a drop of physiological saline (0.85%NaCl solution) for diarrheic and semisolid samples .Then, covered with cover slide and examined for the presence of ova under microscope using first X10 and then X40 objectives (Tigabu *et al.*,2019).

3.9.3.2.Formol-Ether sedimentation method

A portion of each stool sample was used for the detection of parasitic ova using the Formol-ether concentration technique. About 2 grams of each stool sample was first emulsified with three to four ml of 10% formal saline. This was mixed thoroughly pregnant women passed through the gauze (Tigabu *et al.*,2019). Three to four ml of diethyl ether was added and mixed by inverting and intermittent shakings for one minute and then centrifuged at 3,000 rpm for five minutes. After centrifugation, the supernatant (layers of ether, debris, and Formol saline) was discarded by a pipette and the sediment (containing the parasites at the bottom of the test tube) was suspended in Formol saline. Then the sediment was examined microscopically under 10X by 10X and 10X by 40X magnifications for the presence of any parasitic organisms (Tigabu*et al.*,2019). To

maintain the reliability of the study findings, the specimen was pre examined at the end by an experienced laboratory technologist who was blind for the first examination result.

3.10. Quality Control

To ensure reliable information, laboratory materials were pre-tested before the data collection. Standard operating procedures was used for specimen collection and processing. All the reagents were checked for contamination each time. To ensure general safety, disposable gloves was used and universal bio-safety precautions was followed at all times (NCCLS, 2002).Before commencing the actual data collection, the questionnaire were pretest in 20(5% of the total sample size) randomly select pregnant women attending others health center in the town to assess the clarity appropriateness and comprehensibility of the questionnaire ,then to identify misunderstandings in the items of the questionnaire were revise.

3.11 .Variables

The prevalence of the intestinal helminthic infections were the dependant variable, while associated risk factors, sociodemography factors (age, residence, educational level, family size and gestational period) socioeconomic factors (occupation, monthly income, access to the toilet) environmental factors (source of water, place of washing), and behavioral factors (hand wash before food and after toilet, eating raw food, personal hygiene, shoe-wearing habit, waste discharge habit, fingernail status and knowledge about helminthic) were independent variables.

3.12 .Data Analysis

Information recorded on the questionnaire and the results collected from laboratory were checked for completeness and consistency and then coded and entered into the computer. The compiled(bringing) data were analyzed using Statistical Package for the Social Sciences (SPSS version 23). First, descriptive statistics were computed, and the result was reported using frequency and percentage. Chi-square ($\chi 2$) were used to test the possible association between the prevalence of intestinal parasitic infections and potential risk factors considered in the current study. Logistic regression analysis were also used to measure the strength of association between potential risk factors with of helminthic disease. A univariate logistic regression was first employed to select variables with a *p* value cut-off point of < 0.25 (Hosmer et al., 2013). The selected variables in univariate analysis was entered into multivariate logistic regression model

to identify the major explanatory variables of helminthic disease among studied pregnant women in the study area. Finally variables in the final model of multivariate logistic regression with a *p* value of < 0.05 at 95% confidence interval were taken as statistically significant explanatory variables for helminthic disease in studied subjects.

3.13.Ethical Considerations

The study was ethically approved by ethical clearance committee of Science College Bahir Dar University. A letter describing the objective of the study was written to the Andabet Health office. The researcher obtained consent from the study participants after explaining the purposes and the procedures of the study. The laboratory test and the questionnaires were conducted with strict privacy and confidentiality. The pregnant women whose test results were positive and given anti helminthic standard drugs for 3rd trimester of gestational period free of charge after instructed/ recommended by different midwifery nurse as Gebyhu ,Fentanesh and Fsik for pharmaticl experts.

RESULT

4.1. Socio-demographic characteristics of Study Participant

The ages of the study participants ranged between 21 to 48 years old with the mean age (±SD) of 33.3±6.83 years. Majority of the study subjects were in the age group of 31-40 years (50%), followed by 32.8% and 17.2% of the study participants who were in the age group of 21-30 years old and 41 and above years old respectively.

Regarding marital status, about 89.8% of respondents were married and 4.2% of them were single. The remaining 3.1% and 2.9% of respondents were widowed and divorced respectively at the time of data collection. About 13.5% of respondents were unable to read and write and 75% of them were in the primary level of education. While, the remaining 6.5% and 4 .9% of the respondents attained secondary and college levels of education, respectively. In terms of occupation, 73.4% of them were housewives, merchants (14.8%), government employees (5.7%) and 6% of the participants were NGO employees. More than three forth (82.3%)of the subjects were rural dwellers and the remaining 17.7% of them were residents of towns. Monthly income of most (58.3%) of the study participants was between 1501-2500 ETB and while nearly one forth (23.4%) and 18.2% of the study participants earned monthly income less than 1500 ETB and 2500 and above ETB, respectively.

Regarding gravidity, about 54.4% of the studied women became pregnant for the first time (Primigravida) while the other 45.6%were pregnant for more than once(multigravida).At time of enrollment in this study, gestational period of most (50.8%) of the pregnant women was first trimester followed by those 43.0% and 6.3% participants who were in their second and third trimester , in respectively.

Table1 : Socio-demographic characteristics of the study participants

Variable	Frequency (n)	Percentage (%)
Age category (year)		
21-30	126	32.8
31-40	192	50.0
41 & above	66	18.2
Total	384	100.0
Marital status		
Single	16	4.2
Divorced	11	2.9
Widowed	12	3.1
Married	345	89.8
Total	384	100.0
Occupational status		
Housewife	282	73.4
Merchant	57	14.8
Employed in gov't organization	22	5.7
Employed in NGO	23	6.0
Total	384	100.0
Residence		
Rural	316	82.3
Urban	68	17.7
Total	384	100.0
Educational level		
Can't read & write	52	13.5
Primary	288	75.0
Secondary	25	6.5
Collage & above	19	4.9
Total	384	100.0
Monthly income(ETB)		
<1500 ETB	90	23.4
1501-2500 ETB	224	58.3
2500 & above ETB	70	18.2
Total	384	100.0
Gravida		
Primigravida	209	54.4
Multigravida	175	45.6
Total	384	100.0
Gestational period		
First trimester	165	43.0
Second trimester	195	50.8
Third trimester	24	6.3
Total	384	100.0

Source: Andabet health center, survey result 2023.

4.2 Hygienic practices and environmental conditions of the pregnant women

Table 2: Hygienic Characteristics and Associated risk factors of the Respondents with intestinal helminthic disease were.

Majority (81.2%) of the study participants had no the habit of hand washing before meal and after using toilet whereas others (18.7%) of the subjects had such practice. More than 90% of the studied pregnant women had clean and trimmed finger nail whereas the remaining 6.3% had no clean and trimmed finger nail. Majority 312 (81.3%) of the respondents had no toilet of their own while 72 (18.7%) reported they had private or public toilets. Regarding the type of toilet used, most 336 (87.5%) replied that they used open fields for defecation followed by 32(8.3%) and 16 (4.2%) of subjects who used private and public toilets, respectively. When participants are asked where do you take bath, most 339 (88.3%) responded that use bathrooms at home while the remaining 45(11.7%) go to river for bathing. Majority 319 (83.1%) of the study participants replied that they used to wear shoes sometimes while nearly similar proportion of the participants had the habit of wearing shoes always and never accounted for 31(8.0%) and 34(8.9%) respectively.

Nearly four in five (79.4%) of the participants had no practice of wading across river while 79 (20.6%) practice of wading when crossed rivers. Most 320 (83.3%) of the pregnant women practiced washing their clothes along the sides of rivers bare foot while 64 (16.3%) did not have the practice washing at river side's bare foot. The source of potable water of more than 75% of the studied subjects was river followed by pipeline (tape water) , well and pond water which accounted for 10.4, 6.5 and 6.0 % respectively.

In this study, the habit of eating raw meat, and soil by the pregnant women accounted for 84 (21.9%) vs300 (78.1%) ,and 84 (6.3%) vs360 (93.7%) respectively (Table; 2) .

Table2: Hygienic Characteristics and Associated risk factors of the Respondents with intestinal helminthic disease.

Hygienic Characteristics	Frequency	Percent
Hand washing habit before meal and after toilet		
No	312	81.3
Yes	72	18.7
Total	384	100.0
Finger nail clean and trim md		
No	24	6.3
Yes	360	93.7
Total	384	100.0
Present of toilet		
No	312	81.3
Yes	72	18.7
Total	384	100.0
Type of toilet		
open defecation	336	87.5
Public	16	4.2
Private	32	8.3
Total	384	100.0
Place of body washing ANC		
River	45	11.7
in bath room	339	88.3
Total	384	100.0
Shoe wearing habit		
Never	34	8.9
Sometimes	319	83.1

Always	31	8.1
Total	384	100.0
cross river on bar foot		
Yes	79	20.6
No	305	79.4
Total	384	100.0
Washing cloth in the river on bar foot		
Yes	320	83.3
No	64	16.7
Total	384	100.0
source of potable water		
River	296	77.1
Pond	23	6.0
Well	25	6.5
Pipeline	40	10.4
Total	384	100.0
Habit of eating raw meat		
Yes	84	21.9
No	300	78.1
Total	384	100.0
habit of eating raw fruit & vegetable		
Always	16	4.2
Sometimes	353	91.9
Never	15	3.9
Habit of soil eating		
Yes	24	6.3
No	360	93.8
Total	384	100.0

4.3. Prevalence of Parasitic Intestinal Helminthic among pregnant women in Andabet district

Of the total 384 stool samples examined for intestinal helminthiasis, the overall positivity was found to be222 (57.8%).In the studied pregnant women, eight different species of intestinal helminthes were identified, among these *Ascaris lumbricoides* was the most dominant 88 (22.%) followed by hookworm 61(15.9%),Taenia species 54 (14.1%),*Trichuris trichuria* 13(3.4 %), *Schistosoma mansoni* 3(0.8%), and the remaining parasitic helminthes, *Enterobius vermicularis* , *Strongloides Stercoralis* and *Hymenolepis nana* accounted for 0.3% each(Table (3).

