Intestinal Parasitic Infections among Patients Visiting Gorebella Health Center, North-Central Ethiopia

By

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Abstract

Intestinal parasitic infections (IPIs) which are neglected globally remain among substantial public health concerns in Ethiopia. Up-to-date epidemiological information on these infections is indispensable to effectively control them in a locality. This study was thus aimed at evaluating the extent of IPIs and status of related sanitary practices among patients visiting Gorebella health center, north-central Ethiopia. Patients visiting Gorebella health center in January-April 2016 who were suspected of IPIs were recruited in a cross-sectional survey. Socio-demographic data were gathered using a semi-structured questionnaire. Stool samples were processed by the direct saline smear method. Data entry and analysis was done using SPSS software (version 20). Out of 403 samples examined, 282(70.0%) had one or more intestinal parasites belonging to six different species or types. *E. histolytica/dispar/moshkovskii* was detected in 205(72.2%) patients followed by *G. intestinalis* (35(12.4%), *A. lumbericoides* (33(11.7%), hookworm (12(3.0%), *Taenia* spp (7(1.7%) and *H. nana* (4(1.0%). More than half (268(66.5%) of the cases had single infection and only 14(3.5%) were mixed. The result demonstrated the high magnitude of symptomatic IPI in the study area. Simple health promotion actions including education must be scaled-up to sustainably reduce the burden of IPI in the community. The very high prevalence calls for initiation of a deworming scheme in the locality.

Keywords: Intestinal parasites, Prevalence, Ethiopia

Acronyms

AOR	Adjusted Odd Ratio
CDC	Center for Disease Control and Prevention
CI	Confidence Interval
COR	Crude Odds Ratio
FMoH	Federal Ministry of Health
IPIs	Intestinal Parasitic Infections
NTDs	Neglected Tropical Diseases
SPSS	Statistical Package for Social Sciences
WHO	World Health Organization

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1. Introduction

Globally about two billion people are infected with intestinal parasites the majorities being children in resource-poor settings (Gelaw et al. 2013). Sub-Saharan Africa is the most heavily burdened region by intestinal parasites (Evans et al. 1995). Intestinal parasites belong to three broad groups: protozoa, helminthes and microsporidia.

A protozoan *Entamoeba histolytica* infects approximately 50 million people worldwide accounting for approximately 100,000 deaths annually (Ryan and Ray 2004). *Giardia intestinalis*, another most common protozoan, has also global distribution. Even in high-income regions the prevalence of *G. intestinalis* is 2-5%. In technologically least advanced nations *G. intestinalis* prevalence is 15-20% in children ≤10 years and is a major cause of childhood diarrhea (Laupland and Church 2005).

The most outstanding human helminth parasite is the giant roundworm (nematode) *Ascaris lumbricoides.* Over 1.4 billion people are infected with *A. lumbricoides*and is most common in children 2-10 years old and its prevalence decreases over the age 15 years (Seltzer 1999). Although it is a cosmopolitan parasite the highest prevalence of *A. lumbricoides* occurs in tropical countries where warm and wet climates provide environmental conditions that favor year-round transmission. In certain limited localities Ascaris transmission may be seasonal, occurring predominantly during the rainy months (Seltzer 1999).

Hookworm which is next to Ascaris in importance, affects approximately one in four of the world population (Bethony 2006). Its distribution is worldwide but mostly in areas with moist and warm climate co-occurring with Ascaris. *Trichiuris trichiura* is the third most common roundworm parasite of human (www.cdc.gov/parasites/biology.html). The prevalence rates are as high as 80% in these regions rural areas with poor sanitation and tropical climates. *Strogyloides stercoralis*, another prominent nematode is thought to have infected 100 million with prevalence rate of as high as 50% in certain areas (Segarra-Newnham and Marise 2007). The pinworm has a worldwide distribution (Cook 1994), and is the most common helminth infection in the United States (US), Europe and Oceania (Burkhart and Burkhart 2005).

Cestodes such as *Taenia* species are found anywhere when beef or raw pork is consumed, even in countries such as the US, with strict federal sanitation policies. In the US, the incidence of infection is low, but 25% of cattle sold are still infected (Ynnes 2006). The total global infection of *Taenia* is estimated to be 40-60 million (Somers et al. 2010). It is estimated to have 50-75 million carriers of *Hymenolepis nana* with 5-25% prevalence in children worldwide (Ortiz et al. 2002). Of Trematodes schistosomes alone infect about 83.31 million people globally (https://en.wikipedia.org/wiki/Schistosomiasis).

The high prevalence of IPI in least-developed countries is related to poverty, poor living conditions, and poor personal and environmental hygiene, inadequate health services and inadequate sanitations and water supply facilities, and lack of awareness (Haftu et al. 2014). Improved sanitation is associated with a reduced risk of transmission of helminthiasis to human (Ziegelbauer 2012). To prevent IPI infestation measures need to be taken ensure clean drinking water, improve hygiene and sanitary eating habits, keep hands always clean, trim nails, and wash hands before eating or preparing food and wash hands after a toilet visit. Deworming regularly or as directed by your primary physician and discourage thump sucking (nail biting) of children. Theoretical control interventions consist of prevention of barefoot walk, defecating outside latrines and use of human excrement or raw sewage as manure or fertilizer in agriculture (Adegnika et al. 2014). But, effective control is not easy unless socio-economic condition, sanitation, education, and the availability of proper footwear significantly improve at community level.

Apart from causing morbidity and mortality, IP have been associated with stunting, physical weakness and low educational performance of schoolchildren (Evans and Stephenson 1995). However, the degree of harm caused by IPI to the health of individuals and communities depend on the parasite species, the intensity and cause of infection, the nature of interactions between the parasitic species and concurrent infection, the nutritional and immunological status and numerous socio-economical factors of the populations. Thus, it is extremely difficult to measure the suffering caused by IPI because so many cases are asymptomatic and, therefore, remain untreated (WHO 1987).

In Ethiopia, like other least-developed countries, IPI are widespread. Environmental and personal hygiene is poor in the country due to lack of awareness of simple health promotion practices. Ethiopia has one of the lowest quality drinking water supply and latrine coverage in the world (Kumie and Ali 2005). Improper disposal of human excreta is rampant although there is no evidence for use of human feces as fertilizer across the country. As a result, contamination of food and drinking water is frequent in turn leading to extensive occurrence of IPI. According to the federal ministry of health estimate (FMoH 2004) more than a million annual visits to health institutions in the country are related to IPI. The estimate is conservative because most of the health institutions lack appropriate methods to detect low levels of parasitic burden. In addition some of the diagnostics for specific IPI, especially for newly emerging opportunistic ones are not available to peripheral health institutions.

Moreover, the distribution and prevalence of IP differ from locality to locality for a number of environmental, social, geographical and other factors. Evaluation and reevaluation of IPI and the status of local risk factors in a community must be done regularly to generate up-to-date data and devise timely contextual control measures. Accordingly IP have been studied in different parts of the country - in different altitudes, more vulnerable groups such as schoolchildren, prison inmates and irrigated-farm workers (Mamo 2014, Gelaw et al. 2013). Nevertheless, in other areas like Ankober little current information is available. Thus, the aim of this study was determining the prevalence of IPI among patients visiting Gorebella health center in Ankober, north-central Ethiopia.

2. Objectives

2.1 General objective

This study was conducted to determine the prevalence of IP among patients visiting Gorebella health center, Ankober Wereda, North-central Ethiopia.

2.2 Specific objectives

The specific objectives of the study were:

To detect intestinal parasites among patients visiting Gorebella health center, and

To assess the status of risk factors for IPIs

3. Literature review

Intestinal parasites usually dwell in the gastrointestinal tract of humans or animals although they may live throughout their hosts' body (Kidane 2014). The two broad groups of these parasites are parasitic worms (helminths) and protozoa. Intestinal helminths are so named because their life history includes a period of obligatory residence in the human alimentary tract and they induce pathological changes in that site. There are several intestinal helminthic parasites. The most dominant human intestinal helminths are *A. lumbricoides*, hookworm, *T. trichiura, S. stercoralis* (nematodes or roundworms); *H. nana*, *T. sanginata* (cestodes or tapeworms); and schistosomes (trematodes or flukes).

3.1 Parasitic helminths

3.1.1 Nematodes

3.1.1.1 *A. lumbricoides*

A. lumbricoides is the largest and most common parasitic worm in humans, growing to a length of up to 35cm (14in) (https://en.m.wikepedia.orga⁄Ascaris⁄). It is one of several species of genus *Ascaris*. This organism is responsible for the disease ascariasis, one of the groups of neglected tropical diseases (NTD). An estimated 1.4 billion of the human population is infected by *A. lumbricoides* (Seltzer 1999). Ascariasis is highly prevalent worldwide, especially in tropical and subtropical regions.

It is transmitted through the ingestion of mature ova from contaminated food, hands or water (Marsden 1978). An adult female worm living inside an infected person produces on average about 240,000 ova a day for about a year, which are passed in the feces. The ova develop in the soil within 2-3 weeks, given optimal temperature, presence of oxygen, and moisture. On being swallowed, each egg develops into a larval worm in the small intestine. The larva migrates through the body via hepatic portal system to the liver and lungs where they develop further for 1-2 weeks, and then return to the small intestine and attain sexual maturity.

The worms may exit through the nose or mouth in addition to passing in stool. Often, no symptoms are seen with *A. lumbricoides* infections. However, in heavy infection, symptoms may include bloody sputum, cough, fever, abdominal discomfort or pain, intestinal ulcer, vomiting, skin rash and constipation (Dora-Laskey et al. 2012). The infected person may show signs of malnutrition. Several types of complications are associated with Ascariasis, intestinal obstruction may be produced by a bolus of worms, or adult worms may migrate from small intestine into the bile and pancreatic ducts, respiratory passages, and peritoneum.

To diagnose this conditions include abdominal x-ray or other imagining tests, complete blood count, stool ova and parasitic examination. Antiascaris chemotherapy includes broad-spectrum drugs such as albendazole or mebendazole that paralyze or kill intestinal parasitic helminths. These medicines should not, however, be prescribed during pregnancy. If there is a blockage of the intestine caused by a large number of worms, endoscopy may be used to remove the worms. In rare cases, surgery is needed. Patients should be checked again in 3 months. This involves examining the stools to check for worm ova and if ova are present, treatment should be given again (https://en.m.wikepedia.orga ⁄Ascaris ⁄). Infection can be avoided by scrupulous attention to personal hygiene and the careful washing of all fruits and vegetables. And improved sanitation in developing countries is associated with a reduced risk of transmission of helminthiasis to human (Hesse et al. 2012).

3.1.1.2 Hookworms

Hookworm disease is a parasitic disease caused by the entry of larvae of the hookworm, most commonly, *Necator amercanus* and *Ancyclostoma duodenale* into human host (Bethony 2006). The adult stages of these blood-sucking nematodes are found attached to mucosa of the small intestine, particularly of the jejunum. Hookworm is the second most common human helminthic infection (after Ascaris). Hookworm infections are thought to affect approximately one in four of the world population (Bethony 2006). Its distribution is worldwide but mostly in areas with a moist, warm climate sharing common environment with Ascaris. Both *N. amerricanus* and *A. duodenale* are found in Africa, Asia and the Americans.

