THE PREVALENCE OF MALNUTRITION AND GEO-HELMINTH INFECTIONS AMONG PRIMARY SCHOOLCHILDREN IN RURAL KELANTAN

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Abstract. A cross-sectional study of the nutritional status of schoolchildren aged 7-10 years from the Kuala Betis Resettlement Scheme in Gua Musang, Kelantan was done. A total of 291 schoolchildren were examined but only 183 (62.9%) fecal samples were returned for geo-helminth infection analysis. The prevalence of stunting was 40.4% and underweight was 28.4%. A total of 127 schoolchildren (69.4%) were positive for at least one of the 3 geo-helminth infections. The most common geo-helminth was *Ascaris lumbricoides* (62.8%), followed by *Trichuris trichiura* (38.9%), and hookworm infection was relatively low (12.6%). All the anthropometric indices measured were lower in the geo-helminth infected children compared to the uninfected childen, except for the weight-for-height z-score. However the differences were insignificant. Geo-helminth infections may not be a significant factor in malnutrition of these schoolchildren. However, with the availability of safe, efficacious and cheap broad spectrum anthelmintics, regular mass treatment should be given in selected areas where the prevalence of geo-helminth infections is still high, so that these schoolchildren will be able to achieve their growth potential during their school years.

INTRODUCTION

In most countries where geo-helminths are endemic, school-age children experience the highest prevalence and intensity of infection, particularly with *Ascaris lumbricoides* and *Trichuris trichiura* (Hall *et al*, 1997). Morbidity has been traditionally considered a result of heavy geo-helminth infections; children with light infections were thought to suffer no ill effects. There is increasing evidence however, that even low or moderate intensity infections significantly retards childhood growth and development (Hall, 1993; Stephenson, 1994). The relationship between parasitic infections and malnutrition is one of the factors emphasized in the World Development Report 1993 (Word Bank, 1993). Malnutrition is still common among the Malaysian children, especially in the rural areas (Chong *et al*, 1984; Osman and Zaleha, 1995; Norhayati *et al*, 1997). The relationship between geo-helminth infections and malnutrition in such communities should be determined to see it is an important factor in malnutrition. Treatment of such infections can be easily instituted and it will help improve the catch-up growth of these malnourished children and compensate the growth retardation in their early childhood (Tanner, 1981).

The study is a one year prospective, placebo-controlled, double blinded study on the impact of geo-helminth infections on the nutritional status of children in Kuala Betis, Kelantan. The purpose of this study was to determine whether there is an association between geo-helminth infections and the nutritional status among primary schoolchildren in a rural community. In this paper, we report on the baseline cross-sectional study, looking into the point prevalence of intestinal geo-helminth and their association with the nutritional status of the schoolchildren.

MATERIALS AND METHODS

The study area, Kuala Betis, is a rural resettlement scheme, consisting of several villages situated near to each other. Most of the settlers are the Orang Asli, who are brought in from the jungle to resettle in these villages. There are also a number of Malay settlers living nearby in a Malay village. Most of the villagers are rubber tappers, with a poor socio-economic background. The state of sanitation in these villages are also poor, and the river is their main source of water. There are very few toilets built and the villagers generally use the nearby bushes. A total of 291 school children were examined at baseline but only 183 (62.9%)

fecal samples were returned. Only the results from the 183 children with fecal samples were use for the analyses in this study. The schoolchildren are from the Kuala Betis primary school and mainly made up of Malay and Orang Asli children living in the area. All the children in Grade 1, 2 and 3 (7-10 years) were selected for the study. The age of the child was determined based on the school records. The weight was taken with the children in school uniform without shoes using a Seca electronic weighing scale and was recorded to the nearest 0.1 kg. The height was measured to the nearest 0.1 cm using a measuring tape. The child was made to stand against a straight wall with a tape suspended 2 meters from the floor. The weight and height of the children were compared with the National Center for Health Statistics (NCHS) reference values using the Anthro software (Sullivan and Gorstein, 1996). Children were classified as stunted, underweight or wasted if the z-score for height-for-age, weight-for-age and weight-for-height respectively were less than 2 standard deviation (SD) below the NCHS median.

Containers for fecal samples were given to each child. The fecal samples were collected on the following day. The consistency of the feces were noted as hard, soft, diarrheic or watery and were preserved with 10% formalin. The stools were examined for the presence of *Ascaris lumbricoides*, *Trichuris trichiura* and hookworm eggs. If positive, the worm load (eggs per gram of stool) was determined using a modified Stoll's technique, with a correction factor based on the consistency of the stools. The worm load was then categorized into the intensity of infection - negative, mild, moderate and heavy infection according to the WHO (1987) classification. Data entry and analysis were done using the Epi-Info Version 6 computer program (Dean *et al*, 1996). Statistical analyses of comparisons of proportions were tested with the chi-square test. Probability less than 5% for null hypothesis was considered significant.

