# THE PROBLEM OF SOIL TRANSMITTED HELMINTHS IN SQUATTER AREAS AROUND KUALALUMPUR*

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## INTRODUCTION

INTESTINAL HELMINTHIASIS is a very common infection in this country especially among children in the low socio-economic group. Several researchers have investigated this phenomenon these past 60 years. Russel (1934), Schacher & Danaraj (1960), Lie Kian Joe (1964) and Sulaiman *et al.* (1977) carried out studies on stool samples of in-patients in various government hospitals in Singapore and Peninsular Malaysia to provide a general assessment of the problem in this region. Desowitz *et al.* (1966), Balasingham *et al.* (1969) and Lie Kian Joe (1971) approached different communities to ascertain the influence of environmental factors in the incidence of intestinal worm infection.

The aim of this survey is to:

(i) investigate the incidence and types of infection in children of the 4 – 6 years age group in the Kuala Lumpur – Petaling Jaya region.
(ii) assess the relationship between the age and incidence of infections in squatter settlements.

This survey was carried out in March–April 1978.

## MATERIALS AND METHODS

Four kindergartens, two in Kg. Gandhi (referred to as Gandhi and Devi) one each in Kg. Medan and Kg. Pinang were approached (Fig. 1). Bottles were distributed to each child in these kindergartens together with letters of introduction and instructions to their parents. Bottles were recollected each subsequent morning. 211 faecal samples (a response of 75.4%) were thus obtained.

The Methodist Kindergarten, a kindergarten attended by upper middle class children was approached similarly and 40 faecal samples were collected.

House-to-house visits were carried out in Kg. Sentosa (C), another squatter settlement and 243 faecal samples were collected from individuals of various ages. Interviews were also carried out during these visits.

The brine flotation technique was used to concentrate the eggs for identification. Approximately 3 gm. of faeces were mixed with saturated sodium chloride, of S.G. 1.20, and left to stand for ½ to 1 hr. before being examined microscopically. Only *Ascaris lumbricoides*, hookworm and *Trichuris trichiura* eggs were specifically looked for. The procedure was carried out only once for each faecal sample. Beaver's technique was used to estimate the density of eggs in all the faecal samples shown to have helminthic ova by the brine flotation method. Due to the lack of time Beaver counts were only done in triplicate for every 5th sample, each of the remaining samples being counted once only.

All individuals infected with *Ascaris* were treated with pyrantel pamoate (Combantrin ®) and those whose faecal sample had greater than 5000 *Trichuris* eggs/cm$^3$ and/or 1000 Hookworm eggs/cm$^3$ (both arbitary levels) were given a full course (1 tablet b.i.d. for 3 days) of mebendazole (Vermox ®).

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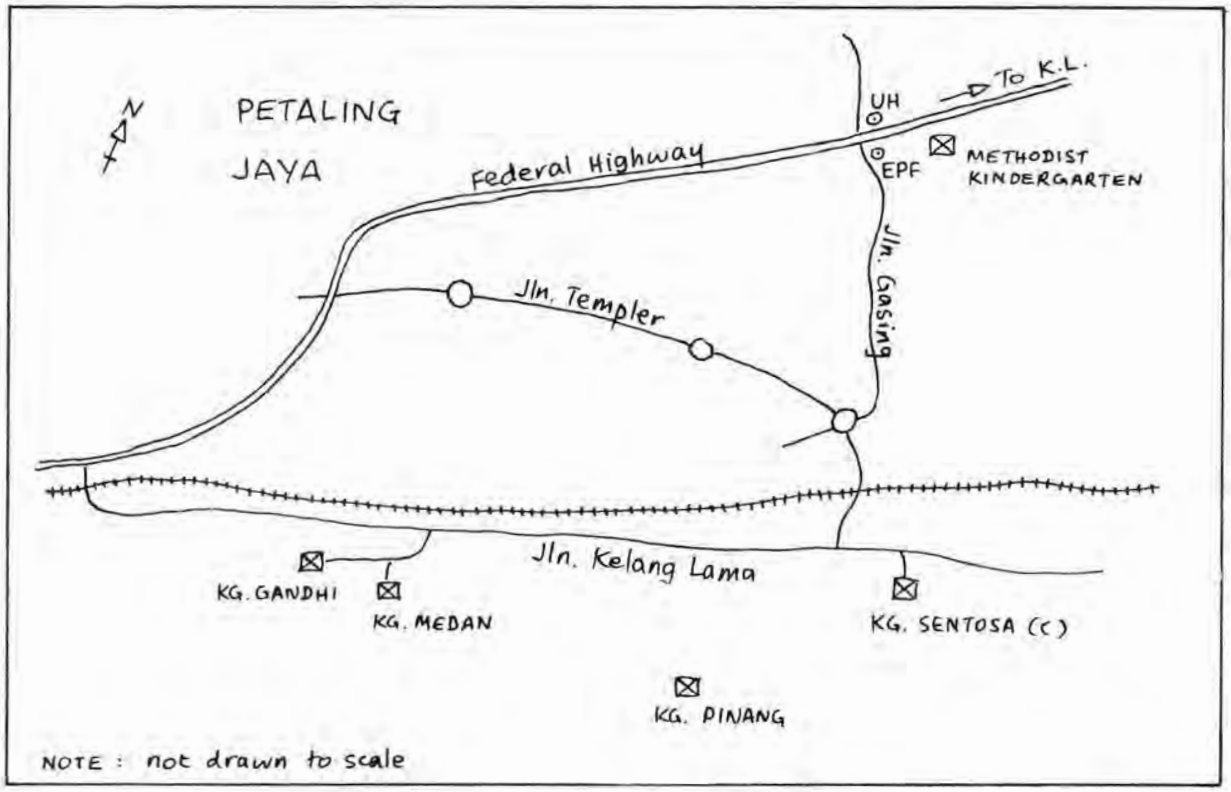


