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Original Research

Schistosoma mansoni Infection in Finchaa Sugar Estate: Public health Problem Assessment based on Clinical Records and Parasitological Surveys, Western Ethiopia

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Abstract

The survey of *Schistosoma mansoni* (*S. mansoni*) in Finchaa Sugar Estate, Western Ethiopia, was conducted to investigate the prevalence and health problems of schistosomiasis with some of the risk factors. The examination was undertaken based on the analysis of retrospective clinical data from the health center and a cross-sectional parasitological examinations using Kato-thick smear slides in April-June 2012/2013. Over the period 2008 to 2013 average prevalence among suspected patients at the health centre was 30.9%. Examination of double kato-thick smear slides from a random sample of 602 individuals from most schistosomiasis affected camp 7 revealed the prevalence of 37.5%. *S. mansoni* infection is become a year-round public health problem in Finchaa, Sugar Estate possibly due to permanent streams, water bodies and water contact behaviors and also reduced effectiveness of current control measures. Among the 7th camps, village A (camp 7) is the most schistosomiasis affected area (37.5%) followed by Kuyisa (25%). This is attributed to the presence of permanent stream (Fekerie stream) near camp 7. The present finding shows that the prevalence and intensity of schistosomiasis in the more affected camp 7 of Finchaa Sugar Estate was significantly higher among males than in females and its prevalence and intensity was found to be higher among study population within the age group of 11-20 years old. This study indicates that schistosomiasis is a major health problem in Finchaa Sugar Estate with moderate prevalence. The study results will provide an additional clinical and parasitological data on the current status of *S. mansoni* in Finchaa Sugar Estate and could serve as a guide in designing, developing and implementing intervention strategies to mitigate morbidity due to *S. mansoni* especially in highly risk groups under the Ethiopian health service system.

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INTRODUCTION

Schistosomiasis is a parasitic disease caused by blood flukes of the genus *Schistosoma.* An estimated 700 million people are at risk of infection in 76 countries, considered endemic, as their agricultural work, domestic chores, and recreational activities expose them to infested water (Ross *et al*., 2007). After malaria, schistosomiasis is the second most devastating tropical disease in the world (Ross *et al*., 2007). The most important species that infect humans are *S. japonicum*, *S. mansoni and S. haematobium*. Adult schistosomes live in mammalian or human host and use freshwater snails as intermediate hosts. The schistosomes develop into adults in the blood vessels surrounding the urinary or intestinal tracts. Adults release eggs which can circulate and become lodged in the veins and other organs causing painful inflammation and chronic illness (Alam *et al*., 2009).

Geographic distribution of the disease depends on the distribution of intermediate snail host and the opportunity to infect humans and snails (Lima *et al*., 1987). Infection occurs throughout much of tropical and subtropical areas of the world. Transmission of *S. mansoni* relies on contamination of water by excrement, adequate environments for appropriate aquatic snail intermediate hosts, and skin exposure to contaminated water. Any contact with contaminated water such as bathing, washing clothes, collecting water for cooking, getting a drink, fishing, sailing, farming canal irrigated lands, and brick making could put one at risk of infection. As little as one exposure to cercariae-containing water per year is sufficient to maintain transmission (King and Dangerfield-Cha, 2008). Social, cultural, behavioral and economic factors interact with local environmental and ecological factors to produce extraordinary variation in the

epidemiology of schistosomiasis with respect to prevalence and intensity of infection (Hibbs *et al*., 2011).

Infection is predominant in endemic countries in school age children, fishermen, farmers, irrigation workers and others using infested water for their domestic and/or recreational purposes. Epidemiologic studies in modern populations typically find a higher prevalence of schistosomiasis among males than females (Abdel-Wahab *et al*., 2000). This is likely the result of a gendered division of labor involving water contact.

