THE EFFECT OF LONG-TERM DEWORMING ON THE PREVALENCE OF SOIL-TRANSMITTED HELMINTHIASES IN MALAYSIA

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SUMMARY

Once-yearly, mass deworming with broad-spectrum anthelmintics over a period of five years among four types of communities in Malaysia resulted in an overall education in the prevalence of soil-transmitted helminthiases by one-third to two-thirds. The reduction in prevalence of infection was highest among inhabitants in semi-urban settlements (65.5%), followed by those in the rural estates (53.0%) and high-rise flats (43.9%). Soil-transmitted helminthiases were only reduced by 35.5% in the urban slums.

Reduction in infection with Trichuris trichiura *was better than that with* Ascaris lumbricoides *whereas hook-infection was completely eliminated in some of the communities surveyed. The reduction in prevalence of soil-transmitted helminthiases by long-term, once-yearly deworming alone, without other supplementary interventions, reinforces the potential and feasibility of regular mass-deworming as an immediate and effective measure for the control of soil-transmitted helminthiases. This is of great public health significance especially in highly endemic communities where some form of intervention is urgently needed and facilities for other control measures such as the improvement of environmental sanitation and nutritional status and health education are neither feasible nor possible nor immediately available.*

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INTRODUCTION

Soil-transmitted helminthiases were very common in many tropical and sub-tropical countries, including Malaysia.[1,2] The prevalence of soil-transmitted helminthiasis was even higher in communities of low socioeconomic status such as urban slums or rural estates where the standards of living and conditions of environmental sanitation were generally poor.[1] In such communities, soil-transmitted helminthiases can be effectively controlled by an integrated approach, involving regular mass chemotherapy, improvement of environmental sanitation and nutritional status and health education. However, in highly endemic areas such as slums or squatter areas, it may not be feasible nor practical to implement any permanent or effective measures to improve the environmental sanitation as most slums were illegal settlements and therefore considered not permanent.

In addition, the improvement of environmental sanitation, nutritional status and health education can be very costly in terms of time, money and effort, and the effects of such

improvements on the prevalence of soil-transmitted helminths can only be seen after some time. On the other hand, regular mass deworming with an effective broad-spectrum anthelmintic can effectively reduce the egg outputs of most of the soil-transmitted helminths by 80–90%,[3] thereby offering the means for the rapid and immediate reduction in the contamination of the environment by helminth eggs or larvae.

The present paper discusses the effect of once-yearly deworming over a period of five years on the prevalence of soil-transmitted helminthiases in four types of communities in Kuala Lumpur and Selangor.

MATERIALS AND METHODS

Mass deworming on a once-yearly basis over a period of five years was carried out in four types of communities within Kuala Lumpur and Selangor. These included urban slums within Kuala Lumpur, rubber and oil-palm estates in the rural areas in Selangor, semi-urban settlements just outside the city and low-cost, high-rise flats within the city itself. The standards of living and conditions of environmental sanitation within the urban slums were generally poor and basic amenities such as toilets, clean water supply, paved roads, proper drainage or facilities for the regular disposal of garbage were very inadequate or totally absent. The houses within these slums were usually poorly constructed and overcrowded. Indiscriminate defaecation together with the accumulation of garbage attracted large numbers of flies and other pests. The conditions of living and environmental sanitation were slightly better within the rubber estates but similar conditions of poverty, ignorance and indifference which prevailed in the slums were present among the rural poor in the estates as well. The socio-economic status of the inhabitants within the semi-urban settlements was usually better and there were adequate toilet facilities and water supply within these communities. Clean water and proper toilets were provided in the low-cost flats within the city.

