Schistosoma mansoni Infection and Associated Risk Factors Among Patients Attending Haik Health Center South Wollo, Northeast Ethiopia

By

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Acronyms

AOR	Adjusted Odds Ratio
CSA	Central Statistical Agency
WHO	World Health Organization
CDC	Center for Disease Control and Prevention
KAP	Knowledge Attitude and Practices
NTDs	Neglected Tropical Diseases
SPSS	Statistical Package for Social Sciences
CI	Confidence Interval
IPIs	Intestinal Parasite Infections

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Abstract

Schistosomiasis caused by *Schistosoma mansoni* is a major public health concern in the tropics and yet is a neglected disease. In Ethiopia, the condition is worsened due to very low latrine coverage and overall poor personal and environmental hygiene. The objective of this study was, therefore, to detect *S. mansoni* infection and investigate related risk factors in Haik, northeast Ethiopia. In this health-facility-based cross-sectional study, patients visiting Haik Health Center (HHC) between December 2015 and April 2016 and who were clinically suspected of intestinal schistosomiasis were successively enrolled. A semi-structured questionnaire was administered to capture socio-demographic and environmental variables in relation to the risk of exposure to *S. mansoni*. Fecal samples were collected and processed using the direct-smear method. Univariate and multivariate logistic regression models were used for data analysis. *S. mansoni* was recovered from 44(8.80%) out of 500 diagnosed patients with the highest proportion (19.23%) of infected cases belonging to the age group 10-15 years followed by 7.30% for >15 and 5.78% among 5-9 years old. Age (adjusted odds ratio (AOR) 2.670, 95% confidence interval (CI) 1.013-7.039, p=0.001), possession and use of toilet (AOR 0.055, 95% CI 0.01-0.29, p=0.001), swimming habit (AOR 0.32, 95% CI 0.114-0.859, p=0.024) and residence (AOR 0.06, 95% CI 0.018-0.480, p=0.001) were independently significantly associated with S. *mansoni*-positivity. *S. mansoni* infection is an important health problem among patients examined at HHC. Therefore, prompt intervention strategies should be designed and implemented including provision of adequate safe water supply, regular deworming and health education on personal as well as environmental hygiene.

Key words: Schistosomiasis, Haik Town

1. Introduction

Intestinal helminthic infections strongly affect human health in the tropics and subtropics. They continue to be global problem, particularly among children in low-income nations and yet such infections are neglected. Several reports showed that the overall high prevalence of intestinal helminthes in the world to be mainly ascribed to infections emanating from the environmental contamination by human excreta. Thus helminthic infections as a whole can be viewed as vivid indicators of the sanitation level of a community. The most prevalent and important intestinal helminthiasis, but standing among neglected tropical diseases (NTDs) are soil-transmitted helminthic infections (ascariasis by *Ascaris lumbricoides*, trichuriasis by *Trichuris trichiura* and ancylostomiasis by the hookworms), and schistosomiasis by the blood flukes, schistosomes.

Currently schistosomiasis is endemic in 76 tropical countries affecting over 207 million people with highest prevalence in sub-Sahara Africa (Hotez et al. 2016). *Schistosoma mansoni*, one of the agents of intestinal schistosomiasis is of significant public health challenge. *S. mansoni* is widely distributed in Ethiopia (Tedla et al. 1998). Increased incidence and spread of intestinal schistosomiasis has been observed in previously non-endemic areas such as Mathara, Wonji and Finchaa following introduction of irrigation schemes for sugar plantation activities in the country (Kloos 1993, Birrie et al. 1997). Intestinal schistosomiasis is reported to be widely endemic in Tigray, north Ethiopia. For instance, a prevalence of 1% and 66% in Maichew and Adwa, respectively was reported (Birrie et al. 1994, Birrie et al. 1998). Recent investigations showed that the disease has covered quite many localities in other regions (reviewed in Amsalu et al. 2015). With introduction of water resource development schemes for hydroelectric power generation and irrigation the potential for further spread of schistosomiasis may become inevitable. Freshwater snails belonging to the genus *Biomphalaria* (Gastropoda: Planorbidae) are the intermediate hosts of *S. mansoni*. In most parts of Ethiopia *Biomphalaria pfeifferi* is the major transmitter of *S. mansoni* (Brown 1964 cited in Abebe et al. 1989).

The occurrence of helminthic infections in general is associated with low socioeconomic status and subsequent effects such as overcrowding, limited access to clean water and latrine facility. Tropical climate and low latitude are environmental or climatic factors that favor intestinal parasitism (WHO 1987, WHO 2006). School-age children are one of the groups at high risk for intestinal schistosomiasis. Ethiopia has one of the lowest quality water supply and latrine coverage in the world (WHO 2002). Because of this and other reasons intestinal parasites in general are widespread in the country.

Although a number of studies in Ethiopia gave due attention to the distribution of different intestinal parasites in different settings, schistosomiasis was not well addressed in the current study area. Effective control of the disease requires monitoring its prevalence rate, identifying risk factors of infection and high-risk groups in a specific setting. Therefore, the objective of this study was to estimate the prevalence of *S. mansoni* infection and associated risk factors among patients examined at Haik Health Center (HHC) in Haik town and its surroundings, northeast Ethiopia.

2. Objectives

2.1 General objective

The general objective of the study was to assess the prevalence of *S. mansoni* infection and associated risk factors among patients examined at HHC**.**

2.2 Specific objectives

The study was initiated with specific objective to:

detect *S. mansoni* among patients in HHC, and

evaluate the status of socio-demographic and environmental factors, as well as community knowledge, attitude and practice (KAP) related to the risk of exposure to schistosomes.

