Original Article

Nutritional Status in Patients with Thalassemia Intermedia

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Abstract: *Malnutrition affects growth pattern, learning, treatment and quality of life in children with thalassemia. This study aimed to assess nutritional status in patients with thalassemia intermedia.* ***Mothods:*** *Nutritional status was evaluated by subjective global assessment (SGA) and anthropometric measurements. Dietary intake was assessed by 24-hour recall. Serum total protein and albumin levels were also determined.* ***Results:*** *Thirty patients with thalassemia intermedia aged between 5-15 years (12 males and 18 females) were enrolled in this study. The results showed that these patients had normal nutrition evaluated by SGA and their serum levels of total protein and albumin were normal. However, the anthropometric measurements including the percentages of weight for age, weight for height, height for age, triceps skinfold thickness, and mid-arm circumference, and body mass index for age demonstrated that these patients were both underweight and stunting. It was found that they had average total energy intake lower than the dietary reference intake.* ***Conclusion:*** *The results of anthropometric measurements in this study indicated that patients with thalassemia intermedia had growth impairment. Although the SGA and biochemical parameters appeared normal in these patients, their dietary intakes were apparently inappropriate. Therefore, the nutritional assessment and appropriate nutritional interventions should be incorporated into therapeutic plans for these patients to improve growth status and clinical outcomes.*

Key Words : ● *Nutritional status* ● *Malnutrition* ● *Thalassemia intermedia* ● *Anthropometry* ● *Dietary intake*

J Hematol Transfus Med 2011;21:167-76.

Introduction

Thalassemia is a hereditary disorder of hemoglobin synthesis commonly found in Mediterranean and Southeast Asian countries, especially in Thailand. Approximately 30-40% of Thai people have thalassemia traits (20-30% with alpha-thalassemia trait and 3-9% with beta-thalassemia trait).[1] Thalassemic patients have ineffective erythropoiesis and accelerated red cell turnover owing to the short life span of red blood cell,[2] which results in increased body demand of energy and nutrients to maintain normal erythropoiesis.[3,4] It was reported that thalassemic children had increased energy expenditure and protein turnover,[3,4] while they had the average energy intake lower than the recommended daily dietary allowances.[5] These patients also had multiple deficiencies of vitamins and minerals such as vitamin A, vitamin E, folate, vitamin B12, and zinc.[4,6] Therefore, thalassemic children are at risk of energy and nutrient deficiencies. The results of malnutrition can affect the maturation and growth of the children. Previous studies showed that thalassemic patients had growth failure, delayed puberty and underweight.[7,8] Nutritional statuses in thalssemic patients should thus be evaluated.

From the past, several techniques have been used to determine nutritional status in thalassemic patients.

Received April 23rd, 2011. Accepted May 24th, 2011.

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However, no studies proved which method was the best in providing information about nutritional status of these patients. In addition, most of the studies involving nutritional status in thalassemic patients were generally conducted for the patients who had severe conditions and received regular blood transfusion. There are still limited studies of nutritional status in patients, especially children, with mild to moderate conditions. Therefore, this study focused on nutritional status in children with thalassemia intermedia who did not require regular blood transfusion. The relationships of nutritional parameters were also evaluated. The information gained from this study is beneficial in developing nutrition recommendation to improve nutritional status, growth, quality of life and treatment in the children patients with thalassemia intermedia.

Subjects and Methods

This study was conducted in 30 patients (12 girls and 18 boys) from Pediatric Hematology Clinic, Siriraj Hospital during the period of March to September 2010. The subjects who were diagnosed with thalassemia intermedia, aged between 5 - 15 years old, and had baseline hemoglobin between 7 - 9 g/dL were recruited into this study. None of them received blood transfusion and iron chelation therapy within 3 months before enrollment. They had no history of infection (either acute or chronic) and surgical operation within 1 month before enrollment. The subjects who received medicines affecting growth and nutritional status such as growth hormones and glucocorticoid therapy were excluded from the study.