**Figure 1. Sketch Map showing Areas studied.**

The Chi-square test was used to analyse data statistically. The level of significance, alpha ($\alpha$), was set at 0.05.

## SOCIO-ECONOMIC & ENVIRONMENTAL CONDITIONS IN KG. SENTOSA (C)

As interviews were only carried out in Kg. Sentosa (C), the following section is based mainly on data from Kg. Sentosa (C).

Kg. Sentosa (C) is a squatter settlement which began more than 10 years ago. It is built on swampy land and many houses (on short stilts) have water below them all year round. About 90% of the individuals with employment are workers in factories, the Jabatan Kerja Raya and in construction sites. The average house-hold income is less than $250/- per month for the majority of the families. The level of schooling was found to be very low among the children. Less than 10% of the children reach Form 4.

Kg. Sentosa (C) consists of about 200 families, yet does not have even a single stand-pipe. The people depend largely on wells for their water supply. A small number of families obtain pipe water for drinking and cooking purposes from nearby non-squatter houses. This holds true for the other squatter settlements studied. In Kg. Pinang, however, drinking water is obtained from the 6 stand-pipes that serve a population of about 1 200 families.

Facilities for faecal disposal in Kg. Sentosa (C) were found to be: (sample size, n = 90)

| | | |
|---|---|---|
| (1) | Pit latrines | 72% |
| (2) | Latrines emptying into the swamp directly | 14% |
| (3) | Latrines emptying into a large drain skirting the settlement | 12% |

It was also found that most of the latrines were shared. Sometimes as many as 5 to 7 families used a latrine. In Kg. Sentosa (C), as well as in Kgs. Pinang, Medan and Gandhi, most of the children who are less than 10 years of age were allowed to defaecate indiscriminately into the area surrounding their houses. It was also noted that the majority of children below 10 years of age went around without wearing shoes or slippers.

The majority of people interviewed in Kg. Sentosa (C) knew that intestinal helminthiasis is a common health problem in their area. But a number (37%, n = 79) mistakenly believed that their own children were not affected. Parents reported giving anthelminthics to their children as follows:

(sample size, n = 60)

| | | |
|---|---|---|
| (1) | Every 2 months or less | 13.3% |
| (2) | Every 2 – 4 months | 18.3% |
| (3) | Every 4 – 6 months | 11.7% |
| (4) | Irregularly | 33.3% |
| (5) | Do not give | 18.0% |

Ridto, a piperazine preparation, was the drug most commonly administered (62.5%, n = 40), probably because it is one of the cheapest. Combantrin ® (pyrantel pamoate) was the next most common (10%, n = 40).

Though the people perceived intestinal worms as a common health problem among their children, very few of them know how infections were acquired. In the course of the interviews we asked the parents how children become infected. The following responses were elicited:

(sample size, n = 68)

| | | |
|---|---|---|
| (1) | Hands soiled by eggs from the ground | 4.4% |
| (2) | Percutaneous, through bare feet | 5.9% |
| (3) | From eating sweets | 5.9% |
| (4) | From powdered milk | 8.8% |
| (5) | Eating fish | 7.3% |
| (6) | From other foodstuff | 14.7% |
| (7) | Do not know | 42.6% |

It is very likely that the people of the other squatter areas studied are equally unaware of the mode of transmission of intestinal helminths.

