PREVALENCE AND DISTRIBUTION OF SOIL-TRANSMITTED HELMINTHIASES AMONG ORANG ASLI CHILDREN LIVING IN PERIPHERAL SELANGOR, MALAYSIA

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Abstract. Soil-transmitted helminthiases are a public health problem in rural communities. A cross-sectional study of the prevalence and distribution of *Ascaris lumbricoides*, *Trichuris trichiura* and hookworm was conducted in 281 Orang Asli children (aborigines) aged between 2 and 15 years, from 8 Orang Asli villages in Selangor, Malaysia. All the children were infected with soil-transmitted helminthes, with 26.3% of the children infected either with *A. lumbricoides*, *T. trichiura* or hookworm and 72.6% having mixed infection. The overall prevalences of *A. lumbricoides*, *T. trichiura* and hookworm were 61.9, 98.2 and 37.0%, respectively. Approximately 19.0, 26.0 and 3.0% of the children had severe infection of ascariasis, trichuriasis and hookworm infection, respectively. The prevalences and mean egg per gram (epg) counts for *A. lumbricoides* and *T. trichiura* were not significantly dependent on age, therefore age-dependent convexity was not seen in this study. However, the results of this study reveal an age-dependent prevalence and mean epg count in children with hookworm infection. We conclude that ascariasis, trichuriasis and hookworm infection are still prevalent and therefore a public health concern in Orang Asli communities. Severe ascariasis and trichuriasis may lead to other health and medical problems.

INTRODUCTION

The World Health Organization has estimated that more than one billion people and almost 10% of the world population are chronically affected by soil-transmitted helminthes (STH) or infected with *Entamoeba histolytica* (WHO, 1987). In Malaysia, *Ascaris lumbricoides*, *Trichuris trichiura*, hookworm, *Giardia duodenalis* and *E. histolytica* are the most common intestinal parasitic infections. Although the incidence of clinical consequences associated with these infections is very low, these infections are still a matter of public health concern in Malaysia because the prevalence and the intensity of these infections are still high. Furthermore, in Malaysia, the prevalence of intestinal parasitic infections is worse in low-income communities, which include aboriginal groups (Norhayati *et al,* 1997; Rahmah *et al,* 1997), rural poor Malays (Rahman, 1994; Norhayati *et al,* 1998a), children in estates (Oothuman *et al,* 1995) and squatter areas (Chan *et al,* 1992; Rajeswary *et al,* 1994; Rahman, 1998). An earlier study of Orang Asli villages in Selangor reported that the overall prevalences of ascariasis, trichuriasis and hookworm infection were 62.9, 91.7 and 28.8%, respectively (Norhayati *et al,* 1997). In the study, almost two-thirds of the children were infected with moderate to severe trichuriasis, 46.3% had moderate to severe ascariasis. In highly endemic areas of ascariasis, trichuriasis and hookworm infection, reinfection occurred as early as 2 months after treatment (Norhayati *et al,* 1995) and children remained predisposed to these infections over a number of reinfection periods (Norhayati *et al,* 2000). Moreover, intestinal parasitic infections interfere with nutrition, growth, cognitive function and educational performances in children

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(Robertson *et al,* 1992; Noakes and Bundy, 1994; Saldiva *et al,* 1999).

The aim of this present study was to determine whether ascariasis, trichuriasis and hookworm infections are still prevalent in Orang Asli children in Selangor and to examine the distribution of these infections in this community.

MATERIALS AND METHODS

Subjects and study areas

This study was conducted among residents of 8 Orang Asli villages in the Districts of Gombak, Kuala Kubu Baru and Hulu Selangor in Selangor, Malaysia. Each village was comprised of a small population and the number of children in each village was estimated between 20 and 100. Most of the residents worked as laborers, farmers, or rubber tappers, and some did odd jobs, such as selling forest products. Most of the houses had electricity and piped water. A total of 281 children aged between 2 and 15 years (143 males and 138 females) participated in this study. Parents of all participating children consented to take part in this study after a clear explanation.

Fecal examination

Fecal samples were collected and examined by Kato-Katz technique for the presence of *A. lumbricoides*, *T. trichiura* and hookworm eggs. Egg counts were also done using this technique and the results were expressed as eggs per gram stool (epg).

Statistical analysis

Data obtained were analyzed using SPSS for windows (version 11.5, March 2002). Chi-squared test on proportion, one-way ANOVA and non-parametric test equivalent (Kruskal-Wallis 1-way ANOVA) were used for the data analysis.

Ethical aspects

This study was approved by the Research and Ethics Committee, Faculty of Medicine, Universiti Kebangsaan Malaysia, Malaysia.