In Ethiopia, both intestinal schistosomiasis caused by *S. mansoni* and urinary schistosomiasis caused by *S. haematobium* are pose considerable public health problem (Ali *et al*., 2006). In the country, *S. mansoni* is widely distributed and covering most of the places between 1300-2200m altitudes where as the distribution of *S. haematobium* is restricted to some lowlands below 800m in Awash, Kurmuk (near the Sudan border) and Wabe Shebele areas (Erko *et al*., 1997a). In the Wester part of Ethiopia, most of the endemic places are located along Nile valley, in Finchaa Sugar Estate, Agallu-Meti and Dalati-Sirba areas (between Benishangul-Gumuz and Oromia) (Erko *et al*., 2003; Gundersen *et al*., 1998). In the country despite the fact that schistosomiasis is high in prevalence and associated morbidity especially in children (Berhe *et al*., 2009) and its control effort (Erko *et al*., 1997a) were not well studied and implemented.

The Finchaa Sugar Estate in Western Ethiopia is such a large estate farm with an irrigation system, associated agro-industrial activities and high population influx. The area has significant occurrence of malaria and other parasitic diseases. Regarding *S. mansoni* Erko *et al*. (2003) reported that, there is a prevalence of 26% among the residents and 56% among the school children of the most schistosomiasis affected camp 7. Morbidity control, the current global strategy in the control of schistosomiasis, calls for research to assess the status of schistosomiasis with some of the risk factors. Therefore the present study was initiated in order to investigate the current extent/status of *Schistosoma mansoni* transmission and its public health importance in Finchaa Sugar Estate, Western Ethiopia.

MATERIALS AND METHODS

Study Area, Study Subjects and Parasitological Examination

Across-sectional study was undertaken from April-June 2012/2013 in about 602 study population, who participated in a *S. mansoni* related morbidity study in the selected village (camp 7) of Finchaa Sugar Estate located in Horro Guduru Wollega Zone of the Oromia Regional state, Wester Ethiopia. The area is about 350 km west of Addis Ababa and is situated between 9^0 30'N to 9^0 60' N latitudes and 37^0 10' to 37^0 30' E longitudes and at an altitude of about 1,350-1600 m above sea level. The area is stretched in most part of the Finchaa River valley cultivating more than 10,500 hectares of irrigated land (Figure 1).

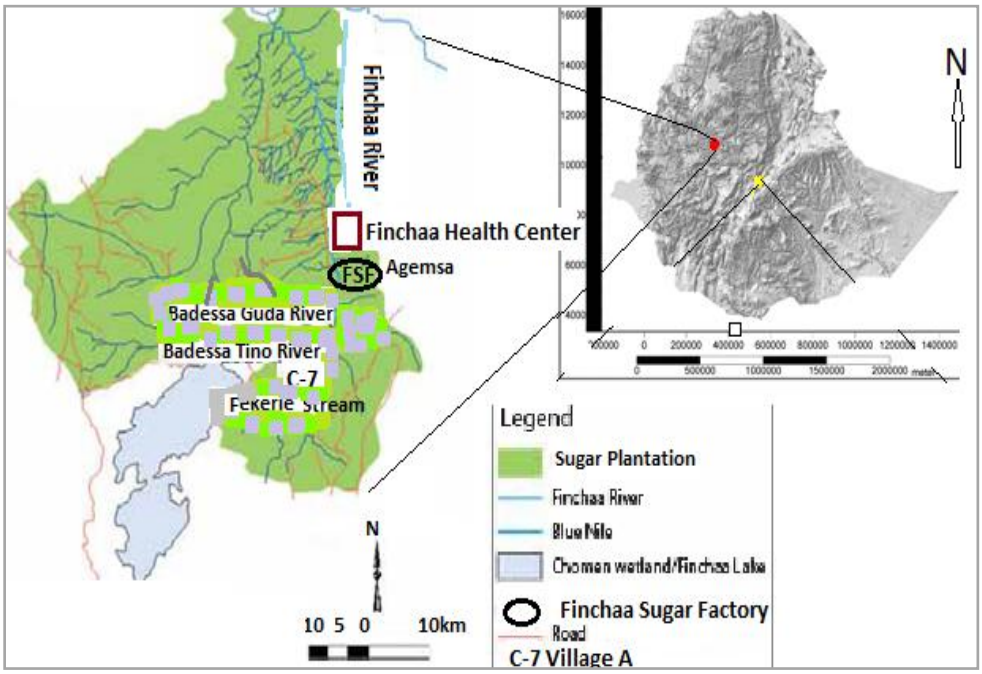

Figure1: Sketch-map of the study area -Finchaa Sugar Estate
(Adapted from www.booker-tate.co.uk/media/4616/ethiopia%20finchaa%202010)

Table 1: The description of the study population in Finchaa (Camp 7) during April 2013 (N= 602), Horro Guduru Wollega, Western Ethiopia.