## RESULTS

### (A) Infection Rates in the Kindergartens

It can be seen from Table I that the most common infection in all kindergartens sampled was due to *Trichuris trichiura,* followed by *Ascaris lumbricoides* and hookworm. The hookworm levels were particularly low, averaging only 5.1% for the squatter kindergartens as a whole.

Though there appears to be some degree of variation between the different squatter kindergartens with Medan having 95.9% of the children with at least 1 worm infection and Pinang having only 76.9% of the children with at least 1 worm infection, the Chi-square test ($\alpha = 0.05$) did not show significant differences ($0.10 > p > 0.05$) in the rates and types of infection between the different kindergartens.

In the Methodist Kindergarten, out of a sample of 40, only 10.0% were found to be infected. Of these, 2.5% had Ascariasis, 7.5% Trichuriasis, and none had hookworm infection. There were no double or triple infections, and the level of eggs in the faeces were low in all the four children with infection. When compared with the rates and types of infections of the squatter Kindergartens taken as an aggregate (Table I), the differences were shown to be significant ($p < 0.001$) by the Chi-square test. This indicates that intestinal helminthiases are predominantly a problem of children from the low socio-economic group, where poor sanitary conditions exist.

In all kindergartens the differences in rates and types of infection between the different sexes were insignificant ($0.95 > p > 0.90$). This may be accounted for by the similar (unhygienic) habits of children of both sexes in the 4–6 yrs. age group.

**Table I**

**Infection Rates in the Squatter Kindergartens including children of the 4–6 yrs. age group of Kg. Sentosa**

| Kindergartens | total no. samples | % positives | % double infections | % triple infections | % *Ascaris* | % Hookworm | % *Trichuris* |
|---|---|---|---|---|---|---|---|
| Pinang | 52 | 76.9 | 34.6 | 5.8 | 48.1 | 5.8 | 65.4 |
| Medan | 49 | 95.9 | 61.2 | 4.1 | 71.4 | 4.1 | 83.7 |
| Devi | 44 | 97.7 | 72.7 | 0.0 | 75.0 | 2.3 | 95.5 |
| Gandhi | 66 | 89.4 | 53.0 | 3.0 | 51.5 | 10.6 | 83.3 |
| Sentosa | 42 | 97.6 | 81.0 | 0.0 | 83.0 | 0.0 | 95.2 |
| Squatter K'gartens combined | 253 | 90.9 | 58.9 | 2.8 | 64.0 | 5.1 | 83.8 |

## (B) Ethnicity and Infection Rates

Infection rates and patterns in different ethnic groups were also investigated (Table II).

(i) *The same ethnic group in different areas:*

In a comparison of Indian children in Kg. Pinang and Kg. Gandhi, it was shown statistically that there was no significant difference ($0.10 > p > 0.05$) in infection rates. Similarly when Malay children in Kg. Medan and Kg. Gandhi were compared with children of Kg. Sentosa (C) (4 – 6 yr. age group), no significant difference was shown ($0.20 > p > 0.10$).

No comparison could be made of the Chinese population as all our samples of Chinese children were from Kg. Pinang.

(ii) *Different ethnic groups in the same areas:*

The infection rates in the Malay, Chinese and Indian children attending Kg. Pinang kindergarten were compared. The Chi-square test did not show any significant difference ($0.20 > p > 0.10$) in the rates and types of infection.

When variation of the infection rates in Malay and Indian children in Kg. Gandhi kindergarten was investigated by the Chi-square test, it was also shown that the difference was insignificant ($0.50 > p > 0.30$).

Hence this survey indicates that infection rates are not significantly influenced by ethnicity for populations sharing similar environments.

## (C) Level of Infections

The Beaver technique was used to assess the density of eggs (no./cm$^3$) for all faecal samples shown to have helminthic ova by the brine flotation method. Analysis of the counts done in triplicate revealed that the coefficient of variation (C.V. = 100 s/x) was 70.7 for *Ascaris* and 95.3 for *Trichuris* counts. For reasons pertaining to scientific objectivity it should be noted that this compares unfavourably with Dr. Beaver's assessment of this technique (1950). Though our estimation of each individual egg density is not accurate we decided to present the data on egg density in aggregate form in Figs. 2 and 3 as it is not unreasonable to assume that errors would tend to cancel themselves out in a large sample.

