

SOIL-TRANSMITTED HELMINTHIASIS IN SELANGOR, MALAYSIA

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SUMMARY

A survey of 25,246 Malay, Chinese and Indian children and adults ranging from birth to over 60 years of age, of both sexes, from 4 types of communities with different conditions of environmental sanitation and socio-economic status revealed an overall incidence of infection with soil-transmitted helminths of 39.6 percent. The incidence of soil-transmitted helminthiasis was highest among rural rubber estates, followed closely by the urban slums or squatter areas and incidence of infection was low in the semi-rural new villages and the urban flats. The commonest helminth in all these areas was *Trichuris trichiura* and the commonest type of helminthic infection was mixed infections with *Ascaris* and *Trichuris*. Infection was most prevalent among Indians, followed closely by Malays. Chinese generally had lower incidences of infection. Soil-transmitted helminthiasis was also more prevalent among the younger age groups, starting from toddlers to 9 years and rising to a peak in the 10-19 years age group. Elderly people (60 years and above) from the squatter areas and some of the estates, new villages and flats also had a higher incidence of infection than the older adults (30-59 years). Malay and Indian children (under 15 years of age) having a higher overall incidence of infection also tended to have higher degrees of infection, as estimated by egg counts. There was no significant differences in the distribution of

infection between males and females in most of the study areas. However, females in the squatter areas had a higher incidence of infection than males. Conversely, females in some of the flats (Sri Melati and Shaw Road) had a lower incidence of infection than males.

INTRODUCTION

A review of the literature on soil-transmitted helminthic infections in Malaysia revealed that numerous surveys have been carried out among people from various areas, communities and ethnic groups in various parts of Malaysia. These included surveys of primary school children in Selangor,¹ children and infants from two rural areas near Kuala Lumpur² and paediatric in-patients at the General Hospital in Kuala Lumpur³ and Penang⁴ Surveys were also carried out among island populations in Pulau Tioman⁵ and Pulau Pinang and Pulau Perhentian Kecil⁶ and also among the staff and their families from an oil palm estate near Klang.⁷ The incidence of soil transmitted helminthiasis among Orang Aslis has also been studied by Sandosham,⁸ Dunn⁹ and Dissanaiké *et al.*¹⁰

Because of the differences in the sample size of these surveys, the differences in the methods and the sensitivity of the methods employed for detection of the helminth eggs, together with the diversity, selectiveness and restrictiveness of the populations surveyed, it is not possible to conclude with certainty the overall incidence of infection with soil-transmitted helminths among the general population in Malaysia.

This communication summarises the prevalence and distribution of the common soil-transmitted

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helminths - *Ascaris lumbricoides*, *Trichuris trichiura* and hookworms in Malaysia and compares the prevalence of these parasites, the intensity of infection, according to the race, age and sex of 25,246 Malay, Chinese and Indian children and adults (from birth to over 60 years of age) from 4 main types of areas with different conditions of environmental sanitation and socio-economic status.

This present survey of soil-transmitted helminthiasis was confined to areas in and around Kuala Lumpur and carried out jointly by the National Family Planning Board and the Department of Parasitology, University of Malaya, as an Integrated Family Planning/Parasite Control Project initiated by the Japanese Organization for International Cooperation in Family Planning (JOICFP). The objective of this Integrated Project is to increase the number of family planning acceptors through parasite control, which is an effective entry point for family planning because of its immediacy, visibility and credibility.

MATERIALS AND METHODS

The present paper reports the results of stool examinations carried out in one year, starting from May 1978, at the commencement of the Integrated Project in Malaysia. An initial target population of almost 58,000 people from 8,500 households from 11 project areas within and around Kuala Lumpur was selected for parasite control. These 11 project areas can be roughly grouped into 4 categories: urban squatter areas, rural plantations or estates, semi-rural new villages and urban flats. The squatter areas, Kampong Sentosa and Kampong Abdullah Hukum, are areas within the Federal Territory where people have built their homes illegally. As such, some of these areas often lacked adequate basic facilities like electricity, piped water, proper latrines, sewage and garbage disposal, drainage and accessible surfaced roads. In addition to poor environmental sanitation, overcrowding, malnutrition and ignorance often prevailed in these squatter areas. The estates, Tanjong Malim and Kerling, are situated outside the Federal Territory. The houses are built by rubber plantations which provide water and some sort of toilet facilities. About the same conditions of poverty, overcrowding, malnutrition and poor environmental sanitation, as seen in squatter areas, are also present in the estates. The semi-rural new villages, Sungei Way, Jinjang and Cheras, are

