Original article

Reinfection of School children with *Schistosoma mansoni* in the Finchaa Valley, Western Ethiopia

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Abstract: Reinfection of school children with *Schistosoma mansoni* and factors thought to be responsible were studied in Finchaa Valley during 1993-95. A cohort of school children treated and cured of schistosome infection were followed for 12 months for reinfection studies. The annual reinfection rate and intensity were 26% and 374 EPG (eggs per gram of stool), respectively. Pretreatment intensity level was regained faster than pre-treatment prevalence 12 months posttreatment. Reinfection rate was associated with age, sex and seasonality of infection in snail hosts. Peak in snail population density and associated cercarial infection was observed in the dry season when high reinfection rate was found among school children. Rainfall appeared to have a pronounced effect in governing snail population density and cercarial infection. Detailed investigations involving all age groups on immunological response and water contact activities are necessary to assess the role of immunity and exposure on schistosome reinfection patterns. The implication of the findings to the control strategies are discussed. [*Ethiop. J. Health Dev.* 1997;11(3):269-00]

Introduction

The commonest observation in schistosomiasis reinfection studies is that reinfection rate and intensity decline with increasing age. This observation has been an issue of inconclusive debate for more than a decade. Two suggestions put forward to explain this phenomenon are diminishing water contact activities and gradual acquisition of resistance to reinfection with increasing age. According to Warren (1), there has been no definitive evidence that protective immunity plays any role in determining the prevalence and intensity of schistosome infection. In studies made in the Volta Lake area in Ghana Dalton and Pole (2) concluded that exposure to infected water alone could explain a pattern of infection in a community. On the basis of the relationship of eosinophilia and resistance to reinfection Sturrock *et al* (3) suggested that immune system was involved in resistance to reinfection. Other studies that support the involvement of immune system in the resistance to reinfection were those of Butterworth *et al* (4), Hagan *et al* (5), and Wilkins *et al* (6).

In the schistosomiasis control program, chemotherapy has proved efficient in the control of morbidity in individual patients but has not proved successful in the management of transmission when used alone (7). The effect of chemotherapy on prevalences and intensities is rapidly reversed by reinfection (8). This has necessitated the backing up of chemotherapy with snail control measures and this presupposes the provision of baseline data on snail ecology.

Although there have been a few studies on the transmission dynamics of *S. mansoni* in Ethiopia (9,10), information on reinfection patterns of schistosomes following chemotherapy is lacking. The present studies, therefore, attempt to investigate snail population dynamics and associated cercarial infection in snail hosts relative to schistosome reinfection patterns in school children.

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Methods

Study Area and Population: The study was carried out in the Finchaa Sugar Project Area, Finchaa Valley, Wellega, Western Ethiopia (Fig.1). The study area is about 385 km west of Addis Ababa and is situated at an altitude of 1280 m above sea level. Here large acreage is being developed for sugar cane plantation using irrigation. At present there are about 10,000 people living in the project area. The Sugar Project has a polyclinic that is staffed with medical doctors and auxiliary staff. The project has about six camps in the plantation area and each camp has one community health agent. The study subjects were school children attending Finchaa Valley Elementary School.

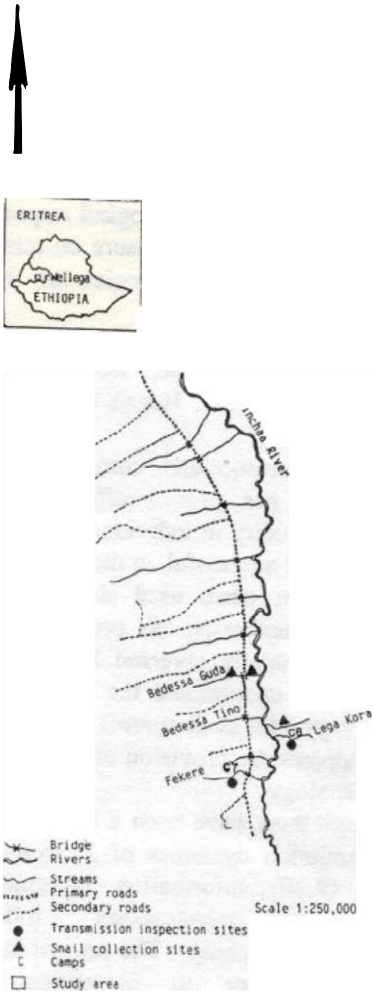


Figure 1: **Skech-map of the study area**

Reinfection Studies: Out of 1000 school children attending Finchaa Valley Elementary School 126 children aged 13 years and below were stool-examined in October 1993 using Kato smear to select a cohort of school children for *Schistosoma mansoni* reinfection studies. The Kato template used delivered 41.7 mg of stool plug and a single Kato smear per stool specimen was used throughout. All children found positive for *S. mansoni* were treated with praziquantel at a single dose of 40 mg/kg body weight to remove pre-existing worms. The treated children were re-examined two months later in December 1993 using both Kato smear and Formol-ether concentration techniques. The use of Formol-ether concentration technique was to rule out false negatives as much as possible so that the cohort constitutes only cured children. The cohort was followed up for 12 months.

