Malnutrition and its risk factors among children 1-7 years old in rural Malaysian communities

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The aims of this study were to investigate the nutritional status of children aged 1-7 years in Malaysian rural communities and to identify its risk factors. In all, 221 children were assessed using anthropometric measurements, dietary questionnaires and other tools. *Weight-for-age, height-for-age, weight-for-height* were analysed. Based on the NCHS standards, the overall prevalence of underweight, stunting and wasting was 46.2%, 18.1% and 30.3% respectively. Almost one-third of the 1-2 years old groups were malnourished. Univariate analysis identified household income ≤ MR750.00 as a significant risk factor of stunting and wasting.

Key words: malnutrition, underweight, stunting, wasting, children, West Malaysia, Malay Villages, Labu, Dengkil, socioeconomic factors, birthweight, parasitosis

Introduction

Studies on the nutritional status of preschool and primary school children in the 1970s have shown that mild to moderate malnutrition was widespread in both urban and rural areas in Malaysia[1-3]. Stunting or chronic malnutrition was more common among primary school children from squatter-urban areas[1] and wasting or acute malnutrition was more prevalent among Malay children living in rural villages and in urban flats[4]. Over the years, Malaysia has shown an upward trend towards improvement in health status of the population[5]. However, recent studies show that prevalence of malnutrition among preschool and school children is still high[6-11].

A number of studies in developing countries have investigated the variables which are associated with, and possible determinants of, child growth. Studies have shown that in developing countries the nutritional status of children has a significant inverse relationship with household income[10,12,13]. Socioeconomic factors such as household income, the education level of parents, distribution of food in the family[13-17], demographic factors[14,16], immunisation status and childhood illness[17], intestinal parasitoses[11,18], and childhood nutrition[11,15,19] also have significant association with the nutritional status of children. A significant decrease in *weight-for-age* with increasing number of parasitic infections per child has been observed among 3-8 years old children in Thailand[18].

The aims of this study were to explore the problems of malnutrition among children aged 1-7 years in rural communities in Malaysia, to determine to earliest occurrence of malnutrition in this community and to identify some selected risk factors related to malnutrition in this age group.

Materials and methods

This study was carried out in rural Malay villages in sub district *Labu* and *Dengkil*, located about 70 km from Kuala Lumpur. The villages were chosen using the following criteria: the main economic activities of the villagers were agricultural, mean household incomes were low, worm infestation was evident and the villages were located near Aboriginal villages (this study is part of a bigger study involving the Aboriginal community). After discussions with the health officer of the district and sub district officer, villages with the above criteria were selected. The majority of residents were estate labourers, drivers and farmers. Households or families who had children 1-7 years old were identified and the families were invited to attend a health and worm infection exhibition held by the authors in the villages. In all, 221 children, 113 males and 108 females, aged 1-7 years old who attended the exhibition were included in this study.

The sociodemographic data was obtained using a questionnaire. Nutrient intake was assessed with a combination of the 24-hour dietary recall and food frequency methods. A nutrition intake profile for 7 days was obtained and averaged. The household measurement utensils such as cups, tablespoons, teaspoons and Chinese bowls were used by interviewers to help the parents in recalling and quantifying their food intake. Ages of the children were confirmed by examining their birth certificates. Stools were collected and examined for the presence of eggs and larva of *Ascaris*, *Trichuris* and hookworm using Kato-Katz and Harada-Mori techniques. Anthropometric measurements were done as

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follows: children were weighed without shoes using a bathroom scale which had intervals of 0.5 kg; height was measured by standing the child against a vertical wall, and marking off on the wall with the aid of clipboard.

