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COMPARATIVE ASSESSMENT OF MALARIA AND INTESTINAL PARASITE PREVALENCE IN AWRAMBA AND NEIGHBORING COMMUNITIES IN WOJIARBAMBA KEBELE, SOUTH GONDAR ZONE, ETHIOPIA.

A THESIS SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES OF ADDIS ABABA UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTERS OF SCIENCE IN BIOLOGY (BIOMEDICAL SCIENCES)

BY

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Comparative assessment of Malaria and intestinal parasite prevalence in awramba and neighboring communities in Wojiarbamba kebele, South Gondar Zone Ethiopia

By

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List of Abbreviations and Acronyms

ACT	Artemisinin-based combination therapy
AL	Artemether/lumefantrine
CDC	Center for disease control and prevention
CQ	Chloroquine
CSA	Central Statistical Agency
E.C	Ethiopian Calender
ELISA	Enzyme linked immunosorbent assays
EOS	Enhanced Outreach Strategy
FMOH	Federal Ministry of Health
FDRE	Federal Democratic Republic of Ethiopia
FWARDO	Fogera Woreda Agricultural and Rular Development Office
HPA	Health Protection Agency
HIV	Human Immunodeficiency Virus
IHI	Intestinal helminth infections
ILRI	International Livestock Research Institute
IPIs	Intestinal parasitic infections
IRS	Indoor residual spraying
ITNs	Insecticide-treated nets
KAP	Knowledge, attitude and practices
LLINs	Long-lasting insecticide-treated bed nets
MOP	Malaria Operational Plan
MOH	Ministry of health
Pf	*Plasmodium falciparum*

Pv	*Plasmodium vivax*
PCR	Polymerase chain reaction
RDTs	Rapid diagnostic tests
rpm	round per minute
rRNAs	Ribosomal ribose nucleic acids
SAF	Sodium acetate - acetic acid-formaldehyde
SDWF	Safe Drinking Water Foundation
SNNP	South Nations and Nationalities People
STHs	Soil-transmitted helminthes
Syn.	Synonym
USD	United states dollar
UNICEF	United Nations International Children’s Emergency Fund
WMDF	World Malaria Day Factsheet
WMR	World Malaria Report
WHO	World health organization

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Abstract

The study was conducted to assess the prevalence of parasitic infections and the level of awareness among Awramba and neighboring communities in Wojiarbamba kebele. The community-based cross–sectional study conducted from November 2009 to April 2010 involved 392 participants from the two communities. Single stool specimens were collected from consenting individuals in the two communities. The specimens were examined microscopically for the presence of helminth parasite eggs, protozoan cysts/oocyst and trophozoites using direct saline wet mount and formol-ether concentration methods. Giemsa stained blood smears were examined for malaria parasites and a questionnaire administered to determine the KAP of study participants. Out of 392 study participants examined, 58(14.8%) had malaria and 173 (44.1%) had intestinal parasites. The prevalence of malaria in the Awramba neighboring communities (24.5%) was significantly ($p<0.05$) higher than that in Awramba community (5.1%).The 10 intestinal parasites identified were Hookworm spp (11.2%), *Ascaris lumbricoides (9.4%)* and *Entamoeba histolytica/dispar* (8.7%), making up the major group and *Cryptosporidium spp (1.8%)*, *Trichuris trichiura (2.8%)*, *E.vermicularis (3.5%)* and *Schistosoma mansoni (1.2%)* were detected in few individuals only. The difference in the prevalence of intestinal parasitic infection between Awramba (18.8%) and the neighboring communities (69.4%) was significant ($p <0.05$). The prevalence of anemia among neighboring communities (27.5%) was significantly ($p<0.05$) higher than that in Awramba community (18.8%). The questionnaire based study showed that Awramba community had better KAP towards protection against malaria and intestinal parasitic infections than the neighboring communities. The study showed that good household and environmental hygiene, good toilet construction and usage, proper utilization of ITN in Awramba community, has significantly contributed to the reduction of the burden of parasitic infections. Thus, the positive achievement in Awramba community could be used as a model for affordable health interventions in the neighboring communities in particular and the whole country in general.

Key words: Anemia, Awramba, Intestinal parasites, KAP, Malaria, Prevalence

1. Introduction

Parasitic diseases caused by helminths and protozoa are the major causes of human and animal health problem in most underdeveloped countries including Ethiopia. Infection with pathogenic parasites has been associated with significant morbidity and mortality especially in the young, malnourished and immunosuppressed individuals (Sullivian *et al*., 1990; Guerrant and Bobak, 1991). Growth stunting, wasting and anemia have been reported in children infested with pathogenic intestinal parasites (Shubair *et al*., 2000).

The high prevalence of parasitic infections is closely correlated with poverty, poor environmental hygiene and impoverished health services (Chandrashekhar *et al*., 2005). Intestinal helminth infections are the most common infections among school age children, and they tend to occur in high intensity in this age group (Savioli *et al*., 1992; Albonico *et al*., 1999). According to the WHO (1987) the level of helminthic infections can be viewed as an index of a community's progress towards a desirable level of sanitation. In developing countries, prevalence rates of intestinal parasites range from 30-60%, as compared to less than 2% in the developed countries (Guerrant and Bobak, 1991; Shubair *et al*., 2000; WHO, 1987).

Ethiopia is among the highly endemic countries where there is a high prevalence of malaria and intestinal parasites. Public awareness regarding the threat of parasitic infections is gaining worldwide prominance especially with the emergence of travel medicine, requiring substantiated knowledge on the prevalence of infectious diseases in countries of destination (Saab *et al*., 2004).

1.1 Malaria

Malaria is an acute infectious vector borne disease caused by protozoan parasites belonging to the genus plasmodium. The vectors are female anopheles mosquitoes. Four *Plasmodium* species namely *P. falciparum*, *P. vivax, P. malariae* and *P. ovale* are anthroponotic while *P.knowlesi* is zoonotic (Cox-Singh *et al.*, 2008) cause of human malaria. *P.falciparum* and *P. vivax* are the most common parasites (Betterton-Lewis, 2007). Clinical manifestations of malaria range from non-specific to severe complicated (Patel *et al*., 2003). *P. falciparum* is the cause of most sever and fatal diseases among the four species of *Plamodium* parasites (Davis, 2010).

Malaria is the primary cause of severe anemia (Hgb < 7 g/dl) in at least 50 % of subjects living in malaria-endemic areas (Anstey *et al*., 1999).

The life cycle of malaria parasite is complicated and involves two hosts- humans and *Anopheles* mosquitoes. The disease is transmitted to humans when an infected *Anopheles* mosquito bites a person and injects the malaria parasites (sporozoites) into the blood. Sporozoites travel through the bloodstream to the liver, mature, and release merozoites which eventually infect the human red blood cells. Further asexual multiplication takes place inside the red blood cells resulting in merozoites that are released up on rupture of the RBCs. Gametocytes develop and a mosquito takes a blood meal from an infected human and ingests human red blood cells containing the gametocytes. After the process of fertilization in the gut and sporogony in mosquito haemocoel, sporozoites are released and eventually invade the mosquito salivary glands. When the infected *Anopheles* mosquito bites a humans for its blood meal, sporozoites are injected with the saliva released as anti-coagulant (Fig 1) (CDC, 2010). *P. ovale* and *P. vivax* have dormant liver phase, hypnozoites, in their life cycle that may not develop for weeks to years (Lambert, 2005).

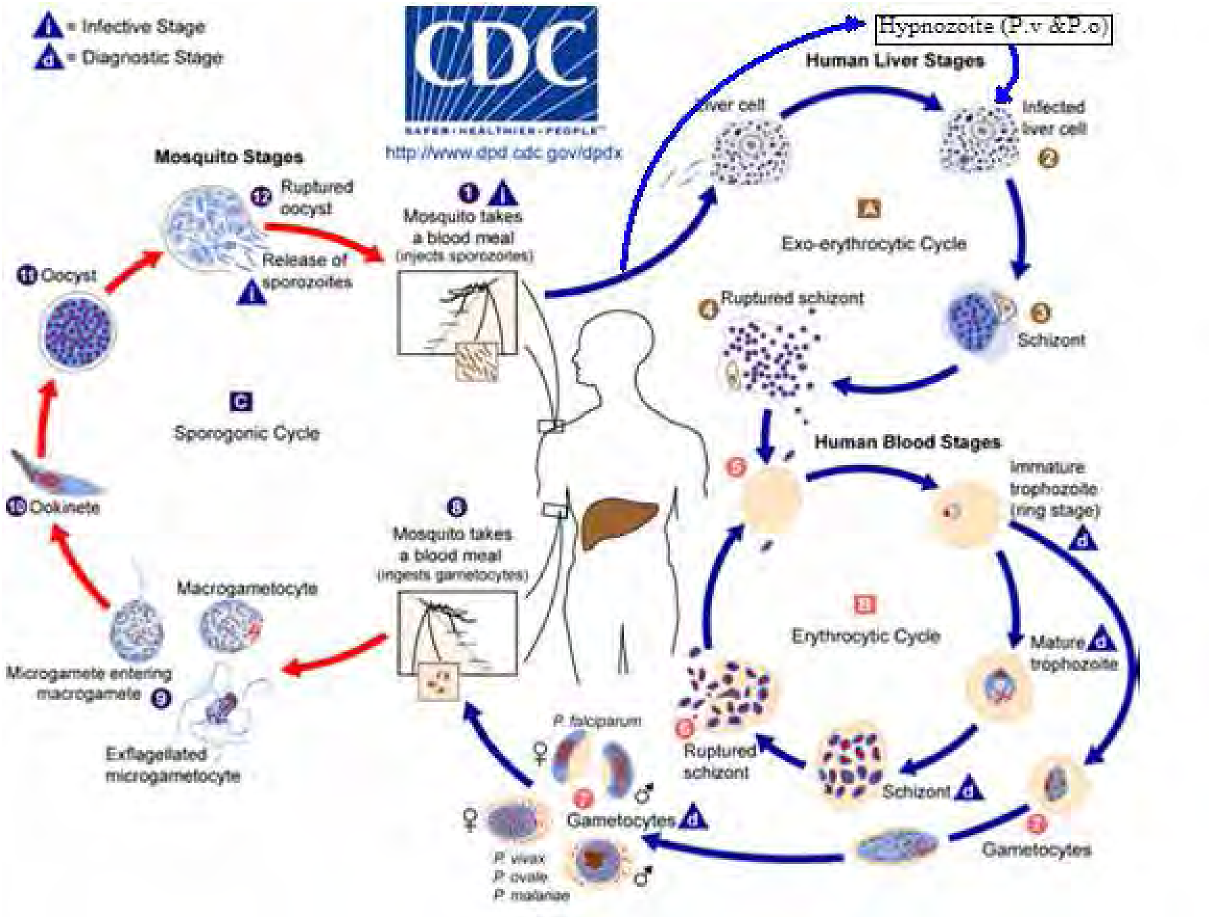

Fig. 1 Life cycle of *Plasmodium* species.

(Modified from: CDC - http://www.cdc.gov/malaria/about/biology/index.html.)

Malaria is mainly widespread throughout tropical areas (WHO, 2008) such as sub-saharan Africa, Central and South America, South-East Asia and the Pacific islands and parts of Europe and the Middle East are also affected (Eddleston and Pierini, 2005). In 2008, one hundred nine countries were reported to be endemic for malaria, with 45 of the countries within the African region (WHO, 2009). Malaria has been recorded as far North 64 ^{0} N latitude and as far South 32 ^{0} S latitude and in altitudinal ranges of 400m below sea level and 2800m above sea level (Gilles and Warrell, 1993) (Fig.2).

Fig 2. World malaria burden

(**Source: http**://www.nature.com/nrmicro/journal/v4/n9_supp/fig_tab/nrmicro1525_F2.html)

It is thought that approximately half of the world's population (3.3 billion people) is at risk from malaria (WMDF, 2009) in different countries and territories (CDC, 2009). In 2009, there were an estimated 225 million cases of malaria worldwide, the vast majority of cases (78%) being in the African Region, followed by South-East Asia (15%) and Eastern Mediterranean Regions (5%).The global number of malaria death is estimated from 985 000 in 2000 to 781 000 in 2009 (WHO, 2010).

Malaria not only poses a high risk to health, but also the repeated clinical consequences of infection in endemic areas, during early life and adulthood and outbreaks in epidemic prone areas, place a burden on households, on the health services and ultimately on the economic growth of communities and the nation. Socioeconomic conditions of the community have direct bearing on the problem of malaria (Kannathasan *et al*., 2008).

Malaria has been called the epidemic of the poor. It is an aspect of ill health that negatively affects adult productivity, and hampers the accumulation of human capital in younger generations (WHO, 2009). Malaria's cost to human and social well-being is enormous. This disease typically strikes its victims not once but repeatedly. As a result, workers' output is diminished, and children miss school, often for periods of a week or more at a time. Malaria is a major cause of poverty, and poverty exacerbates the malaria situation. Taken together, the effects of malaria on lives and livelihoods are devastating for economic progress in hard-hit countries (UNICEF, 2000).

Countries with high malaria transmission have historically had lower economic growth than in countries without malaria (Jeffrey and John, 2001). Malaria causes an average loss of 1.3% of annual economic growth in countries with intense transmission.The estimated economic burden to African countries is 12 billion USD per year (Scholz *et al*., 1997).

Effective control and treatment of malaria presents enormous logistical challenges. The key to addressing the challenge of reducing the burden of malaria is an integrated approach that combines preventative measures, such as long-lasting insecticide-treated bed nets (LLINs) and indoor residual spraying (IRS), with improved access to effective anti-malarial drugs (Kokwaro, 2009). At present there is no malaria vaccine available. Researchers are currently developing vaccines to prevent malaria (CDC, 2009).

