Original Article

Nutritional status, body composition and health conditions of the Karen hill tribe children aged 1-6 years in Northern Thailand

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Introduction: In Thailand, according to the national nutrition survey of the Thai population who live in the cities by the Ministry of Public Health, about 12% of preschool children aged 1-6 years were malnourished. The rate of malnutrition is much higher among mountain minority ('hill tribe') children than city children. This paper reports a study of malnutrition, body composition and health conditions of Karen hill tribe children aged 1-6 years in Thailand.

Methods: All children aged 1-6 years (N = 158; 83 boys, 75 girls) from the three Karen villages (Mae Hae Tai, Mae Yot, Mae Raek) of Mae Chaem district in the north of Thailand were studied. Anthropometric measurements of all children were obtained and body composition data were derived. All children were examined by a qualified medical doctor. A stool sample and blood smear for malaria from all children were examined by a well qualified medical technologist.

Results: All families of the study boys and girls had incomes lower than the Thailand poverty line (US $ 1,000/year). There were no significant differences in weight, height or body mass index of boys and girls from each of the three villages. Malnutrition in children were found 85.5% by using weight-for-age, 73% by height-for-age (stunting) and 48.4% by weight-for-height (wasting). Boys had more total body fat mass than girls. However, all of them had low lean body mass and fat mass. Nearly all children (98%) suffered from either upper respiratory tract infection, skin infection, scabies and/or diarrhoea. Also, nearly all of them (97%) had scaly and dry skin over their chest walls and legs. About 10% of children had either angular stomatitis (5%) or bleeding per gums (3%) or bow legs (1%) or frontal bossing (1%) with their implications for micronutrient deficiency. None of the children from the three villages were infested with the malarial parasite. On average, 54% of children from Mae Hae Tai village and 85% of children from Mae Yot village but only 4% of the children from Mae Raek village were infested with parasites. Ascaris lumbricoides was the most common infestation in all children from three villages.

Conclusion: The prevalence of malnutrition was high among the Karen hill tribe children aged 1-6 years, Thailand. Most of the children suffered from upper respiratory tract infection, skin infection, scabiasis and/or diarrhrea. Nearly all of them had scaly and dry skin over their chest walls and legs which indicated essential fatty acid deficiencies. However, only 10% of them had vitamin deficiencies such as B2, C, and D.

Key Words: nutritional status, body composition, PEM (Protein Energy Malnutrition), micronutrient deficiencies, health, illness, intestinal parasitosis, Karen, children, hill tribes, Thailand

Introduction

Malnutrition contributed roughly 12% of the world's deaths in 1990.[1] It is considered one of the most common causes of death in preschool children worldwide. Most of 14 millions death in children are due to malnutrition.[2, 3] The children who survive will experience a number of consequences from early malnutrition, such as poor learning ability and increased susceptibility to diseases, throughout their lives.[2,3] The most widespread form of malnutrition in children is protein and energy under-consumption (marasmus and kwashiorkor diseases). It is associated with decreased muscle mass, known as sarcopenia (wasting), and lack of growth and development.[4,5] It is also harmful to the immune system, making malnourished children more prone to diseases such as measles, diarrhea, respiratory tract infection, tuberculosis, and malaria, than normal children.[6] However, deficiencies in micro-nutrients like iodine, iron, and vitamin A & E, are also common.[7,8] Countries in Southeast Asia and Africa face problems with malnutrition and diseases combined, rendering the problems more severe.[6]