The Z-score for *weight-for-age* was used to denote underweight as an overall indicator for malnutrition. *Height-for-age* Z-score was used as an indicator for stunting. *Weight-for-height* Z-score was used as an indicator for wasting (acute malnutrition). The Z-scores were calculated based on the median values of the United States National Center for Health Statistics (NCHS) Reference Population. In this study, children who had Z-scores below -2 standard deviations (SD) of the NCHS Reference Population median were considered significantly malnourished, and Z-scores between -1 and -2 SD were mildly malnourished. The Z-scores for *weight-for-age*, *height-for-age* and *weight-for-height* were derived using EpiNut Anthropometry (Epi Info, version 6.02, 1994)[20].

Other analyses were done using Epi Info (version 6.02, 1994)[20] and SPSS for Windows (version 6.0, 1993)[21]. The dependent variables were the Z-scores for *weight-for-age*, *height-for-age* and *weight-for-height* and the independent variables were the education levels of the father and mother, employment status of the mother, household income, family size, mean percentage nutrient requirement (energy and protein intakes) and worm intensity of infection.

Results

Demographic characteristics

Two hundred and twenty one children (113 boys; 108 girls) aged between 1-7 years with a mean age of 4.0 (SD:1.8) participated in this study. The average family size was 6.2 (SD:1.9) persons per household and mean monthly household income of MR 728.10 (SD:490.20). Almost all (97.6%) of the heads of the family had formal education of at least 6 years. Only 7.1% of the mothers had no normal education. About two-thirds (69.2%) of the mothers were full-time housewives. The general characteristics of the children according to age and gender are shown in Table 1.

Table 1. General characteristics of children aged 1-7 years in rural areas in Malaysia

	Age (years)			
	1-2	3-4	5-7	p
	Mean (SD)	Mean (SD)	Mean (SD)	
Males				
Weight (kg)	9.5 (1.7)	13.7 (2.6)	16.2 (3.4)	0.0000[ac]
Height (cm)	79.6 (14.1)	97.3 (7.4)	107.9 (17.1)	0.0000[bc]
Mean Z-score				
Weight-for-age	-2.3 (1.0)	-1.5 (1.0)	-1.8 (1.1)	0.0074[ac]
Height-for-age	-1.3 (1.1)	-1.0 (1.0)	-1.2 (1.1)	0.5307[a]
Weight-for-height	-1.9 (0.9)	-1.1 (1.2)	-1.4 (1.1)	0.0473[bc]
Females				
Weight (kg)	9.2 (2.7)	13.0 (2.5)	16.0 (3.5)	0.0000[ac]
Height (cm)	78.7 (18.6)	97.5 (6.0)	107.9 (6.5)	0.0000[bc]
Mean Z-score				
Weight-for-age	-1.86 (1.3)	-1.8 (1.1)	-1.4 (1.5)	0.3487[a]
Height-for-age	-0.87 (1.6)	-0.94 (1.1)	-1.1 (1.1)	0.7079[a]
Weight-for-height	-1.6 (0.9)	-1.5 (1.2)	-1.2 (1.1)	0.3978[b]

a: one-way ANOVA; b: Kruskal-Wallis 1-way ANOVA; c: significant

Nutrient intake

The actual nutrient intakes were compared to recommended daily intakes (RDI) for Malaysia[22]. In general, the intake of protein, vitamin A and ascorbic acid were adequate or higher than the Malaysian RDI. However, the intakes of energy, calcium, iron, thiamin, riboflavin and niacin were below the RDI. Children aged 1-3 years had better nutrient intake compared to children aged 4 years and above (Table 2).

Table 2. Nutrient intakes among children aged 1-7 years in rural areas in Malaysia

