Environmental Pollution with Soil-transmitted Helminths in Sanliurfa, Turkey

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Soil transmitted helminth (STH) infection are endemic in developing countries. A study was carried out of sewage farms, streams and vegetables to determine the sources and routes of STH infection in Sanliurfa, Turkey. Stool samples from farmhouse inhabitants as well as soil and vegetable samples from the gardens were collected and examined. In addition, water samples from streams and vegetable samples from the city market were collected and examined. One hundred and eighty-seven (59.5%) of a total of 314 samples, including 88.4% of the stool samples, 60.8% of the water samples, 84.4% of the soil samples and 14% of the vegetable samples, were found to be positive for STH eggs.

These results indicate that the water, soil and vegetables are heavily contaminated, and suggest a vicious circle between humans and the environment. Improving environmental sanitation is imperative for the control of soil-transmitted helminthiasis in Sanliurfa.

Key words: environmental pollution - soil-transmitted helminthiasis - Sanliurfa - Turkey

Soil-transmitted helminth (STH) infections are endemic in communities where poor environmental sanitation and poor personal hygiene are prevalent, as occurs in the majority of developing countries (Yodmani et al. 1982). Yu et al. (1993) showed that environmental pollution, sanitary condition and human behaviour play an important role in the transmission of STH infection. Yodmani et al. (1982) indicated that many sources of ascariasis from the host and in the environment such as soil in the shantytowns and vegetables sold in the market resulted in continuous active transmission of ascariasis in the area.

Sanliurfa, a city in southern Turkey, has a modern centre, but is surrounded by shantytowns. Personal hygiene habits are poor, and standard cleanliness, the washing of hands and food, and the cleaning the streets are largely ignored. Garbage is allowed to accumulate at unsanitary refuse stations in the city centre and is not regularly disposed of outside of the city. The machine shops, cement factories and houses dispose of their refuse and sewage in the streams at the city centre. Many sewer pipes have been broken and night soil flows towards the vegetable gardens to cultivate them.

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Soil pollution with faecal materials is instrumental in the transmission of STH infection. Fertilised eggs deposited in the soil develop rapidly and, depending on environmental conditions, may reach the infective stage within a matter of weeks (Klaas 1987). Thereafter, eggs are transferred from soil to the vegetables then onto to hands and finally to the mouth (Kobayashi 1999).

Ozbilge et al. (1998) and Nazligul et al. (1997) have reported the prevalence of intestinal parasites in the population to be near 60% in Sanliurfa, the predominant cause of infestations being *Ascaris lumbricoides*. These studies attributed the high incidence of intestinal parasites to the use of night soil in vegetable gardens. Unfortunately, no data is available on the contamination of soil, water and vegetables in this region.

In the present study, environmental pollution with nematode eggs was investigated in order to determine the sources and routes of infection and to devise effective control strategy.

MATERIALS AND METHODS

In Sanliurfa, the climate is hot and dry. The average temperature is 5-10°C in winter and 40-50°C in summer. The average humidity is 70% in winter and 28% in summer. Annual rainfall is 463 mm, summer and winter rainfall being 70 mm and 0.6 mm respectively. The population of the city is 500,000.

Study area - The study was conducted from February to April 2000. A spot map of the study areas is shown in Fig. 1. The vegetable gardens extend into the environs of the shantytown of Sinekli in the southeast of the city. Farmhouses located in the centre of the gardens, made of breezeblocks, usually have no latrine. Inhabitants defecate in the yard. Vegetables such as onion, garlic, lettuce, spinach and parsley were grown in the gardens which are irrigated by two streams and sewer waters; Bamya tream originates from north of the city and runs through the machine shop district and then to the cement factories, where it receives their wastes (Fig. 2). Thereafter, it flows into the shantytown of Sinekli where sewage from homes drains into it (Fig. 3). Finally, the stream reaches the vegetables gardens and irrigates them.

Karakoyun stream begins in the northwest of the city, near the village of Karakopru. Its bed and banks are cemented and it is nearly dried up. Refuse and sewage from homes are disposed in it as it flows towards the city centre. Karakoyun stream runs past a refuse transfer station where municipal refuse accumulates in the daytime and waste is discharged into the stream (Fig. 4). Later, it is drained near the vegetable gardens by a motor-driven pump. Just behind this refuse transfer station, the city's main underground sewage pipe has been broken by farmers, producing a stream. with a volume higher than that of the natural streams. Sewage water channels flow near gardens, discharging into canaliculi in the gardens and even in the yards. In the same area, the lateral sewer pipe, which drains into the shantytown of Sinekli, is broken prior to the point where it joins the main sewer, and is used as a fertiliser for cultivation of the gardens.

