

## Estimation of Vitamin B<sub>6</sub> Intake and Major Dietary Sources of Vitamin B<sub>6</sub> in Elderly Koreans in the Seoul Area

Youn-Ok Cho<sup>†</sup> and Mie-Kyung Yun

Department of Food and Nutrition, Duksung Women's University, Seoul 132-714, Korea

### Abstract

Dietary intakes and sources of vitamin B<sub>6</sub> in 72 healthy Korean elderly subjects (29 men, 43 women,  $\geq 57$  years of age) living in the Seoul area were estimated using a modified Korean vitamin B<sub>6</sub> database. The dietary vitamin B<sub>6</sub> intake and food sources were estimated by the three day recall method with the help of a trained interviewer. Food portion sizes were estimated using standard household measures and published average portion sizes. The average daily vitamin B<sub>6</sub> intake was  $2.06 \pm 0.46$  mg/d in elderly men, and  $1.94 \pm 0.47$  mg/d in elderly women. Less than 5% of elderly men and 15% of elderly women consumed less than the Korean Recommended Dietary Allowance (RDA) of vitamin B<sub>6</sub>. The average ratios of vitamin B<sub>6</sub> intake to daily protein intake were  $0.03 \pm 0.01$  mg/g in both elderly men and women. The intake of vitamin B<sub>6</sub> was significantly ( $p < 0.01 \sim p < 0.001$ ) and positively correlated to intakes of all other nutrients in elderly women, but was not significantly correlated to intakes of several nutrients in elderly men. Foods from animal and plant sources provided 24% and 76%, respectively, of the total vitamin B<sub>6</sub>. Major dietary sources of vitamin B<sub>6</sub> in Korean elderly were rice, soybean sprout, kimchi, pork, beef, potatoes, garlic, onion, anchovy and kochujang. The major sources accounted for most of the vitamin B<sub>6</sub> intake with the top 20 foods providing nearly 75~76% of the total vitamin B<sub>6</sub> in Korean elderly.

**Key words:** vitamin B<sub>6</sub>, food sources, elderly

### INTRODUCTION

Vitamin B<sub>6</sub> is involved in gluconeogenesis, niacin formation, lipid metabolism, nervous system, nucleic acids, immune system and hormone modulation (1). Because vitamin B-6 metabolism and requirements may be altered in several diseases and pathological conditions, including cardiovascular heart disease, diabetes, alcoholics and asthma (2-4), maintaining adequate intakes of vitamin B<sub>6</sub> is important for optimal health in the elderly. The Korean Nutrition Society began developing a Korean Recommended Dietary Allowance (RDA) for vitamin B<sub>6</sub> in 1995 and renewed its efforts in 2000. Since there was little published data on vitamin B<sub>6</sub> status in Koreans, the Korean RDA had to be established using Western data, which is based on Western dietary habits and intakes. However, Korean dietary habits and intakes are different from Western, and nutrient requirements are affected by physio-cultural factors including race. Because vitamin B<sub>6</sub> is frequently identified as a nutrient with a high prevalence of inadequate intakes, even in Western countries (5-8), there might be a potential vitamin B<sub>6</sub> inadequacy in Korean diets.

Thus, the purpose of this study was to estimate the

dietary intake and major dietary sources of vitamin B<sub>6</sub> in Korean elderly using a modified Korean vitamin B<sub>6</sub> database (9).

### SUBJECTS AND METHODS

#### Subjects

Seventy two healthy elderly Koreans (29 men, 43 women, age  $\leq 57$ y) were interviewed from September to November of 2003. Because of the difficulties of random sampling of the elderly, convenience sampling was used in this study. The subjects comprised those who were grandparents of 'D' university students and live in the Seoul area. Characteristics of the subjects are given in Table 1.

