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Prevalence of *Schistosoma mansoni* infection and associated factors in irrigation workers in Gamo Gofa and South Omo Zone, 2017: A Community based parasitological survey

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Schistosomiasis is one of the most prevalent parasitic diseases and an important public health problem in many developing countries. In this era of global warming and climatic changes, the epidemiology of temperature-dependent infectious diseases could be changing implying the possibility of new transmission area in the world in general and in Ethiopia in particular. This study aims to assess the prevalence of *Schistosoma mansoni* infection and associated factors in irrigation workers in Gamo Gofa and South Omo Zone, 2017. Community based cross-sectional parasitological survey was conducted between March and June; 2017. Data were collected by using pre tested structured questionnaire and stool sample was collected from each participant for laboratory investigation. Kato-katz technique was used as recommended by World Health Organization for stool laboratory investigation to relevant variables. Descriptive frequencies like cross tabulation was calculated to describe the study variables. Binary and Multivariable logistic regression analysis was undertaken to assess the presence and degree of association between dependent and independent variables. The prevalence of *S. mansoni* was found to be 14% [95%CI;(12.2, 15.8)]. Respondents with poor knowledge AOR; 2.18(1.12, 4.85),those not wearing shoes (bare foot) AOR; 1.44(1.15, 4.12) and who have not moved from one agricultural site to other sites; AOR 0.38(0.15, 0.35) were significantly identified as associated factors with *S. mansoni* infection. The prevalence of *S. mansoni* infection was moderate based on World Health Organization (WHO) schistosoma prevalence classification. The following are recommended: improving community knowledge on prevention methods and considering adult agriculture workers in South Omo Zone Nary River basin for mass drug treatment, Improving habit of wearing protective shoes, avoiding frequent contact with contaminated water bodies during bathing, swimming and crossing of water bodies' will be essential behavioral factors to reduce the infection of *S. mansoni.*

Key words: *Schistosoma mansoni*, irrigation workers, parasitological survey.

INTRODUCTION

Schistosomiasis is one of the most prevalent parasitic diseases and an important public health problem in many developing countries. Globally, schistosomiasis ranks second among parasitic diseases of socio-economic and public health importance and is found in 48 African countries (Chitsulo et al., 2000). The disease is mostly

seen among the poor Sub-Saharan Africa. It was listed among the 13 diseases classified by World health organization as “Neglected Tropical diseases (Hotez et al., 2007). Geographic distribution of the disease depends on the distribution of intermediate snail host and the opportunity to infect humans and snails. Infection occurs throughout much of tropical and subtropical areas of the world (Dufera et al., 2014).

In Africa, schistosomiasis is caused mainly due to infection by three endemic species of schistosomes namely *Schistosoma mansoni (S. mansoni*), *Schistosoma haematobium* (*S. haematobium*) and *Schistosoma intercalatum*. Among these, S*. mansoni* and and *S. haematobium* are the two most important species in Sub-Saharan Africa causing intestinal and urinary schistosomiasis (Michael et al., 1999; Lo et al., 1998).

It is a wide public health problem in Ethiopia, and usually occurs in agricultural communities living along small streams, irrigation schemes and lakes in altitudes ranging from 1,300–2,000 meters above sea level for *S. mansoni* whereas the distribution of *S. haematobium* is restricted to some lowlands below 800 m above sea level (Alemayehu and Tomass, 2015).

Despite intensive efforts to control the disease, schistosomiasis together with soil-transmitted helminthiasis continue to represent more than 40% of the disease burden caused by all tropical diseases, excluding malaria (Hotez and Kamath, 2009; Dufera et al., 2014). Schistosomiasis affects human host by slow damage of the host organs due to granuloma formation around the eggs in the tissues. This leads to the development of fibrosis and chronic inflammation in the liver and causes severe damage including bleeding, renal failures, and cancer (Sady et al., 2013).