The hookworm life cycle is direct and begins with the ova being released by the female worms to the lumen of the small intestine and being passed in the feces. The embryos within the ova develop rapidly given moisture, warmth, and oxygen and skin penetrating; third stage infective larvae are formed within 5-10 days after the deposition of the ova. Infection is usually acquired by walking on, handling or lying in contaminated soil (Bethony 2006). The third-stage (filariform) larvae enter the body through intact skin penetration (WHO 1987). Lack of sanitation, indiscriminant defecation, and high egg production ensure constant exposure to hookworm, as do the practices of using the same places for defecation and going barefoot.

Most individuals with hookworm infections are asymptomatic. Symptoms are due to inflammation in the bowl resulting in nausea, abdominal pain and intermittent diarrhea, and clinical manifestation of iron-deficiency anemia. Local skin manifestations (ground itch) can occur during penetration by the filariform larvae and respiratory symptoms may occur during pulmonary migration of the larvae. Although the most common manifestation of hookworm infection is cutaneous larvae migrants, larvae may also occasionally migrate to the bowl lumen and cause eosinophilic enteritis (WHO 1987).

To prevent Hook worm infection, advice for individual includes; do not walk on barefoot, do not defecate outside latrines or toilets and do not use human excrement or raw sewage as manure or fertilizer in agriculture (Adegnika et al. 2014). Treatments which can be used to avoid Hook worms are Anthelmintic drugs these are benzimidazole (example, albendazole, Mebendazole) and pyrantel pamoate (Keizer and Utzinger 2010).

3.1.1.3 *T. trichiura*

T. trichiura (the human whipworm) which mainly lives in the caecum, but can be seen throughout the colon and rectum is the third most common human nematode parasite (https://en.m.wikipedia.org/Tricuriasis) causing trichuriasis. The adult worm usually reaches 3-5cm in length and has a life span of 1-3 years. Humans are the only known host. After mating and oviposition the ova are passed with the feces. The ova develop in soil and become infective after 15-30 days. Transmission is when infective ova are unintentionally ingested. After ingestion via soil-contaminated hands or food, the ova hatch in the small intestine and release larvae that mature into adults. The adults attached to the wall of the caecum and ascending colon. The female adult worm starts oviposition 60-70 days after infection, and sheds 3000-20,000 ova per day.

Mild infections (fewer than 100 worms) are often asymptomatic but may present with lower abdominal discomfort, flatulence, and diarrhea or constipation (Gyorkos 2011). Inflammation at the site of attachment from large numbers of whipworms results in colitis, presenting with bloody diarrhea, abdominal pain, iron-deficiency, anaemia and in severe infestations, rectal prolapsed. Long standing colitis resembles inflammatory, bowel disease, including chronic abdominal pain and diarrhea, as well as impaired growth, anaemia of chronic disease, and finger clubbing.

A stool ova examination reveals the presence of typical whipworm ova. Ova will appear barrel shaped and an embryonated, having bipolar plugs and a smooth shell (https://en.m.wikipedia.org/Tricuriasis). Typically, the kato-katz thick smear technique is used for identification of the ova in stool sample. Although colonoscopy is not typically used for diagnosis as the adult worms can be overlooked, especially with imperfect colon, there have been reported cases in which colonoscopy has revealed adult worms. Colonoscopy can directly diagnose trichuriasis by identification of the tread-like form of worms with an attenuated, whip-like end. Colonoscopy has been shown to be a useful diagnostic tool, especially in patients infected by only a few male worms and with no ova presenting in stool sample. Rectal prolapsed can be diagnosed easily using defecating proctogram and is one of many methods for imaging the parasitic infection.

The drug of choice for trichuriasis is mebendazole. A single dose of 500mg can results in a cure rate of 40-75%. Albendazole is an alternative drug. However, its efficiency for trichuriasis is slightly lower than for mebendazole. The highest clearance rates are obtained by combining Mebendazole or albendazole with ivermectin (Jacson et al. 1998). Ivermectin safety in children under 15kg and pregnant women has not yet been established. People with diarrhea may be treated with loperamide to increase the amount of drug contact with the parasites. Mebendazole is 90% effective in the first dose, and albendazole may also be offered as anti parasitic agent. Adding iron to the blood stream helps solve the iron deficiency and rectal prolapsed.

3.1.1.4 S. stercoralis

S. stercoralis is another intestinal nematode of medical significance causing Strogloidiasis. It sometimes caused by *S. fulleborni*. This helminth affects 30-100 million people worldwide. *S.*

stercoralis is among NTDs, and worldwide efforts are aimed at eradicating the infection. However, prevalence rates of *S. stercoralis* are as high as 50% in certain areas where moist soil and improper disposal of human waste co-exist (Segarra-Newnham and Marsel 2007).

Strogyloides life cycle is more complex than that of most nematodes. Filariform larvae in soil penetrate the skin and travel via the bloodstream to the lungs, from where they migrate through the bronchial tree to the pharynx, and are then swallowed and reach the small intestine. In the small intestine the filariform larvae molt twice and become adult female worms. The females live threaded in the epithelium of the small intestine and produce ova, which yield rhabditform larvae, which can either be passed in the stool or can cause autoinfection. In autoinfection, the larvae become infective filariform larvae, which can penetrate either the intestine mucosa or the skin of the preanal area. In either case, the filariform larvae travel via the blood stream to the lungs, through the bronchial tree, the pharynx and then the small intestine where they mature into adults, or they may disseminate widely in the body (Gompels et al. 1991).

Strogyloidiasis has a variable effect on the host. Individuals may be asymptomatic for many years or may develop a series of acute or chronic nonspecific symptoms. In other cases, specific symptoms make the diagnosis more obvious. Symptoms that may occur include skin involvement where larvae current often occur on the buttocks, groin and truck cause migratory rash. Gastrointestinal involvement shows abdominal discomfort and bloating, profuse watery diarrhea, sometimes alternative with constipation, malabsorption and weight loss. During pulmonary phase during pulmonary migration of the filariform larvae; cough, bronchospasm, haemoptysis and shortness of breath may happen (Swenner et al. 2014).

Diagnosis tests on the microscope identification of larvae (rhabditform and occasionally filariform) in the stool or duodenal fluid. Examination of many samples may be necessary, and not always sufficient, because direct stool examination is relatively insensitive, with a single sample only able to detect larvae in about 25% of cases (Segarra-Newnham and Marsel 2007). It can take 4 weeks from initial infection to the passage of larvae in the stool. The stool can be examined in wet mounts: directly, after concentration (formalin-ethyl acetate) determined, after recovery of the larvae by the Baer man funnel technique, after culture by the Haroda-Mori filter paper technique and after culture in agar plates.

The drug of choice for the treatment of uncomplicated Strogloidiasis is ivermectin. Ivermectin does not kill the *Strogyloides* larvae, only the adult worms, therefore, repeat dosing may be necessary to properly eradicate the infection. There is an autoinfective cycle of roughly two weeks in which ivermectin should be re-administered, however, additional dosing may still be necessary as it will not kill *Strogyloides* in the blood or larvae deep within the bowels or diverticulitis. Other drugs that are effective are albendazole and thiandazole (25mg/kg) twice daily for 5 days 400mg maximum (generally) (Buonfrate et al. 2013).

Prevention of strogyloidiasis is clearly dependent up on improving economic circumstances with installation of adequate human waste disposal systems and reliable water supplies. As additional preventive measures, one should; Dispose of human feces in a sanitary manner. Practice rapid hygiene habits, including the use of foot wear in endemic areas. Examine and treat all infected dogs, cats, and monkeys that are in contact with people.

3.1.1.5 Enterobius

The pinworm (*Enterobius vermicularis*) is also another parasitic roundworm. The medical condition associated with pinworm infestation is known as enterobiasis (Totkova et al. 2003).It has a worldwide distribution and is the most common helminth (parasitic worm) infection in the United States, Western Europe and Oceania. Pinworms are particularly common in children, with prevalence rates in this age group having been reported as high as 61% in India, 50% in England, 39% in Thailand 37% in Sweden, and 29% in Denmark (Burkhart et al. 2005).

E. vermiculris spread through human-to- human transmission, by ingesting infectious pinworm eggs and anal insertion. After the eggs have been initially deposited near the anus, they are readily transmitted to other surfaces through contamination. Finger sucking and nail biting have been shown to increase both incidence and relapse rates enterobiasis (Burkhart et al. 2005). Dust containing eggs become airborne and widely dispersed when dislodged from surfaces. Consequently, the eggs can enter the mouth and nose through inhalation and be swallowed later.

The lifecycle of *E. vermicularis* begins with eggs being ingested and hatch in to larva in the duodenum. The emerging pinworm larvae grow rapidly to a size of 140 to 150µm and migrate through the small intestine towards the colon. During this migration, they molt twice and become adults (Burkhart 2005). The gravid female pinworms settle in the ileum, caecum, appendix and ascending colon, where they attach themselves to the mucosa and ingest colonic contents. Almost the entire body of a gravid female becomes filled with eggs. The estimations of the number of eggs in a gravid female pinworms range from about 11,000 to 16,000 (Burkhart et al. 2005).The female worm s migrate through the colon towards the rectum at a rate of 12 to 14 centimeters per hour. They emerged from the anus and moving on the skin near to the anus, then deposited the eggs either through contracting or expelling the eggs (Garcia 2009).

The diagnosis of pinworms depends on finding eggs or adult worms. The individual eggs are invisible with naked eye, but they can be seen using a low-power microscope (Burkhart et al. 2005). On the other hand, the light-yellowish thread- like adult pinworms is clearly visually detectable, usually during the night when they move near the anus, or on toilet paper. Transparent adhesive tape (e.g. scotch tape) applied on the anal area will pick up deposited eggs, and diagnosis can be made by examining the tape with a microscope (Garcia 2009).

One third of individuals with pinworm infection are totally asymptomatic. The main symptoms are itching in and around the anus and around the perineum (Cook 1994). The benzimidazole compounds albendazole and mebendazole are the most effective way of treating *E. vermicuralis* (Cook 1994).

3.1.2 Cestodes

Cestodes (tapeworms) are parasitic and their life histories are varying, but typically they live in the digestive tracts of vertebrates as adults, and often in the bodies of other species of animals as juveniles. Over a thousand species have been described, and all vertebrate species may be parasitized by at least one species of tape worm. Humans are subject to infection by several species of Cestodes eating undercooked meat such as pork (*Taenia solium*), beef (*T. saginata*), and fish (*Diphyllobotrium* species), living in, or eating food prepared in conditions of poor hygiene (*Hymenolepis or Echinococcus* species).

3.1.2.1 T. Saginata

T. saginata, commonly known as the beef tapeworm, is a zoonotic cestode belonging to the order cyclophyllidea and genus *Taenia*. Cattle are the intermediate hosts, where larvae development occurs, while humans are definitive hosts harbouring the adult worms in the intestine. In human it causes taeniasis and cysticercosis in cattle (http/en.m.wikipedia.org/Taenia).