#### Dietary intake and anthropometric data

Three-day recalls were used to record typical dietary intakes of the subjects: two weekdays and one weekend day. Subjects reported their dietary intakes with the help of a trained interviewer. Food portion sizes were estimated using standard household measures and published average portion sizes (10). Recorded food intakes were converted into vitamin B<sub>6</sub> and nutrient intakes by using

<sup>†</sup>Corresponding author. E-mail: younokcho@duksung.ac.kr  
Phone: +82-2-901-8376, Fax: +82-2-901-8376

**Table 1.** General characteristics of the subjects

	Male	Female
Age (yrs)	68.13 ± 6.87 <sup>2)</sup>	69.24 ± 7.95
Height (cm)	168.6 ± 0.06	155.4 ± 0.06
Weight (kg)	65.37 ± 8.44	56.85 ± 7.96
Body mass index (BMI) <sup>1)</sup>	22.98 ± 2.70	23.48 ± 2.06

<sup>1)</sup>Body mass index (BMI) = Weight (kg) / Height (m)<sup>2</sup>.

<sup>2)</sup>Mean ± SD.

a computerized dietary analysis program (11). When information was unavailable for a particular food, a value was assigned based on values of similar foods. The methods used for the determination of quantitative contribution of various foods to daily vitamin B<sub>6</sub> intake of the subjects followed the method of Block et al. (12). On the day of collection of dietary data, weights and heights were measured and used to calculate body mass index (BMI).

#### Statistical analysis

The statistical analysis was carried out using SAS software (SAS, Inc Cary, NC, USA). Pearson's correlation coefficient was used to determine possible relationships between vitamin B<sub>6</sub> intake and other nutrients.

## RESULTS

Table 2 shows the nutrient intakes expressed as a percentage of Korean RDA. The nutrient intakes ranged from 73% ~ 147% in elderly men and 70% ~ 138% in elderly women of the Korean RDA for their respective nutrients. The subjects' intakes of most nutrients were at levels close to or above the Korean RDA (9), except for calcium. Calcium intakes of the subjects were similar to the average intakes of the general Korean population (13) on the basis of the percent of the Korean RDA, but were above the levels considered to result in sub-clinical deficiency. These nutrient intakes were similar to those reported in the National Health and Nutrition Survey for an urban population (13).

Table 3 shows the estimated average daily intake of vitamin B<sub>6</sub>. The average daily vitamin B<sub>6</sub> intake was 2.06 ± 0.46 mg/d in elderly men, and 1.94 ± 0.47 mg/d in elderly women. The ninety fifth percentile of the subjects consumed 1.59 mg/d, which is more than the Korean RDA of 1.4 mg/d for elderly men. The eighty fifth percentile of the subjects consumed 1.46 mg/d in elderly women, which was more than the Korean RDA of 1.4 mg/d. Table 4 lists the total daily vitamin B<sub>6</sub>, mg vitamin

**Table 2.** Daily nutrient intake of the subjects

Nutrient	Male		Female	
	Mean ± SD	% of Korean RDA <sup>1)</sup>	Mean ± SD	% of Korean RDA <sup>1)</sup>
Energy (kcal)	1711.10 ± 278.11	85.56	1568.29 ± 389.86	92.25
Carbohydrate (g)	270.88 ± 42.98		250.14 ± 61.73	
Protein (g)	72.78 ± 13.48	111.97	66.30 ± 17.86	120.54
Animal protein	33.87 ± 12.32		31.01 ± 11.97	
Plant protein	37.92 ± 7.67		35.29 ± 10.05	
Fat (g)	37.27 ± 13.01		34.15 ± 13.30	
Animal fat	19.80 ± 11.34		17.13 ± 8.90	
Plant fat	17.47 ± 4.71		17.01 ± 7.95	
Cholesterol (mg)	276.21 ± 130.88		232.04 ± 93.30	
Calcium (mg)	534.18 ± 173.66	76.31	491.76 ± 187.01	70.25
Phosphorus (mg)	1053.53 ± 234.42		968.41 ± 272.15	
Iron (mg)	14.04 ± 2.71	116.99	12.70 ± 3.28	105.76
Sodium (mg)	4825.27 ± 1350.16		4286.82 ± 1183.17	
Potassium (mg)	2614.28 ± 567.02		2504.32 ± 783.10	
Vitamin A (RE)	515.24 ± 172.95	73.61	535.32 ± 281.70	76.47
Vitamin B <sub>1</sub> (mg)	1.06 ± 0.26	106.21	1.00 ± 0.23	99.86
Vitamin B <sub>2</sub> (mg)	0.96 ± 0.28	106.21	0.88 ± 0.26	73.33
Vitamin B <sub>6</sub> (mg)	2.06 ± 0.46	147.20	1.94 ± 0.47	138.28
Niacin (NE)	15.73 ± 3.79	121.03	14.08 ± 4.13	108.27
Vitamin C (mg)	69.13 ± 26.91	98.76	74.92 ± 30.89	107.02

<sup>1)</sup>Recommended dietary allowances for Koreans, 7th revision, 2000.