RESULTS

There were a total of 183 schoolchildren surveyed who had returned the container with the fecal specimen. There were 74 schoolchildren (40.4%) who were stunted while 52 schoolchildren (28.4%) were underweight. Only 7 schoolchildren (3.8%) were wasted. A total of 127 schoolchildren (69.4%) were positive for at least one of the 3 geo-helminth infections. The most common helminth was *Ascaris lumbricoides* (62.8%) , followed by *Trichuris trichiura* (38.9%). Hookworm infections was relatively low (12.6%). The intensity pattern of the geo-helminth infections is shown in Fig 1. It show the typical highly overdispersed pattern, where most of the infections were mild and moderate, with few heavy infections. There was no heavy hookworm infections detected. There was no significant difference in the gender and racial distribution between the infected and uninfected children, nor was the mean age of each group different (Table 1).

Comparing the infected children with uninfected children, there was significant difference in the distribution of infection by their grade of schooling. Grade 2 children had the highest prevalence of geo-helminth infections, followed by Grade 3 and Grade 1 children. There were also significant difference in two of the indices for socio-demographic status. More of the infected children were using water from the river as their source of water, as opposed to pipe water supply among the uninfected children. More of the infected children's father work as rubber tappers, indicating a lower socio-demographic background compared to the uninfected children.

The mean weight and height of the infected children were higher compared to the uninfected children but their mean weight-for-age and height-for-age z-scores were lower, although the difference was not significant. The other anthropometric parameters measured *ie* mid-upper arm circumference, triceps skinfold thickness and subscapular skinfold thickness were lower for the infected children compared to the uninfected children. The weight-for-height z-score was the only index where the mean for the uninfected children was higher in the infected children. However, all the differences noted

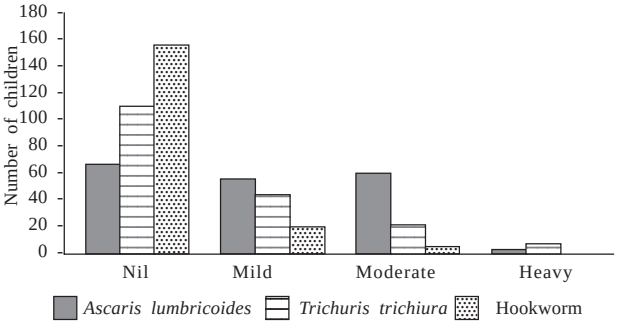

Fig 1–Intensity of geo-helminth infections among schoolchildren in Kuala Betis, Kelantan.

Table 1
Selected characteristics of Grade 1-3 primary schoolchildren in rural Kelantan.

Variables	Worm positive (n=127)	Worm negative (n=56)
1. Gender		
Male	63 (69.2)	28 (30.8)
Female	64 (69.6)	28 (30.4)
2. Race		
Malay	41 (68.3)	19 (31.7)
Orang Asli	86 (69.9)	37 (30.1)
3. Mean age in months (SD)	99.1 (22.5)	89.9 (26.9)
4. Grade		
1	58 (66.7)	29 (33.3) *
2	48 (85.7)	8 (14.3)
3	68 (78.2)	19 (21.8)
5. Water		
Piped	48 (60.8)	31 (39.2) *
Others(river, rain)	79 (76.0)	25 (24.0)
6. Father's occupation		
government business	21 (55.3)	17 (44.7) *
rubber tappers	106 (73.1)	39 (26.9)
7. Anthropometric parameter–mean (SD)		
Weight	21.4 (6.1)	20.1 (5.6)
Height	118.1 (12.3)	114.6 (12.9)
WAZ	-1.5 (1.1)	-1.4 (0.94)
HAZ	-1.7 (1.4)	-1.6 (1.0)
WHZ	0.88 (3.6)	0.02 (3.2)
MUAC	17.3 (2.0)	17.5 (4.9)
Triceps skinfold	8.2 (2.4)	8.4 (3.4)
Subscapular skinfold	6.1 (1.8)	6.5 (3.7)
8. Nutrition		
Normal	68 (53.5)	35 (62.5)
Stunting	56 (44.1)	18 (32.1)
Underweight	38 (29.9)	14 (25.0)
Wasting	4 (3.1)	3 (5.4)

* $p<0.05$

were not statistically significant. There were also more cases of stunting and underweight among the infected children compared to the uninfected children, but the difference was not significant.

Table 2 shows the intensity of infections for the three geo-helminth infections and the indices of malnutrition, *ie* stunting and underweight. There was no significant relationship detected between the intensity of geo-helminth infection and the nutritional status of the child. The proportion of stunted children tends to increase as the intensity of the *Trichuris trichiura* infection increased. However, there were too few 'heavy' geo-helminth infections to make a statistical comparison.