Sites of sample collection - (1) Ten sewage farms were randomly selected. Seventy-eight stool samples were collected from inhabitants of all of the selected farmhouses. Five vegetables and five soil samples were collected from onion, garlic, lettuce, and spinach and parsley gardens at every farm. Three soil samples were taken from the children's playing area in the yard at every farmhouse. Ten soil samples were also taken from the banks of streams and canaliculi into gardens; (2) water samples from Bamya stream were taken from machine shops, cement factories, the shantytown of Sinekli and near gardens. Water samples from Karakoyun stream were taken near the refuse transfer station. Sewage water samples were taken near broken sewer pipes and in gardens; (3) ten kinds of vegetables (lettuce, spinach, parsley, onion, garlic, peppermint, cabbage, black cab-

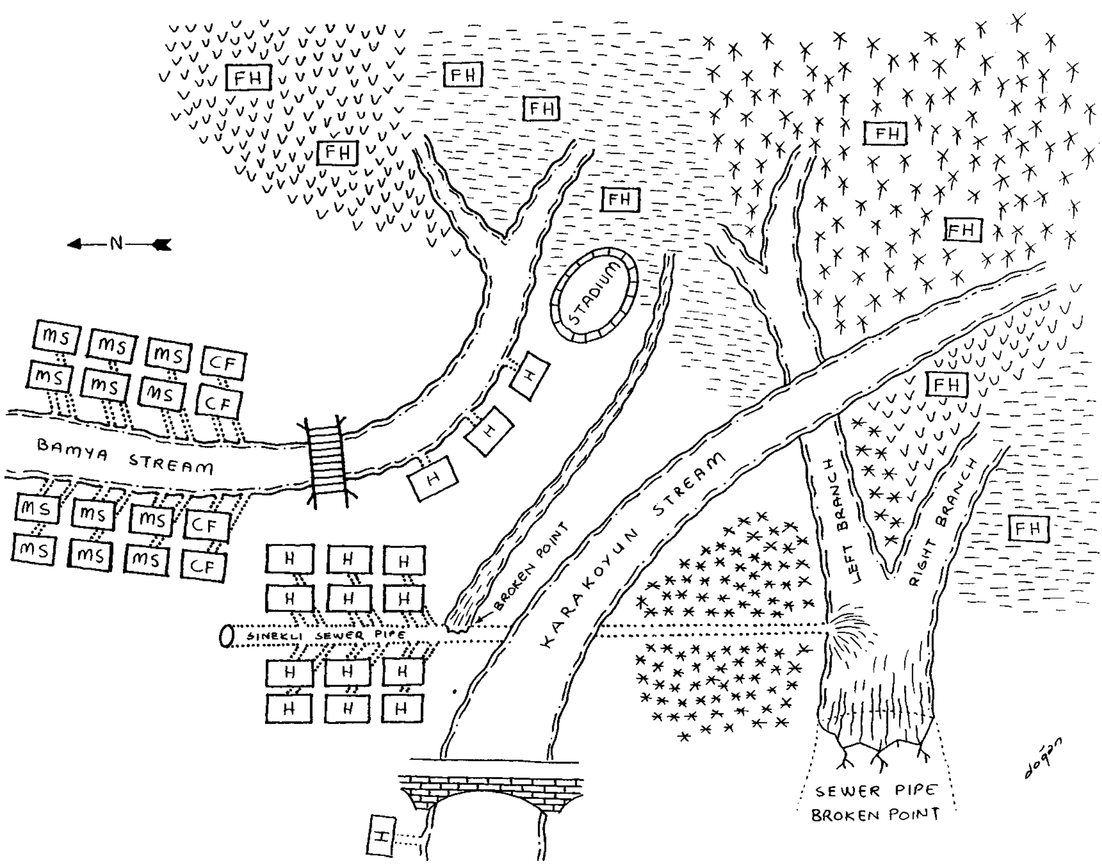

Fig. 1: study area in Sanliurfa; MS: machine shop; CF: cement factory; FH: farmer house; H: house

Fig. 2: a view of Bamya stream flowing near machine shops and cement factories.

Fig. 3: a view of Bamya stream flowing along the border of Sinekli shantytown polluted with wasters and garbages.

bage, mustard and purslane) are sold in the city market and three samples of each kind of vegetable were used in the study.

A total of 314 samples were collected. All water samples were placed in 10 ml screw-lid centrifuge tubes and labelled. Soil samples were taken 2-5 cm beneath the surface of the soil, placed in polyethylene bags and labelled. Vegetable samples were placed in polyethylene bags and labelled.