T. saginata has a strong resemblance to the other human tapeworms, such as *T. asiatica* and *T. solium*, in structure and biology, except for few details. It is typically larger and longer, with more proglottid, more testes, higher branching of the uteri. It also lacks an armed scolex unlike other Tania. Unlike other related tapeworms it does not cause cysticercosis in humans (Burton et al. 2013).

It is found globally and most prevalently where cattle are raised and beef is consumed. The disease is relatively common in Africa, some parts of Eastern Europe, the Philippines, and Latin America (Bogitsh et al. 2013). This parasite is found anywhere, even if in countries such as United States, with strict federal sanitation polices. In the US, the incidence of infection is low, but 25% of cattle sold are still infected (Ynnes 2006). The total global infection is estimated to be between 40 and 60 million (Somers 2010). It is most prevalent in sub-Saharan Africa and the Middle East.

The life cycle of *T. saginata* is direct and digenetic, involving cattle and humans, with an interim of living in the environment. Humans release infective ova into the environment through defecation. Cattle pick up the viable embryonated ova, the oncospheres from contaminated vegetation or food. Oncospheres enter duodenum, the anterior portion of small intestine, and hatch there under the influence of gastric juices. The embryonic membranes are removed, librating free hexacanth ('six-hooked') larvae. With their hooks, they attach to the intestinal wall and penetrate the intestinal mucosa into the blood vessels. The larvae can move to all parts of the body by the general circulatory system, and finally settle in skeletal muscles with 70 days. Inside the tissue, they cast of their hooks and instead develop a protective cuticular shell, called the cyst. Thus, they become fluid-filled cysticerci. Cysticerci can also form in lungs and liver. The inner membrane of the cysticercus soon develops numerous protoscolices (small scolices) that are invertedly attached to the inner surface. The cysticercus of *T. saginata* is specifically named cysticercus bovid to differentiate from that of *T. solium*, cysticercus cellulosae.

Humans contact infective cysticerci by eating raw or undercooked meat. Once reaching the jejunum, the inverted scolex becomes evaginated to the exterior under stimuli from the digestive enzymes of the host, using the scolex, it attaches to the intestinal wall. The larvae mature into adults about 5-12 weeks later. Adult worms can live about 25 years in the host (Uygur-Bayramicli 2012). Usually, only a single worm is present at a time, but multiple worms are also reported. In each mature proglottid, self-fertilization produces zygote, which divides and differentiates into oncospheres, the oldest gravid proglottid detach. Unlike in other Taenia, gravid proglottids are shed individually. In some cases, the proglottid ruptures inside the intestine, and the ova are released. The free proglottid and librated ova are removed by peristalsis in to the environment. On the ground, the proglottid are motile and shed ova are as they move. These oncospheres in an external environment can remain viable for several days to weeks in sewage, rivers, and postures (Ynnes 2006).

T. saginata infection is usually asymptomatic, but heavy infection often results in weight loss, dizziness, abdominal pain, diarrhea, headaches, nausea, constipation, chronic indigestion, and loss of appetite. Intestinal obstruction in humans can be alleviated by surgery. The tape worm can also expel antigens that can cause an allergic reaction in the individual (Lopes et al. 2014).

The basic diagnosis is done from a stool sample. Feces are examined to find parasite ova. The ova look like other ova from the family Taeniidae, so it is only possible to identify the ova to the family, not to the species level. Since it is difficult to diagnose using ova alone, looking at the scolex or the gravid proglottid can help identify it as *T. saginata* (Ynnes 2006). Proglottids sometimes trickle down the thighs of infected humans and are visible with unaided eye, so can aid with identification. Observation of scolex helps distinguish between *T. saginata*, *T. solium,* and *T. asiatica*. When the uterus is injected with India ink, its branches become visible. Counting the uterine branches enables some identification (*T. saginata* uteri have ≥12 branches on each side, while other species such as Taenia solium only have 5-10) (Bogitsh et al. 2013).

Adequate cooking (56^{o}C for 5 minutes) of beef viscera destroys cysticerci. Refrigeration, freezing (-10^{o}C for 9 days) or long periods of salting is lethal to cysticerci. Inspection of beef and proper disposal of human excreta are also important measures (Lopes et al. 2014). Taeniasis is easily treated with praziquantel or niclosamide (Lopes et al. 2014). Albendazole is also highly effective for treatment of cattle infection.

3.1.2.2 *H. nana* (dwarf tapeworm)

Hymenolepiasis mainly caused by *H. nana,* is the most common intestinal tapeworm infection of humans. This infection does not require an intermediate host and can occur directly from one infected person to another by fecal-oral transmission. Infection is most common in children aged 4-10 years; in dry, warm regions of the least developed world. *H. nana* infection affects millions of people, primarily children, worldwide. Estimated rates of infection in various regions range from 0.1-58%. It is estimated to have 50-75 million carriers of *H. nana* with 5-25% prevalence in children worldwide, which can be as high as 50% in children between 1-4 years of age (Ortiz et al. 2002).

Ova of *H. nana* are immediately infective when passed with the stool and cannot survive more than 10 days in the external environment. When ova are ingested by an arthropod intermediate host, they develop into cysticercoids, which can infects humans or rodent upon ingestion and develop into adults in the small intestine. When ova are in contaminated food or water or from hands contaminated with feces, the oncospheres contaminated in the ova are released. The oncospheres penetrate the intestinal villus and develop into cysticercoids larvae. Upon rapture of the villus, the cysticercoids return to the intestinal lumen, evaginated their scolices, attach to the intestinal mucosa and develop into adults that reside in the ileal portion of the small intestine producing gravid proglottid (Schantz 1996). Ova are passed in the stool when released from proglottid through its genital atrium or when proglottid disintegrates in the small intestine. An alternative mode of infection consists of internal autoinfection, where the ova release their hexacanth embryo, which penetrates the villus continuing the infective cycle without passage through external environment. The life span of adult worms is 4 to 6 weeks, but internal autoinfection allows the infection to persist for years (Schantz 1996).

Hymenolepiasis does not always have symptoms, but usually are described as abdominal pain, loss of appetite, itching around the anus, irritability, and diarrhea. However, study shows that successful treatment of the infection made no significant difference to symptoms. Some authorities report that heavily infected cases are more likely to be symptomatic (Ortiz et al. 2002). Symptoms in humans are due to allergic responses or systematic toxemia caused by waste products of the tape worm. Light infections are usually symptomless, where as infection with more than 2000 worms can cause enteritis, abdominal pain, and diarrhea, loss of appetite, restlessness, irritability, restless sleep, and anal and nasal prutitus. Rare symptoms include increased appetite, vomiting, nausea, bloody diarrhea, extremely pain, headache, dizziness and behavioral disturbances. Occasionally epileptic seizures occur in infected children.

Examination of the stool for ova and parasites confirms the diagnosis. The ova and proglottid of *H. nana* are smaller than *H. diminuta*. Proglottids of both are relatively wide and have three testes. Identifying the parasites to the species level is often unnecessary from a medical perspective as the treatment is the same for both. The two drugs that have been well described for the treatment of hymenolepiasis are praziquantel and niclosamide. Praziquantel as a single dose (25mg/kg) is the current treatment of choice for Hymenolepiasis and has an efficacy of 96%. Although structurally unrelated to other anthelmintics, it kills both adult worms and larvae. Praziquantel is well absorbed when taken orally, and it undergoes first pass metabolism and 80% of the dose is excreted metabolities in urine within 24 hours. Repeated treatment is required to *H. nana* at interval of 7-10 days. Single dose albendazole (400mg) is also very efficacious (>95%) (Ortiz et al. 2002).

Good hygiene, public health and sanitation programs help to prevent the speared of Hymenolepiasis. Preventing fecal contamination of food and water in institutions and crowded areas is of primary importance. General sanitation, rodent and insect control (especially control of flea and grain insects) is also essential for prevention of *H. nana* infection (http://en.mwikipedia.org/ Hymenolepiasis).

3.3 Trematodes (flukes)

From Trematodes schistosomes, agents of schistosomiasis (another NTD), are of paramount medical importance (Cromptom 1999). The five major schistosoma species are *S. japonicum*, *S. mansoni*, *S. haemmatobium*, *S. intercalatum* and *S. mekongi*. The first three of these are the most important. Other schistosoma species with avian or nonhuman mammalian primary hosts may cause dermatitis, or insignificant infection. Schistosome transmission requires contamination of water by feces or urine containing ova, a specific fresh water snail as the intermediate host and human contact with water inhabited by the intermediate host snail (Jamison et al. 2006).

Schistosomiasis caused by all the schistosoma species infects over 200 million people (Olivetra et al. 2006). However, *S. mansoni* which causes intestinal schistosomiasis is the most significant species infecting about 83.31 million people worldwide (http://en.m.wikipedia.org⁄Schistosom). It is the widest speared of the human-infecting schistosoma, and is present in 54 countries. These countries are predominantly in South America and Caribbean, Africa including Madagascar, and the Middle East with poor sanitation. Because of the parasite's fecal-oral transmission, bodies of water that contain human waste can be infectious. Water that contains large populations of the intermediate host snail species is more likely to cause infection. Young children living in these areas are at greatest risk because of their tendency to swim and bathe in cercaria-infected waters longer than adults. Any one travelling to the areas described above, and who is exposed to contaminated water, is at risk of schistosomiasis.

After the ova of the human-dwelling parasites is emitted in the feces and into the water, the ripe miracidium hatches out of the ova. The hatching happens in response to temperature, light and dilution of feces with water. The miracidium searches for a suitable freshwater snail to act as an intermediate host and penetrate it. Following this, the parasite develops via a so called mother-sporocyst and daughter-sporocyst generation to the cercaria. The purpose of the growth in the snail is the numerical multiplication of the parasite. From a single miracidium result a few thousand cercaria, every one of which capable of infecting a human.

The cercaria emerges from the snail during day light and they propel themselves in water with the aid of their bifurcated tail, actively seeking out their final host. When they recognize human skin, they penetrate it within a very short time on penetration; the head of the cercaria transforms in to endoparasitic larvae the schistosomule. Each schistosomule spends a few days in the skin and then enter the circulation starting at the dermal lymphatic and venules. Here, they feed on blood, regulating the haem as hemozoin (Bultran and Boissier 2008). The schistosomule migrates to the lungs (5-7 days post-penetration) and then moves via circulation through the left side of the heart to the hepatic portal circulation (>15 days) where, if it meets a partner of the opposite sex, it develops in to asexually mature adult and the pair migrate to the mesenteric veins (Loverde and Chen 1991). The adult female worm resides within the adult male worm`s gynaecophoric canal, which is a modification of the ventral surface of the male, forming a groove. The paired worms move against the flow of blood to their final niche in the mesenteric circulation, where they begin egg production (>32 days). Each female lays approximately 300 ova a day (one egg every 4.8 minute), which are deposited on the endothelial lining of the venous capillary walls (Ryan and Ray 2004). Most of the body mass of female schistosoma is devoted to the reproductive system. The ova move into the lumen of the environment with faces.