An analysis between nutritional status and positivity for any of the 3 geo-helminth infection was done, stratifying for race (Table 3). Malnutrition is defined as positive if any of z-scores for height-for-age, weight-for-age and weight-for-height is less than -2.0. However there was no significant association noted between geo-helminth infection and malnutrition.

DISCUSSION

There was a high prevalence of intestinal geo-helminth infections (69.4%) in schoolchildren in Kuala Betis, Kelantan. *Ascaris lumbricoides* was

Table 2
Intensity of geo-helminth infections and height and weight-for-age nutritional indices for Grade 1-3 primary schoolchildren in rural Kelantan.

Type and intensity of infection	n	Height-for-age		Weight-for-age	
		Normal (%)	Stunted (%)	Normal (%)	Underweight (%)
1. *Ascaris lumbricoides*					
Nil	68	42 (61.8)	26 (38.2)	49 (72.1)	19 (27.9)
Light	55	34 (61.8)	21 (38.2)	38 (69.1)	17 (30.9)
Moderate	59	32 (54.2)	27 (45.8)	43 (72.9)	16 (27.1)
Heavy	1	1 (100.0)	0 (0.0)	1 (100.0)	0 (0.0)
2. *Trichuris trichiura*					
Nil	110	69 (62.7)	41 (37.3)	81 (73.6)	29 (26.4)
Light	44	27 (61.4)	17 (38.6)	29 (65.9)	15 (34.1)
Moderate	21	10 (47.6)	11 (52.4)	15 (71.4)	6 (28.6)
Heavy	6	2 (33.3)	4 (66.7)	4 (66.7)	2 (33.3)
3. Hookworm					
Nil	156	95 (60.9)	61 (39.1)	112 (71.8)	44 (28.2)
Light	19	9 (47.4)	10 (52.6)	13 (68.4)	6 (31.6)
Moderate	4	2 (50.0)	2 (50.0)	2 (50.0)	2 (50.0)
Heavy	0	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)

Table 3
Malnutrition and geo-helminth infection by race among Grade 1-3 primary schoolchildren in rural Kelantan.

Worm infection	Malnutrition		Normal	
	Malay	Orang Asli	Malay	Orang Asli
Positive	9	49	29	36
Negative	2	19	17	18
Total	11	68	46	54

the most common geo-helminth (73%) followed by *Trichuris trichiura* (45%) and hookworm (23%). Mahendra *et al (*1997) found an overall prevalence of 43.1% in Kota Bharu, Kelantan while Rajeswari *et al* (1994) found an overall prevalence of 51.5% geo-helminth infections in Gombak, Selangor among primary schoolchildren. *Trichuris trichiura* infections were the most common followed by *Ascaris lumbricoides* infections. Kan and Poon (1987) found the prevalence of *Ascaris lumbricoides* infections ranged from 9.6% to 52.9%, *Trichuris trichiuria* infections from 32.6% to 75.0 and hookworm from 2.2% to 14.5% in a similar age group. The highest prevalence for *Ascaris lumbricoides* and *Trichuris trichiura* infections were found in the urban slums while the highest prevalence of hookworm infections were found in the rural plantations. Geo-helminth infections are therefore still common among primary schoolchildren in the rural areas, despite the economic progress of the country. Most of the infections were mild to moderate infections. There is a relatively higher prevalence of hookworm infections found in this study, which may be explained by the poor hygiene practices of these children in not wearing shoes in the villages with poor sanitation.

The prevalence and intensity of the geo-helminth infections are closely related and dependent on socio-economic and hygiene conditions. This is

supported by the association of geo-helminth infections with the father's occupation as rubber tappers and the river as their source of water. In the Kuala Betis community, rubber tappers have a lower socio-economic background. They live in villages far from the administrative and commercial center of the resettlement scheme, and are dependent on the river as their source of water. Proper toilet facilities were not available in these villages and using bush latrines was still the norm. With these conditions, it is not surprising to find the high prevalence of geo-helminth infections among the schoolchildren.

The prevalence of stunting (40.2%), underweight (25.7%) and wasting (3.1%) found in this study were high and are comparable to previous studies done. Nearly half of the infected children in this study were found to be stunted. Zamaliah *et al* (1998) found the overall prevalence of stunting, underweight and wasting among children below 9 years in the rural areas were 29.2%, 26.1% and 0.62% respectively. Osman and Zaleha (1995) found that Orang Asli children in rural areas suffered from malnutrition in general and the prevalence of stunting ranged from 66.7% to 80%, while the prevalence of underweight ranged from 28.2% to 61.8%. As shown in other developing countries, stunting is the most common type of malnutrition as it is related to chronic malnutrition which begins in childhood (Martorell and Habicht, 1986). This reflects the poor socio-economic status of the community, where nutritional intake may be inadequate to support growth, and the high prevalence of geo-helminth infections may worsen the situation.