Experimental protocols were explained to the subjects and their parents. The protocol was approved by the Siriraj Institutional Review Board (SIRB), Faculty of Medicine, Siriraj Hospital, Mahidol University. The written informed consents were obtained before the beginning of the study. Then, the subjects did the questionnaires involving demographic characteristics and a 24-hour dietary recall. Nutrition status of each subject was evaluated by SGA and anthropometric measurements. Blood biochemical parameters were also determined.

Anthropometric measurements

Anthropometric assessments included weight, height, body mass index (BMI), triceps skinfold thickness (TSF), mid-arm circumference (MAC), mid-arm muscle circumference (MAMC), arm muscle area (AMA), and arm fat area (AFA). The percentages of weight for age (%W/A), weight for height (%W/H), height for age (%H/A), triceps skinfold thickness (%TSF), mid-arm circumference (%MAC) were calculated based on the reference values for children aged 1 day - 19 years old of Department of Health, Ministry of Public Health, Thailand.[9] The percentages of TSF and MAC and the percentiles of BMI for age were calculated based on the reference values of anthropometric reference data for children and adults, United States.[10] Nutritional status of the subjects was classified by %W/A, as described in the Gomez's classification,[11] and %W/H and %H/A was categorized by the Waterlow's classification.[12,13] Nutritional status was also evaluated by the percentages of TSF, and MAC[14] and the percentiles of BMI for age.[15]

Subjective global assessment

Nutritional status of subjects was classified by SGA. The history of patients including weight change (during 6 months and 2 weeks before participating in the study), dietary intake, frequency and duration of gastrointestinal symptoms (nausea, vomiting, diarrhea, constipation and loss of appetite), and functional capacity were recorded. The physical examination was performed to investigate the loss of subcutaneous fat, muscle wasting and the presence of edema of the sacral area and lower extremities. A score was assigned to each evaluation, and nutritional status was determined based on the SGA score as followed:

SGA score	Nutritional status
1 - 14	Normal nutrition
15 - 35	Mild-moderately malnourished
36 - 49	Severely malnourished

Determination of biochemical parameters

Venous blood sample was drawn from each subject for measuring serum albumin and total protein.

Statistical analysis

Data were expressed as means ± standard errors of the mean (SEM). Correlations of nutritional parameters were reported as the Pearson's correlation coefficient. The significant level was set at $p < 0.05$.

Results

The results showed that the average age of the subjects was 11.9 ± 0.4 years. Most of them (90%) had β-thalassemia/Hb E and the others had Hb AE Bart's disease (3.3%), Hb H disease (3.3%) and Hb H with Constant Spring (3.3%). It was found that the subjects were taking folic acid (100%), multivitamin (66.7%), vitamin E (63.3%) and cucurmin (13.3%). Nineteen subjects (63.3%) received the nutrition counseling for thalassemic patients before participating in this study.

The results of anthropometric measurement are shown in Table 1. It was found that the mean %W/A, %H/A, %TSF and %MAC in males were lower than the normal ranges, but the mean %W/H was in the normal range. In females, the mean %W/A, %TSF and %MAC were lower than the normal ranges, but the mean %W/H and %H/A were in the normal ranges. According to SGA scores, most of the subjects had scores ranging from 7 - 8. Only 2 persons had score of 14. Based on the SGA scores, the subjects appeared to have normal nutritional status. The laboratory data of the subjects

Table 1 Anthropometric measurement of the subjects[a]

