ORIGINAL ARTICLE

Hookworm Infection and Reinfection Following Treatment Among Orang Asli Children

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Summary

In hookworm endemic areas where sanitation is often wanting, reinfection of treated children is a problem. This study was conducted to enumerate the prevalence and the reinfection rate of hookworm in 193 Orang Asli children following treatment with stat dose of 400mg of albendazole at 2 and 4 months post-treatment. All samples were examined using the Kato-Katz and Harada Mori techniques. The overall initial prevalence was 31.0%, with 27.0% in males and 34.0% in females although there was no statistical difference. Only 7.0% of the children had moderate intensity of infection. The overall infection rate at 2 and 4 months post-treatment was 11.0% and 8.0%. New cases were detected at 1.0% and 5.0% at 2 and 4 months post-treatment period. Reinfection rate 2 months post-treatment was 24.0%, and it was 30.0%, 4 months after treatment. All infection at 2 and 4 months post-treatment were light. Long term strategies incorporating health education on personal hygiene, provision of toilets and safe water supply need to be adopted in these Orang Asli villages to control rapid reinfection.

Key Words: Hookworm, *Necator americanus*, Albendazole

Introduction

Hookworm infection is widely distributed throughout the tropics and subtropics, where almost a billion people are infected[1]. Prevalence of hookworm infection in Malaysia varies according to areas or communities studied, and also the method used to detect this infection: *Necator americanus* is the predominant species reported in most of the studies in Malaysia[2,3,4,5]. Prevalence was high, ranging from 11.9% to 75.0% in the 2 types of rural communities where studies have been conducted i.e. Malay traditional villages[3,5,6] and in estates[2,6,7]. Studies among Orang Asli communities also revealed a high prevalence of hookworm, ranging from 26.2% to 95.2%[5,8,9]. In endemic areas where sanitation and poor personal hygiene and health care is a common feature, poor people particularly their children, are continuously exposed to reinfection. Few studies have been carried on the reinfection of hookworm after treatment and the results indicated that reinfection occurred rapidly after treatment[10,11]. Hookworm reinfection studies have not been done among Orang Asli communities where the type of life-style is different from other rural communities. This

study was conducted to observe reinfection with hookworm 2 and 4 months post-treatment in Orang Asli children.

Materials and Methods

This study was carried out in residents of 6 Orang Asli villages from the Temuan group in Dengkil, Selangor. These villages were situated about 50 km from Kuala Lumpur. Each village comprised a very small population and most of the residents worked as palm oil estate labourers, rubber tappers, farmers, doing odd jobs such as fishing and selling forest product. The average monthly household income was low and unfixed and usually below the poverty level. Most of them lived in single-roomed houses made of bamboo and wood. Almost all the 6 villages had no electricity, no piped water and had no toilet facilities. The residents used well or river water for daily use and defecated in open ground among the bush.

One hundred and ninety three children aged 1-13 years old (93 males and 100 females) participated in this study. Children who had taken anthelminthic two months prior to stool examination were excluded from this study. Plastic pill boxes were distributed to all to collect stool. Samples were examined by Kato-Katz for hookworm eggs and Harada-Mori culture was done on all stool samples to identify hookworm species and also to detect *Strongyloides stercoralis* larvae if present. These samples were examined 7 days later. Children with positive stool culture were treated under supervision with a single dose 400mg of albendazole. Stool samples were collected and examined at 2 weeks, 2 and 4 months post-treatment intervals. During the initial and final visits all the children were given full medical examinations.