3. Literature review

3.1 Schistosomes: overview

Schisotosmes which commonly referred to as blood flukes are a member of the invertebrate phylum Platyhelminthes which includes multicellular eukaryotic invertebrates with tube-like or dorsoventrally flattened bodies exhibiting bilateral symmetry. Within the phylum schistosomes belong to class Trematodes (flukes). The term 'Trematoda' is derived from the Greek '*trematodes'* (having holes), referring to the suckers (ventral and oral) which form the characteristic feature of the group (Smyth 1994). Trematodes are subdivided into 3 groups based on whether they are endo- or ecto-parasites, type of adhesive organ and require an intermediate host or not. These are the *Monogenea* – typically external parasites of fish with no intermediate hosts; the *Aspidogastrea* – endoparasites with the entire ventral surface an adhesive organ; the *Digenea* – endoparasite species with simpler adhesive organ and having one or more intermediate hosts. Schistosomes are digenean trematodes in family Schistosomatidae genus *Schistosoma*.

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 is derived the name 'schistosome' meaning split body. In a number of ways schostosomes are peculiar from all other trematodes in general and the digenea in particular. They are dioecious (sexual dimorphism) and live in the blood stream of warm-blooded animals, being the only trematodes to do so. The adults are found in abdominal or pelvic veins. Further, they use a single intermediate host, transmission by skin penetration and do not have redia, or metacercaria stage.

3.2 Taxonomy and ecology of Schistosomes

The taxonomic classification of *S. mansoni* is Kingdom- Animalia, Phylum- Platyhelminthes, Class-*Trematoda*, Order-*Strigeidida*, Family-*Schistosomatidae*, Genus-*Schistosoma* and Species-*S. mansoni*.

The ecology of Schistosomiasis includes Tropical lotic and lentic environment and the behavior of people and their domestic animals that live near these aquatic environments.

3.3 Schistosome transmission and favorable factors

The adult parasites live in the lumen of mesenteric veins (intestinal or urinary).When schisotsome egg-passing humans or animals defecate in or near freshwater, the eggs are released into the water. Once in the water the eggs hatch (a miracidium emerges) and infects the intermediate host, a freshwater snail species specific for each schistosome species. In the snail, the parasite develops and reemerges into the water as free-swimming larvae (cercaria) and can penetrate human/animal skin. Inside, the larvae develop into adult worms (Fig. 1) which live and multiply in blood vessels for years. The female worms releasing thousands of eggs, some of which pass through in the feces and others remain trapped in body tissue leading to long-term morbidity (Kayser et al. 2005).

3.4. Snails Ecology and distribution

Biomphalaria are the obligate intermediate hosts of *S. mansoni* and exist in fresh water and moist terrestrial environments. Two species of genus *Biomphalaria, B. pfeifferi, B. sudanica* are known to transmit S. *mansoni* in Ethiopi*a (*Abebe et al 1989*).*unlike*, B.pfeifferi B. sudanica,* which is known to have a wide geographical distribution, *B. sudanica* has very limited distribution in Ethiopia. Its presence has so far been reported from only three areas in the Rift valley, Ziway and Abaya Lakes and interface between Tikur Wuha River and Awassa Lake (Birrie et al. 1995). It seems therefore, that *B. pfeifferi* has ubiquitous distribution, while *B.sudanica* is limited in its distribution.

3.5 Schistosomiasis pathogenesis

The reaction that can occur in the definitive host is due to penetration of the skin. Up to 40% of the schistosome released from cercariae will die in the skin and these can induce hypersensitivity reactions of both the immediate and delayed types (Wehh 1981). *S. mansoni* worms are located almost entirely in the mesenteric veins of the large intestine. The female worms deposit eggs in the blood venues of the host and about 300 eggs per worm pair per day are produced (Loker 1983). The eggs actively penetrate the tissue of the bladder or intestines to reach the lumen of the bladder or bowels. However, 5% or more become trapped 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 in the sinusoids and eventually die (Pearce and MacDonald 2002). Soluble antigens which are actively excreted through the eggs shell elicit host immune response which is responsible for the development of granulomas and related pathogenesis (Dunne and Pearce 1999, Stadecker 1999). Therefore, the typical pathology of intestinal schistosomiasis is due to egg-mediated immune response in the form of granuloma formation followed by fibrosis which results in obstructive manifestations in the gastrointestinal tract (Wilson et al. 2007). Chronic *S. mansoni* infection causes impaired physical and cognitive developments in children (WHO 2002, Gryseels et al. 2006).