Parameters	Normal range	Males (n = 12)	Females (n = 18)
Weight (kg)	-	30.1 ± 1.8	36.5 ± 2.8
Height (cm)	-	137.5 ± 3.5	146.3 ± 3.7
%W/A	90% - 110%[b]	82.3 ± 2.6	88.9 ± 4.6
%W/H	More than 90%[c]	95.6 ± 2.6	92.5 ± 3.2
%H/A	More than 95%[c]	94.2 ± 1.3	98.5 ± 1.2
TSF (mm)	-	9.5 ± 0.8	12.8 ± 1.1
%TSF	More than 85%[d]	80.8 ± 7.0	78.4 ± 5.8
MAC (cm)	-	18.9 ± 0.6	20.3 ± 0.8
%MAC	More than 85%[d]	79.6 ± 2.2	81.4 ± 2.2
MAMC (cm)	-	15.9 ± 0.6	16.3 ± 0.5
AMA (cm^2)	-	20.4 ± 1.6	21.4 ± 1.3
AFA (cm^2)	-	8.3 ± 0.8	12.1 ± 1.3
BMI (kg/m^2)	-	15.8 ± 0.4	16.5 ± 0.7

[a] Values are expressed as mean ± SEM; [b] Normal ranges were obtained from Cogill, 2003[11]; [c] Normal ranges were obtained from Waterlow, 1972[13]; [d] Normal ranges were obtained from Ekvall et al, 2005[14]; %W/A = percentage of weight for age; %W/H = percentage of weight for height; %H/A = percentage of height for age; TSF = triceps skinfold thickness; %TSF = percentage of triceps skinfold thickness; MAC = mid-arm circumference; %MAC = percentage of mid-arm circumference; MAMC = mid-arm muscle circumference; AMA = arm muscle area; AFA = arm fat area; BMI = body mass index

Table 2 Biochemical parameters of the subjects[a]

Parameters	Normal range[b]	Males (n = 12)	Females (n = 18)
Serum total protein (g/dL)	6.6 – 8.7	7.5 ± 0.1	8.1 ± 0.1
Serum albumin (g/dL)	3.5 – 5.5	4.8 ± 0.1	4.7 ± 0.1

[a] Values are expressed as mean ± SEM; [b] Normal ranges were obtained from laboratory unit, Siriraj Hospital.

are presented in Table 2. The results showed that the subjects had the mean serum levels of total protein and albumin in the normal ranges.

The results of nutritional status classified by %W/A, %W/H and %H/A are presented in Table 3. According to %W/A, 11 subjects (36.7%) were well nourished, 12 subjects (40.0%) were mildly malnourished and 7 subjects (23.3%) were moderately malnourished. Based on %W/H, 50% of the subjects were well nourished, and mild malnutrition was found in 46.7% of the subjects. According to %H/A, 63.3% of the subjects were well nourished, 26.7% and 10.0% of the subjects were classified as mild and moderate malnutrition respectively. No subject was in severely malnourished state when the evaluations were made by %W/A, %W/H and %H/A.

In this study, nutritional status of subjects classified by %TSF and %MAC are presented in Table 4. According to %TSF, 40% of the subjects were in normal nutrition, but 46.7% of the subjects were classified as severe malnutrition. The remaining subjects were malnourished in different degrees. Based on %MAC, 30% of the subjects had normal nutrition whereas 26.7% of the subjects were severely malnourished. According to the percentiles of BMI for age, 50% of the subjects were underweight. Only 1 male subject was overweight.

The dietary intakes of the subject were assessed by 24-hour recall. In this study, the results of average dietary intakes of the subjects are shown in Table 5. It was found that average total energy intake in males and females were lower than the dietary reference intake for Thais 2003 recommended by Department of Health, Ministry of Public Health, Thailand.[16] According to the results, the percentage of energy distribution obtained from carbohydrate in females was lower than the recommended range, while that in males was in the range. In both genders, the percentages of energy distribution from protein were higher than the recommended ranges. The percentage of energy distribution from fat in male was in the recommended range whereas that in female was higher than the recommendation. The results showed that protein intake in both males and females were higher than the recommendation.