1.1.1. Malaria in Ethiopia

Malaria is a major public health problem and a major cause of illness, death and obstacle to socioeconomic development in Ethiopia (WMR, 2008). Its occurrence in most parts of the country is unstable mainly due to the country's topographical and climatic features (Abose *et al.,* 2003). Three-quarters of the country and 48 million (68% of the population) is estimated to be at risk of malaria infection (WMR, 2008). A total of 1.2 million cases were reported in 2007, the lowest number in the period 2001–2007 (WHO, 2008). Malaria is reported to cause 70,000 deaths each year in Ethiopia (MOP, 2010)**.**

Although the two epidemiologically important malaria parasite species in the country are *P. falciparum* and *P. vivax* (Tulu, 1993), the other two species, *P. malariae* and *P. ovale,* are also reported to occur (Abose *et al.,* 1998). Over half of the malaria cases in Ethiopia are caused by *P. falciparum* (WHO, 2008). The levels of malaria risk and transmission intensity exhibit significant spatial and temporal variability related to variations in climate, altitude, topography, and human settlement pattern (Gebremariam, 1988; Tulu, 1993; Teklehaymanot *et al*., 2004). Occasionally, transmission of malaria occurs in areas previously free of malaria, including areas >2000m above sea level, in which the microclimate and weather conditions are favorable for malaria. True explosive epidemic malaria was recorded at exceptionally high altitude (around 2500 m above sea level) (Negash *et al.* 2005). The two main seasons for transmissions of malaria in Ethiopia are September–December, after the heavy summer rains, and March–May, after the light rains (WHO, 2007).

Current malaria control interventions in Ethiopia include early diagnosis and prompt treatment with effective antimalarial drugs, preventive measures such as the use of insecticide-treated nets (ITNs) and indoor residual spraying (IRS) (MOP, 2010).

1.2. Intestinal parasites

Intestinal parasitic infections (IPIs) are globally endemic and have been described as constituting the greatest single worldwide cause of illness and disease (Curtale *et al.*, 1998; Steketee, 2003). IPIs are linked to lack of sanitation, lack of access to safe water and improper hygiene; thus occuring wherever there is poverty. People of all ages are affected by the cycle of prevalent parasitic infections; however, children are the worst affected (Steketee, 2003; Garzon, 2003).

In developing countries, particularly those with tropical climates and at low altitudes, such infections remain a serious medical and public health among the poor, who are negatively affected by low socio-economic conditions, poor personal and environmental hygiene, over-crowding, and limited access to clean water (Mengistu *et al*., 2007; Obeng *et al*., 2007). The main transmission route for most intestinal parasites is fecal-oral, through contaminated food or water (Marshall *et al*., 1997).

1.2.1. Intestinal protozoa

Entamoeba histolytica, *Giardia lamblia* (syn.*G. intestinalis* or *duodenalis*) and *Cryptosporidium parvum* are three of the most common intestinal protozoan parasites infecting human worldwide (Marshall *et al*., 1997). *Entamoeba histolytica* is the causative agent of amebic dysentery and amebic liver abscess. It is one of the leading causes of death from parasitic diseases (Davis *et al*., 2009). Estimates on the prevalence of *Entamoeba* infection range from 1–40% of the population in Central and South America, Africa, and Asia, and from 0.2–10.8% in endemic areas of developed countries such as the USA (Haque *et al*., 1997; Braga *et al*., 1998; Rivera *et al.*, 1998).

Different species and strains of *Entamoeba* exhibit various levels of pathogenicity. *Entamoeba histolytica* and *Entamoeba dispar* are morphologically identical and highly similar species (their rRNAs are 98% identical), but they have vastly different virulence potentials in vivo (Diamond *et al*., 1993) and *E. dispar* has never been documented to cause disease in humans (Shibayama *et al*., 2007).

The most common manifestations of amoebic infection are dysentery and liver abscess, but infections of the lung, heart, and brain also occur (Haque *et al*., 2003). In developing countries amoebic infection depends largely on cultural habits, age, level of sanitation, crowding and socioeconomic status (Petri, 1996). Ingestion of fecally contaminated food or water is the primary mode of transmission (Rivera *et al.*, 1998).

Giardia lamblia is a cosmopolitan parasite with worldwide distribution and the most common protozoan isolated from gastrointestinal tract (Grazioli, 2006). The prevalence of *G.lamblia* infection varies from 2%-7% in industrialized countries to 40% in tropical/subtropical regions with poor sanitation and hygienic conditions (Scotti *et al*., 1996; Odoi *et al*.,2004).

The transmission of *Giardia* to humans is dependent upon the ingestion of cysts excreted in the feces of infected persons or animals. Classically, diagnosis of giardiasis is performed by microscopic examination of stool samples and/or duodenal biopsies and further methods include immunocromathography and immunofluorescence on stool samples (Grazioli, 2006).

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Cryptosporidium is a protozoan parasite that causes an infection called cryptosporidiosis affecting people and cattle (HPA, 2006). Cryptosporidiosis is an important cause of diarrheal disease. *Cryptosporidium* species live inside the epithelial cells of enterocytes within the intestinal tract of a variety of vertebrates, but some species can infect the respiratory tract. A growing number of species have been shown to cause human disease although *C. parvum* (previously *C. parvum* Genotype 2) and *C. hominis* (previously *C. parvum* Genotype 1) remain the main species encountered in England and Wales (Nichols *et al* .,2006). *C. parvum* and *C. hominis* are the two main species that were detected in Ethiopia. A 7.6% prevalence of *Cryptosporidium spp* has been reported from Ethiopia (Adamu *et al.*, 2010). It is transmitted when people or animals ingest food or water that it has contaminated. The most common symptom of cryptosporidiosis is watery diarrhea (HPA, 2006).

In stool surveys of patients with gastro-enteritis, the reported prevalence of *Cryptosporidium spp.* is 1-4% in Europe and North America and 3-20% in Africa, Asia, Australia, South and Central America (Current and Garcia, 1991).

The best ways to prevent cryptosporidiosis are practicing good hygiene, avoiding water and food that might be contaminated and avoiding fecal exposure. There are also many prevention methods that focus on the water supply (HPA, 2006) although the parasite is chlorine resistant (SDWF, 2007**).**

1.2.2 Intestinal helminth infections

Intestinal helminth infections (IHI) are among the most common infections occurring throughout the developing world (Agbolade *et al.*, 2004). Between 500 million and one billion people are estimated to be infected annually (WHO, 1987). Children are especially at increased risk of severe infections and the morbidity and mortality associated with them has serious implications in growth and development (Chan, 1994; Michael *et al*., 1997). Helminth infections have been linked with an increased risk for several nutritional anemias, protein energy malnutrition and reduced physical growth and the development in infants and children (Connoly and Kvalsvig, 1993; Nokes and Bundy, 1994; Stephenson *et al.*, 2000b). Severe complications of IHI, such as bowel obstruction, bile duct infection and pancreatic duct infection have also been reported (Chen and Bo, 1997; Sandouk *et al,* 1997). However, IHI evolves slowly and gradually and remains asymptomatic or mildly symptomatic (Hung *et al.,* 2005).

Intestinal worm infections thrive in communities without good housing, sanitation, water supplies, health care, education and income (Crompton, 1999). Round worms (*Ascaris lumbercoides*), Whip worms (*Trichuris trichuria*), hookworms (*Necator americanus* and *Ancyclostoma duodunale*), members of genus schistosoma (*S.haematobium, S.mansoni and S.japonicum*), *Strongyloid stercoralis*, or the filarial helminthes have particular world wide importance (Chan, 1997)**.** *Ascaris lumbricoides*, *Trichuris trichiura* and hookworms, collectively referred to as soil-transmitted helminthes (STHs), are the most common intestinal parasites (Bethony *et al*., 2006)**.**

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

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

Ascariasis is the most common parasitic infection of the gastrointestinal tract, but invasion of worms into the gall bladder is rare (2.1% of the hepatobiliary ascariasis in endemic areas) (Khuroo *et al*., 1992; Bouree *et al*., 2005).

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

Trichuris trichiura infection is endemic in tropical and subtropical countries, but few sporadic cases have occurred in nonendemic areas, mainly as a result of immigration. It is rare or nonexistent in arid, very hot, or very cold regions (Bogish *et al.*, 2005). It is estimated that over 40.1 million African school-aged children are infected with *T. trichiura* (Brooker *et al.*, 2006)

Intestinal trichuriasis is diagnosed by detecting *Trichuris* eggs in the feces. Prevention of zoonotic trichuriasis depends on the treatment and prevention of *Trichuris* infections in animals, the removal of feces before the eggs can become embryonated, good hygiene and public education (Guyatt, 2000).

Schistosomiasis is the second most important disease in public health importance next to malaria. It is caused by trematode flatworms of the genus *Schistosoma* (WHO, 2007). Schistosomiasis is endemic in 74 developing countries and it is estimated that 650 million people live in endemic areas world wide with more than 200 million infected individuals in rural and peri-urban areas. From these, 85% of all cases of schistosomiasis and most of the severe cases are found in Africa (WHO, 2007; Taylor, 2008).

Schistosoma spp. have a complex life cycle that is dependent on its intermediate host, snail and humans (Gryseels *et al.,* 2006). Humans become infected when they come into contact with the infective stage of the life cycle (the cercaria) in water, where the snail hosts are found (Elderdery *et al*., 2008).

The microscopic examination of excreta is a common method for the diagnosis of schistosomiasis. ELISA IgG testing, histopathology (colon, bladder, lung) demonstrating *Schistosoma* eggs, can also be an alternative diagnosis for schistosomiasis (Wilson *et al.*, 2007). Large scale chemotherapy has been found effective with health education, chemical control of snails and environmental modification in the control of schistosomiasis (Lammie *et al.,* 2006).

1.2.3. Intestinal parasites in Ethiopia

Intestinal parasitic infections, as in many developing countries, are common in Ethiopia and cause serious public health problems such as malnutrition, anaemia and growth retardation as well as higher susceptibility to other infections (Tedla , 1986)**.** The low economic standard, poor sanitation and ignorance of simple health promotion practices favour the wide distribution of intestinal helminthes in Ethiopia (Kloss and Zein, 1993). Of all types of diseases in Ethiopia, helminthiasis is the second most common cause of out patient morbidity next to malaria (FDRE, 1998).

The effect of altitude, urbanization, awareness, irrigation, and resettlement on the distribution of intestinal parasitism was depicted in several studies (Yeneneh, 1994; Haile *et al.*, 1994; Jemaneh, 1998). It has been reported that *A. lumbricoides* is the most prevalent intestinal parasite in different communities of the country usually occurring together with *Trichuris trichuria* infections (Tedla and Ayele, 1986). Hookworm infection, strongyloidiasis and enterobiasis are widely prevalent, although their magnitude is lesser compared to ascariasis (Amare *et al*., 2007). In Ethiopia the prevalence of hookworm estimated as 16% and the prevalences of *A. lumbricoides* and *T.trichiura* as 37% and 30% respectively and the prevalence of taeniasis alone ranges from 1- 48% and the infection rate with *Hymenolopis nana* is 3- 61% (Tadesse *et al*., 2008**).**. Amoebiasis and giardiasis are common causes of intestinal protozoal infections throughout the nation. The prevalence of amoebiasis by microscopy method ranges from 0-4% and that of giardiasis is 3-23% (Amare *et al*., 2007)**.** But, Kebede *et al* (2004) showed the over diagnosis of *E.histolytica* in Ethiopia due to the misleading microscopy method. Their finding reported 0.9% prevalence of *E.histolytica* by real-time PCR based analysis. STH infections have not been targeted for control in Ethiopia, although mass de-worming as a component of the Enhanced Outreach Strategy (EOS) targeting under five children started in 2004 (FMOH,2004).

Intestinal schistosomiasis, in Ethiopia, caused by *S. mansoni* and urinary schistosomiasis due to *S. haematobium* pose considerable public health and socioeconomic problems. The distribution of schistosomiasis is highly focal and discontinuous in the country (Erko *et al*, 1997; Kloss *et al*, 1988).

1.3. Level of awareness and parasite infection

Health status of a community is influenced by individual characteristics and behavioral patterns (lifestyles) but continues to be significantly determined by the different social, economic and environmental circumstances of individuals and populations (Nutbeam, 2000). Many studies have addressed that lack of community awareness about parasites and socioeconomic conditions and lifestyle of the community could contribute to the spread of the diseases in part, hinder control strategy and increase risk of exposure to the diseases (Yadav *et al*., 1999; Deressa *et al*., 2005).

Ignorance and impoverished conditions of people contribute in creating source and spread of parasites and affect disease control strategy. Prevention of the disease through better knowledge and awareness is the appropriate way to keep disease away and remain healthy as illness confusion and health-seeking behavior may enhance or interfere with the effectiveness of control measures (Collins *et al*., 1997). Studies pertaining to knowledge, attitude and practices (KAP) showed that direct interaction with community plays an important role in circumventing parasite problem (Tyagi *et al*., 2005).

With regard to malaria, it is recognized that accessibility to anti-malaria interventions alone will not bring about the desired change. Several studies have demonstrated compliance to anti-malaria interventions depends substantially on social, behavioural and cultural factors that affect understanding of the causes, the relationship between mosquitoes and the disease, diagnosis, treatment and practices about prevention (Agyepong, 1992; Ahorlu *et al*., 1997; Espino *et al.*, 1997; Agyepong *et al*., 1999). People's perceptions and understandings about the perceived cause and transmission of malaria have strong implications on the preventive measures such as the current scale-up ITNs implementation (Espino *et al.*, 1997; Agyepong et *al*., 1999).

A study from an area of seasonal malaria transmission in Eritrea indicated that correct knowledge of malaria transmission through mosquito bite was found to be a good predictor of ITN possession and use within households (Macintyre *et al*., 2006). The study also demonstrated a link between the demand for ITNs and the knowledge of the benefits of the net Raising awareness and understanding, and involving the community in malaria prevention and control could enhance the proper use of ITNs by their self as well as family members (Deressa and Ali, 2009).

Intestinal parasites are more prevalent in communities with low level of awareness and in rural and very remote areas. For instance, intestinal helminth infections (IHI) are very common in the remote rural areas of Vietnam, associated with poor living conditions, poor sanitation, and lack of knowledge (Hung *et al*., 2005).

Hypothesis: The prevalence of parasites in Awramba community (Turign Got) will be lower than its neighboring communities in Wojiarbamba kebele and this will correlate with better knowledge, attitude and practice towards parasitic diseases.

2. Objectives

2.1. General objective

- To assess the prevalence of malaria and intestinal parasitic infections and the level of awareness towards them among Awramba and the neighboring communities in Wojiarbamba kebele, South Gondar zone, Amhara region.

2.2. Specific objectives

- To determine the prevalence of malaria and intestinal parasites in Awramba and its neighboring communities.
- To assess the prevalence of anemia in relation to parasitic infections.
- To assess knowledge, attitude and practice of the two communities towards malaria and intestinal parasites
- To asses intestinal parasitic infection prevalence in relation to hygienic practices of the population in Awramba and neighboring communities.