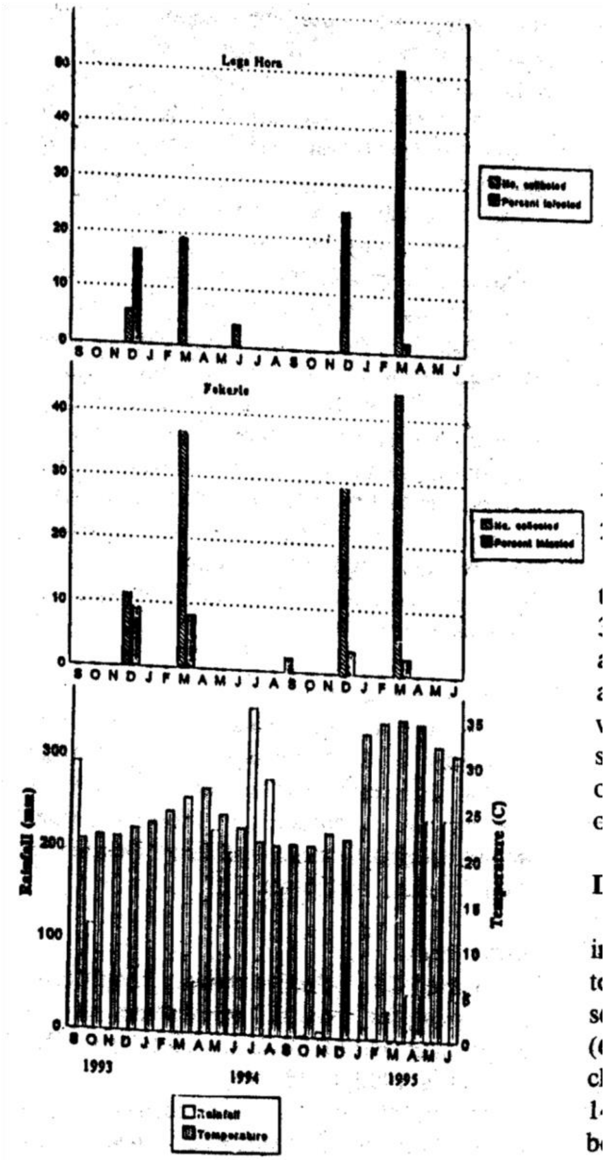
Snail Survey and Schistosome Infection: At the start of the study, general malacological survey was made in all water bodies to identify and map human water contact sites. Out of the identified five sites harboring *Biomphalaria pfeifferi*, only two with intense human water contact activities were selected for snail collection sites. Nevertheless, the other three were also inspected for schistosome transmission during snail collection period. Snails were collected with a standard scoop from vegetation in marked stretch of the streams for 10 minutes. *B. pfeifferi* collected in this way were counted and later transported to laboratories at the Finchaa Sugar Project Clinic or the Institute of Pathobiology and checked for shedding schistosome cercariae. In the event of shedding, the cercariae were identified to the genus level using tail morphology (11). Observation was made on water turbidity and water velocity was also measured. Meteorological data, especially of rainfall and temperature, were received from the Meteorology Station at the Finchaa Sugar Project.

Results

Prevalence and intensity of infection before treatment and during reinfection are presented in Table 1. Pre-treatment prevalence of schistosomiasis mansoni in the school children was 78%. Sixteen percent of the reinfection rate occurred in the first six-months showing that higher reinfection takes place during the

Table 1: **Prevalence and intensity of infection before treatment and during reinfection among schoolchildren, in Finchaa Valley, Ethiopia, 1994.**

	Male	Female	Total
Pre-treatment prevalence	78(58/74) 7	77 (40/52)	78 (98/126)
Intensity (EPG)	262	317	283
6-months post-treatment prevalence	17 (10/58)	13 (5/40)	16 (16/98)
Intensity (EPG)	85	68	78
12-months post-treatment prevalence	33 (19/57)	16 (6/38)	26 (25/95)
Intensity (EPG)	478	102	374



temperature in 2 streams in Finchaa Valley, Wellega, Ethiopia. Figure 2: **Seasonal fluctuation in *Biomphalari pfeifferi* population and schistosomal infection in relation to rainfall and**

early post-treatment period. Males showed higher reinfection rate and intensity. Pre-treatment intensity level was regained faster than pre-treatment prevalence level. Children re-acquired pretreatment egg load by 12 months post-treatment. Reinfection rate appeared to rise with increasing age in the age groups studied. The annual reinfection rate for the age group of 6 - 9 years was 18% while it was 31% for age group of 10 - 13 years (Table 2).