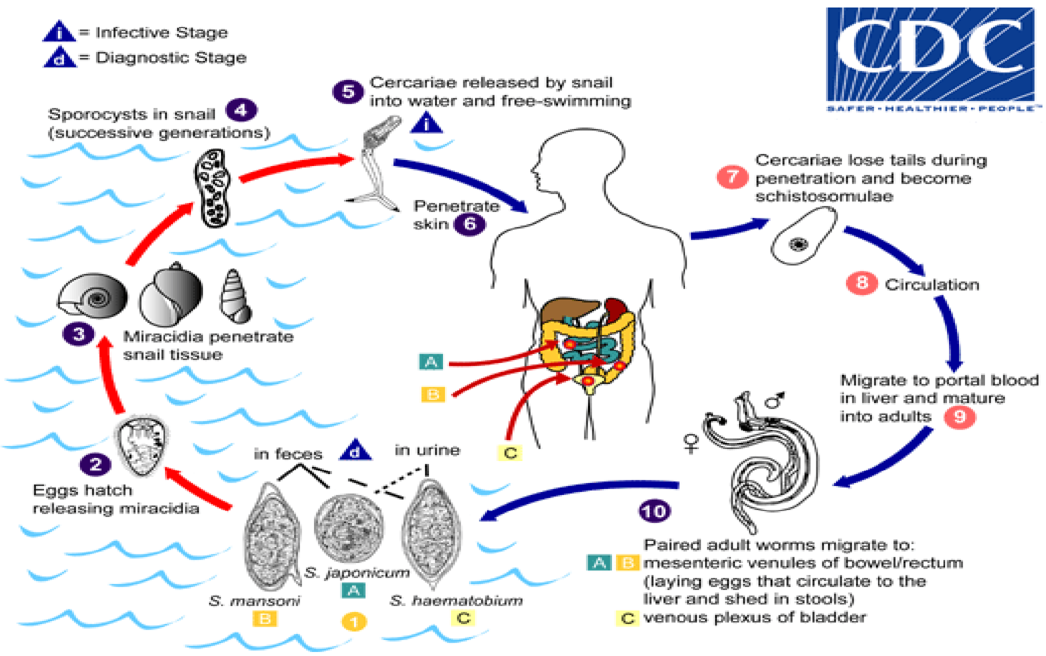

Figure 1 Schistosoma species life cycle (Source: http://www.dpd.cde.gov/dpdx)

3.6 Schistosomiasis burden

3.6.1 Global burden of Schistosomiasis

Intestinal schistosomiasis mainly due to *S. mansoni* is a serious public health problem in tropical and subtropical parts of the world. It is ranked next to malaria with respect to its impact on public health and socio-economic development (Chitsulo et al. 2000). All schistosomes combined infect over 200 million people. *S. mansoni* alone infects about 83.31 million people in 54 countries worldwide (Crompton 1999).

The World Health Organsition estimates that Schistosomiasis and Geohelminths represent more than 40% of the Global disease burden caused by all Tropical diseases, excluding malaria (WHO 2006).Schistosomiasis the third most devastating Tropical diseases globally (after malaria & intestinal heiminthiasis) and is a major cause of morbidity & mortality for developing countries Africa, America, the Caribbean, the Middle East &Asia (WHO 2013, Barakat et al. 2014).

3.6.2 Burden of Schistosomiasis in Africa

According to WHO report showed that the prevalence of *Schistosomia mansoni* increasing in developing countries including Africa due to poor socioeconomic status, poor personal and environmental hygiene together with frequent water contact & lack of pure drinking water. Schistosomiasis is the second most important disease in public health importance next to malaria. It is caused by trematode flatworms of the genus Schistosomia (WHO 2004). Schistosomiasis is endemic in 74 developing countries and it is estimated that 650 million people live in endemic areas worldwide 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 2006). Recent reports indicate even higher estimates. Surprisingly over 207 million people were reported to be infected by schistosmes and region of highest prevalence is sub-Sahara Africa (Hotez et al. 2016).

3.6.3 Schistosomiasis burden in Ethiopia

Factors contributing for the occurrence of *S. mansoni* infection include poor socioeconomic status, change in climate, human water contact behavior and ecological changes related to water resource development projects (Kloos 1995, WHO 2004). Poor personal and environmental hygiene coupled with frequent water contact behaviors of school-age children are reported to render them more vulnerable to schistosomiasis.

S. mansoni infection in the general population or schoolchildren has been assessed across Ethiopia and the disease is widespread in the country such as in 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 Zarima Twon northwest Ethiopia(Abebe et al. 2011, Mulugeta et al, 2014 Alemu et al. 2016), in Haik northeast Ethiopia(Amsalu et al. 2015).

3.7 Diagnostic methods

It include questions to ask medical history, specific signs to look for on physical examination, relevant laboratory examination (concentration technique, kato-katz),Direct wet mount method and radiological investigations that should be under taken for the diagnostic of Schistosomes species.

3.8 Drug resistance in Schistosomiasis

Since Praziquantel was developed in 1970s, it has replaced other anti schistosomal drugs to become the only drug of the choice for treatment of human Schistosomiasis, due to high efficacy excellent tolerability, few side effects, easily used and competitive cost. Praziquantel-based-chemotherapy has been involved in global control. Given that the drug has been widely used for morbidity control in endemic area for more than three decades, the emergence of Schistosoma to praziquantel under drug selection pressure had been paid much attention, however, in the absence of exact of Praziquantel, the mechanism of drug resistance in Schistosomes remain unclear and require further investigation. (Cup and Cunningham 2015).

3.9 Prevention and control

The major intervention used to control the disease is treatment with praziquantel, accompanied by the provision of safe water, adequate sanitation, and, where possible, snail control. Current schistosomiasis control strategies are based mainly on regular drug therapy of specific population groups. Morbidity, mortality, and egg excretion rates are clearly reduced by such programs. Hygienic and organizational measures (construction of latrines, improvement of water supply quality, etc.) aim to reduce Schistosoma egg dissemination and contact with contaminated bodies of water. Individual preventive measures in Schistosoma-contaminated areas include avoidance of skin contact with natural or artificial bodies of water (freshwater).Drinking water that could be contaminated with cercariae must be decontaminated before use by boiling, chlorination, or filtration.

Several promising Schistosome antigens have now reached an advanced phase of development and currently undergoing independent confirmatory testing according to standard protocol. The vaccine development will be promised on breaking the different life cycle stages of the schistosomes' species (WHO 1995).There is now general agreement among experts in the field that durable and sustained spectrum & Transmission can only obtained through long term protection via vaccination linked with chemotherapy. An effective anti Schistosome vaccine contribute greatly to decrease in morbidity associated with Schistosome via protective immune response lead to reduced worm burdens and decrease egg production.