3. Materials and Methods

3.1. Study area

Since the study was comparative, it was conducted from November 2009 to April 2010 in two selected communities: Awramba and its neighboring communities (that include study participants from ‘Gots’; Arbachan, Qorke, Jib-gudguad, Laydewol, Wojiterara, Maksegn, Tizaba, Timinda, Warsa, Dej-mesk). These communities are found in Wojiarbamba kebele, Fogera woreda, South Gondar Zone of Amhara National Regional State in Northwestern Ethiopia which is located 62 kilometers North of Bahirdar. Fogera woreda, where these two communities are found, consists of 26 kebeles. Its total area is 117,414 ha. The woreda has borders with Farta woreda in the east, Dera in the south, Lake Tana in the west and Libokemekem woreda in the north (FWARDO, 2006). According to ILRI (2004) the woreda is characterized agro-ecologically as moist Woina Dega and the annual rainfall is monomodal and ranges from 1103 mm to 1336 mm and the temperature ranges between 19 and 20 ^{o}C. Topographically, the flat area accounts for 76 %, mountain and hills 11 % and the valley bottom is13 %.

Wojiarbamba kebele is divided into 27 local villages called ‘Gots’. Awramba is found in one of these ‘Got’s which is known as “Turign”. The total population of Wojiarbamba kebele is 8843 (FWHO, 2009).

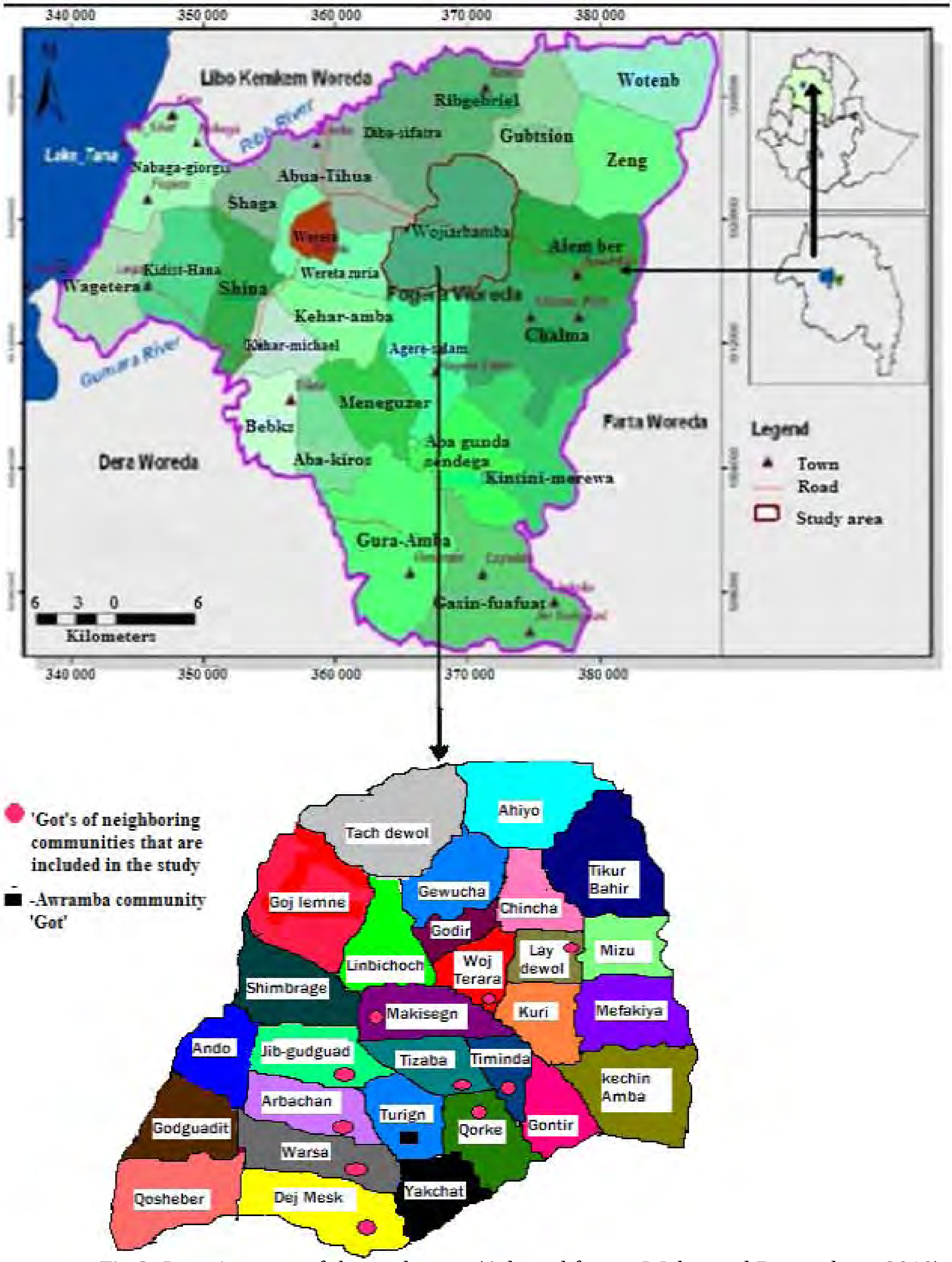

Fig 3. Location map of the study area (Adapted from:- Wubet and Dagnachew, 2010)

3.1.1. Awramba

Awramba is a unique community, located in Turign 'Got' in Wojiarbamba kebele that diverts 5 km to the west inside from the main road of Bahir Dar city to Debre Tabor. This community is the brain child of Ato Zumra Nuru, currently a 62 years old man, who is the founder and chair of Awramba community.

In the 1972 E.C, Ato Zumra Nuru launched the society he dreamed of with 19 other people who adopted his vision. Currently, Awramba community has some 403 members in 109 households, living in over 17 hectares of land. The Awramba Community has its own rules and regulations. Formulated by Ato Zumra, the community has four pillars of rules for its society. This community is lauded as a model to alleviate poverty and promote gender equality, model center for reproductive health, area of best practices of leadership in a country where women generally hold a subservient status to men. Subsequently, in Awramba community, men cook, women plow, and religion has no place. The community is distinct in that its members work together, are diligent, disciplined and self confident.

Children get access to primary education in a school run by members of the community itself. The main means of livelihood for the community is weaving. Women have equal rights as men and there is no distinction in divisions of labor between male and their female counterparts. All people in the community have no religion as distinct from most communities in Ethiopia. The village is unique not only for its attitudes toward gender, religion, and education, but for the social security it provides its members in need. There's a home for the elderly with 24-hour care and a committee that helps out new mothers, who also get three months of maternity leave. Early and forced marriages are forbidden. The community has thirteen committees for different community activities. Health and environmental sanitation committee is one of the committees that perform different activities in relation with health and environmental sanitation.

3.2. Study design

A cross sectional study was the study design. All consenting study subjects were requested to provide blood and fresh stool samples at the time of visit for malaria and intestinal parasite diagnosis. The study also assessed the knowledge, attitude and practice (KAP) of the two study populations on parasitic diseases by using pre-tested structured questionnaire.

3.3. Sample size Calculation

A total of 392 study participants, from all age groups, were included in this study from two communities. 196 subjects were sampled randomly from Awramba community and 196 subjects were also sampled from neighboring communities. A simple random sampling method was employed in the selection of study participants in both study sites.

Sample size determination for study estimating population prevalence was calculated by using the following formula (Daniel, 1999 as cited by Naing *et al.*, 2006).

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

Where: - n = sample size Z = Z statistic for a level of confidence

d = precision P = expected prevalence or proportion

The calculation was conducted by using 95% confidence interval for Z statistics which is conventionally 1.96 and 5% precision. According to Fogera woreda health office 2009/10 report, the prevalence of parasites in the total community was 15%. Therefore, 15% prevalence was taken to determine the sample size. Based on the above formula, the sample size (n) would be 196 from each community.

$$n = \frac{(1.96)^2 (0.15) (0.85)}{(0.05)^2}$$

$$= 196$$

Total study participants (from the two communities) = 196 +196 =392

3.4. Stool sample collection

Fresh fecal samples were collected form the study subjects in separate labeled vials at some season of the year. The specimens were obtained by convincing residents to give small amount of feces. At the time of sampling, the name of individuals, date of sampling, age, sex, consistency of feces (soft, pasty, watery or normal), and code number were recorded for each subject on a recording format. A portion of fresh stool was examined at the field and the remaining part was preserved by adding SAF (15 g sodium acetate, 20 ml glacial acetic acid, 40 ml formalin and 925 ml distilled water) in the ratio of 1 g of stool to 3 ml of SAF for later examination and transported to the Biomedical research laboratory, Department of Biology, Addis Ababa University.

3.4.1 Stool examination

The stool specimens were examined for intestinal parasite tropozoites by using a direct wet mount (with saline) of unconcentrated feces and a wet mount examination of the same stool specimen after concentration under light microscope. The preserved stool samples were processed by formalin - ether concentration method.

3.4.1.1. Wet-mount technique

The stool samples were examined macroscopically for the presence of adult worms, for consistency, and for any other physical abnormalities. The stool samples were emulsified with 3-4 ml normal saline, then a drop of emulsified sample was placed on a glass slide, a few drops of iodine were added, and all covered with a cover slip. The preparation was first examined under a 10x objective lens, then 40x for detailed identification of parasites under low light intensity. This process helped to identify motile trophozoites, larvae, eggs and cysts.

3.4.1.2. Formol-ether concentration technique

One gram (1 g) of each stool sample was emulsified with 10 ml of 10% formaldehyde (formaline). This was mixed thoroughly and passed through gauze. Three to four (3-4) ml of diethyl ether were added and mixed by inverting and intermittent shaking for 1 minute, and centrifuged at 3,000 rpm for 5 minutes. After centrifugation, the supernatant (layers of ether, debris, and formol saline) was discarded and the sediment (containing the parasites at the bottom of the test tube) was re-suspended in formol saline. The sediment was examined microscopically under 10x and 40x magnification, for the presence of parasitic organisms. Some of smears from the deposits were made and stained with modified Ziehl Neelsen stains.

3.4.1.3. Modified Ziehl Neelsen staining technique

A thin smear of sediment from the concentration technique was prepared, air-dried and fixed in methanol for 2-3 minutes. The slides were stained with cold carbol fuchsine for 30 minutes. The slides were washed with tap water and decolorized with 1% hydrochloric acid-ethanol solution (acid - alcohol) for 2 minutes. The slides were rinsed in distilled water and then counterstained with 1 % methylene-blue for 2 minutes. These were then rinsed in tap water, air-dried, and examined microscopically under a 100x objective oil-immersion lens for *Cryptosporidium* oocyst.

3.5. Blood sample collection and examination

Blood samples were taken from each study subject following safety precautions for tick and thin smear using blood lancet. Thick and thin blood smears were prepared as indicated elsewhere (Cheesbrough, 1998). Then, the slides were stained using Giemsa stain prior to fixation incase of tick film and after fixation with methanol incase of thin film. Thick and thin blood smears were examined for confirmation of malaria parasites and species diagnosis.

3.6. Hemoglobin test

Level of anemia status of study participants were tested by HemoCue system that consists of disposable microcuvette. Blood sample was placed in the microcuvettes and hemoglobin level was determined by the HemoCue machine.

3.7. Socio-demographic data collection

Structured questionnaire that can assess the knowledge, attitude and practice (KAP) towards parasitic diseases were developed and administered for each study subject to collect socio-demographic data like age, sex, educational level, presence of latrine in their home, using of bed net, personal and environmental hygiene keeping…etc.

3.8. Data Analysis

Influence of sex, age, awareness and other factors on the prevalence of parasites between two communities was analyzed using chi-square ($\chi 2$) at 95 % confidence intervals. Probability values were considered to be statistically significant when the P-values are equal to or less than 0.05. All statistical analyses were performed using the statistical software SPSS software version 17.

3.9. Ethical clearance

The study was reviewed and approved by ethical committee of Biology Department of Addis Ababa University. The ethical considerations were addressed by treating positive individuals using standard drugs. Informed verbal consent was also obtained from the study participants before interview. At the end of the interview, information about parasites, its mode of transmission, methods of prevention and treatment were explained to the study participants.

4. Results

A total of 392 individuals (196 from Awramba and 196 from neighboring communities) participated in the study. Of these, 213 were males with age ranging from 2 to 84 years (mean 21.5) and 179 were females, age between 2 and 75 years (mean 21.2). Table 1 shows the socio-demographic characteristics of the study participants. The educational background of the study participants varied, ranging from illiterate to secondary education. The majority (50%) of the participants had only primary education. 50.2% of participants were under the age $\geq$15.

Table 1: Socio-demographic characteristics of study participants in Awramba and its neighboring communities in Wojiarbamba kebele, Fogera woreda, South Gondar zone, Ethiopia (November 2009 and April 2010)

Variables	**Awramba community (n=196)**		**Neighboring communities (n=196)**		**Overall total (N=392)**	
	N	**%**	**N**	**%**	**N**	**%**
Sex						
Male	105	53.6	108	55.1	213	54.3
Female	91	46.4	88	44.9	179	45.7
Age						
1-5	17	8.7	50	25.5	67	17.1
6-14	97	49.5	31	15.8	128	32.7
≥15	82	41.8	115	58.6	197	50.2
Religion						
Christian	-	-	184	93.9	184	46.9
Muslim	-	-	12	6.1	12	3.1
Other[¥]	196	100	-	-	196	50
Educational status						
Illiterate	31	15.8	65	33.2	96	24.5
Literate (Read and write)	59	30.1	29	14.8	88	22.5
Primary education	106	54.1	90	45.9	196	50
Secondary education	-	-	12	6.1	12	3
Occupation						
Farmer	10	5.1	66	33.7	76	19.4
Government employee	-	-	7	3.6	7	1.8
Handicraft	58	29.6	16	8.2	74	18.8
House servant	-	-	4	2	4	1
Others[∞]	128	65.3	103	52.6	231	58.9

Key: **¥** - represents those who are neither Christian nor Muslim

∞ - represents study participants including students, children under school age, house wives, self employed..

Parasitological examination of stool and blood by different techniques such as, direct wet mount, formol-ether concentration, modified Ziehl-Neelse and Gimesa staining showed that infections with malaria, various intestinal protozoa and helminthes were common in the study areas among study participants.

4.1. Overall prevalence of intestinal parasites among Awramba and neighboring communities

The stool examinations revealed that the over all pre-valence rate for intestinal parasites was found to be 173(44.1%) in the two communities. The prevalence of intestinal parasites in Awramba community was 37(18.9%) and in neighboring communities 136 (69.4%). The prevalence of intestinal parasites has shown significant difference ($P<0.05$) between Awramba and neighboring communities (Table 2).