The correlations of nutritional parameters are presented in Table 6. It was found that %W/A of the subjects was significantly correlated with weight (R = 0.755, $p < 0.001$), height (R = 0.492, $p = 0.006$), BMI (R = 0.824, $p < 0.001$) and TSF (R = 0.703, $p < 0.001$). Moreover, it was significantly correlated with MAC (R = 0.774, $p < 0.001$), MAMC (R = 0.639, $p < 0.001$), AMA (R = 0.657, $p < 0.001$) and AFA (R = 0.802, $p < 0.001$). The results showed that %W/H was correlated with BMI (R = 0.803, $p < 0.01$), TSF (R = 0.500, $p = 0.005$), and MAC (R = 0.555, $p = 0.01$). In addition, it was significantly correlated with MAMC (R = 0.461, $p < 0.01$), AMA (R = 0.483, $p = 0.007$) and AFA (R = 0.580, $p = 0.001$). This study found the correlations between %H/A and weight (R = 0.648, $p < 0.001$), height (R = 0.708, $p < 0.001$), TSF (R = 0.471, $p = 0.019$) and MAC (R = 0.481, $p = 0.007$). The study also found the correlations between %H/A and MAMC (R = 0.376, $p = 0.041$), AMA (R = 0.373, $p = 0.042$), and AFA (R = 0.501, $p = 0.005$).

Based on the results, %TSF showed significant correlations with weight (R = 0.439, $p = 0.015$), BMI (R = 0.611, $p < 0.001$) and TSF (R = 0.812, $p < 0.001$). It appeared that %TSF was also correlated with MAC (R = 0.533, $p = 0.002$) and AFA (R = 0.745, $p < 0.001$). According to %MAC, it was correlated with weight (R = 0.624, $p = 0.001$), BMI (R = 0.853, $p < 0.001$), TSF (R

Table 3 Nutritional status of the subjects classified by %W/A, %W/H and %H/A

Nutritional status		% W/A			% W/H			% H/A		
		Males	**Females**	**Total**	**Males**	**Females**	**Total**	**Males**	**Females**	**Total**
Normal nutrition	mean ± SEM	93.2 ± 0.9	105.6 ± 5.9	102.2 ± 4.6	99.6 ± 3.0	104.7 ± 5.6	102.0 ± 3.0	98.3 ± 1.2	100.5 ± 1.0	99.9 ± 0.8
	(n, %)	(3, 25.0)	(8, 44.4)	(11, 36.7)	(8, 66.7)	(7, 38.9)	(15, 50.0)	(5, 41.7)	(14, 77.8)	(19, 63.3)
Mild malnutrition	mean ± SEM	83.2 ± 1.0	79.4 ± 1.4	81.3 ± 0.9	87.4 ± 1.1	85.2 ± 1.0	85.8 ± 0.8	92.6 ± 0.8	91.9 ± 0.7	92.4 ± 0.5
	(n, %)	(6, 50.0)	(6, 33.3)	(12, 40.0)	(4, 33.3)	(10, 55.6)	(14, 46.7)	(5, 41.7)	(3, 16.7)	(8, 26.7)
Moderate malnutrition	mean ± SEM	69.7 ± 2.9	69.6 ± 2.2	69.7 ± 1.6	-	79.8 ± 0.0	79.8 ± 0.0	88.2 ± 1.8	89.5 ± 0.0	88.6 ± 1.1
	(n, %)	(3, 25.0)	(4, 22.2)	(7, 23.3)		(1, 5.6)	(1, 3.3)	(2, 16.7)	(1, 5.6)	(3, 10.0)
Severe malnutrition	mean ± SEM	-	-	-	-	-	-	-	-	-
	(n, %)									

%W/A = percentage of weight for age; %W/H = percentage of weight for height;