**Table 3.** Mean and percentile for usual intake of vitamin B<sub>6</sub> (mg/d)

Sex	Number of estimated person	Mean	Selected percentiles								
			5th	10th	15th	25th	50th	75th	85th	90th	95th
Male	29	2.06 ± 0.46	3.04 ± 0.09	2.93 ± 0.00	2.76 ± 0.00	2.37 ± 0.14	2.11 ± 0.07	1.89 ± 0.07	1.69 ± 0.06	1.59 ± 0.00	1.49 ± 0.04
Female	43	1.94 ± 0.47	3.25 ± 0.07	2.58 ± 0.19	2.36 ± 0.04	2.22 ± 0.09	2.04 ± 0.07	1.81 ± 0.09	1.46 ± 0.10	1.34 ± 0.01	1.31 ± 0.02

B<sub>6</sub>/1000 kcal, mg vitamin B<sub>6</sub>/g dietary protein intake and percentage of Korean RDA of vitamin B<sub>6</sub> for the subjects. The daily vitamin B<sub>6</sub> intake from plant and animal sources for the subjects expressed as a percentage of the total is also shown in Table 4. The average ratio of vitamin B<sub>6</sub> intake to daily protein intake was  $0.029 \pm 0.006$  mg/g in elderly men and  $0.030 \pm 0.006$  mg/g in elderly women. Foods from animal and plant sources provided approximately 24% and 76% of the total vitamin B<sub>6</sub> intake in elderly regardless of gender.

There were significant correlations between vitamin B<sub>6</sub> intake and other nutrient intakes (Table 5). As expected, vitamin B<sub>6</sub> intake was positively correlated with all other nutrients in elderly women. However, no significant correlations were found between the intake of vitamin B<sub>6</sub> and the intakes of plant protein, animal fat, carbohydrate, calcium, vitamin A, vitamin B<sub>2</sub> and niacin in the elderly. The percentages of the population consuming various foods rich in vitamin B<sub>6</sub> are shown in

**Table 4.** Dietary vitamin B<sub>6</sub> intake of the subjects

	Male	Female
Vitamin B <sub>6</sub> per day (mg/d)	$2.06 \pm 0.46$	$1.94 \pm 0.47$
Vitamin B <sub>6</sub> per 1000 kcal (mg/1000 kcal)	$1.22 \pm 0.25$	$1.26 \pm 0.24$
Vitamin B <sub>6</sub> per g protein (mg/g protein)	$0.03 \pm 0.01$	$0.03 \pm 0.01$
Vitamin B <sub>6</sub> from plant foods (%)	$75.91 \pm 0.07$	$75.74 \pm 0.07$
Vitamin B <sub>6</sub> from animal foods (%)	$24.10 \pm 0.09$	$24.26 \pm 0.10$

**Table 5.** Correlation between vitamin B<sub>6</sub> intake and nutrients intake of the subjects

Nutrients	Vitamin B <sub>6</sub> intake (mg)	
	Male	Female
Energy (kcal)	0.458** <sup>1)</sup>	0.741***
Total protein (g)	0.510**	0.736***
Animal protein (g)	0.396*	0.630***
Plant protein (g)	0.261	0.558***
Total fat (g)	0.401*	0.678***
Animal fat(g)	0.272	0.404*
Plant fat (g)	0.453*	0.682***
Carbohydrate (g)	0.313	0.611***
Ca (mg)	0.137	0.718***
P (mg)	0.558**	0.814***
Fe (mg)	0.531**	0.746***
Na (mg)	0.400*	0.610***
K (mg)	0.389*	0.715***
Vitamin A (RE)	0.345	0.547***
Vitamin B <sub>1</sub> (mg)	0.566**	0.755***
Vitamin B <sub>2</sub> (mg)	0.331	0.708***
Niacin (NE)	0.315	0.664***
Vitamin C (mg)	0.396*	0.324*
Cholesterol (mg)	0.352	0.583***

<sup>1)</sup> p-value, \*Significant at  $p < 0.05$ , \*\*Significant at  $p < 0.01$ , \*\*\*Significant at  $p < 0.001$ .