4. Materials and Methods

4.1 Study area

The study was carried out from November 2015 to April 2016 in HHC of Haik town, the Administrative city of Tehuledere District, northeast Ethiopia. Haik town is located 430 km north of Addis Ababa with geographic coordinates 130 30.59"N latitude and 039028.849"E longitude. Its altitude is 2200 m above sea level the area covers 447.8 km^2 with a total population of 108,993. From these males are 58,589 and 50,404 females (CSA 2007). The major occupations of the inhabitants include trade, civil service, daily labor and subsistence agriculture in the sub-urban villages. Water bodies including the Ankerca River, Logo Lake, Ardibo Lake and Kett·e River are major sources of irrigation and sanitation usage in Tehuledere *woreda* (Figure 2).

In the Haik Health Center there are eight Health Officers, sixteen nurses, three Laboratory Technologists and nineteen Administrative workers. In the laboratory room there are sufficient compound light microscopes, one Refrigerator, one desk top computer and other diagnosing apparatus, reagents and chemicals were available. At average almost five hundred individuals get treatment, delivery services, education about preventive technique for diseases in the HHC per month.

4.2 Study design and population

In a cross-sectional study patients suspected of Intestinal Parasite Infections (IPIs) (diarrhea and intestinal pain) 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*. Eligible subjects were those patients clinically suspected of IPIs and had stool examination from 5 years old and above included in the study. Under-5years old children were excluded. Observation checklist was done and clinical information including diarrhea medication histories were obtained from the patients' medical records. Systematic observation was used to assess overt and obvious physical appearance of the patients during questionnaire filling to capture pertinent information.

4.3 Sample collection and analysis

A single fresh stool samples were collected with leak proof and tightly cupped, labeled clean stool cups. The stool samples were examined macroscopically for consistency (formed, soft, loose, pasty, watery or bloody), presence of adult worms or segments, and for any other physical abnormalities. The 2gm of stool samples were emulsified with 3-4 ml normal saline, then a drop of emulsified sample was placed on a glass slide, few drops of iodine were added, and all covered with a cover slip. The preparation was first examined under objective lens 10x, then 40x for identification of parasites under low light intensity.

4.4 Data quality control

To ensure reliable information:-Before the data collection period, the questionnaire and laboratory materials was pretested in the random selected patients on 2 % of the total sample size. Training for data fillers was done. Standard operating procedures were used for sample collection and processing for keeping a good quality study. The result of laboratory examination was recorded on well prepare format carefully and it was attached with questionnaire.

4.5 Data analysis

Data were entered into Microsoft Excel, and coded appropriately and SPSS version 16 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.

4.6 Ethical considerations

The study was approved by the Department of Zoological Sciences, Addis Ababa University (ref. № SF/ZS/1491/07). And permission was obtained from Tehuledere Health Office. Informed consent was sought from each adult participant or guardian in case of children aged less than 18 years prior to data collection. All schistosomiasis positives were treated.

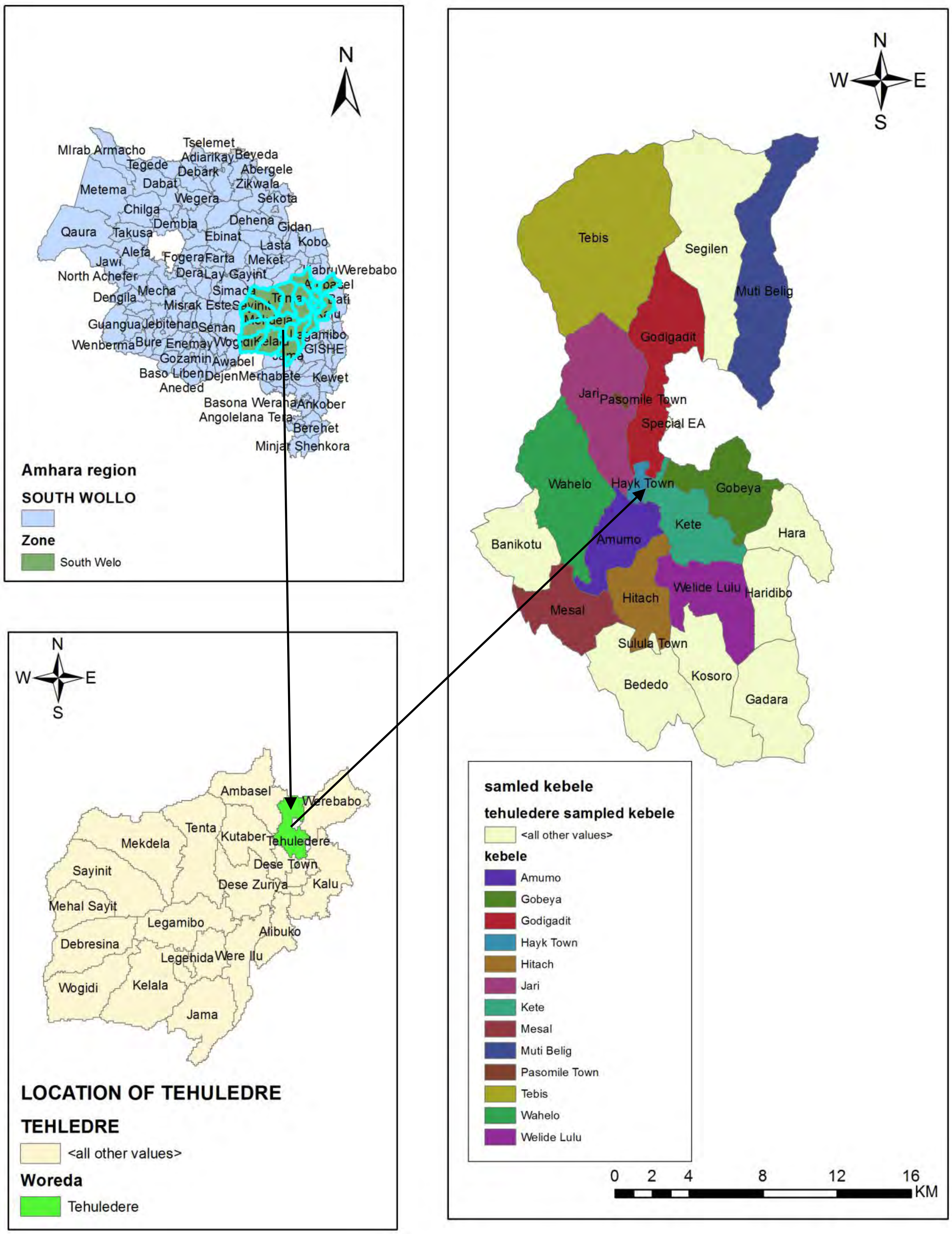

Figure 2 Map of the study area (source: the investigator (May, 2016).