%H/A = percentage of height for age; SEM = standard error of mean

Table 4 Nutritional status of the subjects classified by %TSF and %MAC

Nutritional status		% TSF			% MAC		
		Males	**Females**	**Total**	**Males**	**Females**	**Total**
Normal nutrition	mean ± SEM	108.4 ± 8.0	98.6 ± 5.2	101.9 ± 4.4	88.1 ± 0.3	93.0 ± 4.0	90.8 ± 2.3
	(n, %)	(4, 33.3)	(8, 44.4)	(12, 40.0)	(4, 33.3)	(5, 27.8)	(9, 30.0)
Mild malnutrition	mean ± SEM	81.3 ± 0.0	-	81.3 ± 0.0	82.3 ± 0.3	84.0 ± 0.3	83.3 ± 0.4
	(n, %)	(1, 8.3)		(1, 3.3)	(2, 16.7)	(3, 16.7)	(5, 16.7)
Moderate malnutrition	mean ± SEM	78.9 ± 0.0	77.4 ± 0.9	77.9 ± 0.7	77.7 ± 0.0	76.8 ± 0.4	76.9 ± 0.4
	(n, %)	(1, 5.6)	(2, 11.1)	(3, 10.0)	(1, 8.3)	(7, 38.9)	(8, 26.7)
Severe malnutrition	mean ± SEM	-	58.3 ± 6.5	60.2 ± 4.1	72.1 ± 1.1	70.5 ± 1.2	71.5 ± 0.8
	(n, %)		(8, 44.4)	(14, 46.7)	(5, 41.7)	(3, 16.7)	(8, 26.7)

%TSF = percentage of triceps skinfold thickness; %MAC = percentage of mid-arm circumference; SEM = standard error of mean

Table 5 Average dietary intakes of the subjects[a]

Dietary intake	Recommended range[b]	Males (n = 12)	Females (n = 18)
Energy intake			
Total kcal/day	1,600 - 1,700	1,458.4 ± 103.2	1,307.3 ± 136.6
kcal/kg/day	-	49.8 ± 4.3	46.9 ± 5.8
Energy distribution (%)			
Carbohydrate	45 - 65	47.3 ± 2.3	44.0 ± 2.1
Protein	9.4 - 12.2	18.2 ± 0.7	16.5 ± 1.4
Fat	25 - 35	34.4 ± 2.1	39.5 ± 2.2
Macronutrient intake			
Carbohydrate			
g/day	-	172.2 ± 14.0	161.2 ± 10.7
g/kg/day		5.7 ± 0.4	5.0 ± 0.6
Protein			
g/day	40 - 41	66.3 ± 5.8	58.5 ± 3.6
g/kg/day	1.2	2.3 ± 0.2	1.8 ± 0.2
Fat			
g/day	-	56.0 ± 5.6	66.8 ± 5.9
g/kg/day	-	2.0 ± 0.3	2.2 ± 0.3

[a] Values are expressed as mean ± standard error of mean (SEM).

[b] Normal ranges were obtained from dietary reference intake for Thais 2003, Department of Health, Ministry of Public Health, Thailand.[16]

Table 6 Correlations between nutritional parameters[a]

Parameters	%W/A	%W/H	%H/A	%TSF	%MAC
Weight	0.755*	0.343	0.648*	0.439*	0.624*
Height	0.492*	-0.065	0.708*	0.199	0.293
BMI	0.824*	0.803*	0.294	0.611*	0.835*
TSF	0.703*	0.500*	0.471*	0.812*	0.684*
MAC	0.774*	0.555*	0.481*	0.533*	0.771*
MAMC	0.639*	0.461*	0.376*	0.231	0.647*
AMA	0.657*	0.483*	0.373*	0.254	0.673*
AFA	0.802*	0.580*	0.501*	0.745*	0.778*
Serum total protein	0.013	-0.033	0.194	-0.047	0.037
Serum albumin	-0.081	-0.202	0.107	0.084	-0.089
Energy intake	-0.223	-0.312	-0.042	-0.218	-0.341
Carbohydrate intake	-0.022	0.007	-0.097	-0.039	-0.087
Protein intake	-0.318	-0.364	-0.036	-0.190	-0.331
Fat intake	-0.233	-0.388	0.030	-0.256	-0.342

* Significant correlation within nutritional parameter (Pearson's correlation coefficient, $p < 0.05$)

[a] Correlations are expressed as Pearson correlation coefficient (R).