At the beginning of each year (from 1979 to 1983), fully-labelled plastic stool packets were distributed to all members of all households within the communities selected for the study. The stool samples collected were examined for eggs of *Ascaris lumbricoides, Trichuris trichiura* and hookworms with the Kato thick smear method. People infected with *Ascaris* alone were treated with single doses of 15mg/kg body weight of pyrantel pamoate and mixed infections with any of the soil-transmitted helminths were treated with 100 mg of mebendazole, twice daily, for three consecutive days. As large populations were initially involved (over 20,000), it was not possible to conduct stool examinations and specifically treat infected persons more than once a year. Thus, in all the communities studied, stool collection, specific treatment and post-treatment stool examination were subsequently carried out only once a year.

During the course of the study (1979–1983), very little specific improvements to the environment were attempted, especially in the slums. But during the home visits to distribute stool packets, collect stool samples or deliver anthelmintics, the field workers were trained to give basic health education and general information regarding the life cycle, routes of transmission and ways of control of soil-transmitted helminths.

RESULTS

The overall prevalence of infection with soil-transmitted helminths from the four types of communities studied from 1979 to 1983 are shown in Table I and Fig. 1. The overall prevalence of infection with soil-transmitted helminths dropped markedly after two rounds of annual deworming but stabilised later to be followed by a slight increase at the end of five years (Fig. 1). This trend was followed in infection with *Trichuris* following deworming whereas ascariasis remained steady at around 10.5 – 18.5% throughout the five years of study. Hookworm infections dropped from 6.6% in 1979 to almost negligible levels at 0.9% after one round of deworming.

TABLE I
PREVALENCE OF SOIL-TRANSMITTED HELMINTHIASES FROM 1979–1983

	1979	1980	1981	1982	1983
Number infected with soil-transmitted helminths	8,175	2,318	1,833	1,132	1,505
Percentage infected (%)	(39.8)	(32.3)	(22.3)	(21.2)	(27.3)
Number with *Ascaris*	3,792	982	861	557	889
Percentage with *Ascaris* (%)	(18.5)	(13.7)	(10.5)	(10.5)	(16.1)
Number with *Trichuris*	6,923	1,853	1,362	801	950
Percentage with *Trichuris* (%)	(33.7)	(25.8)	(16.6)	(15.0)	(17.2)
Number with hookworms	1,355	67	16	7	5
Percentage with hookworms (%)	(6.6)	(0.9)	(0.2)	(0.1)	(0.1)
Total population examined	20,519	7,178	8,226	5,331	5,513

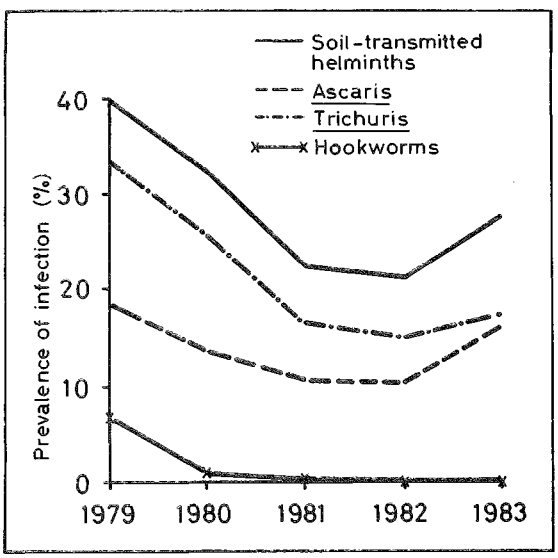

Fig. 1 Prevalence of soil-transmitted helminthiasis from 1979–1983.

The reduction in the prevalence of infection following once-yearly deworming among dwellers in urban slums was similar to the overall trend (Table II, Fig. 2). Trichuriasis dropped from 53.2% in 1979 to 29.4% in 1983, ascariasis from 35.2% to 24.0% and hookworms almost disappeared after one round of annual deworming.

Among inhabitants from the rubber and oil-palm estates in the rural areas, soil-transmitted helminthiasis dropped sharply and continuously right on after the second round of annual deworming with only a slight increase after the third round of anthelmintics (Table II, Fig. 3). This trend was also reflected in the prevalence of trichuriasis and ascariasis whereas hookworm infection dropped drastically from 22.1% to 1.6% after one round of deworming and remained negligible throughout the next few years of study.