Examination - Stool samples were examined by the Kato technique and the number of eggs was determined by the Kato-Katz technique (Suzuki 1980) to evaluate the intensity of infection. Water samples were centrifuged and the sediment was examined. Soil samples were studied in the laboratory by centrifugal flotation using saturated MgSO4 solution, as described by (Kagei (1983). The eggs at different stages of maturation were distinguished by the method described by Suzuki (1981). Vegetables samples each weighed approximately 200 g, except lettuce, which weighed 500 g, and were examined in the laboratory by the method described by Kagei (1983). Cultivation of soil for STH larvae was not conducted in this study.

Fig. 4: a view of refuse tranfer station

RESULTS

Seventy-eight stool, 46 water, 90 soil and 100 vegetables samples were examined for the presence of STH eggs. Specially, 88.5 % of the stool samples, 60.8% of the water samples, 84.4 % of the soil samples and 14 % of the vegetables samples were found positive for STH eggs (Table I).

TABLE I

Results for all of the samples examination for soil transmitted helminth eggs

Samples	No. of samples	No. of positive (%)
Stool	78	69 (88.5)
Water	46	28 (60.8)
Soil	90	76 (84.4)
Vegetables	100	14 (14)
Total	314	187 (59.5)

The results of the stool examination are presented in Table II; 88.5% of the samples were found to be infected by soil transmitted helminthiases. Double infections were most prevalent with only *A. lumbricoides* and *Trichuris trichiura* double infections were detected. In single infections, *A. lumbricoides* was common and closely followed by *T. trichiura*. MEPG (mean eggs per gram stool) represents intestinal worm burden in the host and both *Ascaris* and *Trichirus* infections showed moderate intensities with their MEPG being under 10,000 and 3,000 respectively. The highest worm burden was seen in mixed infections in which their MEPG was 17,000. Eggs of other species were not detected.

The results of the detection of *Ascaris* eggs in soil samples and the rates of different stages of *Ascaris* eggs and MEPGS (mean eggs per gram soil) are shown in Table III. *Ascaris* eggs were detected in 92% of soil samples in which garden soils were found more polluted and followed by yard and bank soil. Embryonated and infective stage eggs were found together in most of the soil samples in average of 3.3 eggs per positive sample (Figs 5, 6).

TABLE II

Prevalence and intensity of *Ascaris lumbricoides (AL)* and *Trichuris trichiura (TT)* among farmhouse inhabitants

Species	Positive cases No. (%)	MEPG
AL	18 (23)	9425
TT	15 (19.2)	2175
AL+TT	36 (46.2)	17,000
Total	69 (88.5)	9533

MEPG: mean eggs per gram stool

The results of the detection of STH eggs in 46 water samples taken from different sites of streams and sewage water were shown in Table IV. *Ascaris* eggs were detected in the 60.8% of the water samples and were found in 31.2% of Bamya stream, 75% of Karakoyun stream and 76.9% of sewage stream samples. The total number of *Ascaris* eggs was higher in sewage water than Karakoyun and Bamya stream water. Moreover, no eggs were detected in the samples taken at the points where Bamya stream passes near the cement factories. Other detected parasites were *T. trichiura* from one sample (2.1%), *H. nana* from one sample (2.1%) and *T. saginata* from one sample (2.1%).

Fourteen vegetables were found to be contaminated with STH eggs. Fertile *Ascaris* eggs were detected in one lettuce sample and two parsley samples from gardens and in four peppermint samples, and in one sample each of lettuce, onion, mustard and parsley from the market. *T. saginata* eggs were detected in one parsley sample from a single garden and *H. nana* eggs were found in one lettuce and one peppermint sample from the market (Table V).

DISCUSSION

This preliminary study indicated that heavy environmental pollution was a source of soil trans-

TABLE III

Results of examination of the collected soil samples for *Ascaris lumbricoides* eggs

Places	No. of samples	No. of positive (%)	Monocell to morula No. (%)	Infected stage No. (%)	MEPGS
Garden soils	50	46 (92)	34 (73.9)	32 (69.5)	3.4
Bank soils	10	7 (70)	7 (100)	-	3.5
Yard soils	30	23 (76.6)	17 (73.9)	13 (56.5)	3.2
Total	90	76 (84.4)	58 (76.3)	45 (59.2)	3.3

MEPGS: mean eggs per gram soil

Fig. 5: embriyonated *Ascaris lumbricoides* egg detected in a soil sample.

Fig. 6: infective stage of *Ascaris lumbricoides* egg detected in a soil sample.

mitted helminthiases that were transmitted by vegetables and soil contaminated with night soil in Sanliurfa. The environmental pollution is the result of poor environmental sanitation and poor hygiene habits, reflecting the population's behaviour regarding environmental sanitation, and the public health authorities' negligence of this issue. The population is unaware both in terms of sanitation and hygiene habits and in terms of knowledge of public health and how to avoid environmental pollution. The health authorities do not see this problem as a public health threading issue.