%W/A = percentage of weight for age; %W/H = percentage of weight for height; %H/A = percentage of height for age; %TSF = percentage of triceps skinfold thickness; %MAC = percentage of mid-arm muscle circumference; BMI = body mass index; TSF = triceps skinfold thickness; MAC = mid-arm circumference; MAMC = mid-arm muscle circumference; AMA = arm muscle area; AFA = arm fat area

= 0.684, $p < 0.001$) and MAC (R = 0.771, $p < 0.001$). It was also significantly correlated with MAMC (R = 0.647, $p < 0.001$), AMA (R = 0.673, $p < 0.001$) and AFA (R = 0.778, $p < 0.001$).

Discussion

Malnutrition has considerable health impacts on growth pattern, learning, treatment and quality of life in thalassemic children.[17] In this study, nutritional assessment including SGA, anthropometry, biochemical parameters and dietary intake were used to evaluate nutritional status. The children with thalassemia intermedia in this study appeared to have normal nutrition status when evaluated by SGA. SGA is a useful tool for assessment of nutritional status in children with chronic and systemic condition.[18,19] Using the SGA method, the prevalence of malnutrition in hospitalized pediatric patients was about 35.9% in the study by Rojratsirikul et al. (2004)[20] and 70.7% in the study by Mahdavi et al. (2009).[19] Undetectable malnutrition among subjects evaluated by SGA in this study may be due to the limitation of the method. The SGA is unable to categorize mild malnutrition.[21] The subjects in this study were thalassemia intermedia who did not required blood transfusion. All of them were taking folic acid for increased erythropoiesis[3] and most of them experienced nutritional counseling. Therefore, the degree of malnutrition in these patients may not be high. In addition, Mahdavi et al. (2009)[19] found that SGA did not correlate with the objective nutritional assessment. Thus, using this method alone to evaluate nutritional status in thalassemia intermedia patients may not be appropriate. Anthropometric assessments should be used together with SGA.

Anthropometric parameters have been used to assess nutritional status in children with thalassemia. The measurements used to assess nutrition status in children with thalassemia include %W/A,[6,22,23] %W/H,[6] %H/A,[6,8,22-24] %TSF,[5] %MAC[5,25] and the percentiles of BMI for age.[22-24,26] However, there were no studies indicating which parameter provided the best information for evaluating nutritional status in these patients. Hence, it is probably necessary to use combination of various parameters to determine nutritional status in thalassemic patients.

The nutritional status classified by %W/A showed that 63.3% of subjects were underweight, arising from gaining insufficient weight relative to age. The percentage of W/A is often used to categorize overweight or underweight and used to assess the current nutritional status.[27] With this measurement, Tanphaichitr et al. (1995)[5] found that 74.5% of thalassemic children were underweight. Tienboon et al. (1996)[6] also found that 64% and 78% of male and female thalassemic children respectively were moderately to severely underweight when evaluated by %W/A. In the case of unknown age, present nutritional status can be assessed by W/H.[13] The results of this study showed that 50% of the subjects evaluated by %W/H were underweight. They were thin or wasted. This agreed with previous study that thalassemic patients had an evidence of acute wasting when nutrition status was assessed by %W/H.[5] Evaluation of nutrition status by both %W/A and %W/H in this study showed similar results that most of the children with thalassemia intermedia were currently underweight.

The past nutrition or chronic malnutrition is able to be evaluated by %H/A. When a child is exposed to inadequate nutrition for a long period of time, growth is impaired resulting in stunting. It was found that 36.7% of children with thalssemia intermedia from this study had delayed linear growth. This result was consistent with the previous study that 72.3% of thalassemic children were stunted[5] and 69.8% of patients with thalassemia major had short stature.[28] The etiology of impaired growth in thalassemic patients might be attributed to the chronic undernutrition. Long-term poor dietary intake may be one of the causes of short stature of patients in this study.