Results

Table I shows the distribution of hookworm infection at the onset of the study detected by Kato-Katz and Harada Mori techniques according to age and sex. The overall initial infection rate was 29.0% (Kato-Katz) and 31.0% (Harada-Mori), with 27.0% males and 34.0% females being infected. Hookworm

Table I
Hookworm infection rate according to age among Orang Asli children aged 1-13 years old at the beginning of the study in Dengkil

	Number examined	Number infected		% infected
		Kato-Katz	Harada-Mori	
Age (years)				
1 - 2	30	5	5	16.0
3 - 4	46	12 (1)	14	30.0
5 - 6	36	13 (2)	15	41.0
7 - 8	50	15 (1)	19	38.0
9 - 10	16	3	5	31.0
11 - 13	14	4	2	13.0
Not sure of age	1	0	0	0.0
Total	193	56	60	31.0

( ) Moderate burden egg output

All others had low burden egg output

infection occurred in very young children, aged 1-2 years old and there was an increase in the infection rate with age until it peaked at 5-6 years old age group. Following this, there was a decline in the infection rate. Fifty-two (92.0%) children had low burden egg output {< 2000 eggs per gram (EPG)} and only 4 (7.0%) children had moderate burden egg output (2000-10000 EPG). The moderate burden egg output occurred in 2 males and 2 females children, aged between 3-8 years old.

In male children, infection rate peaked at 40% in the 7-8 years old age group. However in female children, the infection rate peaked in the much younger age group (5-6 years old). The infection rate remained lower in male children except among the age 7-8 years old age group, however the difference was not statistically significant ($X^2=0.63$, $p>0.05$). The distribution of initial hookworm infection rate according to age and sex is shown in Table II.

Of the 60 children who were positive for hookworm larvae and treated, 39 children provided stool samples 2 weeks following treatment. Of these, 36 (92.0%) children were cured. The three uncured children were all male: one aged 3-4 years old and two aged 7-8 years old.

Of 60 children who had hookworm infection at the initial phase and treated, 33 children provided stool samples at 2 weeks, 2 months and 4 months post-treatment. Reinfection was detected in 8 (24.0%) children at 2 months post-treatment period and at 4 months, only 2 more children were detected to be reinfected, with the reinfection rate rose to 30.0%. The reinfection children according to age were: 1-2 years (1 child), 3-4 years (2 children), 5-6 years (3 children) and 7-8 years (4 children). Reinfection did not occur in the older age groups. Of the 10 reinfected children, 6 were females and 4 males. All reinfection cases recorded was of low burden egg output. Reinfection rate at 2 and 4 months post-treatment is shown in Table III.

Of 193 children who returned stool samples in the initial survey, 112 of them returned stool samples 2 months post-treatment, and 138 children 4 months post-treatment. Considering the treatment result, four possible combination of stool finding between the initial and post treatment period (2 and 4 months)

Table II
Hookworm infection rate according to age and sex among Orang Asli children aged 1-13 years old at the beginning of the study in Dengkil

	Number examined		Number infected		% infected	
	Male	Female	Male	Female	Male	Female
Age (years)						
1 - 2	14	16	2	3	14.0	18.0
3 - 4	18	28	5	9	27.0	32.0
5 - 6	18	18	5	10	27.0	55.0
7 - 8	30	20	12	7	40.0	35.0
9 - 10	6	10	2	3	33.0	30.0
11 - 13	6	8	0	2	0.0	25.0
Not sure of age	1	O	0	0	0.0	0.0
Total	93	100	26	34	28.0	34.0

Table III
Hookworm reinfection rate at 2 and 4 months post-treatment among Orang Asli children aged 1-13 years old, Dengkil

Description	Months after treatment 2	4
No. of hookworm cases	33	33
No. of reinfected cases	8	8+2
% of reinfected cases	24.0%	30.0%

Table IV
Overall hookworm infection rate (new cases, treatment failure cases and reinfected cases) at 2 and 4 months post-treatment among Orang Asli children aged 1-13 years old, Dengkil

Description	Months after treatment 2	4
No. examined	112	138
No. of new cases	2	7
No. of reinfected cases	8	2
No. of treatment failures	3	3
Overall infection rate	13 (11.0%)	12 (8.0%)

can be made: (- -, not infected) the child was not infected neither in the initial phase or at the end of the phase; (+ +, treatment failure/uncured or reinfected) the child was either reinfected or is a treatment failure; (- +, fresh infection or new case) the child was infected afresh; (+ -, cured or not reinfected) the child was infected at the initial phase and was cured or not reinfected.