5. Results

5.1 Socio-demography

A total of 500 individuals (226 from Haik Town and 274 its surroundings) participated in the study (Table 1 and 2). Of these, 295(59.0%) were males and 205(41.0%) females (Table 1 and 2). Overall 301(60.2%) individuals were aged>15 years, 78(15.6%) between 10-15 and the rest 121(24.2%) were 5-9 years old (Table 1 and 2). The educational background of the participants varied, ranging from illiterate 208 (41.6%), read/write 25(5%), primary education 118 (23%) to secondary education and above 149(29.8%) (Table 1 and 2). In case of occupation, 206(41.2%) were farmers, 57(11.4%) civil servant, 6(1.2%) housemaid and 231(46.2%) merchants, students and others (Table 1 and 2).

5.2 Stool sample result

From a total of 500 patients examined at HHC participated in the study 44(8.80%) were found to be positive for *S. mansoni* (Table 1 and 2). The higher prevalence of infection (75.0%) was found from the neighboring communities and the rest 25% from Haik town with significant difference (p=0.001). The proportion of positive individuals among males (61.36%) was slightly higher than that in females (38.64%), but the difference was not significant. With respect to age the highest prevalence (21(47.72%) was among age group 10-15 years followed by >15 (15(43.09%), 5-9 years 8(18.18%) with significant difference (Table 1 and 2).

5.3 Risk analysis

Patients aged 10-15 years were almost three times more likely infected than the other age groups (adjusted odds ratio (AOR) 2.670, 95% confidence interval (CI) 1.013-7.039, p=0.001). Patients having toilet facility were more protected than those having improper toilet (AOR 0.055; 95% CI 0.01-0.299, p=0.001). Similarly, patients who did not perform irrigation activities were less likely to be infected by *S. mansoni* than involving in irrigation and related activities (AOR 4.842, 95% CI 1.956-11.986, p=0.001) (Table 2). On the other hand, patients who are using river as a source for domestic needs were almost three times more infected than those using tap\piped water (AOR 3.232; 95% CI 0.834-12.52, p= 0.001). Patients who do not exercise swimming frequently were significantly more protected (AOR 0.32; 95% CI 0.114-0.859, p=0.024) than those who swim regularly (Table 2). In the same fashion, patients who are using untreated drinking water were seven times more infected than using properly treated water(AOR 7.424, 95% CI 1.907- 28.94, p = 0.004) (Table 2).

In case of residence, patients who were living in Haik town were more significantly protected (AOR 0.062; 95% CI 0.018- 0.480, P = 0.001) than those from rural communities (Table 2). The Univariate and multivariate logistic regression analysis results are indicated in Tables 1 and 2.

Table 1 Binary logistic regression analysis of Socio-demographic and other variables associated with *S. mansoni* infection in patients examined at HHC, northeast Ethiopia, November 2015-April 2016 (N=500)

Variables	Options	N	Positive(n, %)	COR	95% CI	P-value
Sex	Male	295	27 (9.15)	1.14	1.59-2.102	0.739
	Female	205	17(8.2)	1.00		
Age (year)	5-9	121	7(5.78)	0.94	0.40-2.19	0.89
	10-15	78	15(19.23)	3.17	1.55-6.501	0.002*
	>15	279	22(7.88)	1.00		
Residence	Town	226	11(4.86)	1.00		
	Rural	274	33(12.04)	5.42	1.32-5.42	0.006*
Educational status	Illiterate	208	12(6.12)	1.20	0.32-4.41	0.79
	Read/write	25	1(4.0)	0.81	0.081-8.27	0.86
	Primary school	118	18(15.2)	3.54	1.00-12.5	0.05
	≥High school	149	13(8.7)	1.00		
Occupation	Farmer	206	22(10.6)	0.33	0.158-0.73	0.006*
	civil servant	57	2(3.50)	0.02	0.056-1.031	.055
	Housemaid	6	0(0.00)	0.73	0.056-1.031	.771
	Others	231	20(8.6)	1.00		
Aware of transmission	Yes	116	4(3.45)	1.00		
	No	340	40(11.76)	8.540	1.15-8.70	0.036*
Toilet access and use	Yes	116	4(3.44)	1.00		
	No	384	40(10.4)	14.00	1.906-102.8	0.009*
Water treatment	Boiling	131	3(2.3)	0.375	0.081-1-72	0.208
	Filtering	169	8(4.9)	0.691	0.196-2.442	0.567
	Nothing	132	29(28.15)	0.72	1.584-13.9	0.005*
	Other	68	4(5.88)	1.00		
Irrigation practice	Yes	176	28(15.9)	4.092	2.12-7.86	<0.0001*
	No	324	16(4.9)	1.00		
Health education	Usually	155	2(1.2)	0.057	0.14-0.240	<0.0001*
	Sometimes	136	3(2.2)	0.98	0.030-0.325	<0.0001*
	Never	209	39(18.6)	1.00		
Swimming habit	Never	119	3(2.5)	3.014	1.137-7.99	0.027*
	Rarely	9	2(22.2)	2.742	1.271-5.915	0.010*
	Frequently	163	10(6.1)	5.275	1.281-21.72	0.021*
	Sometimes	206	29(14.0)	1.00		
Water collecting source	Stream	124	6(4.8)	3.051	0.845-11.019	0.089
	Hand pump	24	8(33.3)	17.33	5.885-51.051	<0.0001*
	River	142	26(18.30)	60.00	14.92-241.29	<0.0001*
	Tap water	210	4(1.9)	1.00		

