ORIGINAL ARTICLE

IMPACT OF IRRIGATION ON THE PREVALENCE OF INTESTINAL PARASITE INFECTIONS WITH EMPHASIS ON SCHISTOSOMIASIS IN HINTALLO-WEJERAT, NORTH ETHIOPIA

Tadesse Dejene, Tsehaye Asmelash

ABSTRACT

BACKGROUND*: Intestinal parasites adversely affect the health of humans in many parts of the world. They continue to be global problem, particularly among children in developing nations. Several reports showed an overall high prevalence of intestinal helminths be mainly ascribed to infections emanating from environmental contamination by human excreta and increased water collection for irrigation scheme. Several dams were developed in Tigray region over the past 15 years which may create more suitable conditions for the transmission of water borne parasites and breeding vector snails thereby causing an increase in the incidence rate of schistosomiasis and malaria. Hence a survey on intestinal parasites with emphasis on Schistosomiasis in Hintallo-Wejerat district, South Tigray, was carried out to assess the impact of irrigation on the prevalence of intestinal parasite*.
METHODS*: A cross-sectional survey of intestinal parasitic infections was made in primary school children of Hintallo-Wejerat to determine the prevalence of the infection with regard to the water body development. A total of 800 stool specimens were collected from 481 male and 319 female school children in 23 Hamlets (Kushet) of Hintallo–Wejerat district, South Tigray. The stool specimens were examined with the Ritchie formal Ether concentration technique in order to investigate the prevalence of intestinal parasites among student population living in different irrigation settings.*
RESULTS*: Of the total 800 examined, 285 (35.6 %) harbored one or more intestinal parasites. There was no significant difference between different irrigation settings and sexes for intestinal parasites other than S. mansoni infection (P>0.05). Twenty one cases of S. mansoni were found only in 6 hamlets with highest prevalence of 38.3% in Bele'at. The results showed that marked differences in the prevalence of S. mansoni among long-standing irrigation, newly introduced irrigation and non-irrigated areas (P<0.001) and sexes.*
CONCLUSION*: The presence of S. mansoni in Hintallo-Wejerat district gives reason for concern. With the tendency for increased irrigation practices, schistosomiasis may further increase in prevalence and intensity. Further studies are needed to monitor and control parasitic infections such as creating community awareness on the proper disposal of wastes and control of the snail.*
KEY WORDS: *Irrigation, Intestinal parasite, Schistosomiasis, North Ethiopia*

INTRODUCTION

Intestinal parasites adversely affect the health of humans in many parts of the world. They continue to be global problem, particularly among children in developing nations (1). Several reports showed the overall high prevalence of intestinal helminths in the world to be mainly ascribed to infections emanating from 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 helminths in developing countries are the soil-transmitted group: *Ascaris lumbricoides, Trichuris trichiura* and hookworms (2) and the blood flukes, schistosomes (3). Schistosomiasis is endemic in 74 tropical countries worldwide affecting over 200 million people while 500 to 600 million people are at risk of becoming infected (3). Schistosomiasis is also endemic in Ethiopia. While the intestinal form caused by *S. mansoni* is widely distributed, the urinary form caused by *S. hamatobium* is limited to some lowland areas (4, 5).

Increased incidence and spread of schistosomiasis has been observed following new irrigation scheme developments and dam construction (6). In Ethiopia the establishment of the endemicity of *S. mansoni* infection in areas previously non-endemic following introduction of water based and

Mekelle University, Telephone number 0914721412 e-mail:taddej2002@gmail.com, Fax 0344409304

water related activities has been reported from Methara, Wonji, and Finchaa Sugar plantation areas (5, 6, 7, 8)

Intestinal schistosomiasis is reported to be widely endemic in Tigray. Recent investigations showed that the disease has covered quite many localities in the region. A group of researchers reported a prevalence of 1% and 66% in Maichew and Adwa, respectively (9). Therefore, It is evident that with the introduction of irrigation, the potential for further spread of schistosomiasis may become inevitable. As a matter of fact, Tigray region has been repeatedly affected by drought and about 85% of the population is engaged in subsistence agriculture (10). To alleviate such problem the Regional State of Tigray started rural development program through "Sustainable Agricultural and Environmental Rehabilitation in Tigray" with a main objective of minimizing dependence on rain fed agriculture and improving food production through the construction of dams to be used for irrigation.