Fig. 2 shows results of snail survey and meteorological data. Snail population density showed seasonal fluctuation with peak density from December to March when there was little or no rain. Few or no *B. pfeifferi* were recovered during the big rains from May to September. There was a definite positive association between snail population and cercarial infection in the dry season. In the dry season the water was clear but during the rainy season it became highly turbid. The velocity of the water during the dry season fell to below 10 cm/second while it went well over 25 cm/second during the rainy season.

Interviews made with schoolchildren showed that 43 out of 57 males (75%) and 20 out of 38 females (53%) were engaged in bathing and playing in water. Such water contact activities as water collection and laundering were equally performed by children of both sexes. It was not possible to estimate duration of exposure for each activity for specific ages on the basis of the interview.

Discussion

Age-specific infection rates tended to increase with increasing age, i.e., from age six to 13 years. On the contrary, in age-related schistosome reinfection studies, Wilkins *et al* (6) observed heavier reinfection levels in children under ten years of age than in 10 - 14-year-olds. Explanation to the controversy between these observations is deferred until detailed exposure and immunological studies involving a cohort of subjects of all age groups be made in Finchaa Valley ecological setting. In such a study, allowances have to be made for exposure to assess the role immunity plays in reinfection after removing pre-existing worms with drug therapy.

Despite equal pre-treatment prevalence of infection in male and female children, six-months and 12-months post-treatment prevalence of infections were higher among males than among females. It is difficult to explain why pre-treatment prevalence of infection was the same for both sexes and why post-treatment prevalence of infection was not so. Higher post-treatment prevalence of infection among males could be explained in terms of differences in exposures to infective water between sexes. In agreement with Kloos and Lemma (12), interview made with school children showed that more males than females were engaged in playing in water and bathing. Although duration of exposure was not determined for specific activity, the two activities involve long duration and maximal bodily exposure to infective water.

Table 2: **Twelve-months post-treatment prevalence of *Schistosoma mansoni* reinfection among school children by age and sex in Finchaa Valley, 1994.**

Age	Male		Female		Total	
Group (Yrs)	Number Exam	Numbe r(%)+ ve	Number Exam	Number (%) + ve	Number Exam	Numbe r(%) + ve
6	2	0(0)	-	-	2	0(0)
7	2	0(0)	1	0(0)	3	0(0)
8	9	3(33)	4	0(0)	13	3(23)
9	10	2(20)	6	1(17)	16	3(19)
10	10	4(36)	8	0(0)	18	4(22)
11	7	4(37)	10	2(20)	17	6(35)
12	13	5(39)	5	2(40)	18	7(39)
13	4	1(25)	4	1(25)	8	2(25)
Total	57	19(33)	38	6(16)	95	25(26)

The first six-months reinfection rate was higher than the second six-months of reinfection as the former period coincided with the dry season when more snails and higher cercarial infection were observed. This suggests that higher transmission takes place during the dry season. Nevertheless, the observation of cercarial infection during the dry season by no means rule out the possibility of intermittent transmission in other seasons of the year. In a lake ecology, in northwestern part of Ethiopia, heavy transmission in the dry season with little intermittent transmission in the rest of the year has been observed (9).

Seasonality in snail population density and cercarial infection appear to be mainly influenced by rainfall cycles. Decline in snail population during the rainy season could result from direct and indirect effects of rainfall. High turbidity or siltation caused by flooding and increased water velocity observed during the rainy season could be categorized as an indirect effect of rainfall while splashing out of snails in a flood is a direct effect of rainfall. Both of these factors appeared to affect the snail population density and cercarial infection negatively

In reinfection of schoolchildren with *Schistosoma mansoni*, age and sex of the subjects and seasonality of infection in snails appeared to play important role in influencing the rate at which individuals become infected. Detailed exposure and immunological studies involving all age- groups are essential to assess the effect of exposure and immunity on reinfection patterns of schistosomes. The observation that prevalence and intensity level rose to the pre-treatment level in a year after post-treatment implies that chemotherapy alone is not sufficient for the control of schistosomiasis.

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