The present status of *Schistosoma mansoni* infection and associated risk factors in Harbu Town, South Wollo Zone of the Amhara Region, Ethiopia

YIMER SEID HUSSEIN

MSc. Thesis

Addis Ababa

Ethiopia

August 2017

The present status of *Schistosoma mansoni* infection and associated risk factors in Harbu Town, South Wollo Zone of the Amhara Region, Ethiopia

A Thesis Submitted to the
School of Zoological Sciences, School of Graduate Studies
ADDIS ABABA UNIVERSITY

In Partial Fulfillment of the Requirements for the Degree of MASTER OF SCIENCE IN NATURAL SCIENCE (GENERAL BIOLOGY)

By
YIMER SEID HUSSEIN

August 2017

DEDICATION

This paper is dedicated to my beloved Father Seid Hussein Worku, who had given me unlimited aids and treated me with love and affection. Without his encouragement and contribution, accomplishing the work would have been too difficult.

ACKNOWLEDGMENT

First of fall, I am too pleased to thank God for giving me strength, and power and granting me hope, love, patience, blessing and also for his commitment and protection to me and my family throughout my postgraduate study.

My wonderful and deepest appreciation goes to my advisor, **Dr. Mekuria Lakew**, who advised me starting from the proposal preparation, research work and the final write-up and shaping of the Thesis. No words to mention for his management, very nice approach, admirable assistance and open information.

I honestly thank my brothers Ato Tadyos Zewdu and Yossef Zewdu for their strong moral and technical support. In the write up of this Thesis. I would like to extend my thanks to the laboratory technicians of Harbu Health Center, who helped me in collecting stool samples and screening them.

My deepest gratitude also goes to my family members, w/r Aster Zewdu, daughters Tigist Yimer, Dagmawit Yimer , my brothers Hassen Seid, and my sister Sofya Seid for their financial and moral support.

I thank the study participants and others who were directly or indirectly involved in this study whom I have not stated by name. My honest appreciation is extended to the Addis Ababa University School of Graduate Studies and Department of Zoological Sciences for its financial and technical support.

LIST OF ABBREVIATIONS

AOR	Adjusted Odds Ratio
CDC	Center for Disease Control and Prevention
CI	Confidence Interval
CSA	Central Statistical Agency
ELISA	Enzyme linked immuno sorbent assay
GPAQ	Global physical activity Questioner
IPIs	Intestinal Parasite Infections
KAP	Knowledge Attitude and Practices
MOA	Ministry of Agriculture
MOH	Ministry of Health
NTDs	Neglected Tropical Diseases
SPSS	Statistical Package for Social Sciences
WHO	World Health Organization

Table of Contents

Table page

LIST OF TABLES

Table Page

LIST OF FIGURES

Figure **page**

The present states of *Schistosoma mansoni* infection and associated risk factor in Harbu Town, South Wollo Zone of the Amhara region, Ethiopia

ABSTRACT

Schistosomiasis is a disease caused by a parasitic worm belonging to the genus schistosoma. It is a debilitating disease that over a long course infection could also kill some of the infected subjects. S. mansoni is one of the source that is transmitted by Bimophalaria pfeiffer and widely distributed all over Ethiopia. The prevalence of S. mansoni has been studied in Harbu and integrated intervention program were implemented in2002, since that no study has been made. It is to fill this gap the present study was designed to study the present status of S. mansoni infection and associated risk factors among neglected communities of Harbu town northeast Ethiopia. To that effect a semi structured questionnaire was administered to capture the socio-demographic and environmental factors that could influence the transmission of S. mansoni in Harbu and using data of Harbu health center diagnostic laboratory record that surveyed for six months (December2016 to May 2017), present status of S. mansoni infection was determined. Univariate and multivariate logistic regression models were used for data analysis. The result of socio-demographic study, for aware about transmission426,(71%) participant say no and only 174(29%) say yes, which showed that the public is still ignorant of the disease, whereas laboratory stool examination of Harbu health center showed that out of 600 subjects that were tested in the laboratory 131 (21.8%) were positive for S. mansoni . When categorized by age, relatively higher frequency of infection was found in age group 12-18 99(30.46%) followed by age group 5-11 years with 29(15.1%) and the rest 3(3.61%) were above 18 years old. Age Adjusted odd ratio (AOR) 1.767, 95% confidence interval (CI) 0.098-0.564, p= 0.004), other factor including lack of toilet and its improper use with (AOR 2.251, 95% CI 1.351-3.752, p=0.002),Swimming habit (AOR 2.496, 95% CI 0.778-8.003, p=0.049)and residence with AOR 2.251,95%CI 1.355-3.752,p=0.002) were found to be significantly associated with S. mansoni positivity. Over all the result showed that S. mansoni infection is a major health problem of people of Harbu and transmission is still in progress as infection of the new generation (12-18) followed by (5-11) is rating the highest frequency. This mean the earlier S. mansoni control program in Harbu Town were not sufficient to stop the spread of S. mansoni in Harbu. Therefore, it is the writer's opinion that prompt intervention strategies should be designed and implemented including provision of adequate safe water supply, regular deworming and health education on personal and environmental hygiene must be employed if the problem is to be tackled.

***Keywords**: Schistosomiasis, Harbu and S. mansoni.*

1. INTRODUCTION

Schistosomiasis is an acute and chronic parasitic disease caused by Threadworms of the family Schistosomatidae, genus Schistosoma. Eighteen species of the genus are known, out of which S. mansoni*, S. hematobiem. S. japonicum, S. intercalutum* or *S. guineensis* and *S. mekongi* are infective to man *(WHO 2017)*. These species differ according to their snail host, their final location in the permanent host, the clinical presentation, the pathogenesis and the immune responses (Abebe 2002). The first 3 are major human disease causing Schistosoma. *S. mansoni live* in the portal and mesenteric vessels and their eggs passed out with feces, while S. haematobium worms live in the renal vessels and their egg are voided with urine. The *S. japonicum* experience like *S. mansoni.*

The male *S. mansoni* is approximately 1cm long and 0.1cm wide, it has a funnel-shaped oral sucker at its anterior end followed by a second pre-decollated sucker. The female are a cylindrical body, longer and thinner than the males (1.2 to 1.6 cm long by 0.016cm wide), its color is darker and looks gray. They lyse the red blood cell to gain access to nutrients. *S. mansoni has* 8 pairs of chromosomes (homozygous male and heterozygous female). The worm prevent host immune defenses by tegument which coates the worm and antioxidant proteins which block the effect of superoxide. They require their intermediate host to complete their life cycle, the snail Bimophalaria which live in freshwater habitats are important for them to reproduce asexually (WHO 2014). Ones the egg of schistosomes reach in freshwater hatched and transformed into miracidia to find the snail and then one miracidium transformed into mother sporocysts which then give rise to second generation of sporocysts and then daughter sporocysts that able to transform to cercaria which released in to freshwater habitat and fined its definitive hosts. The overall steps of the life cycle of *Schistosomes* is shown on figure 1 below.