About 57 dams were constructed since 1994 all over the Regional State of Tigray (11, 12, 13). Dams in Hintallo–Wejerat district account for 32 % of the recently constructed dams. The district has the three settings for which the study compares: long standing irrigation, recently constructed dams and no irrigation sites.

Although potential advantage exists with the development of water resources and irrigation systems, this may create more suitable conditions for the transmission of water borne parasites and breeding vector snails and mosquitoes, thereby causing an increase in the incidence rate of schistosomiasis and malaria. Hence a survey on intestinal parasites with emphasis on Schistosomiasis in Hintallo-Wejerat district, South Tigray, was carried out to assess the impact of irrigation on the prevalence of intestinal parasite infection.

MATERIALS AND METHODS

Hintallo-Wejerat district is found in Southern Zone of the Tigray Regional National State, about 50 km south of Mekelle on the way to Addis Ababa, located between 13^0 25"N latitude and 39^0 31" E longitudes. The altitude of the district ranges from 1400 - 3050 meters above sea level, but most areas lie in the average altitude range. The total population of the district in 1998 EC was 111,196 (14). Traditional agriculture is a means of subsistence for 80% of the population. The average annual rainfall in the district is 500 - 600 mm (14). The district embraces 3 sub-districts, 19 peasant associations.

Five primary schools and 23 hamlets with different settings (Figure 1) were purposely selected. Total number of students in the district was 13,640. Among this only 6% that is 800 (see Table 1) was our sample size. Schools and hamlets were selected by purposeful samples, while students were selected by random sampling technique.

This cross-sectional survey was conducted from April to June 2000. A total of 800 (from 481 male and 319 female school children) stool samples (one sample per student) from 23 hamlets, i.e., 300 students from longstanding irrigation, 300 students from newly introduced irrigation sites and 200 students from non-irrigated sites were included in the study. In the selected schools, the objectives of the study were explained to the students before they participated in the study. Altitude, settings, and students name, age, sex, travel history, and hamlet were documented during data collection.

The stool samples were collected in 10ml screw capped vials pre filled with 5 ml of 10% formalin. Samples were transported to Mekelle University and examined according to the Ritchie Formal Ether Concentration Technique (15). Snail sample collection was made using forceps from water bodies to check for the presence of appropriate snail intermediate host in the study area. *Biomphalaria species* were collected and squashed between two slides for checking the presence of cercariae of *S. mansoni*. *S. mansoni* cercariae were identified morphologically by checking for their bifurcated tail. The collected data were analyzed by percentile and chi-square test.

RESULT

A total of 800 school children (481 males and 319 females) were examined for intestinal parasitic infections. The age of study subjects ranged from 7 to 19 years, 392 (49.0) of them being in the age group of 5-9 years and 320 (40.0) in the age group of 10-14 years (Table 1).

Table 2. Distribution of intestinal parasites cases by Hamlets (Kushet) and irrigation practices in Hintallo-Wejerat, North Ethiopia, 2000.

