

**CONTAMINATION WITH HELMINTH EGGS OF VARIOUS
PROCESSING STAGES OF THE SEWAGE TREATMENT PLANT
IN ISFAHAN, CENTRAL IRAN*(1973)**

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ABSTRACT

Because of the establishment of a sewage treatment plant in the city of Isfahan in recent years, a study was undertaken to investigate the effect of this system in reducing the high prevalence of helminthiases.

Samples obtained from various parts of the plant and at different stages of processing were examined and it was found that the eggs of *Ascaris*, *Trichostrongylus* spp. and *Trichuris* are found in very high numbers in the canal entering the plant, the majority of which were undeveloped. The average number of *Ascaris* ova found in one gram of fertilizer at the end of processing was 18, 100; the culture of which yielded a high proportion (up to 45 per cent) of eggs in larval stages.

An examination of the inhabitants of two quarters of the city, one with and the other without a sewage system, showed high prevalences of infection with helminths among both groups. The difference between the prevalence of infection with each helminth was not significant in these two groups. Similar infection rates were also found among the laborers working at the sewage plant.

The contaminated fertilizer is used in vegetable farms and, because of the large consumption of vegetables by the inhabitants of the city, the important role of contaminated fertilizer in the transmission of *Ascaris* infection in the city of Isfahan is discussed.

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INTRODUCTION

The high prevalence of some soil-transmitted helminths such as *Ascaris*, *Trichuris* and *Trichostrongylus* spp. in the city of Isfahan has been reported previously (Biocca, 1959; Faghieh, 1950; and Ghadirian *et al.*, 1968^a, 1968^b). The unsanitary habits of the inhabitants in carrying night-soil from latrine pits to farms and the contamination of the soil in the streets of Isfahan with eggs and transmission of helminthiasis as a result, have been shown by Ghadirian *et al.* (1968^a).

Because of the establishment of a sewage system in the city in recent years and the consequent limitation of the use of faeces as fertilizer, a study was undertaken in the summer to determine the condition of sewage materials at various processing stages and the changes in the prevalence of infection among the inhabitants of Isfahan.

MATERIALS AND METHODS

Sewage in various processing stages from 23 points in the sewage treatment plant was sampled and examined for the presence of the ova of helminths. The processing stages were as follows: the main canal sewage materials to a Barr screen, great chamber, primary sedimentation which has been divided into two parts. The first part goes through a trickling filter, secondary sedimentation and finally to the digester. The second part from the primary sedimentation goes directly to the digester which together enters the evaporation pond which produces the final humus material. Liquid samples were examined by the formaline ether technique and fertilizer by flotation and formaline ether methods. Eggs from the latter were also counted by the Stoll method. Sampling was repeated five times in the mornings and five times in the afternoons.

To assess variations in the distribution and number of eggs at various hours of the day, samples were collected for three days from the canal entering the plant, every hour from 9 a.m. to 6 p.m. These samples were examined by the formaline ether method and counted by the Stoll technique.

In order to determine the infestation of the sewage system in Isfahan, two samples (one in the morning and one in the afternoon) were collected from 20 manholes in various parts of the city and examined by the formaline ether method.

All samples of fertilizer containing the ova of helminths were cultured in petri dishes and tubes (Harada Mori technique) at 24–31°C and examined for the presence of the infective stage of ova or larvae 15 to 17 days after their culture.

To determine the extent of relation between the infestation of the sewage system and that of humans with helminth ova, stool samples of 220 individuals from areas with a sewage system, 220 from

areas without a sewage system, and of 44 laborers working in the sewage treatment plant were examined by the flotation technique.

RESULTS

Examination of samples from 20 manholes revealed the presence of *Ascaris* ova in all of them and the eggs of *Trichuris* and *Trichostrongylus* spp. in 15 and 12 of them respectively.

All samples collected at various times from the canal entering the plant were infested with eggs of *Ascaris* while the eggs of *Trichostrongylus* and *Trichuris* were absent from some of the samples.

All samples examined from 23 points of the sewage treatment plant showed the presence of *Ascaris* ova and some showed the presence of eggs of *Trichostrongylus* spp. and *Trichuris*. The number of eggs of *Ascaris*, *Trichostrongylus* and *Trichuris* in one gram sample from the canal entering the plant and from fertilizer was determined by Stoll method (table 1).

The results of cultures of fertilizers, which was studied from observation on the development and viability of *Ascaris* eggs is shown in table 2.

The results of the examination of inhabitants of areas with and without a sewage system and the laborers of the plant are summarized in table 3. As is shown in this table, the prevalences of all three helminthiases do not differ significantly in the various groups. As is shown in table 4, the prevalence of all three helminths varies in different age groups of the populations of areas with and without a sewage system. While for *Ascaris* the variation of prevalence in different age groups is not significant, for *Trichostrongylus* spp. the prevalence increases with the age of the population and decreases among people 60 years old and over. The same trend is observed for *Trichuris* but the prevalence decreases in the age group 50 and over. The difference observed is usually low when comparing the prevalence of the three parasites in each age group among population with and without sewage system.