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In a post-hoc analysis of weight-for-age Z scores and cause-specific mortality data from 10 prospective, developing world cohort studies, there was a step-wise relationship between severity of underweight and both total mortality and death rate from four main specific infectious diseases (diarrhea, pneumonia, malaria, measles). It was estimated that the population attributable fraction of deaths caused by undernutrition in most of the poorer regions was between 50-60%.[9] Another study showed the risk of having diarrhea or acute respiratory tract infection was higher if a child had two or more of wasting, stunting or underweight.[10] In Thailand, according to the national nutrition survey of the Thai population who live in the cities by the Ministry of Public Health, about 12% of preschool children aged 1-6 years were malnourished.[11] However, another study showed that the prevalence of malnutrition tends to be higher among vegetarian and mountain minority ('hill tribe') children.[12] Several factors affect weight and height of children such as hemoglobin, hematocrit, amount of food eaten per day, birth weight, parental income, and parental age.[13] This paper reports a study of malnutrition in a minority ethnic group of Karen hill tribe children aged 1-6 years. It is the first study of body composition of Karen hill tribe children in Thailand.

Methodology

Study sites and subjects

All children aged 1-6 years (N = 158) from the three Karen villages (Mae Hae Tai, Mae Yot, Mae Raek) of Mae Chaem district were studied. Mae Chaem district is located about 160 kilometers southwest of Chiang Mai province in the north of Thailand. Chiang Mai is the second largest city in Thailand with a population of about 1.5 million. The Karen is the largest mountain ethnic minority ("hill tribe") group in Thailand. The study included 83 boys and 75 girls as shown in Table 1. All subject's parents were asked to complete a socio-demographic questionnaire. This research project was approved by Chiang Mai University Human Ethic Committee, Thailand.

Table 1. Total number of subjects from 3 different villages

Village	Boys	Girls	Total
Mae Hae Tai	27	24	51
Mae Yot	23	32	55
Mae Raek	33	19	52
Total	83	75	158

Assessment of nutritional status and body composition

Weight (WT), length/height (HT), skinfold thicknesses (biceps - BSF, triceps - TSF, subscapular - SSF, suprailiac - SISF), head circumference (OFC), mid-arm circumference (MAC), chest circumference (CC), abdominal circumference (AC), hip circumference (HC) were measured in all subjects.

Body mass index (BMI - kg/m^2), Waist-to-hip ratio (WHR), Subscapular-to-triceps ratio (STR), sum of two skinfold thicknesses (TSF + SSF) (SUM2SF - mm), sum of three skinfold thicknesses (TSF + SSF + BSF) (SUM3SF - mm) and sum of four skinfold thicknesses (TSF + SSF + BSF + SISF) (SUM4SF - mm) were derived.

The children's nutritional status (normal, mild, moderate, severe) was classified according to the scheme of Gomez's classification[14] and Waterlow's classification.[15,16,17] National Center for Health Statistic (NCHS) data[18] were used as reference values.

Gomez's classification (%weight-for-age)

Normal	>90
First degree	90-75
Second degree	<75-60
Third degree	<60

Waterlow's classification (%height-for-age, %weight-for-height)

	%height-for-age	%weight-for-height
Grade 0	>95	>90
Grade 1	95-90	90-80
Grade 2	<90-85	<80-70
Grade 3	<85	<70

Arm muscle circumference (AMC - cm), arm muscle diameter (AMD - cm), arm muscle area (AMA - cm^2), arm fat area (AFA - cm^2), cross-sectional arm area (CAA - cm^2) were calculated from MAC and TSF. Percent total body fat mass (%FMSF), total body fat mass (FMSF - kg), total lean body mass (LBM - kg) and percent total lean body mass (%LBM) calculated from skinfold thicknesses. Body density (BD) for children was calculated from the formulae below:[19, 20]

% Total body fat = [(4.95/Body Density) - 4.5] x 100

Body density (BD) can be calculated as follow.

Sex	Age (y)	BD
Male	1-11	1.1690 - 0.0788 x log (SUM4SF)
	13-15	1.1533 - 0.0643 x log (SUM4SF)
Female	1-11	1.2063 - 0.0999 x log (SUM4SF)
	13-15	1.1369 - 0.0598 x log (SUM4SF)

SUM4SF = Sum of four skinfold thicknesses (TSF + SSF + BSF + SISF) in millimeter

Clinical assessment

All children aged 1-6 years were examined by a qualified medical doctor to assess general health and other clinical signs of nutritional deficiencies. Children who were found to have vitamin and mineral deficiencies were treated accordingly. All children's parents were requested to sign or thumb printed a consent form. A stool sample was obtained from all children and examined by microscopy. Individuals identified with parasites were treated with anti-parasitic drug. Blood smear was also obtained in all children and be examined for malarial parasite by well qualified medical technologist.