In this era of global warming and climatic change, the epidemiology of temperature-dependent infections could be changing implying the possibility of new transmission area in the world in general and in Ethiopia in particular. There was established small scale and large scale sugar cane, cotton, banana, maize, fruit and vegetable irrigation activity as well as fishing activity in Gamo Gofa and South Omo Zone owned by government and private sectors. Based on the report of South Omo Zone Heath office *S. mansoni* and *haematobium* infection was among the major helmenthic infections during outpatient visit. In addition to Arba Minch Zuria *woreda* Health center especially Shelle health center reported the same cases at outpatient department (OPD) level. Despite the existence of this irrigation lifestyle of the communities and environmental conditions favouring survival of the parasite and transmission to human host in the two Zones there is no current study under taken to determine the prevalence and associated risk factors. Therefore this study was conducted to fill this research gap and dig out concrete evidence on those agricultural working group.

MATERIALS AND METHODS

Study area and period

The study was conducted from March to June, 2017 in Gamo Gofa and South Omo zone which are among the 13 administrative zones found in SNNPR. According to 2007 national housing and population census the projected estimated population of Gamo Gofa zone for the year 2015/2016 was 2,040,972 with 15 Woredas, 34 urban and 452 Kebeles. In the zone there are 3 hspitals, 73 health centers and 471 health posts which provide health promotions, preventive, curative and rehabilitative service to the community. As per the information collected from agriculture office there are 9 community based small scale irrigation and 9 large scale, state and private irrigation zones.

Study design

The study is a cross-sectional study survey.

Population

All irrigation site workers in Gamo Gofa and South Omo zones were the source population and selected irrigation workers were found in 6 irrigation sites of Gamo Gofa and South Omo zones. Individuals who have been involved for at least three months in irrigation activities were included in the study. Individuals under medication for schistosomiasis three weeks prior to the data collection and individuals who were severely ill and cannot provide the required information were excluded from the study.

Sample size determination and sampling procedures

Sample size was calculated by Epi-info software with the assumptions of p=67.6% which is the prevalence of *Schistosoma mansoni* infection in Fincha sugar industry and margin of error (d) =5% and 95% confidence level. By taking 10% none response rate the sample size was 370. There were nine small scale and four large scale irrigation sites which were found in Gamo Gofa and South Omo Zone. Among these sites four irrigation sites were selected at random. Then for each irrigation site the sample size was allocated proportionally; interviewed and stool sample was taken from randomly selected households by taking randomly one adult individual who work currently in irrigation farm.

Study variables

The dependent variable is presence of Schistosomiasis [1=Yes if there is *S. Mansoni* or *hematobium* or mixed infection), 2=No- if stool and urine examination was negative. Independent variables were socio demographic variables; sex, age, occupation, educational level, monthly income, wealth index; water source for

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Table 1. Classification of intensity of *S. mansoni* infections.

Parasite	Intensity of infection		
	Light	Moderate	Heavy
S. mansoni	1-99 epg	100-399 epg	≥400 epg

domestic use, water contact habit ,water body contact -swimming, crossing with bare foot, bathing, latrine utilization, washing clothes, habit of wearing shoes, habit for cutting grass near by the drainage.

Operational definitions

S. mansoni infection = Under stool; egg or ova were being observed; if parasite egg or ova was detected then it was considered as *S. mansoni* infection (Meurs et al., 2013).

Data collection tools and procedures

Data were collected using pre tested structured questionnaire and laboratory investigation of stool and urine specimens. The questionnaire had three parts that were designed to cover specific area of each factor, including socio-economic and demographic status, environmental health conditions and behavioral aspects of workers. The questionnaire was prepared originally in English and was translated into Amharic. Respondents for the administered questionnaire were irrigation workers. Ten research assistants with diploma in clinical nursing and medical laboratory assisted in data collection. The research assistants were under 4 supervisors who have second degree assisted in overseeing the whole of data collection process. The research assistants introduced themselves to the respondents and explained the aim and the objectives of the study and verbally requested them to participate in the study. Data were collected for 20 days from the study participants through face to face interviews.