Table 6. The 50 major food sources of vitamin B<sub>6</sub> in the diet provided 92~93% of the total daily vitamin intake and the top 20 foods provided 75~76% of total vitamin B<sub>6</sub> in both genders. Rice was the first rank contributor accounting for 16~18% of the daily intake of vitamin B<sub>6</sub> in both men and women. Major dietary sources of vitamin B<sub>6</sub> in Korean elderly were rice, soy-bean sprout, kimchi, pork, beef, potatoes, garlic bulb, onion, anchovy and kochujang. Table 7 lists the 20 foods reported by the subjects with the highest vitamin B<sub>6</sub> content expressed per serving and per 100 g of food. A comparison of Table 6 and 7 reveals that the top 10 foods in the two tables had only 2 foods in common. Seven foods of the top 10 foods in Table 6, namely rice, kimchi, pork, beef, garlic bulb, onion, anchovy were not present in Table 7.

## DISCUSSION

This study provides the data for estimation of vitamin B<sub>6</sub> intakes and major food sources of vitamin B<sub>6</sub> in elderly Koreans. The average vitamin B<sub>6</sub> intake of elderly Korean male subjects older than 57 years was 2.06 mg/d, which was similar to 2.04 mg/d for elderly men aged 51~70 years in the CSFII study (14) and 2.10 mg/d for elderly men aged 51~70 years in NHANES III (15). However, it was higher than the 1.3 mg/d for elderly men over age 60 years in the BNSSE study (16). The average vitamin B<sub>6</sub> intake of elderly Korean women subjects older than 57 years was 1.94 mg/d, which was higher than the 1.50 mg/d for elderly women aged 51~70 years in CSFII (14), 1.69 mg/d for elderly women aged 51~70 years in NHANES III (15) and 1.1 mg/d for elderly women over age 60 in the BNSSE study (16), respectively. Thus, the intakes and status of vitamin B<sub>6</sub> in elderly Koreans in the Seoul area were better than or similar to those of American elderly in the CSFII, NHANES III and BNSSE studies. The adequacy of vitamin B<sub>6</sub> intakes for meeting dietary requirements is also influenced by the bioavailability of the vitamin from different food sources. The bioavailability of vitamin B<sub>6</sub> from food varies because the bioavailability of vitamin B<sub>6</sub> is reduced when it is conjugated with  $\beta$ -glucosides (17). Thus, if considering the bioavailability of vitamin B<sub>6</sub>, the available vitamin B<sub>6</sub> in Korean elderly could not be more than that of American elderly, because Korean elderly in this study obtained 76% of their vitamin B<sub>6</sub> from plant sources, whereas approximately one-half of the dietary vitamin B<sub>6</sub> was reported to come from meat and one-half from plant-based foods in Americans (15).

The vitamin B<sub>6</sub> intakes of elderly Koreans were 147% of the Korean RDA in elderly men and 138% of the Ko-

