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Association between Nutrients Intake and Nutritional Status in Young Men*

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ABSTRACT

The association between nutrient intake and nutritional status was investigated with anthropometric measurements, body composition and blood biochemical indices in 56 healthy young men fed balanced diet for two years. Compared with Korean recommended dietary allowances (Korean RDA), all nutrient intakes were adequate. Height and body weight were significantly ($p < .01 - p < .05$) positively correlated to the intakes of energy, protein, sodium, potassium vitamin A and vitamin B_1. The lean weight was significantly ($p < .001 - p < .05$) correlated to the intake of energy, protein, sodium, potassium, vitamin A, vitamin B_1, niacin and vitamin C. The skinfold thickness of triceps and suprailiac was significantly ($p < .01 - p < .05$) correlated to the intake of energy, sodium, potassium, but that of thigh was not correlated. The significant correlations neither between nutrient intake and blood biochemical indices nor between nutrient intake and blood pressure were shown. These results suggest that nutritional status as anthropometric indices and body composition is associated with nutrient intake in young healthy adults on balanced diet, however, the nutritional status as blood biochemical indices of active people is neither endangered nor improved in comparison with less active ones.

KEY WORDS: nutritional status, nutrient intake, anthropometric measurements, body composition, biochemical indices.

INTRODUCTION

Escalating costs of crisis medical care add an economic incentive for both individuals and the nation to prevent chronic diseases. Several epidemiologic studies have demonstrated an increased mortality ratio in patients with abnormal nutritional status and mounting scientific evidence indicates that changes in dietary intake by adults could produce measurable gains in the health and longevity of the population.[1-5]

Nutrition interventions are essential components of programs to promote adult health and prevent the leading chronic diseases.[6] Nutritional health is determined by the sum of its nutritional status with respect to each needed nutrient. The nutritional health of a person is determined by anthropometric measurements, biochemical measurements of nutrients or their by-products in blood and urine, a clinical examination, and a dietary analysis.[7] Although the relations between the diet and nutritional status or anthropometric indices have been elucidated in childhood and the elderly,[8-11] there hasn't been much follow-up of previously established relations in young adulthood. Moreover, recent interest in adult diet has focused on overconsumption of dietary components such as energy, fat, cholesterol, and sodium, that related health problems. Also, it is known that the nutritional status indicators is hardly to be changed in adult, especially by non-extreme ways and in non-disease state.[12-14] Indices commonly used for nutritional assessment need to be verified, for measuring nutritional status in healthy young men because of the metabolic adaptation in young adult. Therefore, the aim of this study was to investigate the association between nutrient intake and nutritional status indicators in healthy young adults.

SUBJECTS AND METHODS

1. Subjects, dietary intake and physical activity assessment

Fifty-six highly active young men aged 20 to 22 years with no health problems participated in this study. Subjects kept 7-day food record on the same days of the physical activity record slightly modified from Bouchard *et al.*[15] each season for two years. Participants were given the instructions on how to fill in records with exact amounts of all foods and drinks consumed. Recorded food intakes were converted into nutrient intake by using a computerized dietary analysis program.[16]

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2. Anthropometric measurements, body composition and biochemical analysis

Weights, heights, diastolic blood pressure and systolic blood pressure were measured. Body mass index (BMI) were calculated according to the formula weight (kg)/height $(m)^2$. Skinfold thicknesses were measured to the nearest 0.1 mm at the suprailiac, thigh, and triceps using skinfold caliper (Skindex. Caldwell, Justiss & Co., Inc., U.S.A.). To estimate the body composition, portable body composition analyzer based on near infrared interaction technique (Futrex 5000, Futrex Inc, Japan) was used. Measurements were taken by the same person all the times. Plasma glucose and total cholesterol was analyzed with commercial kit based on enzymatic method (Youngdong Pharmaceutical Co., Korea). Total protein and albumin were analyzed with commercial kit based on biuret reaction (Youngdong Pharmaceutical Co., Korea). Microhematocrit was determined by reading the percent red cell after centrifuge. Hemoglobin concentration was determined with commercial kit based on cyanmethemoglobin method (Youngdong Pharmaceutical Co., Korea).

3. Statistical analysis

The data were analyzed for correlations between nutritional status indices and nutrient intake using Pearson's correlation coefficients.