Table3:Helminths positivity in stool specimens examined from pregnant women

Helminthic spp	**Frequency (n) (%)**
Ascaris lumbricoides	88(22.9)
Hookworms	61(15.9)
Taenia species (*T saginata*)	54(14.1)
Trichuria trichuris	13 (3.4)
Schistosoma mansoni	3(0.8)
Enterobius vermicularis	1(0.3)
Strongloides Stercoralis	1(0.3)
Hymenolepis nana	1(0.3)

4.4.Prevalence of intestinal helminthic infection among pregnant women

As shown Table 4, the highest prevalence of intestinal helminthic infections was detected among women who were in 31-40 age group (74.0%), urban dweller(59.4%) married (58.8%) ,among those who attained primary school (60.7%)followed by those who cannot read and write(46.2%). In addition, higher rates of intestinal helminthic infection was recorded in housewives(60.6%) ,earned from 1501to2500 ETB (64.7%), lack of hand washing after toilet and before meal (61.2%), lack of toilet & used open felid(58.6%),river water uses(77.3%), eating unlashing raw fruit &vegetable(57.5%),that had no habit of wearing shoe all the times(66.7%), Washing cloth in river on bar foot(61.9%) found positive integration about helminthic infections. Similarly, higher proportion of intestinal helminthic infection was observed among those whose nail was not clean and trimmed (62.5%),(Table; 4)

Table4: **prevalence of intestinal helminthiasis infection among ANC in relation to associated with risk factors in Andabet health center 2023.**

Variables	Options	Total (%)	Positives No (%)	Negatives No (%)	x^{2df}	P value
Age of respondents	21-30	66(17.2)	29(43.9)	37(56.1)	2.235 (2)	0.268
	31-40	192(50.0)	142(74.0)	50(26.0)		
	41 & above	126(32.2)	51(40.5)	75(59.5)		
Residence of respondents	Rural	315(82.0)	181(57.5)	134(42.5)	0.024(1)	0.030*
	Urban	69(18.0)	41(59.4)	28(40.6)		
Marital status of respondents	Single	16(4.2)	7(43.8)	9(56.2)	14.821(1)	0.002*
	Divorced	11(2.9)	6(54.5)	5(45.5)		
	Widowed	12(3.1)	7(58.3)	5(41.7)		
	Married	345(89.8)	202(58.6)	143(41.4)		
Educational level of respondents	can't read & write	39(10.2)	18(46.2)	21(53.8)	15.114(3)	0.002*
	Primary	313(81.5)	190(60.7)	223(39.3)		
	Secondary	24(6.3)	11(45.8)	13(54.2)		
	college & above	8(2.1)	3(37.5)	5(62.5)		
Occupation of respondents	Housewife	282(73.4)	171(60.6)	111(39.4)	17.615(3)	0.001*
	Merchant	57(14.8)	28(49.1)	29(50.9)		
	Employed gov't organization	22(5.7)	11(50.0)	11(50.0)		
	employed inNGO	23(6.0)	12(52.2)	11(47.8)		
Monthly income of respondents	<1500ETB	90(23.4)	50(55.6)	40(44.4)	19.114(2)	0.001*
	1501-2500ETB	224(58.3)	145(64.7)	79(35.3)		
	2500 & above	70(18.2)	27(38.6)	43(61.4)		
Hand washing before meal after toilet	No	312(81.3)	191(61.2)	121(38.8)	6.122(1)	0.017*
	Yes	72(18.8)	31(43.1)	41(56.9)		

Finger nail clean and trimmed	No	24(6.3)	15(62.5)	9(37.5)	0.003(1)	1.000
	Yes	360(93.8)	207(57.5)	153(42.5)		
Present of toilet	No	312(81.3)	202(64.7)	110(35.3)	5.212(2)	0.025*
	Yes	72(18.8)	20(27.8)	52(72.2)		
Type of toilet	open defection	336(87.5)	197(58.6)	139(41.4)	2.241(2)	0.325
	Public	16(4.2)	9(56.3)	7(43.7)		
	Private	32(8.3)	16(50.0)	16(50.0)		
Shoes wearing habit	Never	33(8.6)	22(66.7)	11(33.3)	9.810(2)	0.007*
	Sometimes	320(83.3)	189(59.1)	131(40.9)		
	Always	31(8.1)	11(35.5)	20(64.5)		
Source of potable water	River	297(77.3)	177(59.6)	120(40.4)	9.825(3)	0.020*
	Pond	23(6.0)	14(60.9)	9(39.1)		
	Well	24(6.3)	13(54.2)	11(45.8)		
	Pipeline	40(10.4)	18(45.0)	22(55.0)		
Habit of eating raw fruit & vegetable	Always	360(93.8)	207(57.5)	153(42.5)	3.880(2)	0.144
	Sometimes	24(6.3)	15(62.5)	9(37.5)		
	Never	7(43.8)	9(56.2)	7(4.3)		

*: Statistically significance at p<0.05 of $x^{2\ df}$

4.5.Logistic Regression Analysis of Associated Risk Factors with intestinal helminthiasis

Logistic regression analysis was used to determine the degree of association and to identify the major explanatory risk factors of intestinal helminthic infections among pregnant women at Andabet health center. A bivariate logistic regression analysis was first done and then a p value with a cut-off point, 0.25 (Hosmer *et al.*, 2013) was used for selecting the candidate variables for multivariate analysis to identify the major explanatory risk factors for intestinal helminthicinfections.

4. 5.1 Bivariate logistic regression analysis of potential risk factors of intestinal helminthiasis

Bivariate logistic regression analysis of the potential risk factors of intestinal helminthiasis infection was presented as crude odds ratio (COR) at 95% CI in Table 5.

The likelihood of intestinal helminthiasis was 0.54(0.32-0.93) times higher among pregnant women who live rural setting as compared with urban dwellers (p=0.028). There was statistical significant association between marital status and intestinal helminthiasis. The odds of intestinal helminthiasis were 6.75 and 16.50 times higher among divorced and widowed pregnant women respectively as compared with married pregnant women (p<0.05).With regard to occupational status of the respondents, merchants were 3.21 times (COR=3.21, 95% CI=1.16 -8.85) more likely to be infected with intestinal helminthiasis than government employed women and the association was statistically significant ($p < 0.05$). Similarly, there was statistically significant association between monthly income and the risk of intestinal helminthiasis ($p < 0.05$), pregnant women who earn monthly incomes less than 1500 ETB and 1501-2500ETB were2.79and3.92times in respectively more likely to be infected by intestinal helminthic parasites than those who earn monthly income above 2500 ETB. There was about 2.00 (95% CI=1.15-3.48) times more likelihood of intestinal helminthic infections among the study participants who didn't wash their hands before meal and after toilet than those who had the practice of hand washing after toilet and the association was statistically significant ($p < 0.05$).Similarly, the likelihood of intestinal helminthic infection was 0.47 and 0.37 times higher among pregnant women who never wear shoes and among those who wear shoes sometimes as compared with those who wear shoes always and the association was statistically significant ($p < 0.05$).There was statistically significant association between intestinal helminthic infection and history of deworming ($p <0.05$). The odds of intestinal helminthic infections were 2.50 times (95% CI=1.25-4.96) higher among pregnant women who had no previous history of taking anti helminthic drugs than those who had history of taking anti helminthic drugs. With regard to gestational period, pregnant women in their first trimester and second trimester were 2.02 and 1.68times respectively more likely to contract intestinal helminthic infection than those pregnant women in their third trimester but the association were not statistically significant (P> 0.05)**(**Table 5**)**.

There was no significant association between age, gravidity, gestation period of pregnant women, the finger nail trimming and cleanliness, place of bath , habit of eating soil, types of toilet, with intestinal helminthic infection ($p > 0.05$).

Table5: Prevalence of intestinal helminthiasis infection among ANC in relation to associated risk factors in Andabet health center 2023

Variables	Options	Total (%)	Positives No (%)	Negatives No (%)	COR(95%CI)	P value
Age of respondents	21-30	66(17.2)	29(43.9)	37(56.1)	1.55(0.73-3.29)	0.245
	31-40	192(50.0)	142(74.0)	50(26.0)	0.94(0.50-1.75)	0.945
	41 & above	126(32.2)	51(40.5)	75(59.5)	1*	
Residence of respondents	Rural	315(82.0)	181(57.5)	134(42.5)	0.54(0.32-0.93)	0.028*
	Urban	69(18.0)	41(59.4)	28(40.6)	1*	
Marital status of respondents	Single	16(4.2)	7(43.8)	9(56.2)	0.50(0.15-1.58)	0.238
	Divorced	11(2.9)	6(54.5)	5(45.5)	6.75(1.43-3.17)	0.016*
	Widowed	12(3.1)	7(58.3)	5(41.7)	16.50(2.10-129.2)	0.008*
	Married	345(89.8)	202(58.6)	143(41.4)	1*	
Educational level of respondents	can't read & write	39(10.2)	18(46.2)	21(53.8)	0.11(0.03-0.45)	0.012*
	Primary	313(81.5)	190(60.7)	223(39.3)	0.18(0.03-0.45)	0.001*
	Secondary	24(6.3)	11(45.8)	13(54.2)	0.10(0.02-0.46)	0.008*
	college & above	8(2.1)	3(37.5)	5(62.5)	1*	
Occupation of respondents	Housewife	282(73.4)	171(60.6)	111(39.4)	1.11(0.48-2.87)	0.714
	Merchant	57(14.8)	28(49.1)	29(50.9)	3.21(1.16-8.85)	0.024*
	Employed gov't organization	22(5.7)	11(50.0)	11(50.0)	1.22(0.38-4.34)	0.672
	employed inNGO	23(6.0)	12(52.2)	11(47.8)	1*	
Monthly income of respondents	<1500ETB	90(23.4)	50(55.6)	40(44.4)	2.79(1.35-5.74)	0.005*
	1501-2500 ETB	224(58.3)	145(64.7)	79(35.3)	3.92(2.06-7.46)	0.001*
	2500 & above	70(18.2)	27(38.6)	43(61.4)	1*	