settlements built on the out-skirts of the urban areas as a resettlement scheme for the rural population during the emergency (1948-60). Most of these new villages have electricity, water, sanitation amenities and accessible roads for the provision of adequate garbage disposal. The urban flats, Sri Melati, Sri Pahang, San Peng and Shaw Road Flats, are low cost flats built by City Hall for the low socio-economic group within the city. These flats have electricity, proper water supply, toilet facilities, refuse disposal and good ventilation. Some of the flat dwellers are resettled squatters.

At the initiation of the project, field workers from the National Family Planning Board collected stool samples from all members of all households in the 11 project areas. The stool samples were collected in clearly-labelled plastic packets with adhesive seals and sent to the Department of Parasitology where the stool samples were screened for helminth eggs with the Magnesium sulphate-brine flotation method and the Kato method. Egg counts of positive cases were made with the Beaver's method in heavy infections and Katz method in light to moderate infections. Details of the size and location of the households, the race, age and sex of each member in the household, together with the results of the stool examinations for soil-transmitted helminths, were recorded. Because of the large numbers of samples to be collected and examined, no provision was made for the detection of *Strongyloides* larvae in the stool samples. The incidences of enterobiasis was not studied except to note those cases where the *Enterobius* eggs spilled over in the stool samples. Hookworms eggs in the stool samples were not cultured to differentiate *Necator americanus* from *Ancylostoma duodenale*.

RESULTS

A total of 25,246 stool samples were examined from both children and adults in the 11 project areas. The overall incidence of infection with soil-transmitted helminths and the incidence of infection with each of the common soil-transmitted helminths - *Ascaris lumbricoides*, *Trichuris trichiura* and the hookworm are tabulated in Table I. An overall incidence of infection of 39.6 percent was obtained, with the highest incidence in the estates, followed closely by the squatter areas. Infection was low in the new villages and flats, the majority of which was under 30 percent or just over 30 percent, with the exception of Cheras new village (42.3 percent) and Shaw Road flats (35.2

TABLE I
INCIDENCE OF INFECTION WITH SOIL TRANSMITTED HELMINTHS AMONG CHILDREN AND ADULTS IN AND AROUND KUALA LUMPUR, MALAYSIA

Types of Areas		Numbers examined	% infected (Overall infected)	<i>Ascaris</i>	<i>Trichuris</i>	Hook-worms
I	Squatter areas:					
	Kampung Sentosa	3,402	64.6	38.7	55.9	10.7
	Kampung Abd Hukum	943	51.2	22.7	43.5	4.7
II	Estates:					
	Tanjong Malim	1,511	73.0	73.0	55.1	22.6
	Kerling	1,070	56.8	18.6	44.6	21.5
III	New Villages:					
	Jinjang	3,162	31.1	11.3	27.4	1.2
	Cheras	858	42.3	17.4	34.7	4.2
	Sungei Way	3,607	25.5	5.2	21.2	5.4
IV	Flats:					
	Sri Melati	2,047	19.3	5.6	15.5	0.6
	Sri Pahang	2,923	28.5	5.6	25.1	2.5
	San Peng	3,869	7.9	1.4	6.5	0.4
	Shaw Road	1,854	35.2	7.3	33.4	4.2
Total (% overall infected)		25,246	(39.6)	(18.8)	(33.0)	(7.1)

TABLE II
INCIDENCE OF INFECTION AMONG MALAYS, CHINESE AND INDIANS IN DIFFERENT AREAS

Types of Areas	Racial Distribution (%)			% Infected			
	Malay	Chinese	Indian	Malay	Chinese	Indian	
I	Squatter areas:						
	Kampung Sentosa	63.0	23.3	13.7	71.6	37.5	77.9
	Kampung Abd Hukum	56.6	11.5	31.9	46.3	45.0	62.1
II	Estates:						
	Tanjong Malim	7.7	1.3	90.6	64.7	36.8	67.1
	Kerling	8.2	11.5	77.1	50.0	45.2	59.0
III	New Villages:						
	Jinjang	-	100.0	-	-	31.1	-
	Cheras	2.9	85.1	11.7	41.7	40.5	55.2
	Sungei Way	26.5	58.7	11.6	38.6	12.0	37.9
IV	Flats:						
	Sri Melati	20.5	60.0	19.1	34.1	1.1	34.5
	Sri Pahang	58.1	16.6	22.9	32.2	13.0	30.5
	San Peng	4.4	87.0	8.3	14.8	6.2	22.1
	Shaw Road	49.4	30.1	18.9	39.2	19.5	49.2
Average				43.3	28.8	49.6	