RESULTS

Analyses were conducted on data collected from 56 subjects. These subjects had a mean height of 172.85 ± 4.22 cm and body weight of 67.83 ± 6.70 kg. Table 1 shows that subjects in this study were within the normal range for anthropometric measurements, body composition, and blood biochemical value of healthy men. Table 2 gives nutrient intake expressed as percent of Korean RDA. This Korean RDA was compensated by an activity level. The weighted resting energy expenditure factor of the subjects was 2.37 ± 0.05. The nutrient intake of subjects were 98.6 ± 9.0 − 226.3 ± 56.8% of Korean RDA. The overall acceptance of the nutrient intake of subjects was good.

There were correlations between nutrient intake and anthropometric measurements (Fig. 1, 2). As expected, energy intake had a strong positive correlation with the height ($p < 0.05$) and weight ($p < 0.001$). Protein intake also had a strong positive correlation with the height ($p < 0.01$) and weight ($p < 0.05$). Among micronutrients, sodium, potassium, vitamin A, and vitamin B_1 had strong positive correlations with the height and weight respectively. Vitamin C had a positive correlation with the height while niacin had a positive correlation with weight. No correlation was shown between blood pressure and nutrient intake except vitamin A.

Table 1. Anthropometric measurements, body composition and blood biochemical indices of the subjects

Measurement	Mean ± S.D.
Height(cm)	172.85 ± 4.22
Body weight(kg)	67.83 ± 6.70
SBP(mmHg)[1]	114.35 ± 7.88
DBP(mmHg)[1]	72.61 ± 6.89
BMI(kg/m²)[1]	22.66 ± 1.63
Triceps(mm)[2]	11.57 ± 2.07
Suprailiac(mm)[2]	12.14 ± 4.51
Thigh(mm)[2]	13.67 ± 3.03
fat wt(g)[3]	7.30 ± 1.62
Lean wt(g)[3]	60.70 ± 5.45
Hemoglobin(g/dl)	13.98 ± 0.65
Hematocrit(%)	41.13 ± 2.07
Cholesterol(mg/dl)	164.30 ± 29.01

1) SBP: systolic blood pressure, DBP: diastolic blood pressure, BMI: body mass index
2) Skinfold thickness was determined by caliper
3) Values are determined by bioelectrical impedance

Table 2. Daily nutrient intake of the subjects

Nutrient	Mean ± S.D	% of Korean RDA[1]
Energy(kcal)	3976.6 ± 362.4	98.6 ± 9.0
Carbohydrate(g)	551.0 ± 60.3	
Protein(g)	180.7 ± 24.4	149.4 ± 20.1
Fat(g)	117.5 ± 19.4	
Cholesterol(mg)	692.3 ± 286.4	
Phosphorus(mg)	2593.2 ± 323.6	
Iron(mg)	26.0 ± 4.2	134.2 ± 21.6
Sodium(mg)	10480 ± 1549.8	
Potassium(mg)	5825.3 ± 624.0	
VitaminA(RE)	1656.8 ± 394.2	146.8 ± 34.9
VitaminB_1(mg)	2649.5 ± 0.4	126.4 ± 19.4
VitaminB_2(mg)	2375.5 ± 0.4	92.1 ± 14.1
Niacin(mg)	40.7 ± 7.0	148.4 ± 25.6
VitaminC(mg)	200.6 ± 50.3	226.3 ± 56.8

1) RDA: Recommended dietary allowance compensated by an activity level

Fig. 3, 4 show the correlations between nutrient intake and body composition. As expected, the lean weight had a strong positive correlation with energy intake ($p < 0.01$) and protein intake ($p < 0.01$). The lean weight was also correlated to the intake of sodium, potassium, vitamin A, vitamin B_1, niacin, vitamin C. No correlation was shown between fat weight and nutrient intake except potassium. BMI was correlated to the intake of energy, vitamin B_2, niacin.

Fig. 5, 6 show the correlations between nutrient intake and skinfold thickness. Triceps skinfold measurement had