Data Analyses

Descriptive statistics, Students' t-test, analysis of variance were used to analyse the data.

Results

Sociodemography

None of the fathers and mothers from the study villages completed tertiary education. The percentages of fathers who completed primary and secondary schools were more

Table 2. Anthropometric characteristics among boys from the three villages

	Mae Hae Tai			Mae Yot			Mae Raek			F	*p*
	n	Mean	SD	n	Mean	SD	n	Maen	SD		
AGE(yr)	27	3.61	1.60	23	3.75	1.35	33	3.83	1.32	0.17	0.83
WT(kg)	26	12.0	2.69	23	12.9	2.48	33	13.3	2.25	2.21	0.11
HT(cm)	27	91.1	11.3	23	93.5	9.90	33	95.2	9.25	1.23	0.29
BMI(kg/m^2)	26	14.5	2.25	23	14.7	1.06	33	14.6	1.32	0.17	0.83
OFC(cm)	27	47.7	2.03	23	48.2	1.33	33	48.5	1.46	1.66	0.19
MAC(cm)	27	13.8	0.69	23	13.9	0.84	33	14.5	0.77	6.39	<0.05
CC(cm)	27	49.6	3.12	23	49.8	2.80	33	50.4	2.60	0.69	0.50
AC(cm)	27	44.9	3.80	23	47.6	3.07	33	46.8	2.79	4.53	0.01
HC(cm)	27	46.1	4.02	23	47.5	3.45	33	48.2	3.35	2.52	0.08
TSF(mm)	27	7.85	1.52	23	7.85	2.13	33	7.67	1.76	0.10	0.90
BSF(mm)	27	6.16	1.31	23	4.52	1.48	33	4.92	1.19	10.9	<0.05
SSF(mm)	27	4.29	0.88	23	4.21	0.83	33	4.78	1.01	3.32	0.04
SISF(mm)	27	3.69	0.84	23	3.40	0.80	33	4.02	1.20	2.68	0.07
SUM2SF	27	12.1	2.11	23	12.0	2.76	33	12.4	2.62	0.20	0.81
SUM3SF	27	18.3	2.89	23	16.5	4.07	33	17.3	3.55	1.50	0.22
SUM4SF	27	22.0	3.49	23	19.9	4.64	33	21.4	4.54	1.43	0.24
WHR	26	0.97	0.04	23	1.00	0.04	33	0.97	0.04	3.36	0.03
STR	27	0.55	0.10	23	0.56	0.13	33	0.63	0.09	4.33	0.01

Weight (WT), length/height (HT), Body mass index (BMI - kg/m^2), head circumference (OFC), mid-arm circumference (MAC), chest circumference (CC), abdominal circumference (AC), hip circumference (HC), skinfold thicknesses (biceps - BSF, triceps - TSF, subscapular-SSF, suprailiac - SISF), sum of two skinfold thicknesses (TSF + SSF) (SUM2SF - mm), sum of three skinfold thicknesses (TSF + SSF + BSF) (SUM3SF - mm), sum of four skinfold thicknesses (TSF + SSF + BSF + SISF) (SUM4SF - mm), Waist-to-hip ratio (WHR), Subscapular-to-triceps ratio (STR)