TABLE II
PREVALENCE OF SOIL-TRANSMITTED HELMINTHIASES AMONG URBAN SLUMS FROM 1979–1983

	1979	1980	1981	1982	1983
Number infected with soil-transmitted helminths	2,681	408	144	201	375
Percentage infected (%)	(61.7)	(47.6)	(41.6)	(37.3)	(39.9)
Number with *Ascaris*	1,531	194	102	121	226
Percentage with *Ascaris* (%)	(35.2)	(22.6)	(29.5)	(22.5)	(24.0)
Number with *Trichuris*	2,312	353	104	156	276
Percentage with *Trichuris* (%)	(53.2)	(41.4)	(30.1)	(28.9)	(29.4)
Number with hookworms	388	1	0	0	0
Percentage with hookworms (%)	(8.9)	(0.1)	(0)	(0)	(0)
Total population examined	4,345	858	346	539	940

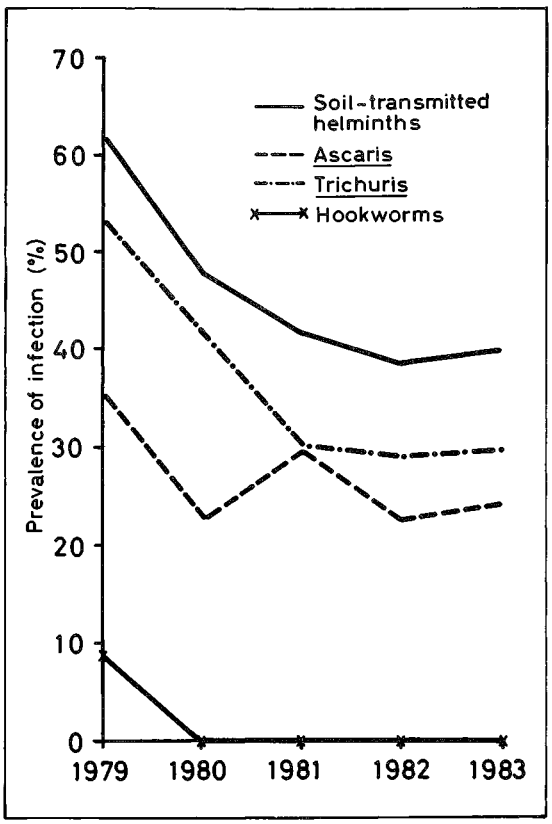

Fig. 2 Prevalence of soil-transmitted helminthiasis among urban slums from 1979–1983.

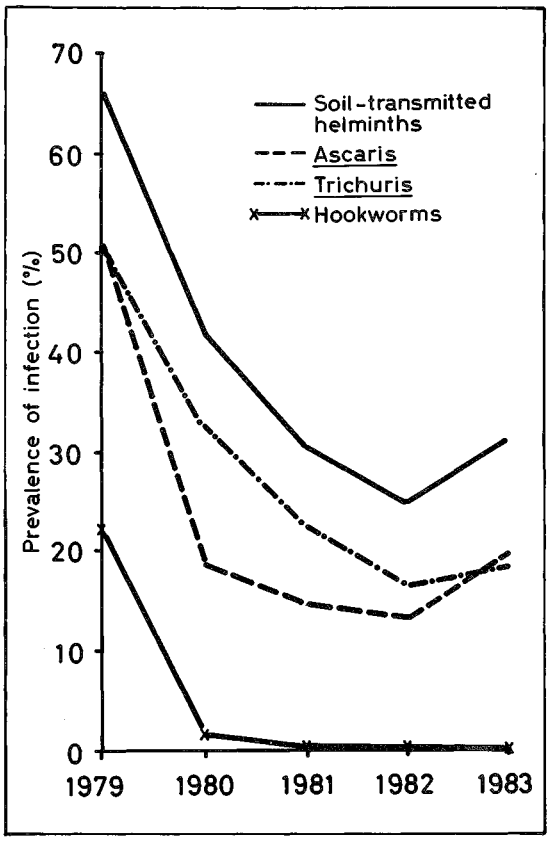

Fig. 3 Prevalence of soil-transmitted helminthiasis among rural estates from 1979–1983.