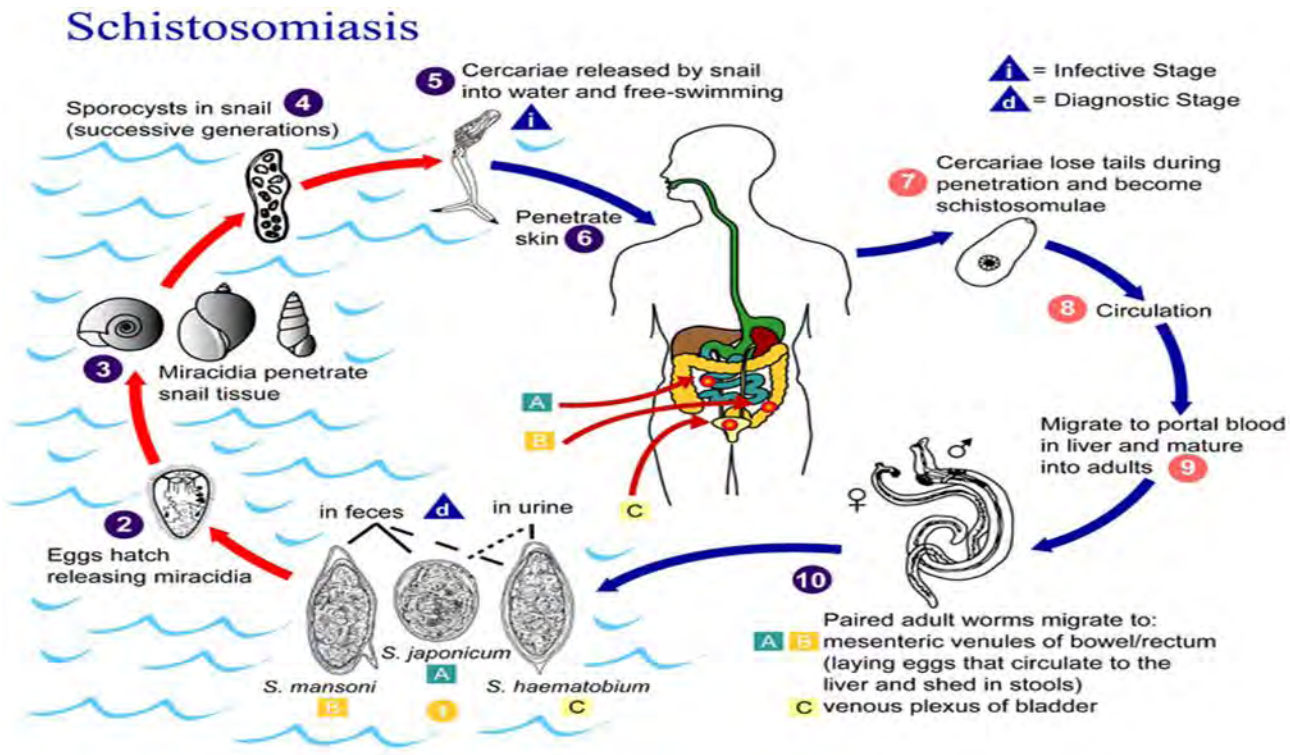

Figure-1. Schistosomes Species life cycle (source: CDC 2010)

There are 34 species in the genus Bimophalaria, of which 22 species are in America and 12 in developing world like Africa, from those 34 Bimophalaria species *(B. glabrata, B. pfeifferi, B. straminea and B. tenagophila*) have recently expanded their native ranges (WHO 2017). Schistosomiasis is one of the intestinal helminthic infections that strongly affect the human health in tropical countries of Africa, the Caribbean, Eastern South America, South East Asia and the Middle East. Schistosomiasis is one of the chronic infections disease that contribute to anemia, children's growth retardation, physical activity and cognitive function (WHO 2002). This likely makes it the most common parasitic infection second to malaria and causing about 207 million cases in 2013 (WHO 2006).

Schistosomiasis mostly affects poor and rural communities, particularly agricultural and fishing populations. Women doing domestic tasks in infested water, such as washing clothes, are also at risk. Access to "safe" water and "adequate" sanitation are emphasized as important measures for schistosomiasis control (Jack et al 2014). Migration to urban areas and population movements are

introducing the disease to new areas, inadequate hygiene and contact with infected water make children especially vulnerable to infection (WHO, 2017).

S. mansoni is widely distributed in Ethiopia (Tedla *et al.* 1998), the major transmitter of *S. mansoni B, Pfeiffer* has much wider distribution than the parasites. That means there is still a chance for the parasite to spread to new areas as the conditions for establishment are fulfilled such that enough infected persons from endemic areas, water development programs –irrigation system for agricultural development, Hydroelectric dam reservoirs and the likes. As shown by (Lakew. 1983) areas that have limitation of temperature if the other factors are fulfilled could have intense seasonal transmission in dry seasons, that is why it is over increasing and spread to new areas. That the number of known endemic localities for *S. mansoni* increase the abundance of snails and change in climate that optimize conditions for replication of the parasites has increased from less than ten % between 1930s and 1970s to some 45% in 2002 (Erko et al. 2002). The rate of its spread is increased fast to new foci of *S. mansoni* such as Wonji and Finchaa due to the introduction of irrigation system for sugar plantation activities (Kloos 1993, Birrie et al. 1994). The pattern of schistosomiasis prevalence in Tigray where it was highest in the long standing irrigated areas followed by the urban communities with water nearby and next in the newly constructed irrigated sites (Dejenie and Petros 2009). According to (Amsalu *et al* .2015) reports the disease is widely spread in different regions of the country including Maichew and Adwa, with introduction of water resource for irrigation and hydroelectric power. According to (Mulugeta et al .2015) *S. mansoni* was distributed with prevalence of 89.6%, in Wondo Genet, 59.9% Kemissie and 31.6% Sille-Elgo, of highest intensity of infection, comparable variation in the prevalence and intensity of infection among the study localities was documented (Erko et al.2002).

Yet, it is very well known that new foci for *S. mansoni* has been discovered patchily distributed here and there evidencing that it is still an ongoing public health problem which requires more attention at governmental level. Elsewhere in countries like China 1st 2nd and 3rd Phase has successfully been done with dramatic reduction in prevalence and intensity of infection was achieved on *S. japonicum* ,has animal reservoir (WHO, 2017), which is relatively difficult compared to *S. mansoni* are moved to eradication programs like wise Schistosomiasis control has been successfully implemented over the past 40 years in several countries, including Brazil, Cambodia, Egypt, Mauritius, Islamic Republic of Iran and Saudi Arabia (Marianette et al. 2017).. There is evidence that schistosomiasis transmission was interrupted in Morocco. In Burkina Faso, Niger, Sierra Leone and Yemen, it has been possible to

scale up schistosomiasis treatment to the national level and have shown observable impact on the disease in a few years (Marianette *et al*. 2014).

An assessment of the status of transmission is being made in several countries. In Ethiopia many intervention mechanisms were implemented on pilot program in different endemic area of *S. mansoni* like Kemise, Harbu, Bati and Wongi by mass treatment of society with praziquantel and by applying Endod-based intervention for snail killing (Erko *et al*. 2002). But was not continued for many years.

Although country wise investigation were conducted on Schistosomiasis distribution, the measures taken to control the disease were not adequate to make drastic change on the status. Effective control of the disease requires monitoring of its current prevalence and eliminates the transmission foci and factors that contribute for the spread of the disease. Therefore, this study was conducted in order to determine the status of *S. mansoni* infection among communities of Kalu wereda Harbu Town Northeast Ethiopia that had control programs implemented in1998 (Erko *et al*. 2002).

1.1. Objectives

1.1.1. General objectives

To determine the status of *S. mansoni* infection and describe the risk for its spread in Harbu.

1.1.2. Specific Objectives

-To determine the present status of *S. mansoni* among patients in Harbu Town, based on data from Harbu Health Center stool diagnostic laboratory result.

-To evaluate the states of socio demographic and environmental factors related to the risk of exposure to *S. mansoni.*

-Based on the findings to suggest control strategies.