Setting	Hamlets (Kushet)	Detected Intestinal Parasite Ova(cyst)											Total	Percent
		S.m	Hw	E.v	H.n	T.tr	S.s	T.sp.	A.l	E.h	G.l	No.+ve	examined	positive
Long Standing Irrigation	Hiwane	3	9	1	5	1	1	1	2	2	7	32	73	43.8
	Aybeto	0	2	1	11	1	0	0	2	2	2	21	42	50.0
	Korkora	0	0	0	6	0	0	0	1	1	2	10	23	43.5
	Gebezya	0	2	1	1	0	0	0	0	0	0	4	22	18.2
	Bele-At	13	1	0	7	1	0	0	0	0	6	28	34	82.4
	May - Nebri	0	1	0	3	1	0	0	0	0	3	8	35	22.9
	Adi-Kelehes	0	0	0	2	0	0	0	1	1	1	5	14	35.7
	Mesgi	0	0	1	4	0	0	0	1	1	0	7	22	31.8
	Others (May-Nebri Tabiya)	0	1	2	2	0	0	1	3	3	3	15	35	42.9
	Sub Total	16	16	6	41	4	1	2	10	10	24	130	300	43.3
Recent irrigation (dams)	Hidimo	2	0	0	4	0	0	0	0	11	2	19	48	39.6
	Mehaydi/Asergeda	0	0	2	1	0	0	0	0	3	1	7	11	63.6
	Adihana	0	0	1	3	0	1	0	0	0	0	5	23	21.7
	Me-ara	1	3	1	5	0	0	0	0	3	10	23	87	26.4
	Dur-Anbesa	0	2	4	17	1	3	1	2	1	11	42	121	34.7
	Manda	1	1	0	3	0	1	0	0	0	1	7	10	70.0
	Sub Total	4	6	8	33	1	5	1	2	18	25	103	300	34.3
No Irrigation	Adi-Kalakil	0	3	0	3	0	0	0	0	0	2	8	31	25.8
	Adi-Senbet	0	1	0	2	0	0	0	0	1	2	6	20	30.0
	Hareko	1	5	2	0	0	0	1	2	2	5	18	60	30.0
	Akila	0	0	1	3	0	0	0	0	0	2	6	19	31.6
	Adi-Shinba	0	2	2	7	0	0	0	0	1	2	14	30	46.7
	Azewa	0	0	0	1	0	0	0	0	0	4	5	14	35.7
	Adi-Hasha	0	2	1	1	0	0	1	0	0	2	7	9	77.8
	Angua	0	0	0	0	0	0	0	0	1	2	3	17	17.6
	Sub total	1	13	6	17	0	0	2	2	5	21	67	200	33.5
	Grand Total	21	35	20	91	5	6	5	14	33	70	300	800	37.5

Abbreviations: S.m = *S. mansoni*, Hw = Hookworm, E.V = *E. vermicularis*,
H.n = *H. nana*, T.t = *T. trichiura*, S.s. = *S. stercolaris, T.sp = Taena sp.*
A.l = A. lumbricoides, E.h = E. histolytica, G.l = G. lambela

Table 1. Age and gender composition of the study subjects Hintallo-Wejerat, North Ethiopia, 2000.

Characteristics	Number	Percent
Age(in ears)	392	49.0
5-9	320	40.0
10- 14	88	11.0
15-19		
Sex	481	60.1
Male	319	39.9
Female		
Total	800	100

Out of 800 stool samples examined, 285 (35.6%) harbored one or more ova or cyst of intestinal parasites. Ninety nine (12.4%) of the stool samples were positive for *Hymenolopis nana* followed by *Giardia lamblia* 71(8.9%) (Table 2). Of the 23 hamlets, *S. mansoni* was encountered only in 6 hamlets, namely from Hiwane 3/73 (4.2%), Bele'at 13/34 (38.3%), Hidimo 2/48(4.2%), Me-ara 1/87 (11.1%), Manda 1/10(10.0%) and Hareko 1/60(1.7%). All cases were borne and brought up in their respective hamlets.

A significant difference was found between the different settings and sex in the prevalence of *S. mansoni* (P<0.001) but none for the other intestinal parasitic infections (Table 2 and 3).

Table 3. Prevalence of *S. mansoni,* geo-helminths and other intestinal parasites by sex and settings, Hintallo-Wejerat, North Ethiopia, 2000.