**Table 6.** Major dietary sources of vitamin B<sub>6</sub> for subjects  
▷ Male

Rank	Description	Percent of total Vitamin B <sub>6</sub>	Cumulative percent of Vitamin B <sub>6</sub>	Percent of population
1	Rice products, paddy rice, cooked rice, undermilled	16.46	16.46	100.00
2	Soybean sprout, raw	13.88	30.34	68.97
3	Kimchi, Korean cabbage	7.30	37.63	100.00
4	Pork, loin, raw	5.31	42.95	82.76
5	Beef, imported cattle, frank, raw	4.84	47.78	100.00
6	Potatoes, raw	3.49	51.27	75.86
7	Galic, bulb, raw	2.97	54.25	100.00
8	Onion, raw, domestic	2.84	57.09	96.55
9	Anchovy boiled-dried	2.55	59.63	100.00
10	Kochujang (fermented 5% red pepper soybean paste)	2.31	61.95	93.10
11	Yellow croacker, raw	1.87	63.82	48.28
12	Pepper, green pepper, native	1.54	65.36	96.55
13	Red pepper powder	1.45	66.80	100.00
14	Small red bean, dried	1.43	68.23	93.10
15	Soybean, black soybeans	1.23	69.46	48.28
16	Chicken's egg whole egg, fresh	1.22	70.69	96.55
17	Sugar, white sugar	1.21	71.90	100.00
18	Hair tail, raw	1.17	73.07	93.10
19	Soybean paste	1.09	74.17	48.28
20	Barley, naked barley, milled	1.02	75.18	96.55
21	Chicken, meat and skin, raw	1.01	76.19	100.00
22	Starch syrup	1.01	77.20	44.83
23	Radish, Korean radish, root	0.93	78.13	34.48
24	Spanish mackerel, raw	0.92	79.04	79.31
25	Soybean curd, pressed	0.83	79.88	96.55
26	Sorghum, milled grain	0.77	80.65	44.83
27	Glutinous millet	0.77	81.42	82.76
28	Cow's milk, ordinary liquid milk	0.74	82.16	37.93
29	Buckwheat noodle, wet form, raw	0.73	82.89	24.14
30	Mungbean, sprout, raw	0.73	83.62	13.79
31	Carrot, raw	0.70	84.32	75.86
32	Spanish mackerel, raw	0.62	84.94	6.90
33	Udong, boiled	0.62	85.56	6.90
34	Spinach, raw cultivation	0.61	86.17	44.83
35	Soy sauce	0.60	86.78	100.00
36	Loaf bread	0.60	87.38	17.24
37	Fast food, Pizza	0.55	87.93	6.90
38	Pacific saury, raw	0.53	88.46	10.34
39	Sweet potatoes, raw	0.51	88.97	6.90
40	Lettuce, native	0.49	89.46	31.03
41	Welsh onion	0.46	89.92	100.00
42	Pumpkin, immature, raw	0.46	90.38	86.21
43	Curry, Ottogi	0.46	90.84	10.34
44	Mackerel, raw	0.42	91.26	10.34
45	Cucumber, improved	0.42	91.68	65.52
46	Fish paste, fried	0.38	92.06	24.14
47	Shad, salt-fermented	0.33	92.40	3.45
48	Strawberry, raw, native	0.32	92.72	13.79
49	Banana, fresh	0.28	93.00	6.90
50	Common squid, raw	0.27	93.27	62.07

**Table 6.** Continued  
▷ Female

Rank	Description	Percent of total Vitamin B <sub>6</sub>	Cumulative percent of Vitamin B <sub>6</sub>	Percent of population
1	Rice products, paddy rice, cooked rice, undermilled	17.78	17.78	100.00
2	Soybean sprout, raw	11.29	29.08	72.09
3	Kimchi, Korean cabbage	7.57	36.64	100.00
4	Beef, imported cattle, frank, raw	5.57	42.21	88.37
5	Pork, loin, raw	6.18	48.40	86.05
6	Potatoes, raw	3.85	52.25	93.02
7	Onion, raw, domestic	3.11	55.36	100.00
8	Galic, bulb, raw	2.88	58.24	100.00
9	Anchovy boiled-dried	2.62	60.85	100.00
10	Yellow croacker, raw	2.31	63.17	39.53
11	Kochujang (fermented 5% red pepper soybean paste)	1.76	64.93	83.72
12	Small red bean, dried	1.71	66.64	51.16
13	Pepper, green pepper, native	1.38	68.02	100.00
14	Sugar, white sugar	1.37	69.39	95.35
15	Red pepper powder	1.26	70.65	100.00
16	Udong, boiled	1.22	71.87	13.95
17	Soybean paste	1.19	73.06	97.67
18	Hair tail, raw	1.16	74.22	32.56
19	Spinach, raw cultivation	1.05	75.28	58.14
20	Starch syrup	1.01	76.29	72.09
21	Chicken's egg whole egg, fresh	1.01	77.30	88.37
22	Carrot, raw	1.00	78.30	79.07
23	Cow's milk, ordinary liquid milk	0.96	79.27	37.21
24	Chicken, meat and skin, raw	0.96	80.22	39.53
25	Mungbean, sprout, raw	0.93	81.15	51.16
26	Glutinous millet	0.93	82.07	51.16
27	Spanish mackerel, raw	0.87	82.94	39.53
28	Sweet potatoes, raw	0.79	83.73	4.65
29	Soybean curd, pressed	0.74	84.47	93.02
30	Soybean, black soybeans	0.72	85.19	46.51
31	Soy sauce	0.66	85.84	97.67
32	Lettuce, native	0.63	86.47	39.53
33	Fish paste, fried	0.57	87.04	25.58
34	Mackerel, raw	0.49	87.53	20.93
35	Welsh onion	0.47	88.01	100.00
36	Barley, naked barley, milled	0.46	88.46	13.95
37	Grape	0.45	88.91	46.51
38	Pumpkin, immature, raw	0.38	89.29	88.37
39	Curry, Ottogi	0.33	89.62	6.98
40	Fast food, Pizza	0.30	89.92	4.65
41	Perilla leaf, raw	0.28	90.20	37.21
42	Bracken, raw	0.27	90.48	27.91
43	Cucumber, improved	0.26	90.74	55.81
44	Korean cabbage, raw	0.26	91.00	20.93
45	Lentinus edodes, raw	0.26	91.26	30.23
46	Chestnuts, raw	0.25	91.51	11.63
47	Galic, young stem	0.23	91.74	6.98
48	Alaska pollack, raw	0.23	91.97	20.93
49	Salt, table salt	0.23	92.20	100.00
50	Perilla seeds, powder	0.22	92.42	13.95