TABLE III
PREVALENCE OF SOIL-TRANSMITTED HELMINTHIASES AMONG RURAL ESTATES FROM 1979 TO 1983

	1979	1980	1981	1982	1983
Number infected with soil-transmitted helminths	1,711	1,580	1,224	639	946
Percentage infected (%)	(66.2)	(41.9)	(30.4)	(24.9)	(31.1)
Number with *Ascaris*	1,302	706	582	336	601
Percentage with *Ascaris* (%)	(50.5)	(18.7)	(14.5)	(13.1)	(19.8)
Number with *Trichuris*	1,310	1,239	897	421	563
Percentage with *Trichuris* (%)	(50.8)	(32.8)	(22.3)	(16.4)	(18.5)
Number with hookworms	571	61	12	7	5
Percentage with hookworms (%)	(22.1)	(1.6)	(0.3)	(0.3)	(0.2)
Total population examined	2581,	3,773	4,029	2,566	3,039

Among the inhabitants from the semi-urban settlements outside Kuala Lumpur, soil-transmitted helminthiases dropped markedly from 28.1% to 7.2% after one round of deworming to remain relatively stable at around 10% throughout the next four years of study (Table IV, Fig. 4). This trend was reflected in infections with *Trichuris* but ascariasis remained constant at around 2–4% after its initial reduction from 8.1% at the beginning of the study. Hookworm infections remained negligible throughout the course of study.

Among high-rise flat dwellers within Kuala Lumpur, trichuriasis dropped by more than half, from 24.5% to 11.0% after two rounds of annual deworming and remained steady afterwards (Table V, Fig. 5). Ascariasis, on the other hand, remained practically unchanged at 3.9% to 7.1% throughout the five years of study.

The overall reduction of soil-transmitted helminthiases as well as the reduction in individual prevalences of ascariasis, trichuriasis and hookworm infection after five years of deworming are tabulated in Table VI. The highest overall reduction in the prevalence of soil-transmitted helminthiases was observed in semi-urban settlements (65.6%), followed

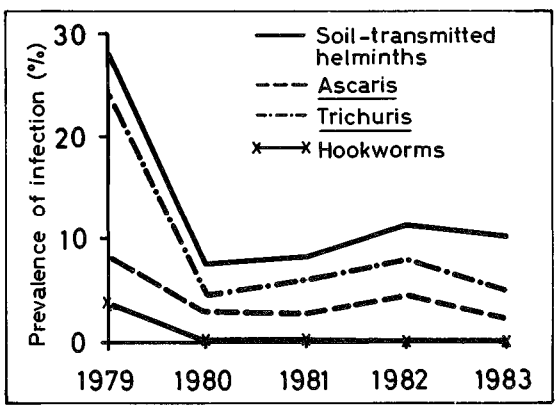

Fig. 4 Prevalence of soil-transmitted helminthiasis among semi-urban settlements from 1979–1983.

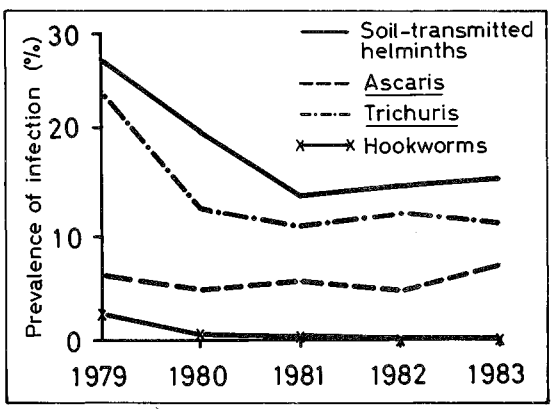

Fig. 5 Prevalence of soil-transmitted helminthiasis among urban flats from 1979–1983.