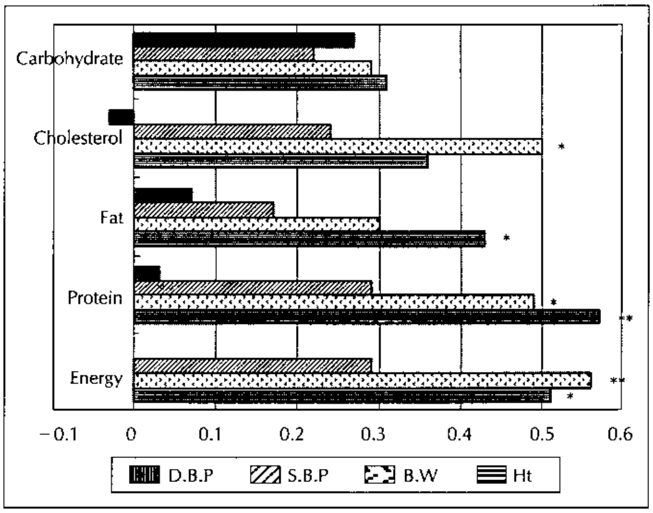

Fig. 1. Correlation coefficients between energy-nutrient intake and anthropometric measurements.
1) Ht: height (cm), BW: body weight (kg), SBP: systolic blood pressure (mmHg), DBP: diastolic blood pressure (mmHg).
2) *: Significant at $p < 0.05$, **: Significant at $p < 0.01$, ***: Significant at $p < 0.001$.

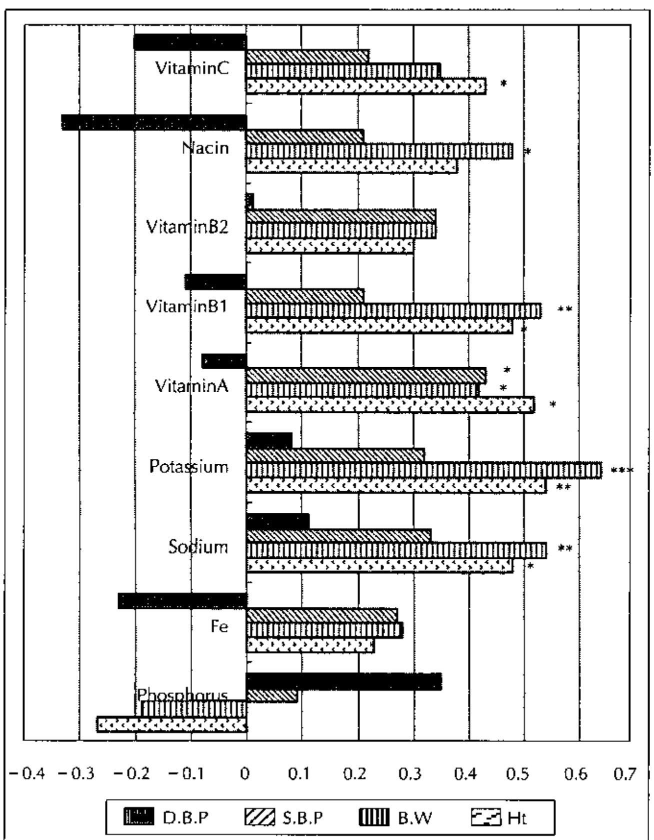

Fig. 2. Correlation coefficients between micro-nutrient intake and anthropometric measurements.
1) Ht: height (cm), BW: body weight (kg), SBP: systolic blood pressure (mmHg), DBP: diastolic blood pressure (mmHg).
2) *: Significant at $p < 0.05$, **: Significant at $p < 0.01$, ***: Significant at $p < 0.001$.

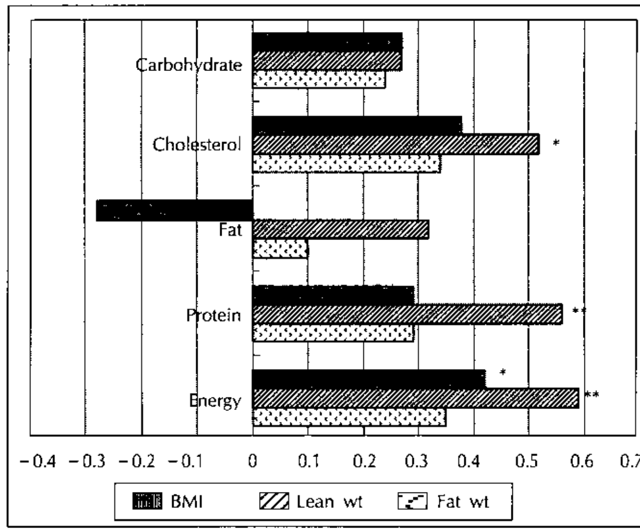

Fig. 3. Correlation coefficients between energy-nutrient intake and body composition determined by near infrared interaction technique.
1) Wt: weight (g), BMI: body mass index (kg/m^2).
2) *: Significant at $p < 0.05$, **: Significant at $p < 0.01$, ***: Significant at $p < 0.001$.