Hand washing after toilet and before meal	No	312(81.3)	191(61.2)	121(38.8)	2.00(1.15-3.48)	0.014*
	Yes	72(18.8)	31(43.1)	41(56.9)	1*	
Finger nail clean and trimming	No	24(6.3)	15(62.5)	9(37.5)	0.99(0.42-2.26)	0.957
	Yes	360(93.8)	207(57.5)	153(42.5)	1*	
Present of toilet	No	312(81.3)	202(64.7)	110(35.3)	0.51(0.32-0.92)	0.023*
	Yes	72(18.8)	20(27.8)	52(72.2)	1*	
Type of toilet	open defection	336(87.5)	197(58.6)	139(41.4)	0.60(0.29-1.25)	0.179
	Public	16(4.2)	9(56.3)	15(62.5)	9(37.5)	0.838
	Private	32(8.3)	16(50.0)	16(50.0)	1*	
Shoes wearing habit	Never	33(8.6)	22(66.7)	11(33.3)	0.42(0.15-1.16)	0.095
	Sometimes	320(83.3)	189(59.1)	131(40.9)	0.37(0.14-0.67)	0.003*
	Always	31(8.1)	11(35.5)	20(64.5)	1*	
Source of potable water	River	297(77.3)	177(59.6)	120(40.4)	0.35(0.10-0.91)	0.003*
	Pond	23(6.0)	14(60.9)	9(39.1)	0.30(0.15-1.17)	0.33
	Well	24(6.3)	13(54.2)	11(45.8)	0.42(0.15-1.17)	0.99
	Pipeline	40(10.4)	18(45.0)	22(55.0)	1*	
Habit of eating fruit and vegetable	Always	360(93.8)	207(57.5)	153(42.5)	2.92(1.22-7.02)	0.016*
	Sometime	24(6.3)	15(62.5)	9(37.5)	0.16(0.04-0.57)	0.005*
	Never	7(43.8)	9(56.2)	7(4.3)	1*	
Eat raw meat	Yes	84(21.9)	52(61.9)	32(38.1)	1.03(0.63-1.68)	0.888
	No		170(56.7)	130(43.3)	1*	
History of deworming drug	No	335(87.2)	207(61.8)	128(38.2)	2.50(1.25-4.96)	0.009*
	Yes	49(12.8)	15(30.6)	34(69.4)	1*	
Parity Gravida	Primigravida	209(54.4)	125(59.8)	84(40.2)	0.95(0.63-1.42)	0.808
	multi Gravida	175(45.6)	97(55.4)	78(44.6)	1*	
Gestational period	first trimester	165(43.0)	106(64.2)	59(35.8)	2.02(0.79-5.14)	0.138
	second trimester	195(50.8)	108(55.4)	87(44.6)	1.68(0.67-4.26)	0.267
	third trimester	24(6.3)	8(33.3)	16(66.7)	1*	

Cross river on bar foot	Yes	79(20.6)	32(40.5)	47(59.5)	0.71(0.41-1.17)	0.174
	No	305(79.4)	190(62.3)	115(37.7)	1*	
Place of bath among ANC	River	45(11.7)	31(68.9)	14(31.1)	0.72(0.38-1.39)	0.339
	in bath room	339(88.3)	191(56.3)	148(43.7)	1*	
Washing of cloth river on bar foot	Yes	320(83.3)	198(61.9)	122(38.1)	0.63(0.37-1.08)	0.098*
	No	64(16.7)	24(37.5)	40(62.5)	1*	
Soil eating habit of ANC	Yes	24(6.3)	13(54.2)	11(45.8)	0.54(0.22-1.34)	0.188
	No	360(93.8)	209(58.1)	151(41.9)	1*	

: Statistically significance at p<0.05 1 : Reference category

4.5.2 Multivariate logistic regression analysis of potential Risk Factors of intestinal helminthiasis

The variables with $p < 0.25$ in bivariate analysis were selected and included in multivariate logistic regression analysis model to identify major explanatory variables of intestinal helminthic infections among the pregnant women.

Accordingly, residence, marital status, occupational status, monthly income, history of deworming, hand washing before meal and after toilet use, present of toilet, habit of wearing shoes, water source, were found to be significant explanatory factors of intestinal helminthic infections among the studied pregnant women ($p < 0.05$).

The odds of being infected with intestinal helminthic infection were 0.40 times (AOR = 0.40, 95% CI= 0.19-0.85, P = 0.018), the residence of rural were more infected with intestinal helminthic infection than in those who the residence of urban (reference category) and the association was statistically significant ($p < 0.05$).

Regarding to marital status, the odds of being infected with intestinal helminthic infection were 27.28 and 11.28 times (AOR = 27.28, 95% CI = 0.98-757.98, P = 0.051), AOR=11.28,95% CI=1.13-112.70,P= 0.039), higher in pregnant divorced and widowed women respectively than married pregnant women and the odd of association was statistically significant ($p < 0.05$). In the case of occupational statuses of the study subjects, the odds of being infected with intestinal helminthic infection were 2.33 (95% CI: 0.71-7.65; p= 0.160) more likely among occupationally housewives and it was 6.38 times (95% CI = 1.62-24.99, P = 0.008) more likely infected in those women who are merchants than NGO employed women.

Earning monthly income of less than1500 and 1501-2500 Ethiopian birr increase the odds of intestinal parasitic helminthic infection by about 3.98 (1.78-8.87) and 3.81 (1.78-8.11) respectively folds higher than those pregnant who earn monthly income of 2500 Ethiopian birr and above ($p< 0.05$).

Having no previous history of taking anti helminthic drugs increased the odds of intestinal helminthic infections by 3.32 folds higher than had practice history of deworming and the risk of intestinal helminthic infections.

There was statistically significant association between prevalence of intestinal helminthic infections and the habit of hand washing before meal and after toilet use ($p<0.05$). Accordingly, the risk of intestinal helminthic infections was nearly five (4.98) times higher among pregnant women who had no the habit of hand washing before meal and after toilet use.

There was non-statistically significant 13.67 times increased risk of intestinal infections among pregnant women who practiced open defecation as compared with those who used private toilets. Moreover, nearly two fold odds of intestinal infections was observed among pregnant women who had the habit of soil eating but the association is not statically significant ($p>0.05$). Similarly, the likelihoods of intestinal infections were 2.38 and 1.48 times higher among pregnant women who had the habit of eating raw fruits and vegetables always and sometimes respectively, as compared with those women who never eat raw fruits and vegetables ($p>0.05$).

Table6: Univariate and multivariable logistic regression analysis on sociodemography factors that associated with intestinal helminthiasis infection among pregnant women 2015 (*n* = 384).in Andabet health center, South Gondar Zone 2023

Sociodemography variables	Intestinal parasite		COR (95% CI)	*p* value	AOR (95% CI) *p* value	*p* value
	Positive (%)	Negative (%)				
Residence Rural	181(57.5)	134(42.5)	0.548(0.323-0.930)	0.028*	0.40(0.19-0.85)	0.018*
Urban	41(59.4)	28(40.6)	1*		1*	
Marital status Single	7(43.8)	9(56.2)	0.50(0.15-1.58)	0.238	2.14(0.43-10.71)	0.351
divorced	6(54.5)	5(45.5)	6.75(1.43-3.17)	0.016*	27.28(0.98-75.98)	0.051*
widowed	7(58.3)	5(41.7)	16.50(2.10-129.2)	0.008*	11.28(1.13-112.70	0.039*
married	202(58.6)	143(41.4)	1*		1*	
Occupations housewife	171(60.6)	111(39.4)	1.181(0.48-2.87)	0.714	2.33(0.71-7.65)	0.160
merchant	28(49.1)	29(50.9)	3.21(1.16-8.85)	0.024*	6.38(1.62-24.99)	0.008*
in gov't	11(50.0)	11(50.0)	1.29(0.38-4.34)	0.672	0.94(0.17-5.20)	0.944
inNGO	12(52.2)	11(47.8)	1*		1*	
Monthlyincome<1500ETB	50(55.6)	40(44.4)	2.79(1.35-5.74)	0.005*	3.98(1.78-8.87)	0.001*
	145(64.7)	79(35.3)	3.92(2.06-7.46)	0.001*	3.81(1.78-8.11)	0.001*

1501-2500 ETB 2500 & above	27(38.6)	43(61.4)	1*		1*	
Gravidity Primigravida	125(59.8)	84(40.2)	0.95(0.63-1.42)	0.808	0.57(0.32-1.01)	0.056*
multi Gravida	97(55.4)	78(44.6)	1*		1*	
History of deworming No	207(61.8)	128(38.2)	2.50(1.25-4.96)	0.009*	3.32(1.40-7.87)	0.006*
Yes	15(30.6)	34(69.4)	1*		1*	

1∗: reference category, ∗: statistically significant $p < 0.05$ value

Table 7 : Univariate and multivariable analysis on hygienic & behavioral potential risk factors associated with helminthic infection among pregnant women in Andabet health center, South Gondar Zone 2023 (*n* = 384).