Stool specimen collection and examination

Following the interview a labeled polyethylene screw cupped stool container was given to each selected participants to collect the stool. Then the collected stool sample was placed in test tube containing 10 % formalin and the specimen was transported to the nearby health center laboratory. Each stool specimen was prepared by kato-katz technique with a template of 41.7 mg as recommended by WHO and was examined by trained laboratory technologists. The number of ova was counted and recorded. The number of parasite eggs was counted and multiplied by 24 in order to obtain the number of parasites per gram of stool. Egg counts were utilized to classify the intensity of infection in to light moderate or heavy infections as recommended by WHO are presented in Table 1.

Data quality control

The quality of data was assured before, during and after data collection process. Before data collection objective based and standardized designing of questionnaire, preparation of data collectors training manual, experience based selection of research assistants and finally their training and supervisors on sampling procedures, techniques of interviews and data collection process and giving of training manuals were performed.

In addition the research, assistants and supervisors participated in pre-testing of the questionnaire for its understandability by 5% of sample size in irrigation site found in the study area which was not included in the study and the result of the pretest was used to correct some unclear ideas and statements. During data collections the supervisors and principal investigator was closely followed the day-to-day data collection process and ensure completeness and consistency of questionnaires administered. Biological stool sample data quality was maintained by implementing clean and standardized procedure.

After data collection the collected information was re-checked for its completeness and consistency by the supervisors and principal investigators before transferring in to computer software. Non overlapping numerical code was assigned to each question and the coded data entered and cleaned into Epi Info soft ware Version 3.5.3 by doing simple frequency and cross tabulation.

Data analysis

Data analysis was performed by using SPSS version 20 statistical software for each specific objectives stepwise. For the first specific objective and all independent variables descriptive statistic including proportions, mean and standard deviations were performed to describe the sample population in relation to relevant variables

For the second specific objective bivariate logistic regression analysis (crude odds ratio with 95% confidence interval) was performed for each group of independent variables to see the association with the outcome variable. Then, to determine the significant determinant factors of schistosomiasis multivariable logistic regression analysis (Adjusted odds ratio with 95% confidence interval) was employed. Variables with $P < 0.05$ were considered as statistically significant. Finally data was presented by using tables and figures.

Ethical consideration

Ethical clearance was obtained from the Institutional Review Board Committee (IRB) of College of Medicine and Health Sciences, Arba Minch University. Permission to conduct the study was sought from two zones administrators. During data collection, the purpose of the study was clearly explained to workers and informed verbal consent was obtained. For those who were *S. mansoni* positive treatment was given in collaboration with the nearby health facility.

Dissemination plan

The final findings of this study were presented to the Community of College of Medicine and Health Sciences and submitted to College of Medicine and Health Sciences CRTC-NTD office, Gamo Gofa and South Omo Zonal health departments.

RESULT

Socio demographic characteristics

98% response rate was realized in the study. 364 out of 370 respondents participated and gave stool sample.

Table 2. Selected socio demographic characteristics of irrigation workers in Gamo Gofa and South Omo Zones, 2017.

Variable	Frequency	Percentage (%)
Sex		
Male	164	45.8
Female	194	54.2
Age (years)		
15-35	218	60.9
36-45	96	26.8
>45	44	12.3
Distance from health facility (km)		
≤5	174	48.6
≥6	184	51.4
Educational status		
No formal education	175	48.9
Primary school	120	33.5
Secondary and above	63	17.6
Wealth index		
Poor	78	21.8
Medium	145	37.7
Rich	135	37.7

From collected stool samples, 6 samples were not examined due to small amount and mislabeling. Slightly above half (54.2%) were females and the rest were men. Regarding the age distribution two third of respondents (60.9%) were in the age range of 15-35 years, with mean age of 32.48±12.0 years. Almost half of the study participants had no formal education as one third attained elementary education (Table 2).