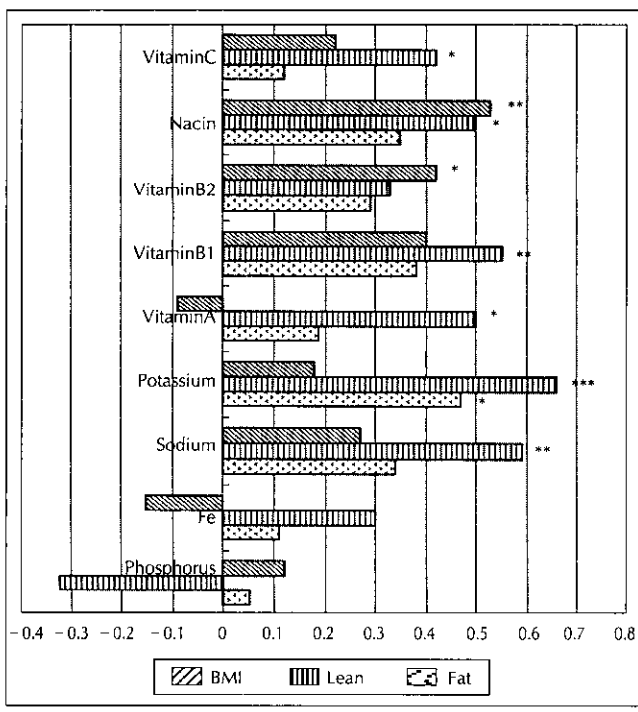

Fig. 4. Correlation coefficients between micro-nutrient intake and body composition determined by near infrared interaction technique.
1) Wt: weight (g), BMI: body mass index (kg/m^2).
2) *: Significant at $p < 0.05$, **: Significant at $p < 0.01$, ***: Significant at $p < 0.001$.

a positive correlation with the intake of energy, cholesterol, sodium and potassium. Suprailiac skinfold measurement was positively correlated to the intake of energy, protein, iron, cholesterol, sodium, potassium, vitamin A, vitamin B_1, niacin. No correlation was shown between thigh skinfold meas-

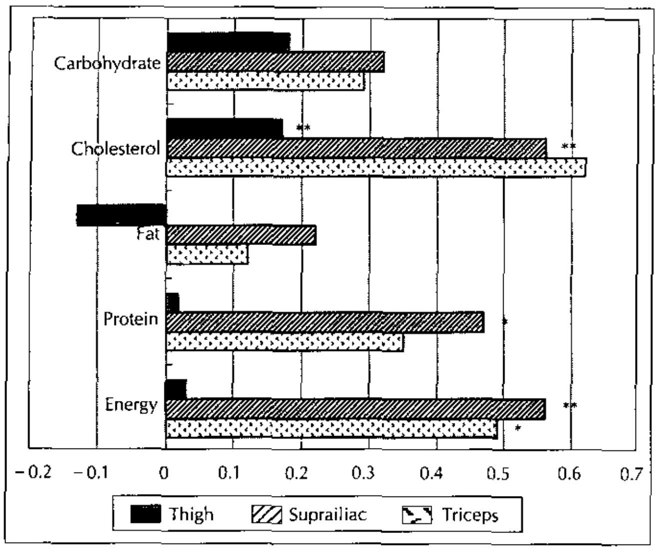

Fig. 5. Correlation coefficients between energy-nutrient intake and skinfold thickness.
1) *: Significant at $p < 0.05$, **: Significant at $p < 0.01$, ***: Significant at $p < 0.001$.

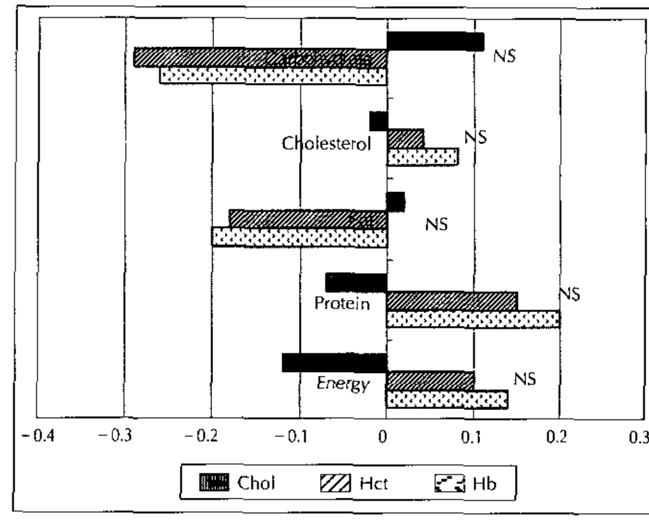

Fig. 7. Correlation coefficients between energy-nutrient intake and blood biochemical indices.
1) Hb: hemoglobin (g/dl), Hct: hematocrit (%), Chol: cholesterol (mg/dl).
2) NS: not significant at $p < 0.05$.