Settings	*Schstosoma manssoni*			Geo-helminths			Others intestinal parasites			Total
	Male N(%)	Female N(%)	Total N(%)	Male N(%)	Female N(%)	Total N(%)	Male N(%)	Fe male N(%)	Total N(%)	N(%)
Longstanding Irrigation	13(4.3)	3(1.0)	16(5.3)	12(4.0)	196.3)	31(10.3)	32(10.7)	51(17.0)	83(27.7)	130(43.3
Recently constructed dams	3(1.0)	1(.0)	4(1.3)	5(1.7)	9(3.0)	14(4.7)	27(9.0)	58(19.3)	85(28.3)	103(34.3
No-irrigation	1(0.1)	0(0)	1(0.1)	5(2.5)	10(5.0)	15(7.5)	17(8.5)	34(17.0)	51(25.5)	67(33.5)
Total	17(3.5)	4(0.1)	21(2.6)	22(2.8)	38(4.8)	60(7.5)	76(9.5)	143(17.9)	219(27.4)	300(37.5)

Highest number of *Biomphalaria species* was collected from Bel'at among the longstanding irrigated areas and none from the non-irrigated areas. Similarly, *S. mansoni* infected *Biomphalaria species* were also identified from the same area. Uninfected *Biomphalaria species* were found in Hiwane, Hidmo, and Maynebri with 4.2%, 4.2% and 0% human *S. mansoni* infections, respectively.A single case of S. *mansoni* ova was detected in Hareko, where there was no intermediate host, *Biomphalaria species* (Table 4).

Table 4. Distribution of *Biomphalaria* species in Hintallo-Wejerat district, North Ethiopia, 2000.

Hamlets	Name of water body	Altitude (meters)	*Biomphalaria* spp load	
			Load	Status of infection with S. *mansoni*
Hiwane	Gereb-Hiwane	2060	+	uninfected
Maynebri	Gereb-Maynebri	1970	+	uninfected
Bel'at	Gereb-Shahishahita	2050	+++	Infected
Hidmo	May-Haydi	2000	+	uninfected
Manda	Gereb-Edaba-Hadera	2080	+	Uninfected
Hareko	Edaga-Arbi	2150	0	None