The overall infection rate (new cases, reinfected cases and treatment failure cases) at 2 and 4 months post-treatment is shown in Table IV. Of 112 children's stool samples examined at 2 months post-treatment period, 75 (66.0%) children initially uninfected remained uninfected; 24 (21.0%) children were not reinfected or cured; 2 (1.0%) children had acquired fresh infection; 8 (7.0%) children were reinfected and 3 (2.0%) children were treatment failures. The two new cases were in females, one detected in child aged 2 years old and one in child aged 7 years old. The overall infection rate at 2 months post-treatment was 11.0%, approximately one third lower than the initial infection rate and the difference was statistically significant (X^2=10.26, $p<0.05$).

At 4 months post-treatment, of 138 children stool samples, 100 (72.0%) children who were initially uninfected remained negative; 28 (20.0%) children were not reinfected or cured; 7 (5.0%) children had acquired fresh infection; 2 (1.0%) children were reinfected and 3 (2.0%) children were treatment failures. In all seven children who acquired fresh infection during this period, (all aged between 1-6 years), 5 of whom were males and 2 females. The

overall infection rate according to the recovery of hookworm larvae in the cultured stool was 8.0%, slightly lower than the overall infection rate at 2 months post-treatment. New cases were detected at 1.0% at 2 months post-treatment and 5.0% at 4 months post-treatment. All new cases had light infection.

Discussion

Early studies on the hookworm infection in Orang Asli communities found a high prevalance rate ranging from 51.0% to 95.0%[8,9]. The present study revealed that hookworm infection is still common and endemic in Orang Asli children as shown by the high overall infection rate, high infection rate in younger children and very rapid reinfection developing following treatment. Detection of new cases of hookworm at 5.0% within 4 months post-treatment also shows that the transmission of this helminths is occurring continuously.

The initial infection rate reached peak at age group 5-8 years old and showed a decline in the older children. In other studies where all age group were studied it was shown that the prevalence of hookworm increased rapidly with age and stabilized or lowered in the older group[11,12,13]. Even though the statistical analysis of infection rate and sexes was not significant, this study showed that the initial infection rate was higher in females. A study in a fishing community in India showed that infection rate was significantly higher in females compared to males[11]. However other studies have reported that the infection rate was significantly higher in males[13,14]. It is more probable that behavioural factors associated with the community and degree of exposure of the particular group and sex to hookworm larvae play an important role in a specific group being infected.

Our study also showed that even though the infection rate is high, the average intensity of egg output was low with only 7.0% of the children having moderate intensity of infection. Similar findings also has been reported from India[15].

It is interesting to note that all the reinfection cases occurred in young children aged between 1-8 years old and not in older children. Similar findings of lower reinfection rate in older children have been reported from other parts of the world[16]. The possible reasons for this age dependent pattern is probably related to the children's habits and exposure. In endemic areas reinfection is a major problem faced by the health workers in the control of hookworm and other soil transmitted helminths. Since reinfection occurs continuously, for parasite control programmes to be effective, repeated regular treatment is required. Reinfection study on ascariasis in Burma has stated that 3-monthly chemotherapy strategy has succesfully lowered the intensity of the infection[17]. Our study has shown that hookworm reinfection occurred rapidly following treatment i.e. as early as 2 months. It is because of this that 6-monthly chemotherapy control programme as adopted by many government health systems have failed to reduce or lower the intensity of this infection in the endemic areas. In order to achieve better results from control programmes besides chemotherapy, other long term strategies such as health education on personal hygiene, provision of toilets and the importance on the use of it, safe water supply need to be adopted in endemic areas.

Conclusion

This study showed that even though the infection rate of hookworm among Orang Asli children was high (31.0%), only 7.0% of the children had moderate intensity of infection. Reinfection was detected as early as 2 months post-treatment period and all the reinfection cases had light intensity infection.

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