Many individuals do not experience symptoms. If symptoms do appear, it usually takes four to six weeks from the time of infection. The first symptom of the disease may be a general ill feeling. Within twelve hours of infection, an individual may complain of a tingling sensation or light rash, commonly referred to as 'swimmer`s itch', due to irritation at the point of entrance. The rash that may develop can mimic scabies and other types of rashes. Other symptoms can occur 2-4 weeks later and can include fever, aching, cough, diarrhea, or gland enlargement. These symptoms can also be related to avian schistosomiasis, which does not cause any further symptoms in humans.

Diagnosis of infection is confirmed by the identification of ova in stools. Antibodies and/or antigens detected in blood or urine samples are also indications of infection. The eggs of intestinal schistosomiasis can be detected in fecal specimens through a technique using methylene blue-stained cellophane soaked in glycerin or glass slides, known as the kato-katz technique (www.who.int/mediacenter/factssheet/).

Currently there are two drugs available, praziquantel and oxamniquine, for the treatment of schistosomiasis (Brinkmann et al. 1988). They are considered equivalent in relation to its lower cost per-treatment, in general praziquantel is considered the first option for treatment. The treatment objective is to cure the disease and to prevent the evolution of the acute to the chronic form of the disease. All cases of suspected schistosomiasis should be treated regardless of presentation because the adult parasite can live in the host for years (Ryan and Ray 2004).

Many countries are working towards eradicating the disease. The WHO is promoting these efforts. In some cases, urbanization, pollution, and consequent destruction of snail habitat have reduced exposure, with a subsequent decrease in new infections.

3.2 Intestinal protozoa

The most important intestinal protozoan pathogens are *E. histolytica, G. intestinalis,* the coccidia (*Cryptosporidium spp, Isospora belli, Cyclospora cayetanensis*) and members of the Phylum microsporidia.

3.2.1 *E. histolytica*

E. histolytica infection is the cause of Amoebiasis (Ximenez et al. 2011). Although 90% of *E. histolytica* infections are often asymptomatic it may cause dysentery as well as invasive extra-intestinal disease particularly in the liver (Dolabella et al. 2012). *E. histolytica* infection causes approximately 100,000 deaths annually. *E. dispar* another species has been thought in the past to be non-pathological but *in vitro* and *in vivo* experiments suggests, it is capable of causing liver damage.

Humans are the only reservoir, and infection occurs by ingestion of mature cyst in food or water, or on hands contaminated by feces. The cysts of *E. histolytica* enter the small intestine and release active amoebic parasites (trophozoites), which invade the epithelial cells of the large intestine, causing flask-shaped ulcers. Infection can then spread from the intestine to other organs, example, the liver, lungs and brain, via the venous system. Asymptomatic carriers pass cysts in the feces and the asymptomatic carriage state can persist indefinitely. Invasive Amoebiasis most often causes an amoebic liver abscess but may affect the lung, heart, brain urinary tract and skin (Ryan and Ray 2004).

The most common type of amoebic infection is the asymptomatic passage of cysts, found to be mainly associated with *E. dispar* infection (Dolabella et al. 2012). Symptomatic patients initially have lower abdominal pain and diarrhea and later develop dysentery (with blood and mucus in stool). Amoebic colitis with dysentery is characterized by loose stools with fresh blood. The patient is usually generally well with mild or moderate abdominal pain. Symptoms often fluctuate over weeks or even months with the patient becoming debilitated. Amoebic colitis without dysentery is a change in bowel habit, blood stained stools, flatulence and colicky pain, tenderness in the right iliac fossa or other places over the colon. This may disappear or progress to dysentery. Rectal bleeding may occasionally be the only sign, with or without tenesmus commonly in children.

Asymptomatic human infections are usually diagnosed by finding cysts shed in the stool. Various flotation, or sedimentation procedures have been developed to recover the cysts from fecal matter and stains help to visualize the isolated cysts for microscopic examination (http://en.m.wikipedia.org/wiki/Amoebiasis). Since cysts are not shed constantly, a minimum of three stools should be examined. In symptomatic infections, the motile form (the trophozoites) can often be seen in fresh feces. Serological tests exist and most individual (whether with symptoms or not) will test positive for the presence of antibodies. The levels of antibody are much higher in individuals with liver abscesses. Serology only becomes positive about two weeks after infection. More recent developments include exit that detects ameba DNA in feces. These tests are not in widespread use due to their expense.

Metronidazole and thiandazole are effective for amoebic absence of the liver. Diloxanide furoate is ineffective against hepatic amoebiasis but a10 day course should be given at the completion of metronidazole or thiandazole treatment to destroy any amoebae in the gut (Esch and Petersen 2013). To help to prevent the spread amoebiasis around the home wash hands thoroughly with soap hot running water for at least 10 seconds after using the toilet or changing a baby’s diaper, and before handling food. Avoid eating raw vegetables obtain from the areas of having improper human waste. Boil water or treat with iodine tablets.

Good sanitary practice as well as responsibility of sewage disposal or treatment, are necessary for the prevention of *E. histolytica* cysts are usually resistant to chlorination, therefore, sedimentation and filtration of water supplies are necessary to reduce the incidence of infection (http://en.m.wikipedia.org/wiki/Amoebiasis).

3.2.2 *G. intestinalis*

Giardiasis (popularly known as beaver fever) is a zoonotic parasitic disease caused by the flagellate protozoan *G. intestinalis* (also sometimes called *G. lamblia* and *G. duodenale*). The Giardia organism inhabits the digestive tract of a wide variety of domestic and wild animal species, as well as humans. It is one of the most common pathogenic parasitic infections in humans worldwide; in 2013, there were about 280 million people with symptomatic Giardiasis (Esch and Petersen 2013).

Giardia has worldwide distribution occurring in both temperate and tropical regions. It continues to be the most frequently identified human protozoan enteropathogen. Prevalence rates vary from 4-42%. In the industrialized world, overall prevalence rates are 2-5%. In the less developed world, *G. intestinalis* infects infants early in life and is a major cause of epidemic childhood diarrhea. Prevalence rates of 15-20% in children younger than 10 years are common (Giangaspero et al. 2007, Laupland 2005).

Giardia is the most common gut parasite in the United Kingdom, and infection rates are especially high in Eastern Europe. Prevalence rates of 0.94-4.66% and 2.41%-10.99% have been reported in Italy. A 2005 study demonstrated a giardia infection rate of 19.6 per 100,000 populations per year in Canada (Dib et al. 2008) while the yearly incidence of the disease was stable, a significant seasonal variation was observed, with a peak in late summer to early fall, which correlates with the pattern found in the US. New Zealand reports more than 30 cases of Giardiasis per 100,000 populations every year, which is one of the highest among the industrialized countries (Gelanew et al. 2007). The highest prevalence of *G. intestinalis* reached 73.4% in western Nepal. In Bangladesh, a disparity between health prevention health spending is observed. The Dhaka study performed within the urban areas had identified *G. intestinalis* in 11% of diarrhea stool specimens.

Giardia infection can occur through ingestion of dormant microbial cysts in contaminated water, food, or, by fecal-oral rout through poor hygiene practices. The cyst can survive for weeks to months in cold water (Kidane et al. 2014). So it can be present in contaminated wells and water systems, especially in stagnant water sources, such as naturally occurring ponds, storms, water storage systems, and even clean-looking mountain streams. The life cycle begins with a non-infective cyst being excreted with the faces of an infected individual. The cyst is hardy, providing protection from various degrees of heat and cold, desiccation, and infection from other organisms.

Symptoms vary from none to severe diarrhea with poor absorption of nutrients (Roseblat and John 1993). It results weakness, loss of appetite, stomach cramps, vomiting (uncommon), bloating, excessive gas, and burping. Symptoms typically develop 9-15 days after exposure but may occur as early as one day. Symptoms are caused by giardia organisms infecting the cells of the duodenum and jejunum of the small intestine and blocking nutrient absorption.

Detection of antigens on the surfaces of organisms in stool specimens is the current test of choice for diagnosis of Giardiasis and provides increased sensitivity over more common microscopy techniques. A trichrome stain of preserved stool is another method used to detect giardia. Microscopic examination of the stool for motile trophozoites or for the distinctive oval *G. intestinalis* cysts can be performed (http://en.m.wikipedia.org/wiki/Giardiasis).

Treatment is not always necessary as the infection usually resolves on its own. However, if the illness is acute or symptoms persist, medications are needed to treat it. A nitroimidazol medication is used such as metronidazole, thiandazole, secnidazole or ornidazole. Hand washing and avoiding potentially contaminated food and untreated water are used to prevent giardiasis (http://www.cdc.gov/parasites/giardia). Boiling suspect water for one minute is the surest method to make water safe to drink and kill disease causing microorganisms such as *G. intestinalis* if in doubt about whether water is infected and chemical disinfectants or filters may be used (Batancourt and Rose 2004).

3.2.3 Coccidia

While coccidia can infect a wide variety of animals, including humans, birds, and livestock, they are usually species-specific. One well-known exception is toxoplasmosis which is a parasitic disease caused by *Toxoplasma gondii* (https://en.m.wikipedia.orga⁄ wiki⁄ Coccidiosis). Up to half of the world population is infected by toxoplasmosis but have no symptoms (Fleger et al. 2014). Humans may first encounter coccidia when they acquire a young puppy or kitten that is infected. Infections with toxoplasmosis usually cause no symptoms in adult humans. Occasionally there may be a few weeks or months of mild flu-like illness such as muscle aches headaches and tender lymph nodes (Hunter and Sibly 2012) and most infants who are infected while in the womb have no symptoms at birth, but may develop symptoms later in life.

Toxoplasmosis is generally transmitted through the mouth when *T. gondii* cysts are accidentally eaten (Weiss 2009).Oral transmission may occur through: ingestion of raw or partly cooked meat containing Toxoplasma cysts. Diagnosis of toxoplasmosis in humans is made by biological, serological, histological or molecular methods or by some combination of them (Hill and Dubey 2002). Treatment of the disease is often only recommended for people with serious health problems, such as people with HIV whose CD4 counts under 200 cells⁄mm^3, because the disease is most serious when the one's immune system is weak. Trimethoprim⁄sulfamethoxale is the drug of choice to prevent toxoplasmosis, but not treating active disease (Doggett 2012).

3.3 Microsporidium

Microsporidiosis also known as microsporidiasis is caused by the parasitic protozoa microsporidia, which are obligatory intracellular, spore-forming parasites that belong to the phylum Microspora and the order microsporidia. They are found everywhere, including honeybees, fish, mosquitoes, ticks, grasshoppers, rodents, rabbits, and other fur-bearing mammals and humans. Currently, most case of human Microsporidiosis is associated with HIV infection or other forms of immunosupression (Loignon et al. 2014). Microsporidia have a worldwide distribution. Cases of microsporidoisis have been reported in both developed and least developed countries and both immunosupress and immunocomputent individuals (Aikawa et al. 2011).