RESULTS

Fecal smears from 281 Orang Asli children aged between 2 and 15 years were examined. The prevalences of ascariasis, trichuriasis and hookworm infection in these children according to intensity of infection are shown in Table 1. The overall prevalences of ascariasis, trichuriasis and hookworm infection were 61.9, 98.2 and 37.0%, respectively. Severe trichuriasis and ascariasis were found in 23.5% and 18.9% of these children, respectively. However, only 2.5% of the children had severe hookworm infection. The frequency of distribution by egg counts per person (estimated by epg) for hookworm was markedly broad with 88.6% of these children either not infected or having mild infection. However the frequency of distribution by egg counts per per-

Table 1
Prevalence of ascariasis, trichuriasis and hookworm infection according to intensity of infection and gender.

Intensity of infection	Type of Infection		
	Ascariasis No. (%)	Trichuriasis No. (%)	Hookworm infection No. (%)
Negative	107 (38.1)	5 (1.8)	177 (63.0)
Mild infection	68 (24.2)	84 (29.9)	72 (25.6)
Moderate infection	53 (18.9)	126 (44.8)	25 (8.9)
Severe infection	53 (18.9)	66 (23.5)	7 (2.5)
Gender			
Male	90 (62.9)	142 (99.3)	51 (35.7)
Female	84 (60.9)	134 (97.1)	53 (38.4)
Total	174 (61.9)	276 (98.2)	104 (37.0)

Table 2
Prevalences of ascariasis, trichuriasis and hookworm infection according to type.

	Single infection	Ascariasis + Trichuriasis	Ascariasis + Trichuriasis + Hookworm infection	Trichuriasis + Hookworm infection	Ascariasis + Hookworm infection
Frequency, no. (%)	77 (27.4)	100 (35.6)	59 (21.0)	34 (12.1)	1 (0.4)

Table 3
Correlation of mean epg counts for *A. lumbricoides*, *T. trichiura* and hookworm according to age and gender.

Age groups (years)	No.	*A. lumbricoides* + *T. trichiura*	*T.trichiura* + Hookworm	*A. lumbricoides* + Hookworm
All	281	0.185[b]	0.100[a]	0.079
Gender				
Male	143	0.156[b]	0.095	0.028
Female	138	0.206[b]	0.100	0.122
Age groups				
2-4	68	0.239[b]	0.123	0.177
5-7	85	0.148	0.041	-0.033
8-10	71	0.181[a]	0.090	0.024
11-13	43	0.155	0.208	0.164
>13	14	0.198	-0.025	0.066

[a]significant at the 0.05 level
[b]significant at the level of 0.01

son for *A. lumbricoides* and *T. trichiura* was not widely dispersed with 62.3% and 31.7% of these children had either no infection or a mild infection, respectively.

Table 2 shows the distribution according to the type of infection. All children were infected with *A. lumbricoides*, *T. trichiura* or hookworm. Almost 27.0% of the children had single infection, while 73.0% of them had mixed infection. The most prevalent mixed infection was a combination of ascariasis and trichuriasis (35.6%), followed by a combination of ascariasis, trichuriasis and hookworm infection (24.5%), and trichuriasis and hookworm infection (12.1%). The least prevalent mixed infection was a combination of ascariasis and hookworm (0.4%).

The age-related prevalences and mean epg counts for ascariasis, trichuriasis and hookworm infection are shown in Figs 1 and 2. Ascariasis occurred in young children, with no significant change in the prevalence until age 8-10 years and reached a peak at 11-13 years. After that the prevalence declined slightly with age. Hookworm infection also occurred in young children age 2-4 years. There was a significant increase in the prevalence of hookworm infection with age that reached maximum at age 13 years and above (χ^2=11.476; p=0.022). Compared to ascariasis and hookworm infection, the prevalence of trichuriasis was high in all age groups, ranging from 95.6% to 100.0%. Thus, there was no significant difference in the prevalence of ascariasis and trichuriasis in the different age groups. There was also no significant difference in the prevalence of ascariasis, trichuriasis and hookworm infection in males and females.

The overall mean epg counts for *A. lumbricoides*, *T. trichiura* and hookworm were 39,501.9±51,458.1, 6,209.0±7,106.3 and 1,688.7 ± 2,843.0, respectively. The mean epg

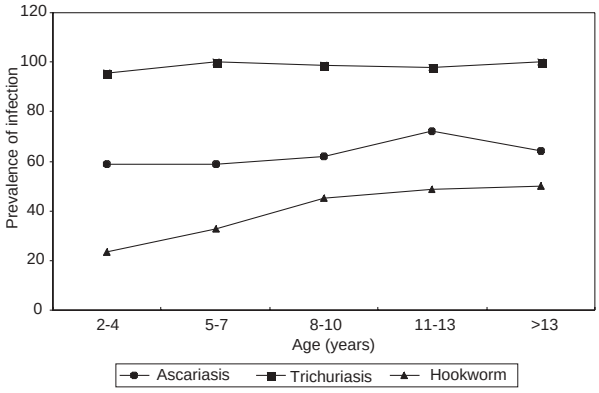

Fig 1–Age-related prevalences of ascariasis, trichuriasis and hookworm infection.