Chi square tests performed showed that the difference between the prevalences of ascariasis and trichuriasis among three different groups is not significant.

For trichostrongyliasis, the difference in prevalence between the area with and the one without a sewage system is significant, with a $P < 0.01$. Table 3 also indicates that the rates of all three infections do not differ significantly in the two sexes but it is different between each group.

DISCUSSION AND CONCLUSION

The results obtained from the present investigation clearly indicate the contamination of different stages of the sewage treatment plant and of the fertilizer obtained from this system with eggs of various soil-transmitted helminths, particularly *Ascaris Iumbricoides*. The plant was installed recently and the digestion tank of this plant had a maximum temperature of 30°C which did not kill the eggs of *Ascaris*.

This highly infested fertilizer (with 18, 100 eggs of *Ascaris*/gr) is packed into polyethylene bags and used on various types of farms, including vegetable farms. Vegetables from these are later sold to the population of the city for consumption.

Water from treated waste effluents is chlorinated and re-enters the river in the city.

This study shows that the high infestation of vegetables with eggs of various soil-transmitted helminths, together with the contamination of the soil with these eggs, as shown by Ghadirian *et al.* (1968^a), are the main factors accounting for the high prevalence of intestinal helminthiasis in the city of Isfahan. The insignificant difference in prevalences of helminths infection of the inhabitants of the areas with and without sewage system and of laborers of the plant indicate that the transmission of helminthiasis, especially ascariasis and trichuriasis, are mostly caused by the use of infested fertilizers rather than by contact with sewage system.

It should be noted that the presence of helminth ova in the sewage, water from waste effluents and manure seen in Isfahan has also been reported by several workers from other countries (Kogan, 1960; Lysek, 1967; Kebina and Agranonik, 1970; and Wolf, 1971). Destruction of these eggs has been attempted by some of these workers, but often without successful results (Kebina and Agranonik, 1970).

It was also concluded from this study that the establishment of a sewage system under present conditions does not help in reducing the prevalence of soil-transmitted helminths among the inhabitants. Because of the high infection rate in this city, especially for ascariasis, careful and restricted measures together with intensive health education using all available media should be implemented for the dehelminthization of the sewage treatment plant and especially for the destruction of eggs in fertilizer.

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Table 1
Number of helminth eggs found in samples from
different stages of sewage system
(Isfahan, 1972)

Sites	No. of eggs/gr of sample for:					
	Ascaris		Trichos. spp.		Trichuris	
	Range	Mean	Range	Mean	Range	Mean
Canal*	1,000- 13,000	6,500	500- 2,000	1,110	500- 1,500	750
Ferti- lizer**	14,600- 25,400	18,100	—***	—***	—***	—***

* Canal, at entrance to plant

** Fertilizer (last stage of process)

*** Eggs not found in examination by Stoll Method.

Table 2
Percentage of Ascaris eggs found at various stages of
development at different sites of sewage plant
(Isfahan, 1973)

No. of Stations	Damaged	Unseg- mented	Seg- mented	Pre-larval	Larval
17	10	12	30	14	34
18	7	5	45	10	33
19	9	8	39	6	38
20	8	10	31	6	45
21	4	11	42	5	38
22	3	6	40	9	42

Table 3
Prevalence of various intestinal helminthiases among inhabitants of quarters with and without sewage system and laborers of the sewage plant (Isfahan, 1973)

Areas	No. examined						Percentage found infected with:											
							Ascaris						Trichostrong.					
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T			
With sewage system	113	107	220	68.	75.	73.	61.	74.	67.	44.	42.	43.						
Without sewage system	100	120	220	68.	78.	73.	50.	66.	59.	43.	48.	46.						
Laborers	44	--	44	84.	--	84.	31.	--	31.	48.	--	48.						
Total	257	227	484	71.	77.	73.	73.	58.	70.	44.	47.	45.						

Table 4
Prevalence of infection with three helminths among various age groups in different areas
(Isfahan, 1973)

Age Group	Prevalence of Infection (%) with:									
	Ascaris			Trichostrongylus			Trichuris			
	With Sewage	Without Sewage	Laborers	With Sewage	Without Sewage	Laborers	With Sewage	Without Sewage	Laborers	
0-4	65	46	--	--	17	--	23	17	--	
5-9	66	82	--	34	42	--	28	33	--	
10-14	73	68	--	69	53	--	42	53	--	
15-19	67	69	100	67	58	67	40	35	--	
20-29	71	80	87	79	70	73	50	53	47	
30-39	65	96	80	83	79	80	61	58	50	
40-49	78	80	83	96	80	33	61	73	67	
50-59	87	100	--	100	100	--	47	67	--	
60+	70	73	--	70	73	--	50	64	--	
TOTAL	71	74	84	66	57	70	44	45	48	