2. LITERATURE REVIEW

2.1. Schistosoma overview

Schistosoma is a genus name that belong to the Class trematoda of phylum Platyhelminthes which are parasites of humans and animals. There are liver, lung, gut, and blood fluke, all of them cause a serious disease. Schistosoma species are blood flukes. They are Dioceses (female found in the grove of the male) in the blood stream of warm-blooded animals, being the only trematodes to do so. Adult schistosomes are 15-20mm long and the longer and more slender female lives almost permanently in a groove (gynaecophoral canal) in the body of the male, from which it derived the name 'schistosome' meaning split body. In a number of ways schistosomes are peculiar from all other trematodes in general and the digenea in particular. The adults are found in abdominal manly hepatic portal veins or pelvic veins. They infect human through the skin and do not have redia or metacercaria stage that is used by those trematodes transmitted orally (cdc.gov 2014).

2.2. Taxonomy and ecology of Schistosomes

The taxonomic classification of *S. mansoni* is kingdom – Animalia, phylum-platyhelmintes, class-Trematoda, order-strigeidida, Family-Schistosomatidae, Genus- Schistosoma and Species-*S. mansoni* . The ecology of schistosomes including Tropical lotic and lentic environment and the behavior of people and their domestic animals that live near the aquatic environments (Crompton et al. 1999). The high prevalence of the major nematode parasites and *S. mansoni* in the lower altitudes (< 2000m) accounted for by the relatively high temperature and moisture conditions favorable for larval development (Dejene and Petros 2009)

2.3. Schistosomes transition and favorable factors

The disease is spread by human feces or urine carrying egg of the schistosomes that enter water supply with which humans come in to contact. Infected individuals release schistosoma egg into water with fecal material or urine. The egg hatched into larvae that infects its specific type of freshwater snail. The

larvae (miracidia) spend the life cycle in the snail and develop into cercaria and re-enter in water to find the permanent host but the parasite can live in the water for 48 hours with-out a human host. When the worm get a human host penetrate the skin and enter to the blood vessel and remain for several weeks in the lung travel to hepatic portal veins and mesenteric veins and lay to develop into its adult phase. When the schistosomulem matured mating occurs and egg that are excreted through urine and feces and the process repeats. Humans encounter larvae of the schistosoma parasite when they enter contaminated water for bathing, playing, swimming, washing, fishing or other activity.

2.4. Snail Ecology and Distribution

For *S. mansoni transmission* to occur freshwater intermediate host snail Biomphalaria species are mandatory. Two species of genus Biomphalaria *B. pfeifferi* and *B. sudanica* are known to transmit *S. mansoni* in Ethiopia (Abebe et al. 1989). *B. pfeifferi* has a wide geographical distribution. The distribution of *B. sudanica* has been reported in only three areas in the rift valley, ziway and Abaya Lakes and interface between Tikur Wuha River and Hwassa Lake (Birrie *et al*.1995). Bu. abyssinicus and Bu. Africanus are the only bolinid species found naturally transmitting S. hematobium in Ethiopia (Alebie et al. 2014). As Lakew (1983) experimentally demonstrated areas that are non-endemic today, are potentially capable of support life cycle of the parasite and affecting an intensified transmission in dry seasons of the year.so the snail *B.pfeifferi*

2.5. Schistosomiasis Pathogenesis

After the larva (cercariae) penetrate the skin by use of mechanical and proteolysis enzymes. The first symptom of the disease, light rash ('swimmers itch') is seen within twelve hours after entrance of the cercarial larva. The adult warms stay in the portal and mesenteric blood vessels, after four to six weeks. The female worm starts producing 300 eggs/day throughout their life. About half the number of eggs produced is excreted with feces or urine while the rest stay in the tissue and die within 20 days (Warren 1978). Most other eggs are transported to the liver via the hepatic portal vein where they get trapped and eventually die (Pearce and Mac Donald 2002).

Soluble antigens which are actively excreted through the egg shell elicit host immune response which is responsible for the development of granulomas and related pathogenesis (Dunne and Pearce 1999, Stadecker 1999). The infected individual may have a pot belly, eggs can also become lodged in the

liver, leading to high blood pressure, enlarged spleen, and swollen areas in the esophagus. Schistosomiasis is also known to affect the pulmonary and genital area and childhood infection may lead to growth retardation, cognitive impairment and memory frailer (Ross et al. 2002)

2.6. Burden related with Schistosomiasis

2.6.1. Global burden of schistosomiasis

Schistosomiasis is being one of the most prevalent parasitic infections and has significant economic and public health consequences WHO (2017). It was estimated that 200 million people are infected, of whom 120 million are symptomatic and 20 million have severe disease. 600 million people are at risk of infection (WHO 2014). According to WHO (2017) report the prevalence of *S. mansoni is* on the rise in developing countries' like Africa. That is because of the poor socioeconomic status, poor personal and environmental hygiene and frequent open water contact habits (WHO 2017).

2.6.2. Schistosomiasis burden in Ethiopia

The population of Ethiopia is increasing, that is an increase in population in endemic areas mean that more people may be at risk of infection. In addition these large population size requires more water for irrigation and electricity and favorable conditions for introduction of schistosoma in new area increase the risk of infection.

In Ethiopia the distribution of *S. mansoni* was reported in different area of the country like Tigray (Jemaneh 1998, Dejene and Petros 2009) , in Fincha Valley western Ethiopia (Erko et al. 2001 Erko et al. 2009), in Babile Town Eastern Ethiopia (Girum 2005), in Gorgora Town North Weast Ethiopia (Tarko Essa et al. 2013), In Zarima town Northwest Ethiopia (Abebe et al 2011, Mulugeta et al. 2014, Alemu et al. 2016), In Haik northeast Ethiopia (Amsalu et al. 2015, Retta. 2017). In Kemise, Harbu and Bati (Erko et al. 2002). This indicates that schistosomiasis is a burden of Ethiopian. The poor personal and environmental hygiene experienced by the people and climatic change aggravate spread of *S. mansoni in* new area of the country, so the problem of schistosoma has been a great burden for Ethiopian.

2.7. Diagnostic Methods

Many techniques are available for the diagnosis of schistosomiasis including Direct parasitological methods that detect eggs in stool or urine under the microscope, histological methods that disclose adult worms or eggs in tissue biopsies, Clinical methods detect symptoms, Biochemical or Immunological markers detect signs such as microhaematuria proteinuria, leucocyturia in urine or occult blood in stool and Immunological methods (ELISA), may measure specific antibodies to certain Schistosomes antigens (Abebe 2002). In most Ethiopian Health centers *S. mansonai* positivity is confirmed by the identification of eggs in stool. The eggs of *S. mansoni* have a lateral spine and about 140 by 60 μm size. Microscopic identification of eggs in stool is the most practical method for diagnosing *S. mansoni* and *S. japonicum*. The examination can be performed on a simple smear (WHO 2006).

2.7. Treatment of *Schistosoma mansoni*

To lower the distribution of *S. mansoni* treating the infected persons by drug is one method world health organization (WHO, 2002) advocated different drugs for treating *S. mansoni.* Oxaminiquine amino ethyl terahydroquinolone is effective for treating *S. mansoni.* Praziquantel is more effective and is used by many countries, the alternative drugs artemisinin is effective against the younger stages (Cupit, Cunningham 2015). One successful example of combining different strategies to form an integrated control program was the National Schistosomiasis Control Program implemented in the People's Republic of China in 2004. This program aimed to reduce the rate of infection in humans to <5% by 2008 and to <1% by 2015. The strategies used include mass treatment with Praziquantel and intensified health education. One of the strategies is to reduce transmission from humans to snails by supplying tap water and building lavatories, public latrines, and marsh gas pools, and providing boats with containers for fecal matter to avoid contamination of water with feces. In the control program implemented in the People's Republic of China, cattle were replaced with small farm machines and grazing of cattle on grassland was prohibited in an effort to eliminate cattle as a source of infection. This program was successful in reducing the rate of infection by 75%–90% after 30 months. Aside from the reduction in infection rate, the program also had a significant impact on transmission (WHO 2017).