TABLE III
INCIDENCE OF INFECTION IN DIFFERENT AGE GROUPS

Types of Areas	Age group in years						
	0-9	10-19	20-29	30-39	40-49	50-59	60 & above
I Squatter areas:							
Kampung Sentosa	65.6	73.1	60.0	59.9	44.1	54.5	57.6
Kampung Abd Hukum	53.8	62.9	42.2	47.2	27.3	50.0	64.3
II Estates:							
Tanjung Malim	71.3	73.8	64.9	57.7	56.3	56.8	52.8
Kerling	59.6	66.4	50.0	45.4	43.6	55.9	58.3
III New Villages:							
Jinjang	37.9	41.2	21.0	17.3	18.5	25.6	16.1
Cheras	50.8	49.5	33.3	29.9	35.0	25.0	17.1
Sungei Way	20.1	35.7	31.1	17.0	14.8	20.3	23.3
IV Flats:							
Sri Melati	18.6	22.9	23.5	17.4	12.6	12.9	9.5
Sri Pahang	27.4	39.0	25.6	23.4	17.8	17.5	22.5
San Peng	34.1	46.6	39.4	27.6	24.8	28.7	20.9
Shaw Road	8.3	9.2	7.9	8.7	6.0	1.7	10.3
Average:	40.7	47.3	36.3	30.6	27.3	31.7	32.1

percent). With the single exception of Tanjong Malim estate, *Trichuris* was the commoner parasite, compared with *Ascaris*. As was expected, hookworms were more prevalent in the rural estates, followed by the squatter areas and the semi-rural new villages.

The incidence of infection was further analysed according to the racial distribution in these areas (see Table II). Except for Jinjang New Village, which is an exclusively Chinese area, the 3 main races - Malays, Chinese and Indians - are distributed in all the 11 study areas from the 4 main groups. However, the racial distribution in these areas varies. Malays predominate in the squatter areas and also in 2 of the 4 flats: Sri Pahang and Shaw Road flats. Chinese predominate in the New Villages and the other 2 flats: Sri Melati and San Peng flats. Indians, on the other hand, tend to concentrate in the estates where they form the main labour force of the estates and account for 77.1 to 90.6 percent of the total population in the 2 estates studied.

However, despite the differences in the racial distribution in these areas and the differences in conditions of environmental sanitation and socio-

economic background of these areas, Indians consistently had the highest incidence of infection, except in Sungei Way New Village and Sri Pahang flats, where Malays had a marginally higher incidence of infection. In contrast, Chinese had the lowest incidence of infection in all the project areas. Thus, intestinal helminths appear to be most prevalent among Indians, followed closely by Malays and are least common among Chinese.

The incidence of infection was further analysed according to the ages of the people (Table III). The following trend of distribution of infection according to age was seen: the incidence of infection was uniformly high in the 0-9 years age group and this incidence rose to a peak at the 10-19 years age group, after which the incidence decreased with age, with the lowest incidence of infection being observed in those over 60 years of age, as seen in Tanjong Malim Estates, Jinjang and Cheras New Villages and 2 of the flats which were predominantly occupied by Chinese - Sri Melati and San Peng Flats. In the other areas, the incidence-of infection decreased in the 30-59 years age group to reach another peak in the over 60 years age group. This peak was not as high as the