Nutrient	Age (years)					
	1-3 Mean (SD)	%RDI	4-6 Mean (SD)	%RDI	7-9 Mean (SD)	%RDI
Energy (kcal)	900 (401)	66	1085 (370)	59	1306 (476)	60
Protein (g)	36.2 (20.1)	157	37.5 (16.1)	129	43.5 (16.5)	124
Calcium (mg)	439 (430)	98	259 (178)	58	262 (117)	58
Iron (mg)	4.9 (3.1)	49	7.0 (3.9)	70	9.0 (5.0)	90
Vitamin A (μg)	383 (316)	153	334 (248)	111	405 (236)	101
Thiamin (mg)	0.6 (0.5)	120	0.5 (0.3)	71	0.6 (0.2)	67
Riboflavin (mg)	1.04 (0.9)	130	0.7 (0.4)	64	0.7 (0.4)	54
Niacin (mg)	5.3 (3.9)	59	4.8 (2.7)	40	5.4 (2.5)	37
Ascorbic acid (mg)	25.6 (27.8)	128	37.3 (52.7)	187	45.5 (76.8)	228

Anthropometric measurements

The prevalence of malnutrition based on the Z-scores of *weight-for-age*, *height-for-age* and *weight-for-height* is presented in Table 3. Twenty two percent of children had normal *weight-for-age* (ie Z-scores >-1.0). The overall prevalence of mild and significant underweight was 31.7% and 46.2%, respectively. There were no significant differences in the prevalence of underweight among age-groups and between genders. However, the prevalence of mild and significant underweight increased with age. From these data, underweight seemed to occur very early in life; about one-quarter (25.7%) and one-third (30.4%) of children between 1-2 years had mild and significant underweight respectively.

Table 3. Prevalence of malnutrition among children aged 1-7 years in rural areas in Malaysia.

Age (years)	Criteria					
	Underweight*		Stunting*		Wasting*	
	Mild N (%)	Significant N (%)	Mild N (%)	Significant N (%)	Mild N (%)	Significant N (%)
1-2	18(25.7)	31(30.4)	21(25.3)	13(32.5)	22(24.7)	25(37.3)
3-4	21(30.0)	26(25.5)	24(28.9)	7(17.5)	29(31.8)	13(19.4)
5-7	31(44.3)	45(44.1)	38(45.8)	20(50.0)	40(44.0)	29(43.3)
Total	70(31.7)	102(46.2)	83(37.6)	40(18.1)	91(41.2)	67(30.3)

Z-score = (-2 to -1.01) = Mild underweight, stunting and wasting; (< -2) = significant underweight, stunting and wasting

The prevalence of mild stunting was 37.6%, while another 18.1% had significant stunting. Nevertheless, about one-half (44.3%) of children were not stunted (*height-for-age* Z-scores >-1.0). There was no significant difference in the prevalence of stunting among the various age-groups and between genders. As with the underweight children, the prevalence of mild stunting also increased with age except

in the significant stunting group. Stunting also occurred early in life (1-2 years old); ie 25.3% and 32.5% of the children had mild and significant stunting, respectively.

The prevalence of mild wasting was 41.2%, while another 30.3% had significant wasting. About one-third (28.5%) of children were not wasted (*weight-for-height* Z-scores > -1.0). There was no significant difference in the prevalence of wasting among the various age-groups and between genders. As with the underweight children, the prevalence of mild and wasting also increased with age except in the significant wasting group. Wasting also occurred early in life (1-2 years old); 24.7% and 37.3% of the children had mild and significant wasting, respectively.

Factors that may be associated with significant underweight, stunting and wasting were analysed and the results of univariate analysis are presented in Tables 4, 5 and 6. Household income ≤ MR750.00 (Malaysian Ringgit) was a significant risk factor of significant stunting and wasting. Other socioeconomic factors, age, gender, energy and protein intakes, worm infection were not significant predictors of malnutrition in this study.