2.8. Prevention and control

Avoiding contact with open water source in endemic area is the basic means to prevent schistosoma infection, but most of the people in developing country mostly contact with open fresh water source for swimming, irrigation and for any other aquatic activities. To prevent infection by schistosomiasis boiling water for one minute, Fine-mesh filter and Preventive chemotherapy are some of the mechanisms (WHO 2017).The major curative intervention used to control the disease is treatment with praziquantel, accompanied by the provision of safe water, adequate sanitation and using possible snail control. As with other major parasitic disease there is ongoing research into developing schistosomiasis vaccine that will prevent the parasite from completing its life cycle in humans, (Cupit, Cunningham 2015).

3. MATERIALS AND METHOD

3.1. Study area

The study was carried out from December 2016 to May 2017 in two bordered area of Kalu woreda, following its common river, in the town of Harbu and its surrounding. Harbu is located 355 km North of Addis Ababa, it is one of the districts in South Wollo zone Amhara region Figure 2 on peage12. It is situated in an altitude ranging from 800m to 1484m at 10^0 53' 54 " N longitude and 39^0 47' 0.7"E latitude in the semi-arid tropical belt of north-eastern Ethiopia (goggle earth). Its mean annual maximum and minimum temperatures were 28.5 ^{0}C and 15 ^{0}C, respectively whereas the mean annual rainfall of the district varied from 750 to 1000 mm. It receives a bimodal rainfall, namely the main rainy season and short rainy season. The main rainy season extends from the beginning of August to mid of September while the short rainy season starts by the end of March and lasts up to the end of April (MoA 1998,). Harbu is a flat area surrounded by Mountainous High land areas, and crossed by two main rivers (Dirma and Borkena). In Harbu health center there are 3 Health officer, 4 nurse, 2 laboratory technician, 4 pharmacy technician, 4 mid y-free and different administration worker. In the laboratory room there are 2 binocular compound light microscopes, one refrigerator, centrifuge, tables, chairs and other important material with required reagent.

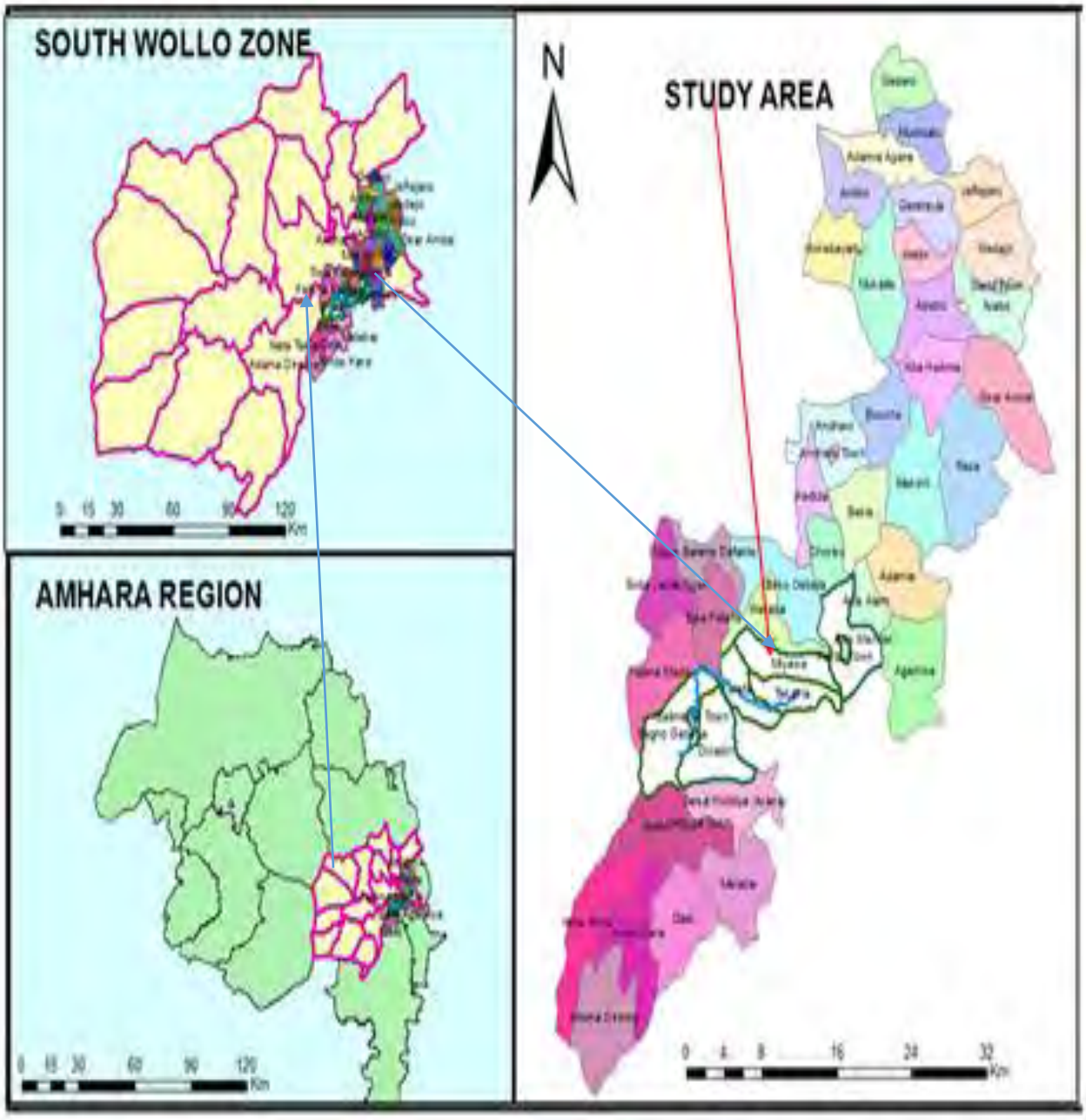

Figure- 2. Map of Amhara region, South Wollo Zone and Study Area (Source: the investigator May 2017).

3.2. Research design

Patients suspected of Intestinal Parasite Infections (IPIS) or intestinal pain and diarrhea and who consented to participate in the study were requested to respond to a semi-structured questionnaire for socio demographic and risk factors related to exposure to *S. mansoni*. Suitable subjects were those patients clinically suspected of IPIS and had stool examination in harbu health center and older than 5 years were included in the study. Observation check list was done and clinical information including diarrhea medication histories were obtained from the patients' medical records of the laboratory.

3.3. Sample collection and analysis

The data of 600 persons that were listed in the stool sample column for 6 months (December2016 to May 2017) in Harbu health center were collected and processed statically to determine the prevalence of *S. mansoni* in Harbu town. The day to day activity that affect the distribution of *S. mansoni* were studied by semi structured questionnaire that obtained from participant patients of the study from Harbu health center.

3.4. Data quality control

To ensure reliable information:-Before the data collection period, the questionnaire were prepared in accordance with WHO steps instrument for chronic disease Risk surveillance and the global physical activity questionnaire (GPAQ) Analysis guide (http://www. who. Int /chp /steps /GPAQ /en/ index. Html). Training for data fillers was done. Short discussion about preparation of clear roistering of patient stool result were performed with laboratory workers. The result of laboratory examination that was recorded on well prepared format of the laboratory was attached with questionnaire.