TABLE IV
INCIDENCE OF INFECTION AMONG MALES AND
FEMALES IN DIFFERENT AREAS

Types of Areas	Overall infected %	% Infected	
		Male	Female
I Squatters areas:			
Kampung Sentosa	64.4	62.8	66.2
Kampung Abd Hukum	51.2	29.0	51.0
II Estates:			
Tanjong Malim	73.0	63.9	69.0
Kerling	56.8	59.7	54.4
III New Villages:			
Jinjang	31.1	32.3	30.2
Cheras	42.3	42.9	41.7
Sungei Way	25.5	23.8	26.9
IV Flats:			
Sri Melati	19.3	29.9	19.2
Sri Pahang	28.5	28.8	28.2
San Peng	7.9	7.6	0.1
Shaw Road	35.2	34.7	35.7
Average:	39.6	37.8	38.4

peak observed in the 10-19 years age group, as seen in Kampung Sentosa, Kerling Estate, Sungei Way New Village and Sri Pahang flats. On the other hand, in Kampung Abdullah Hukum and Shaw Road flats, the incidence of infection was even higher in the over 60 years age group than in the younger age groups.

The difference in the incidence of infection among males and females was not very significant in most of the project areas (Table IV). However, in both squatter areas, females had a higher incidence of infection than males. The reverse situation was observed in 2 of the 4 flats: Sri Melati and San Peng flats where Chinese predominate. In these flats, females are less frequently infected than males. This situation was however not observed in the other two flats (Sri Pahang and Shaw Road flats) where Malays predominated.

The distribution of helminthic infections according to type of helminths, race, age and sex in squatter areas, estates, new villages and flats is summarised in Table V.

Previous studies carried out by other workers, together with the results of the present study, indicate that children, from toddlers to those in their middle teens (3-15 years) have the highest

incidence of infection with soil-transmitted helminths. Therefore, in this study the intensity of infection with *Ascaris* and *Trichuris*, as estimated from egg counts, was further analysed in children under 15 years of age (Tables V & VI)

In the squatter areas (Table VI), Indian and Malay children who had higher overall incidences of infection (46.3-77.9 percent) had moderate to heavy *Ascaris* infections, as indicated by egg counts (26,698 - 90,544 EPG). On the other hand, Chinese children who had the lowest overall incidence of infection in these areas (37.5 - 45.0 percent), only had light to moderate *Ascaris* infections (4,667 - 29,993 EPG). Similarly in the estates, Indian children with the highest overall incidence of infection also had the heaviest *Ascaris* worm burden (30,348 - 49,012 EPG). This was followed closely by Malay children (16,057 - 27,661 EPG) whereas Chinese children in estates having the lowest overall incidence of infection only had low *Ascaris* worm burdens, as shown in Chinese children in Kerling Estate (9,991 EPG). In contrast, Chinese children in the new villages had heavier *Ascaris* worm burdens (10,596 - 35,540 EPG) than Malay and Indian children (4,588 - 13,334 EPG), despite the lower overall incidence of infection among Chinese staying in new villages. Among children living in the flats, *Ascaris* worm burden was heavier among Indian and Malay children (1,203 - 27,897 EPG) where the overall incidence of infection was higher than Chinese children, who in contrast, showed a lower *Ascaris* worm burden (2,021 - 20,420 EPG).

The intensity of infection with *Trichuris* among children under 15 years is shown in Table VII. The pattern of *Trichuris* worm burdens among Malay, Chinese and Indian children living in squatter areas, estates, new villages and flats more or less followed that of *Ascaris*. Indian children in squatter areas and estates had the heaviest *Trichuris* worm burdens (1,429 - 26,698 EPG), followed closely by Malays. In contrast, Chinese children in the squatter areas and Kerling Estates only had light *Trichuris* worm burden (488 - 3,869 EPG). Most of the Malay, Chinese and Indian children in new villages had light *Trichuris* infection (1,356 - 2,557 EPG), except Indian children in Cheras New Village where the *Trichuris* worm burden was significantly higher (4,938 EPG). *Trichuris* worm burdens of children staying in the flats ranged from light (2,081 - 3,087 EPG) to heavy (13,395 EPG) among Malay children, very light to

TABLE V
DISTRIBUTION OF HELMINTHIC INFECTION
ACCORDING TO RACE, AGE AND SEX IN
SQUATTER AREAS, ESTATES, NEW VILLAGES AND
FLATS IN AND AROUND KUALA LUMPUR