Knowledge and modifiable factors of participants on schistosmiaisis prevention

Majority of the study participants, 260 (72.6%) had poor knowledge on transmission, causative agent and prevention on schistosomiasis disease. Regarding the prevention habit of respondents 142(39.7%) of those who wore shoes regularly, 162(45.3%) sometimes and the rest, 15.1% of them never wore shoes in their daily life activities. There were no sanitary facilities in large scale irrigation site and irrigation workers defecated in and around farm land (Table 3).

Prevalence of *S. mansoni* and intensity of infection

The prevalence of *schistosoma mansoni* is 14% (95% CI: 12.2-15.8%) and the rest have negative stool result after conducting stool concentration. There was no positive urine sample for *S. haematobium*. Comparing the prevalence in terms of study site; the prevalence of *S. mansoni* in Jinka irrigation site was high 27.88% as opposed to Arba Minch Zuria (Shell and Alego Area) with 8.3%. Among respondents who were positive for *S. Mansoni* 60% had moderate infection intensity while the rest of them had heavy infection intensity (Figure 1).

Distribution of mollusks- respondents were interviewed about mollusks observation in irrigation land; 137(38.92%) were observed in irrigation land, 12(3.4%) on canal side and 36(10.22%) both in irrigation land and canal.

Factors associated with *S. mansoni*

Among the socio - demographic characteristics in binary logistic analysis those who were low in wealth index COR; 2.37(1.10, 5.10) and poor knowledge COR; 2.17(1.17, 4.00) were associated with *S. mansoni* infection. Modifiable risk factors like respondents who were not wearing shoes (bare foot) COR 1.62(1.24, 1.50) and those who have not moved from one agricultural site to another COR 0.40(0.18, 0.92) were associated with *S. mansoni* infection. Variables associated in binary logistic analysis and with p value < 0.3 fitted to multi variable

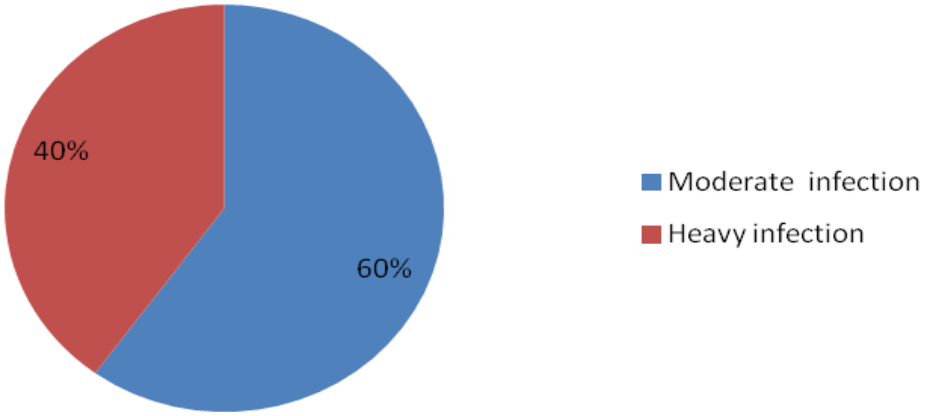

Figure 1. The distribution of *Schistosomiasis mansoni* infection intensity among irrigation workers in Gamo Gofa and South Omo Zone in Agricultural Farm, 2017.

Table 3. Modifiable risk factors on schistosomiasis disease prevention among irrigation workers in Gamo Gofa and South Omo Zones, 2017.