Village	Total household No. (%)	Sampled household No. (%)	Total population No. (%)	Sampled population No. (%)		
				Male (%)	Female (%)	Total
A (Camp 7)	225	11	5000	322 (53.5)	280(46.5)	602

Using a computer software Open Epi, Version 2, SSCC, for a cross-sectional study, assuming OR=2.50 (Kelsey *et al*., 1996) about 602 individuals were taken at random from the census data of the study village. A day before the date of examination, field assistants visited all households selected for the study and invited all household members to provide stool specimens. Stool samples were processed using 41.7 mg templates according to the modified Kato-Katz technique (Peters *et al.,* 1980). For each study population, double Kato-Katz thick smears were prepared to optimize detection of *S. mansoni* infection. In order to express infection intensities as the number of eggs per gram of feces egg counts per slide were converted into eggs per gram of feces (EPG) by multiplying number of eggs on a slide by 24. The intensity of infection for positive subjects were then expressed as geometric mean and categorized as light, moderate and heavy infections as per the WHO (2002) protocol. All smears were examined within two weeks of their collection by two experienced technicians at Finchaa health center. As a quality control measure, 10% of randomly selected smears were re-examined by a third experienced laboratory technician who is blinded of the previous results.

Statistical Analysis

Data were entered on a computer and validation were performed in Microsoft Excel 2007 spreadsheets, and transferred in to SPSS version 20.0 software for statistical analysis.

Ethical Considerations

Ethical clearance was obtained from Research and Development ethics review committee of Wollega University (Reference No: WU-RD/194/2013). The aims of the study were initially explained during a meeting of community leaders and heads of households. All diagnostic and treatment procedures were carried out after obtaining informed consent/assent from each subject or his/her guardians as the case may be. Free treatment was offered to all study population with schistosomiasis and/or other helminth infections under the supervision of Finchaa health center physician based on the national protocol.

RESULTS

Demographic Data

From the total of 602 study population (from Camp 7) 322 (53.5%) were males and 280 (46.5%) were females. The mean age of the study population was 21.47±13.32.

Clinical Records

Clinical records of monthly mean prevalence from 2008-2013 showed that there is a higher prevalence of schistosomiasis after heavy rainy seasons (September and October) and during small rainy seasons (April, May and June). This is due to the favorable environmental conditions created by the rainy seasons for snail vector (*Biomphlaria piffeferi*) to be more reproduced.