	Squatter areas	Estates	New Villages	Flats	Total (Average)
Total numbers examined	4,345	2,581	7,627	10,693	25,246
Overall incidence of infection (%)	58.6	66.6	29.7	25.3	(39.6)
% infected with <i>Ascaris</i>	35.6	26.7	9.1	6.1	(18.8)
% infected with <i>Trichuris</i>	53.2	50.7	25.3	23.1	(33.0)
% infected with Hookworms	9.4	22.2	3.5	2.4	(7.1)
Race					
Malays (% infected)	59.0	57.4	28.6	30.1	(43.3)
Chinese (% infected)	41.0	41.0	27.9	1.0	(28.8)
Indians (% infected)	70.0	63.0	31.0	34.1	(49.6)
Age					
0-9 years	59.7	65.5	36.3	22.1	(40.7)
10-19 years	68.0	70.1	42.1	29.4	(47.3)
20-29 years	51.1	57.5	28.5	24.1	(36.3)
30-39 years	52.1	51.6	21.4	19.3	(30.6)
40-49 years	35.7	50.0	22.8	15.3	(27.3)
50-59 years	52.3	56.4	23.6	15.2	(31.7)
60 years & above	61.0	55.6	18.8	15.8	(32.1)
Sex					
Males	45.9	61.8	33.0	25.3	(37.8)
Females	58.6	61.7	32.9	20.8	(38.4)

moderate (160 - 4,509 EPG) among Indian children and very light to light (328 - 3,729 EPG) among Chinese children.

Infection with soil-transmitted helminths among children under 15 years of age from the 11 study areas was further analysed according to the type of infections - single infection with only one species of helminths or mixed/multiple infections with two or more species of helminths, as tabulated in Table VIII. As can be seen, single infections were more common among children living in flats where 52.0 - 80.6 percent of all infections were infections with a single species of helminth. Single infections were also more common among children in Kerling Estate (52.2 percent) and the two new villages - Sungei Way (68.8 percent) and Jinjang (57.5 percent). The predominant helminth occurring as single infections in children from all 11 study areas was *Trichuris trichiura* which accounted for 60.0 to 79.3 percent of all cases of single infections reported. The only exception was Kampung

Sentosa where 64.4 percent of the single infections were *Ascaris* infections. Single infections with hookworms was not reported among this group of children analysed.

In contrast, double infections were more prevalent in the squatter areas (Kampung Sentosa, 78.1 percent; Kampung Abdullah Hukum, 55.6 percent), Tanjong Malim Estate (47.5 percent) and Cheras New Village (59.5 percent). Of the double infections reported among children from all the 11 study areas, the majority of them (84.6 - 100 percent) were double infections with *Trichuris* and *Ascaris*. Double infections with *Ascaris* and hookworms or *Trichuris* and hookworms were negligible (1.5 - 12.5 percent).

Triple infections with *Ascaris*, *Trichuris* and hookworms were significantly more prevalent among children in the estates (9.0 - 12.7 percent), followed by the squatter areas (0.5 - 4.6 percent) and to a lesser extent, in 2 of the 3 new villages - Cheras (2.5 percent) and Sungei Way (1.8 percent)

TABLE VI
INTENSITY OF ASCARIS INFECTION IN CHILDREN UNDER 15 YEARS OF AGE

	Overall % Infection	Mean EPG	Overall % Infection	Mean EPG	Overall % Infection	Mean EPG
I Squatter areas:						
Kampung Sentosa	46.3	90,544 (139)	37.5	29,993 (29)	62.1	78,379 (76)
Kampung Abd Hukum	71.6	31,113 (77)	45.0	4,667 (19)	77.9	26,698 (35)
II Estates:						
Tanjung Malim	64.7	27,661 (9)	36.8	-	67.1	49,012 (71)
Kerling	50.0	16,057 (16)	45.2	9,991 (16)	59.0	30,348 (93)
III New Villages:						
Jinjang	-	-	31.1	35,540 (144)	-	-
Cheras	41.7	-	40.5	39,749 (53)	55.2	5,921 (8)
Sungei Way	38.6	13,334 (30)	12.0	10,596 (24)	37.9	4,588 (9)
IV Flats:						
Sri Melati	34.1	22,000 (12)	1.1	2,021 (5)	34.5	25,017 (13)
Sri Pahang	32.2	16,900 (56)	13.0	20,420 (8)	30.5	27,997 (33)
San Peng	14.8	23,635 (58)	6.2	9,777 (6)	22.1	25,868 (35)
Shaw Road	39.2	13,395 (4)	19.5	4,598 (8)	49.2	1,203 (1)

Figures within brackets: Number of egg counts made
 Light *Ascaris* infection: Under 10,000 EPG
 Moderate *Ascaris* infection: 10,000 - 40,000 EPG
 Heavy *Ascaris* infection: Over 40,000 EPG
 EPG: Eggs per gram of faeces

and in 3 of the flats - Sri Pahang, San Peng and Shaw Road (2.3 - 3.1 percent).