Most cases of intestinal and disseminated microsporidiosis in patients infected with HIV are reported in those who are severely immunocompromised (CD_4<100⁄µl); in these patients, morbidity can be significant. E. bieneusi is a species of the order microsporidia which infects the intestinal epithelial cells. Its infections carry mortality up to 56%. Chronic diarrhea, malabsorption and wasting can occur in persons with AIDS. *Entercytozoan bieneusi* is responsible for more than 90% of intestinal microsporidiosis cases in this population (Font et al. 2003). The different modes of transmission that may be possible include the fecal-oral or oral-oral route, inhalation of aerosols, or ingestion of food contaminated with fecal material (Mathis et al. 2005).

Diagnosis of microsporidiosis currently depends on morphological demonstration of the organisms themselves. Initial detection of microsporidia is carried out by light microscopic examination of tissue sections and of more readily obtainable specimens such as stool, duodenal aspirates, urine, sputum, nasal discharge and bronchoalveolar large fluids (Weber and Bryan 1994). Treatment options are limited, but symptomatic improvement of *E. bieneusi* infection may be achieved with the anthihelminthic-antiprotozoan infection may be cured with albendazole (Weber and Bryan 1994).

4. Materials and Methods

4.1 Study area and Design

Across-sectional study design was conducted for the assessment of prevalence of parasitic infection from January to April 2016 in Gorebella health center of Ankober wereda. The wereda is one of the 24 weredas in North Shoa zone, Amhara national regional state of Ethiopia. It is located at about 42km from Debre birhan, the capital town of the zone and at a distance of 172km from Addis Ababa. The wereda shares a boundary with Tarmaber wereda in north, Asagirt wereda in south, Afar Regional State in east and Basona worona in west. It has a total of 19 rural and 3 urban kebeles with a total population of 88,392. Of which 45800(51.81%) are males and 42592(48.19%) are females.

The majority of inhabitants are Christians orthodox and Amhara in ethnicity. They mainly live by cultivating barely and teff and rearing livestock's like cattle and sheep. The wereda is situated at an altitude of 3,700 meters above sea level. Its weather condition is cold and wet, but some of the area found in the wereda is hot and dry. There are four health centers in the Ankober wereda. The study was carried out in one of the health centers, namely Gorebella health center. It is found on the main town of the wereda.

4.2 Study population and sample size

People with intestinal problem and visited Gorebella health center during the study period were included. The actual sample size (n) was determined using single population proportion formula $n=z^2 p (1-p)/d^2$ (Daniel 1995), where, p=the expected prevalence rate, d=margin of error and z=standard score corresponds to 1.96; this gives the sample size of 384. The expected prevalence rate was 50% for calculation, a 95% confidence interval (CI) and 5% margin of error was used. To minimize errors arising from noncompliance, 5% of the sample size was added.

4.3 Stool sample collection

Before stool collection, the data was collected through direct observation when patients with intestinal complains were examined and interviewed. The interview included information such as age, sex, religion, hand washing habit, family size, water source, eating undercooked meat, awareness about IPIs and shoes-wearing using a predesigned questionnaire (Annex III). Each questionnaire was checked for accuracy and completeness. After proper instruction, each patient was given a piece of carton sheets and applicator stick to bring fresh stool.

4.4 Analysis of stool samples

The sample were checked certain characteristics such as consistency, content, color and presence of adult worms or their fragments before subjecting them to the direct wet-mount procedure. About 2gram of stool sample was emulsified with 3-4ml normal saline, and a drop of that was placed on a clean microscope slide, then a few drops of iodine solution was added and covered with a cover slip. The smear was first examined under 10x objective lenses, then 40x for detailed identification. The presence of intestinal parasite ova, cyst, Trophozoites and larva of intestinal parasites were observed under the microscope (Kidane E et al. 2014).

4.5 Quality control

Before starting the actual work, quality of the microscope was checked by an experienced laboratory technician. Each stool sample was examined by two laboratory technicians. In cases where the results were discordant, a third senior reader was used. The result of the third experiment reader was considered the final result.

4.6 Data Analysis

Data was entered into Excel and analyzed by statistical package for social science (SPSS), window's version 20 (IBM (SPSS) Statistics 2011). Descriptive statistics was applied to assess the prevalence of intestinal parasitic infections. In all cases, $p<0.05$ were considered statistically significant.

4.7 Ethical considerations

Permission was obtained from Addis Ababa University of Zoological Science Department and from health center administrative officials prior to conducting the study. Verbal consent was obtained from each individual before recruitment.

5. Results

5.1 Study population

Of 403 participants 218(54.1%) were males and 185(45.9%) females. Overall 171(42.4%) individuals were aged ≥25 years. Except for four people who were Oromo the participants belonged to Amhara ethnic group with 389(96.5%) identified themselves with the Ethiopian Orthodox Christianity. The rest 6(1.5%) and 8(2.0%) were Muslims and protestants respectively. Most of the participants (265(65.8%) had primary education, 52(12.9%) self-reportedly completed high school, and 26(6.5%) had completed higher preparatory and above, the rest 60(14.9%) were illiterate.

Most participants (251(62.3%) were unmarried, 150(37.2%) married and the rest 2(0.5%) were divorced. The livelihood of 73(18.1%) was subsistence agriculture, 20(5.0%) daily workers, 38(9.4%) government employees, 23(5.7%) merchants 49(12.9%) housewives, 200(49.6%) who were categorized as 'others' included students, house maids and private workers. Most of the participants (245(60.8%) were members houses 0f having family size of 2-5, 113(28.0%) had ≥6 and the rest 45(11.2%) were living alone.

5.2 Prevalence of intestinal parasites in patient samples

Totally 282(70.0%) participants harbored one or more intestinal parasites belonging to six different species or types (2 protozoa and 4 helminths). *E. histolytica/dispar/moshkovskii* was detected in 205(72.2%) patients followed by *G. intestinalis* (35(12.4%), *A. lumbricoides* (33(11.7%), hookworm (12(3.0%), *Taenia* species (7(1.7%) and *H. nana* (4(1.0%). More than half (268(66.5%) of the cases were single and 14(3.5%) mixed infections were detected (table 1).

Table 1 Distribution of intestinal parasite species among patients in Gorebella health center, Ankober, north-central Ethiopia, January-April 2016 (N=403)

Parasite species	no.(%)
Protozoa (single)	
E. histolytica/dispar/moshkovskii	191(47.4)
G. intestinalis	30(7.4)
Helminths (single)	
A. lumbericoides	24(6.0)
Hookworm	12(3)
H. nana	4(1.0)
Taenia species	7(1.7)
Protozoa/helminth (mixed)	
E. histolytica/dispar/moshkovskii, *A. lumbricoides*	9(2.2)
E. histolytica/dispar/moshkovskii, *G. intestinalis*	5(1.1)

5.3 IPIs and socio-demography

The proportion of male IPIs-positives (70.2%) was similar to that of females (69.7%). Patients aged 15-24 years had the highest proportion of individuals (66(76.7%) positive for IPIs followed by those ≥25 years (123(71.9%) and 5-14 years old (93(63.7%). The proportion of IPIs-positives among the illiterates, those who had primary education and who completed high school and above was, respectively, 75.0%, 67.9% and 73.1%, respectively. In terms of occupation, 52(71.2%) were farmers, 16(80.0%) daily laborers, 16(69.6%) merchants, 28(73.7%) civil servants, 35(71.4%) housewives and 135(67.5%) 'Others' were IPI-positive. These and other socio-demographics and the number (proportion) of individuals positive for IPIs in each category including logistic regression analysis results are shown in table 2.

Individuals who self-reported not to practice 'proper' dispose of solid or liquid wastes were at significantly higher risk of being IPI-positive compared to those who claimed 'proper' waste removal (odds ratio (OR) 1.642, 95% CI 1.006-2.681, p=0.047). Similarly, participants who reported to have pets sleeping on beds with them had a significantly increased risk of IPI than those who reported the opposite (OR 1.828, 95% CI 1.189-2.811, p=0.006). Participants who regularly access tap water had significantly lower risk of IPIs compared to those who do not (OR 4.361, 95% CI 2.375-6.956, p=0.000). Post-toilet-pre-meal hand washing significantly reduced the risk of IPIs compared to the opposite behavior (OR 2.183, 95% CI 1.356-3.512, p=0.001). Similarly those who claimed to wash vegetables/fruits before eating had significantly lower risk of IPIs (OR 1.854, 95% CI 1.193-2.883, p=0.006). However; education, marital status, occupation as well as most other variables were not significant predictors of IPIs.

Table 2 Proportion of IPI-positive patients with respect to socio-demographic variables and univariate/multivariate analysis results for patients attending Gorebela health center, north-central Ethiopia, January-April 2016 (N=403)

Variable		N	no.(%)	COR, 95% CI	p-value	AOR, 95% CI	p-value
Sex	Male	218	153(70.2)	1.022(0.667,1.567)	0.921		
	Female	185	129(69.7)	1.00			
Age	5-14	146	93(63.7)	0.685(0.426,1.100)	0.118		
	15-24	86	66(76.7)	1.288(0.706,2.350)	0.410		
	≥25	171	123(71.9)	1.00			
Education	Illiterate	60	45(75.0)	1.105(0.512,2.385	0.785		
	Elementary	265	180(67.9)	0.780(0.444,1.370)	0.387		
	≥high school	78	57(73.1)	1.00			
	1	45	33(73.3)	1.00			
Family size	2-5	245	163(66.5)	0.723(0.355,1.473)	0.372		
	≥6	113	86(76.1)	1.158(0.526,2.551)	0.715		
Occupation	Civil servant	38	28(73.7)	1.00			
	daily laborer	20	16(80)	1.429(0.385,5.306)	0.436		
	Merchant	23	16(69.6)	0.816(0.260,2.564)	0.878		
	Farmer	73	52(71.2)	0.884(0.366,2.137)	0.785		
	Housewife	49	35(71.4)	0.893(0.345,2.312)	0.981		
	'other'	200	135(67.5)	0.742(0.340,1.619)	0.557		
Post-toilet,	Yes	255	164(64.3)	1.00		1.00	
pre-meal hand-washing	No	148	118(79.7)	2.183(1.356,3.512)**	0.001	1.584(0.925,2.71)	0.094
	Yes	86	56(65.1)	1.00			
Post-animal-contact hand-washing	No	317	226(71.3)	1.330(0.802,2.206	0.269		
	Yes	222	168(75.7)	1.828(1.189,2.811)*	0.006	1.432(0.901,2.27)	0.129
Sleeping pets on beds	No	181	114(62.9)	1.00		1.00	
	Yes	97	74(76.3)	1.516(0.896,2.565)	0.121	1.020(0.556,1.87)	0.949
Unpeeled/raw fruit	No	306	208(67.9)	1.00		1.00	
	Yes	221	142(64.3)	1.00		1.00	
Washing vegetables/fruits before eating	No	182	140(79.9)	1.854(1.193,2.883)*	0.006	1.333(0.778,2.28)	0.296
	Yes	91	56(61.5)	1.00		1.00	
Proper disposal of dry/liquid waste	No	312	226(72.4)	1.642(1.006,2.681)*	0.047	0.866(0.490,1.53)	0.620
	Yes	74	54(72.0)	1.00			
Raw meat consumption	No	329	228(69.3)	1.196(0.680,2.102)	0.534		
	Yes	121	83(68.6)	1.00			
Information about IPI	No	282	199(70.6)	1.098(0.692,1.741)	0.692		
	Yes	195	107(54.9)	1.00		1.00	
Regular access to tape water	No	208	175(84.1)	4.361(2.735,6.956)*	0.000	0.000(0.000,-)	0.999
	Yes	368	253(68.8)	1.00			
Shoes-wearing	No	35	29(82.9)	2.197(0.888,5.438)	0.082		

CI: confidence interval, COR: Crude Odd ratio, AOR: Adjusted odd ratio *Significant relationship

6. Discussion

The study showed the occurrence of several intestinal parasites of public health importance with high prevalence. Although the 70.0% prevalence was lower than a previous report (80.0%) from southwest Ethiopia (Mengistu et al. 2007) and (83.8%) from Sousedeast of Lake Langano (Legesse and Erko 2004) it is higher compared to results of a number of other community-based studies in various settings in Ethiopia. For instance, the prevalence of IPIs was 32.2% in Gondar (Gelaw et al. 2013), Gamo Gofa (39.9%) (Wagayehu et al. 2013), Wukro town, Tigray (60.7%) (Kidane et al.2014) and Arba Minch Town, South Ethiopia (27.7%) (Haftu et al. 2014). Possible explanations for the apparent differences between different findings might be related to variations in sampling techniques used, sample size, quality of drinking water source, difference in controlling personal and environmental hygiene and variation in the environmental condition of the different study localities.