CI: confidence interval: COR: Crude odds ratio, n: number of people, %: percentage;*statistically significant

Table 2 Multivariate logistic regression analysis of socio-demographic and other variables independently associated with *S. mansoni* infection in patients examined at HHC, northeast Ethiopia, November 2015-April 2016 (N=500)

Variables	Options	N	Positive (n, %)	COR	AOR	95% CI	P value
Water collecting source	Streams	124	6(4.8)	3.051	4.048	1.337-12.309	0.014
	Hand pumps	24	8(33.3)	17.33	7.061	1.517-32.804	0.090
	River	142	26(18.3)	60.00	3.232	0.834-12.526	0.001*
	Tape water	210	4(1.9)	1.00	1.00		
Swimming Habit	Never	122	3(2.4)	1.00	1.00		
	Frequently	9	2(22.22)	5.275	0.32	0.114-0.859	0.024*
	Rarely	163	10(6.1)	3.014	5.473	0.551-54.364	0.147
	Sometimes	206	29(14.0)	2.742	2.482	0.475-13.021	0.281
Treatment of water	boiling	131	3(2.2)	0.37	2.212	0.393-12.454	0.368
	Filtering	169	8(4.7)	0.375	4.394	0.930.20.773	0.062
	Do nothing	132	29(21.9)	0.691	7.424	1.907-28.940	0.004*
	Other	68	4(5.88)	1.00	1.00		
Age(years)	5-9	121	7(5.7)	0.94	0.514	0.164-1.610	0.253
	10-15	78	15(19.2)	3.17	2.670	1.013-7.039	0.001*
	>15	301	22(7.3)	1.00	1.00		
Residence	Haik	226	11(4.8)	1.00	1.00		
	Rural	274	33(12.0)	5.42	0.062	0.018-0.480	0.001*
Toilet access and use	Yes	116	4(3.4)	1.00	1.00		
	No	384	40(10.4)	14.00	0.055	0.010-0.299	0.001*
Irrigation practice	Yes	176	28(15.9)	4.092	4.842	1.956-11.986	0.001*
	No	324	16(4.9)	1.00	1.00		
	Total	500	44(8.80)				

CI: confidence interval: AOR Adjusted odds ratio, no: Number, %: percentage;*statistically significant

6. Discussion

In the present study an overall prevalence of *S. mansoni* infection was 8.80%. This result is higher than the findings of previous studies from Babile town, eastern Ethiopia, which was 4.3% (Girum 2005). However, lower than the findings on schoolchildren of Libo-kemkem northwest Ethiopia, which was 15% prevalence (Tesfahun and Achenef 2015), in Mizan-Aman Town which was 44.8% prevalence, southwest Ethiopia (Jejaw et al. 2015). And in Haik town the stool samples were processed for microscopic examination using kato-katz technique and prevalence was found to be 45% (Amsalu et al. 2015). In Dembia, northwest Ethiopia it was 11.2 % (Alemu et al. 2016). Moreover, *S. mansoni* infection among school children in different parts of Ethiopia was higher than the current prevalence (Jemaneh 1998; Erko et al., 2001; Erko et al., 2009). The apparently lower prevalence of *S. mansoni* in this study may be due to the direct wet-mount method, season and type of study population. Most of the above studies were on schoolchildren who are high-risk groups. Moreover, the variation might be due to differences in water-contact behavior of the participants, environmental sanitation and socioeconomic status, ecological distribution of snails, local endemicity and sample size.

In present study, there was age-related difference with the highest prevalence among patients 10 -15 years old followed by >15 and 5-9 years. This is in disagreement with reports of many investigators in different localities of Ethiopia (Fekadu et al. 1993; Berrie et al., 1998; Dejene and Petros 2009) and in other countries such as, (Handzel et al. 2003) from Kenya and (John et al. 2008) from Uganda. In contrast to this, some reports described that the highest infection prevalence of *S. mansoni* to be in children with ages ranging from 5-9 years old and the least prevalence to be in patients with ages ranging from 10-14 years (Grum 2005; Dejene and Petros 2009). This might be due to higher rate of water contact among those children with ages ranging from 10-14 years and the least infection in the age groups 5-9 and >15years, which might be due to low outdoor water contact activities and the development of age-acquired immunity to re-infection, respectively.

In this study, toilet ownership and use, swimming habit, irrigation practice*,* rural residence, source of water and ways of treating water were significantly associated with *S. mansoni* positivity. Similar previous reports found statistically significant association of schistosomiasis with swimming habit of schoolchildren (Abebe et al. 2011). Frequency of water contact was identified as risk factor for *S. mansoni* infection in which children with frequent water contact were more infected than those who have less frequent water contact. Similarly, patients who use river water source for household use were more infected than those who use piped water. This corroborates with other studies (Mulugeta et al. 2014; Rupiah et al. 2015). This could be due to patients who have frequent water contact activities may have high rate of vulnerability to *S. mansoni* infection. 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, this could be due to rivers that act as a road between Haik town and catchment kebeles of Tehuledere communities, which makes them to stay in contact with water bodies that contain *S. mansoni* cercariae.

At the end, 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 in Kitt'e and Jiri Rivers may further increase the prevalence of schistosomiasis.