Ten different parasites were identified in the two communities: *Ascaris lumbricoides (*9.4%), *Strongyloid stercoralis* (0.3%), *Enterobius vermicularis* (3.6%), *Schistosoma mansoni* (1.3%) *Cryptosporidium spp.* (1.8%), hookworm *spp.* (11.2%), *Hymenolepsis nana* (0.8%) *Giardia lamblia* (4.3%) and *Entamoeba histolytica/dispar* (8.7%). Of those infected study participants, 115(29.3%) had parasitic worm infections, while the remaining 58 (14.8%) had protozoan infections (Table 2).

Among the ten species of intestinal helminthes that were recovered, the most dominant were hookworm species (11.2%) followed by *Ascaris lumbricoides* (9.4%) and *Enterobius vermicularies* (3.6%). Hookworm spp. infection prevalence in neighboring communities (17.3%) was higher than the prevalence in Awramba community (5.1%) and shows significant difference ($P<0.05$) (Table 2).

Table 2: Prevalence of intestinal parasites among Awramba and its neighboring communities in Wojiarbamba kebele, Fogera woreda, South Gondar zone, Ethiopia (November 2009 and April 2010)

Types of Parasites	Awramba community (n=196)			Neighboring community (n=196)			Total n=392
	Male n=105 No.observed (%)	Female n=91 No.observed (%)	Total n=196 No.observed (%)	Male n=108 No.observed (%)	Female n=88 No.observed (%)	Total n=196 No.observed (%)	No.observed (%)
Protozoa	**9(8.6)**	**5(5.5)**	**14(7.1)**	**23(21.3)**	**21(23.9)**	**44 (22.5)**	**58 (14.8)**
E. histolytica/dispar	4(3.8)	1(1.1)	5 (2.6)	16(14.8)	13(14.8)	29 (14.8)	34 (8.7)
Giardia lamblia	3(2.8)	1(1.1)	4 (2)	7(6.5)	6(6.8)	13 (6.6)	17(4.3)
Cryptosporidium spp.	2(1.9)	3(3.3)	(2.6)	-	2(2.3)	2 (1)	7 (1.8)
Helminths	**11(10.5)**	**12(13.2)**	**23(11.8)**	**52(48.1)**	**40 (45.5)**	**92(46.9)**	**115 (29.3)**
A. lumbricoides	1(0.9)	7(7.7)	8(4.1)	14(12.9)	15(17)	29 (14.8)	37 (9.4)
T. trichiura	1(0.9)	-	1(0.5)	6(5.5)	4(4.5)	10 (5.1)	11(2.8)
Hookworm species	7(6.7)	3.(3.3)	10(5.1)	19(17.6)	15(17)	34 (17.3)	44 (11.2)
S. stercoralis	1(0.9)	-	1(0.5)	-	-	-	1 (0.3)
S. mansoni	-	-	-	4(3.7)	1(1.1)	5(2.6)	5 (1.3)
E.vermicularis	1(0.9)	2(2.2)	3(1.5)	8(7.4)	3(3.4)	11 (5.6)	14(3.6)
H.nana	-	-	-	1(0.9)	2 (2.3)	3(1.3)	3 (0.8)
Overall total	**20(19)**	**17(18.7)**	**37(18.9)**	**75(69.4)**	**61(69.3)**	**136 (69.4)**	**173(44.1)**

Table 3 also shows the prevalence of intestinal protozoa and intestinal helminths in comparison among study participants of the two communities. There was significant ($p<0.05$) difference in the prevalence of intestinal protozoa among Awramba 14(7.1%) and neighboring communities 44(22.5%). The prevalence of intestinal helminthes between Awramba 23(11.8%) and neighboring 92(46.9%) communities also showed significant difference ($p<0.05$).

Table 3: Prevalence of intestinal protozoa and helminths among study participants of Awramba and its neighboring communities in Wojiarbamba kebele, Fogera woreda, South Gondar zone, Ethiopia (November 2009 and April 2010).

Study community	No of study participants	Parasites identified					
		Intestinal protozoa			Intestinal helminths		
		No. positive	Prev (%)	**P-value**	No. positive	Prev (%)	**P-value**
Awramba Community	196	14	7.1	0.00*	23	11.8	0.00*
Neighboring Communities	196	44	22.5		92	46.9	

Key: ***** - represents significant difference ($P<0.05$)

P-value – comparing prevalence of parasites between the two study sites

4.2. Prevalence of intestinal parasites in relation to sex among Awramba and neighboring communities

The number of females infected with intestinal parasites among Awramba community was 17(18.7%) and males were 20 (19%) and females among neighboring communities were 61

(69.3%) and males were 75 (69.4%) (Table 2). The prevalence of the intestinal parasite infection was not different between females and males with in Awramba (p>0.05) as well within neighboring communities.

4.3. Prevalence of intestinal parasites among different age groups of the two communities

Out of the 392 participants, majority of participants 128 (32.7%) were between the age group of 6 to 14 years(Table 1). Unfortunately, no children less than 1 year age category were included in this study. The highest level of intestinal parasite infection 97 (24.7%) was recorded in the ≥15 year age group, as shown in (Table 4). The prevalence of intestinal protozoa in the age group of 6-14 was 11 (11.3%) in Awramba community and 11 (35.5%) in neighboring communities participants. In addition, intestinal protozoa prevalence in age group ≥ 15 was 3 (3.7%) in Awramba community and 28 (24.3%) in neighboring communities participants. Similarly, the prevalence of intestinal helminthes among age groups of 6-14 and ≥ 15 was [8(8.2%) Vs 18 (58%)] and [11(13.4 %) Vs 55(47.8%)] in Awramba community and its neighboring communities study participants respectively. Statistical significant difference (P<0.05) was observed in all of the above two age groups of the two communities (Table 4).

Among the children in the 1 to 5 years age category, 0 (0%) and 5 (10%) were found positive for intestinal protozoa in Awramba and neighboring communities participants respectively and 4 (23.5%) and 19 (38%) were positive for intestinal helminthes in Awramba and neighboring communities study participants. In both cases, no statistical significant difference (P>0.05) was observed (Table 4).

Table 4: Prevalence of intestinal helminth and protozoan infections among by age groups of study participants in Awramba and its neighboring communities of Wojiarbamba kebele,Fogera woreda, South Gondar Zone, Ethiopia (November 2009 and April 2010)

Age group(yrs)	Study community	No of participants	Intestinal protozoa		Intestinal helminths	
			Prevalence n (%)	**P-value**	Prevalence n (%)	**P-value**
1-5	Awramba	17	-	(0.18)	4 (23.5)	(0.28)
	Neighboring	50	5 (10)		19(38)	
6-14	Awramba	97	11 (11.3)	(0.01)*	8 (8.2)	(0.00)*
	Neighboring	31	11 (35.5)		18 (58)	
≥ 15	Awramba	82	3 (3.7)	(0.00)*	11 (13.4)	(0.00)*
	Neighboring	115	28(24.3)		55 (47.8)	
Overall total		**392**	**58(14.8)**		**115(29.3)**	

Key: ***** - represents significant difference (P<0.05)

P-value – comparing prevalence of parasites between the two study communities

4.4. Parasite co-infections

A single parasitic infection was more prevalent than multiple parasitic infections in both communities. Overall co-infection was detected in 47 (12%) of study participants. Among the co-infections, 38(9.7%) was double infection and 9(2.3%) was triple infection (Table 5). In Awramba community, out of 37 (18.8%) (Table 2) infected individuals 6(3.1%) (Table 5) had co-infections. Likewise, in neighboring communities, out of the total 136 (69.3%) (Table 2) infected individuals, 41(20.9%) (Table 5) had co-infection. Among the double parasitic infection, hookworm *& A. lumbercoides* comprised the highest proportion followed by *G. lamblia & E.histolytica/dispar.* Among the triple co-infections, *E. vermicularis, A.lumbericoides & E.histolytica/dispar* and *Hookworm spp, S. mansoni & E. vermicularis* comprised the highest proportion.

Table 5. Co-infection prevalence of intestinal parasites in Awramba and its neighboring communities in Wojiarbamba kebele, South Gondar Zone , Ethiopia (November 2009 and April 2010)

	Awramba community n=196 No.observed (%)	**Neighboring communities n=196 No.observed (%)**	**Total n=392 No.observed (%)**
Double infection			
Hookworm & A. lumbercoides	2(1)	5 (2.5)	7(1.8)
G. lamblia & E.histolytica/dispar	1(0.5)	4 (2)	5 (1.3)
Hookworm & G.lamblia	1(0.5)	1(0.5)	2 (0.5)
Hookworm & Cryptosporidium spp.	1(0.5)	-	1(0.3)
Hookwom & E. histolytica/dispar	-	4 (2)	4 (1)
A.lumbericoides & T.trichuria	-	3 (1.5)	3(0.8)
E. vermicularris & H.nana	-	1(0.5)	1(0.3)
A.lumbericoides &G. lamblia	-	1(0.5)	1(0.3)
E. vermicularis & Hookworm	-	2 (1)	2(0.5)
E. histolytica/dispar &A. lumbericoides	-	4 (2)	4(1)
Hookworm & T. trichuria	-	2 (1)	2(0.5)
S. mansoni & T.trichuria	-	1(0.5)	1(0.3)
A. lumbericoides & E. vermicularis	-	3 (1.5)	3(0.8)
T. trichuria & E.histolytica/dispar	-	1(0.5)	1(0.3)
T. trichuria & E. vermicularies	-	1(0.5)	1(0.3)
Triple infection			
Hook worm, S. mansoni & E. vermicularies	-	1(0.5)	1(0.3)
E. vermicularis, A.lumbericoides & E.histolytica/dispar	-	2 (1)	2(0.5)
Hookworm ,G. lamblia & E. histolytica/dispar	-	2 (1)	2(0.5)
Hookworm, A. lumbericoides & T. trichria	1(0.5)	1(0.5)	2(0.5)
E.vermicularis, A.lumbericoides & Cryptosporidium	-	1(0.5)	1(0.3)
E. vermicularis, T. trichria & E.histolytica/dispar	-	1(0.5)	1(0.3)
Overall total	**6(3.1)**	**41(20.9)**	**47(12)**

There was no malaria and intestinal parasite co-infection in Awramba community. *Hookworm & P. falciparum* co-infection (3.6%) comprised the highest proportion of malaria and intestinal parasites co-infection among the neighboring communities (Table 6).

Table 6. Prevalence of malaria and intestinal parasites co-infection in Awramba and its neighboring communities in Wojiarbamba kebele, South Gondar Zone , Ethiopia (November 2009 and April 2010)

Co-infections	**Awramba community n=196 No.observed (%)**	**Neighboring communities n=196 No.observed (%)**	**Total n=392 No.observed (%)**
Double infection			
E.vermicularis & P. falciparum	-	1(0.5)	1(0.3)
E.histolytica/dispar & P. falciparum	-	3 (1.5)	3(0.8)
Hookworm & P. falciparum	-	7(3.6)	7(1.8)
Hookworm & P. vivax	-	1(0.5)	1(0.3)
A.lumbericoides & P. falciparum	-	2 (1)	2 (0.5)
Cryptosporidium spp. & P. falciparum	-	1(0.5)	1(0.3)
G. lamblia & P. falciparum	-	1(0.5)	1(0.3)
T. trichuria & P. falciparum	-	1(0.5)	1(0.3)
Triple infection			
Hook worm, E.histolytica/dispar & P. falciparum	-	1(0.5)	1(0.3)
E. vermicularis, A.lumbericoides & P. falciparum	-	2 (1)	2(0.5)
A. lumbericoides ,G. lamblia & P. falciparum	-	1(0.5)	1(0.3)
A. lumbericoides, T. trichria & P. falciparum	-	3 (1.5)	3(0.8)
E.vermicularis, A.lumbericoides & P. vivax	-	1(0.5)	1(0.3)
A. lumbericoides , Hook worm & P. falciparum	-	1(0.5)	1(0.3)
A. lumbericoides , Hook worm & P. vivax	-	1(0.5)	1(0.3)
Overall total	-	**27(13.8)**	**27(6.9)**

4. 6. Malaria prevalence in the two communities

Blood smear samples were examined from a total of 392 study participants. Out of these, 10 (5.1 %) from Awramba community and 48 (24.5%) from the neighboring communities were positive for malaria parasites.

Out of 27(12.7%) infected males, 6 (2.8%) were in Awramba community and 21 (9.9%) were in neighboring communities. Out of 31 (17.3 %) infected females, 4 (2.2%) were in Awramba community and 27 (15.1%) were in neighboring communities (Table 7). Overall malaria infection prevalence in neighboring communities 48 (24.5 %) was significantly ($p<0.05$) higher than the prevalence in Awramba community 10 (5.1%). Moreover, the result revealed no significant ($P>0.05$) difference of malaria prevalence between the two sexes.

Table 7: Overall sex-specific malaria prevalence in Awramba and its neighboring communities in Wojiarbamba kebele, Fogera woreda, South Gondar zone, Ethiopia (November 2009 and April 2010)

	Number of study participants	Malaria positive cases		**Total n (%)**
		Awramba n (%)	Neighboring communities n(%)	
Male	213	6 (2.8)	21(9.9)	27(12.7)
Female	179	4 (2.2)	27(15.1)	31(17.3)
Overall total	**392**	**10(5.1)**	**48 (24.5)**	**58 (14.8)**

The parasite species detected were *Plasmodium falciparum* and *Plasmodium vivax*. The prevalence of *P. falciparum* and *P. vivax* was 12.8% and 1.8 % respectively. There was no significant difference in the prevalence of *P. falciparum* among different age groups of two communities (*p>0.05*). Similarly, there was no significant difference in the prevalence of *Plasmodium vivax* among all age groups (*p>0.05*) (Table 9). The prevalence of *P. falciparum* in neighboring communities is significantly higher than the prevalence in Awramba community. But, no significant difference was observed in the prevalence of *P. vivax* among the two communities (Table 8)

Table 8. Overall prevalence of malaria in Awramba and its the neighboring communities of Wojiarbamba kebele, Fogera woreda, South Gondar zone, Ethiopia (November 2009 and April 2010).