When individual parasite species are considered, *E. histolytica/dispar/moshkovskii* was the most predominant parasite (72.2%) detected which was substantially higher than the findings of all aforementioned authors. *G. intestinalis* prevalence (12.4%) found in this study was also relatively higher in comparison with the previous reports for instance, the prevalence of G. intestinalis was (6.2%) in Southeast of Lake Langano (Legesse and Erko 2004), Gonder community school, Northwest Ethiopia (3.9%) and Arba Minch Town, South Ethiopia (4.2%). On the other hand, the level of *A. lumbricoides* (11.7%) and hookworm (3.0%) cases observed in this study were much lower than that of the above same works. For instance, Mengistu et al. 2007 recorded 41.9% Ascaris and 17.5% hookworm prevalence.

Considering the prevalence rate of H.nana (1%) in this study, it was lower than the value of Lake Langano (Legesse and Erko 2004) recorded (3.5%), Northwest Ethiopia (13.8) (Gelaw et al 2013) and (2.2%) in Arba Minch (Haftu et al 2014). In current study, 64.3% participants had good hand washing before eating and after visiting toilets. IPIs were more significantly associated with poor hand washing practice ($p<0.05$). This finding is consistent with the study conducting in Arba Minch Town (Haftu et al 2014) and Gonder (Gelaw et al 2013). Similarly, Participants who do not regularly access tap water were more acquire IPIs than participants who regularly accessed tap water ($p<0.05$). This finding is similar with a study done by Kidane et al 2014 in Wukro Town Tigray.

Reasons for the higher prevalence of protozoan parasites than helminths such as hookworm could be due to different modes of transmission of the parasites and quality of drinking water. Protozoan parasites are transmitted through contaminated hands, food, water and contamination with pets. Whereas hookworms need skin penetration which is affected by shoes-wearing habits and Tapeworms are by eating raw meat. In general, the higher rate of feco-orally transmitted infections like *E. histolytica/dispar/moshkovskii* suggests dissemination of the infection perhaps under community or household level. *A. lumbricoides* and *Entamoeba* differ a bit in their biology and transmission. Although both orally, protozoa are immediately infectious, whereas helminth eggs need a while in the environment to become infective. As a result autoinfection is more likely for *Entamoeba*. Once infected, individuals may indefinitely propagate the protozoa at community and/or family level unless effectively treated. This may explain the most common occurrence of *Entamoeba* among the study populations in the present study. Contamination of drinking water with *Entamoeba sp* has been increasingly recognized as a major cause of water-borne human disease worldwide (WHO 1987).

Although the study did not find significant difference between sexes, which is indeed expected for IPIs, observing more positive individual among adults than children is infrequent. This requires further confirmatory investigation.

Epidemiological studies on IPIs in different settings are essential to have up-to-date insight into the extent of the problem and design appropriate interventions. To this end, the present study produced pertinent data for concerned decision-makers to use in the fight against IPIs in the study area. Although the study used only the direct wet-mount method and presented only one season data, both might have affected the actual prevalence, the very high infection rate calls for immediate intervention.

7. Conclusion

IPI is a significant health setback in the study area, with varying magnitude among different groups of community members. Protozoan infections appear to be predominant compared to helminth suggesting waterborne transmission. Prompt action is required to improve on the health status of the people. Coverage and quality of drinking water and toilet facility need special attention. Other measures including health education on personal and environmental hygiene should be practiced.

8. References

Adegnika AA, zinsou FJ, Issifous S, Ateba-Ngoa U, Kassa FR, Feugap NE, Honkopehdji JY, Agdo D Jean-claude, Kengule MH, Massing–Loembe M, Agnandji TS, Mordimuller B, Ramharter M, Yazdanbaksh M, Kremsner GP, Lell B (2014). Randomized, controlled assessor-blind clinical trial to assess the efficacy of single-versus repeated-dose albendazole to treat Ascaris lumbricoids, Trichuris trichiura, and hookworm infection. Antimicrob Agents chemother 58(5):2535-40.

Aikawa NE, Twadosky OA, Carvalho FJ, Silva AC, Silva FA, Ribeiro MC, Saad SGA, Moraes BCJ, Toledo AR, Bonfa E (2011). Intestinal Microsporidiosis; a hidden risk in rheumatic disease patients undergoing anti-tumor necrosis Factor therapy combined with disease-modifying anti-rheumatic drugs? Clinics (Sao Paulo) 66(7): 1171-5.

Batancourt QW, Rose BJ (2004). Dirnking water treatment processes for removal of Cryptosporidium and Giardia". Vet Parasitol 126(1-2):219-34.

Bethony J, Brooker S, Albonico M, Geiger SM, Loukas A, Diemert D, Hotez PJ (2006). Soil-transmitted helminth infections: ascarriasis, trichuriasis and hookworm. Lancet. 367(9521): 1521-32.

Brinkmann UK, Werler C, Traore M, Doumbia S, Diarra A (1988)."EXpriences with mass chemotherapy in the control of schistosomiasis in Mali ". Trop Med parasitol: 39(2):167-74.

Bultran S, Boissier J (2008)."Schistosome monsani: who, how, and why?" Trends Parasitol. 24(9): 386-91.

Buonfrate D, Requena-Mendez A, Angheben A, et al (2013). Severe strongyoidiasis; systematic review of case reports. BMC infect Dis.13:78.

Burkhart CN, Burkhart CG (2005). "Assessment of frequency, transmission and genitourinary complications of enterobiasis (pinworm)".Int J Dermatol. 44(10): 837-40.

Burton B, Clint C (2013).Human parasitology (4th ed.).Amsterdam: Academic Press. Pp. 244-245.

Caccio SM, Ryan U (2008). Molecular epidemiology of giardiasis. Mol Biochem Parasitol 160(2):75-80.

Center for disease control and prevention. Hook worm infection. Available at http://WWW.cdc.Gov parasites⁄hookworm⁄index.html. Accessed: April 22, 2016.

Chero JC, Saiton M, Bustos JA, Blanco EM, Gonzalver G, Garcia HH, (2007)."Hymenolepis nana infection: symptoms and response to nitazoxanid in field conditions". Trans R Soc Trop Med Hyg 101(2):203-5.

Cook GC (1994). Enterobius vermicularis infection. Gut 35(9):1159-62.

Crompton DW 1999. How much human helminthiasis is there in the world? J Parasitol 85(3):397-403.

Danile WW (1995). Biostatics a foundation for analysis in the health science. In: statical analysis. 6th ed, Nework; John Will and sons Inc, USA, p.155.

Dib HH, Lus Q, Wen SF (2008). Prevalence of *Giardia lamblia* with or without Diarrhea in South east, south East Asia and the far east. Parasitol Res 103(2): 239-51.

Dogget JS, Nisen A, Forquer I, Wegmann KW, Jones-Brando L, Yolken RH, Bordon C, Charman SA, Ketneni K, Schultz T, Burrows Jn, Hinriche DJ, Meunier B, Caruters VB, Riscoe MK (2012). "Endochin-like quinolones are highly efficacious against acute and latent experimental toxoplasmosis. Proce Natl Acad Sci USA 109(39):15936-41.

Dolabella SS, Serrano-Luna J, Navarr-Garcia F, Cerritos R, Ximenez C, Galvan-Moroyoqui JM, Silva EF, Tsutsumi V, Shibayama M (2012). Amoebic liver abscess production by Entamoeba dispar. Ann Hepatol. 11(1): 107-17.

Dora-Laskey A, Ezenkwele U, Weiss E (2012). Ascaris lumbricoides, Mediscape 2012.

Esch KJ, Petersen CA (2013). Transmissions and epidemiology of zoonotic protozoan diseases of companion animals. Clin microbial Rev 26(1):58-85.

Evans AC, Stephenson LSC (1995). Not by drugs alone the fight against parasitic helminthes. World health forum. 16(3):258-61.

FMoH 2004. Comprehensive health service directory. Federal Ministry of Health, Addis Ababa, Ethiopia.

Font RL, Su GW, Matoba AY (2003). Microsporidia stromal keratitis. Arch ophthalmol. 121(7): 1045-7.

Garcia SL (2009). Practical guid to diagnostic parasitology. Am Soci Microb. PP. 246-247.

Gelanew T, Lalle M, Hailu A, Pozio E, Caccio SM (2007). Molecular characterization of human isolates of Giardia duodenalis from Ethiopia. Acta Trop. 102(2):92-9.

Gelaw A, Anagaw B, Nigussie B, Silesh B, Yirga A, Alem M, Endris M, Gelaw B (2013). Prevalence of IPIS and risk factors among school children at the University of Gonder, community school, Northwest Ethiopia: BMC Pub Health. 13:304.

Giangaspero A, Berrilli F, Brandonisio O (2007). Giardia and cryptosporidium and public health: The epidemiological scenario from the Italian perspective. Parasitol Res. 101(5):1169- 82.

Giardia|Parasites|CDC (2015). http://www.cdc.gov/parasites/giardia. Accessed February 20,2016.

Gyorkos TW, Gilbert NL, Larocque R, casapia M (2011)."Trichuris and hookworm infections associated with anaemia during pregnancy."Trop Med Int Health. 16(4): 531-7.

Gompels MM, Todd J, Peters BS, Main J, pin ching AJ; Todd; peters; Main; pinchi (1991)."Disseminated Strogloidiasis in AIDS: Uncommon but important". AIDS. 5(3) 329-32.