Hygienic & behavioral variables	Intestinal parasite		COR (95% CI)	P value	AOR (95% CI)	P value
	Positive (%)	Negative (%)				
Hand washing after toilet and before meal No Yes	191(61.2)	121(38.8)	2.00(1.15-3.48)	0.014*	4.89(2.09-11.40)	0.001*
	31(43.1)	41(56.9)	1*		1*	
Present of toilet No	202(64.7)	110(35.3)	0.551(0.329-0.9)	0.023*	0.43(0.20-0.92	0.032*
Yes	20(27.8)	52(72.2)	1*		1*	
Type of toilet open defection	197(58.6)	139(41.4)	0.67(0.29-1.257)	0.179	13.67(0.47-395.77)	0.128
public	9(56.3)	7(43.7)	0.88(0.26-2.93)	0.838	0.10(0.01-1.73)	0.115
private	16(50.0)	16(50.0)	1*		**1***	
Shoes wearing	22(66.7)	11(33.3)	0.43(0.15-1.16)	0.095	0.01(0.01-0.24)	0.003*

Never sometimes Always	189(59.1)	131(40.9)	0.30(0.14-0.67)	0.003*	0.04(0.01-0.09)	0.001*
	11(35.5)	20(64.5)	1*		1*	
Water source	177(59.6)	120(40.4)	0.35(0.14-0.91)	0.003*	0.93(0.34-2.57	0.898
River	14(60.9)	9(39.1)	0.30(0.15-1.17)	0.33	0.033(0.001-0.69)	0.001*
pond	13(54.2)	11(45.8)	0.42(0.152-1.1)	0.99	0.47(0.03-7.44)	0.593
well pipe line	18(45.0)	22(55.0)	1*			
Habit of Soil eating Yes	13(54.2)	11(45.8)	0.545(0.220-1.34)	0.188	1.93(0.68-5.43)	0.212
No	209(58.1)	151(41.9)	1*		1*	
Eating fruit and Always	207(57.5)	153(42.5)	2.92(1.22-7.02)	0.016*	2.38(0.25-22.13)	0.444
Sometimes	15(62.5)	9(37.5)	0.16(0.04-0.57)	0.005*	1.48(0.25-8.68)	0.664
Never	9(56.2)	7(4.3)	1*		1*	

1∗: reference category, ∗: statistically significant $p < 0.05$ value

CHAPTER FIVE DISCUSSION

5. DISCUSSION

The overall prevalence of intestinal helminthic infection among pregnant women in the current study was 57.8%. The finding of this study was in alignment with the result reported from Venezuela (57.0%), (Rodr´ıguez-Morales *et al.*,2006) Northwest Ethiopia Yifag (53.4%) (Minichil and Destaw,2021), Nigeria (48.3%), (Egwunyenga *et al*., 2001).However, the current investigation showed lower prevalence rate than the result from Bushlo Health Center, Ethiopia (58.3%), (Tsehayu *et al.*,2009), Gabon(65%), (Adegnika., 2010), Amhara region Delgi (77.9%), (Mulat Alamir., 2012). Differences in findings among various studies can be explained by variations in geographical setup, socioeconomic conditions, difference in parasitological examination methods and tools, the number of study population, parasitological examination skill among expertise, difference environmental personal sanitation.

In contrast the finding of this study was much higher than the reports from northwestern Ethiopia at Shahura primary hospital (19.8) (Gebre Ayanaw, Abaineh Munshea and EndalkachewNibret.,2021), East Wollega, Oromia, Ethiopia (24.7%) (Mengiste., 2017), Kenya (13.8%) (Wekesa W*et al.,* 2014), Ethiopia (13.7%) (Haider , 2010), Hossana, Sothern Ethiopia (29.4%,) (Jember *et al*., 2015). High prevalence of Intestinal helminthic species among pregnant women in the study area wear due to low socioeconomic level, education level among pregnant women, failing to wear shoes, use of contaminated and unhygienic potable water, habit of eating raw meat, vegetable and fruits, use of open field for defecation than private toilet, lack habits of hand washing before meal and after toilet which may increase an exposure to helminthic infections.

The prevalence of *A. Lumbricoides* in the current study was 22.9%. It is comparable with the result of a report from Wondo Genet district, Southern Ethiopia (24.9%) (Bolka and Gebremedhin,2019).But it was higher than the findings in East Wollega, Oromia, Ethiopia (6.5%)(Mengiste.,2017), Shahura primary hospital northwestern Ethiopia at (8.6%)(Gebre Ayanaw and Abaineh Munshea, Kenya (6.5%) (Wekesa *et al.,* 2014),Lalo Kile district, Western Ethiopia (7.3%) (Yesuf *et al.,* 2019),Gilgel Gibe Dam area, Southwest Ethiopia (15%)(Gizaw *et al*.,2018), primary hospital, North Ethiopia (12.6%) (Gebrehiwet *et al*., 2019).But it is lower than results from Mecha District, Northwest Ethiopia (32.2%)(Feleke and Jember.,2018),

Nigeria (52.2%) (Ivoke et al., 2017) and Venezuela (57.0) (Rodr´ıguez-Morales *et al*., 2006).The observed differences across studies might be due to personal and environmental sanitation hand washing before meal and after toilet ,differences parasitological examination methods and tools, the number of study population, and parasitological examination skill among expertise, difference habit of eating raw vegetable and fruit, different working activity and employed among pregnant women.

The prevalence of hookworm in present study was 15.9%. This is in agreement with other studies conducted in Ethiopia; East Wollega ,Oromia (15.1%) (Mengist *et al*., 2017), Mecha district, Northwest Ethiopia (14.2%), Wondo Genet district East district, Southern Ethiopia (11.2%). However it was higher than the reports from Bahir Dar, Northwest Ethiopia (5.5%),Yifag northwest Ethiopia (9.0%)(Minichil andDestaw,2020) and Venezuela (8.1%)(Rodr´ıguez-Morales *et al*., 2006). But it is lower than a report from Anbesame Health Center (20%), Gilgel Gibe Dam area ,Southwest Ethiopia (29.4%)(Jember D *et al.,2015*), LaloKile district, Western Ethiopia (33.7%) (Yesuf *et al.,201*), Maytsebri primary hospital, North Ethiopia (39.96%) (Hailu T *et al*., 2019), Uganda (40.5%) (Chami *et al*., 2015), and Nigeria (44.4%)(Ivoke N *et al*., 2019). The observed discrepancy might be due to the differences environmental condition , habit of wearing shoe, parasitological examination methods and tools used, the sample size of study population.

The third predominant intestinal helminthic infections in present investigation was Taenia species(14.1%).This prevalence is far higher than the study conducted in East Wollega, Oromia Ethiopia(1.3%)(Mengist *et al*., 2017). Bahir Dar, Northwest, Ethiopia (0.8%, Arba Minch Town, Ethiopia (0.6%) (Bekele *et al*., 2016) and Iran (0.014%) (Saki *et al*., 2017), Northwestern Ethiopia at Shahura primary hospital (3.6%) (Gebre Ayanaw ,Abaineh Munshea and EndalkachewNibret,2021).But this prevalence was lower than Northwest Ethiopia Yifag (18.1%)(Minichil and Destaw,2020).This difference may be due to the differences in the habit of eating raw meat, open defecation, difference in awareness prevention and control method of the parasite difference the number of study population .

Several factors have been reported to predispose pregnant women who reside in rural settings to intestinal parasitic infections, these might include their lower educational status, low awareness about the risk and preventive mechanisms of intestinal parasites, poor practice toward personal

hygiene, use of contaminated water, and walking barefooted (Mosisa Getu *et al*., 2023). In current study, more than eighty percent of the participants were rural residents and rural residence was positively associated with odds of being infected with intestinal helminthic infections (AOR= 0.40; p<0.05). According to a recent finding of a systematic review and met analysis by Mosisa Getu *et al*. (2023), rural residence was positively associated with intestinal parasites among pregnant women. This finding indicated that the odds of developing intestinal parasite infection were 3.75 times higher among women who reside in the rural than their urban counterparts.

We found statistically significant association between marital status and prevalence of intestinal helminthic infections ($p < 0.05$). The odds of being infected with intestinal helminthic infection among divorced and widowed pregnant women were 27.28 and 11.28 times higher respectively than married pregnant women. This might be associated with their lower socioeconomic status, poor personal hygiene and practices.

In the case of occupational statuses of the studied subjects, the odds of being infected with intestinal helminthic infections were 2.33 times more likely among occupationally housewives and it was 6.38 times more likely in those women who are merchants than employed women. Differences in hygienic practices, degree of exposure to parasitic helminthes, personal income, and awareness towards the modes of transmission of the parasites may attribute to the variations in risk of the intestinal helminthic infections. However, Edosa Kebede *et al*. (2022) did find any significant differences in prevalence and association between occupational statuses and intestinal parasitic infections.

Several studies showed that there is a high prevalence of intestinal parasitic infections in pregnant women, especially in some low- and middle-income countries (Taghipour *et al*., 2021). In addition, according to Pan American Health Organization (2009) report, pregnant women and their infants and children living under the poverty line in low income countries are at a high risk of intestinal parasitic infections. In agreement with this , the present study demonstrated that women earning lower monthly incomes(<1500 and 1501-2500 Ethiopian birr) were at 4 times increased risk of intestinal parasitic helminthic infections than those pregnant who earn monthly income of 2500 Ethiopian birr and above (p< 0.05). This might be due to the reason that pregnant women who earn lower monthly income and live in poverty might not get access for

fulfilling their needs and unable to afford to buy materials necessary for keeping their personal hygiene and environmental sanitation.

Previous studies clearly demonstrated that poor personal hygienic practices such as not washing hands before eating and after using a toilet, eating unwashed foods, walking and playing outdoors barefooted, leaving food uncovered from flies, and geophagia have a crucial role in transmission of intestinal parasitic infections (Rai*et al*., 2000; Luoba *et al*., 2005; Tesfaye, 2015). In agreement with this, the present study demonstrated statistically significant association between prevalence of intestinal helminthic infection and the habit of washing hand before meal and after toilet use ($p<0.05$). Accordingly, the likelihood of intestinal helminthic infections was nearly five (4.98) times higher among pregnant women who had no the habit of hand washing before meal and after toilet use.

There was non-statistically significant 13.67 times increased risk of intestinal infections among pregnant women who practiced open defecation as compared with those who had private toilets. Open-field defecation habit, might contaminate food and water that pregnant women consume, and finally, predispose them to intestinal parasites. Moreover, nearly two fold odds of intestinal infections was observed among pregnant women who had the habit of soil eating but the association was not statically significant ($p>0.05$). Eating fecal contaminated of soil increases the odds of intestinal parasitic helminthic infections due to the adherence the ova of the parasite to the soil. Similarly, the likelihoods of intestinal infections were 2.38 and 1.48 times higher among pregnant women who had the habit of eating raw fruits and vegetables always and sometimes respectively, as compared with those women who never eat raw fruits and vegetables ($p>0.05$).Ingestion of raw vegetables increases the odds of intestinal parasitic infection, this is due to the reason that raw vegetables acts as vehicle for transporting intestinal parasites (Omowaye and Audu,2012 ; Kefiyalew et al., 2014; Mahande, 2016; Feleke and Jember ,2018).