3.5. Data analysis

Data were entered into Microsoft Excel, and coded appropriately and SPSS version 20 statistics (IBM, USA) was used for analysis. Questionnaire and KAP information were sorted out, verified and organized. Percentage *S. mansoni infection* was determined. Univariate logistic regression analysis was used to assess the association between various variables and *S. mansoni* -positivity. To determine the

independent risk factors multiple logistic regression analysis was performed. All tests were performed at 95% confidence interval (CI) and p-values of less than 0.05 were considered statistically significant.

3.6. Ethical considerations

The study was approved by the Department of Zoological Sciences, Addis Ababa University (ref. № SF/ZS/2241/08/2016). And permission was obtained from Kalu Health Office and Albuko Health office. All schistosomiasis positives were treated by the clinic.

4. RESULTS

4.1. Socio-demographic result

Socio-demographic profile of the participant were sex, age, residence, educational positions, occupation distance from river, drinking water source, use of toilet, water treatment and swimming habit and washing cloth. A total of 600 individuals (338 (56.3%) from Harbu Town and 262(43.7%) from the surrounding villages participated in the study. Males were 250(41.6%) and females 350(58.3%). The age distribution of the sample population constitute of 325(56.2%) were age group between12-18 years, 192 (32%) between 5-11 and the other 83(13.83 %) were above 18 years old. The educational background of the participants varied, ranging from illiterate 169(28.166%), read/write 114(19%), primary education 239(39.8%), secondary education 64(10.7%) and above2ry school were 14(2.3%). In case of occupation, 193(32.2%) were farmers, 24(4%) civil servant, 247(41.2%) housemaid and 126(21%) merchants, others10(1.7%).The village of the participants varied, ranging from town village close to river were 171(28.5%) town village far away from river 174(29%), Rural close to river 190(31.7%) and rural far away from river were 65(10.83%) (Table1).

4.2. Stool sample result

From a total of 600 patients examined at HHC 131(21.8%) were found to be positive for *S. mansoni.* The higher prevalence of infection (65.6%) was found from Harbu town and (34.35 %) from the neighboring communities with significance (p=0.002). The proportion of positive individuals among females 85(64.88%) was higher than that in males 46(35.11%) with significance (p=0.086). With respect to age the highest prevalence 99(75.57%) was among age group 12-18 years followed by 5-11 years with 29(22.13%), and years >18 was 3(2.29%) the difference was statistically significant (p=0 .001) Table.1.

Table 1. Univarate logistic regression analysis of socio demographic and other variables associated with S. mansoni infection in patient examined at Harbu Health Center Northeast Ethiopia from December 2016-May 2017 (N=600)

Variable	Option	N	Positive (n) (%)	COR	95% CI	P-value
Sex	Male	250	46(18.4)	1.422	0.954-2.127	0.086
	Female	350	85(24.285)	1.00		
Age	5-11	192	29 (15.1)	1.491	0.199-1.215	0.124
	12-18	325	99 (30.46)	1.765	0.098-0.564	0.001*
	>18	83	3 (3.61)	1.00		
Residence	Town	338	86(25.44)	1.00		
	Rural	262	45(17.175)	0.608	0.406-0.910	0.016*
Educational states	Illiterate	169	47(27.81)	1.038	0.310-3.473	0.951
	Read & write	114	31(27.1)	1.071	0.313-3.667	0.913
	Primary school	239	38(15.9)	2.116	0.631-7.079	0.225
	2ry school	64	11(17.199)	1.927	0.510-7.280	0.333
	Above 2^{ry} school	14	4(28.57)	1.00		
Aware of transmission	Yes	196	37(18.88)	1.00		
	No	403	94(23.35)	3.696	2.465-5.544	0.000*
Irrigation practice	Yes	372	72(19.354)	1.00		
	No	228	59(25.88)	0.687	0.464-1.018	0.061
Toilet access and use	Yes	212	25(11.792)	1.00		
	No	387	105(27.13)	2.785	1.734-4.473	0.000*
Occupation	Civil servant	24	3(12.5)	1.00		
	Farmer	193	42(21.76)	1.353	0.862-2.121	0.227
	Merchant	126	22(17.49)	1.436	0.598-3.445	0.418
	House maid& student	247	64(25.91)	1.638	0.951-2.824	0.075
	Others.	10	0	1.353	0.862-2.121	0.188
Water treatment	Boiling	8	1(12.5)	1.00		
	Filtering	27	2(7.4)	0.393	0.185-0.834	0.015
	Nothing	432	117(27.08)	0.589	0.270-1.285	0.184
	Chemical	109	11(10.09)	0.270	0.138-0.540	0.000*
Village	Town Close to river (up to 500m)	171	67(39.18)	0.120	0.046-0.315	0.000*
	Town Far from river (> 500m)	174	16(9.19)	0.823	0.289-2.345	0.715
	Rural Close to river (up to 500m)	190	43(22.63)	0.313	0.118-0.830	0.020*
	Rural Far from river	65	5(7.69)	1.00		
Swimming habit and washing cloth in river	Never	38	0	1.00		
	Rarely	129	19(14.73)	2.038	0.678-6.120	0.205
	Frequently	252	90(35.71)	1.166	0.647-2.101	0.049*
	Some times	181	22(12.154)	0.623	0.393-0.988	0.609
Moving to other endemic area	Move	338	86(25.44)	1.646	1.099-2.464	0.016*
	Not move	262	45(17.175)	1.00		
Drinking water source	Paced water	38	4(10.52)	1.00		
	River	129	22(17.05)	2.038	0.678-6.120	0.044*
	Spring	252	70(27.78)	1.166	0.647-2.101	0.609
	Pipe	181	35(19.33)	0.623	0.393-0.988	0.205

CI: confidence interval: COR Crude odds ratio, n: Number; %: percent, * statistically significant

4.3. The Risk factor analysis

The risk factor analysis indicate that Patients aged 12-18 years compered to all other age groups were more likely to be infected (adjusted odds ratio (AOR) 1.029; 95% confidence interval (CI) 0.765-1.391, p=0.004). Patients having toilet facility were more protected than those having no toilet (AOR 2.251; 95% CI 1.651-3.752, p=0.000). Similarly, patients of harbu town which are closer to borkena river were more likely to be infected by *S. mansoni* than the rural residence (AOR 0.698, 95% CI 0.447-1.090, p=0.018). Patients who do not exercise swimming and open water contact frequently were significantly more affected (AOR 1.166; 95% CI 0.647-2.101, p=0.049) than those who never swim and wash clothes in river. The patients who are using untreated drinking water were likewise were found to be more infected than those using properly treated water (AOR 2.038, 95% CI 0.678-6.120, p = 0.044).In case of residence, patients who were living in Harbu town were affected (AOR; 0.608;95% CI 0.406-0.910, P = 0.016) than those from rural communities. The Univariate logistic regression analysis results were shown in Tables 1 above.