Haftu D, Deysa N, Agidew E (2014). Prevalence and Determinant factors of Intestinal parasites among school children in Arba Minch Town, Southern Ethiopia. Ame J Health Res. 2(5): 247-254.

Hesse AA, Nouri A, Hassan HS, Hashish AA (2012). Parasitic infections requiring surgical interventions. Semin pediatr surg.; 21(2): 142-50.

Hill D, Dubey JP (2002). " Toxoplasma gondii: transmission, diagnosis and prevention." Clin Microbiol infect. 8(10): 634-40.

Hunter AC, Sibly DL (2012). " Modulation of innate immunity by Toxoplasma gondii Virulence effectors". Nat Rev Microbiol. 10(11): 766-78.

Jacson TF, Epstain SR, Gous E (1998). Comparison of mebendazole and albendazole in treating children with *Trichuris trichiura* infection in Durban, South Africa. S Afr Med J 88(7):880-883.

JamisonTD, Bremn GJ, Measham RA, Alleyne G, Claeson M, Evans BD, Jha P, Mills A, Mossgrove P (2006). Disease control priorities in developing countries (2nded.). Pp 271-286.

Jeremy F, Peter H, Thomas J, Gagandeep K, David L, Nicholas JW (2013). Manson`s Tropical disease. Else Health Sci Pp 664-671.

Keiser J, utzinger J (2010). The drugs we have and the drugs we need against major helminth infections. Adv parasitol. 73: 197-230.

Kidane E, Menkir S, Kebede A, Desta M (2014). Prevalence of intestinal parasitic infections and their associations with anthropometric measurements of school children in selected primary Schools, Wukro Town, Tigray, Ethiopia. Int. J. Curr Microbial. App. Sci. 3(3): 11-29.

Kumie A, Ali A (2005). AN overview of environmental health status in Ethiopia with particular emphasis to its organization, drinking water and sanitation: a literature survey. Ethiop J Health Dev. 19(2): 89-103.

Laupland KB, church DL (2005).Population-based laboratory surveillance for Giardia Sp. and cryptosporidium sp. infections in a large Canadian health region. BMC Infect Dis. 16(5):72

Legesse M, Erko B (2004).Prevalence of intestinal parasites among school children in a rural area close to the southeast of Lake Langano, Ethiopia. Ethiop J Health Dev. 18(2): 116-120.

Loignon M, Labrecque LG, Bard C, Robitaille Y, Toma E (2014). Cerebral Microsporidiosis Manifesting as progressive multifocal leukoencephalopathy in an HIV-infected individual a Case report. AIDS Res Ther 11:20.

Lopes WD, Cruz BC, Soares VE, Nunes JL, Teixeila WF, Maciel WG, Buzzulini C, Pereira JC, Fellippelli G, Soccol VT, de Olivera GP, de Costa AJ (2014). History of therapeutic efficacy of albendazole sulphoxide adminstered in different routes, dosages and treatment schemes, against Taenia saginata cysticercus in cattle experimentally infected. Exp Parasitol 137(1):14-20.

Loverde PT, Chen L (1991). Schistosome female reproductive development. Parasitol Today 7(11):303-8.

Mamo H (2014). Intestinal parasitic infections among prison inmates and tobacco farm workers in Shoa Robit, north-central Ethiopia. PLoS ONE 9(6):e99559.

Mengistu A, Gebresilassie S, Kassa T (2007). Prevalence of intestinal parasitic infections among urban dwellers, in southwest Ethiopia. Ethiop. J. Health Dev 21(1):12-17.

Marsden PD (ed) (1978). The biology of parasite infection. Clin Gastroenterol 7(1):1-243.

Mathis A, Weber R and Deplazes P (2005). Zoonotic potential of the microsporidia. Clin Microb Rev 18(3):423-445.

Olivetra MF, d`Avila JC, Torres CR, Olivera PL, Tempon AJ, Rumjank FD, Braga CM, Silva JR, Donsa-Petretski M, Olivera MA, de Sousa W, Ferreira ST (2000). Haemozoin in Schistosoma mansoni". Mol Biochem Parasitol 111(1):217-21.

Ynnes O (2006). Foodborne parasites. springer. New York. Pp 207-10.

Ortiz JJ, Favennec L, Chegne NL, Gargala G (2002). Comparative clinical studies of nitazoxanide, albedazole and praziquantel in the treatment of ascariasis, trichuriasis and hymenolepiasis in the children from Peru. Trans R Soc Trop Med Hyg 96(2):193-96.

Rosenblatt EJ, Sloan ML, Schneider KS (1993). Evaluation of an enzyme-linked immunosorbent assay for the detection of Giardia lamblia in stool specimens. Diag Microbiol Infect Dis 16(4):337-41.

Ryan KJ, Ray CG (2004). Sherris medical microbiology (4th ed). MC Graw Hill. pp. 733-8.

Segarra-Newnham, Marisef (2007)."Mannifestations, diagnosis and treatment of strongyloide stercoralis infection. Annals pharmacother. 41(12).

Seltzer E (1999). Ascariasis. In: Tropical infectious diseases; principles, pathogens and practice 1st ed. Gurrant. RL, weller, PF(Eds), philadelphia: churchill Livingstone; 553.

Somers KD, Orse SA (2010). Large microbiology and infectious diseases flash cards (2nd ed.). Newyork: Lange Medical books/Mcgraw-Hill.pp.184-186/.

Swanner AY, Meunier ST (2014). Tropical diseases: a practical guide for medical practitioners and students. Oxford. Oxford University Press, USA. P.40.

Schantz PM (1996)."Tapeworms (cestodiasis)". Gastro-enterol. Clin North Am. 25(3):637-53.

Totkova A, Klobusicky M, Holkova R, Valent M (2003). "Enterobius gregorii-reality or fiction?" Bratislavske Lekarske Listy. 104(3): 130-3.
Uygur-Bayramicli O, Dabak R, Demihran G, ozer S (2012)."Taenia saginata a rare Cause of acute cholangitis; a case report". Acta clinical Belgica. 67 (6):436-7.
Weber R, Bryan RT (1994). Microsporidial infections in immunodeficient and immunocompetent patient. Clin infect Dis 19(3):517-21.
Wegayehu T, Tsala T, Seiyfu B, Teklu T (2013). Prevalence of IPIS among highland and lowlands dweller in Gammo area, South Ethiopia. BMC Public Health 13:151.
Weiss ML, Dubey PJ (2009). Toxoplasmosis: A history of clinical observation. Int J Parasitol. 39(8): 895-901.
WHO/ schistosomiasis. Available: www.who.int/mediacenter/factssheet/. Accessed 20 February 2016.
WHO Technical report series (1987). Prevention and control of intestinal infection; report of a WHO expert committee. No .749.
Wikipedia website https://en.m.wikepedia.orga/Ascaris/. Accessed January 16, 2016.
Wikipedia website https://en.m.wikipedia.org/wiki/pinworm. July 26, 2016.
Wikipedia website http://en.m.wikipedia.org/Schistosomes. Accessed November 5, 2013.
Wikipedia website http://en.m.wikipedia.org/Taenia. Accessed. February 20, 2016.
Wikipedia website https://en.m.wikipedia.org/ Tricuriasis. Accessed January 18, 2016.
Wikipedia website https://en. m. Wikipedia. orga/ wiki/ Coccidiosis. July 30, 2016.
Wikipedia website http://en.mwikipedia.org/ Hymenolepiasis. Accessed March.2, 2016.
Wikipedia website http://en.m.wikipedia.org/wiki/Giardiasis.Accessed February 22, 2016.
Wikipedia website http://en.m.wikipedia.org/wiki/Amoebiasis. Accessed January 30, 2016.
Ximenez C, Moran P, Rajas L, Valades A, Gomez A, Ramiro M, Cerritos R, Gonzalez E, Hernandez E, Oswaldo P (2011). Novelties on amoebiasis: a neglected tropical disease. J Glob Infect 3(2):166-74.
Ziegelbauer K, Speich B, Mausezahl D, Bos R, Keiser J, Utzinger J (2012). Effect of sanitation on soil-transmitted helminth infection: Systematic review and meta-analysis. PLOS Med 9(1):.

9. Annexes

9.1 Annex I Consent form

Addis Ababa University College of natural science department of zoological science information sheet and verbal consent form.

Research title :-Prevalence of intestinal parasitic infection among patients visiting Gorebella Health center, Ankober wereda, North Shoa, North central Ethiopia, January to April 2016

Name of investigator:

Introduction

This information sheet and consent form is prepared by the investigator whose main aim is to study the prevalence of intestinal infection. The investigator is MSC student from Addis Ababa University Science faculty zoological science department.

Purpose: The purpose of this research is to assess the prevalence of intestinal parasitic infection.

Procedures: You are kindly invited to take part in the research. I believe you can provide the necessary information for the research. Participation into the study is on voluntary basis. If you are willing to participate in my project, you need to understand and agree on the consent. All the responses given by the participants and the results obtained will be kept anonymous and confidential. No outside the researcher will have access to your responses?

Risk and/or Discomfort: There will be no discomfort/risk that you will face associated to your participation on their research.

Benefits: Up on finalization of this research, the result will be disseminated information to all individual about the prevalence of intestinal parasitic infection.

Incentives: There will be no incentive provided to you for your participation on this research.

Confidential and Anonymity: The information I will collect for this research will kept confidential. Information about you will be collected from the study will be stored in a file, which will not have your name on it and it will not be revealed to anyone except the investigator.

Right to refuse or withdraw: You have the full right to refuse from participating in this research (you can choose not to respond some or all of the questions) if you do not wish to participate and this will not affect you. You have also the full right to withdraw from this study at any time and you wish to without losing any of your rights as a resident of the site.

Persons to contact for further information: If you have any question, you can contact the investigator in the following address:

Name______Asnakech Deneke_______________________tel 0913381146

Contact information for compliant: If you have any concern that the researcher is conducting their activities unethically or inappropriately, please contact Addis Ababa University College of Natural Science Zoological Department with the following address.

Tell ________________________________email_______________________________.