Table 4. Results of univariate analysis of potential associated factors with underweight among children aged 1-7 years in rural areas in Malaysia

Variables	Prevalence of underweight(%)			
	Normal + Mild	Significant	OR (95% CI)	p
Low father education	53.2	46.3	1.32 (0.73,2.38)	0.4028
Low mother education	47.3	40.6	1.12 (0.62,2.03)	0.7959
Mother working	34.5	26.3	0.68 (0.35,1.29)	0.2619
Family income ≤MR*750/month	66.7	70.6	1.20 (0.63,2.28)	0.6547
Family size ≥ 8	25.4	26.4	1.03 (0.53,2.01)	0.9530
Male	45.3	42.1	1.65 (0.94,2.92)	0.0867
Age≥ 5 years	47.9	44.1	0.86 (0.49,1.51)	0.6695
Infected with worm (soil-transmitted helminths)	22.5	18.1	0.76 (0.32,1.77)	0.6213
Energy intake <RDI	253.8	46.2	2.21 (0.91,5.77)	0.0868
Protein intake <RDI	253.8	46.2	0.83 (0.44,1.56)	0.5374

* Malaysian Ringgit

Table 5. Results of univariate analysis of potential associated factors with stunting among children aged 1-7 years in rural areas in Malaysia

Variables	Prevalence of stunting(%)			
	Normal + Mild	Significant	OR (95% CI)	p
Low father education	46.0	64.1	1.20 (0.96,4.68)	0.0640
Low mother education	42.6	48.7	1.28 (0.60,2.74)	0.6083
Mother working	50.0	20.0	0.50 (0.19,1.21)	0.1474
Family income ≤MR*750/month	57.5	85.0	4.20 (1.62,12.77)	0.0021
Family size ≥ 8	24.9	30.8	1.34 (0.57,3.04)	0.5774
Male	50.8	52.5	1.34 (0.57,3.04)	0.0867
Age≥ 5 years	45.3	50.0	1.21 (0.57,2.54)	0.7158
Infected with worm (soil-transmitted helminths)	19.4	25.9	1.45 (0.47,4.07)	0.6137
Energy intake <RDI	81.9	18.1	2.16 (0.61,11.7)	0.3249
Protein intake <RDI	81.9	18.1	0.94(0.39,2.12)	0.9699

* Malaysian Ringgit

Discussions

The overall prevalence of underweight, stunting and wasting among children aged 1-7 years in this study was higher than in studies of other rural villages[4,11,23] and of slum areas around Kuala Lumpur[10,24]. However, it was lower than the study of rural areas in Sarawak[6].

Table 6. Results of univariate analysis of potential associated factors with wasting among children aged 1-7 years in rural areas in Malaysia

Variables	Prevalence of wasting (%)			
	Normal + Mild	Significant	OR (95% CI)	p
Low father education	40.9	51.6	1.54 (0.82,2.88)	0.1963
Low mother education	42.4	46.8	1.19 (0.62,2.27)	0.6764
Mother working	33.6	24.2	0.63 (0.30,1.29)	0.2415
Family income ≤MR750/month	57.8	73.1	1.99 (1.02,3.96)	0.0440
Family size ≥ 8	27.9	21.3	0.70 (0.31,1.49)	0.4169
Male	48.7	56.7	1.38 (0.74,2.57)	0.3425
Age≥ 5 years	47.4	43.3	0.85 (0.45,1.57)	0.6761
Infected with worm (soil-transmitted helminths)	23.0	14.6	0.57 (0.19,1.50)	0.3182
Energy intake <RDI	69.7	30.3	1.23(0.49,3.38)	0.7993
Protein intake <RDI	69.7	30.3	1.65(0.84,3.18)	0.1537

It is interesting to note that underweight, stunting and wasting occurred early in life in this community, with almost one-quarter of the 1-2 years old showing malnutrition. Moreover, the prevalence of underweight, stunting and wasting was higher than that of urban slum children in the same age group[10]. In the 5-7 years-old group, nearly half of the children were stunted (indicator of past or chronic malnutrition), indicating that most had chronic, inadequate feeding or the presence of recurrent illness or chronic illness. Wasting is a good indicator of acute malnutrition and usually the result of acute infection/illness or acute, inadequate feeding practices. Children aged 6-24 months usually suffer from an acute nutritional deficiency as a result of weaning. The percentage of wasted children in this study was high in those aged 1-2 and 5-7 years old. Inadequate energy and iron intake in those aged 1-2 years old and inadequate intake of most of the nutrients in those aged 5-7 years (Table 2) may explain the high percentage of wasting in this community. This study also shows that the prevalence of mild and significant underweight, stunting and wasting increased with age, although it was not statistically significant. Other studies have shown a significant increase in the prevalence of underweight with age in Malaysia[6,10].