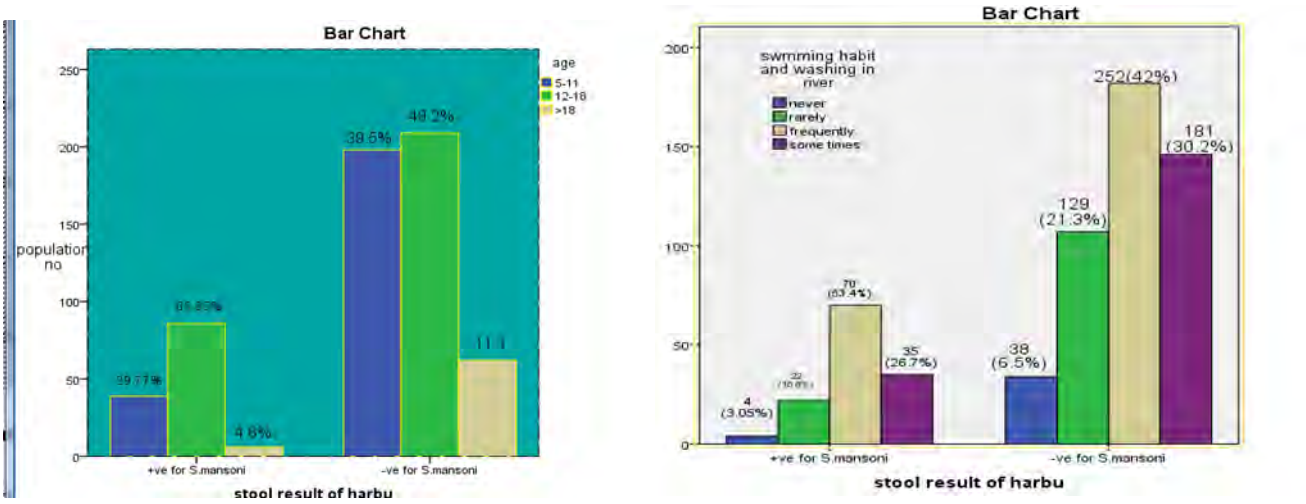

Figure.3. stool sample result of participant (a) based on their age and (b) based on water contact habit

Table 2. Binary logistic regression analysis of Socio-demographic and other variables associated with *S. mansoni* infection in patients examined at HHC, northeast Ethiopia, December 2016-May 2017 (N=600)

Variable	Options	N	Positive (n(%)	AOR	95% CI	P-value
Age	5-11	192	29(15.1)	0.503	0.196-1.289	0.152
	12-18	325	99(30.46)	1.029	0.762-1.391	0.004*
	>18	83	3(3.61)	1.00		
Aware about transmission	Yes	196	37(18.88)	1.00		
	No	403	94(23.35)	2.958	1.907-4.581	0.000*
Water treatment	Boiling	8	1(12.5)	1.00		
	Filtering	27	2(7.4)	0.734	0.058-9.289	0.811
	Nothing	432	117(27.08)	0.183	0.023-1.452	0.108
	Chemical	109	11(10.09)	0.431	0.049-3.754	0.456
Toilet access and use	Yes	212	25	1.00		
	No	387	105	2.251	1.351-3.752	0.002*
Residence	Town	338	86	1.00		
	rural	262	45	0.698	0447-1.090	0.018*
Swimming habit or water contact	Never	34	3	1.00		
	Rarely	105	22	2.496	0.778-8.003	0.124
	Sometimes	165	19	1.421	0.739-2.731	0.292
	Frequently	252	87	0.747	0.451-1.237	0.257
Drinking water	Packed	38	4	1.00		
	River	129	22	2.496	0.778-8.003	0.124
	Spring	252	70	1.421	0.739-2.731	0.292
	Pipe	181	35	0.747	0.451-1.237	0.257

CI: confidence interval: AOR Adjusted odds ratio, n: Number; %: percent,*statistically significant

5. Discussion

The prevalence of *S. mansoni* infection observed in the present study was very high compared to most study conducted in different parts of Ethiopia. This study result show an overall prevalence of *S. mansoni* infection was 21.8%. The present study outcome was greater than the outcomes of former studies in Dembia, Northwest Ethiopia which was 11.2% (Alemu et al. 2016), from Haik which was 8.8 (Reta 2016), from Babile town, Eastern Ethiopia, which was 4.3% (Girum 2005), and even from the results on schoolchildren of Libo-kemkem Northwest Ethiopia, which was 15% prevalence (Tesfahun and Achenef 2015). The relatively high prevalence of *S. mansoni* in this study was may be the data of this study was from IPI suspected participant which are highly suspected of *S. mansoni in* endemic area.

The 21.8% prevalence of *S. mansoni* in this study compared to similar studies elsewhere in Ethiopia seems to be lower: Wondo Genet 89.6% (Mulugeta et al. 2015), Damot Woide 81.3% by (Alemayehu 2015), kemisse 59% by(Erko et al. 2002) and Mizan Aman Town 44.8% by (Jejaw et al. 2015) Mizan-Aman Town which was 44.8% prevalence (Jejaw et al. 2015), and in Haik Town using kato-katz technique and prevalence was 45% (Amsalu et al. 2015). However, taking into account the fact that shistosomiasis is asymptomatic disease in the population and the work of this thesis is based on Health center laboratory data which does not reflect the percentage occurrence the parasite in the population but the ones that are experiencing disease symptoms and those who were able to reach the referral clinic in the years considered for the study. So there is a difference in the determination power of the two approaches. If we were to add the asymptomatic cases it would not be less than the above findings in the different populations shown above. Even if the prevalence was low, considering the biology of the parasite, the efficiency of the intermediate hosts and suitability of the environment to support the transmission dynamics it would not take more than a few year to catch the level of infection seen in the different regions of the country. That is to say in brief: Parasite literarily search and infect the intermediate host and replicate in the snail host at unimaginable rate (one miracidia entering to snails gives rise up to 10,000. Human infective cercaria).

S. mansoni infection among school children in different parts of Ethiopia was greater than the present prevalence (Jemaneh 1998; Erko *et al*., 2001; Erko *et al*., 2009). Essentially lower prevalence of *S. mansoni* in this study may be due to the direct wet-mount method and the use of chemotherapy to at

least these confirmed to be positive at health services. The present study was based on data from stool sample examination of health center but most of the above studies were on school children who are high-risk groups. Besides, the variation might be due to differences in water-contact behavior of the participants, environmental sanitation and socioeconomic status, local endemicity and sample size.

Different study result indicate that the age group from 5-9 and 10-14 were more and equally affected by *S. mansoni*, because of their water contact behavior (Alebie et al. 2014). For this study age was categorized from 5-11, 12-18 and above 18 years old, from which highest prevalence was among patients 12 -18 years old (p=0.004) followed by 5-11 years and more than 18 years. That was in contract with reports of several researchers in different localities of Ethiopia (Fekadu *et al*. 1993; Berrie *et al*, 1998; Dejene and Petros 2009), from other countries such as, (Handzel *et al*. 2003) from Kenya and (John *et al.*2008) from Uganda. Compared to the above result,

The bivariate analysis of the study show that urban areas *S. mansoni* infection was 2.3 times (95% CI: 0.447-1.090) more likely affected than rural participants. Water contact practice, low awareness of Schistosomiasis source of drinking water and water treatment mechanism were significantly associated with *S. mansoni* positivity (table 2).

Regularity of water contact practice was identified as risk factor for *S. mansoni* positivity in which individuals with frequent open water contact were more infected than those who have less frequent water contact. Correspondingly, patients who use river water source for household use and drinking were more infected than those who use piped water, this supports other studies like (Mulugeta et al. 2014; Rupiah et al. 2015). Frequent water body contact was significantly associated with *S. mansoni* infection, this is in agreement with other findings in Ethiopia (Enk et al. 2010; Dejene and Asmelash 2008; Dejene and Asmelash 2010). Therefore in the study area the occurrence of rivers, that used for irrigation, construction, washing and recreation activity increase the vulnerability of the residence for *S. mansoni.* At the end, Even if that, this study revealed low infection for *S. mansoni* infection compared to the previous majority reports in Ethiopia, but the presence of *S. mansoni* in patients examined at HHC indicated that the frequent contact of the resident to Borkena and Dirma Rivers may further increase the prevalence of schistosomiasis for the future.