Examination of stools revealed that STH infection in farmers was very prevalent (88.7%) than the population (60%) in Sanliurfa. On farms, adults and children were equally susceptible to STH infections. Adults work in the soil with their hands and mode of infection is by ingestion of embryonated infective eggs, which have developed in soil, and reach the mouth by soiled hands. In addition, they were

TABLE IV

Positive findings for *Ascaris lumbricoides* eggs in water samples

Places of samples	No. of samples	No. of positive (%)	Total egg count
Bamya stream			
machine shops	3	-	-
cement factories	3	-	-
shantytown	6	2 (33%)	3
gardens	4	3 (75%)	4
Karakoyun stream near refuse transfer station	4	3 (75%)	21
Main sewer water			
broken point	6	6 (100%)	92
left branch	2	1 (50%)	21
near gardens	7	6 (85.7%)	64
inside gardens	6	3 (50%)	32
Lateral sewer water			
broken point	2	2 (100%)	61
Sewer water			
Sinekli shantytown	3	2 (66.6%)	23
Total	46	28 (60.8%)	321

ingested to eggs by eating the raw vegetables without cleaning. The children contaminate the yard with their excreta and thus seede the soil with *Ascaris* eggs, which after development and maturation provide a source of reinfection.

This study showed that viable-stage ova were present in the irrigation water (60.8%) and cause soil contamination. Refuse and wastes were disposed in the streams without any precautions. Nearly all of the sewer pipes in the city was broken and the night soil passed into small canaliculi in the gardens and even in the yards. Night soil has been used on cultivated fields as fertiliser, and consequently eggs are dispersed in the soil of yards and gardens, and occasionally onto vegetables. This study also revealed that although, Bamya stream was polluted by the machine shops and cement factories, *Ascaris* eggs were not detected in samples taken from this area. It may be that chemical pollution kills STH eggs. *Ascaris* eggs appear after the stream reaches to the shantytown of Sinekli.

Soil examination results explained the high prevalence of *Ascaris* infections in farmers. Infective eggs in the garden soil was also transmitted by farmers hands to the vegetables and caused to continuous transmission to the population. Although, *T. trichiura* was involved in up to 65% of the infections in farmers families, we could not find its eggs in the soil. This may be explained by the fact that eggs of *T. trichiura* are less resistant to environmental stress such as drying or direct exposure to sunlight (Klaas 1987).

Examination of vegetables revealed that the onion, garlic, lettuce, spinach, peppermint and parsley carried *A. lumbricoides, T. saginata* and *H. nana* eggs. These vegetables are grown in Sanliurfa and usually eaten raw. These highly contaminated vegetables were a source of STH for the population in Sanliurfa. Cabbage, black cabbage and purslane, which are exported to other parts of Turkey, were not found to be contaminated.

Many studies were reported environmental pollution with soil transmitted helminths. Toan (1994) made a study in similar environmental conditions in a rural area in Vietnam and found that the prevalence of soil transmitted helminth infection was high and all of the soil samples were positive for *Ascaris* eggs. Muttalib et al. (1983) reported that 80-90% of human excreta found its way into soil or water, and refuse, garden, and water sources were found to be infected in Bangladesh, predominantly by *Ascaris* ova. Fueki (1952) established that night soil is widely used as fertiliser in rural areas in Japan, and that nearly half of the vegetables sold in markets are contaminated with *Ascaris* eggs.

The city's municipal, health and other governmental sectors have responsibility for this serious environmental pollution. The authorities of these sectors neglect these seriously public health thread-

TABLE V

Detected soil transmitted helminths in vegetables

	No. of samples	No. of positive (%)	*AL* (%)	*TS* (%)	*HN* (%)
Gardens	50	4 (8)	3 (6)	1 (2)	-
Market	50	10 (20)	8 (16)	-	2 (4)
Total	100	14 (14)	11(11)	1 (1)	2 (2)

AL: *Ascaris lumbricoides*; *TS*: *Taenia saginata*; *HN*: *Hymenolepis nana* ing conditions and take no preventive measurements against usage of night soil in vegetable gardens. However, academic sectors may play a role to aware of governmental and non-governmental organizations about environmental pollution. A joint project should be implemented with the cooperation of municipal, health, governmental, and private sector. These projects should contribute to a wide-ranging examination of the problem, and preventative education for the population. Public health conditions should have top priority in solving this serious health problem. First priority is that prohibition of the use of night soil as a fertiliser for cultivation of vegetables. In addition, media (radio, television, newspaper etc.) programmes may be effective to awareness of community about environmental sanitation and hygienic habit.

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