6. Conclusions and Recommendations

6.1 Conclusions

- ✓ The overall prevalence of intestinal helminthic parasites among pregnant women attending prenatal care at Andabet Health center is higher (57.8%). A total of eight species of intestinal helminthic parasites were identified in this study. These include *A.lumbricoides* , hookworm, Taenia species, *T.trichuria, S. mansoni* , *S. stercoralis*, *E. vermicularis*, and *H. nana*, among these *A. lumbricoides* infection (22.9%) was the predominant followed by hookworm (15.9%) and Taenia species(14.1%).Low socioeconomic level , rural dweller, marital status of divorced and widowed ,occupational status of housewife & merchant, failing to wear shoes, use unhygienic potable water, use of open field for defecation ,lack habits of hand washing before meal and after toilet to be significant explanatory risk factors of intestinal helminthic infections among the studied pregnant women in the study ($p < 0.05$).

6.1 Recommendations

Based on the conclusions made the following recommendations were forwarded :

- ❖ Health workers should give health education on personal hygiene, environmental sanitation related to day to day activity and mode of transmission of intestinal helminthic parasites for pregnant women during their ANC follow up.
- ❖ To clearly see the impact of intestinal parasite helminthic infections, further studies should be required on the details hematological profiles and nutritional statuses of the pregnant women.

Provision of clean and safe drinking water, improving living standard, expansion of public toilet, keeping personal and environmental hygiene are recommended for community to prevent the possible adverse maternal and fetal effects resulting from these risk infections.

Reference

Abebe, N., Erko, B., Medhin,G.,andBerhe,N., "Clinico-epidemiological study of schistosomiasismansoni in wajatimuga, district of Alamata, Northern Ethiopia," *Parasites &Vectors*, vol. 7, no. 1, p. 158, 2014.

AdaneDerso, EndalkachewNibret, AbainehMunshea. (2016). Prevalence of IPIs and associated risk factors among pregnant women attending antenatal care at Felege Hiwot Referral Hospital, northwest Ethiopia. *Biomedical Center Infectious Diseases***16**: 2-25.

Adegnika, A.A., Ramharter, M. S. T. ,Agnandji et al., "Epidemiology of parasitic co infections during pregnancy in Lambaréné, Gabon," Tropical Medicine &International Health ,vol. 15, no. 10, pp. 1204–1209, 2010.

Ahmed, A. K. A. H., and Al-Rubaea, A. M. A. H., "Prevalence of parasitic infection and relationship with anemia in Al- Doullab village, Babylon province, Iraq," *Ge Egyptian Journal of Experimental Biology (Zoology)*, vol. 9, no. 2, pp. 231–236, 2013.

Alamneh Abera and Endalkachew Nibret. (2014). Prevalence of gastro intestinal helminthic infections and associated risk factors among school children in Tilili town, North West Ethiopia*: Asian pacific Journal of Tropical Medicine*: 525-53.

Alem, M., Enawgaw, B., Gelaw, A.,Kenaw,T., Seid, M., and Olkeba,Y., "Prevalence of anemia and associated risk factors among pregnant women attending antenatal care in Azezo Health Center Gondar Town, Northwest Ethiopia," *Journal of Interdisciplinary Histopathology*, vol. 1, no. 3, pp. 137–144, 2013.

Allen LH and AM (.2007) Anemia and iron deficiency: effects on pregnancy outcome. 1:1280S–12804S.

Alli, J., Okonko, I.,Kolade ,A., et al., "Prevalence of intestinal nematode infection among Pregnantwomen attending antenatal clinic at the University College Hospital, Ibadan, Nigeria," *Advances in Applied Science Research*, vol. 2, no. 4, pp. 1–13, 2011.associated risk factors among pregnant women attending antenatal care center at.

associated risk factors among pregnant women attending antenatal care at Shahura Primary Hospital, north Ethiopia .*Biomedical Center Infectious Diseasesvol.2021, no. 1, p.12.*

Bahador Sarkari, Ghasem Hosseini, Mohammad Hossein Motazedian. (2016). Prevalence and risk factors of intestinal protozoan infections: a population-based study in rural areas of Boyer-Ahmad district, Southwestern Iran. *Advanced Journal*.**16**: 703.

Baidoo, S. Tay, S., Obiri-Danso, K., and Abruquah, H., "Intestinal helminths infection and anemia during pregnancy: a community-based study in Ghana," *African Journal of Microbiology Research*, vol. 2, no. 16, pp. 13, 2010.

Bakarman, M.A., Hegazi, M.A., and Butt, N.S. Prevalence, Characteristics, Risk Factors, and Impact of Intestinal Parasitic Infections on School Children in Jeddah, Western Saudi Arabia. *Journal of Epidemiology and Global Health* **9** (1): 81–8 ,2019.

Banchiamlak Mekonnen, Berhanu Erko and MengistuLegesse.Prevalence of Intestinal Parasitic Infections and Related Risk Factors among Street Dwellers in Addis Ababa, Ethiopia. *Journal of Tropical Diseases and Public Health* **2** (2):132-138, 2014 .

Bekele, A., Tilahun. M., and Mekuria, A., "Prevalence of anemia and its associated factors among pregnant women attending antenatal care in health institutions of Arba Minch town, Gamo Gofa Zone, Ethiopia: a cross-sectional study," *Anemia*, vol. 2016, Article ID 1073192, 2016.

Berhanu ElfuFeleke ,Tadesse Hailu Jember. Prevalence of helminthic infections and determinant factors among pregnant women in Mecha district, northwest Ethiopia: a cross sectional study. BMC Infectious Diseases (2018) 18:373.

Bethony J., Brooker S., Albonico M, Geiger, S.M., Loukas A., Diemert D. and Hotez, P.J. (2006). Soiltransmitted helminthes infections: ascariasis, trichuriasis, and hookworm. *Lancet* **12**: 1521-1532.

BikilaGariLemu.Prevalence, intensity and risk factors of soil – transmitted helminths parasitic infections among Biftu primary school children, Gelemso, Town Western Hararghe, Ethiopia, M.Sc. Thesis.Haramaya University, Ethiopia , 2014.

Bolka,A., and Gebremedhin. S., "Prevalence of intestinal parasitic infection and its association with anemia among pregnant women in Wondo Genet district,Southern Ethiopia: cross-sectional study," BMC Infectious Diseases, vol. 19, no. 1, p. 483, 2019.

CDC (2013 b). Parasites Soil-transmitted Helminths (STH).

CDC(2013a).Global Health, Division of Parasitic Diseases and Malaria.*https://www.cdc.gov/parasites/whipworm/biology.html.*

CDC(2013c).Global Health, Division of Parasitic Diseases and Malaria.*https://www.cdc.gov/parasites/whipworm/biology.html.*

CDC(2017).Globa Health,Division of Parasitic Disease and Malaria.*https://www.cdc.gov/dpdx/trichuriasis/index.html.*

*CDC(2019*a*).Global Health, Division of Parasitic Diseases and Malaria.https://www.cdc.gov/parasites/hookworm/biology.html.*

CDC(2019b).Global Health, Division of Parasitic Diseases and Malaria. *https://www.cdc.gov/parasites/ascariasis/biology.html.*

CDC(2019b).Global Health, Division of Parasitic Diseases and Malaria. *https://www.cdc.gov/parasites/hookworm/biology.html.*

Chami,G. F.,Fenwick, A., Bulte, E., et al., "Influence of Schistosomamansoni and hookworm infection intensities on anemia in Ugandan villages," *PLoS Neglected Tropical Diseases*, vol. 9, no. 10, Article ID e0004193, 2015.

Chandrashekhar, T.S., Joshi, H.S., Gurung, M., Subba, S.H., Rana, M.S., and Shivananda, P.G.Prevalence and distribution of intestinal parasitic infestations among school children in Kask District, Western Nepal.

Chiodini, P.L., Moody, A.H., and Manser, D.W., (2011). Atlas of Medical Helminthology and Protozoology, Churchill Livingstone.

De Silva NR, Brooker, S., Hotez,PJ.,Montresor, A., Engels, D., Savioli, L.,.(2003) Soil-transmitted helminths infections.

Derso,A., Nibret, E., and A. Munshea, A., "Prevalence of intestinal parasitic infections and

DestawDamtie and MinichilLiyih,(2021)Prevalence and Associated Risk Factors of Intestinal Parasitic Infections among Pregnant Women Attending Antenatal Care in Yifag Health Center, Northwest Ethiopia *BiomedicalCenter Infectious Diseases vol 2021, no.1, p.10 ,2021*

EdosaKebede ,NetsanetAsefa,ChalaDaba,and Daniel Gebretsadik. Prevalence of Intestinal Parasitic Infections and Their AssociatedRisk Factors among Pregnant Women Attending Antenatal CareCenter at Woreilu Health Center, Woreilu, Northeast Ethiopia.*Journal of Parasitological Research*; 2022, 8 : 1-8.

Egwunyenga, AO., Ajay, JA., Nmorsi, OPG., Ppopva, DD., Plasmodium/intestinal helminths co-infections among pregnant Nigerian women. MemInstOswaldoCruz.2001;96(8):1055–9.emphasis on intestinal helminthic infection at Bushulo Health Center.

Ethiopia, *"Environmental Health and Preventive Medicine*, vol. 23, no. 1, p. 26,2019.

FelegeHiwot Referral Hospital, Northwest Ethiopia," *BMC InfectiousDiseases*, vol. 16, no. 1, p. 530, 2016.

Feleke,B. E., andJember,T. H., "Prevalence of helminthic infections and determinant factors among pregnant women in Mecha district, Northwest Ethiopia: a cross sectional study," *BMC Infectious Diseases*, helminthic

GebreAyanaw, AbainehMunshea, and EndalkachewNibret,(2021),). Prevalence of IPIs and

Gebrehiwet, M. G.,Medhaniye,A. A., and Alema,H. B., "Prevalence and associated factors of soil transmitted helminthes among pregnant women attending antenatal care in Maytsebri Primary Hospital, North Ethiopia," *BMC Research Notes*, vol. 12, no. 1, p. 644, 2019. M.Sc. thesis, Southern Ethiopia.