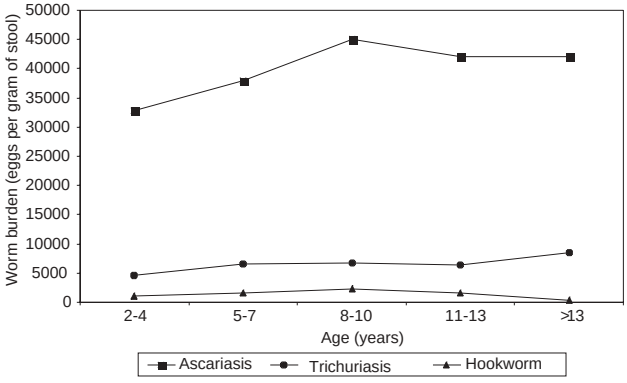

Fig 2–Age-related intensities for ascariasis, trichuriasis and hookworm infection.

count for *A. lumbricoides* was low in the age group 2-4 years and rose steadily until age group 8-10 years. Following that the mean epg count stabilized. The mean epg count for *T. trichiura* was similar for all age groups. However the mean epg count for hookworm rose with age and reached a peak at age 8-10 years. Following that, the mean epg count decreased steadily with age. The mean epg count for hookworm was significantly related to age (Kruskal Walis 1 way ANOVA χ^2=13.172, p=0.010). However, the mean epg count for *A. lumbricoides* and *T. trichiura* did not show a significant change with age (ANOVA of log 10 transformed egg counts F=0.569, p=0.689; F=1.465, p=0.123). The mean epg count for *A. lumbricoides*, *T. trichiura* and hookworm were higher in females than males but the difference was not significant.

The correlation of the mean epg count for *A. lumbricoides*, *T. trichiura* and hookworm in individual children were analyzed using Kendall's rank correlation. The relationship is shown in Table 3. A strong positive correlation (r_s=0.185, p<0.01) between the mean epg counts for *A. lumbricoides* and *T. trichiura* passed by the same individual was observed. The same correlation was also seen when the data were stratified according to gender. A weak positive correlation (r_s=0.100, p<0.05) between mean epg count for of *T. trichiura* and hookworm was also observed in this study but not between *A. lumbricoides* and hookworm. A positive correlation between mean epg counts for *A. lumbricoides* and *T. trichiura* was only seen in age groups of 2-4 and 8-10 years.

DISCUSSION

Ascariasis, trichuriasis and hookworm infection are still a major public health problem in poor communities in developing countries (Carla *et al,* 2000; Janabhai *et al,* 2001; Kabatereine *et al,* 2001; Raja'a *et al,* 2001; Azazy *et al,* 2002; Steven *et al,* 2003; Verla *et al,* 2003). The findings in this study confirm that ascariasis, trichuriasis and hookworm infection still remains endemic in Orang Asli communities in Malaysia, with all the children studied being infected by at least one species soil-transmitted helminthes (STH). The prevalence of STH in this present study is similar to the observations seen in Orang Asli children in Malaysia in an earlier study (Norhayati *et al,* 1997). However the prevalence of these infections in the present study was higher than recent studies carried out in other parts of the world (Carla *et al,* 2000; Janabhai *et al,* 2001; Kabatereine *et al,* 2001; Azazy *et al,* 2002; Steven *et al,* 2003; Verla *et al,* 2003).

Trichuriasis was found to be the commonest infection, with almost 98% of children being infected. This observation is in agreement with previous studies in Malaysia (Chan *et al,* 1992; Norhayati *et al,* 1997; Rahman, 1998). Observations in other parts of the world have recorded that ascariasis and hookworm infections are more common than trichuriasis (WHO, 1987; Gagandeep *et al,* 1998; Brooker *et al,* 1999;

Lwambo *et al,* 1999; Carla *et al,* 2000; Kabatereine *et al,* 2001; Steven *et al,* 2003; Verla *et al,* 2003). Resistance of moderate and severe trichuriasis to anthelmintic drugs, which are know to be prevalent in Malaysia (Norhayati *et al,* 1997, 1998b) may be one of the possible reasons for this.

The results of this study also confirm the prevalence of STH was higher among Orang Asli children living in peripheral Malaysia than those living in the interior part of this country (Rahmahn *et al,* 1997). Regular deworming, as part of the primary health care activities carried out in the interior settlement of Orang Asli, may be the reason for the observed difference. As expected, mixed infection was the commonest STH infections observed in this study (73.0%); 36% of the children were infected with a combination of trichuriasis and ascariasis and 25% were infected with a combination of trichuriasis, ascariasis and hookworm infection. The present study also confirms previous findings that the prevalence and mean epg counts for STH were not significantly different between genders (Chan *et al,* 1992; Al-Eissa *et al,* 1995; Norhayati *et al,* 1997). This suggests that there is no difference in socio-behavioral activity or immune status between males and females.