One important observation in this study is that low family income (≤ MR 750.00) is a significant risk factor for stunting and wasting. Other selected socioeconomic characteristics (father's education, mother's education, working mother, family size ≥ 8), demographic characteristics (age and gender), worm infection and energy and protein intake below RDI were not risk factors for malnutrition in this community.

Our finding with regard to association of household income with malnutrition was similar to those found in other developing countries. In Ghana, 12% of the variance in current *weight-for-age* among children aged 12-18 months can be explained by their socioeconomic background including household income[13]. A study in Bangladesh revealed that household wealth indicators were negatively associated with proportion of children classified as malnourished[12]. This study shows that parents' education had no significant association with malnutrition. The importance of parents' education in determining nutritional status of children were reported in some studies[14-17,23]. A study in Tanzania showed that mothers with a secondary education are more likely to have nutritionally normal

children than those with only primary education[17]. A study in the Lao PDR also showed that children whose mothers had completed primary education were less stunted and wasted than children whose mothers had never been to school[25].

This study shows that a working mother was not a risk factor for malnutrition. A similar finding was reported in a study among Brazilian children[26]. It was reported that the person who takes care of the child is much more important than is the mother's employment status in determining the child's nutritional status[27]. Large families are also more prone to having malnourished children[28,29]. However, this study did not find that a large family (family size ≥ 8) was a risk factor for malnutrition. This study also found that gender was not risk a factor for malnutrition. Similar findings were reported in a studies in Brazil[26] and Turkey[27]. However, a study in Tanzania reported that males were nutritionally more sound than females[17] and conversely, a study in the Lao PDR showed that females were less malnourished than males[25].

Besides socioeconomic factors, childhood illness such as diarrhoea and malaria and immunisation status were identified as significant predictors of nutritional status[15,17]. In this study, worm infection had no significant association with malnutrition. However, significant differences in the Z-scores for *height-for-age* between infected and non-infected children were observed among 3-8 years-old children in Thailand[18]. Our results differed from Thailand probably on the basis that as the communities which were studied had a low prevalence of soil-transmitted helminth infection.

The present study revealed that energy and protein intakes below RDI were not risk factors for malnutrition, in agreement with studies in Tanzania[17] and Brazil[26]. We did not measure factors such as birth weight, breast feeding, type of food and frequency of food given during the first year of life in this study. Studies have shown that birth weight is an important factor in determining nutritional status at age 1 year[13,15]. However, birth size and subsequent growth of children may not correlate[30].

Two of our findings have particular relevance for the implementation of programs to prevent malnutrition in this community. Firstly, between one-quarter to one-third of mild and significant malnutrition occurred early in life (1-2 years-old) and the prevalence of mild malnutrition increased with age. This suggests that any intervention measures to improve nutritional status or to prevent malnutrition should be undertaken during infancy. Secondly, low household income was a risk factor for significant stunting and wasting. Improvement in nutritional status can be expected when these risk factors are addressed.

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馬來西亞鄉村一至七歲兒童的營養不良及其危險因素

摘要

本研究以調查馬來西亞鄉村一至七歲兒童的營養狀況及有關危險因素爲主。總共評估了221位兒童。評估方法包括人體測量，飲食問卷及其它。同時也分析了體重與年齡，身高與年齡及體重與身高之間的關系。根據美國健康統計國家中心（NCHS）所規定的標準，體重不足，成長障礙和損害的比率分別是46.2%, 18.1% 及30.3%。將近三分之一的一至二歲兒童被證實爲營養不良。單變异分析指出家庭月收入低于七百五十馬元爲成長障礙和損害的危險因素。

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