TABLE IV
PREVALENCE OF SOIL-TRANSMITTED HELMINTHIASES AMONG SEMI-URBAN SETTLEMENTS FROM 1979–1983

	1979	1980	1981	1983	1983
Number infected with soil-transmitted helminths	1,902	103	100	115	89
Percentage infected (%)	(28.1)	(7.2)	(8.1)	(11.1)	(9.7)
Number with *Ascaris*	545	38	33	44	18
Percentage with *Ascaris* (%)	(8.1)	(2.7)	(2.7)	(4.2)	(2.0)
Number with *Trichuris*	1,631	63	73	81	42
Percentage with *Trichuris* (%)	(24.1)	(4.4)	(5.9)	(7.8)	(4.6)
Number with hookworms	233	2	1	0	0
Percentage with hookworms (%)	(3.4)	(0.1)	(0.1)	(0)	(0)
Total population examined	6,769	1,431	1,236	1,041	919

TABLE V
PREVALENCE OF SOIL-TRANSMITTED HELMINTHIASES AMONG URBAN FLATS FROM 1979–1983

	1979	1980	1981	1982	1983
Number infected with soil-transmitted helminths	1,881	227	365	177	95
Percentage infected (%)	(27.6)	(20.3)	(14.0)	(14.9)	(15.5)
Number with *Ascaris*	414	44	144	56	44
Percentage with *Ascaris* (%)	(6.1)	(3.9)	(5.5)	(4.7)	(7.1)
Number with *Trichuris*	1,670	198	288	143	69
Percentage with *Trichuris* (%)	(24.5)	(17.7)	(11.0)	(12.1)	(11.2)
Number with hookworms	163	3	3	0	0
Percentage with hookworms (%)	(2.4)	(0.3)	(0.1)	(0)	(0)
Total population examined	6,824	1,116	2,615	1,185	615

by the rural estates and urban flats (53.0% and 43.9% respectively). Soil-transmitted helminthiases among the urban slums were reduced by only about one-third (35.3%). Ascariasis was reduced by 75.7% in the semi-urban settlements, 60.8% in the rural estates and only 31.8% in the urban slums; whereas among flat dwellers in the city, ascariasis registered an increase of 17.5% at the end of the study period. *Trichriasis* was again more effectively reduced in the semi-urban settlements and rural estates (8.10% and 63.5% respectively) compared to urban flats and slums (54.1% and 44.8% respectively). In all four types of communities, hookworm infection was practically eliminated by the end of five years of study.

At the beginning of every year of stool examination, stool packets were distributed to all members of all households in the communities selected for the study. It can be seen that there is a drastic reduction in the rate of return of stool samples among the inhabitants in the slums, semi-urban settlements and flats after the first round of deworming (Fig. VI). By the fifth year of study in 1983, stool samples were returned from only about one-eleventh to one-fifth of the population in these communities who responded at the beginning of the study in 1979. On the other hand, the numbers of stool samples returned from the rubber estates remained consistently high throughout the five years of study.

TABLE VI
PERCENTAGE REDUCTION IN PREVALENCE OF SOIL-TRANSMITTED HELMINTHIASES AFTER FOUR ROUNDS OF ANNUAL DEWORMING, FROM 1979 TO 1983

	Soil-transmitted helminths	*Ascaris*	*Trichuris*	Hookworms
Urban slums	35.3	31.8	44.8	100.0
Rural estates	53.0	60.8	63.5	99.3
Semi-urban settlements	65.6	75.7	81.0	100.0
Urban flats	43.9	17.5*	54.1	100.0

* Percentage increase in infection with *Ascaris*.