++ + = indicates abundance in prevalence

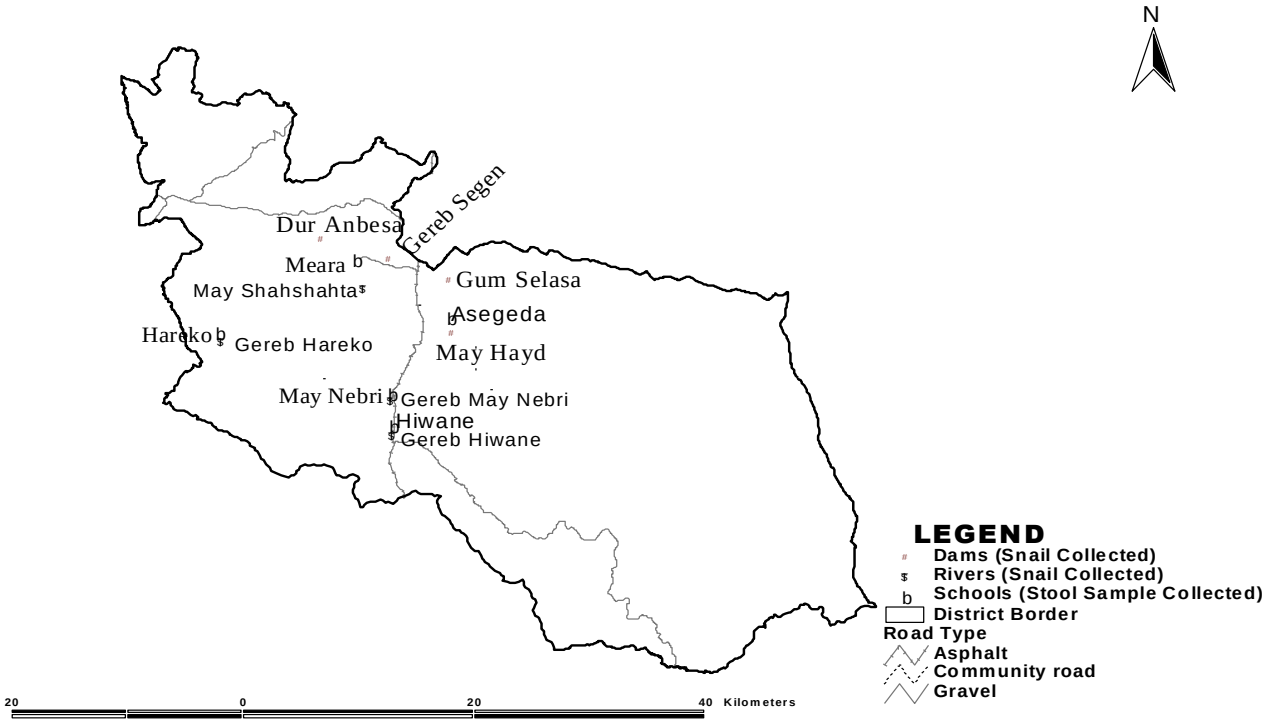

Figure 1: Location of Study Area (Hintalo Wajirat district)

DISCUSSION

In this survey new foci of *S. mansoni* infection were registered in 5 Hamlets (Hamlets in which both human infection and presence of snail intermediate host registered (Bele'at, Hidimo, Me-ara and Manda)). The prevalence of *S. mansoni* infection in the different irrigation settings showed significant difference. This finding agrees with other observations (16, 6). The occurrence of *S. mansoni* infection and the snail intermediate host coincided only in five hamlets (Table 3). This could be attributed to the availability of water bodies which create a favorable environment for the multiplication of snail intermediate host. The overall prevalence of intestinal parasites observed in this study area was below what is recorded for other parts of Ethiopia (17), which could be attributed to the low amount of moisture in the region. The results for *S. mansoni* in this study do not agree with previous reports (Ghebreyesus et al., 1999 unpublished), which showed no *S. mansoni* infection from near and far of Gum-Selasa dam, which is very close to Hidmo (May Hydi dam) with 4.17% *S. mansoni* infection.

There was no significance difference in the prevalence of intestinal parasites ,except for *S. mansoni* ,between the two sexes. The higher prevalence of *S. mansoni* infection in males ($P < 0.05$) reported in this survey is similar to reports from the Awash Valley (16). Such a difference may be due to differences in the division of work between sexes; males have high water contact in the irrigation system.

Biomphalaria species were found in five hamlets except in Hareko. There were very small number of *Biomphalaria species* in the upper area of the stream which flow from Hidmo to Bele'at. This stream, when it reaches Bele'at, it is called Shahishahita. Abundant number of *Biomphalaria species* was found in Bele'at. Moreover, the highest prevalence for *S. mansoni* infection was observed in this area. It was only in Gereb (stream) Shahishahita that infected *Biomphalaria species* were found indicating the actual transmission foci of schistosomiasis in the area. This may be the first report that indicates the presence of foci of transmission of *S. mansoni* infection in the area. Gereb Shahishahita flows to lowlands of Samre where it is used for bathing and irrigation purpose by many downstream dwellers. Thus, further study is necessary along this stream. This finding also clearly demonstrates the positive relationship between abundance of snail intermediate host and the prevalence of *S. mansoni* infection.

In conclusion, this study revealed low rate of infection for all intestinal parasitic infection compared to the previous reports in Ethiopia. The presence of *S. mansoni* in Hintallo-Wejerat, with the tendency for expansion of irrigation practices, may further increase the prevalence and intensity of schistosomiasis. Further studies are needed to monitor and control parasitic infections such as creating community awareness on the proper disposal of wastes and control of the snail using local plant Endod (Phytolacca dodecandra).