Table 3. Anthropometric characteristics among girls from the three villages

	Mae Hae Tai			Mae Yot			Mae Raek			F	*p*
	n	Mean	SD	n	Mean	SD	n	Maen	SD		
AGE(yr)	24	3.45	1.25	32	3.70	1.43	19	3.72	1.15	0.30	0.74
WT(kg)	24	11.3	1.96	32	11.8	2.87	19	13.2	2.30	3.53	0.03
HT(cm)	24	89.8	9.32	32	90.1	10.4	19	93.7	9.39	1.04	0.35
BMI(kg/m^2)	24	13.9	1.05	32	14.3	1.15	19	15.0	1.19	4.68	0.12
OFC(cm)	24	46.8	1.26	30	47.3	1.87	18	47.8	1.38	2.00	0.14
MAC(cm)	24	13.5	0.79	30	13.7	1.06	18	14.8	0.96	10.7	<0.05
CC(cm)	24	47.8	2.01	30	47.9	3.40	18	49.8	3.11	3.01	0.05
AC(cm)	24	45.1	2.78	30	45.8	3.39	18	47.4	2.86	3.13	0.04
HC(cm)	24	45.5	3.08	30	47.1	4.35	18	49.7	3.55	6.67	<0.05
TSF(mm)	24	8.09	1.86	30	9.04	1.88	17	9.57	1.77	3.49	0.03
BSF(mm)	24	5.91	1.11	30	5.04	1.29	17	5.55	1.09	3.66	0.03
SSF(mm)	24	4.43	0.87	30	4.51	1.01	17	5.64	1.07	9.19	<0.05
SISF(mm)	24	4.28	1.01	30	4.00	1.09	17	4.64	0.82	2.22	0.11
SUM2SF	24	12.5	2.44	30	13.5	2.64	17	15.2	2.62	5.50	<0.05
SUM3SF	24	18.4	2.85	30	18.5	3.66	17	20.7	3.48	2.92	0.06
SUM4SF	24	22.7	3.64	30	22.6	4.51	17	25.4	4.16	2.88	0.06
WHR	24	0.99	0.04	30	0.97	0.04	18	0.95	0.04	3.63	0.03
STR	24	0.56	0.11	30	0.50	0.09	17	0.59	0.09	4.59	0.01

Weight (WT), length/height (HT), Body mass index (BMI - kg/m^2), head circumference (OFC), mid-arm circumference (MAC), chest circumference (CC), abdominal circumference (AC), hip circumference (HC), skinfold thicknesses (biceps - BSF, triceps - TSF, subscapular - SSF, suprailiac - SISF), sum of two skinfold thicknesses (TSF + SSF) (SUM2SF - mm), sum of three skinfold thicknesses (TSF + SSF + BSF) (SUM3SF - mm), sum of four skinfold thicknesses (TSF + SSF + BSF + SISF) (SUM4SF - mm), Waist-to-hip ratio (WHR), Subscapular-to-triceps ratio (STR) Body composition.

than the mothers (primary school: 32.7% vs 13.7%; secondary school: 20% vs 1.8%, respectively); and could speak Thai language more than the mothers (32% vs 15%). All families of the study boys and girls had incomes lower than the Thailand poverty line (US $ 1,000/year).

Anthropometry

Within each of the 3 villages, there were no significant differences in weight, height or body mass index of boys and girls (Tables 2 & 3). Boys from Mae Hae Tai village had chest circumference (CC) more than girls ($p = 0.01$) where as girls had suprailiac skinfold (SISF) more than boys ($p = 0.02$) as shown in Table 2 & 3. Similar to Mae Hae Tai village, boys from Mae Yot village had CC more than girls ($p = 0.04$) where as girls had SISF more than boys ($p = 0.03$) as shown in Table 2 & 3. Girls also had triceps skinfold (TSF) ($p = 0.03$) and sum of four skinfold thicknesses (SUM4SF) ($p = 0.04$) more than boys but a lesser waist-to-hip ratio (WHR) ($p = 0.02$) than boys (Table 2 & 3). Girls from Mae Raek village had TSF ($p < 0.05$), subscapular skinfold (SSF) ($p < 0.05$), sum of two skinfold thicknesses (SUM2SF) ($p < 0.05$), sum of three