Study communities	No of participants	Parasites identified					
		Plasmodium falciparum			*Plasmodium vivax*		
		No. positive	Prev. (%)	P-value	No. positive	Prev. (%)	P-value
Awramba Community	196	8	4.1	0.00*	2	1	0.25
Neighboring Communities	196	42	21.4		5	2.6	
Total	**392**	**50**	**12.8**		**7**	**1.8**	

Key: - * -represents significant difference (P< 0.05)

P- value- comparing prevalence between the two study communities

In neighboring communities, all age categories showed higher proportion malaria infection prevalence as compared to Awramba community (Table 9). However, the difference was not significant (*p>0.05*) . In both Awramba and neighboring communities, infection prevalence of *P. falciparum* was significantly ($p<0.05$) higher than infection prevalence of *P. vivax*.

Table 9. Malaria prevalence in the Awramba and its neighboring communities by age group and parasite species in Wojiarbamba kebele , Fogera woreda, South Gondar zone, Ethiopia (November 2009 and April 2010).

Age group (yrs)	**Awramba community (n=196)**				**Neighboring community (n=196)**				**Total (n=392)**
	No. examined (%)	No. positive (%)			No. examined (%)	No. positive (%)			No positive (%)
		Pf	Pv	Pf & Pv		Pf	Pv	Pf & Pv	
1-5	17(8.7)	-	-	-	59(25.5)	10(20)	2(4)	-	12(3.1)
6-14	97(49.5)	3(3.1)	2(2.1)	-	31(15.8)	11(35.5)	1(3.2)	1(3.2)	18(4.6)
≥15	82 (41.8)	5(6.1)	-	-	115(58.7)	21(18.3)	2(1.7)	-	28(7.1)
Over all total	**196(100)**	**8(4.1)**	**2(1)**		**196(100)**	**42(21.4)**	**5(2.5)**	**1(0.5)**	**58(14.8)**

4.7. Prevalence of malaria and intestinal parasites among each 'Got's of neighboring communities.

Among the ten 'Got's of neighboring communities, both Timinda and Jibgudguad had high proportion (71.4%) of intestinal parasite prevalence and Wojiterara had high proportion of malaria parasite prevalence (31.3%). No significant difference was observed in malaria and intestinal parasites prevalence among each 'Got' of neighboring communities ($p>0.05$) (Table 10).

Table 10: Prevalence of intestinal parasites and malaria among study participants of neighboring communities from each 'Got' in Wojiarbamba kebele, Fogera woreda, South Gondar zone, Ethiopia (November 2009 and April 2010).

Name of 'Got'	**No of study participants**	**Intestinal parasites n=196**	**P-value**	**Malaria n=196**	**P-value**
		Prev. n(%)		**Prev. n(%)**	
Arbachan	22	15 (68.2)	(0.60)	6 (27.3)	(0.87)
Qurke	20	14 (70)		5(25)	
Jibgudguad	21	15 (71.4)	(0.78)	6(28.6)	(0.83)
Laydewol	12	8(66.7)		3(25)	
Wojiterara	16	11 (68.8)	(0.96)	5 (31.3)	(0.41)
Maksegn	25	17 (68)		5(20)	
Tizaba	23	16(69.6)	(0.89)	6 (26.1)	(0.86)
Timinda	21	15 (71.4)		5(23.8)	
Warsa	17	12 (70.6)	(0.89)	3 (16.7)	(0.79)
Dejmesk	19	13 (68.9)		4 (22.2)	
Overall total	**196**	**136(69.4)**		**48(24.5)**	

Key: - ***** - represents significant difference (P<0.05)

P-value – comparing prevalence of parasites between the two study communities

4.7. Anemia Prevalence

The mean serum hemoglobin concentration, as measures with Hemocue analyser was 13.34 $\pm$ 2.03 g/dl among Awramba community study participants and 12.6 $\pm$ 2.36 g/dl among neighboring communities participants. The overall prevalence of anemia in all study participants was 23.2% (Table 11). Less prevalence of anemia among Awramba community 37 (9.4 %) study participants than the neighboring community 54(13.8%) study participants showed statistical significant difference ($p<0.05$).

Table 11. Prevalence of anemia among different age groups of Awramba and its neighboring communities in Wojiarbamba kebele , Fogera woreda, South Gondar zone, Ethiopia (November 2009 and April 2010)

Age group	**Study communities**	**No samples examined**	**Anemic study participants n (%)**	**P-value**
1-5	Awramba	17	4 (23.5)	
	Neighboring	50	15(30.0)	(0.61)
6-15	Awramba	99	21(21.2)	
	Neighboring	31	12 (38.7)	(0.05)
>15	Awramba	80	12 (15)	
	Neighboring	115	27 (23.4)	(0.15)
Overall total	**Awramba**	**196**	**37 (18.9)**	
	Neighboring	**196**	**54(27.6)**	(0.04)*

Key - * -represents significant difference ($P< 0.05$)

P- value- comparing prevalence between the two study sites

No statistical significant difference ($P>0.05$) was observed in the prevalence of anemia in all age categories between Awramba community and neighboring communities (Table 11).

Table 12. Prevalence of different levels of anemia among Awramba and its neighboring communities in Wojiarbamba Kebele, Fogera woreda, South Gondar zone, Ethiopia (November 2009 and April 2010)

Level of anemia	Study communities	No examined samples	Anemic n (%)	**P-value**
Mild anemia (9-12gm/dl)	Awramba	196	34 (17.3)	(0.60)
	Neighboring	196	38 (19.4)	
Moderate (7-9gm/dl) to Severe (<7gm/dl)	Awramba	196	3 (1.5)	(0.041)*
	Neighboring	196	15(7.5)	

Key - * - represents significant difference (P< 0.05)
P- value- comparing prevalence between the two study sites

Moderate to severe anemia (Hgb less than 9 g/dl) prevalence showed significant difference (p<0.05) among Awramba 3 (1.5%) and its neighboring communities 15 (7.5%) study participants.

4.8. KAPs Survey

Of the total participants interviewed from the two study communities, malaria was mentioned as a health problem among 125 (63.8%) of Awramba community study participants and 158 (80.6%) of neighboring community study participants (Table 13). The proportion of participants who experienced malaria in the neighboring communities was significantly higher than Awramba community participants ($p<0.00$).

With regard to mode of malaria transmission, 159 (81.1%) of study participants from Awramba community and 102 (52%) of study participants from neighboring communities mentioned that malaria infection is transmitted through mosquito bites ($p<0.05$) (Table 13). Other misconceptions including drinking dirty water, body contacts, breathing or through sharing meals with a malaria patient were also suggested as ways of malaria transmission.

Stagnant water was mentioned by 132 (67.3%) of Awramba community and 83 (42.3 %) of neighboring communities respondents as breeding site of malaria vector. While others mentioned clean flowing water, under stone and dry area as possible breeding sites.

The most common malaria vector protection method mentioned by the study participants was using mosquito net. 132 (67.3%) of Awramba community study participants and 93(47.4%) of neighboring communities study participants use mosquito net to protect themselves from malaria vector (Table 13).

168 (85.7%) of Awramba community and 145 (74%) of neighboring communities study participant consult either government or private health centers for treatment when they are infected with malaria and intestinal parasites. Meanwhile, quite a few 3 (1.5 %) of neighboring community and none of Awramba community study participants consult the traditional local healers. Moreover, the rest 6(3.1%) from neighboring communities and 2(1%) from Awramba community respondents follow other type of health care system such as the use of herbal remedies in the treatment of malaria. For instance, they use *Zingiber officinale* 'zingibil',

Zehneria scabra 'Hareg-ressa', *Ocmium lamifolium* 'Damacassie', leaves of papaya (*Carica papaya*), *Ruta chalengenesis* 'Tenadam' and other remedies as home treatment (Table 13).

In relation with their perception towards the severity of malaria, 2(1%) of Awramba community and 73 (37.2%) of neighboring communities categorized a disease as ordinary disease. In contrast, participants from Awramba 158 (80.6%) were found to be better in categorizing malaria as serious disease if not treated than participants from neighboring communities 80 (40.8%) ($p < 0.05$).

103(52.6%) of Awramba community study participants and only 66 (33.7%) of neighboring communities study participants perceive that malaria control is the responsibility of all stakeholders, that is, the government, the community and private organizations.The remaining participants mentioned that malaria control is the responsibility of either government or private agencies only (Table 13 & Annex5).

Regarding environmental sanitation, significantly high proportion 102 (52%) of neighboring communities' study participants dispose home garbage on the open ground than Awramba community 12 (6.1%). Majority of Awramba community 149 (76%) dispose their home garbage by burning than the neighboring communities 38(19.4%). More than three–fourth 175(89.3%) of Awramba community study participants had their own toilet. But, among the neighboring communities, only 72 (36.7%) of the study participants had their own toilet. High proportion 115 (58.67%) of Awramba community study participants use toilet as compared to 75(38.3 %) of the study participants in neighboring communities (Table 13 & Annex 5). The difference in environmental sanitation appears to parallel the prevalence of intestinal parasites.

Significant difference was also seen on their knowledge about mode of transmission of intestinal parasites. Majority of Awramba community study participants had better knowledge about the mode of transmission of intestinal parasites than neighboring community study participants. High percentage 59(30.1%) of neighboring communities study participants never wear shoe than Awramba community study participants 2(1%).

Of the interviewed participants about hand washing habit before meal and after toilet, 164 (83.7%) of Awramba community and 115 (58.2%) of neighboring communities study participants wash their hand usually (Table 13). This could be related with high prevalence of soil transmitted helminths among Awramba community than neighboring communities. On the other hand, significant difference ($p<0.05$) was seen in eating of vegetables without proper washing and cooking among Awramba community 97(49.5%) and neighboring community study participants 134(68.4%).The consumption of raw meat in neighboring community 84 (42.8%)is significantly higher than Awramba community33 (16.8%) ($p<0.05$) (Table 13).

Table 13. Knowledge, attitude and practice on malaria and intestinal parasites among Awramba and its neighboring communities in Wojiarbamba Kebele, Fogera woreda, South Gondar zone, Ethiopia (November 2009 and April 2010)

KAP about	Awramba community n=196 n(%)	Neighboring communities n=196 n(%)	Total n=392 n(%)	P-value
●Malaria as health problem	125(63.8)	158(80.6)	283(72.2%)	(0.00)*
●Mode of malaria transmission by mosquito bite	159(81.1)	102(52)	261(66.6)	(0.00)*
●Stagnant water as a breeding site of mosquito	132(67.3)	83(42.3)	215 (54.8)	(0.00)*
●Protection of malaria vector by mosquito net	132(67.3)	93(47.4)	225 (57.4)	(0.00)*
●Consulting health centers when infected with malaria and intestinal parasites.	168(85.7)	145(74)	313(79.8)	(0.00)*
●Consulting traditional healers when infected with malaria and intestinal parasites	-	3(1.5)	3 (0.8)	(0.08)
●Using herbal remedies as malaria treatment	2(1)	6(3.1)	8 (2)	(0.15)
●Malaria as a sever disease if not treated	158(80.6)	80(40.8)	238 (60.7)	(0.00)*
●The responsibility of malaria control is all stake Holders	103(52.6)	66(33.7)	169 (43.1)	(0.00)*
●Disposing home garbage on open ground	12(6.1)	102 (52)	114 (29.1)	(0.00)*
●Attending health education usually	115 (58.7)	75 (38.3)	190 (48.5)	(0.00)*
●Disposing home garbage by burning	149(76)	38(19.4)	187 (47.7)	(0.00)*
●Possessing toilet	175(89.3)	72(36.7)	247(63)	(0.00)*
●Using toilet to dispose stool	158(58.7)	43(38.3)	190 (48.5)	(0.00)*
●Not wearing shoe	2(1)	59(30.1)	72 (18.6)	(0.00)*
●Washing hand before meal and after toilet usually	164(83.7)	115(58.2)	278 (70.9)	(0.00)*
●Consuming vegetables with out proper washing and cooking	97 (49.5)	134(68.4)	231 (58.9)	(0.00)*
●Consuming raw meat	33 (16.8)	84(42.8)	117(29.8)	(0.00)*

Key: * - represents significant difference (P<0.05)

P-value – comparing prevalence of parasites between the two study communities

4.9. Study area survey

Wojiarbamba kebele consists of twenty seven local villages called "**Got**". "Turign" is one of the 'Gots' where Awramba community is found. All the "Got"s are categorized under rural areas. Since this study included both members of Awramba community and neighboring communities, half of the study participants were selected from Turign "Got" whereas the remaining half of the study participants were randomly selected from the remaining local villages or "**Got**"s.

Awramba community lives in a small village with clustered settlement. Most houses of Awramba community are made up of corrugated iron top and mud wall reinforced with wood and some others are made up of thatched grass top and mud wall reinforced with wood (Fig 4). Some of neighboring communities have houses similarly constructed as in Awramba community.

Fig 4. An overall view of Awramba community village, Turign Got, November 2009- March 2010. (A picture taken by an investigator)

An attempt was made to assess proper usage of mosquito net (ITN) in the two communities. With regard to this, most of Awramba community use mosquito net properly to protect themselves from mosquito bite (Fig 5). In most houses, there are ITN suspended over their beds. No one, in Awramba community, was found using mosquito nets for other purposes. But, in neighboring communities, even though each household has mosquito nets, only few households were observed using nets properly. During the survey, many individuals of neighboring communities in Wojiarbamba kebele were observed using the mosquito nets for other purpose such as for straw ("Geleba") transportation, as hair cover, for rope ("mechagna"), to cover different crops such as maize and barley (Fig 6 & Fig 7).

Fig 5. Mosquito nets in rental bedrooms and houses of Awramba community, Turign Got, November 2009- March 2010. (A picture taken by an investigator)

(A) (B)

Fig 6. Improper usage of mosquito net as wood cover (A) and straw cover (B) in Woji small village, Maksegn Got, November 2009- March 2010. (A picture taken by an investigator)

Fig 7. Straw "*Geleba*" covered with mosquito net in Woji small village market, Maksegn Got, November 2009- March 2010. (A picture taken by an investigator)

During survey, it has been observed that most houses of Awramba community were clean and with good looking. But, in contrast to this, I saw many houses of neighboring community unclean or dirty (Fig 8). Most households of Awramba community have well organized and clean kitchen.

(A) (B)

Fig 8. Dirty internal appearance (A) and improper hanging of mosquito net (B) in some houses of neighboring communities in Arbachan 'Got', November 2009- March 2010. (A picture taken by an investigator)

In Awramba village, there are many dirt baskets. Most of the community members use these baskets to drop home garbage (Fig 9).