**Table 7.** Vitamin B<sub>6</sub> content of foods reported by the subjects

	Rank	Description	Vitamin B <sub>6</sub> (mg/serving)	Vitamin B <sub>6</sub> (mg/100 g)
Male	1	Wild garlic	0.67	0.96
	2	Mungbean, sprout, raw	0.67	0.96
	3	Soybean sprout, raw	0.67	0.96
	4	Galic, young stem	0.38	0.96
	5	Potatoes, raw	0.35	0.27
	6	Fast food, Pizza	0.33	0.22
	7	Sikhye (Sweet rice beverage)	0.30	0.30
	8	Common sea bass, raw	0.28	0.40
	9	Water melon	0.27	0.11
	10	Cinnamon tea	0.27	0.27
	11	Sweet potatoes raw	0.27	0.27
	12	Tcha Jang, Black noodle sauce pasta type	0.26	0.22
	13	Starch syrup	0.24	0.72
	14	Sea bream, blanguillo	0.23	0.46
	15	Pork, loin, raw	0.22	0.57
	16	Pacific saury, raw	0.22	0.45
	17	Sandwiches, Ham subway	0.21	0.14
	18	Kochujang (Fermented 5% red pepper soybean paste)	0.20	1.03
	19	Spanish mackerel, raw	0.20	0.40
	20	Banana, fresh	0.19	0.32
Female	1	Wild garlic	0.67	0.96
	2	Mungbean, sprout, raw	0.67	0.96
	3	Soybean sprout, raw	0.67	0.96
	4	Tomato, raw	0.50	0.20
	5	Cream-jam bread	0.48	0.60
	6	Toro	0.40	0.80
	7	Potatoes, raw	0.35	0.27
	8	Fast food, Pizza	0.33	0.22
	9	Sikhye (Sweet rice beverage)	0.30	0.30
	10	Water melon	0.27	0.11
	11	Sweet potatoes raw	0.27	0.27
	12	Ssanghwa tea	0.27	0.27
	13	Tcha Jang, Black noodle sauce pasta	0.26	0.22
	14	Starch syrup	0.24	0.72
	15	Sea bream, blanguillo	0.23	0.46
	16	Pork, loin, raw	0.22	0.57
	17	Havest fish	0.22	0.45
	18	Sandwiches, Ham subway	0.21	0.14
	19	Kochujang (fermented 5% red pepper soybean paste)	0.20	1.03
	20	Spanish mackerel, raw	0.20	0.40

