J. Food Sci. Nutr.
Vol. 3, No. 3, p. 256~259 (1998)

An Association between Menarche and Nutritional Status of Female Students of a Rural Primary School

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Abstract

The association of menarche and nutritional status was studied in 116 female students of the 6th grade in a rural primary school. Participants were divided into two groups based on menarcheal status. The anthropometric data showed that mean heights and weights of menarcheal group on two occasions were significantly higher than those of the other group ($p<0.01$). Neither hemoglobin levels nor hematocrit values for determination of anemia were not associated with menarche. Twenty four hour dietary recall revealed that young females with menarche consumed less energy and Ca compared to the other group. Ca intake was 34.8% of RDA in menarcheal group. It might be suggested that effective intervention strategies need to be developed and include education programs for nutritional needs and food sources of Ca, targeting rural residents.

Key words: menarche, nutritional status, anthropometric data, dietary recall, anemia

INTRODUCTION

Recently there appears to be a trend for female children to have increased height and weight more distinctly than male children in later part of primary school (1). Early adolescence includes the onset of puberty and usually takes places by the age of 10 to 12 years in girls and 11 to 13 years in boys (2). During puberty young female usually matures earlier and becomes taller because of her growth spurt than the male (3).

The entry into puberty is a gradual maturing process for young females and males. For young girls, the onset of menstruation, menarche, occurs around age 13, but may come somewhat earlier or later (2). Menarche is related to body weight, nutrition, heredity and overall health (4). Until 1960, girls generally had their menarche somewhat between 14 and 16 years of age in Korea. These days, girls tend to have their menarche earlier than before due to industrialization and change in life style including nutrition. It was reported that menarche in young girls occurred around fourth and fifth grade in a primary school in a big city (5).

For young girls with menarche nutritional requirement is critical because of physiological changes. Requirements for Fe, protein and other nutrients should be increased to offset the nutrient loss from blood via menstruation. Inadequate supply of these nutrients may result in serious nutritional problems such as anemia.

Despite the importance of adequate nutrition for young girls with menarche, the research to assess their nutritional status has not been extensively done, especially in rural area. In this study, the association of menarche and other selected variables for determining nutritional status in girls of two groups with different menarcheal status was investigated. Anthropometric measurement, nutrient analysis and biochemical analysis were done to assess nutritional status of female primary school students in a rural area.

MATERIALS AND METHODS

Subjects and experimental design

Subjects were 116 female students of the sixth grade of a rural primary school in Hwasoon Kun, Chun-Nam Province. Subjects were asked to fill out questionnaires on external environmental factors, and they were divided into 2 groups based on menarcheal status.

Nutrient intake analysis

Dietary data were obtained by a 24-hour dietary recall during one of weekdays for determining typical food consumption pattern. With the aid of food model and the table of approximate quantities of various food items, nutrient intakes were measured. Nutrient intake analysis was done with the computer program developed by Korean Agricultural Development Center, and compared with Korean Recommended Daily Dietary Allowances (RDA) (5).

Anthropometric measurements

The trained teacher measured the height and weight of participants with consistency in May and November.

Biochemical analysis

Venous blood samples were obtained during fasting and analyzed by an automatic blood analyzer (Sysmex F 2500, Japan) for levels of hematocrit and hemoglobin. Fe deficiency anemia was determined based on WHO standard (6).

Statistical analysis

Statistical Analysis System (SAS) procedures were used to compute mean, frequency, standard deviation. ANOVA and t-test were used to find the statistical significance between two groups. A probability value of 0.05 was chosen as the level of statistical significance.

RESULTS AND DISCUSSION

Anthropometry

The mean heights and weights for both groups are given

in Table 1. Mean height and weight of menarcheal group in May were 151.8±5.8 cm and 47.0±7.5 kg, respectively which is higher than average value of height (146.3 cm) and weight (38.1 kg) of all the subjects in the study, and those in the Korean Standard Growth data of the same age and sex (148.0 cm, 41.0 kg). On the other hand, mean height and weight of nonmenarcheal group in May were 145.4±6.3 cm and 36.7±5.9 kg. Thus, there was a significant difference in height ($p<0.01$) and weight ($p<0.01$) between these two groups. Similarly, the anthropometric measurements of two groups in November showed the statistical significance concerning on growth pattern. However, the results in the study did not indicate much difference in the magnitude of growth rate between these two groups during this interval.