7. Conclusion and recommendation

S. mansoni infection is an important health problem among patients examined at HHC. The possession and use of toilet, swimming habit, Irrigation practice and Residence were observed as strong risk factors for *S. mansoni* infection. Therefore, prompt intervention strategies should be designed and implemented including provision of adequate safe water supply, regular de-worming and health education on personal as well as environmental hygiene.

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9. Annexes

Annex 1: Written consent form

Date_________

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 "Schistosomiasis mansoni infection & associating risk factors in Haik town Tehuledere district, South Wello Zone" which helps in understanding the prevalence of parasitic infection in relation with KAP of different communities towards parasitic disease. For this study, I was requested to give stool sample for intestinal parasites identification and I was informed that I will get proper therapy if I found to be positive for 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 participant 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 2: Consent form (Amharic version)

የስምምነት ቅጽ (consent form Amharic version)

ተራ ቁጥር------------------

የካርድ ቁጥር---------------

ስም-------------------------

እኔ ከላይ በስም ተጠቃሹ የአንጀት ጥገኛ (Intestinal Schistosomiasis) ሳይኖርብኝ እንደማይቀር ተነግሮኛል በሽታየን ለመመርመር የሰገራ ናሙና እንደሚይያስፈልገኝ ተነግሮኛል:: ይህ ናሙና የበሽታየን | የልጅን በሽታ ምንነት ለማወቅ የሚያስቹል ምርመራ የሚካሄድበት ነው:: በተጨማሪም ከዚሁ ናሙና የተወሰነው ክፍል የበሽታውን ስርጪት(prevalence) ለማጥናት ለሚደረገው ጥናት አላማ እንደሚውል ተገልጾ ተነግሮገኛል::እኔም ሰለጥናቱ በደንብ ከተረዳሁ በሁላ የጥናቱ መረጃ : መሰብሰቢያ መጠይቅ ላይ የተዘረዘሩትን መረጃዎች ሁሉ በሚሰጥር የሚያዙ መሆናቸውንና የሰምምነት ቅጹም በሚሰጥር ተይዞ ጥናቱ እንደሚካሄድ ተገንዝቢአለሁ ሰለሆነም ያለምንም አስገዳጂ ሁኔታ የጥናቱ ተሳታፊ መሆኔን በፊርማየ አገልጻለሁ::

ፊርማ---------------

ቀን----------------

Annex 3: 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 figure Part

I-Study participant identification

Woreda: __________

Kebele: ____________

Age______________

Sex: Male-- Female---

Educational status: Illiterate Read/write __only Years of formal education others (Specify)

II- information about occupation: Farmer ----- Merchant--- Government employee---

Dayworker-- Servant--- other (specify)

III-Information about KAP towards parasitic disease

1. Do you face helminthes problem? A. Yes B. No

2. Schistosomiasis can be transmitted from person to person? A. Yes B. No

3. Do you know how *S. masoni* infect human? A. penetrate Skin B. Housefly bite C. Drinking of dirty water D. Due to sins E. No idea

4. When infected with intestinal parasites you consulted to--A. Govt. health centers B. Private Clinics C. Both Govt. and private clinics D) Traditional healers E. Do nothing

5. According to you, Schistosomiasis is? A. Ordinary disease B.Serious disease if not treated in time C. No idea

6. According to you, Schistosomiasis control should be carried out by the A.Govt. agencies only B. Private Agencies C. Public D. all E. No idea

7. Do you follow health extension education which is given by health extension workers? A) Usually B) Sometimes C) Never

8. What is the source of infection of Bilharziosis? A. River B .soil C Air D.no idea

9. Do you have your own toilet? A. Yes B. No

10. How do you use drinking water? A-By boiling B- By filtering C- Without treatment D- Other (specify)…..

11. Where do you fetch drinking water? A.Stream B. open well C. hand pump water D.River E.Tap water

12. Do you wear shoe while you walk? A) Usually B) Sometimes C) Never

13. Do you wash your hand before eating A) Usually B) Sometimes C) Never

14. Do you practice irrigation? A) Yes B) No

15. Do you go swimming? A Never B. Rarely C. frequently D. Sometimes

Adapted: from research journals

Thank you for your cooperation

Annex 4: Questionnaire (Amharic version)

ቀን-------------------

የኮድ ቁጥር ---------------

ስ ም ----------------------

የብልሃርዚያ በሽታ ስርጭት እና አጋላጭ ደንቢዎች ለማጥና ት የተዘጋጀ ቃለ መጠይቅ

የዚህ ቃለመጠይቅ አላማ በሐይቅ ከተማ እና ዙሪዋ ባሉ በተሁለደሬ ወረዳ ውስጥ በሚገኙ ቅርብ

ቀበሌዎች ያሉ እና በሐይቅ ጤና አጠባበቅ ጣቢያ የአንጀት ጥገኛ በሽታ ታካሚዎች ላይ ስረጭትን ጥገኛው ላይ ያለን አመለካከት ልማድ እና አጠቃላይ የጤና ደረጃን ለመገንዘብ እና ለመግለጽ ታስቦ የተዘጋጀ ነው፡ ፡

የአንጅት ጥገኛ በሽታውን ለመመርምር የሰገራ ናሙና ከሰጡ በኋላ ለጥናቱ ተባባሪ የሆኑትን ታካሚዎች መጠይቁን እንድሞሉ አጥኚው በትህትና ይጠይቃል ፡፡ ስለሆነም ሁሉም የሞሏቸው መረጃዎች ሚስጥራቸው የተጠበቀ ይሆናል ፡ ፡

መጠይቁን የሞሉት አጠቃላይ መረጃ

ወረዳ ----- ቀበሌ------- የቤት ቁጥር --------- እድሜ------ ፆታ ወ------ሴ-------

የስራ ሁኔታ አርሶ አደር ---------ንጋዴ-----------የመንግስት ተቀጣሪ---------የቀን ሰራተኛ-----የ ቤት ሰራተኛ ---------