If you agree to participate in this study, I appreciate your truth fullness and continue my interview. Are you willing to participate in this study? yes ☐ No ☐

9.2 Annex II Consent form (Amharic version)

አዲስ አበባ ዩኒቨርስቲ የተፈጥሮ ሳይንስ የስነ-እንስሳ ት/ት ክፍል የመረጃና የስምምነት መግለጫ

የጥናት ርዕስ፡ ጥናቱን የሚያከናውነው ባለሞያ ስም፡ አስናቀች ደነቀ

<u>መግቢያ</u>፡-ይህ መረጃና ስምምነት መግለጫ ቅፅ የተዘጋጀው ጥናቱን በሚያካሂደው ባለሙያ ሲሆን አላማው የአንጀት ጥገኛ ስርጭትን ለማጥናት ነው፡፡ ጥናቱን የሚያከናውነው ባለሙያ በአዲስ አበባ የሳይንስ ፋካሊቲ የዞሎጂካል ሳይንስ ተማሪ ነው፡፡

የጥናቱ መረጃ አሰባሰብ ሂደት

እርስዎ በዚሂ ጥናት ላይ እንዲሳተፉ ስጋብዘዎት የሚሰጡን መረጃ ለጥናቱ ጠቃሚና አስፈላጊ መሆኑን በማመን ነው፡፡ ተሳትፎዎትም በእርስዎ ፍቃደኝነት ላይ የተመሰረተ ነው፡፡ በመሆኑም በጥናቱ ላይ ለመሳተፍ ፍቃደኛ ከሆኑ ለሚጠየቁት ጥያቄ መልስ በመስጠት ይተባበሩን፡፡ የሚሰጡት መልስ ሙሉ ሚስጥራዊ መሆኑን ሊታወቅ ይገባል፡፡

<u>በተሳትፎ ሊደርስ የሚችል ጉዳት</u>፡-በዚህ ጥናት ላይ በመሳተፍዎ ምንም ሊደርስብዎ የሚችል ችግር የለም፡፡

<u>በተሳትፎ የሚገኝ ጥቅም</u>፡-ይህ ጥናት አንጀት ትላትል ስርጭትን ለማወቅ ያስችላል፡፡

<u>ክፍያ</u>፡-በዚህ ጥናት ስለተሳተፉ ምንም የሚከፈልዎት ክፍያ የለም፡፡

<u>የመረጃው ሚስጥር አጠባበቅ</u>፡-በዚህ ጥናት ሲሳተፉ ለሚጠየቁት ጥያቄ የሚሰጡት መረጃ ሚስጥራዊነቱ የተጠበቀ ነው፡፡ መረጃው በሚሞላበት የመጠይቅ ቅፅ ላይ ስምዎት አይመዘገብም፡፡

<u>በጥናቱ ያለመሳተፍ መብት</u>፡-በዚህ ጥናት ላይ በሙሉም ይሁን በከፊል ያለመሳተፍ መብትም የተተበቀ ነው፡፡ በመሆኑም የሚጠየቋቸውን ጥያቄዎች በሙሉም ይሁን በከፊል ያለመመለስ መብት አለዎት፡፡ ይህን በማድረግም ምንም የሚደርስብዎት ችግር የለም፡፡

<u>በጥናቱ ላይ ሙሉ መረጃ ለማግኘት</u>፡-በጥናቱና መረጃ አሰባሰብ ላይ ጥያቄ ካለዎት ጥናቱን በባለቤትነት የሚያከናውነውን ሰው በሚቀጥለው አድራሰሃ ማግኘት ይችላሉ፡፡

ስም አስናቀች ደነቀ ስልክ 251-0913381146 ኢሜል-------------

<u>በጥናቱ ላይ ቅሬታ ካለዎት</u>፡-ይህ ጥናት በሚከናወንበት ጊዜ መረጃ አሰባሰብ ሂደት ከስነ ምግባር ውጭ ሆኖ ካገኙት ለአዲስ አበባ ዩኒቨርሲቲ ስነ-እንስሳ ትምህርት ክፍል በሚከተለው አድራሻ ያሳውቁ፡፡

ኢሜል-------------------------.

በጥናቱ ለመሳተፍ ፍቃደኛ ከሆኑ ለሚሰጡኝ እውነተኛ መረጃ ልባዊ አድናቆቴን በመግለፅ ቃለመጠይቄን እቀጥላለሁ፡፡በጥናቱ ለመሳተፍ ፍቃደኛነዎት፡፡ አዎ ☐ አይደለሁም ☐

9.3 Annex III Questionnaire

Questionnaire for prevalence of intestinal parasitic infection among patients visiting Gorebela, health center, Ankober wereda, North Shoa, north central Ethiopia.

Name of the interviewer---

Date: ------------------------

Residence (kebeles):---------------------Got(cluster:--------------------

The purpose of this research is to assess the prevalence of intestinal parasitic infection .To understand the distribution of the intestinal parasites in the area, I would like to aske questions in this respect.

1.sex 1.male 2.femal

2. Age 1. 5-14 3.15-24 4.greater than 25

3. Education 1. Illiterate 2.Elemantary 3.High school & above

4. Nationality 1.Amhara 2. Oromo 3. Other

5. Religion 1. Orthodox 2.Muslim 3.Protestant 4.Other

6. Marital status 1.single 2. Married 3. Divorced 4. Widowed

7. Relation to the family. 1.Father 2. Mother 3.child 4.other

8. Family size of the household where the patient live with:

1. Single 2.2-5 family members 3. 6 and above members

9. Occupation 1. Government employee 2. Daily labour 3. Merchant

4. .Farmer 5.House wife 6.Other

10. Have you had intestinal problem, unexplained fever and night sweat?

1.Yes 2.No

11. Do you wash your hand after visiting latrine and before food? 1. Yes 2.No

12. Do you wash your hand after getting or cleaning your animals? 1.Yes 2.no

13.Does your pets sleep with you in your bed? 1. Yes 2.No

14. Do you clean your cats litter box? 1 .Yes 2.No

15. Do you work in experimental laboratory or veterinary clinic? 1. Yes 2. No

16. Do you work in sanitation? 1 .Yes 2.No

17. Do you regularly eat unpeeled raw fruit? 1. Yes 2.No

18. DO you properly washed vegetables and fruits before eating? 1. Yes 2. No

19 . Do you dispose dry and liquid wastes properly? 1. Yes 2. No

20. Did you have taken medicine for the past seven days? 1. Yes 2. NO

21. Do you have information about intestinal parasitic infection? 1. Yes 2. No

22. DO you drink tape water regularly? 1. Yes 2. No

23.Do you drink untested well water? 1. Yes 2.No

24. Do you eat meat that is undercooked? 1. Yes 2. No

25. Do you wear shoe when walking or doing a job? 1. Yes 2.No

26. Laboratory result

1. E. Histolytica 4.S. mansoni 7. H. nana 10. No ova or parasite

2. A. Lumbericoides 5. T. trichiura 8. S. stercoralis 11.E.histolytica and A.lumbericoides

3. G. intestinalis 6. Hookworm 9. Taenia 12.E.histolytica and G.intestinalis

9.4 Annex IV Questionnaire (Amharic version)

የአንጀት ጥገኞች የስርጭት መጠንን ለማወቅ በስሜን መዕከላዊ ኢትዮጵያ ፣ሰ/ሸዋዞን ፣ አንኮበር ወረዳ ጎረቤላ ከተማ ጤና አጠባበቅ ጣቢያ ለሚመረመሩ ህሙማን የተዘጋጀ መጠይቅ፡፡

ቃለ መጠይቁን የሚያካሂደው ሰው ስም-------------------------

ቀን-----------------------

ቀበሌ--------------------- ጎጥ---------------------------------

የጥናትና ምርምሩ አላማ የአንጀት ጥገኞችን ስርጭት ለማወቅ ስለሆነ ጥያቄዎችን በመመለስ እንዲተባበሩኝ በማክበር እጠይቃለሁ፡፡

ፆታ 1. ወንድ 2. ሴት

ዕድሜ 1. ከ5-14 3. ከ15-24 ዓመት 4. 25 ዓመት እና በላ

የት/ት ደረጃ 1. ያልተማረ 2. አንደኛ ደረጃ 3. ሁለተኛ ደረጃ 4. መሰናዶ እና ከዛ በላይ

ብሐር 1. አማራ 2. ኦሮሞ 3. ሌላ

እምነት 1. ኦርቶዶክስ 2. ሙስሊም 3. ፕሮቴስታንት 4. ሌላ

የጋብቻ ሁኔታ 1. ያላገባ 2. ያገባ

የቤተሰብ ሁኔታ 1. አባት 2. እናት 3. ልጅ 4. ሌላ

አብሮ የሚኖረው የቤተሰብ ብዛት 1. አንድ 2. ከ2-5 3. 6 እና ከዚያ በላይ

ስራ 1.የመንግስት 2. የቀን ሰራተኛ 3. ነጋደ 4. . ግብረና 5. የቤት እመቤት 6. ሌላ

የሆድ ህመም ከፍተኛ ትኩሳትና ሌሊት ሌሊት ማላብ ስሜት አለህ? 1. አለኝ 2. የለኝም

ከሽንት ቤት በኂላና ከምግብ በፊት እጅህን ትታጠባለህ? 1. እታጠባለሁ 2. አልታጠብም

እንስሳትን ከነካካህ/ሽ ወይም ካፀዳህ/ሽ በኂላ እጅህን/ሽን ትታጠባለህ/ሽ? 1. አዎ 2. አልታጠብም

ትንንሽ የቤት እንስሳት አብረው ይተኛሉ? 1. አዎ 2. አይተኙም

የድመቶችን ማደሪያ ታፀዳለህ/ሽ? 1. አፀዳለሁ 2. አላፀዳም

በቤተ ሙክራ ወይም በእንስሳት ህክምና ክሊኒክ ትሰራለህ/ሽ? 1. አዎ 2. አልሰራም

የፅዳት ስራ ትሰራለህ/ሽ? 1. አዎ 2. አልሰራም

ያልተላጡና የልበሰሉ ፍራፍሬዎችን ሁልጊዜ ትመገባለህ/ሽ? 1. አዎ 2. አልመገብም

አትክልትና ፍራፍሬዎችን ከመበላታቸው በፊት በሚገባ ታጥባለህ/ሽ? 1. አዎ 2. አላጥብም

ደረቅና ፈሳሽ ቆሻሻዎችን በአግባቡ ታስወግዳለህ/ሽ? 1. አዎ 2. አላስወግድም

ባለፉት ሰባት ቀናት ውስጥ መድሃኒት ወስደሃል/ሻል? 1. አዎ 2. አልወሰድኩም

ስለ አንጀት ጥገኛ ተዋሲያን የምታውቀው/ቂው ነገር አለ? 1. አለ 2. የለም

ሁልጊዜ የቧንቧ ውሃ ትጠቀማለህ/ትጠቀሚያለሽ/? 1. አዎ 2. አልጠቀምም

ያልተጣራ የጉድጓድ ውሀ ትጠጣለህ/ ትጠጫለሽ/? 1. አዎ 2. አልጠጣም

ጥሬ ስጋ ትበላለህ/ትበያለሽ? 1. እበላለሁ 2. አልበላም

ስራ በምትሰራበት/ሪበት እና በምትንቀሳቀስበት/ሽበ ጊዜ ጫማ ተደርጋለህ/ታደርጊያለሽ?. 1. አደርጋለ 2.አላደርግም

የላብራቶሬ ውጤት 1. E.histolytica 2. A.lumbricoides 3. G.intestinalis 4. S.mansoni

5. T.trichuria 6. Hookworm 7. H.nana 8. S.stericolaris

9. Taenia SPP 10. No ova/Parasite 11. E.histolytica and A.lumbericoides

12. E .histolytica and G.lumblia

10. Declaration

I, the undersigned, declare that this Thesis is my original work and all source materials used are duly acknowledged.

Name Asnakech Deneke   Signature _________________________Date___________________

11. Statement of the supervisor(s)

This Thesis has been approved for submission to the Department of Zoological Sciences for public defense.

Name Hassen Mamo (PhD)

Signature_________________________________Date_________________________________