From this study, nutritional status classified by %TSF, %MAC and the percentile of BMI for age showed that 60%, 70% and 50% of subjects, respectively, had low body fat and muscle wasting. The results were similar to the

previous study by Tanphaichitr et al. (1995)[5] that 53.7% and 75.6% of thalssemia children evaluated by %TSF and %MAC respectively had malnutrition. Moreover, the previous studies on BMI found that underweight was a common finding in children with thalassemia.[23,26] The percentage of TSF is a parameter for assessment the total body fat reserves, and %MAC is used to evaluate the status of muscle wasting.[27,29] Body mass index is an indicator for the chronic protein and energy status of the individual, and it also correlates better with body fat than body weight.[29] The results of %TSF and %MAC indicated that the subjects in this study had low body fat and muscle compared with standard. These findings may be due to the combination of low energy reserves and mildly hypercatabolic state in thalassemic patients[30] that make body muscle degradation leading to wasting condition. Overall, the results of anthropometry measurements demonstrated that children with thalassemia intermedia were both wasting and stunting.

Biochemical parameters provide information about nutrient availability in biological fluid and tissue.[31] In this study, serum total protein and albumin were measured to evaluate nutritional status of the subjects. It was found that the levels of both parameters were in normal range. The results were similar to those in children with thalassemia major.[32] Total protein is an index of visceral protein status,[33] while serum albumin concentration reflects changes occurring within the intravascular space. Both parameters are influenced by dietary protein.[29] It is possible that serum total protein and albumin levels were in normal ranges because the amount of protein intake of the patients in this study was higher than the recommendation by Department of Health, Ministry of Public Health, 2003.[16]

Dietary intake plays a role in optimal nutrition status. It was reported that thalassemic patients required higher amount of nutrients to support the normal body function.[6,32] However, Tanphaichitr et al. (1995)[5] found that thalassemic children had low energy intake (65% of the mean recommended energy intake). Similarly, the subjects in this study also had total energy intake lower than the dietary reference intake recommended by Department of Health, Ministry of Public Health, Thailand.[16] The energy distribution from carbohydrate of the female subjects was lower than the recommended range while energy from carbohydrate of male subjects was at the minimum end of recommendation. With considering on energy intake, low total energy intake, especially in females, in this study may be the results from low amount of food intake and low caloric distribution from carbohydrate, which is the major energy providing nutrient. Nutritional counseling may be beneficial in improving dietary intakes of these patients.

In the present study, the significant interrelationships between the various parameters were found. The percentages of W/A, W/H and H/A were found to be associated with weight, body fat and muscle. From the previous study, the correlation of %H/A and AMA indicated that height may be an indicator of muscle store in the children with thalassemia.[34] The percentage of TSF is a parameter indicating the total body fat reserves. According to the results, %TSF was correlated with BMI, which is obtained from weight and height and is related with body fat.[26] These demonstrated that anthropometric parameters used to evaluate nutritional status in this study (%W/A, %W/H, %H/A, %TSF and %MAC) could reflect the storage of body fat and muscle. Improvement of these anthropometric parameters is necessary for promoting nutritional status, and this can be accomplished by nutritional counseling.

Although the results of anthropometric measurements in the present study obviously indicated growth impairment in patients with thalassemia intermedia, it was difficult to make a clear conclusion that lower anthropometric parameters than normal reference in these patients were primarily due to malnutrition. Several factors could affect growth in this population, such as ineffective erythropoiesis causing chronic anemia, hypercatabolic state and endocrine dysfunction.[35] Furthermore, other methods evaluating nutrition status such as SGA and

biochemical parameters appeared normal in most patients. Therefore, abnormal anthropometric measurements in these patients may result from combination of many factors. However, malnutrition may still, in part, play a role in growth impairment of the patients with thalassemia intermedia as it was found that these patients had energy consumption less than the recommendation. Nutritional assessment and counseling are thus essential components in the treatment of thalassemia intermedia patients.

Conclusion

This study demonstrated that patients with thalassemia intermedia had growth impairment assessed by anthropometric measurements. The SGA and biochemical parameters appeared normal, while dietary intakes are apparently inappropriate and lower than daily recommendation. The nutrition improvement in both calorie and composition requirement should be incorporated in to patient care to improve growth status in these patients.