This cross-sectional study however, did not find any significant association between geo-helminth infections and nutritional status. This may suggest that other factors which affect the nutritional status, are predominant. Therefore, the prospective study looking at the impact of deworming on the growth of the schoolchildren may help provide some answers. Also, methodological constraints in this study tend to diminish the potential differences observed between the infected group and the control. The presence of eggs in stool is the most commonly used technique for the diagnosis of geo-helminthiasis. Because of logistic and economic limitations, one stool examination was used to designate children as uninfected, and serve as a control group for comparison. Since egg excretion is variable from day to day, a single examination will sometimes miss very light infections. The effect of this error would be to diminish the statistical significance of differences between the two groups. Taking more than one stool sample from each child will help reduce this misclassification error.

In a previous study, it was found out that geo-helminths was not a critical component affecting growth of Indian schoolchildren in Malaysia, and mass deworming programs for improving nutritional status, at least as measured by weight and height, will not be effective (Lai *et al*, 1995). It was recommended that such programs should concentrate on supplying adequate nutrition, and not on treating the geo-helminth infections. Mahendra (1998) also found no difference in growth between treated rural Malay children and uninfected controls, but found that children infected at baseline level but worm free at follow-up, were observed to have experienced greater increments in height and height-for age. He also found that children with heavy *Ascaris lumbricoides* infections gained significantly less weight and tended to have reduced linear growth rates between measurements (Mahendra, 1997). However, another study on Indian schoolchildren living in estates, found that *Ascaris lumbricoides* infections was a factor for growth differences in height while *Trichuris trichiura* infection was a factor for the growth differences in height, weight and arm circumference (Foo, 1986). The conflicting results from these local studies serves to demonstrate the multifactorial nature of malnutrition and the role played by geo-helminth infections will vary based on these other factors.

Broad spectrum anthelmintic drugs of proven safety and efficacy are nowadays available for mass treatment at low cost. The risk of morbidity due to infections exceeds the risk of side effects due to treatment. School-based deworming has been advocated as a highly cost-effective public health measure in less-developed countries. Studies in East Africa found that treating children for helminthiasis or anemia improved weight gains per month at least as much as and usually much more than school feeding programs, which may be much more labor intensive, complicated and expensive (Pieters *et al*, 1977). Thus, mass treatment of school age children, the group at highest risk of geo-helminth infections, is recommended by the WHO (1987). At present, treatment is thought to aim to reduce levels of infection below those associated with morbidity rather than to eradicate or prevent infection (Savioli *et al*, 1992). In the long term, a more comprehensive approach is required, dealing with poverty, health care and education, living conditions, sani-

tation and water supplies (Evans and Stephenson, 1995).

Growth and nutritional status represent one of the most sensitive indicators of health in children. However, there are other health parameters where geo-helminth infections play a role. Hookworms have long been recognized as an important cause of iron deficiency anemia (Stephenson *et al*, 1994). There is also increasing evidence that geo-helminth infections can have a detrimental effect on cognition and educational achievement in children (Sternberg *et al*, 1997; Mohammod *et al*, 1998). Physical fitness is also poorer among the infected schoolchildren (Stephenson *et al*, 1993). The aim of improving health may alone be sufficient cause for mass deworming but this neeed is greatly enhanced because good health is important for education (Pollitt, 1990) The World Health Organization has also recommended regular mass treatment for schoolchildren where the prevalence of helminth infections exceeds 50% (WHO, 1995). In areas where the prevalence of mild to moderate underweight exceeds 25% and where parasites are widespread, high priority should be given to deworming programs. Many schoolchildren in the rural areas of Malaysia certainly meets both these criteria of high prevalence of malnutrition and helminthiasis among the schoolchildren. It is important for regular deworming programs for the schoolchildren to be carried out until such time when the measures taken have reduced the prevalence of geo-helminth infections and malnutrition to a low level, with the standards of sanitation adequate to prevent transmission and recurrence of the infection.

CONCLUSION

Malnutrition and geo-helminth infections are still highly prevalent among the rural communities in Malaysia. As malnutrition is a multifactorial problem, the contribution of geo-helminth infections will vary based on these other factors. Children living in high risk areas of geo-helminth infections, such as rural villages and estates, should be given special consideration at control of these infections, so that they can achieve their potential during their school years. The availability of effective, safe and economical anthelmintics will help achieve control of these geo-helminth infections in such communities. Mass deworming of schoolchildren should be implemented, in tandem with other measures to improve the nutritional status of the schoolchildren in these communities.

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