In the present study remarkable difference in weight (over 10 kg) between these two groups was noted. This result is consistent with the findings observed in North American and European females (7). The researchers reported pubertal onset to a change in body composition and pointed out the critical body weight of 47.8 kg which caused the metabolic rate change and triggered menarche and initiated the growth spurt of adolescent girls. Some investigators (8,9) were in agreement with the view of an association between change in body composition and the onset of menarche though they did not agree with the aspect of triggering factor of puberty. In this study mean weight of menarcheal group was 47.0 kg in May which is almost identical to their critical body weight of 47.8 kg. This slight change might be due to the difference in Western and Oriental frame size. To resolve the triggering mechanism related to menarche well designed longitudinal study might be needed.

Biochemical analysis

Iron deficiency anemia is the most common nutritional problems seen among teenagers (10). Due to increased demands from accelerated growth and the onset of menses, subjects in the menarcheal group probably have a chance of suffering from iron deficiency anemia.

22.8% of subjects by hemoglobin levels and 14.7% of participants by hematocrit concentration were determined to be anemic, which indicated higher prevalence of anemia compared with other Korean study (11). Table 2 and 3 presented an association between menarche and anemia when subjects were diagnosed by levels of hemoglobin and hematocrit.

Table 1. Comparisons of anthropometic data by menarcheal status

		Menarcheal group (16)	Non-menarcheal group (100)
Weight	Wt[1]	47.0±7.5[3]	36.7±5.9**
	Wt[2]	50.5±8.5	39.9±6.4**
Height	Ht[1]	151.8±5.8	145.4±6.3**
	Ht[2]	154.0±5.9	148.8±6.4**

[1]The values measured in May.
[2]The values measured in November.
[3]Mean±SD, **$p<0.01$

Table 2. Association between menstration and anemia by hemoglobin levels (g/dl)

	Anemic	Nonanemic	Total
Mense	4[1] (25%)	12 (75%)	16 (13.79%)
Nonmense	22 (22%)	78 (78%)	100 (86.21%)
Total	26 (22.41%)	90 (77.59%)	116 (100%)
χ^2, p	χ^2=0.071, p=0.789		

[1]Number of subjects

Table 3. Association between menstration and anemia by hematocrit levels (mg/dl)

	Anemic	Nonanemic	Total
Mense	1[1] (6.25%)	15 (93.75%)	16 (13.79%)
Nonmense	16 (16%)	84 (84%)	100 (86.21%)
Total	17 (14.66%)	99 (85.34%)	116 (100%)
χ^2, p	χ^2=0.071, p=0.789		

[1]Number of subjects

However, neither hemoglobin levels nor hematocrit values could determine an association between menarche and anemia in the study.

Nutrient intakes

Nutrient intakes between two groups were compared and shown in Table 4. Unexpectedly, nutrient intakes of menarcheal group were less than those of non-menarcheal group except for niacin and vitamin A.

Since nutritional requirements are influenced by growth

Table 4. Nutrient intakes by menarcheal status

Nutrients	Menarcheal group	Nonmenarcheal group
Energy (kcal)	1435.05 ± 393.46[1] (75.5[2])	1678.46 ± 663.97* (88.3)
Protein (g)	58.76 ± 23.35 (97.9)	70.20 ± 34.88 (117)
Fat (g)	22.97 ± 12.27	29.00 ± 21.03*
Ca (mg)	278.52 ± 152.25 (34.8)	398.10 ± 262.81* (49.8)
Fe (mg)	17.28 ± 6.47 (96.0)	19.59 ± 7.51 (103.1)
Vitamin A (RE)	1032.4 ± 168.4 (172.1)	851.3 ± 131.0 (141.9)
Thiamin (mg)	0.96 ± 0.39 (96.0)	1.03 ± 0.47 (103.0)
Riboflavin (mg)	0.98 ± 0.58 (81.8)	1.18 ± 0.82 (89.6)
Niacin (mg)	16.49 ± 10.77 (126.8)	15.55 ± 7.33 (120.0)
Vitamin C (mg)	58.18 ± 49.29 (116.4)	65.02 ± 59.04 (130.0)