It is seen that for the 162 children with Ascariasis the mode of distribution of egg densities is in the 10,000 – 49,999 eggs/cm$^3$ category (32.1%). In the case of the 212 children with Trichuriasis, 57.1% were in the 0 – 2999 eggs/cm$^3$ category. We did not

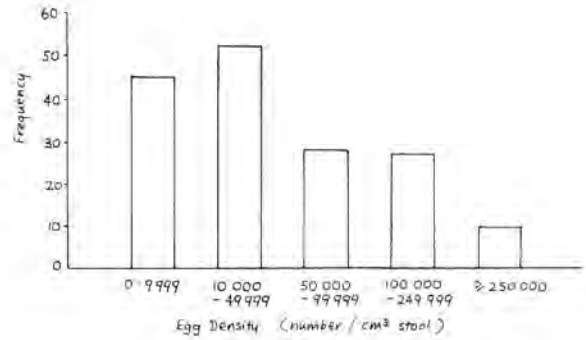


**Figure 2. Level of *Ascaris* Infection in Squatter Kindergartens including children of the 4–6 yrs. age group of Kg. Sentosa.**

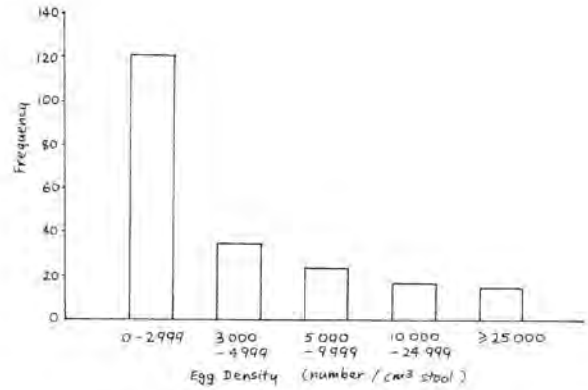


**Figure 3. Level of *Trichuris* Infection in Squatter Kindergartens including children of the 4–6 yrs. age group of Kg. Sentosa.**

attempt to assess the worm load on the basis of these egg densities because several other researchers have commented that no definite relationship exists between these 2 parameters (Lie, 1971). Distribution of Hookworm egg densities is not presented here as the large majority of infections were low, having a density of less than 1000 eggs/cm$^3$ of faeces.

## (D) Influence of Age on Infection Rates

Fig. 4 shows the prevalence rates of the 3 main soil-transmitted helminths in the different age groups in Kg. Sentosa (C). Trichuriasis is the most common infection for all age-groups except the 0 – 1 year age group, in which there is a slight predominance of Ascariasis. The youngest infant found to be infected by *Trichuris* and *Ascaris* was eight months old. The oldest person infected was a lady of 60 years who had both *Trichuris* and *Ascaris*. The rate of *Trichuris* infection increased from 34.4% in the 0 – 1 yr. age group to 88.5% in the 2 – 3 yrs.

**Table II Rate of Infection by Ethnic Groups in Squatter Kindergartens including the 4–6 age group of Kampung Sentosa**

| | Malays | | | | | Chinese | | | | | Indians | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total No. samples | % +ve | % A | % H | % T | Total No. samples | % +ve | % A | % H | % T | Total No. samples | % +ve | % A | % H | % T |
| Pinang | 5 | 100.0 | 60.0 | 0.0 | 100.0 | 23 | 65.2 | 26.1 | 0.0 | 52.2 | 24 | 79.2 | 62.5 | 16.7 | 66.7 |
| Medan | 49 | 95.5 | 71.4 | 4.1 | 83.7 | – | – | – | – | – | – | – | – | – | – |
| Devi | *– | – | – | – | – | – | – | – | – | – | 44 | 97.7 | 75.0 | 2.3 | 95.5 |
| Gandhi | 48 | 87.5 | 54.2 | 14.6 | 81.3 | – | – | – | – | – | 18 | 94.4 | 44.4 | 0.0 | 88.9 |
| Sentosa | 36 | 97.2 | 80.6 | 0.0 | 100.0 | – | – | – | – | – | 6 | 100.0 | 100.0 | 0.0 | 100.0 |

* (–) indicates that that particular ethnic group is not represented.