rean RDA in elderly women, respectively. If the average intake is the amount needed to prevent clinical signs of vitamin B<sub>6</sub> deficiency, and because the subjects exhibited no clinical signs of vitamin B<sub>6</sub> deficiency, it is concluded that either Korean elderly in this study consumed sufficient quantities of vitamin B<sub>6</sub> or the Korean RDA for vitamin B<sub>6</sub> in this age group was lower than the level that needed to meet requirements for vitamin B<sub>6</sub>. The vitamin B<sub>6</sub> requirement is affected by the level of dietary protein intake, with the requirement growing with increasing protein consumption (18,19). For comparative purposes, the requirement was also estimated assuming that there is a direct relationship between protein intake and the B<sub>6</sub> requirement. Hence, the adequacy of dietary intakes of the vitamin is frequently evaluated in terms

of mg vitamin B<sub>6</sub>/g protein consumed (2). The Korean RDA for vitamin B<sub>6</sub> is based on the ratio of 0.02 mg/g dietary protein and is set at the same level as for younger adults. In this study, the average ratios of vitamin B<sub>6</sub> intake to daily protein intake were 0.03 mg/g. Thus, when this criteria was applied to the protein intake data, the intakes for elderly were judged to be unreasonably high. As with the elderly, there is no compelling evidence to suggest that requirements should be adjusted to protein intake, and vitamin B<sub>6</sub> status typically declines with aging (20), although the absorption of vitamin B<sub>6</sub> is not affected by aging (21).

As expected, there were positive correlations between vitamin B<sub>6</sub> intake and all other nutrient intakes in elderly women in this study. However, no significant correla-

tions were shown between the intake of vitamin B<sub>6</sub> and the intakes of plant protein, carbohydrate, calcium, vitamin A, vitamin B<sub>2</sub> and niacin. The reason of this discrepancy might be that these nutrients intakes were less varied in elderly men than in elderly women. Dietary contributors of vitamin B<sub>6</sub> for Koreans are less varied than those for Americans in the NHANES study. Rice makes a substantial contribution (16~18%) to the daily vitamin B<sub>6</sub> intake in the Korean diet and other major food sources are also plant sources; it is important to note that the bioavailability of vitamin B<sub>6</sub> from plant sources is known to be less than that from animal sources (22). Among the major dietary sources of vitamin B<sub>6</sub>, the top 20 foods provided 75~76% of total vitamin B<sub>6</sub>, whereas the top 10 foods provided nearly 76% of total vitamin B<sub>6</sub> in Korean young men (23) and the top 20 foods provided nearly 70% of total vitamin B<sub>6</sub> in Korean young women (24). Thus, it can be concluded that the dietary sources of vitamin B<sub>6</sub> in the Korean elderly are less varied than those of young Koreans. Although the vitamin B<sub>6</sub> content of rice is only 0.11 mg/100 g, it was the largest contributor to the total intake because it was consumed very frequently and in large amounts. Also, kimchi, a Korean style pickled vegetable, is not is not very high in vitamin B<sub>6</sub>, with vitamin B<sub>6</sub> content of 0.11 mg/serving, but still provided 7.3~7.6% of the total daily vitamin intake because of its frequency and amounts usually consumed. Therefore, it is suggested that Korean elderly, in this study, consumed sufficient amount of vitamin B<sub>6</sub>. However, considering the major food sources of vitamin B<sub>6</sub>, it is suggested that the supply of vitamin B<sub>6</sub> for Korean elderly should be based on not only sufficient amounts but also varied food sources. Furthermore, because the subjects of this study were the grandparents of college students and lived in the Seoul area, the elderly subjects of this study were assumed to be economically upper middle class. Therefore, the nutrients intakes of these subjects might be greater than those of the elderly in rural area or the elderly living alone.