[1]Mean±SD, [2]% RDA, *$p<0.05$

and the change in body composition and physiology that takes place as a result of maturation (2), nutrient requirements for female students in the menarcheal group will be high. However, mean energy intake in this group was equivalent to 75.5% of Korean RDA. Furthermore, mean Ca intake was only 34.8% of RDA. On the other hand, energy and Ca intakes in non-menarcheal group were equivalent to 88.3% and 49.8% of Korean RDA respectively. Thus, there are significant differences in intakes of these nutrients and fat between two groups. Energy ratio of protein : fat : carbohydrate was 16 : 14 : 69 for menarcheal group, while 17 : 16 : 68 for non menarcheal group. Generally subjects in the study consumed more carbohydrate and less fat when compared to the recommended level as an ideal ratio of energy contributing nutrients for Koreans (5).

There is considerable interests in iron status of young female. With rapid growth the need for iron increases and there is additional iron need with menarche because menstural losses of iron increase demands for iron. It is documented that iron losses from menstruation in teenagers vary widely but it seems that the losses are correlated with iron absorption (12).

In the present study iron intakes of subjects with menarche in the diet were adequate when compared with RDA. However, more caution should be taken to include a meal which can enhance iron absorption.

Table 5 and 6 shows correlation of nutrients in both groups. Table 5 revealed the strongest association between the intake of energy and protein ($r=0.81$, $p<0.001$) in the menarcheal group. Actually 5 nutrients were associated with energy intake in contrast to Ca intake which was not correlated with any nutrient intake at all. Fe intake was correlated with energy and protein intake, respectively ($p<0.001$).

In the nonmenarcheal group, 9 nutrients were significantly associated with energy. Among these, intakes of fat ($r=0.79$, $p<0.001$) and Fe ($r=0.75$, $p<0.001$) had the strongest correlation with energy. In this group Ca intake was associated with energy, protein and fat, which were not observed in the menarcheal group. Thus, their associated nutrient intake pattern was quite different from menarcheal group due to differences in food consumption.

In summary, the results of this study indicate that nutritional status of young female subjects with menarche was appropriate. However, dietary intakes of energy and Ca were below the RDA. Especially, special attention should be given to marginal intakes of Ca in the subjects. Effective nutrition education program targeting rural residents should be developed and implemented to increase energy and Ca consumption. Intervention strategies for nutrition improvement including education for specific nutritional needs and food sources might be suggested.

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Table 5. Correlation coefficients among selected nutrients in menarcheal group

	Energy	Prot	Fat	Ca	Fe	Vit A	Thi	Ribo	Niacin
Protein	0.81**								
Fat	0.55*	0.55*							
Ca	NS	NS	NS						
Fe	0.67**	0.72**	NS	NS					
Vitamin A	NS	NS	NS	NS	NS				
Thiamin	0.70**	0.76**	NS	NS	0.52*	NS			
Riboflavin	NS	0.70	NS	NS	0.74**	0.52*	NS		
Niacin	0.57*	0.78**	NS	NS	0.77**	NS	NS	0.64**	
Vitamin C	NS	NS	NS	NS	NS	NS	NS	0.62**	NS

*$p<0.05$, **$p<0.001$

Table 6. Correlation coefficients among selected nutrients in non-menarcheal group

	Energy	Prot	Fat	Ca	Fe	Vit A	Thi	Ribo	Niacin
Protein	0.63**								
Fat	0.79**	0.66**							
Ca	0.43**	0.73**	0.47**						
Fe	0.75**	0.79**	0.58**	0.51**					
Vitamin A	0.25*	0.34**	0.31**	0.35**	0.44**				
Thiamin	0.70**	0.67**	0.52**	0.39**	0.71**	0.35**			
Riboflavin	0.37**	0.56**	0.37**	0.51**	0.47**	0.42**	0.39**		
Niacin	0.47**	0.75**	0.38**	0.44**	0.73**	0.22**	0.58**	0.37**	
Vitamin C	0.26**	NS	NS	NS	0.36**	0.62**	0.40**	0.23*	0.27*

*$p<0.05$, **$p<0.001$

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(Received July 23, 1998)