A *A. lumbricoides*
H Hookworm
T *T. trichiura*

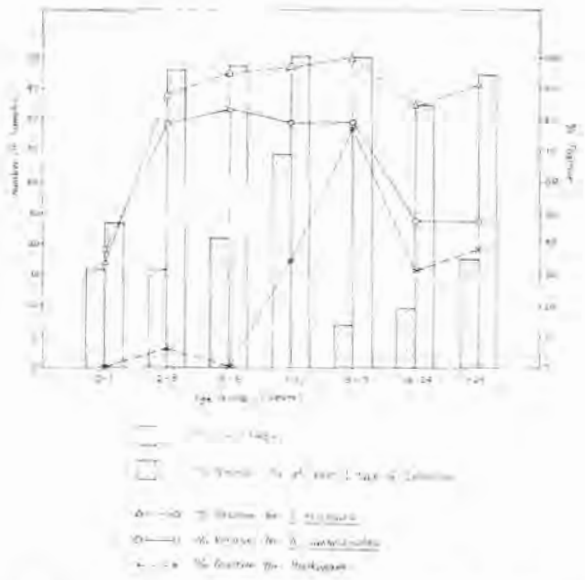

**Figure 4. Rates of Infection by Age Group in Kg. Sentosa.**

age group. Similarly the rate of *Ascaris* infection increased from 37.5% in the 0 – 1 yr. age group to 78.1% in the 2 – 3 yrs. age group. These increase were found to be significant ($0.01 > p > 0.001$).

Thereafter, the level of Trichuriasis remained high, reaching 100% in the 13–15 yrs. age group. The level of *Ascaris* infection did not exceed 80% for any age group and appeared to decrease more markedly than Trichuriasis after the age of 16. However the Chi-square test revealed that this decrease was not significant statistically ($0.5 > p > 0.3$).

Hookworm infection levels remained low until the age of 6 yrs. Then the level of infection rose and remained above 30% for all subsequent age groups. We were unable to explain why the level of hookworm infection was low for preschool children. As most of these children go around without adequate footwear it would seem that this age group is even more exposed to infection than adults. The peak of 78.6% observed for the 13 – 15 yrs. age group was found to be statistically significant ($p < 0.001$). This remains unaccounted for.

The scatter diagroms (Figs. 5 and 6) indicate that:

(a) The variation in egg densities was greater in the lower age groups.

(b) Children tended to have higher egg densities in their faeces than did adults. This may be due either to a higher worm loan or the fact that children excrete a lesser amount of faeces per day than do adults.

(c) Infants (< 1 year) had few if any eggs in their faeces.

(d) On the average, *Ascaris* egg densities were very much higher than *Trichuris* egg densities. Even after correcting for the fact that a percentage of *Ascaris* eggs are unfertilised and therefore non-viable, and that prevalence rates for Trichuriasis were slightly higher than Ascariasis, the number of viable *Ascaris* eggs reaching the soil would still have been in excess of the number of Trichuris eggs. One would therefore expect a higher rate of infection for *Ascaris*. The lower prevalence level of Ascariasis in the population may be due to the following factors:

(i) About 80% of the parents reported administering anthelminthics to their children either regularly or otherwise. This widespread use of anthelminthics of which most are more effective against *Ascaris* than *Trichuris* may be a factor tending to reduce the level of Ascariasis.

(ii) The longer lifespan of *T. trichiura* may contribute to the higher prevalence of Trichuriasis.

However the above two factors do not adequately explain the more marked decrease in *Ascaris* infection in adults. It is possible that some other factors are also operating.

## (E) Incidental findings

Out of the examination of 494 faecal samples, 2 *Strongyloides stercoralis* larvae (one rhabditiform & one filariform) were observed. It appears that infection rate for *S. stercoralis* is very low in the population surveyed. This may not be an accurate reflection of the true level of *Strongyloides* infection as the proper diagnostic methods were not employed.

Several *Enterobius vermicularis* eggs and adults were observed. Since no method appropriate for *E. vermicularis* egg detection was used, no numerical data is presented.