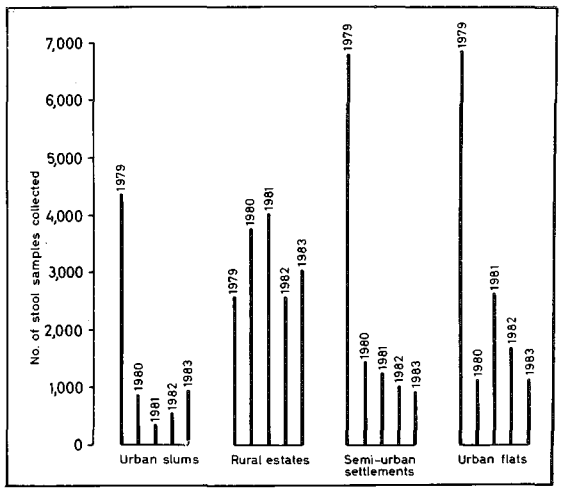

Fig. 6 Number of stool samples collected from 4 types of communities from 1979–1983.

DISCUSSION

Once-yearly deworming with broad-spectrum anthelmintics alone in the absence of other interventions, over a period of five years, was able to reduce the prevalence of soil-transmitted helminthiasis by about one-third in urban slums and by almost half to two-thirds in high-rise flats, rural estates and semi-urban settlements. There is no doubt that once-yearly deworming is very inadequate for the control of soil-transmitted helminthiases especially in highly endemic areas where re-infection can occur as rapidly as two months after treatment. However, the yearly routine of distribution of stool packets, collection of stool samples and delivery of anthelmintics by the field workers served as a constant reminder to the community about the threat of soil-transmitted helminths, the need for continuous awareness about the parasites and the necessary precautions to be taken to avoid infection.

Trichuris trichiura, despite being one of the most difficult intestinal nematodes to eliminate because of its particular mode of attachment to the caecal mucosa, was a lesser problem to the community than *Ascaris lumbricoides.* At the end of five years, *Trichuris* in all the four types of communities was reduced by 44.8% to 81% whereas the reduction of ascariasis was less and there was in fact an increase in the prevalence of ascariasis among flat dwellers examined at the fifth year of study. This may be probably due to the mode of action of the anthelmintics used for the treatment of *Ascaris* and *Trichuris* infections. Pyrantel pamoate rapidly blocks the neuromuscular junctions of *Ascaris* worms which were subsequently rapidly expelled from the host and the eggs within the expelled worms were hardly affected by the action of the anthelmintic, with the result that all the eggs released from the treated worms were still viable and able to develop into infective eggs to infects others in the community.

Mebendazole, on the other hand, had been shown to produce morphological alterations of *Trichuris* eggs two to nine days after treatment and 90% of these deformed eggs were not viable when they were released into the external environment.[4] Thus, *Trichuris* worms which were treated with mebendazole only produced fewer eggs but most of these eggs would not be able to develop into infective eggs in the soil.

The drastic reduction of hookworms eggs in the stools collected from all four types of communities demonstrated that people from all those communities had acquired the habit of wearing shoes which was one of the most effective ways of prevention of hookworm infection as this nematode infect man through the skin. Nevertheless, the 100% reduction of hookworm infection in some of the areas may be partly due to the high rate of false negatives for hookworm eggs examined by the Kato thick smear method. The glycerine used in the Kato thick smear preparation tends to render the hookworm eggs to become too transparent and sometimes even altered in appearance with the result that hookworm eggs were often difficult to recognise, especially if the preparation was kept for too long before examination. Thus, very low infections with very few hookworm eggs would have been missed by this

method of stool examination. However, as the same method was used throughout the five-year study period, the initial prevalence of hookworms, as detected by the Kato method, was still markedly higher than that detected by the same method in the same areas in subsequent year.