Fig 9. Dirt basket in Awramba community village, Turign Got, November 2009- March 2010. (A picture taken by an investigator)

Most members of Awramba community have their own toilets which are constructed very far from their resident houses (Fig 10). Most of toilets have water to wash hand after defecation. The toilets are constructed from thatched top and wood wall. In neighboring communities, there were only few toilets which also are not constructed well and are unhygienic as a result of which most residents defecate on open grounds (Fig 11), contaminating the environment.

(A)

(B)

Fig 10. Internal appearance of Awramba community toilet (A) and a group of Awramba communities toilets that are constructed far from the residence houses (B), Turign Got, November 2009- March 2010. (A picture taken by an investigator)

Fig 11. A toilet in neighboring community, Maksegn Got, November 2009- March 2010. (A picture taken by an investigator)

For Wojiarbamba kebele, there are health extension workers that provide health education concerning HIV, malaria, tuberculosis and other communicable diseases. They also diagnose malaria by RDT and provide vaccination for children. In Awramba community, the health extension worker usually provides health education on Tuesday on their work place. Most members of the community follow the health education.

There are some differences between Awramba community and neighboring community in infrastructure. Almost all houses of Awramba community have electricity, common tap and hand pump water, small clinic and telephone services etc.

5. Discussion

This study investigated prevalence, risk factors and awareness about malaria and intestinal parasitic infections among Awramba and the neighboring communities. It was hypothesized that Awramba community would be at a lesser risk for malaria and intestinal parasites compared to the neighboring communities since their environmental and hygiene consciousness would in relative terms, protect them from exposure to different sources of infection.

The prevalence of malaria among the study population of neighboring communities (24.5%) was significantly high compared to the findings of the National Malaria Indicator Survey (4%) (MOH, 2007); from that of Shargie *et al.* (2008) in Oromia and SNNPR regions (2.4%), and that of Endeshaw *et al.* (2008) from Amhara Regional state (4.6%). However, malaria prevalence in Awramba community (5.1%) was not much different from the findings of the above studies. The overall malaria prevalence (14.8%) in Wojiarbamba kebele, however, was closer to the prevalence (10.5%) among the population in south west Ethiopia (Deribew *et al.*, 2010). The high overall prevalence of malaria indicates that the burden of malaria is still high in different parts of the country in spite of the dramatic decrease in malaria prevalence the modeling on trends of health and health related indicators predicted over the last decade (Abraha and Nigatu, 2009). The local variation in malaria prevalence in Ethiopia is further complicated by the focal variation documented in this study whereby the prevalence was significantly higher in the neighboring communities compared to Awramba.

The prevalence of intestinal parasites in Awramba community (18.9%) and neighboring communities (69.4%) was lower than the findings that were reported from residents of four villages in southwestern Ethiopia (82.7%) by Yeneneh (1994). However, the finding in neighboring communities is comparable to Kloos *et al* (1991) (65%) from the study conducted among indigenous people in three resettlement farms of western Ethiopia and Dagnew *et al* (1993) (61%) from the study conducted on small farming village, near lake Tana, Ethiopia. The variation in prevalence could be owing to differences environmental and personal hygiene, geographical location and climatic conditions influence parasite prevalence. The significantly higher prevalence in the neighboring communities than in Awramba community can be accounted for the predisposing factors to parasite infection that were revealed by the KAP study for in the neighboring communities. These included the poor personal and environmental hygiene, the relatively low level of education, poor dwelling conditions, the low level of awareness about mode of transmission and prevention of intestinal parasites.

The prevalence of human giardiasis in the present study (4.3%) was relatively higher than the prevalence reported by Fontanet *et al.* (2000) (3%) among residents of Wonji sugar estate, Ethiopia and the findings of Birre and Erko (1995) (3.1%) in different parts of Ethiopia. The prevalence was also lower than the findings of Teklehaymanot (2009) (10.7%) in lower Omo Valley, Southwestern Ethiopia. The variation between the present and previous study findings might be due to variation in the quality of drinking water source, and variation in the environmental condition of the different study localities. *Entamoeba histolytica/dispar* and *G.lamblia* are environmental contaminants of drinking water supplies. They can be transmitted by drinking infected water and by consuming contaminated vegetables (Nasiri *et al*., 2009).

The prevalence of *Cryptosporidium* spp. in Awramba community (2.6%) and neighboring communities (1%) was lower than the findings of Adamu *et al*. (2010) (7.6%) among study participants from different locations of Ethiopia. In the present study, the prevalence of cryptosporidiosis in Awramba community was not significantly higher than neighboring communities ($p>0.05$). Low prevalence of *Cryptosporidium* infection among the study participants might be associated with the source of drinking water. Majority of Awramba community uses tap water where as majority of neighboring communities uses hand pump water which is treated with chlorine usually.

The prevalence of hookworm infection in Awramba community (5.1%) and neighboring communities (17.3%) was lower than the findings previously reported from different regions of Ethiopia by Birrie *et al*. (1997) (20%) among the current residents of future Finchaa sugar plantation area and Woldemichael *et al.* (1999) (53.1%) among village residents of western Abaya. The rate was also higher than the findings of previous school-based study by Haile *et al.* (1994) (0.3%) and the finding by Teklehaymanot (2009) (3.5%) in semi pastoralist tribes in lower Omo Valley, Southwestern Ethiopia. The prevalence in Awramba community was significantly lower than neighboring communities ($p<0.05$). The high proportion of hookworm infection among neighboring communities could be explained by the fact that majority study participants in a community have no shoe wearing habit as compared to Awramba, resulting in higher exposure to infective egg and filariform larvae in the soil. The fact that hookworm infections were highly prevalent in the study population is a matter of serious concern as hookworms could be responsible of chronic anemia.

In agreement with a nation-wide study conducted on ascariasis in Ethiopia by Tedla and Ayele (1986) and the finding among village residents of western Abaya by Woldemichael *et al.* (1999) (10%), the study showed relatively low prevalence of ascariasis (9.4%) among study participants found in Wojiarbamba kebele. On the other hand, the study undertaken by Zein and Assefa

(1985) among farming cooperatives in Gondar region showed an over all prevalence rates of 31.8% ascariasis which is higher than this study. This variation in the distribution of *A. lumbricoides* most probably is an indication of the variations in the local environments with regard to soil type, temperature, etc., that determine the transmission of the parasite.

The rate of *Trichuris trichiura* prevalence in this study (2.8%) was relatively lower compared to finding among small farming village, near lake Tana, Ehiopia (5.7%) (Dagnew *et al*., 2005) and findings of semi-pastoralist tribes in lower Omo Valley, Southwestern Ethiopia by Teklehaymanot (2009) (16 %). The rate was also relatively lower compared to the other previous studies by Yeneneh (1994) (13, 9%) from residents of four villages in southwestern Ethiopia and Kloose *et al.* (1991) (6.2%) from the study conducted among indigenous people in three resettlement farms of western Ethiopia.

A. lumbricoides, T.trichiura and hookworms, as soil-transmitted helminths, are closely associated with poverty, crowding, poor sanitation, poor personal hygiene and poor awareness of health **(**Rodina and Teodorescu, 2002**)**. The prevalence of soil transmitted helminthes in neighboring communities was higher than Awramba community. This could be due to the poor personal hygiene and poor health awareness of neighboring communities as revealed by KAP study in neighboring communities.

Even though no schistosoma parasite was identified in Awramba community, the prevalence of *S. mansoni* in the neighboring communities (2.6%) was found to be higher than the reports of Teklehaymanot (2009) (1%) among rural residents of lower Omo valley, Southwestern Ethiopia. The prevalence rates in this study were lower than the findings of Birre *et al.* (1993) (12.4%) among rural residents of Fincha river valley, Western Wellega, Ethiopia and Woldemichael *et al.*

(1999) (4.1%) among village residents of western Abaya. A possible reason for difference in prevalence figure might be associated with difference in awareness of the study participants, unhygienic habits and behavior of study participants towards water body.

The prevalence rate of *Strongyloides stercoralis* in the present study (0.2%) was relatively low as compared to the findings reported by Tesfa -Yohannes *et al* (1988) (13.8%), by Woldemichael *et al.* (1999) (2.8%) among village residents of western Abaya and the findings by Yeneneh (1994) (2.1%) among residents of four villages in Southwestern Ethiopia. This difference could be explained by the fact that Strongyloidiasis prevalence rate depends on the environmental safety conditions, quality of housing, socio-economic status, standards of hygiene in the community. etc (Alzain, 2006). The rarity of Strongiloides is perhaps because of the difficulty of detecting them in stool specimen.

The prevalence of intestinal parasitic infections was higher in females than males, in the findings of a study in school based study of southwestern Ethiopia (Ali *et al*, 1999) and in a study in Tigray, Northern Ethiopia (Dejenie and Asmelash, 2010). As in those studies, differences between the two sexes were not observed in the overall prevalence of intestinal parasites in this study. This denotes a similar exposure risk of males and females to infection by intestinal parasites.

The prevalence of multiple infections (polyparasitism) (12%) does not agree with a study done in urban dwellers of southwest Ethiopia portraying a polyparasitism of 68.3% among study participants (Mengistu *et al*.(2007). On the other hand, the prevalence of multiple infections was higher compared to the previous studies (Kloos *et al*., 1980; Lo *et al*., 1989).

The prevalence of helminth infection was higher than that of protozoan infection in both communities. This suggests that soil transmitted helminthic parasitic infections are very common among community members in Wojiarbamba kebele, which reflects the poor sanitary conditions and poor health awareness existing in the area.

Anaemia remains a widespread public health problem with major health, social and economic consequences and is often used as a screening test for iron deficiency (Umeta *et al.,* 2008). It is multifactorial in origin and remains the major public health problem especially of children and pregnant women in Africa (Crawley, 2004) and in Ethiopia in particular (Getahun *et al*., 2001). The estimated overall prevalence of anemia in the population of sub-Saharan Africa is 36 % and an estimated 37 % of school age children are affected (WHO, 1992). About 30% of the world population is anemic (Agbolade *et al*., 2009).

The overall prevalence of anemia (23.2%) in the study area was not much lower than the finding by Deribew *et al.* (2010) (34.2%) malaia vulnerable groups, southwest Ethiopia and Umeta *et al.* (2008) (30.4%) among women of reproductive age in nine administrative regions of Ethiopia**.** It is however to be noted that higher rates have been reported from different parts of Ethiopia by different investigators. For instance, Zein (1991) had reported (47.2 %) from Northern Ethiopia, Iannotti, *et al*. (1998) from Ijaji Oromiya 47 % and Adish *et al*. (1999) from Tigray 42%. Nevertheless, the prevalence of anemia in Awramba community was significantly lower than in the neighboring communities of the Wojiarbamba kebele ($P<0.05$).The dramatic decrease of anemia prevalence from time to time might be associated with the overall improvement of adequate prevention and treatment of anemia. Nowadays, appropriate approaches to prevent anemia are launched for the primary causes of anemia in a population. Therefore, the integrated malaria control programs such as, control of the mosquito vector, use of chemotherapeutic agents and control using insecticides are strengthened from time to time to reduce the high level of anemia. Anti-helminthic treatments are seriously considered to protect the population from exacerbation of anemia by intestinal helminths infections. Awareness creation through health education is also improved.

Because it is difficult to know the exact cause of anemia among the study participants, the etiology of anemia is complex and multi-factorial in origin. Parasitic diseases, including malaria and helminth infections, have long been recognized as major contributors to anemia in endemic countries (Brooker *et al*., 2007). Several studies have identified malaria as the primary cause of anemia, while other studies cite an iron deficient diet as an important cause (Tatala *et al*., 1998). The major staple diet in the study area is "*teff*" (*Eragrosis teff*), a cereal which has high iron content mainly due to contamination with the soil (Wolde-Gebriel *et al*., 1993). Therefore, iron deficient diet can not be taken as a primary cause of anemia for this study.

Recent meta-analyses of malaria intervention trials among African children provide compelling evidence that both symptomatic and asymptomatic malaria contributes substantially to anemia in endemic regions (Brooker *et al*., 2007). In Ethiopia, Gebre and Negash (2007) had suggested that anemia is an important cause of morbidity and probably mortality in patients with acute *Plasmodium falciparum* infection.

Furthermore, it has been shown that the presence of parasitic infections such as hookworm and *S.haematobium*, have the innate tendency to elicit anemia in humans (Gu *et al.*, 2002; Wolde-Gebriel *et al*, 1993; Haidar *et al*., 1999). Intestinal parasitic infections cause anemia through loss of nutrients, decreasing appetite, decreasing efficiency of absorption, and competition for nutrients (Haidar, 2010). Therefore, the multiple effects of parasitic infections among study participants with parasites might have contributed to high occurrence of anemia in the study area especially in the neighboring communities than Awramba.

Majority of study participants in Awramba community knew that malaria is a serious disease for all age groups than the study participants in the neighboring communities. The finding in Awramba was in agreement with the report by Legesse and Deressa (2009) in that 81% of rural residents in the highlands of central Ethiopia know that malaria is a serious disease. This might be due to high level of knowledge that they have got from the health education.

A considerable number of the study participants in the neighboring communities showed lack of clear knowledge about the spread of the disease. Among those individuals who knew that malaria could be transmitted from person-to-person, a considerable number of them wrongly believed that the disease could be transmitted from a malaria patient to another person in several ways other than mosquito bite. This was supported by the report of Deressa and Ali (2009) that showed the misperceptions perceived as a cause of malaria such as consuming wet corn, sleeping together with a malaria patient, hunger and exposure to unhygienic surroundings. Another study, in Ghana, also reported that malaria is presumed to be caused as a result of excessive heat and eating oily or starchy food (Agyepong and Manderson, 1994). The wrong perception among the high proportion of study participants from neighboring communities could be due to lack of knowledge about the mode of transmission of malaria. People's perceptions and understandings about the perceived cause and the mode of transmission of malaria have strong implications on the use of preventive measures (Ahorlu, 1997).

In India, the misconception about the breeding site of malaria vectors was associated with lack of knowledge (Tyagi *et al*., 2005). Similar misconception prevailed more among the large number of respondents from neighboring communities than the respondents of Awramba community. Awareness about vector's breeding preferences should be created to control the malaria vector.

Even though the majority of Awramba and neighboring communities study participants preferred government and private health centers for treatment of illnesses, recourse to traditional healing was more common among the study participants from the neighboring communities. This is in agreement with report of a research done in rural highlands of central Ethiopia (Legesse and Deressa, 2009) whereby the use of traditional medicines such as garlic, butter, tobacco and other remedies for treatment and prevention of malaria was frequente. This could have a considerable impact on the treatment seeking behavior of the communities in the study areas.