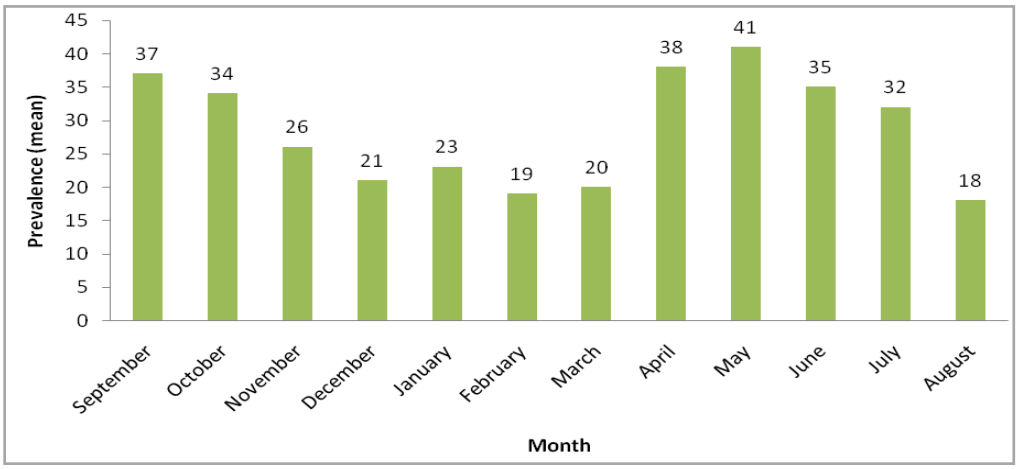

Figure 2: *S. mansoni* prevalence in Finchaa Health Center outpatients' from September to August in year 2008 to 2013.

Clinical records from 2008 to 2013 showed that there is a higher prevalence of schistosomiasis among males than females. This is attributable to more out door and water related activities among men than women (a gendered division of labor).

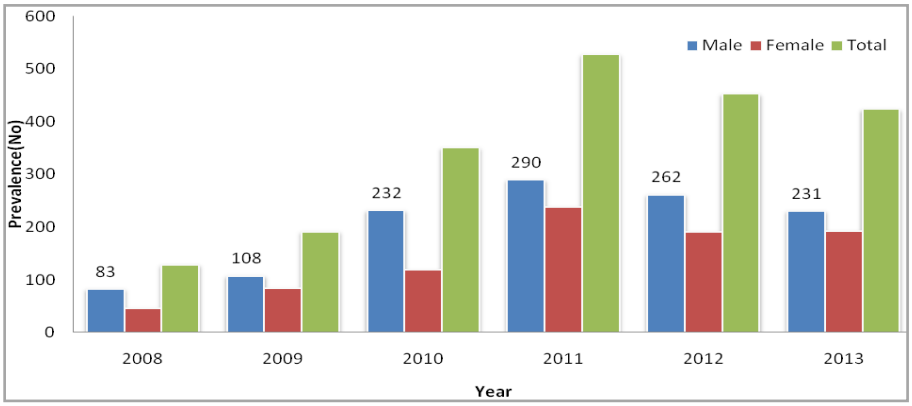

Figure 3: Sex specific prevalence of *S. mansoni* in Finchaa Health Center outpatients' from year 2008 to 2013.

Clinical records of *S. mansoni* in relation to other intestinal helminths from year 2008 to 2013 showed that *S. mansoni* infection is the first and most prevalent among other intestinal helminths. This is thought to be due to favorable environmental conditions created by the irrigation activities.

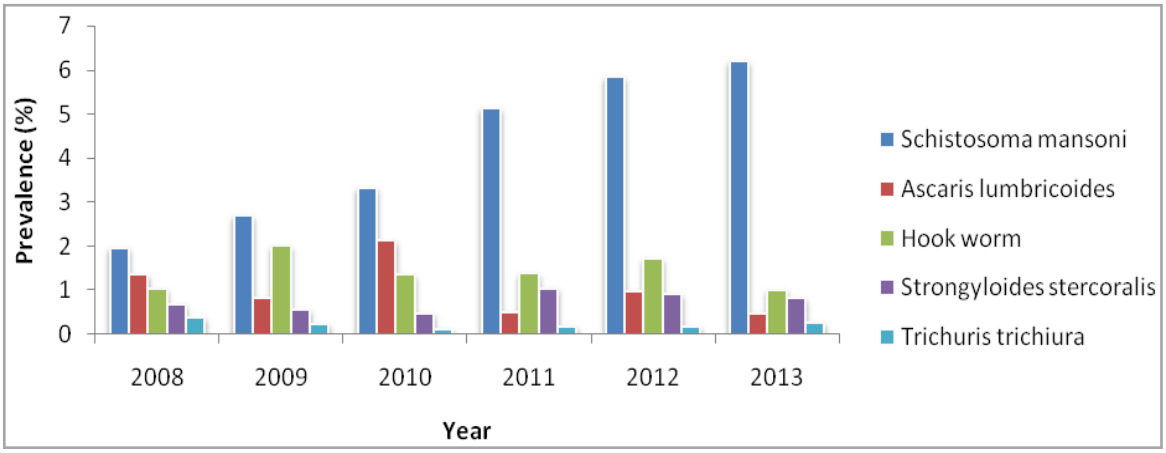

Figure 4: *S.mansoni* prevalence in relation to other intestinal helminths in Finchaa Health Center outpatients' from year 2008 to 2013