Another interesting finding of this present study was the high prevalence (37.0%) and proportion of severe hookworm infection cases (2.5%) compared to previous studies in Malaysia (Chan *et al,* 1992; Norhayati *et al,* 1997; Rahman, 1998). This present study also demonstrated a high percentage of children with severe trichuriasis (23.5%) and severe ascariasis (18.9%), which is in agreement with the study carried out in Orang Asli children before (Norhayati *et al,* 1997). The high percentage of children with severe infection with STH is clinically important because problems associated with this infection are proportional to the worm burden. Overt complications of soil-transmitted helminthiases, such as intestinal obstruction in severe ascariasis, or dysentery and rectal prolapse in severe trichuriais, have been reported. It is well established that severe hookworm infection can lead to iron deficiency anemia (Hopkins *et al,* 1997; Stoltzfus *et al,* 1997; Brooker *et al,* 1999; Dreyfuss *et al,* 2000; Guyatt, 2000; Stoltzfus *et al,* 2000). Trichuriasis, with or without concomitant ascariasis, has been associated with malnutrition, iron deficiency anemia and growth stunting (Layrisse *et al,* 1967; Cooper *et al,* 1990; Robertson *et al,* 1992; Stephenson *et al,* 1993; Saldiva *et al,* 1999). Severe ascariasis has been associated with malnutrition (Thein-Hlaing *et al,* 1991, 1994; Stephenson *et al,* 1993; Saldiva *et al,* 1999). It is considered as a cause of acute abdominal pain in tropical countries (Anonymous, 1989; Thein-Hlaing *et al,* 1990; Kamiya, *et al*, 1993). In Malaysia, clinical features of severe trichuriasis have been described in a few studies (MacKay *et al,* 1971; Kamath, 1973). It has also been reported that ascariasis was responsible for 42.0% and 41.0% of all acute abdominal emergencies and intestinal obstruction, respectively, in children aged 7 years and below admitted to Hospital Kuala Lumpur (Mahmud, 1978).

The present study shows that the age-related prevalence of *A. lumbricoides* and *T. trichiura* is not significantly dependent on age and therefore these infections do not show age-prevalence convexity. This is because the prevalence of these infections was high in the younger age groups. The age-related mean epg count for *T. trichiura* also showed a similar pattern. Although age-related mean epg count for *A. lumbricoides* showed some convexity with age, the differences in the mean epg count in the different age groups was not significant. This finding is in contrast to the results of previous studies carried out in Malaysia, (Bundy *et al,* 1988; Chan *et al,* 1992; Norhayati *et al,* 1997). The high prevalence and mean epg counts for ascariasis and trichuriasis in the younger age group was the reason why age-prevalence convexity and age-mean epg convexity were not seen in this study. Thus, in endemic areas where infection occurs at a very early age and reinfection is continuous throughout life, the prevalences and mean epg counts tend to be very high. Therefore, age-prevalence and age-mean epg convexity were not seen in this data. In contrast, the prevalences and mean epg counts for hookworm showed a significant increase with age and convexity with age. The differences in mode of infec-

tion and infectious stages with *A. lumbricoides* and *T. trichiura* may explain why hookworm infection tends to occur in older age groups and shows convexity with age.

A positive correlation in mean epg counts for *A. lumbricoides*, *T. trichiura* and hookworm within individuals was seen. It was not surprising to observe a strong significant correlation between *A. lumbricoides* and *T. trichiura* due to the similar mode of infection and high prevalence and mean epg counts for both species in the community. However, a weak positive correlation was also seen between hookworm and *T. trichiura* despite the different mode of transmission. This suggests that both the prevalence and mean epg counts in an infection are important factors in this correlation. There was no correlation between *A. lumbricoides* and hookworm. This may reflect the low prevalence and mean epg counts for hookworm in the community. A similar trend in correlation has been reported before in Malaysia (Norhayati *et al,* 1997) as well as in studies conducted in other countries (Holland *et al,* 1989; Ferreira *et al,* 1994).

In conclusion, this study shows that ascariasis, trichuriasis and hookworm infection are still prevalent, and are of public health concern in Orang Asli communities living in the periphery of this country. The high prevalence of children with severe ascariasis and trichuriasis may lead to other health and medical problems, such as micronutrient deficiency (iron deficiency anemia, vitamin A deficiency), protein-energy malnutrition, poor school performance and other acute illnesses among the children. Trichuriasis, which affected almost all the children in this community, has important implications for the control of STH because of its resistance to many anthelmintics.

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