Most study participants from Awramba and the neighboring communities were found possessing mosquito nets during the study survey since this measure was a newly adopted control strategy in Ethiopia. This is in agreement with the national malaria indicator survey carried out from October to December 2007 indicating that in areas below 2000 m, about 65% of the households owned at least one ITN (MOH, 2008)**.**

The practice of malaria prevention by participants is related to perception of the risk, their knowledge of the causes of malaria and its prevention measures (Agyepong and Manderson, 1999). Study participants from Awramba communities were better in the appreciation of the protective values of ITN than the neighboring communities against mosquito bite, which is reflected in the utilization of ITN by most members of neighboring communities. Such lack of awareness on the utilization of ITN was reported by Belay and Derassa (2008) in north Ethiopia suggesting the need for educating the community to improve the utilization of ITN for malaria control.

The impact of ITN distribution can be lost if vulnerable populations do not use the nets or re-purpose them (Kokwaro, 2009). Most of study participants in neighboring community were found using the mosquito net for other purposes during the survey. Such improper usage of ITNs has been shown to compromise malaria control programs in other countries. For instance, a study of fishing villages on Lake Victoria in Kenya reported bed nets being used for fishing and drying fish, with reasons given that the nets were inexpensive or free and allowed the fish to dry very quickly (Minakawa *et al.*, 2008).

Study participants from Awramba community had significantly low intestinal parasitosis as opposed to the neighboring communities. According to the results of this study, low level of education, life style and hygienic conditions of study participants were influential determinants of intestinal parasitosis. A study in Northwest Ethiopia, Chilga district suggested that the differences in prevalence of intestinal parasites among the different communities appear to be associated with environmental sanitation, water supply and socioeconomic status of households (Jemaneh, 2001). Other study in western Nepal also supports this in that the prevalence of intestinal parasitosis is associated with socio-economic status, dwelling condition, family size, sanitary disposal and toilet use, type of water supply for cooking and drinking and practice of personal hygiene and habits **(**Chandrashekhar *et al.,* 2005).

This study has provided evidence that the common practice of indiscriminate defecation and urination on the open grounds further increases the risk of significantly high parasite prevalence among neighboring communities.

A significantly lower prevalence rate of intestinal parasites ($p<0.05$) in Awramba community could be associated with the relatively high literacy rate and health awareness as compared with the neighboring communities as was evident from this study such association has also been reported from studies elsewhere (Chandrashekhar *et al*., 2005; Rabindranath *et al*., 2006; Ayeh-Kumi *et al*., 2009**).**

The consumption of vegetables without proper washing and cooking in the two communities was highly associated with intestinal parasite prevalence in this study. Similar study in Nepal had shown the association of knowledge of green vegetable consumption and intestinal parasite prevalence (Raji *et al*., 2001). In a study from Ghana, The very common consumption of fresh vegetables among food vendors was shown to increase the risk of intestinal parasite infection in the population (Ayeh-Kumi *et al*., 2009)**.**

Contamination of the hands enhances the transmission of gastrointestinal infections. The proportion of study participants that wash their hands before meal and after toilet in this study (70.9%) was relatively lower than the findings (98.8%) reported by Vivas *et al*. (2010) among school children in Angolela, Ethiopia indicating need for standardization of health education in the country. According to Andargie *et al*. (2007**)** inadequate hand washing after defecation was one of major causes for intestinal parasite prevalence among the study participants from Gondar**.** Significant numbers of study participants from neighboring communities do not wash their hands before eating meals than study participants from Awramba community. *A. lumbricoides, T.trichiura* and hookworms, as soil-transmitted helminths, are closely associated with poor sanitation, crowding, and poverty (Brooker *et al*., 2007). Therefore, in the present study, poor sanitation and poverty might contribute for high prevalence of soil transmitted helminths among neighboring community .

The percentage of study participants that wear shoe in this study was lower than the rate reported by Tadesse (2005) (95.7%) among school children in Babile town, eastern Ethiopia but comparable with the finding of a study that was done among school children in Southern Ethiopia (46.3%) (Erosie *et al*., 2002). Higher percentage of Awramba community study participants wear shoes than neighboring communities, which appears to be associated with the relatively higher level of health awareness and better economic standing. Thus, the high prevalence of hookworm infection in neighboring communities is associated with the exposure of individuals to paddy fields infected with infective larvae.

Health extension workers are responsible for explaining and promoting disease prevention and control, family health, hygiene and environmental sanitation, health education and communication. They conduct home visits and outreach services to promote preventive actions (FMOH, 2007). High proportion of Awramba community attends health education than neighboring communities. This shows that Awramba community has better awareness towards health education than neighboring community.

6. Conclusion and Recommendations

➢ Conclusions

The following conclusions can be drawn from the present study on the prevalence of parasitic infections and the level of community awareness in Wojiarbamba kebele.

- ✓ Significantly higher prevalence of malaria and intestinal parasites was observed in the neighboring communities as compared to Awramba.
- ✓ An increased prevalence of intestinal parasites in the neighboring communities was associated with factors such as lifestyle, lack of awareness about parasite transmission, indiscriminate defecation by the inhabitants, absence of well constructed toilets, poor sanitation, poor personal hygiene and high illiteracy.
- ✓ The prevalence of intestinal helminth infections was higher compared to the protozoa.
- ✓ Anemia was more prevalent in the neighboring communities and it's level of prevalence was associated with parasite prevalence in the two communities.
- ✓ The relatively higher prevalence of hookworm infection detected among the neighboring communities was associated with low shoe wearing and defecation on open grounds.
- ✓ Awramba community had better knowledge, attitude and practice about the cause, mode of transmission, and prevention of malaria as well as intestinal parasite infections than the neighboring communities.

➢ Recommendations

In light of the high prevalence of malaria and intestinal parasites among the neighboring communities compared to Awramba:-

- ✓ Conditions must be facilitated for the neighboring communities to share experience with Awramba community on personal and environmental hygiene, toilet construction and usage and the relationship of the community to health extension workers.

- ✓ Positive changes such as covering open water sources, improving sanitary food and water storage, handling basic personal hygiene such as hand washing after using the toilet and before handling food, avoiding damping of household garbage into local rivers and streams as well as avoiding the frequent practice of defecating on the open grounds and near drinking water sources, can be accomplished through health education and promotion activities. Health workers should mobilize the neighboring communities to improve the health situation through health education related to personal and environmental hygiene.

- ✓ Educational interventions that create awareness must be provided so that personal protection from malaria through the use of ITN is effectively practiced particularly in the neighboring communities.

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Annex 1. Questionnaire

Date:__________
Code No________

This questionnaire is about socio-demographic health status of the community. It will help the researcher to find out study subject characteristics, knowledge, attitude and practice of the study subjects towards parasites. All information given in the questionnaire will be handled confidentially.

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

Part I

I-Study participant identification

Woreda: ________________________
Kebele: ________________________
Household number: ________________________
Age________________
Sex: Male ☐ Female ☐
Religion: Orthodox ☐ Protestant ☐ Muslim ☐ other____
Educational status: Illiterate ☐ Read and write only ☐
_____ Years of formal education others (Specify) _______

II- information about occupation of subject

Farmer ☐ Merchant ☐ Government employee ☐ Day worker ☐ Servant ☐ others (specify)…………………

III-Information about knowledge, attitude and practice towards parasitic diseases

1. Do you face malaria problem?

A. Yes B. No

2. If yes, what type of methods do you use in your home to prevent yourself from mosquito bite?

A. Use of mosquito net B. Use of mosquito mat

C. Use of insecticides D. Use of fan only

E. Just covering of bodies with sheets

3. Malaria can be transmitted from person to person

A. Yes B. No

4. Malaria is transmitted by

A. Mosquito bite B. Housefly bite C. Drinking of dirty water D. Due to sins

E. No idea F. Other (specify)……………………

5. Where do you think that Malaria vector breeds in?

A. Dirty stagnant water B. Clean stagnant water

C. Dirty flowing water D. Clean flowing water E. No idea

6. When infected with malaria and intestinal parasite parasites you consulted to--

A. Govt. health centers B. Private clinics C. Both Govt. health centers and private clinics C) Traditional healers D) others specify---- E. Do nothing

7. According to you, malaria is a/an

A. Ordinary disease B. Serious disease if not treated in time C. No idea

8. According to you, malaria control should be carried out by the

A. Govt. agencies only B. Private agencies C. Public D. all E. No idea

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

A) Usually B) Sometimes C) Never

10. Where do you eliminate your stool?

A-In toilet B- Open ground C-Both D-No idea

11 Do you have your own toilet?

A. Yes B. No

12. How do you use drinking water?

A-By boiling B- By filtering C- With out treatment D- Other (specify)…..

13. What is you source of drinking water?

A-Stream B –open well C -hand pump water D-River E-Tap water F) Tap water hand pump water

14. How do you dispose home garbage?

A-Burn B- open ground C-River or ravine D-Bury E) Burning and Burying

15. Do you eat green vegetable with out proper washing and cooking?

A. Yes B. No

16. Do you wear shoe while you walk?

A) Usually B) Sometimes C) Never

17. Do you wash your hand before eating?

A) Usually B) Sometimes C) Never

18. Do you eat raw meat?

A) Yes B) No

Annex 2. Written consent form

Code No____________

Name of the study participant________________________Age_______Sex__________

Name of Physician_________________________Study site/Health center______________

I have been informed about a study that plans to investigate the "**Comparative assessment of malaria and intestinal parasitie prevalence and community awareness in Awramba and neighboring community in Wejiarba amba Kebele, South Gondar Zone**" which helps in understanding the prevalence of parasitic infection in relation with knowledge, attitude and practice of different communities towards parasitic disease. At the same time, it enables concerned body in designing better control and preventive measures of parasitic diseases in the study.

For this study, I was requested to give stool sample for intestinal parasites identification and blood sample for malaria parasite identification and status of anemia test by determining the level of hemoglobin. I was informed that I will get proper therapy if I found to be positive for any malaria and intestinal parasites. The investigator has also briefed me that there would no health related risks associated with the sampling procedure. He also informed me that all laboratory results would be kept in secret. Moreover, I was clearly informed that my participation in this study is completely voluntary and I have right to withdraw from participating in this study and in so doing there will be no impact on the overall management of my conditions. Refusal to participate will not result in loss of medical care provided or any other benefits. I was given enough time to think over before I signed this informed consent. It is therefore; with full understanding of the situation that I gave informed consent and cooperate at my will in the course of the study.

Name (participant)_____________________________Signature____________Date__________

Name (Wittiness)_______________________________Signature ________ Date_________

Name (Investigator)_____________________________Signature _________ Date ________

Annex 3. Malaria parasite distribution among the study subjects by sex, age, and community and stage of parasite in Wojiarbamba kebele, 2009/10 (N=392).

No	Slide No	Sex	Age	Comunity	Parasite type
1	Aw-165	M	26	Awramba	*P.falciparum*
2	Aw-166	M	16	Awramba	*P.falciparum*
3	Aw-173	F	19	Awramba	*P.falciparum*
4	Aw-175	F	18	Awramba	*P.falciparum*
5	Aw-181	F	14	Awramba	*P.falciparum*
6	Aw-186	M	45	Awramba	*P.vivax*
7	Aw-189	M	10	*Awramba*	*P.falciparum*
8	Aw-191	M	40	Awramba	*P.falciparum*
9	Aw-193	M	6	Awramba	*P.falciparum*
10	Aw-196	M	11	Awramba	*P.vivax*
11	Al-024	M	24	Non Awramba	*P.falciparum*
12	Al-023	F	40	Non Awramba	*P.falciparum*
13	Al-028	M	6	Non Awramba	*P.falciparum*
14	Al-031	M	42	Non Awramba	*P.falciparum*
15	Al-036	M	9	Non Awramba	*P.falciparum*
16	Al-037	F	50	Non Awramba	*P.falciparum*
17	Al-038	F	4	Non Awramba	*P.vivax*
18	Al-044	F	14	Non Awramba	*P.falciparum*
19	Al-045	F	28	Non Awramba	*P.falciparum*
20	Al-047	M	25	Non Awramba	*P.falciparum*
21	Al-048	M	20	Non Awramba	*P.falciparum*
22	Al-054	F	8	Non Awramba	*P.falciparum*
23	Al-058	F	14	Non Awramba	*P.falciparum*
24	Al-059	F	30	Non Awramba	*P.falciparum*
25	Al-064	F	40	Non Awramba	*P.falciparum*
26	Al-068	M	67	Non Awramba	*P.falciparum*
27	Al-070	F	25	Non Awramba	*P.falciparum*
28	Al-072	F	2	Non Awramba	*P.falciparum*
29	Al-073	M	4	Non Awramba	*P.falciparum*
30	Al-076	M	6	Non Awramba	*P.falciparum*
31	Al-080	F	25	Non Awramba	*P.falciparum*
32	Al-081	F	33	Non Awramba	*P.falciparum*
33	Al-082	M	10	Non Awramba	*P.falciparum*
34	Al-094	M	30	Non Awramba	*P.falciparum*
35	Al-095	F	33	Non Awramba	*P.falciparum*
36	Al-101	F	27	Non Awramba	*P.falciparum*
37	Al-104	F	11	Non Awramba	*P.falciparum*
38	Al-107	M	20	Non Awramba	*P.falciparum*

39	Al-109	F	9	Non Awramba	*P.falciparum*
40	Al-112	F	25	Non Awramba	*P.vivax*
41	Al-122	M	2	Non Awramba	*P.falciparum*
42	Al-132	M	4	Non Awramba	*P.falciparum*
43	Al-140	M	30	Non Awramba	*P.falciparum*
44	Al-146	F	2	Non Awramba	*P.falciparum*
45	Al-150	F	26	Non Awramba	*P.falciparum*
46	Al-153	M	25	Non Awramba	*P.falciparum*
47	Al-154	M	5	Non Awramba	*P.falciparum*
48	Al-161	F	50	Non Awramba	*P.falciparum*
49	Al-162	F	3	Non Awramba	*P.falciparum*
50	Al-163	M	4	Non Awramba	*P.falciparum*
51	Al-174	M	7	Non Awramba	*P.vivax*
52	Al-175	M	6	Non Awramba	*P.falciparum*
53	Al-181	M	4	Non Awramba	*P.vivax*
54	Al-185	F	2	Non Awramba	*P.falciparum*
55	Al-188	F	6	Non Awramba	*P.falciparum*
56	Al-195	F	54	Non Awramba	*P.vivax*
57	Al-130	F	6	Nonawramba	*P.vivax* & *P.falciparum*
58	Al-050	F	14	Nonawramba	*P.falciparum*

Annex 4. Intestinal parasites distribution among the study subjects by sex, age, and community and stage of parasite in Wojiarbamba kebele, 2009/10 (N=392).