Acknowledgement

This study was supported in part by CU.GRADUATE SCHOOL THESIS GRANT, 2010.

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ภาวะโภชนาการในผู้ป่วยธาลัสซีเมียชนิดรุนแรงปานกลาง

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บทคัดย่อ : *ภาวะทุพโภชนาการมีผลกระทบต่อการเจริญเติบโต การเรียนรู้ การรักษา และคุณภาพชีวิตของผู้ป่วยเด็กธาลัสซีเมีย การศึกษานี้มีวัตถุประสงค์เพื่อประเมินภาวะโภชนาการของผู้ป่วยธาลัสซีเมียชนิดรุนแรงปานกลาง* ***วิธีการศึกษา :*** *ทำการประเมินภาวะโภชนาการโดยใช้ข้อมูลจากตัวบุคคลแบบองค์รวม และการวัดสัดส่วนของร่างกาย ประเมินการบริโภคอาหารโดยใช้บันทึกการบริโภคอาหารย้อนหลัง 24 ชั่วโมง และวัดระดับโปรตีนทั้งหมดและระดับอัลบูมินในซีรัม* ***ผลการศึกษา :*** *มีผู้ป่วยอายุระหว่าง 5 - 15 ปี จำนวน 30 คน* ***(ชาย 12 คน และหญิง 18 คน) เข้าร่วมการศึกษานี้ เมื่อประเมินภาวะโภชนาการโดยใช้ข้อมูลจากตัวบุคคลแบบ*** *องค์รวม พบว่าผู้ป่วยเหล่านี้มีภาวะโภชนาการปกติ มีระดับโปรตีนทั้งหมดและระดับอัลบูมินในซีรัมอยู่ในช่วงปกติ แต่เมื่อประเมินภาวะโภชนาการโดยการวัดสัดส่วนของร่างกาย ได้แก่ น้ำหนักตามเกณฑ์อายุ น้ำหนักตามเกณฑ์ส่วนสูง ส่วนสูงตามเกณฑ์อายุ ความหนาของชั้นไขมันใต้ผิวหนัง เส้นรอบกึ่งกลางแขน และค่าดัชนีมวลกายตามอายุ พบว่าผู้ป่วยมีน้ำหนักต่ำกว่าเกณฑ์มาตรฐานและมีภาวะเตี้ย ผลการศึกษายังพบว่าผู้ป่วยได้รับพลังงานทั้งหมดจากอาหารที่บริโภค ต่ำกว่าปริมาณสารอาหารอ้างอิงที่ได้รับประจำวัน* ***สรุป :*** *ผลการวัดสัดส่วนของร่างกายแสดงให้เห็นว่าผู้ป่วยธาลัสซีเมียชนิดรุนแรงปานกลางมีการเจริญเติบโตที่ผิดปกติ และยังมีการบริโภคอาหารไม่เหมาะสม แม้ว่าผู้ป่วยมีภาวะโภชนาการปกติเมื่อประเมินโดยใช้ข้อมูลจากตัวบุคคลแบบองค์รวมและมีค่าชีวเคมีอยู่ในช่วงปกติ ดังนั้นการประเมินภาวะโภชนาการและการดูแลทางด้านโภชนาการที่เหมาะสม จึงควรเป็นส่วนหนึ่งในแผนการรักษาผู้ป่วยธาลัสซีเมียชนิดรุนแรงปานกลางเพื่อแก้ไขให้ผู้ป่วยมีภาวะการเจริญเติบโตและผลลัพธ์ทางคลินิกที่ดีขึ้น*

Key Words : ● *ภาวะโภชนาการ* ● *ภาวะทุพโภชนาการ* ● *ธาลัสซีเมียชนิดรุนแรงปานกลาง* ● *การวัดสัดส่วนของร่างกาย* ● *การบริโภคอาหาร*

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