Life style factor	Frequency	Parentage (%)
Wearing habit of shoes		
Always	39.9	39.9
Sometimes	45.0	45.0
Not wear (bare foot)	15.1	15.1
Frequency of contact with water body		
Daily	208	58.1
1-3 weekly	114	31.8
No contact at all	36	10.1
Latrine utilization for defecation		
Yes	315	88.0
No	40	11.2
Source of water for bathing and washing of clothes		
Irrigation canal/pond	77	21.81
River	204	57.78
Protected spring	26	7.3
Pipe/bono water	46	13
Source of drinking water		
Irrigation canal/pond	12	3.38
River	8	2.25
Protected spring	19	5.35
Pipe/bono water	316	89.0

model respondents with poor knowledge, AOR 2.18(1.12, 4.85), who were not wearing shoes (bare foot) AOR 1.44(1.15, 4.12) and who had not moved from one agricultural site to another AOR 0.38(0.15, 0.35) were identified as significant associated factors with *S. mansoni* infection (Table 4).

DISCUSSION

The prevalence of *S. mansoni* was found to be 14% (95%CI; 12.2%- 15.8 %) and this result is lower compared to a study conducted in Yemen which revealed that 31.8% of the participants were found to be positive

Table 4. Factors associated with *S. mansoni* infection among irrigation workers in Gamo Gofa and South Omo Zone small and large scale Agricultural Farm, 2017.

Variable	*Schistosoma mansoni* infection				
	Yes (%)	No (%)	COR (95%)	AOR (95%)	P value
Sex					
Male	20 (40.0)	144 (46.8)	1.32(0.72, 2.42)	1.31 (0.68, 2.53)	
Female	30 (60.0)	164 (53.8)	1	1	0.42
Educational status					
No formal	24 (48.0)	151 (49.0)	0.84 (0.44, 1.62)	0.84 (0.42, 1.69)	
Primary	19 (38.0)	101 (32.8)	1.27 (0.52, 3.12)	1.15 (0.45, 2.93)	0.62
Secondary and above	7 (14.0)	56 (18.2)	1	1	0.77
Wealth index					
Poor	17 (34.0)	61 (19.8)	2.37 (1.20, 5.10)	2.18 (1.12, 4.85)**	
Medium	11 (22.0)	134 (43.5)	0.69 (0.35, 1.41)	0.79 (0.37, 1..67)	0.45
Rich	22 (44.0)	113 (36.7)	1	1	0.54
Knowledge on Schistosomiasis					
Good	29 (58.0)	231 (75.0)	1	1	
Poor	21 (42.0)	77 (25.0)	2.17 (1.17,4.00)	1.98(1.03, 3.78)**	0.04
Shoes warning habit					
Always	17 (34.0)	126 (40.9)	1	1	
Sometimes	27 (54.0)	134 (43.5)	0.92 (0.34, 2.48)	0.65 (0.32, 1.31)	0.22
Not wear (bare foot)	6 (12.0)	48 (15.6)	1.62 (1.24, 1.50)	1.44 (1.15, 4.12)**	0.04
Moving from one Agricultural site to others					
Yes	9 (18.0)	25 (8.1)	1	1	
No	41 (82.0)	283 (91.9)	0.40 (0.18, 0.92)	0.38 (0.15, 0.35)**	0.05

*Significant factors p-value < 0.05; COR, Crude Odds Ratio; AOR, Adjusted Odds Ratio.

for *S. mansoni*, Co ˆte d'Ivoir the overall infection prevalence of *S. mansoni* was 50.1% [Barbara et al., 2007], in Northern Senegal the prevalence of overall *S. mansoni* infection was 55% (Meurs et al., 2013) compared with domestic studies. Previous studies showed that the result is far lower than the prevalence of *S. mansoni* in Finchaa sugarcane irrigation workers whose prevalence was 67.6% and in Wondogent in Southern Ethiopia which accounted for 59.9% (Dufera et al., 2014). This variation in prevalence is due to the effect of deworming program, variation in study year and a set up difference in socio demographic characteristics of study population.