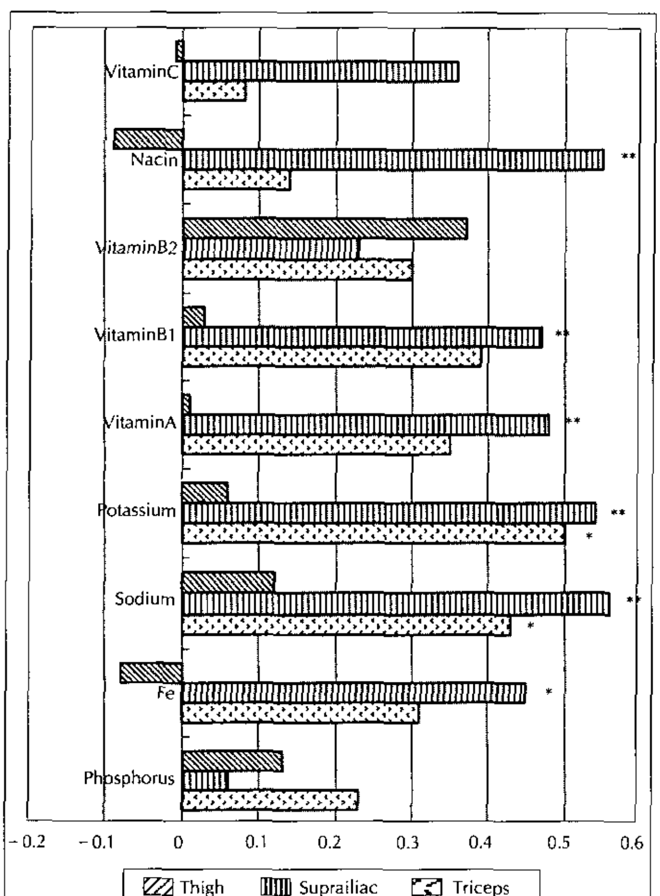

Fig. 6. Correlation coefficients between micro-nutrient intake and skinfold thickness.
1) *: Significant at $p < 0.05$, **: Significant at $p < 0.01$, ***: Significant at $p < 0.001$.

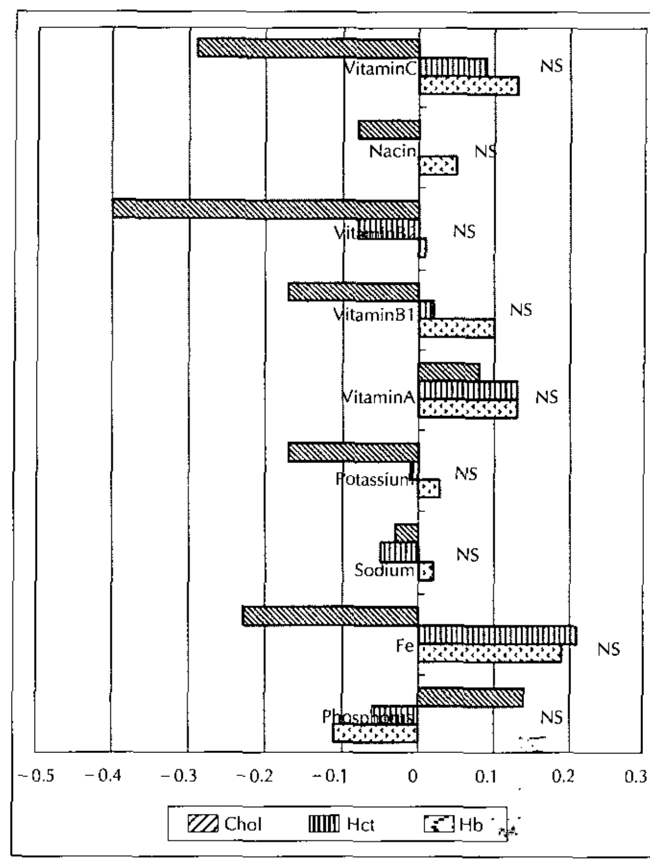

Fig. 8. Correlation coefficients between micro-nutrient intake and blood biochemical indices.
1) Hb: hemoglobin (g/dl), Hct: hematocrit (%), Chol: cholesterol (mg/dl).
2) NS: not significant at $p < 0.05$.

urement and nutrient intake. There were also no correlations between nutrient intake and the levels of hemoglobin, hematocrit, cholesterol, total protein, and albumin (Fig. 7, 8).