Table 4. Body composition characteristics among boys from the three villages

	Mae Hae Tai			Mae Yot			Mae Raek			F	*p*
	n	Mean	SD	n	Mean	SD	n	Maen	SD		
AMC(cm)	27	11.4	0.70	23	11.4	1.01	33	12.1	0.74	6.69	<0.05
AMD(cm)	27	3.63	0.22	23	3.65	0.32	33	3.85	0.23	6.69	<0.05
AMA(cm^2)	27	10.4	1.30	23	11.5	1.86	33	11.7	1.46	6.54	<0.05
AFA(cm^2)	27	22.3	2.80	23	22.6	4.00	33	25.1	3.13	6.53	<0.05
CAA(cm^2)	27	32.7	4.12	23	33.1	5.86	33	36.8	4.59	6.53	<0.05
BD	27	1.06	0.01	23	1.06	0.01	33	1.06	0.01	2.04	0.13
%FMSF	27	15.4	2.33	23	13.7	3.61	33	14.8	2.89	2.00	0.14
FMSF(kg)	26	1.84	0.49	23	1.73	0.41	33	1.96	0.39	1.89	0.15
LBM(kg)	26	10.1	2.32	23	11.2	2.48	33	11.3	2.09	2.33	0.10
%LBM	26	84.6	2.38	23	86.2	3.61	33	85.1	2.89	1.92	0.15

arm muscle circumference (AMC), arm muscle diameter (AMD), arm muscle area (AMA), arm fat area (AFA), cross-sectional arm area (CAA), body density (BD), percent total body fat mass (%FMSF), total body fat mass (FMSF), total lean body mass (LBM), percent total lean body mass (%LBM).

Table 5. Body composition characteristics among girls from the three villages

	Mae Hae Tai			Mae Yot			Mae Raek			F	*p*
	n	Mean	SD	n	Mean	SD	n	Maen	SD		
AMC(cm)	24	10.9	0.68	30	10.9	1.02	17	11.7	0.83	5.29	<0.05
AMD(cm)	24	3.49	0.21	30	3.47	0.32	17	3.73	0.26	5.28	<0.05
AMA(cm^2)	24	9.64	1.20	30	9.58	1.73	17	11.0	1.55	5.57	<0.05
AFA(cm^2)	24	20.6	2.58	30	20.5	3.72	17	23.6	3.33	5.58	<0.05
CAA(cm^2)	24	30.3	3.79	30	30.1	5.46	17	34.6	4.89	5.57	<0.05
BD	24	1.07	0.01	30	1.07	0.01	17	1.06	0.01	2.79	0.06
%FMSF	24	12.0	3.15	30	11.8	3.84	17	14.1	3.03	2.80	0.06
FMSF(kg)	24	1.34	0.37	30	1.39	0.59	17	1.85	0.44	6.27	<0.05
LBM(kg)	24	9.96	1.89	30	10.4	2.68	17	11.3	2.15	1.68	0.19
%LBM	24	87.9	3.15	30	88.1	3.84	17	85.8	3.03	2.79	0.06

arm muscle circumference (AMC), arm muscle diameter (AMD), arm muscle area (AMA), arm fat area (AFA), cross-sectional arm area (CAA), body density (BD), percent total body fat mass (%FMSF), total body fat mass (FMSF), total lean body mass (LBM), percent total lean body mass (%LBM)

skinfold thicknesses (SUM3SF) ($p < 0.05$), SUM4SF ($p < 0.05$) more than boys (Table 2 & 3).