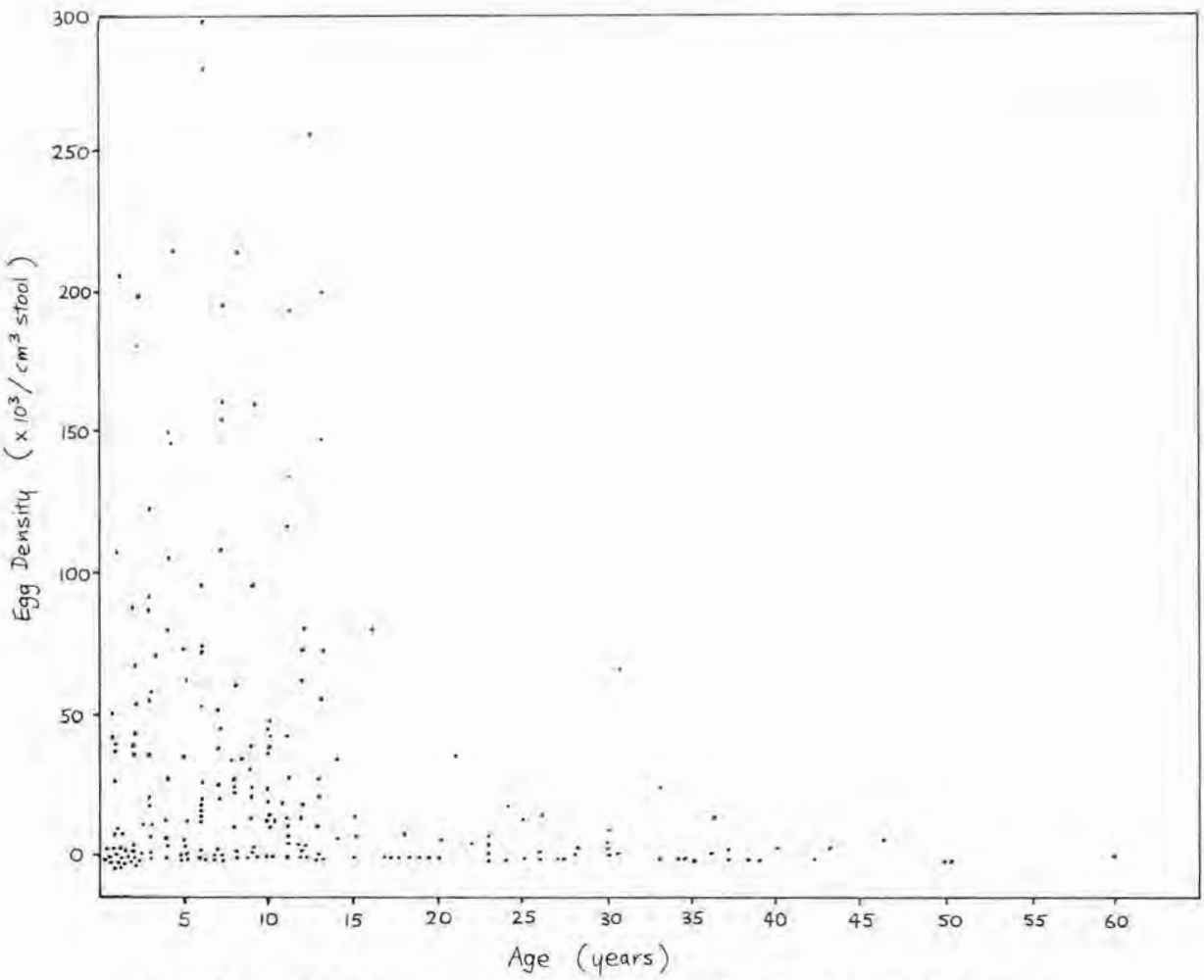


**Figure 5. The Age-*Ascaris* Egg Density Relationship of the Population in Kg. Sentosa***

* 1. Eight readings with egg densities above 300 000 were omitted.
2. One reading, positive for Brine Flotation method but having zero count for Beaver's method, was also omitted.
3. Each dot represents one sample.

Several protozoan trophozoites and cysts including *Giardis lamblia, Entamoeba histolytica* and *Dientamoeba fragilis* were also noted. As we were not specifically looking for these protozoans, no meaningful numerical data was obtained.

Forty children from the squatter kindergartens with mixed infections were treated with mebendazole. Out of ten children contacted after treatment, 3 reported migration of *Ascaris* up the oesophagus and nasopharynx. In subsequent treatment of individuals with mixed infections, in Kg. Sentosa (C), this was avoided by first administering pyrantel pamoate.

In Kg. Sentosa (C), a small number of parents told us that their children experienced abdominal pains and bouts of vomiting after being given pyrantel pamoate. On further inquiry, we found that all these cases had high *Ascaris* loads (more than 20 worms were passed out from each child subsequently).