DISCUSSION

Studies examining the relationship between nutrient intake and nutritional status indicators in the young are inconsistent and contradictory. Some studies have indicated an association between nutrient intake and nutritional status indicators,[9)17)18)] whereas others have not.[19)20)] Age differences, overconsumption of dietary components, duration on a specific diet may partially explain the differences in results.

As expected, energy and protein intake had a strong positive correlation with the height and weight. Among micronutrients, sodium, potassium, vitamin A, vitamin B_1, niacin and vitamin C had a strong positive correlation with the height and (or) weight respectively. These are the nutrients known as anabolic nutrients. Thus, even in adults, the intake of anabolic nutrients can be associated to the growth of the body. Further support for a need of anabolic nutrients on growth in adults is provided by the correlations between nutrient intake and body composition. As expected, the lean weight had a strong positive correlation with the intake of energy, protein, sodium, potassium, vitamin A, niacin and vitamin C. BMI was also correlated to the intake of energy, vitamin B_2 and niacin. BMI includes muscle and bone weight as part of its measure and is a major component of growth at this age.

Skinfold thickness measurements are more direct reflection of body fatness. Although the accuracy of measurements of the subcutaneous fat by means of an indirect method using a skinfold caliper has been questioned by many investigators,[21)22)] skinfold thickness measurements have been used to provide an estimate of the size of the subcutaneous fat depot, which in turn provides an estimate of the total body weight.[23)24)] Among skinfold measurements, suprailiac skinfold measurement was more correlated to the intake of nutrient than other skinfold measurements in this study. Moreover, suprailiac skinfold measurement was positively correlated to the intake of many energy producing nutrients including energy, protein, fat, vitamin B_1 and niacin. Also, it is reported that skinfold measurements can be useful if they are used as a baseline to monitor the changes in somatic protein changes.[25)] Thus, suprailiac skinfold measurement can be useful to assess body composition and nutritional status. No correlation was shown between fat weight and nutrient intake while the lean weight had a positive correlation with the intake of energy, protein as well as other anabolic nutrients in this study. There is general agreement that body fatness is related to energy intake,[9)] however, no correlation was shown between fat weight and nutrient intake in this studty. This results of this study are consistent with the report that the active persons had higher absolute energy intakes compared with inactive persons.[26)] The differences in intakes however are not reflected in the nutritional status.

Although it is reported that intakes of vitamin C, protein, haem and non-haem iron and antioxidant were positively associated with hematologic status and nutritional status respectively,[27)28)] no correlation was shown between erythropoietic nutrients and hematologic status in this study. A possible reason of this descrepancy may be the amount of intakes (deficient vs sufficient) or the age of subjects (old vs young). Because the consumption of protein, iron and other erythropoietic nutrients was more than the Korean RDA and, the subject's levels of hemoglobin and hematocrit were within the normal range, no correlation might be shown between erythropoietic nutrients and hematologic status. Also, because the blood biochemical indices of in healthy young adults are fairly well controlled in homeostatic system and are within the normal range as reported[12)14)] there might be no correlations between nutrient intake and the levels of blood pressure, hemoglobin, hematocrit, cholesterol, total protein, and albumin. Although intakes of foods of animal origin are associated with significant increases in plasma cholesterol concentrations,[11)] no correlation was shown between blood cholesterol and the inake of cholesterol nor animal fat in this study. A possible reason of this descrepancy may be the activity levels. Becacuse moderate exercise-training has been reported to increase HDL-cholesterol and improves the blood cholesterol profile[29)30)] and the activity level of subject in this study was very high (weighted resting energy expenditure factor of the subjects was 2.37 ± 0.05), no correlation might be shown between blood cholesterol and the inake of cholesterol nor animal fat in this study.

These results suggest that nutritional status as anthropometric indices and body composition is associated with nutrient intake even in young healthy adults on balanced diet, however, the nutritional status as blood biochemical indices of more active people is neither endangered nor improved in comparison with less active.

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