From the three different villages, boys from Mae Raek village had the highest mid arm circumference (MAC) ($p < 0.05$), SSF ($p = 0.04$) and subscapular-to-triceps ratio (STR) ($p = 0.01$). Boys from Mae Yot village had the highest abdominal circumference (AC) ($p = 0.01$) and WHR ($p = 0.03$). Boys from Mae Hae Tai village had the highest AC ($p = 0.01$) and biceps skinfold (BSF) ($p < 0.05$) as shown in Table 2 & 3. Girls from Mae Raek village had the highest weight (WT) ($p = 0.03$), MAC ($p < 0.05$), AC ($p = 0.04$), hip circumference (HC) ($p < 0.05$), TSF ($p = 0.03$), SSF ($p < 0.05$), SUM2SF ($p < 0.05$), STR ($p = 0.01$) as shown in Table 2 & 3. Girls from Mae Hae Tai village had the highest BSF ($p = 0.03$) and WHR ($p = 0.03$).

Within the same village, boys from Mae Hae Tai village had more arm muscle mass ($p = 0.03$) and arm fat mass ($p = 0.03$) more than girls (Table 4 & 5). Boys also had total body fat mass (FMSF) ($p < 0.05$) more than girls. Boys from Mae Yot village had total body fat mass (FMSF) ($p = 0.02$) more than girls (Table 4 & 5). No significant differences of the study parameters were found between boys and girls from Mae Raek village (Table 4 & 5).

From different villages, boys from Mae Raek village had the highest arm muscle mass ($p < 0.05$) and arm fat mass ($p < 0.05$) among the boys from the three villages (Table 4 & 5). Girls from Mae Raek village had the highest arm muscle mass ($p < 0.05$), arm fat mass ($p < 0.05$) and total body fat mass (FMSF) ($p < 0.05$) among the girls from the three villages (Table 4 & 5).

Prevalence of protein energy malnutrition (PEM)

According to height-for-age, 4.3% of boys from Mae Yot village had severe stunting. No significant difference ($p = 0.06$) of the prevalence of stunted boys between the three villages. On average for the three villages, 48% of boys had mild stunting and 22% had moderate stunting and 1% had severe stunting (only boys from Mae Yot village). According to height-for-age, 6.3% of girls from Mae Yot village had severe stunting. There was no significant difference ($p = 0.27$) in the prevalence of stunted girls between the three villages. On average for the three villages, 53% of girls had mild stunting and 19% had moderate stunting and 3% had severe stunting (only girls from Mae Yot village). According to weight-for-age, 3.8% of boys from Mae Hae Tai village had severe wasting. No significant difference ($p = 0.01$) of the prevalence of wasting in boys between the three villages. On average for the three village, 56% of boys had mild wasting and 28% had moderate wasting and 1% had severe wasting (only boys from Mae Hae Tai village). According to weight-for-age, 3.1% of girls from Mae Yot village had severe wasting. All of the girls from Mae Hae Tai village were wasted. There was a significant difference ($p < 0.05$) of the prevalence of wasting in girls between the three villages. On average for the three villages, 57% of girls had mild wast-

ing and 28% had moderate wasting and 1% had severe wasting (only girls from Mae Yot village).

According to weight-for-height, none of the boys from the three villages were wasted. There was no significant difference ($p = 0.01$) of the prevalence of wasting in boys between the three villages. On average for the three villages, 39% of boys had mild wasting and 7% had moderate wasting. According to weight-for-height, 3.1% of girls from Mae Yot village had severe wasting. There was a significant difference ($p = 0.03$) of the prevalence of wasting in girls between the three villages. On average for the three villages, 44% of girls had mild wasting and 5% had moderate wasting and 1% had severe wasting (only girls from Mae Yot village).

Table 6 summarizes the prevalence (%) of malnutrition of the study children from the three villages. Malnutrition prevalence rates in children were found to be 85.5% using weight-for-age, 73% using height-for-age (stunting) and 48.4% using weight-for-height (wasting).

Health status

Nearly all children (98%) from the three study villages sufferred from upper respiratory tract infection, skin infection, scabiasis and/or diarrhrea. Also, nearly all of them (97%) from the three study villages had scaly and dry skin over their chest walls and legs. About 10% of children from the three villages had either angular stomatitis (5%) or bleeding per gum (3%) or bow legs (1%) or frontal bossing (1%).