DISCUSSION

As the present survey covered a large population of people (25,246 males and females) of all ages (from birth to over 60 years of age) belonging to the three main ethnic groups in the country (Malays, Chinese and Indians) from urban slums, rural estates, semi-rural new villages and urban flats, the overall incidence of infection of 39.6 percent reflects quite closely the overall incidence of infection of the general population, especially the

lower income group. Similar surveys of helminthic infections in Malaysia have been carried out by numerous workers previously, the results of which are tabulated in Table IX. The great diversity of the population size (65 - 2,732), the selectiveness and restrictiveness of some of these communities surveyed (hospital in-patients, island populations, primary school children, estate workers and their families) together with the great variety of methods employed in stool examination - did not permit a meaningful comparison of the results of these surveys with those obtained in the present study. However, it can be concluded that the prevalence of soil-transmitted helminths and their distribution

TABLE VII
INTENSITY OF *TRICHURIS* INFECTION IN CHILDREN UNDER 15 YEARS OF AGE

Types of Areas	Malay		Chinese		Indian	
	Overall % Infection	Mean EPG	Overall % Infection	Mean EPG	Overall % Infection	Mean EPG
I Squatters areas:						
Kampung Sentosa	46.3	9,387 (126)	37.5	3,869 (30)	62.1	18,907 (72)
Kampung Abd Hukum	71.6	1,652 (90)	45.0	2,302 (25)	77.9	26,698 (35)
II Estates:						
Tanjung Malim	64.7	2,767 (13)	36.8		67.1	4,724 (87)
Kerling	50.0	3,851 (20)	45.2	488 (29)	59.0	1,429 (111)
III New Villages:						
Jinjang			31.1	2,125 (158)		
Cheras	41.7		40.5	2,557 (59)	55.2	4,938 (8)
Sungei Way	38.6	1,881 (28)	12.0	1,744 (27)	37.9	1,356 (28)
IV Flats:						
Sri Melati	34.1	5,127 (17)	1.1	328 (13)	34.5	1,889 (20)
Sri Pahang	32.2	2,081 (88)	13.0	491 (6)	30.5	2,688 (51)
San Peng	14.8	3,087 (90)	6.2	1,882 (13)	22.1	4,509 (55)
Shaw Road	39.2	13,395 (5)	19.5	3,729 (18)	49.2	160 (3)

EPG: Eggs per gram of faeces

Figures within brackets: Number of egg counts made

Very light *Trichuris* infections: Under 1,000 EPG

Light *Trichuris* infections: 1,000 - 4,000 EPG

Moderate *Trichuris* infections: Over 4,000 - 10,000 EPG

Heavy *Trichuris* infections: Over 10,000 EPG

according to race, age, sex and types of helminthic infections seen in the present study reflect more or less the same trend of distribution shown in previous surveys.

The prevalence of infection in different areas surveyed in the present study is influenced mainly by the environmental sanitation and the socio-economic background of the people in these areas. The incidence of infection was highest in the estates, followed closely by squatter areas. Infection with soil-transmitted helminths was relatively low in the new villages and the flats. Both the estates and squatter areas have more or less similar conditions of poor environmental sanitation with inadequate toilet facilities, water supply, drainage and garbage disposal, resulting in a

preponderance of flies, which, together with conditions of poverty, over-crowding, ignorance and malnutrition - permit the rapid and continuous transmission of soil-transmitted helminths in these areas. The condition in the estates is further aggravated by some degree of negligence and lack of parental supervision in personal hygiene and cleanliness as both parents are employed by the rubber estate in most cases. In contrast, most of the inhabitants of the new villages are of a slightly better socio-economic status and live in conditions of better environmental sanitation as most of the households have the basic amenities of toilets, water, electricity, paved roads, proper drains and garbage disposal. Similarly, transmission in the flats is low or minimal as all flats have toilets and

