STUDIES ON THE CONTROL OF HOOKWORM AND OTHER SOIL-TRANSMITTED HELMINTHIASES IN FARMERS IN ZHEJIANG PROVINCE, CHINA

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Abstract. Different periodic selective chemotherapeutic schemes were used to control hookworm and other soil-transmitted helminthiases in eight villages in five counties in Zhejiang Province, China, 1985-1988. The results showed that the prevalence rates of hookworm, ascariasis, and trichuriasis decreased from 35.0-74.4%, 47.0-.76% and 22.9-47.5% to 3.2-15.8%, 9.9-47.8%, and 3.5-31.2%, respectively, using pyrantel pamoate (10 mg/kg for 1-2 days) or albendazole (400 mg for 1-2 days, once or twice a year for 2-3 years). The eggs per gram of feces of hookworm and *Trichuris trichiura* also dropped markedly after control. Moreover, the mean hemoglobin levels of sampled populations increased after several treatments. The authors recommend periodic selective chemotherapy as the main method to control soil-transmitted helminthiases, especially hookworm infections.

INTRODUCTION

Hookworm and ascariasis are two of the most common parasitic diseases in China (Yu *et al,* 1989). They are particularly Widespread in rural areas where the farming practices facilitate the transmission of these infections. In previous studies among agricultural workers in Zhejiang Province, the prevalence rates for hookworm, ascariasis, and trichuriasis were 35.0-74.4%, 47.0-76.7%, and 22.9-47.5%, respectively (Xia *et al,* 1986). It was also found that some adults had heavy hookworm burdens and some school children were heavily infected with *Ascaris lumbricoides.* The present study was initiated to investigate the best and most practical means of controlling these diseases.

MATERIALS AND METHODS

Study sites

The study was conducted in rural areas of Zhejiang Province which is located in southeastern China. Nine villages, having populations of 900-1,300, from five counties were selected as the field study sites. Cluster sampling was used.

Stool examination methods

Brine floatation, Kato-Katz and larval culture methods were used to determine the prevalence and intensity of infections with hookworm, *A. lumbricoides,* and *T. trichiura.* The culture method was also used to determine the species of hookworm.

Scheme of control

Periodic selective population chemotherapy and health education were used in different groups. The nine villages were divided into five groups : Group I included villages A and B; pyrantel pamoate or albendazole was used twice a year for three consecutive years. Group II consisted of village C; pyrantel pamoate or albendazole was used once a year for three consecutive years. Group III included villages D, E, F, and G; pyrantel pamoate or albendazole was used twice each year for 2.5 years. In Group IV, village H, only albendazole was used twice a year for two years. Group V, village I, was the control group; mass stool examinations were carried out in 1986 and 1988.

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Anthelmintics and dosages

Pyrantel pamoate was used in 1985-1986 in a single dose of 10 mg/kg body weight for *A. lumbricoides* infections; 10 mg/kg/day for two days for hookworm and *T. trichiura* infections. Albendazole was used in 1986-1988 in a single dose of 400 mg for *A. lumbricoides,* and 400 mg/day for two days for hookworm and *T. trichiura.* The dosage was reduced in the treatment of children.

Health education

Throughout all the groups, except the control group, there were educational posters displayed with the life cycle of hookworm and *A. lumbricoides;* there were slogans and interviews to encourage the farmers to join the program. When stool examinations and chemotherapy took place, the villagers were shown the large numbers of hookworms and *A. lumbricoides* expelled after the deworming of heavily infected people.

RESULTS

The prevalence rate of hookworm gradually decreased in all experimental groups (Table 1). The rates of decrease ranged from 72.7% to 93.9% between 1985 and 1988. The difference between the prevalence of hookworm in 1985 and in 1988 was statistically significant ($p < 0.01$). The efficacy of hookworm control was most distinct in village H (Group IV) and village D (Group III); the decreases were 93.9% and 93.4%, respectively. The larval counts per gram of feces for egg-positive persons also decreased markedly after control (Table 2). The best results were in village D, with the prevalence decreasing 79.9%.

The difference in prevalence rates for *T. trichiura* in 1985 and in 1988 were also statistically significant for all groups ($p < 0.01$). The best results were in village D, with a prevalence decrease of 80.0%. This was probably due to the use of pyranteloxantel compound for egg-positive persons in an earlier treatment trial of this village; oxantel is specific for trichuriasis (Xia *et al,* 1983).

Larval counts for hookworm and egg counts for *T. trichiura* in some groups in 1988 were higher than the counts in 1985; this was due to the absence of heavily infected individuals in these groups when stool examinations and chemotherapy were carried out in the previous year.

The decreasing prevalence rates of hookworm, *A. lumbricoides,* and *T. trichiura* in the control group (village I) were 13.3%, 2.3% and 40.6%, respectively.

Most of the hookworm egg-positive villagers in the experimental groups were infected with *Ancylostoma duodenale* and *Necator americanus.* There was no change in the presence of these two species after control.

Hemoglobin levels were examined in 145 persons (79 males and 66 females) between 7 and 80 years of age. The hemoglobin levels increased with the frequency of treatment. The mean hemoglobin value for males was 10.2 g/dl in 1985 and 12.1 g/dl in 1988. The average increase was 1.9 g/dl. The difference between these two means was statistically significant ($p < 0.01$). The mean hemoglobin values for females was 9.4 g/dl in 1985 and 11.3 g/dl in 1988 (difference between means = $p < 0.01$). Results are shown in Table 3.