None of the children from the three villages were infested with malarial parasite. On average, 53.5% of children from Mae Hae Tai village and 84.5% from Mae Yot village were infested with parasites. Ascaris lumbricoides was the most common infestation in all children from three villages. However, only 4% of the children from Mae Raek village had parasitic infestation (Table 7).

Discussion

This paper reported results from a study of malnutrition in a minority ethnic group of Karen hill tribe children aged 1-6 years. It was also the first research project studying on body composition of the Karen hill tribe children in Thailand. All children from the study villages came from families which had yearly income less than US$ 1,000 and low educational background. According to the government of Thailand, this income is below the poverty line. It is not surprising that in the future, these children will face several kinds of problems such as health conditions, illnesses and malnutrition.

In the present study, most of the children from the three villages had malnutrition in various degrees, for example 85.5% of them by using weight-for-age, 73% by height-for-age (stunting) and 48.4% by weight-for-height (wasting). These figures were much higher than the national nutrition survey of the preschool children in Thailand which is about only 12%.[11] From the body composition study, they had low lean body mass and fat mass as shown in the figures 1. In Thailand, there are currently no reference values of the body composition measurements to be used for comparision with the study children.

Due to poor sanitary conditions of their households and children playground in the villages and also low immunity of these children from undernutrition, it was not surprising that nearly all children (98%) from the three study villages sufferred from upper respiratory tract infection, skin infection, scabiasis and/or diarrhrea. They (97%) also had scaly and dry skin over their chest walls and legs which indicated essential fatty acid deficiencies such as linoleic acid (omega 6 fatty acid) and alpha-linolenic acid (omega 3 fatty acid). These reflected low intakes of fat and oil. Some of them also had less intakes of certain vitamins than their normal requirements. About 10% of the study children had angular stomatitis (vitamin B2 deficiency), bleeding per gum and gingivitis (vitamin C deficiency), bow legs (vitamin D deficiency), frontal bossing (vitamin D deficiency).

None of the children from the three villages were infested with malarial parasite. This may be due to the climate and living conditions in this mountainous area which are not compatible with mosquitos. Parasitic infestations does appear to be an important factor contributing to malnutrition. This study revealed that 87% of boys and 82% of girls from Mae Yot village were infested with parasites. Ascaris lumbricoides was the most common infestation in

Table 6. Prevalence of malnutrition (%) in children from the three villages

	Mild			Moderate			Severe			Total
Criteria	Boys	Girls	Ave*	Boys	Girls	Ave*	Boys	Girls	Ave*	Ave*
%Weight-for-age	56	57	56.5	28	28	28	1	1	1	85.5
%Height-for-age	48	53	50.5	22	19	20.5	1	3	2	73.0
%Weight-for-height	39	44	41.5	7	5.3	6.2	-	1.3	0.65	48.4

Ave* = average between boys and girls

Table 7. Percentage of children from the three villages who were infested with parasites

Parasite*	Mae Hae Tai			Mae Yot			Mae Raek		
	Boys	Girls	Ave*	Boys	Girls	Ave*	Boys	Girls	Ave*
1*	48	55	51.5	64	66	65	3	5	4.0
2*	4	-	2.0	-	-	-	-	-	-
3*	-	-	-	5	-	2.5	-	-	-
4*	-	-	-	18	16	17.0	-	-	-
Total (%)	52	55	53.5	87	82	84.5	3	5	4

1* = A. lumbricoides, 2* = A. lumbricoides + Hookworm, 3* = A. lumbricoides + Strongyloide stercolaris, 4* = A. lumbricoides + Trichuris trichiura

Figure 1. A study child was examined by a medical doctor & a group of the study children.

all children from the three villages. However, only a few percent of the children from Mae Raek village had parasitic infestation as shown in table 7. This was due to the living areas in the Mae Raek village being paved with cement and most children wearing sandals or shoes whereas the children from the other two villages did not.