TABLE VIII
TYPES OF HELMINTIC INFECTIONS AMONG CHILDREN UNDER 15 YEARS OF AGE

Types of Areas	Types of infections (%)			Types of single infection (%)			Types of double infections (%)		
	Single	Double	Triple	<i>Ascaris</i>	<i>Trichuris</i>	Hookworm	<i>Ascaris</i> & <i>Trichuris</i>	<i>Ascaris</i> & Hookworm	<i>Trichuris</i> & Hookworm
I Squatter areas:									
Kampung Sentosa	17.3	78.1	4.6	64.4	35.6	0	98.5	1.5	0
Kampung Abd Hukum	43.9	55.6	0.5	31.7	68.3	0	100	0	0
II Estates:									
Tanjung Malim	39.8	47.5	12.7	34.0	66.0	0	87.5	12.5	0
Kerling	52.2	38.8	9.0	35.2	64.8	0	84.6	5.1	10.3
III New Villages:									
Jinjang	57.5	42.5	0	44.3	55.7	0	100	0	0
Cheras	38.0	59.5	2.5	40.0	60.0	0	100	0	0
Sungei Way	68.8	29.5	1.8	37.7	62.3	0	97.0	0	3.0
IV Flats:									
Sri Melati	80.6	19.4	0	31.5	68.5	0	100	0	0
Sri Pahang	60.6	37.1	2.3	28.3	71.7	0	96.8	0	3.1
San Peng	52.0	45.2	2.8	20.7	79.3	0	93.8	0	6.2
Shaw Road	78.1	18.9	3.1	24.0	76.0	0	100	0	0

water and very few flies, especially those in the higher levels. Flat dwellers may acquire some of their infection by eating uncooked or contaminated hawker food and transmission within the flats can still be maintained by carelessness or poor personal hygiene.

Despite the differences in the racial distribution in the different study areas and the differences in the conditions of environmental sanitation and socio-economic background in these areas, Indians consistently showed the highest incidence of infection, followed closely by Malays; with Chinese having the lowest incidence of infection. This distribution of infection among the races was also observed in hospital patients^{3,4} and primary school children.¹ However, the distribution of soil-transmitted helminths among the different races is not due to any particular racial susceptibility or resistance to infection but is mainly attributed to cultural practices and habits which may increase the chances of exposure to infection, like the practice of eating with the fingers among Indians and Malays.

The incidence of infection was shown to be highest among young children and those in their teens. This group of children is most active and inquisitive and at the same time least careful about personal hygiene and cleanliness. In addition, some elderly people (60 years and above) also tend to

have a higher incidence of infection than adults in other age groups (30 - 59 years). This may be partly due to a lower resistance to infection among the elderly, who, being less strong and active, will tend to spend more time within or around the home where transmission occurs rapidly all the time, as in the case of squatter areas and estates in general. On the other hand, the incidence of infection among elderly people in some of the new villages (Jinjang and Cheras) and flats (Sri Melati and San Peng), where transmission is minimal, remains very low.

There is no marked difference in the distribution of infection between males and females in most of the study areas (Table IV). However, in both squatter areas, Kampung Sentosa and Kampung Abdullah Hukum, females have a higher incidence of infection than males. This can probably be explained by the fact that women and girls tend to spend more time at home doing the housework and therefore are more exposed to the sources of infection which are found in the compound around their homes. In contrast, the men and boys spend more time out of the house either at work or in school and are therefore less exposed to infection at home. However, the reverse situation was observed in 2 of the 4 flats : Sri Melati and San Peng flats where Chinese predominate. In these flats, females are less frequently infected than males - for the same reasons that apply in the squatter areas. The