6. CONCLUSION AND RECOMMENDATION

6.1. Conclusion

S. mansoni infection is an important health problem among patients examined at HHC. The possession and use of toilet, swimming habit/water contact, Irrigation practice, use of untreated water for drinking and residence were observed as strong risk factors for *S. mansoni* infection. Thus the 21.8% infection from clinical laboratory result is an alarming situation and should be able to mobilize the public and the concerned health officials alike to control the disease.

6.2. Recommendation

The Intervention and prevention programs that involves cross sectional community diagnosis at least once a year and when the infection is higher than the WHO recommends a blank treatment of the population should be effected. I, therefore, recommended that MOH and the society should implement more coordinated intervention and control programs to /see/ make sure that the population is protected.

7. REFERENCES

Abebe F (2002). Studies on the influence of hormones and praziquantel on the intensity of Schistosoma mansoni infection and parasite specific antibody responses in residents of NortEast Ethiopia. University of Oslo 6-7

Abebe A, Asmamaw A, Zelalem A(2011).Soil transmitted helminthes and *S. mansoni* infections among school age children in Zarima Twon northwest Ethiopia. BMC infect Dis 11:121- 32.

Abebe F, Lakew M, Lo TC (1989). Malacology. In: Tedla S, Kloos S, Tilahun G (eds). Schistosomiasis in Ethiopia. Addis Ababa University printing press, Addis Ababa, Ethiopia; Pp 99-107.

Alemu A, Tegegne Y, Melku M (2016). Prevalence, intensity of *S. mansoni* infection and STH among preschool children in Chuahit, northwest Ethiopia. BMC Public Heal 16:422.

Amsalu G, Zelalem M, Berhanu E (2015). New focus of schistosomiasis in Hayk Town, northeast Ethiopia. BMC Res notes 8:22.

Barakat R, Farghaly A, Masry A, Sayed M, Hussien M (2014).The epidemiology of schistosomiasis in Egypt: patterns of *S. mansoni* infection and morbidity in kafr. Amer J Med 62:21-27.

Birrie H, Fikadu A, Svein G, Girmay M, Nega B ,Gemetchu T(1998). Epidemiology of Schistosomiasis mansoni in three endemic communities in northeast Ethiopia. Ethiop Med J 36:101-111.

Birrie H, LO CT, Erko B, Redda A, Gemeda N (1995). Further investigations on fresh water snails of Ethiopia. Ethiop J Sci 18:195-206.

Birrie H, Medhin G, Erko B (1997). Intestinal helminthes infections among the current residents of the future Finchaa sugar plantation area, western Ethiopia. Ethiop J Heal Dev 11:219- 28.

Birrie H, Weldemichael T, Redda A, Chane T (1994). The status of *Schistosoma mansoni* and snail hosts in Tigray and north wello regions. Ethiop J 32:245-54.

CDC (2006). Laboratory Identification of Parasites of Public Health Concern. Atlant

CDC (2014). “Chapter 3 infectious disease related to travel” cdc.gov retrieved November 2017.

Chitsulo L, Engels D, Montresor A, Savioli L (2000). The global status of schistosomiasis and its control. Acta Tropica 77:41-51.

Cupit PM, Cunningham C (2015).What is the mechanism of action of Praziquantel and how might resistance Strike? Future Med Chem 7:705-5.

Dejene T, Asmelash T (2008).The impact of Irrigation practice on the prevalence of intestinal Parasites infection with emphasis on schistosomiasis in Hintallo-Wejirat northern Ethiopia. Ethiop J Heal Sc 18:33-45.

Dejene T, Asmelash T (2010). *Schistosomiasis mansoni* among school children of different Water source users in Tigray, Northern Ethiopia. Momona Ethiop J Sci 2: 49-60.

Dejene T, Petros B (2009).Irrigation practice and Intestinal helimenths infection in Southern and Central Zone of Tigray, Northern Ethiopia. Ethiop J Heal Dev 23: 48-56.

Dunne D, Pearce E (1999). Immuology of hepatosplenin *S. mansoni:* a human perspective. J Microbs Infect 1:533-60.

Enk J, Lima L, Barros D, Masarra L, Coelho Z, Schall T (2010). Factors related to transmission and infection with *S. mansoni* in village in the south eastern Brazil. Cruz Rio Janeiro 105:570-77.

Erko B, Gemechu T, Medhin G, Birre H (2009). Reinfection of School children with *S. mansoni* in the Finchaa Valley, Western Ethiopia. Ethiop J Heal Dev 11:269-300.

Erko, B Toshome G, Fekede B, Svein G (2001). Implication of papio Anubis in the transmission of schistosomiasis in three new foci in Kime area Ethiopia. Parasitol Int 50:259-66.

Erko.B Abebe.F Berhe.N Medhin.G Gebre.T Gemetcu T (2002) control of Schistosoma mansoni by the soap Berry Endod (*Phytolacca dodecandra*) in wollo North Eastern Ethiopia.

Essa T, Birhane Y, Endris M, Moges A, Moges F (2013). Current status of *Schistosoma mansoni* infection and associated risk factors among student in Gorgora Town North West Ethiopia. 7

Fekadu A, Tedla S, Birrie H, Girmay M (1993).Transmission dynamics of *S. mansoni* in an irrigation setting in Metahra sugar Estate, Ethiopia. Ethiop J Heal Dev 1:10-15.

Grum T (2005). Prevalence of intestinal helminthes infection and associated risk factors among School children in Babile town, Eastern Ethiopia. Ethiop J Heal Dev 19:140 -147.

Gryseels B, Polman K, Clerinx J, Kestens L (2006). Human schistosomiasis. Lancet 368:1106- 1118.

Handzel T, Karanja D, Addiss D, Hightower A, Rosen D, Andove J, Secor W (2003).Geographical distribution of schistosomiasis and STHs in Western Kenya: Implications for anti-helminthic mass treatment. Amer J Trop Med Hyg 69:318- 323.

Hotez P, Brindely P, Bethony J (2016). Helminthes infections: the great Neglected Tropical Diseases. J clin Invest 18:4

Jack E. T. Grimes , David Croll, Wendy E. Harrison, Jürg Utzinger, Matthew C. Freeman, Michael R. Templeton (2014) The Relationship between Water, Sanitation and Schistosomiasis: A Systematic Review and Meta-analysis.

Jejaw A, Zemene E, Alemu Y, Mengistie Z (2015). High prevalence of *Schistosoma mansoni* and other intestinal parasites among elementary School children in south west Ethiopia: cross sectional study. BMC Public Heal 15:600-12.

Jemaneh L (1998). *Schistosoma mansoni* and Geo-helminthsiasis in school children in the Dembia plains, northwest Ethiopia. Ethiop J of Heal Dev 12:237-44.

John R, Ezekiel M, Philbert C, Andrew A (2008). Schistosomaisis transmission at high altitude Crater Lake in Western Uganda. BMC Infect Dis 8: 110.

Lakew M (1983) comparative study on the ecology of *biamopalaria pfeifferi* (rrauss1847) in endemic and non-endemic areas of *Schistosoma mansoni* in Ethiopia.

Kloos H (1993).Water resource development& Schistosomiasis in the awash valley Ethiopia. Soc Sci Med 20:609-25.

Marianette T inobaya, Remigion Molveda, Thao NP Chau, David U Olveda and Allen GP Ross (2014). Prevention and control of schistosomiasis: a current perspective Res Rep Trop Med: doi, 1021 47/RRTM S 44274:66-75

Mulugeta A, Nega B, Berhanu E (2015).Status of *Schistosoma mansoni* prevalence and intensity of infection in geographically apart Endemic localities of Ethiopia. Ethiop J Heal Sci 24:63-71.