Parasitological Results

Among the 602 study populations examined from Camp7, 226 (37.5%) were positive for *S. mansoni* with geometric mean intensity, of 239.59 ± 172.94 eggs per gram of stool and a maximum intensity of 912 EPG among male and 576 in female.

Among the 7th camps, village A (camp 7) is the most schistosomiasis affected area (37.5%) followed by Kuyisa (25%).This is attributed to the presence of permanent stream (Fekerie stream) near camp 7 in addition to the numerous irrigation canals throughout the year.

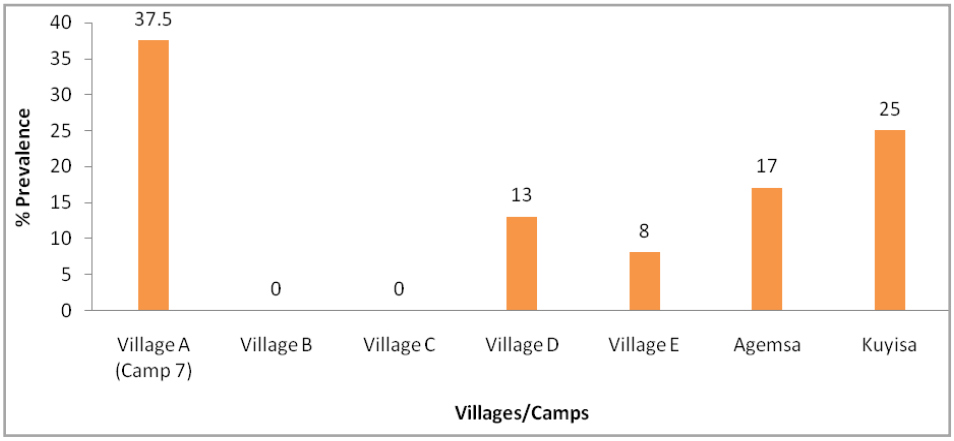

Figure 5: *S.mansoni* distribution and prevalence among villages of Finchaa Sugar Estate, April 2013

The highest infection of helminth cases was due to *S. mansoni* (37.5%) followed by hookworm infection (21%) and *S. stercoralis* (17%).Other Intestinal helminths which were not specifically shown here because of their extremely low prevalences includes: *Taenia saginata, H. nana*, *H. diminita* and *Enterobius vermicularis*.

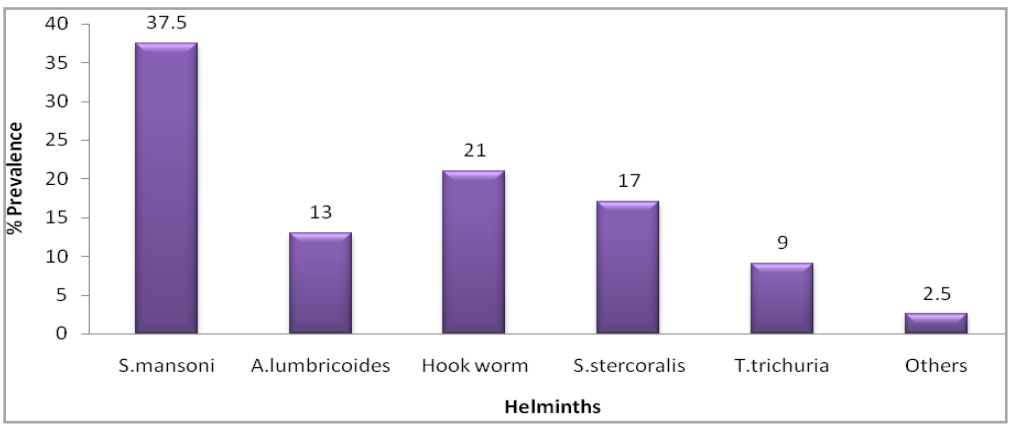

Figure 6: *S.mansoni* prevalence in relation to other intestinal helminths among study population in Camp 7, Finchaa Sugar Estate, April 2013 (n=226).