TABLE IX
COMPARISON OF SURVEYS ON SOIL-TRANSMITTED HELMINTHS CARRIED OUT IN MALAYSIA

Author (Year)	Number examined	Age	Type of population surveyed	Percentage infection	Method(s) used
Lie (1964) ³	2732	0-9 yrs	Malay, Chinese and Indian patients from General Hospital, KL, Selangor	43	Sed.
	2054	over 13 yrs	"	69	Sed.
Heyneman <i>et al</i> (1967) ⁵	65	1 - over 13 yrs	Inhabitants of Pulau Tioman, off Johore	93.8	DS, MIF
Balasingam <i>et al</i> (1969) ⁶	277	children & adults	Inhabitants of Pulau Pinang and Pulau Perhentian Kechil, off Trengganu	90	DS, MIF
Bisseru & Aziz (1970) ¹	678	7-12 yrs	Malay, Chinese and Indian children from 5 urban and rural schools in Selangor and Pahang	40-90	FE
Lie <i>et al</i> (1971) ²	57	0-15 yrs	Children from Chinese farming families in KL	69	DS
	145	0-6 yrs	Malay children from 5 kampungs in Beranang, Selangor	51.1	DS, ZnSO ₄ Stoll
Sulaiman <i>et al</i> (1977) ⁴	107	0-below 10 yrs	Malay, Chinese and Indian patients from General Hospital, Penang	41	DS, ZnSO ₄ Stoll
Sinniah <i>et al</i> (1978) ⁷	150	1-65 yrs	Indian workers and families from oil palm estate in Klang, Selangor.	82.7	DS, BF, FE
Kan, Present study	25,246	0-over 60 yrs	Malay, Chinese and Indian families from squatter areas, estates, new villages and flats in Selangor.	39.6	BF, Kato

BF = Brine flotation; DS = Direct smear; FE = Formol ether; Sed. = Sedimentation; TIF = Thiomersal-Iodine-Formol

women and girls spend more time doing the housework in the highly-urbanized flats where transmission is very low, so they are less exposed to infection, whereas the men and boys are more exposed to infection in their places of work or in schools. This situation was however not observed in the other two flats (Sri Pahang and Shaw Road flats) where Malays predominate. A possible explanation for this is that the practise of eating with the fingers among Indians and Malays tend to increase the chances of infection with soil-transmitted helminths - even in an area (e.g flats) where transmission is minimal.

The degree or intensity of infection, or worm burden, is directly related to the degree of contamination of the soil, the frequency of contact with the soil and therefore the degree of exposure to infection. Thus, as to be expected, the degree of infection is directly related to the incidence of infection. Moderate to heavy infections with both *Ascaris* and *Trichuris* were reported among Malay

and Indian children under 15 years of age, especially among those from squatter areas and estates where the overall incidence of infection was high. In contrast, Chinese children with a lower overall incidence of infection had only light to moderate *Ascaris* and *Trichuris* infections.

The intensity of infection or worm burden was estimated from egg counts by the Katz method and expressed as eggs per gram of stool. These egg counts are not empirical counts of the exact numbers of eggs produced by all the female worms harboured by the host, but they are just estimates of the egg output, which, in turn, act only as an indicator of the intensity of infection. It has been shown that egg output and factors related to egg counts are dependent on the amount of stool passed daily, the distribution of eggs within a 24-hour stool sample, the daily egg output of the female worms, the number of female worms harboured by the host, the degree of maturity of the female worms and finally, the technique used to determine the

egg count.¹¹ Thus, egg counts cannot predict the actual worm burden but only indicate the degree or intensity of infection.

In the present study, *Trichuris* was found to be the commonest soil-transmitted helminth in almost all the study areas. *Trichuris* was also reported as the commonest soil-transmitted helminth in surveys of hospital in-patients in Kuala Lumpur and Penang,^{3,4} inhabitants in Pulau Pinang and Pulau Perhentian Kecil⁶ primary school children¹ and Indian estate workers and their families.⁷ In the present study, *Trichuris* either occurred as single infections or mixed infections with *Ascaris*. This combination of double helminthic infections formed the greater majority of all mixed infections reported in this survey. Mixed infections with *Trichuris* and *Ascaris* were also shown to be the commonest type of helminthic infections among Indian estate workers and their families.⁷

In conclusion, the main factors influencing the prevalence and degree of soil-transmitted helminthiasis among a population of any race, age group or sex, within any area or community, are basically the overall health status and the economic resources of that community. If the conditions of poverty, malnutrition and poor environmental sanitation can be alleviated, and concepts of better personal hygiene and health awareness can be instilled within a community through health education, community involvement and community participation, the overall health and cleanliness of the community, as well as the standard of living, will be improved and this will automatically bring about a decrease in the incidence and degree of soil-transmitted helminthiasis in that community.

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