## DISCUSSION

### Comparison with other studies

The level of intestinal helminthiasis was found to be high in Kg. Sentosa (C) (Fig. 2). This pattern of infection was observed in Bukit Ho Swee Squatter area in Singapore by Kleevens (1966). Lie (1971)

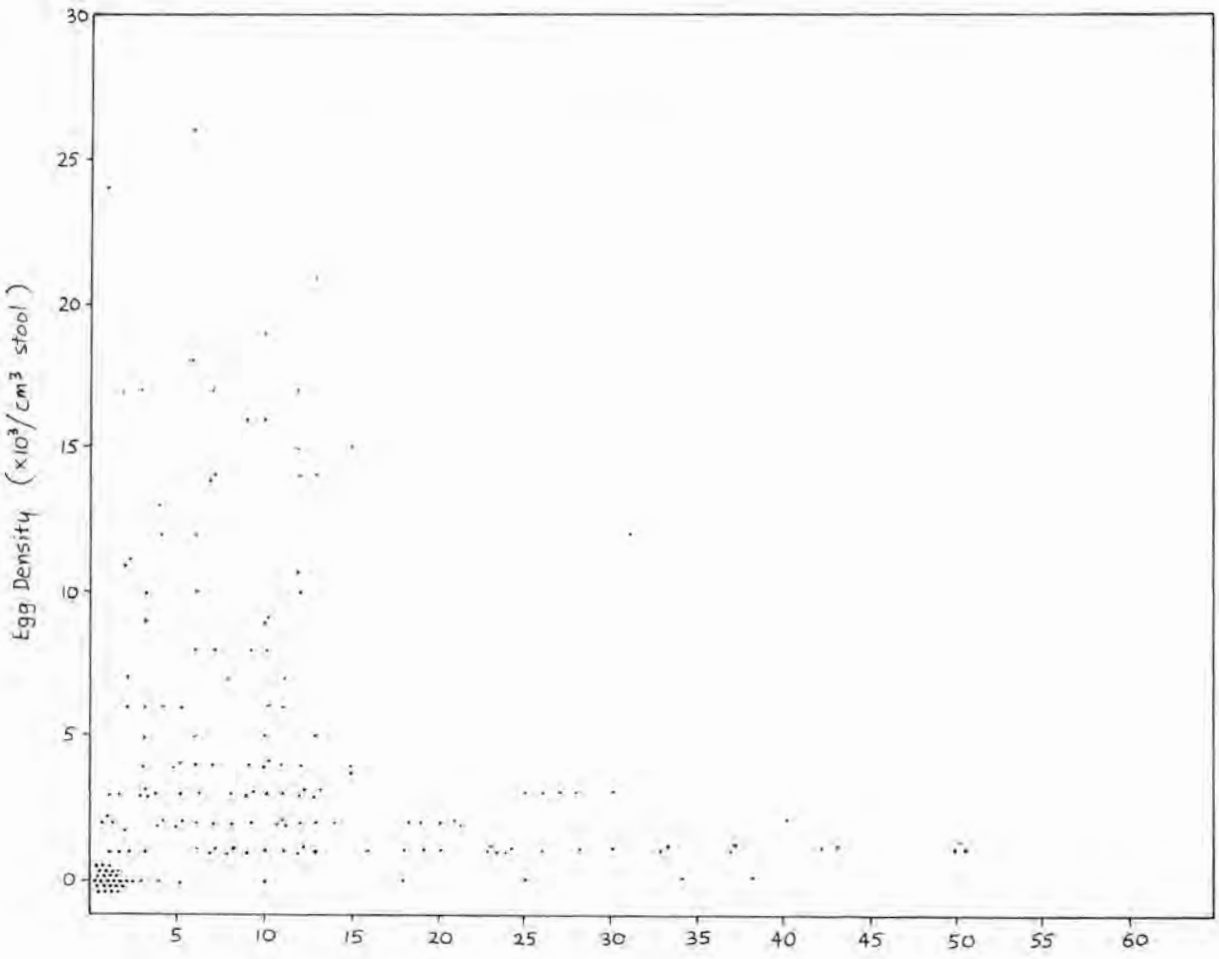


**Figure 6. The Age-*Trichuris* Egg Density Relationship of the Population in Kg. Sentosa***

* 1. Seventeen readings with egg densities above 30 000 were omitted.
2. Twenty readings, positive for Brine Flotation method but having zero count for Beaver's method, were also omitted.

demonstrated that a similar pattern existed among families engaged in vegetable gardening in Ampang, Kuala Lumpur. It is interesting that the level of infection in squatter areas is comparable to that obtained for communities using night soil as manure.