Of the 226 *S.mansoni* positive individuals, the prevalence was 151 (66.81%) among male study population which is higher than the prevalence in females 75(33.19%).

Table 2: Sex specific prevalence and intensity of *S.mansoni* among study population in Camp 7, Finchaa Sugar Estate, April 2013 (n=226).

Sex Category	Prevalence n, (%)	Mean Intensity EPG±SD
Male	151 (66.81%)	0.99±0.757
Female	75 (33.19%)	0.80±0.658

The study population were classified in to five age groups (5-10, 11-20, 21-30, 31-40 and >40); based on this age category, the prevalence of *S. mansoni* was found to be higher among children within the age group of 11-20 (39.4%) years old (Table 3).

Table 3: Age specific *S. mansoni* infection and intensity in Finchaa from April 2013 among study population in Camp 7, Finchaa Sugar Estate, (n=226).

Age category	Prevalence n, (%)	Mean intensity EPG±SD
5-10	84 (37.16%)	180.62 ±161.12
11-20	89 (39.38%)	251.06 ± 159.15
21-30	33(14.60%)	301.09±173.18
31-40	11(4.86%)	272.73±215.27
>40	9 (3.98%)	410.67±165.16

Based on WHO intensity category the intensity (EPG) of *S. mansoni* among different age groups was found to be higher among children within the age group of 11-20 years old (Fig.7).

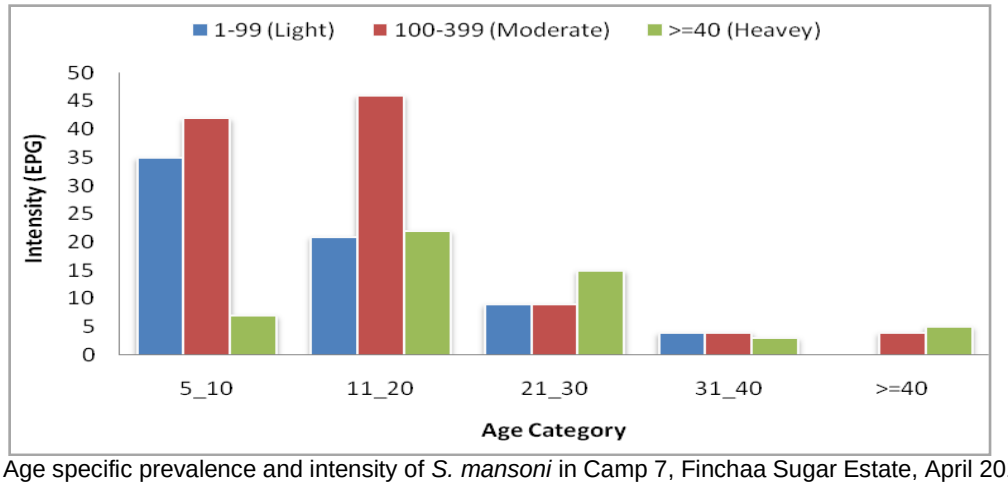

Figure 7: Age specific prevalence and intensity of *S. mansoni* in Camp 7, Finchaa Sugar Estate, April 2013, (n=226).

DISCUSSION

The study area falls within an area of *S.mansoni* endemicity in Ethiopia. In addition to the favorable climatic factors, there exists extensive irrigation farming which could create favorable conditions for a year-round schistosomiasis transmission. The presences of temporary and permanent streams in addition to the numerous irrigation canals are additional factors that may favor schistosomiasis transmission throughout the year. A clinical record showed that schistosomiasis has been increased from year to year (Fig.4).This is most likely due to population migration associated with irrigation development (Erko *et al*., 1997a). The main aim of the study was to assess the current status of schistosomiasis in morst schistosomiasis affected area camp 7.