No	Sample No	Sex	Age	Community	Parasite type	Remark
1	AW-002	M	33	Awramba	*Cryptosporidium spp*, Hookworm spp.	
2	AW-186	M	20	Awramba	*Enterobius vermicularis*	
3	AW-009	M	53	Awramba	Hookworm spp.	
4	AW-012	M	6	Awramba	*E.histolytica*	
5	AW-018	M	60	Awramba	*Strongyloid stercoralis*	
6	AW-020	M	13	Awramba	Hookworm spp	
7	$AW\text{-}023_1$	M	12	Awramba	*E.histolytica*	
8	AW-028	F	9	Awramba	Hookworm spp, *A.lumbericoids*	
9	AW-029	M	9	Awramba	*E.histolytica*	
10	AW-030	M	62	Awramba	Hookworm spp	
11	AW-033	F	7	Awramba	*A.lumbericoids*	
12	AW-036	M	4	Awramba	Hookworm spp, *A.lumbericoids*, *T.trichuria*	
13	AW-039	F	8	Awramba	*Giardia lamblia*	
14	AW-046	F	4	Awramba	*E.vermicularies*	
15	AW-049	M	10	Awramba	*E.histolytica*, *Giardia lamblia*	
16	AW-051	F	15	Awramba	*A.lumbericoids*	
17	AW-052	F	7	Awramba	*Cryptosporidium spp*	
18	AW-058	F	9	Awramba	*Cryptosporidium spp*	
19	AW-076	M	7	Awramba	*Giardia lamblia*, Hookworm spp	
20	AW-077	F	15	Awramba	*Cryptosporidium spp*	
21	AW-091	F	10	Awramba	*E.vermicularies*	
22	AW-093	F	30	Awramba	Hookworm spp,	
23	AW-101	M	9	Awramba	*Giardia lamblia*	
24	AW-104	F	55	Awramba	*E.histolytica*	
25	AW-106	F	46	Awramba	Hookworm spp	
26	AW-112	M	13	Awramba	*Cryptosporidium spp*	
27	AW-117	F	14	Awramba	*A.lumbericoids*	
28	AW-125	F	12	Awramba	*A.lumbericoids*	
29	AW-130	M	12	Awramba	Hookworm spp	
30	AW-142	F	16	Awramba	*A.lumbericoids*	
31	AW-002	M	33	Awramba	*A.lumbericoids*	
32	AW-072	M	35	Awramba	*A.lumbericoids*	
33	AL-001	F	2	Non awramba	*E.histolytica*, *A.lumbericoids*, *E.vermicularies*	
34	AL-002	F	48	Non awramba	*E.histolytica*	
35	AL-003	M	16	Non awramba	*E.histolytica*, *A.lumbericoids*	
36	AL-005	M	4	Non awramba	*Giardia lamblia*, *E.vermicularies*	
37	AL-006	M	10	Non awramba	*E.histolytica*, *A.lumbericoids*	

38	AL-007	M	30	Non awramba	*E.histolytica*, *Giardia lamblia*, Hookworm spp	
39	AL-008	M	4	Non awramba	*H.nana*	
40	AL-010	M	20	Non awramba	*A.lumbericoids*	
41	AL-98	F	13	Non awramba	Hookworm spp, *A.lumbericoids,E.vermicularies*	
42	AL-012	M	7	Non awramba	*E.histolytica*	
43	AL-014	M	56	Non awramba	*E.histolytica*, *T.trichuria*	
44	AL-015	M	30	Non awramba	*S.mansoni*	
45	AL-018	F	50	Non awramba	-	
46	AL-021	M	27	Non awramba	*T.trichuria*, *E.vermicularies*	
47	AL-009	M	18	Non awramba	*Giardia lamblia*	
48	AL-023	F	28	Non awramba	*S.mansoni*, *T.trichuria*	
49	AL-024	M	24	Non awramba	*A.lumbericoids*, *E.vermicularies*	
50	$AL\text{-}024_1$	F	13	Non awramba	*A.lumbericoids*	
51	AL-027	F	35	Non awramba	*A.lumbericoids*	
52	AL-028	M	6	Non awramba	*A.lumbericoids*, *E.vermicularies*	
53	AL-030	M	45	Non awramba	Hookworm spp	
54	AL-034	M	35	Non awramba	*E.histolytica*, *T.trichuria*, *E.vermicularies*	
55	AL-036	M	9	Non awramba	*A.lumbericoids*, *T.trichuria*	
56	AL-037	F	12	Non awramba	*E.histolytica*, *Giardia lamblia*	
57	AL-039	M	22	Non awramba	*S.mansoni*	
58	AL-038	F	4	Non awramba	*A.lumbericoids*, *E.vermicularies*	
59	AL-045	F	19	Non awramba	EH, *Giardia lamblia*	
60	AL-042	M	18	Non awramba	*Giardia lamblia*	
61	AL-048	M	25	Non awramba	*E.histolytica*, Hookworm spp	
62	AL-051	M	35	Non awramba	Hookworm spp, *E.vermicularies*	
63	AL-052	F	12	Non awramba	*Giardia lamblia*, *H.nana*	
64	AL-054	M	20	Non awramba	Hookworm spp	
65	AL-059	F	14	Non awramba	*A.lumbericoids*, *T.trichuria*	
66	AL-060	M	30	Non awramba	*E.vermicularies*	
67	AL-062	M	32	Non awramba	*E.histolytica & Giardia lamblia*	
68	AL-064	F	30	Non awramba	Hookworm spp	
69	AL-067	F	16	Non awramba	*H.nana*, *E.vermicularies*	
70	AL-070	M	67	Non awramba	*Giardia lamblia*	
71	AL-072	F	25	Non awramba	*Cryptosporidium spp*	
72	AL-073	F	2	Non awramba	*Giardia lamblia*, *A.lumbericoids*	
73	AL-075	F	35	Non awramba	Hookworm spp, *E.vermicularies*	
74	AL-076	M	4	Non awramba	*E.histolytica*	
75	AL-077	M	24	Non awramba	*E.histolytica*, Hookworm spp	
76	AL-078	M	40	Non awramba	*E.vermicularies*	
77	AL-080	M	6	Non awramba	*A.lumbericoids*	
78	AL-084	M	35	Non awramba	Hookworm spp, *A.lumbericoids*, *T.trichuria*	

79	AL-086	M	42	Non awramba	*E.histolytica*, *Giardia lamblia*	
80	AL-087	F	4	Non awramba	Hookworm spp, *A.lumbericoids*	
81	AL-091	F	20	Non awramba	*E.histolytica*	
82	AL-094	F	33	Non awramba	Hookworm spp	
83	AL- 152	M	10	Non awramba	Hookworm spp	
84	AL-103	M	42	Non awramba	*Giardia lamblia*	
85	AL-105	F	27	Non awramba	Hookworm spp	
86	AL-106	F	10	Non awramba	*A.lumbericoids*	
87	AL-110	F	17	Non awramba	*E.histolytica*	
88	AL- 111	F	20	Non awramba	*Cryptosporidium spp*, *E.vermicularies*, *A.lumbericoids*	
89	AL-112	F	9	Non awramba	*T.trichuria*	
90	AL- 115	F	25	Non awramba	Hookworm spp, *A.lumbericoids*	
91	AL- 117	M	4	Non awramba	Hookworm spp	
92	AL- 193	M	2	Non awramba	Hookworm spp	
93	AL-122	M	4	Non awramba	*A.lumbericoids*	
94	AL-8	M	8	Non awramba	*E.histolytica*	
95	AL- 186	F	30	Non awramba	Hookworm spp	
96	AL-129	F	37	Non awramba	*E.histolytica*, *A.lumbericoids*	
97	AL-132	F	14	Non awramba	*E.histolytica*	
98	AL-133	M	20	Non awramba	Hookworm spp, *A.lumbericoids*	
99	AL-134	M	14	Non awramba	*E.histolytica*	
100	AL-138	F	18	Non awramba	Hookworm spp,TT	
101	AL- 139	M	68	Non awramba	Hookworm spp	
102	AL- 140	M	30	Non awramba	Hookworm spp	
103	AL-144	F	17	Non awramba	Hookworm spp, *A.lumbericoids*	
104	AL-147	F	8	Non awramba	*E.histolytica*, *Giardia lamblia*, *A.lumbericoids*	
105	AL-152	M	50	Non awramba	*A.lumbericoids*, *S.mansoni*	
106	AL-156	M	12	Non awramba	Hookworm spp,*S.mansoni*,EV	
107	AL-157	M	6	Non awramba	*A.lumbericoids*	
108	AL-159	M	50	Non awramba	Hookworm spp	
109	AL-163	M	4	Non awramba	*A.lumbericoids*,TT	
110	AL-164	M	7	Non awramba	Hookworm spp	
111	AL-167	F	60	Non awramba	Hookworm spp, *A.lumbericoids*	
112	AL- 182	M	22	Non awramba	Hookworm spp	
113	AL-171	F	40	Non awramba	*E.histolytica*	
114	AL-173	F	32	Non awramba	*E.histolytica*	
115	AL-175	M	70	Non awramba	*E.histolytica*, Hookworm spp	
116	AL-176	F	30	Non awramba	Hookworm spp	
117	AL-189	F	6	Non awramba	*E.histolytica*	
118	AL-193	F	20	Non awramba	Hookworm spp	
119	AL- 195	F	54	Non awramba	Hookworm spp	
120	AL-141	F	6	Non awramba	Hookworm spp	
121	AL-188	M	4	Non awramba	Hookworm spp, *A.lumbericoids*	

Annex 5. Responses of study participants about their awareness and knowledge of malaria and intestinal parasites in Wojiarbamba kebele , Fogera woreda, South Gondar zone, Ethiopia (November 2009 and April 2010).

Queries	**Awramba community (n=196) No(%)**	**Neighboring community (n=196) No(%)**	**Total (N=392)**
-Did you face malaria problem?			
Yes	125(63.8)	158(80.61)	283(72.2)
No	71 (36.2)	38 (19.38)	109 (27.8)
- Malaria is transmitted by			
Mosquito bite	159(81.1)	102(52)	261 (66.6)
Drinking of dirty water	-	3(1.5)	3 (0.76)
No idea	31(15.8)	48(24.5)	79(20.1)
Other	6 (3.1)	43(21.9)	49 (12.5)
- Malaria vector breeds in			
Dirty stagnant water	132(67.3)	83(42.3)	215 (54.8)
Flowing water	7 (3.6)	20(10.2)	27 (6.9)
Other	3 (1.5)	13(6.6)	16(4.1)
No idea	40 (20.4)	50(25.5)	90 (22.9)
-When infected with malaria and intestinal parasites you consult			
Govt. health centers	123(62.8)	125(63.8)	248 (63.3)
Government and private health centers	45(23)	20(10.2)	65 (16.6)
Traditional healers	-	3(1.5)	3(0.8)
Other	2(1)	6(3.1)	8(2)
Do nothing	26(13.3)	42(21.4)	68 (17.3)
-What type of methods you used in your house to protect yourself from mosquito biting?			
Use of mosquito net	132(67.3)	93(47.4)	225(57.4)
Use of smoking	3(1.5)	12(6.1)	15 (3.8)
Use of insecticides	5(2.6)	3(1.5)	8 (2.0)
Covering of bodies with sheets	15(7.7)	25(12.8)	40 (10.2)
Do nothing	34(17.3)	59(30.1)	93 (23.7)
-According to you malaria is			
an ordinary disease	2(1)	73 (37.2)	75(19.1)
a serious disease if not treated in time	158(80.6)	80(40.8)	238(60.7)
No idea	36 (18.4)	43(21.9)	79 (20.2)

-According to you, malaria control should be carried out by the			
Govt. agencies only	60(30.6)	79(40.3)	139(35.5)
Public	3(1.5%)	6(3.1)	9(2.3)
Govt., private agencies & public	103(52.6)	66(33.7)	169 (43.1)
No idea	30(15.3)	45(23)	75 (19.1)
-Do you attend health education which is given by health extension worker?			
Usually	115(58.67)	75 (38.3)	190 (48.5)
Sometimes	30 (15.30)	20 (10.2)	50 (12.8)
Never	51 (26.02)	101(51.5)	152 (38.8)
- Where do you dispose your stool?			
In toilet	158 (80.6)	43 (21.9)	201(51.3)
Open ground	-	109 (55.6)	109(27.8)
Both	12(6.1)	9(4.6)	21 (5.4)
-Do you have your own toilet?			
Yes	175(89.3)	72(36.7)	247(63)
No	21 (10.7)	124 (63.3)	145 (37)
- How do you use drinking water?			
By filtering	-	3(1.5)	3 (0.8)
with out any treatment	170(86.7)	124(63.3)	294(75.0)
Other (specify)…..	3(1.5)	29(14.8)	32 (8.2)
No idea	23(11.7)	40(20.4)	63 (16.1)
-How do you dispose home garbage?			
Burn	149(76)	38(19.4)	187 (47.7)
open ground	12(6.1)	102(52)	114 (29.1)
River	-	4(2)	4 (1)
Bury	14(7.14)	3(1.5)	17 (8.67)
No idea	21(10.7)	49(25)	70 (17.9)
-Do you eat green vegetables without proper washing and cooking?			
Yes	97 (49.5)	134(68.4)	231 (58.9)
No	99 (50.5)	62(31.6)	161 (41.1)
-Do you wear shoe			
Usually	116(59.2)	53 (27.04)	169 (43.1)
Some times	78(39.8)	84 (42.8)	162 (41.3)
Never	2(1)	59 (30.1)	61 (15.6)
-Do you wash your hands before eating?			
Usually	164(83.7)	115(58.2)	279 (71.2)
Sometimes	27(13.8)	50(25.5)	77 (19.6)
Never	5(2.6)	31(16.3)	36 (9.2)
-Do you consume raw meat? Yes	33(16.8)	84(42.8)	
No	163(83.2)	112 (57.1)	

Declaration

I, the undersigned declare that this thesis is my own original work, has not been presented for a degree in any University and that all sources of materials used for this thesis have been dully acknowledged.

Name of the Candidate:

Gebeyehu Yihenew **Signature**________

Date 29 June 2011

This thesis has been submitted for examination with approval as University advisor

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1. **Prof. Beyene Petros** **Signature**________

Date 29 June 2011