Findings from this study reveal that the habit of working and walking bare foot in irrigation area(10.1%), frequent contact with contaminated water 58.1%, defecation habit of the community in the field (11.2%), use of river contaminated water for bathing and washing clothes (57.79%) were the identified as risk habits of the workers that expose them to schistosomiasis infection. This findings are supported in a study conducted in similar setting which revealed that contact with contaminated water such as bathing, washing clothes, collecting water for cooking, getting a drink, 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; Hibbs et al., 2011). In addition during house to house observation poor larine utilization, personal and environmental hygiene of the community coupled with frequent water contact behaviors increase vulnerability to schistosomiasis infection.

Majority 260(72.6%) of the participants had poor knowledge of schistosomiasis ways of transmission, prevention and others related issues. Only 14.25% participants had information about schistosomiasis and 63(17.6%) agreed that proper latrine utilization is one of the prevention methods for schistosomiasis infection. In general respondents who had poor knowledge on schistosomiasis were two times (1.98, 1.03, 3.78) more

likely infected by *S. mansoni* as compared to their counterparts. These findings are in line with study conducted in Mwea Kirinyaga Kenya; this might be due to the fact that poor knowledge results in improper prevention measure to control schistosomia infection.

Respondents who have no habit of wearing shoes or walking barefooted during agricultural activities are 1.44 (1.25, 4.12) more likely infected by *S. mansoni* as compared to those who have habit of wearing shoes regularly. This result is supported by study conducted in Western part of Gameballa region in Amibera District. The result shows that individuals who have water contact like swimming, walking on bare foot and domestic water source of the household were significantly associated with risk of infection by parasite. The finding reveals that individuals who have swimming habit had AOR 6.41 (3.515, 11.718) more likely infected as compared to their counterparts (Worku and Molalign, 2013). This might be due to the fact that water contact during swimming, crossing water bodies with bare foot, working in irrigated agricultural filed and bathing increase schistosomiasis infection through direct skin penetration of cercaria.

Agricultural workers who have no history of movement from one agricultural site to other irrigation site were 62% (AOR 0.38 (0.15, 0.35)) less likely get infection as compared to their counterparts. The result is consistent with meta-analysis study which documented that population movements which may occur for various reasons have led to an important increase in the spread of schistosomiasis. This might be due to the infected individuals carrying parasites during travel. The movement does not only intensify infection in endemic areas but also introduces new infection to previously non endemic areas given the presence of susceptible intermediate snail hosts (Steinmann, 2006).

Conclusion

The prevalence of *S. mansoni* infection is moderate based on World Health Organization (WHO); the prevalence is higher in Jinka small scale agricultural household as compared to Arba Minch Zuria Woreda large scale and small scale irrigation workers. There is a gap of knowledge on schistosomiasis infection transmission and prevention. Respondents who have habit of working in agricultural land on bare foot, habit of moving from one irrigation area to others and those who have poor knowledge were the identified significant factors for *S. mansoni* infection.

Recommendation

For health extension workers, health education should be given for the community on prevention and transmission of *schistosomia* infection. On improving habit of wearing protective shoes, avoiding frequent contact with contaminated water bodies during bathing, swimming and crossing and proper utilization latrine. For large scale irrigation scheme, during recruitment of irrigation workers who have history of movement from other irrigation site, de-worming is mandatory to reduce risk infection. Constructing pit latrines in irrigation plantations for worker to avoid defecating in open farm lands to minimize water body contamination. For health institution and regional and zonal neglected tropical disease coordinators, they should consider adult during mass drug treatment of agriculture farmers and their family in South Omo Zone Nary River basin annually. Regarding Arba Minch Zuria Worda in Gamo Gofa Zone since the prevalence of *S. mansoni* infection is low supporting and Mobilizing community on proper latrine utilization and constructing latrine in large scale irrigation farm to prevent water body contamination is necessary.

ABBREVIATIONS

WHO, World Health Organization; **SNNPR,** South Nation Nationalities and People Region; **NTD,** Neglected Tropical Diseases.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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