ACKNOWLEDGEMENTS

The authors would like to acknowledge to the Ethiopian Science and Technology Commission for funding this research through the Research and Publication Office of Mekelle University. The authors wish also to extend their gratitude to School Directors, and students of Asegeda, May-Nebri, Hiwane, Meara and Hareko primary schools for their cooperation.

REFERENCES

1. World Health Organization, Scientific Group. Intestinal protozoa and helminths infection. WHO Tech Rep Ser. 666. Geneva, 1981:7-43.
2. World Health Organization. Soil transmitted helminths. *WHO Tec Rep ser.* Geneva, 1963; No. 277.
3. Rozendaal JR. Vector Control Methods for use by Individuals and Communities, WHO, Geneva, 1997:337- 356.
4. Tedla S, Tilahun G, Burie H. Parasitology. In: *Schistosomiasis in Ethiopia and Eritrea*, Hailu Birrie, Shibru Tedla and Lykun Jemaneh (Eds), second ed. Institute of Pathobiology, AAU. 1998: 9 – 28.
5. Lo CT, Kloos H, Hailu B. Schistosomiasis. In: *The Ecology of Health and Disease in Ethiopia*, Ahmed, Z. and Kloos, H. (editors). Addis Ababa: EMPDA Press, 1988: 196- 207.
6. Markell. E.K. and Voge, M. *Medical Parasitology*.3rd Ed. W.B. sounders company. Philadelphia London. Toronto, 1971: 173.
7. Kloos H. Water resource development and Schistosomiasis in the Awash Valley, Ethiopia. *Soc Sci Med* , 1993; 20: 609-625.
8. Birrie H, Medhin G, Erko B, Beshah G, Gemechu T. Intestinal helminth infections among the current residents of the future Finchaa Sugar plantation area, Western Ethiopia. *Ethiop J. Health Dev* , 1997; 11: 219-228.
9. Birrie H, Weldemichael T, Redda A, Chane T. The status of *S. mansoni* and snail hosts in Tigray and northern Wollo regions, northern Ethiopia. *Ethiop Med J*, 1994; 32: 245-254.
10. SAERT, 1994. Sustainable Agriculture in Tigray working document, Mekelle, Ethiopia.
11. De Wit J. Stuwmeren in Tigray (Noord-Ethiopië): kenmerken, sedimentatie en sedimentbronnen. Unpublished M.Sc. thesis, Department of Geography, K.U.Leuven, 2003.
12. Nigussie, H., Poesen J., Nyssen J., De Wit J., Mitiku H., Govers G. & Deckers J., 2006. Reservoirs in Tigray: characteristics and sediment deposition problems. *Land Degradation and Development*, 17: 211–230.
13. Tsehaye A., Tadesse D., Declerck, S., Nyssen, J., Van der Gucht, K., Risch, S., Rousseaux, S., De Wit, J., Afework M., Nigussie H., Abreha G., Poesen, J., Deckers, J., Vyverman, W., De Meester, L., 2007. Ecological atlas of reservoirs in Tigray, Northern Ethiopia. Tigray Livelihood Papers No. 4, VLIR, Mekelle University IUC Programme and Zala-Daget Project, 80 p.
14. Tamirie Huwando. Appraisal and Project proposal Hintallo-Wajerat Woreda Based on Integrated Development Program, South Tigray 1998-2002, Relief Society of Tigray, Mekelle 1998.
15. Ritchie LS. An Ether Sedimentation Technique for routine Stool Examination. *Bull US Army Med Dep*, 1948; 8: 326-329.
16. Lemma A. Bilhariasis in Awash Valley. An Epidemiological study with special emphasis on its possible future economic and public importance. *Ethiop Med J*, 1969; **7**: 147-176.
17. Mc Connel E, Armistrong JC. Intestinal Parasitism in Fifty Communities on Central Plateau of Ethiopia. *Ethiop Med J*, 1976; 14(4): 159-168.