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#### REFERENCES

1. Leklem JE. 1996. Vitamin B<sub>6</sub>. In *Present knowledge in nutrition*. 7th ed. Ziegler EE, Filer LJ, eds. ILSI press, Washington DC. p 174-183.
2. Driskell JA. 1994. Vitamin B-6 requirements of humans. *Nutr Res* 14: 293-324.
3. Donald EA. 1986. Nutritional aspects of vitamin B<sub>6</sub>. In

- Vitamin B<sub>6</sub>, pyridoxal phosphate, chemical, biochemical and medical aspects*. Dolphin D, Poulson R, Avramovic O, eds. John Wiley and Sons, New York. p 477-506.
4. Meydani SN, Ribaya-Mercado JD, Russell RM, Sahyoun N, Morrow FD, Gershoff SN. 1991. Vitamin B<sub>6</sub> deficiency impairs interleukin 2 production and lymphocyte proliferation in elderly adults. *Am J Clin Nutr* 53: 1275-1280.
  5. Kant AK, Block G. 1990. Dietary vitamin B<sub>6</sub> intake and food sources in the US population: NHANES II, 1976~1980. *Am J Clin Nutr* 52: 707-716.
  6. Lowik MH, Van Poppel G, Wedel M, Berg HVD, Schrijver J. 1990. Dependence of vitamin B<sub>6</sub> status assessment on alcohol intake among elderly men and women (Dutch Nutrition Surveillance System). *J Nutr* 120: 1344-1351.
  7. Ribaya-Mercado JD, Russell RM, Sahyoun N, Morrow FD, Gershoff SN. 1991. Vitamin B<sub>6</sub> requirements of elderly men and women. *J Nutr* 121: 1062-1074.
  8. Selhub J, Jacques PF, Wilson PWF, Rush D, Rosenberg IH. 1993. Vitamin status in intakes as primary determinants of homocysteinemia in an elderly population. *J Am Med Assoc* 270: 2693-2698.
  9. The Korean Nutrition Society. 2000. *Recommended dietary allowance for Koreans*. Jungangmoonhwasa, Seoul.
  10. Korean Dietetic Association. 1995. *Food exchange list*. Korean Dietetic Association, Seoul.
  11. Korean Nutrition Society. 2002. Computer Aided Nutritional analysis program for Professionals.
  12. Block G, Dresser CM, Hartman AM, Carroll MD. 1985. Nutrient sources in the American diet: quantitative data from NHANES II survey. Part I: vitamins and minerals. *Am J Epidemiol* 122: 13-26.
  13. Ministry of Health and Welfare. 1999. *National nutrition survey report*. Korea.
  14. Dodd KW, Carriquiry AL. 1997. *Usual intake distributions for selected B vitamins*. A report prepared for the food and nutrition board of the national academy of sciences.
  15. Institute of medicine. 1998. *Dietary reference intakes for thiamin, riboflavin, niacin, vitamin B<sub>6</sub>, folate, vitamin B<sub>12</sub>, pantothenic acid, biotin, and choline (prepublication copy)*. National Academy Press, Washington DC.
  16. Hartz SC, Russell RM, Rosenberg IH. 1992. *Nutrition in the elderly*. The Boston nutritional status survey. Smith Gordon, London.
  17. Kabir H, Leklem JE, Miller LT. 1983. Relationship of the glycosylated vitamin B<sub>6</sub> content of foods to vitamin B<sub>6</sub> bioavailability in humans. *Nutr Rep Int* 28: 709-716.
  18. Baker EM, Canham JE, Nunes WT, Sauberlich HE, McDonald ME. 1964. Vitamin B<sub>6</sub> requirement for Adult men. *Am J Clin Nutr* 15: 59-66.
  19. Miller LT, Linkswiler HM. 1967. Effect of protein on the development of abnormal tryptophan metabolism by men during vitamin B<sub>6</sub> depletion. *J Nutr* 93: 53-59.
  20. Rose CS, Gyorgy P, Butler M. 1976. Age differences in vitamin B<sub>6</sub> status of 617 men. *Am J Clin Nutr* 29: 847-853.
  21. Ferroli CE, Trumbo PR. 1994. Bioavailability of in young and older man. *Am J Clin Nutr* 60: 68-71.
  22. Reynolds RD. 1990. Determination of dietary vitamin B<sub>6</sub> intake: is it accurate? *J Am Diet Assoc* 90: 799-801.
  23. Cho Y, Kim B. 2003. Dietary intake and major food sources of vitamin B<sub>6</sub> in Korean young men. *FASEB J* (abstract), No. 439.3.
  24. Cho Y, Yoon M, Choi E. 2004. Dietary intake and major food sources of vitamin B<sub>6</sub> in Korean young women. *FASEB J* (abstract), No. 3664.

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