Getachew ,M., Tafes, K., Zeynudin, A., Yewhalaw, D., Prevalence of soil transmitted helminthiasis and malaria co-infection among pregnant women and risk factors in Gilgel Gibe dam Area ,Southwest Ethiopia. BMCRes Notes. 2013;6:263.

GetuMosisa, DerejeChalaDiriba, RetaTsegaye, GemechuKejela, DiribaBayisa, AdugnaOluma, BizunehWakuma, MuktarAbadiga, EbisaTuri, TesfayeAbera, LamiBayisa, and GirmaTufa.Burden of intestinal parasitic infections and associated factors among pregnant women in East Africa: a systematic review and met analysis. *Maternal Health, Neonatology and Perinatology*(2023) 9:5.

Ghipour, A., Olfatifar, M., Rostami, A., (2020). Intestinal parasites in hemodialysis patients from developing countries: a systematic review and meta-analysis HemodialInt. ;24(1):12–21.2. BelyhunYeshambel, MedhinGirmay, AmberbirAlemayehu, ErkoBerhanu.. (2010).

Gizaw, Z., Adane, T., Azanaw, J., Addisu,A., and Haile, D., "Childhood intestinal parasitic

Gladwin M. and Trattler B (2004).Clinical Microbiology made ridiculously simple. Medmaster.

Goodman, D., Haji, H. J., Bickle, Q. D., Stoltzfus, R. J., Tielsch, J. M., Ramsan, M. and Albonico, M. (2007). A comparison of methods for detecting the eggs of Ascaris, Trichuris, and hookworm in infant stool, and the epidemiology of infection in Zanzibari infants.*The American Journal of Tropical Medicine and Hygiene* **76** (4): 725-731.

Haider, J., Prevalence of anemia, deficiencies of iron and folic acid and their determinants in Ethiopian women. J health populnutr. 2010;28(4):359–68. implications of transmission of infection from mother to fetus. Parasitology.;134(13);1855-62.

Hailu,T, S. Kassa, B. Abera, W. Mulu, and A. Genanew, "Determinant factors of anemia among pregnant women attending antenatal care clinic in Northwest Ethiopia," *Tropical Diseases, Travel Medicine and Vaccines*, vol. 5, no. 1, p. 13, 2019.

Hartenstein V, Jones M (2003) The embryonic development of the bodywall and nervous system of the cestode flatworm *Hymenolepisdiminuta*.Cell Tissue Res 311:427–435

Hosmer,D. W., S. Lemeshow, and R. X. Sturdivant, (2013), Applied Logistic Regression, John Wiley and Sons, Hoboken, New Jersey, 3rd edition.

infection and sanitation predictors in rural Dembiya, Northwest

Ivoke, N.,Ikpor,N., Ivoke, O., et al., (2018) "Geophagy as risk behavior for gastrointestinal nematode infections among of intestinal parasitic infections in rural Ecuador. J Trop Pediatr ;49:17–2.outcome. 1:1280S–12804S.

Jejaw, A., emene.Z, Y. Alemu, and Mengistie.Z, "High prevalence of Schistosomamansoni and other intestinal parasites among elementary school children in Southwest Ethiopia: a cross-sectional study," *BMC Public Health*, vol. 15, no. 1, pp. 600–607, 2015.

Jember, D., Beshir,WG.,Dejene, T., Tewelde, T., Prevalence of intestinal helminthiasis and associated factors among pregnant women attending antenatal clinic of NigistEleni Mohammed Memorial Hospital, Hossana, Southern Ethiopia. Open Access Libr J. 2015;2:1–11.

Joseph, P., (2013). Hook Worm Treatments for Humans. Official Partner of the Levo strong Foundation, 25-45.

Jurberg AD, Gonçalves T, Costa TA, de Mattos AC, Pascarelli BM, de Manso PP, Ribeiro-Alves M, Pelajo- Machado M, Peralta JM, Coelho PM, Lenzi HL (2009) The embryonic development of *Schistosomamansoni*eggs: proposal for a new staging system. Dev Genes Evol 219:219–234

Kefiyalew F, Zemene E, Asres Y, Gedefaw L. Anemia among pregnant women in Southeast Ethiopia: prevalence, severity and associated risk factors. BMCresearch Notes. 2014;7(1):1.

King,JD.,Endeshaw, T., Escher, E., Alemtaye, G., Melaku, S., Gelaye,W.,(2013).

Kwabena, O.,Duedu, Eric, Peprah, Isaac, Anim, Baidoo, Patrick, F.(2015). Prevalence of Intestinal Parasites and Association with Malnutrition at a Ghanaian Orphanage, Biomedical, and Allied Health Sciences. The university of Ghana.

Luoba AI, Wenzel GP, Estambale B, Ouma JH,Alusala D, Ayah R, Mwaniki D, Magnussen P &Friis H. (2005). Earth-eating and reinfection with intestinal helminthsamong pregnant and lactating women in western Kenya.*Trop. Med. Int. Health*. **10(3):** 220-227.

Mahande AM, Mahande MJ. Prevalence of parasitic infections and associations with pregnancy complications and outcomes in northernTanzania: a registry-based cross-sectional study. BMC Infect Dis. 2016;16(1):1.

Mahmud MA., Spigt M., Bezabih AM., et al (2020) . Associations between intestinal parasitic infections, anemia, and diarrhea among school aged children, and the impact of hand-washing and nail clipping.BMC Res Notes.;13.

MengistH.M. , O. Zewdie, and A. Belew, "Intestinal helminthic infection and anemia among pregnant women attending ante-natal care (ANC) in East Wollega, Oromia, Ethiopia,"*BMC Research Notes*, vol. 10, no. 1, p. 440, 2017.

Mpairwe H, Tweyongyere R, Elliott (2014) Pregnancy and helminths infections.

Naing, T., Winn, and Rusli,B. N., "Practical issues in calculating the sample size for prevalence studies," Archives Of Orofacial Sciences, vol. 1, pp. 9–14, 2006.

Omowaye O, Audu P. Parasites contamination and distribution on fruits and vegetables in Kogi,Nigeria. Cibtech Journal of Bio-Protocols. 2012;1(1):44–47.

Palmeirim, M. S.,Ouattara, M.,Essé.C. (2018). "Are schoolchildren less infected if they have good knowledge about parasitic worms? A case study from Côte d'Ivoire," *BMC Public Health*, **18**:1.

Pan American Health Organization, Epidemiological profiles of neglected diseases and other infections related to poverty inLatin America and the Caribbean, Pan American Health OrganizationWashington, 2009.

Petersen E(2007). Protozoan and helminths infections in pregnancy.Short term and long-term pregnant women attending antenatal clinics in a humid tropical zone of Nigeria," *African Health Sciences*, vol. 17, no. 1, pp. 24 31, 2017.

Rai SK, Uga SU, Ono K, Rai G & Matsumura T. (2000). Contamination of soil with helminthes parasite eggs in Nepal.Southeast Asian. J. *Trop.Med. PublicHealth*.**31**: 388-393.

Rodr´ıguez, A.J.,Morales, Barbella,R. A., Case, C., et al., “Intestinal parasitic infections among pregnant women in Venezuela,” Infectious Diseases in Obstetrics and Gynecology, vol. 2006, 2006.

Rodr´ıguez-Morales, A. J., Barbella, R. A.,Case,C., et al., “Intestinal parasitic infections amongpregnant women inVenezuela,” *Infectious Diseases in Obstetrics and Gynecology*, vol. 2006, Article ID 23125, 2006.

Sackey ME., WeigelMM.,Armijos RX (2003), Predictors and nutritional consequences.

Sakanari, J.A., and McKerrow, J.H., (2012). In: Parasitological.Medical Microbiology 26th edi, 715 817.

Saki,J S. Khademvatan, M. Foroutan-Rad, and M. Gharibzadeh, “Prevalence of intestinal parasitic infections in Haftkel County, Southwest of Iran,” *International Journal of Infection*, vol. 4, no. 4, Article ID e15593, 2017.

Shirley, D.T., Farr, L., Watanabe, K., Moonah, S., (2018).New Diagnostics, and Current Therapeutics for amobiasis.*Open Forum Infectious Diseases* **5**: 123-161.

Stephenson, C.S., Catham, M.C., Ottesen, E.A. (2015). Malnutrition and parasitic helminthic infections.*Parasitology***121**: 1-2.

Taghipour A, Ghodsian S, Jabbari M, Olfatifar M, Abdoli A, Ghaffarifar F. Global prevalence of intestinal parasitic infections and associated risk factors in pregnant women: a systematic review and meta-analysis. Trans R Soc Trop Med Hyg. 2021;115(5):457–470.

Tesfaye DJ. Prevalence of intestinal helminthiasis and associated factors among pregnant women attending antenatal clinic of NigistEleniMohammed memorial hospital, Hossana, Southern Ethiopia. Open Access Libr J. 2015;2(07):1.

Tian, LG., Chen, JX., Wang TP, Cheng GJ, Steinmann P, et al. (2012) Co infection of HIV and intestinal parasites in rural area of China. Parasite Vectors5: 3.

Tigabu ,A., Taye, S., Aynalem,M., and K. Adane (2019), “Prevalence and associated factors of intestinal parasitic infections among patients attending Shahura Health Center, Northwest Ethiopia,” *BMC Research Notes*, vol. 12, no. 1, p. 333,.2019.

Tonga, C., Ngo Bayoi, F., Tchanga, C., et al., “Schistosomiasis among pregnant women in Njombe-Penja Health district, Cameroon,” *Ge Journal of Infection in Developing Countries*, vol. 13, no. 12, pp. 1150–1158, 2019.

Tsehayu,TB.,Belete, H., Determinants of anemia in pregnant women with emphasis on intestinal helminthic infection at Bushulo Health Center. M.Sc. thesis, Southern Ethiopia. 2009.

Venezuela," *Infectious Diseases in Obstetrics and Gynecology*, vol. 2006, Article ID 23125, 2006.