In recent years, there has been increasing concern about the health and well-being of people living in villages at different points along this transformational gradient. Of particular relevance here is concern about the capacity of agroecosystems at intermediate stages of intensification to provide sufficient nutrition for children, since serious malnutrition could reduce their capacity to adapt to conditions in 'settled' systems and 'modern' society. Home gardens producing vegetables for subsistence consumption are very prominent. Socio-economic status and cultural factors also play important roles in determining food consumption patterns. As these are all Karen villages with little cash income, but have access to considerable sources of wild and domesticated vegetables, malnourishment of children could relate to low consumption of fat, protein, carbohydrate, and also minerals & vitamins.

In conclusion, poor sanitary conditions, inadequate food consumption, poor socioeconomic status, and low educational background contributed to malnutrition of these Karen children. Indeed, it would appear that the priority recommendations for improving nutrition in Karen villages would at least be: (1) control of intestinal parasites; (2) increased use of oil; and (3) more general work with Karen communities on how children's diets might be improved in a culturally acceptable manner, so as to bring consumption patterns closer to recommended allowance levels.

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Original Article

Nutritional status, body composition and health conditions of the Karen hill tribe children aged 1-6 years in Northern Thailand

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泰國北部 Karen 山區部落 1-6 歲少數民族兒童營養狀況、體組成及健康情形

前言：在泰國，依據公共衛生部針對泰國城市族群所做的國民營養調查，約有 12%1-6 歲的學齡前兒童為營養不良。在山區少數(“山區部落”)兒童營養不良率遠較城市兒童高。此研究報告居住在泰國 Karen 山區部落的 1-6 歲兒童之營養不良、體組成及健康狀況。

方法：泰國北部湄蔣縣的三個 Karen 村落(Mae Hae Tai、Mae Yot、Mae Raek)1-6 歲兒童(N=158；83 名男孩、75 名女孩) 全部納入研究。所有兒童均進行體位測量及並換算成體組成資料。所有的兒童均經過一位合格的醫生評估。所有兒童的糞便及血液塗片經過一位合格的醫事技術員檢查是否有瘧疾。

結果：參與研究的男孩及女孩的家庭收入均低於泰國的貧窮線(1,000 美元/年)。來自於三個村落的男孩及女孩的體重、身高或是身體質量指數沒有顯著差異。採用年齡別體重評估營養不良的兒童為 85.5%，年齡別身高(發育遲緩)為 73%及身高體重別(耗損)為 48.4%。男孩總體脂肪量雖較女孩高，但是男女的瘦體組織及脂肪重均是低的。幾乎所有的兒童(98%)患有上呼吸道感染、皮膚感染、疥瘡及/或腹瀉。同樣的，幾乎全部的兒童(97%)在他們的胸部及腿部呈現鱗狀及乾性皮膚。約有 10%的兒童因為他們的微量營養素缺乏，而有口角炎、牙齦出血(3%)、O 型腿(1%)或是額骨突起之現象。三個村落的兒童均未感染瘧原蟲。平均 54%Mae Hae Tai 兒童、85%Mae Yot 兒童，但是只有 4%Mae Raek 兒童感染寄生蟲。蛔蟲是三個村落所有的兒童最常見的寄生蟲感染問題。

結論：在泰國 Karen 山區部落的 1-6 歲兒童有高的營養不良盛行率。大部分的兒童患有上呼吸道感染、皮膚感染、疥瘡及/或腹瀉。幾乎所有的兒童胸部及腿部皮膚呈現鱗片狀及乾性，指出必需脂肪酸缺乏的問題。只有 10%的兒童有維生素缺乏，如維生素 B2、C 及 D。

關鍵字：營養狀況、體組成、PEM(蛋白質熱量營養不良)、微量營養素缺乏、健康、生病、腸內寄生蟲病、Karen、兒童、山區部落、泰國。