የትምህርት ሁኔታ ያልተማረ-------------ማንበብእና መጻፍ ብቻ የ-----ዓ መት የተማረ

<u>መጠይቅ</u>

1. በትል የሚመጣ በሽታ ይዞዎት ውቃል ሀ . አያውቅ ም ለ . ያውቃል

2. የ ብልሀርዚያ በሽ ታ ከሰው ወደ ሰው የተላለፋል ሀ . አዎ ለ . አይተላለፍም

3. የ ብልሀርዚያ በሽታ ወደ ሰው የሚገባው? ሀ . ቆዳን በመሰርሰር ሐ. የቆሸሸ ውሃ በመጠጣት

 ለ . በዝንብ ንክሻ መ.በእርግማን ረ . ሀሳብየለንም

4. ወባ ና የአንጀት ጥገኛ ተህዋስ ሲይዘዎት ማንን ያማክራሉ ሀ . የመንግስት ጤና ጣቢያ ለ . የግል

ክሊኒክ ሐ. ሑለ ቱንም መ. ባህላዊ ሃኪሞችን ረ . አላማክርም ሸ . ሌላ ምካለ ይግለጹት

5. እንደ እርሰዎ ሃሳብ የብልሀርዚያ በሽታ--አይነት በሽታ ነው፡፡

 ሀ መደኛ በሽታ ለ.ካልታከሙት አደገኛ በሽታ ሐ.መልስ የለም

6. በእርሰዎ ሃሳብ የብልሀርዚያ በሽታን መቆጣጠር ና መከላከል ስራ የሚሰራው ማነው? ሀ . መንግስት ለ የግል ድርጅት ሐ. ህዝቡ መ. ሁሉም ሠ. አላውቅ ም

7. በጤና ኤክስቴንሽን የሚሰጠውን የጤና ትምህርት ይተገብራሉ ?ሀ . ሁል ጊዜ ለ . አንዳዴየ ሐ. ፈጽሞ አልሰራም

8. የብልሀርዚያ በሽታ ምንጭ የሆነው ሀ . ወንዝ ውሃ ለ . አፈር ሐ. አየር መ. መልስ የለም

9. እ ራሰዎ መጸዳጃ ቤት አለዎት? ሀ . አዎ ለ .የለኝም

10. የ መጠጥ ውህ እንዴት ይጠቀ ማሉ? ሀ . በማፍላት ለ . በማጥለል ሐ. እንድሁ መ. ሌላ ካለይዘርዝሩ

11. የ ሚጠጡትን ውሃ ከየት ይቀዳሉ? ሀ . ከምንጭ ለ . ከቧንቧ ውሃ ሐ. ከወንዝ መ. ከሀይቅ ሠ. ከጉድጓድ

12. ሲንቀሳቀሱ ጫማ ይለብሳሉ?ሀ . አንዳንድ ጊዜ ለ . ሁል ጊዜ ሐ. አለብስም

13. ከ መመገበዎ በፊት አጀዎን ይታጠባሉ ?ሀ. አንዳንድ ጊዜ ለ. ሁል ጊዜ ሐ. አልፎአልፎ መ.አለታጠብም

14. የመስኖ ስራ ይሰራሉን ?ሀ እሰራለሁ ለ.አልሰራም

15. ወንዝ ወይም ሃይቅ ይዋኛሉ? ሀ .አልዋኝም ለ . አልፎ አልፎ ሐ. ሁልጊዜ መ. በጣም አልፎ አልፎ

Annex 5: Operational definitions of variables in the Thesis

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

Haik town -Administrative town of the Tehuledere Woreda.

Tehuledere woreda - Is segments of South Wollo Zone and compartmentalized into 22 kebeles.

S.mansoni -Causative agents of Bilharziasis.

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 cross sectional study -An observational study in which exposure & disease are determined at study the same point in time in a given population.

Annex 6: *S. mansoni* parasite Distribution among patients examined at HHC December 2015/ 2016.

Slide no	Sex	Kebeles
S3	Male	Kete
S9	Female	Kete
S14	Female	Fegro
S15	Male	Nebo
S23	Female	Pissa
S24	Female	Kete
S30	Female	Seglen
S35	Male	Seglen
S59	Female	Mutibelg
S71	Female	Mutibelg
S74	Male	Amumo
S91	Male	Amumo
S96	Male	Kete
S97	Male	Kete
S106	Male	Fegro
S111	Female	Fegro
S118	Female	Kekewa
S119	Male	Woldelulu
S125	Male	Woldelulu
S228	Male	Fegro
S239	Male	Fegro
S240	Female	Gobeya
S241	Male	Gobeya
S251	Male	Kete
S269	Male	Mesale
S309	Female	Meale
S310	Male	Hiteca
S334	Female	Hitecha
S335	Female	Kete
S359	Male	Wahelo
S369	Female	Kete
S371	Male	Wahelo
S372	Male	Wahelo
S373	Female	Jari
S401	Female	Jari
S435	Male	Jari
S446	Male	Pasomile
S451	Male	Pasomile
S452	Male	Godgadit
S461	Female	Tebasit
S462	Male	Tebasit
S484	Male	Amumo
S485	Male	Korke
S499	Male	Korke

Figure: Haik Health Center photo taken by an investigator April (2016).

Figure: 4 Field observations of people activities at Kette River about 1km far from HHC (2016)

10. Declaration

I, the undersigned, declare that this is my original work and has never been presented for a degree before and all source materials used are duly acknowledged.

Name Seid Retta

Signature________

Date September 20, 2016

11. Statement of the Supervisor(s)

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

Name Hassen Mamo (PhD)

Signature ___________

Date________________