Wekesa, A., Mulambalah, M., Muleke, C., and Odhiambo, R., "Intestinal helminths infections in pregnant women attending antenatal clinic at Kitale District Hospital, Kenya," *Journal of parasitology research*, vol. 2014, Article ID 823923, 2014.

Wekesa, AW., Mulambalah, CS., Muleke CI, Odhiambo R. Intestinal helminths infections in pregnant women attending antenatal clinic at Kitale District Hospital, Kenya. J Parasitol Res. 2014;2014:1–5.

WHO ,(1998) . Public health significance of intestinal parasitic infections. Bull World Health Organ.;65(5):575–88.

WHO, "Model prescribing information: drugs used in parasitic disease," in Cestodes (Tapeworm) Infection, Helminths, Second edition, 2017.

WHO, (1998) . Public health significance of intestinal parasitic infections. Bull World Health Organization;65(5)575-884.

WHO, (1993) Prevention and management of severe anemia in pregnancy. Geneva: World Health Organization.

WHO, (2006) Preventive chemotherapy in human helminthiasis. Coordinated use of anti helminthic drugs in control interventions: a manual for health professionals and program managers.

WHO, (2017). Soil transmitted helminths infections. Fact sheet.**12**:40-57.

WHO, hemoglobin concentrations for the diagnosis of anemia and assessment of severity, World Health Organization,Geneva,2011,WHO/NMH/NHD/MNM/11.1).

WHO,(2017). preventive chemotherapy to control soil-transmitted helminth infections in at-risk population groups.Neglected Tropical Diseases.*journal.pntd*.0002865.

WHO,(2018). Strengthen operations and maintenance through water safety planning: World Health Organization, A collection of case studies. Geneva: Switzerland.

WHO,(2018). Strengthen operations and maintenance through water safety planning: World Health Organization, A collection of case studies. Geneva: Switzerland.

Worku, L., Damte. D., Endris, M., Tesfa H.,,Aemero M., (2014) *Schistosomamansoni*infection and associated determinant factors among school children inSanja Town, Northwest Ethiopia. Parasitology Res. ;10:1155–2536.

Yesuf,D. A.,Abdissa,L. T., Gerbi,E. A., and Tola, E. K .,"Prevalence of intestinal parasitic infection and associated factors among pregnant women attending antenatal care at public health facilities in LaloKile district, Oromia, Western Ethiopia," *BMC Research Notes*, vol. 12, no. 1, p. 735, 2019.

Yetim I, Ozkan OV, Semerci E, Abanoz R. (2009). Rare cause of intestinal obstruction, *Ascarislumbricoides*infestation: Two case reports. *Cases* J;**2**: 7970.

Appendices

Annexes- I. Participant Information Sheet and Informed Consent Form participant (to be presented in local language)

Name of the organization;- Department of Biology, Science College, Bahir Dar University, Bahir Dar, Ethiopia

My name is Zenaw Assefa and I am Masters student in biomedical stream at Bahir Dar University, College of science. I am doing research on'' **Prevalence of intestinal helminthiasis and its associated risk factors among pregnant Women attending antenatal care at Andabet health center south Gondar Ethiopia".** I kindly request you to give me your attention for collection of information from you.

First of all I would like to thank you in advance for your cooperation and in participation in this study. Please read or listen to give about the general information of the study. If you have any question regarding the study please ask freely.

Title of the research Project: Prevalence of intestinal helminthiasis infections and associated risk factors among pregnant Women attending antenatal care at Andabet health center south Gondar Ethiopia.

Background information :-Intestinal helminthic infections are still a major global health concern, especially in developing countries approximately3.5 billion people are affected by helminthiasis worldwide; of these, 450 million suffer with a broad-spectrum of helminthiasis . common human parasitic infections globally. They affect the world's most poorest and deprived communities especially in rural areas of Sub-Saharan Africa (SSA), Latin America, South East Asia and china**.** helminthiasis is a serious public health problem throughout the world, particularly in developing countries..*Ascariasis, Hookworm* and *S. stercolaris, Taenia* species, *Hymenolepis nana, Schistosoma mansoni, Enterobius vermicularis, Trichuriasis,* are among the ten most common infections in the world. Ethiopia is a developing country where intestinal parasitic infections (IPIs) are major public health problems. Previous studies carried out in Ethiopia revealed a high prevalence of helminths. The burden of intestinal parasites, particularly the helminths is often very high in pregnant women. Anemia is defined as a condition in which there is less than the normal hemoglobin (HB) level in the body, which decreases oxygen-carrying capacity of red blood cells to tissues.

Procedures and duration: Stool specimen wear collected from pregnant women by lab technologist and the sample wear examined by lab expertise. Furthermore, you are kindly requested to fill the questionnaire by themselves. In case, they wear not read and write correctly, they wear assisted by data collectors.

Benefits and risks of the study: There wear not be any direct payment for participating in this study. But any positive finding in laboratory examination result would reported to your physician for appropriate treatment and management. Moreover, this study would have a great value on preventive and control measures against intestinal helminthic infections in the study area. You would not be at any physical or psychological risk, but during collection of the stool you may feel some discomfort, this does not produce serious pain.

Confidentiality of your information: In this study and all personal information collected from you would remain confidential and kept in a secure place. Your specimen will be used only for this study purpose and no need write your name for labeling purpose rather a unique code would given to you.

Rights: Participation for this study is fully voluntary. You have full right to either participate or not in this study and it will never affect your right of getting appropriate treatment. If you feel uncomfortable with data and sample collection process you have full right to withdraw the data and sample collection process at any time.

Contact address: If you have any question or concerns about the research, you always well come at the following address given bellow.

Principal investigator

Name; - Zenaw Assefa

Phone No:0918291075 Email;-zenawassefa3@gmail.com

Consent form for pregnant women

I am agreed for my pregnant women to participate in study mentioned. I understand that this study will be used to improve prevention, control and treatment of intestinal helminthiasis parasite. I also trust that at the end of study, the results will be shared with the concerned body or the local health bureau and Ministry of health.

Name _____Signature_____ Date_____

Data collector

Name _____Signature _____Date_____

Thank you!!!

Consent form for pregnant women

I am agreed with objectives of the research. And I can make sure by signing the agreement.

Name of pregnant women Signature Date

---------- ---------- ----------

Name of data collector Signature Date

---------- ---------- ----------

Thank you!!!

Appendix 2.Information to participant and Consent form (Amharic version)

(የስምምነት ቅጽ በአማረኛ)

በጥገኛተ ዋህሲያን ላይ ጥናትና ምርምር ልሰራ ነኝ፡፡ እርስዎ ፈቃደኛ ከሆኑ በጥናቱ ላይ እንዲሳተፉ ተጋብዘዋል፡፡ በጥናቱ ላይ ተሳታፊ ከሆኑ እርስዎ ላይ ለምርምር የሚያገለግል የሰገራ ናሙና በመስጠት እንዲተባበሩኝ በትህትና እጠይቅዎታለሁ፡፡ የእርስዎ በዚህ ጥናት መሳተፍ የእርስዎ ሙሉ ፈቃድ ሲሆን በጥናቱ ላይ ላለመካተትም ሆነ ከተካተቱም በሁዋላ ያለምንም ቅድመ ሁኔታ ፈቃደኝነትዎን የማንሳት መብትዎ ሙሉ በሙሉ የተጠበቀ ነዉ፡፡ እርስዎ በጥናቱ ያለመካተት መወሰንዎ በእርስዎ ላይ ያገኙት የነበረን የህክምና ተጠቃሚነትንም ሆነ ሌላ ችግር ፈጽሞ ሊያስከትልብዎት አይችልም፡፡ ለእርስዎ የተባለዉን ነገር በትክክል ተረድተዉ ጥያቄ ካልዎት መጠየቅ እና ማብራሬያ የማግኘት መብት አለዎት፡፡ ስለጥናቱ አላማ ምርመራ እና ሂደት ተገልጾልኛል፡፡ ምክንያት ሳያስፈልገኝ ከጥናቱ ላለማቋዋረጥ ተረድቻለሁ፡፡ ይህ ስምምነት ቅጽ በአፍ መፍቻ ቋንቋ የአንብቤ/ ተነቦልኝ በትክክል ተረድቸ በራሴ ፈቃደኝነት በጥናቱ ለመሳተፍ ተስማምቻለሁ፡፡ ለዚህም ፊርማ የአረጋግጣለሁ፡፡

የጥናቱ ተሳታፊ ስም----------ፊርማ----------ቀን----------

Appendix III. Questionnaire

Bahir Dar university Dep't of biology

Faculty of natural science and computational health center survey for intestinal parasitic helminthiasis infection are the cause of disease in pregnant women

I. Name of health center----------card code of pregnant women----------

No	Questionnaires on socio demographic characteristics of study participants
1	Your Age .....
2	Residence, A/ Rural B/ Urban
3	Marital status A/Married B/ Single C/Divorced D/ Widowed
4	Educational status A/ Not read and write B/ Primary C/Secondary school D/ College and above
5	Your occupation A/ Government employee B/Non government employee C/Merchant D / House wife D/ NGO
6	Your monthly income .....
II	Questionnaires that related to associated risk factors of helminthes
7	Do you wash your hand with soap before meal & after toilet use ? A/ Yes B/ No
8	Do you Trimming and clean your fingernails when grown ? A/ Yes B/ No
9	Presence of toilet in your home ? A/ Yes B/ No
10	Types of the toilet : A/ Privet B/ Public C/ Open defecation
11	Your frequency of shoes wearing habit : A/ Never B/ Sometimes C/ always
12	Your source of water : A/ pipe line B/ river C/pond D/ well
13	Do you eat raw meat ? A/ Yes B/ No
14	Do you eat raw &unwashed fruit and vegetable ? A/ never B/ sometimes C/ always
15	Do you have soil eat habit (geophagy) during your pregnancy ? A/ Yes B/ No
16	Do you intestinal parasitic are the cause of disease for human? A/yes B/No
17	Do you history of deworming drug in the last month? A/Yes B/ No

18	Did you get health education about helimnthes? A/Yes B/No
19	Gravidity A/ Primigravida B/ Multi Gravida
20	Trimester A/ First B/ Second C/ Third
21	Do you swimming ? A/ Yes B/ No
22	Do you washing cloth on barefoot in the river ? A/ Yes B/ No
23	Do you walking on the river without wearing shoes? A/ Yes B/ No

III. Hematological Parameter

a) Hemoglobin(g/dl) .....

b)Hematocrit(%) .....