In this study, the prevalence of *S. mansoni* among the community in the most schistosomiasis affected camp of Finchaa Sugar Estate (Camp 7) was 37.5% with geometric mean intensity, of 208.60±163.44 eggs per gram of stool. The disease has increased from 26% among the residents (Erko *et al*., 2003) to 37.5% as a result of population migration from time to time associated with irrigation development and expansion which is consistent with previous studies by Erko *et al*. (1997a).

In relation to other intestinal helminths among study population the highest infection of helminth cases was due to *S. mansoni* (37.5%) followed by hookworm infection (21%) and *S. stercoralis* (17%).This highest infection due to schistosomiasis might be the result of irrigation developments. It is well known that a strong association exists between water resource development projects, especially irrigation, and the transmission of schistosomiasis (Dejenie and Petros, 2009).

The present finding shows that the prevalence and intensity of schistosomiasis in the most schistosomiasis affected camp 7 of Finchaa Sugar Estate was significantly higher among males (66.81% and 0.99 ± 0.76 EPG) than

in female (33.19.% and 0.80±0.66 EPG) (Table 2). The result is almost in agreement with previous studies conducted by Erko *et al*. (2003) which reported that the prevalence and mean intensity of the disease was 63.00% and 125 EPG among male and 44% and 92 EPG among females. Similarly, studies conducted in Wondo Genet (Erko *et al*., 2002b) and Adwa (Legesse, 2008) also indicates similar results. The main reason accounted for this high infection of male was attributable to more out door and water related activities among men than women (Tadesse, 2005; Legesse, 2008). In addition, a study on re-infection patterns among Finchaa valley elementary school children also indicated that, male children are more engaged in bathing and playing in water than the females (Erko *et al*., 1997b).

WHO (2002) classifies the prevalence of schistosomiasis into three categories i.e., a prevalence rate > 50% as category I (high prevalence), 10%-50% as category II (moderate prevalence) and a prevalence of lower than 10% as category III (low prevalence). In this context, in the present study since *S.mansoni* prevalence was (37.5%) and less than 50% it is categorized under category II (moderate prevalence).

Regarding age groups the prevalence and intensity of *S. mansoni* infection was found to be higher among study population within the age group of 5-10 and 11-20 years old (5-20) (Table 3 and Fig.5).This is in agreement with previous studies conducted by Gunderson *et al*., (1990). Chronic infection negatively affects all aspects of children's health, nutrition, cognitive development and learning. The main reason accounted for this high infection rate among age 5-20 years old was attributable to more water related activities than other or older age groups.

CONCLUSIONS

The present clinical and parasitological survey is a study of public health problem assessment of *Schistosoma mansoni* infection. Based on information from clinical records and the parasitological survey data, the following conclusions and recommendations may be drawn about *S. mansoni* infection.

S. mansoni is among the major causes of morbidity and become a serious public health problem in most schistosomiasis affected camp of Finchaa Sugar Estate (Camp 7). Its prevalence in relation to other intestinal helminths among study population is 37.5% and shows the dominance infection. There is a higher prevalence of schistosomiasis after heavy rainy seasons (September and October) and during small rainy seasons (April, May and June). The study shows that there is a higher prevalence of schistosomiasis among males than females. The prevalence and intensity of *S. mansoni* among different age groups is found higher among children within the age group of 11-20 years old. Hence it has a serious health problem on this age groups and chronic infection negatively affects all aspects of children's health, nutrition, cognitive development and learning. The degree of water contact extensively for bathing, swimming, washing and domestic purpose is become the most important risk factor for infection of intestinal schistosomiasis. This survey can be used for the design and implementation of some intervention strategies to mitigate morbidity due to schistosomiasis.

Schistosomiasis survey in the community should be done more often accompanied with targeted chemotherapy for positive cases. Public health education, community participation and socioeconomic developments are necessary for reducing the risk of *S. mansoni* infection. In addition to the applications of chemotherapy against the parasite, Endod application against the snail vector should be used side by side.

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