DISCUSSION

The results of this study indicated that periodic selective chemotherapy along with health education is effective for the control of hookworm infections. The prevalence of hookworm decreased from 52.3% to 3.2% within two years with albendazole treatment twice a year. Zhang (1990) showed that albendazole is a safe and effective drug against hookworm infection. Most adult worms will be expelled from the human body with four drug treatments. Through the health education part of the control program, farmers now understand how to protect themselves against hookworm infections by wearing shoes during the rainy season, which is when much of the farming is done.

The efficacy of ascariasis control is dependent on the frequency and course of treatment each year. In all experimental villages, except village D, the results of ascariasis control were not very satisfactory, even when chemotherapy was carried out twice a year for three consecutive years. It is well known that even though most of the adult worms are expelled through treatment, there are still a large number of eggs in the environment which remain alive for many years. Henry (1988) has reported that 50% of the children become rein-

Table 1

Prevalence of soil-transmitted helminthiasis before and after control.

Treatment regimen	Village	Year	No. examined	Hookworm positive No.	Hookworm positive %	*A. lumbricoides* positive No.	*A. lumbricoides* positive %	*T. trichiura* positive No.	*T. trichiura* positive %
Pyrantel, albendazole 2/year for 3 yrs	A	1985	707	527	74.4	533	75.5	316	44.8
		1988	564	81	14.4	231	40.9	65	11.6
	B	1985	1025	527	51.4	787	76.7	461	44.9
		1988	907	127	14.0	406	44.8	283	31.2
Pyrantel, albendazole 1/year for 3 yrs	C	1985	783	535	68.3	573	73.2	295	37.7
		1988	728	115	15.8	497	68.3	167	22.9
Pyrantel, albendazole 2/year for 2 1/2 year	D*	1985	1137	591	52.0	535	47.0	540	47.5
		1988	824	28	3.4	82	9.9	78	9.5
	E	1985	632	259	40.9	417	65.9	247	39.1
		1988	742	43	5.8	233	31.4	153	20.6
	F	1985	818	387	47.3	605	74.0	187	22.9
		1988	601	38	6.3	287	47.8	82	13.6
	G	1985	500	175	35.0	311	62.2	165	33.0
		1988	548	40	7.3	128	23.4	112	20.4
Albendazole 2/year for 2 years	H	1986	731	382	52.3	441	60.3	207	28.3
		1988	691	22	3.2	258	37.3	24	3.5
Control	I	1986	852	494	58.0	579	70.0	273	32.0
		1988	752	378	50.3	514	68.4	142	19.0

* Persons with *Ascaris lumbricoides* also received two days treatment in this village.

fected with *A. lumbricoides* six months after chemotherapy. Seo (1980) suggested that in endemic areas, treatment must be repeated at least every three months. In Zhejiang Province people become reinfected very soon after deworming.

Why the prevalence rate of *T. trichiura* dropped from 32.0% to 19.0% within two years in the control group (village I) is unknown. It may be due to the irregular egg production of *T. trichiura,* which is thought to possibly be seasonally influenced and, therefore, warrants further study.

The performance of this control program was

Table 2

Intensity of hookworm and *Trichuris* infections before and after control.

Treatment regimen	Village	Years	Hookworm (culture) No. examined	Hookworm (culture) Mean no. larvae per gram feces	*T. trichuris* (Kato-Katz) No. examined	*T. trichuris* (Kato-Katz) No. positive	*T. trichuris* (Kato-Katz) Eggs per gram feces
Pyrantel, albendazole 2/year of 3 years	A	1985	231	1148	33	22	245
		1988	48	411	205	38	214
	B	1985	73	361	98	62	371
		1988	71	540	211	114	306
Pyrantel, albendazole 1/year for 3 years	C	1985	-	-	182	106	264
		1988	-	-	204	42	57
Pyrantel, albendazole 2/year for 2 1/2 years	D	1985	417	1082	184	128	241
		1988	12	449	204	40	170
	E	1985	38	334	100	69	226
		1988	26	272	104	41	482
	F	1985	100	1203	204	66	221
		1988	32	230	214	31	77
	G	1985	25	1753	59	43	190
		1988	25	338	103	27	179
Albendazole 2/year for 2 years	H	1986	118	731	101	45	161
		1988	9	202	256	23	122
Control	I	1986	203	1050	204	134	215
		1988	115	423	206	52	31

affected by many factors. The main problem was that many of the participants were missed at various times because some leave their villages for several months to work elsewhere and were absent at times of stool collecting, examination, and chemotherapy.

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Table 3

Mean level of hemoglobin in sampled population in Nighai County, pre- and post-treatment (1985-1988).

Year	Male			Female			Hookworm infection rate (%)
	No. examined	Mean value (g/dl)	SD	No. examined	Mean value (g/dl)	SD	
1985	111	10.07 (7.1-12.5)	1.12	90	9.53 (7.3-11.5)	0.88	100.0
1986	84	10.83 (8.5-13.8)	0.89	63	9.92 (7.0-11.4)	0.78	48.9
1987	92	10.96 (9.0-12.1)	0.64	83	10.32 (9.0-11.7)	0.64	17.3
1988	79	12.10 (10.0-14.0)	0.85	66	11.24 (9.5-12.5)	0.65	6.9

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