C) Red blood cell count ($_{x10}^{6}$/mm^3).....

d) White blood cell count ($x10^3/mm^3$) .....

e) Neutrophils (%) .....

f) Lymphocytes (%) .....

g) Eosinophils (%) .....

h) Platelets ($x10^3/mm^3$) .....

IV.HIV status: A/ Positive B/ Negative

V. TB status: A/ Positive B/ Negative

Appendix IV.Questionnaire (Amharic version)

ባህር ዳር ዩንቨርስቲ የተፈጥሮ ሳይንስ ፋኩሊቲ የስነ-ህይወት ት/ት ክፍል

በአንጀት ጥገኛ ትላትሎች ምክንያት በነፍሰጡር እናቶች ላይ የሚከሰት በሽታ እና ጉዳት የጤና ጣቢያ ደሰሳ ጥናት ጥያቄዎች

ተ.ቁ	የጤና ጣቢያ ስም ---------- የእናቶቹ መለያ ቁጥር ----------
1	የዕድሜ ክፍል .....
2	የመኖሪያ ቦታ ሀ/ ገጠር ለ/ ከተማ
3	የጋብቻ ሁኔታ ሀ/ ያገባች ለ/ ያላገባች ሐ/ የፈታች መ/ ሰተኛአዳሪ
4	የትምህርት ሁኔታ ሀ/ የማታነብ ለ/ የምታነብ ሐ /ሁለተኛ ደረጃ መ/ ኮለጅ አና ዩኒቨርሰቲ
5	የስራ ሁኔታ ሀ/ የመንግስት ተቀጣሪ ለ/ መንገስታዊ ከአልሆነ ድርጅት ሐ /ነጋዴ መ/ አርሶ አደር ሠ /ሌላ
6	ወራዊ የቤተሰብ ገቢ .....
7	ከመጸዳጃ መልስ ምግብን ከመመገብሸ በፊት እጅሽን በሳሙና ትታጠቢያለሽን ? ሀ/አዎ ለ/ አልታጠብም
8	የእጅ ጥፍሮችሸ ሲያድጉ እና ሲቆሸሹንጽህናቸውን ትጠብቂያለሽን ? ሀ/አዎለ / አልጠብቅም
19	መጸዳጃ ቤት አላችሁን ? ሀ/አዎ ለ/የለነም
10	የመጸዳጃ ቤት አይነት; ሀ/የግል ለ/ የህዝብ ሐ/ በሜዳ
11	ለመጠጥ የትጠመቀበት ውኃ የሚቀደዉ ከየት ነዉ ? ሀ/ ከቧንቧ ለ/ ከወንዝ ሐ /ከኩሬ መ/ከጉድጊድ
12	ጫማ ትለብሻለሽን ? ሀ/ አዎ ለ/ አለብስም ሐ /አልፎአልፎ
13	ጥሬ ስጋ እና ወተት ትመገቢያለሽን ? ሀ/ አዎ ለ/ አልመገብም
14	የአልታጠበ እና የአልበሰለ አትክልት እና ፍራፍሬ ትመገቢያለሽን ? ሀ/አዎ ለ/ አልመገብም
15	በዚህን ወቅት አፈር ትገቢያለሽን ? ሀ/ አዎ ለ/ አልመገብም
16	የአንጀት ጥገኛ ትላትሎች ለሰዉ ልጅ የበሽታ መንስኢ መሆናቸዉን ታዉቂያለሽን ?
17	የርግዝና ጊዜ ሀ/ የመጀመሪያጊዜ ለ/ ሁለተኛጊዜ ሐ/ የመጨረሻጊዜ

18	ወንዝ ላይ ትዋኛለሽን ? ሀ/አዎ ለ/ አልዋኝም
19	ወንዝ ላይ ልብስ ስታጥቢ ጫማ ትለብሻለሽን ? ሀ/አዎ ለ/ አለብስም
20	በወንዝ ላይ ስትራመጂ ጫማ ትለብሻለሽን ? ሀ/አዎ ለ/ አለብስም
21	ከዚህ በፊት ስንት ልጆች አሉሽ ? ሀ /አንድ ለ /ሁለትእናከዚያበላይ
22	ከዚህ በፊት ስለአንጀት ጥገኛ ትላትሎች ግንዛቤ አለሽን? ሀ/አወለ/ የለኝም

<u>የስምምነት ቅጽ በአማረኛ</u>

በጥገኛ ተዋህሲያን ላይ ጥናትና ምርምር ልሰራ ነኝ፡፡ እርስዎ ፈቃደኛ ከሆኑ በጥናቱ ላይ እንዲሳተፉ ተጋብዘዋል፡፡ በጥናቱ ላይ ተሳታፊ ከሆኑ እርስዎ ላይ ለምርምር የሚያገለግል የሰገራ ናሙና በመስጠት እንዲተባበሩኝ በትህትና እጠይቅዎታለሁ፡፡ የእርስዎ በዚህ ጥናት መሳተፍ የእርስዎ ሙሉ ፈቃድ ሲሆን በጥናቱ ላይ ላለመካተትም ሆነ ከተካተቱም በሁዋላያ ለምንም ቅድመ ሁኔታ ፈቃደኝነትዎን የማንሳት መብትዎ ሙሉ በሙሉ የተጠበቀ ነዉ፡፡ እርስዎ በጥናቱ ያለመካተት መወሰንዎ በእርስዎ ላይ ያገኙት የነበረን የህክምና ተጠቃሚነትንም ሆነ ሌላ ችግር ፈጽሞ ሊያስከትልብዎት አይችልም፡፡ ለእርስዎ የተባለዉን ነገር በትክክል ተረድተዉ ጥያቄካልዎት መጠየቅ እና ማብራሬያ የማግኘት መብት አለዎት፡፡ ስለጥናቱ አላማ ምርመራ እና ሂደት ተገልጾልኛል፡፡ ምክንያት ሳያስፈልገኝ ከጥናቱ ላለማቁዋረጥ ተረድቻለሁ፡፡ ይህ ስምምነት ቅጽ በአፍ መፍቻ ቋንቋ የአንብቤ/ ተነቦልኝ በትክክል ተረድቸ በራሴ ፈቃደኝነት በጥናቱ ለመሳተፍ ተስማምቻለሁ፡፡ ለዚህም በፊርማየ አረጋግጣለሁ፡፡

የጥናቱ ተሳታፊ ስም----------ፊርማ----------ቀን----------

የምስክር ስም----------ፊርማ----------ቀን----------

የአጥኝዉ ስም----------ፊርማ----------ቀን----------

Appendix V The status of HIV and TB among pregnant women

Among the studied pregnant women, about 8(2.1%) were HIV seropositive and 3(0.8%) tuberculosis (TB) infected Table (5).

Table5 : HIV and TB examined from pregnant women studied

Status of HIV and TB infection	Categories	Frequency(%)
HIV infection	Positive	8(2.1)
	Negative	376(97.9)
	Total	384(100.0)
TB infection	Positive	3(0.8)
	Negative	381(99.2)
	Total	384(100.0)

Source : Andabet health center 2023

Appendix VI **Hematological Profiles of randomly selected study subjects**

Of the 14 randomly selected helminthic parasites positive pregnant women 7 (50%) had hemoglobin (Hb) levels below 11 g/dl indicting their anemic status while the remaining seven women had hemoglobin levels in the normal ranges. Besides, the averages hemoglobin (Hb) levels of the 14/222 randomly selected helminthic parasites positive pregnant women was 10.1, this figure deviated from the normal range, 12–18 g/dL, of Hb in pregnant women, indicating Hb anemic status of these women. Similarly, the averages Hematocrit (%) and RBC count ($\times 10^6/mm^3$) of the 14/222 randomly selected helminthic parasites positive pregnant women were 30.3% and $3.8x10^6/mm^3$ respectively. On the other hand, the averages of the other hematological profiles, WBC count, percentages of Neutrophils , lymphocytes, and Eosinophils (%) and platelet count were relatively similar with the normal values. The World Health Organization defined anemia during pregnancy has hemoglobin level of g/dl(WHO, 2011).

Hematological Profiles

Hematological profilesof randomly selected ones among the total helminthic parasite positive subjectswere.

Hematology	**Normal levels**	**Randomly selected Helminthic parasite positives (n=14) among the total 222 Helminthic positives subjects.**														**Ave.**
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	
Hb (g/dL)	12-18	12	10.6	7.3	11.3	13.5	10	10.6	10.3	10.9	8.1	8.4	8.6	8.6	11.0	10.1
Hematocrit (%)	34-54	36.0	32.0	21.9	34.1	40.7	30.0	32.0	31.1	32.8	24.2	25.2	25.8	26.1	33	30.3
RBC count ($\times 10^6/mm^3$)	4-5.2	4.4	3.8	2.1	4.2	5.2	3.3	4.2	4.6	4.4	3.2	3.2	4.3	2.6	4.4	3.8
WBC count ($\times 10^3/mm^3$	4.5-11	5.4	7.6	2.9	1.9	7.1	2.7	7.1	6.0	5.4	6.1	7.4	8.7	1.5	6.4	5.4
Neutrophils (%)	35-80	50.3	72.8	21.6	57.0	65.8	62.9	56.8	65.8	42.4	84.6	83.3	79.0	72.3	28.3	60.2
Lymphocytes (%)	20-50	40.1	20.5	20.5	24.9	21.8	20.5	33.7	23.5	50.5	10.6	10.5	38.5	25.6	20.7	25.8
Eosinophils (%)	2-4%	2.3	3.4	2.6	1.8	1.9	2.7	2.8	3.3	3.4	3.2	2.2	2.8	1.7	3.7	2.7
Platelets (×103/ mm3)	150-350	208	165	38	229	211	100	233	141	207	25	182	142	155	118	153.9

Source : Andabet health center 2023