## Ethnicity and Infection Rates

Several researchers have investigated prevalence and types of infection among the different ethnic groups in West Malaysia. Russel (1934), in the 5 years or less age group and Lie (1964) in the 0–9 years age group, observed significant differences in infection rates among the 3 major ethnic groups. No mention or correction for environmental factors were made. Schacher and Danaraj (1960) made a similar observation but the population studied consisted of people from all age groups. Itam Sulaiman *et al.* (1977) reported that there were significant differences in infection rates among children of different ethnic groups, considered to come from the lower socio-economic class, investigated in the third class pediatric ward in the General Hospital, Pulau Pinang. No level of significance was mentioned in their report but on statistical analysis based on data from Table 2 of their report (omitting *Strongyloides* infection), it was found that $0.20 > p > 0.10$; a level we have set as significant for our report. This figure was in fact similar to our probability range for Kg. Pinang ($0.20 > p > 0.10$). Our findings do not indicate any significant

differences in infection rates among children of 4 – 6 years of age of different ethnic groups living in squatter areas. It therefore appears that ethnicity is much less important than environmental conditions as a determining factor of the level of intestinal helminthiasis, as shown by our comparison of squatter kindergartens to a middle class kindergarten. These findings are in accordance with those of Desowitz *et al.* (1961).

**Prevention**

In the course of our investigation in Kg. Sentosa (C), it was found that the majority of adults (89.7%) did not know how intestinal helminthiases were transmitted. It is clear that they will be unable to implement any effective preventive measures until they acquire a better understanding of the phenomenon. It was also observed that children less than 10 years old defaecated indiscriminately into the areas surrounding their houses. Parents probably allow their children to do so because existing latrine facilities are unsafe for young children to use on their own. Faecal disposal in the case of adults was relatively more sanitary (e.g. into pits or buckets). Children, therefore, serve as the main source of infection for the community.

A comprehensive worm control programme would necessarily include the following features:

(i) Raising the awareness of the community as to how intestinal helminthiases are transmitted, and ways of limiting transmission.

(ii) Reducing the contamination of the soil by young children. Providing safe and sanitary facilities for faecal disposal is the best solution. However if this is not possible in the near future, parents could be advised to encourage their children to defaecate into small containers which could then be emptied into the pits or buckets used by the adults.

(iii) Periodic deworming of the susceptible population, perhaps every 3 months, to minimise the egg contamination of the soil.

The measures suggested require the cooperative effort of the entire community, since even a small number of infected children can serve as a reservoir of infection for the whole community. If cooperation is attained, the measures mentioned above can greatly reduce the level of infection at a reasonably low expenditure.

This type of cooperative endeavour may be difficult to elicit for several reasons. Certain squatter families may be facing more pressing problems such as low per capita income, unemployment, alcoholism, and drug dependence on the part of the Youth. Furthermore their perception of impermanence of residence and the possibility of eviction probably dampen any inclination to embark on a cooperative effort to improve their common living conditions.

Any attempt to reduce helminthiases among squatter populations will have to be integrated into an overall approach to the problems of squatters. Such an approach would include giving the squatters some sense of permanence by granting them some legal rights to occupy the land. It should also include the provision of basic utilities such as piped water (at least stand-pipes), proper drainage and paved roads.

## SUMMARY

Results from the study on children of the 4 to 6 years age group revealed that 90.9% of those from the squatter kindergartens were infected with one or more intestinal helminths. Trichuriasis was the commonest infection (83.8%), followed by Ascariasis (64.0%) and hookworm infection (5.1%). In contrast, only 10.0% of the children from a upper-middle class kindergarten in P.J. were found to be infected. This indicates that intestinal helminthiasis is predominantly a problem of children from the low socio-economic group, where poor sanitary conditions exist. No significant difference in infection rates was observed among children of different ethnic groups or sex living under similar conditions.

In the study of the entire age range of a squatter population, it was observed that people from all age groups were infected. Infection rates were low in the 0 – 1 year age group, and rose to about 80 to 90% for Ascariasis and Trichuriasis. The rates remained thus and declined only slightly after 15 years of age. The level of hookworm infection was low in pre-school children and then rose to remain above 30% for the older age-groups.

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