The reduction in the prevalence of infection with soil-transmitted helminths in the various communities was also correlated with the stool return rates from these communities. There was a very high drop-out rate in the return of stool samples from inhabitants in the slums, semi-urban settlements and flats over the course of the study. However, this high rate of drop-outs was not too unexpected especially in longitudinal cohort studies involving large numbers of subjects over a long period of time. The positive aspect of this high drop-out rate was that during the course of the study, the people had developed greater awareness of the problem and also greater self-reliance to overcome it, as was probably the case with the inhabitants from the semi-urban settlements. Despite the high drop-out rate from 6,769 participants in 1979 to only 919 people who returned stool samples in 1983, soil-transmitted helminthiases among these semi-urban settlements showed the highest reduction in prevalence of 65.6% at the end of five years. The people in these semi-urban settlements were of a slightly higher income group and during the course of the deworming project, many of the inhabitants within the community had had the members of their own households dewormed regularly even before the annual visits of the field workers. As they already had access to anthelmintics on their own, many of them dropped out of the project as they did not feel the necessity to participate in it any longer. This may account for the great reduction in soil-transmitted helminthiases despite the high drop-out rate among inhabitants in the semi-urban settlements.

The negative outcome of a high drop-out rate was that the people within the community had become indifferent towards the deworming activities and were therefore less willing to cooperate in the return of stool samples. This resulted in fewer stool samples being examined and fewer infected people being detected for treatment and therefore the reduction of soil-transmitted helminthiases in these communities was less, as was probably the case among inhabitants in the urban slums or squatter areas which had the lowest reduction in the prevalence of infection at the end of the deworming project. Another factor which contributed to this poor reduction of infection was the lack of any concrete improvements in the environmental sanitation within these communities throughout the study period.

People in the rubber and oil-palm estates had the highest stool return rates and also at the same time, a high rate of reduction of soil-transmitted helminthiases, after the semi-urban settlements. This was because rubber estates are closely-knit communities. The inhabitants were more disciplined and willing to cooperate and there was always the estate foreman or supervisor who could supervise or assist in the return of stool samples.

Reduction of soil-transmitted helminthiases among flat dwellers was expectedly high as transmission of infection in the flats was low. In a study on the effect of re-housing and infection with soil-transmitted helminths, Kleevans[5] concluded that adequate sanitary provisions in the flats was the major contributary factor for the significant differences in the prevalence of ascariasis and trichuriasis between flat dwellers and squatters.

Thus, it can be concluded that the prevalence of soil-transmitted helminthiases can be reduced by 35% to 66% by only once-yearly mass deworming of a population over a period of a few years. While the reduction in the prevalence of infection was not too high, the simultaneous reduction in the intensity of infection can be expected to be more significant. A longitudinal study of a population of primary school children showed that while the prevalence of infection was reduced by only 15% after five years of

deworming, the intensity of infection with *Ascaris* and *Trichuris* was reduced by 60% and 88% respectively, as indicated by egg counts.[3]

Therefore, despite its restricted coverage and limited effectiveness, once-yearly deworming over a period of time provided an effective means for the rapid and marked reduction in the prevalence and probably the intensity of infection with soil-transmitted helminths. This is especially important in communities where facilities for the improvement of environmental sanitation were neither possible nor practical. If human and financial resources permitted selective chemotherapy of all infected persons several times a year, instead of only once annually; the prevalence and intensity of soil-transmitted helminthiases can be expected to be even more markedly reduced. In another study, Cabrera and his co-workers,[6] were able to reduce the prevalence of ascariasis from 84.4% to 0.5% after four quarterly treatments over a period of one year. However, in the absence of other control measures or before these measures could be implemented or their effects could be felt, long-term deworming alone would be able to effectively reduce the prevalence and intensity of soil-transmitted helminthiases within a community. These reduced prevalence and intensity of infection could then be subsequently maintained by other more permanent measures such as improvement in environmental sanitation and nutritional status.

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