Retta Seid (2016) *Schistosoma mansoni* infection and associated risk factors among patients attending Haik Health Center South Wollo, Northeast Ethiopia. Addis Abeba University. Msc thesis

Rupiah M, Berhanu J, Abraha (2015). A study of the prevalence of *Schistosoma mansoni* geohelmenthic infections among patients examined at Workmeda Health Center. Afr J Parasitol Res 2:94-97.

Tedela S, Tilahun G, Birrie H (1998). Schistiosomiasis in Ethiopia and Eerteria. Ethiopia J Heal Sci 18:55-77.

Tesfahun A, Achenef A (2015).A survy of soil-Transmitted and *S.mansoni* among school children in Libo-kemkem District, NorthWest Ethiopia. American J Heal Res 3:57-62.

Warren KS (1978). Hepatosplenic *Schistosoma mansoni:* an immunologic disease bulletin of the new work. Academy Med 51:545-50

WHO (1987). Prevention and control of intestinal parasitic infections. World Health Organization Technical Report Series. Geneva 749:121 –130

WHO (1993). Control of schistosomiasis, second report of the WHO expert committee .WHO Geneva. WHO Technical Report Series. 830:1-86.

WHO (1995). Special programme for Research and Training in Tropical Diseases. Mem inst Oswaldo cruz Rio dejaneiro 90:221-227.

WHO (2002).Prevention and control of schistosomiasis and STH.WHO Technical Report Series.912:157.

WHO (2004).Prevention and control of schistosomiasis and STHs. WHO/CDS/CPC/ SIP/2004.9.

WHO (2006). Schistosomiasis and soil-transmitted helminth Infections--preliminary estimates of the number of children treated with albendazole or mebendazole. Wkly Epidemiol Rec 81: 145-6

WHO (2013). Tropical Disease Research (TDR). Accessed from http://www.who.int/tdr.Access date july23, 2016.

WHO (2014). Schistosomiasis. http://en.wikipedia.org/wiki/Schistosomiasis. Retrieved February 24 2017.

WHO (2017). Prevention and control of schistosomiasis and STH.WHO Technical Report Series.912:157.

WHO (2017) http://www.who.int/mediacenter/ factsheets/fs115/en/, Schistosomiasis. retrieved on June 20, 2017.

Appendix-1: Questionnaire

Name (if you want to write) 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 figure Part

I-Study participant identification

Woreda: _____

Kebele: _____

Age_____

Sex: Male-- Female--- Age_____

-Educational status: Illiterate____ Read/write __primary school _____High School and above_____

- Information about occupation: Farmer ----- Merchant--- Civil servant------ Merchant-------House made andstudent

III-Information about KAP towards parasitic disease

1. Do you know about Schistosoma and its way of transmission? A. Yes B. No
2. Do you have your own toilet and use it properly? A. Yes B. No
3. How do you use drinking water? A-By boiling B- By filtering C- without treatment D. By chemical treatment
4. Do you practice irrigation activity? A. Yes B. No
5. Do you go swimming or wash cloth in river? A Never B. frequently C. Sometimes
6. Do you move to other area? A Yes B no
7. Where do you get your drinking water A. packed water B. River C spring D pipe

Adapted: from research journals

Thank you for your cooperation

Appendix-2: Questionnaire (Amharic version)

የኮድ ቁጥር ----------

ስ ም ስመጻፍ ከፈለጉ ብቻ----------

ቀን----------

የብልሃርዚያ በሽታ ስርጭት እና አጋላጭ ጽንቢዎች ስማጥናት የተዘጋጀ ቃስ መጠይቅ የዚህ ቃስ መጠይቅ ስላማ በሀርቡ ከተማ እና ዙሪዋ ባሉ በቃሉ ወረዳ ውስጥ በሚገኙ ቅርብ ቀበሌዎች ያሉ እና በሀርቡ ጤና ስጠባበቅ ጣቢያ የስንጀት ጥገኛ በሽታ ታካሚዎች ላይ ስረጭትን ጥገኛው ላይ ያለን ስመስላካከት ልማድ እና ስጠቃላይ የጤና ደረጃን ስመገንዘብ እና ስመግስጽ ታስቦ የተዘጋጀ ነው፡ ፡

የስንጅት ጥገኛ በሽታውን ስመመርምር የሰገራ ናሙና ከሰጡ በኋላ ስጥናቱ ተባባሪ የሆኑትን ታካሚዎች መጠይቁን እንድሞሉ ስጥኒው በትህትና ይጠይቃል ። ስስሆነም ሁሉም የሞሏቸው መረጃዎች ሚስጥራቸው የተጠበቀ ይሆናል ፡ ፡

መጠይቁን የሞሱት ስጠቃላይ መረጃ

ወረዳ ----- ቀበሌ--------- እድሜ------ ፃታ ወ------ሴ-------

የስራ ሁኔታ ስርሶ ስደር ---------ንጋዴ----------የመንግስት ተቀጣሪ----------የ ቤት ሰራተኛ/የቤት እመቤት ወይም ተማሪ ----------

የትምህርት ሁኔታ ያልተማረ-----ማንበብ እና መጻፍ ብቻ---- የመጀመሪ ደረጃ ተማሪ------- የ2ኛ ደረጃ የተማረ ---------ከ2ኛ ደረጃ በላይ----

1.ስስ ብልሃርዚያ በሽታ ምንነት እና መተላለፊያ መንገድ ያወቃሉ? ሀ. አወ ስ. ስላወቀም

2. በአግባቡ የሚጠቀሙበት የእራስዎ መጸዳጃ ቤት ስለዎት? ሀ . አዎ ስ .የለኝም

3. የ መጠጥ ውሃ እንዴት ይጠቀማሉ? ሀ . በማፍላት ስ . በማጥለል ሐ. እንድሁ መ. ኬሚካል /ሴላ መንገድ/

4. የመስኖ ስራ ይሰራሉን? ሀ ስሰራለሁ ስ.ስልሰራም

5. ወንዝ ስመጥኘት ወይም ልብስ ስማጠብ ይሄዳሉ? ሀ. በጭራሽ ስልሄድም ስ . ስልፎ ስልፎ ሐ. ሁልጊዜ እሄዳለሁ

6.ስንገድ ወይም ስሴላ ስራ ወደ አገራቸች ወረዳ ይሄዳሉ? ሀ አወ ስ ስልሄድም

መረጃውን ስለሞሉልኝ በጣም አመሰግናለሁ !

Appendix -3: Operational definitions of variables in the Thesis

Catchment kebeles - Place where patients come to HHC for examination of intestinal parasites

Harbu town – one of the Administrative town in Kalu Woreda.

Kalu Woreda - Is segments of South Wollo Zone and compartmentalized into 38 kebeles.

S. mansoni. -Causative agents of Bilharzias.

Risk factors -Any factors or conditions exposing person for *S. mansoni*.

Age- Patients who came to the HHC within greater than and equal to five years old.

Prevalence -Is simply the proportion of individuals with *S. mansoni* in a population.

A comprehensive System – All the data of the clinic at specific time for stool laboratory examination were taken as study sample.

Figure 5 Harbu health center

Figure-6 filed observation around Harbu Rivers

Figure-7 documentation in Harbu health center

Declaration

I, the undersigned, declare that this thesis is my original work and has not been presented to any other university and all sources of information used for the thesis have been fully acknowledged.

Name Yimer Seid

Signature_____

Date _____

This Msc thesis has been submitted for examination with my approval as an advisor.

Name Mekuria Lakew(PhD)

Signature _____

Date _____