Calcium Requirement and Its Intake of the Elderly in Japan: An Attempt to Improve Its Intake

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Estimation of calcium requirement of the elderly Japanese

Only few data are available for estimation of the requirement for calcium of elderly Japanese. Results of some balance studies on elderly Japanese, including patients with osteoporosis, suggest that the average intakes of calcium required for maintaining positive balance are in the range of 10–17 mg/kg (1, 2). Based on these data and the average body weight of Japanese over 60 years of age, the calcium requirement can be estimated to be 510–970 mg per day for a male, and 440–860 mg per day for a female.

In the new version of the RDA for Japanese, revised in 1984, an allowance of 600 mg per day of calcium is tentatively recommended for the elderly over 60 years of age, with an irrational comment as follows: "Although the requirement of calcium of the aged is considered to be higher than that of young adults for maintaining their bone health, the allowance of 600 mg is recommended for both males and females over 60 years of age, because of the difficulties in changing dietary habits of the elderly Japanese (3)."

It has been pointed out that manipulation of calcium intake in the study of calcium requirement produces balance changes that are not immediately representative of a true equilibrium situation, and thus the true nutritional effect of an altered intake cannot be determined in short term studies (4). This suggests that longitudinal studies or long-lasting intervention trials are essential for elucidation of the relationship between the dietary intake of calcium and bone health of the aged.

Calcium intake of the elderly Japanese

Although the National Nutrition Survey has been conducted every year in our country since

1964, estimation of nutrients intake for persons by age is not available, because the measures have only been made for each sample family, and not for each sample person. For estimation of calcium intake of the elderly, we reviewed 30 fragmentary reports, which appeared between 1970 and 1984. These reports include data from 42 populations residing in 16 areas in Japan, including 6 populations of the disabled and 5 populations of the institutionalized. The total number of individuals studied was about 3,200; about 40% were men and 60% were women. In each study weighing food items, keeping food records, or dietary recall was used as a method for the estimation of nutrient intake.

Figure 1 shows the average calcium intake of each population plotted against the year in which the values were reported. The solid line indicates the RDA of calcium for the elderly over 60 years of age. Although the average intakes of calcium of the populations surveyed were in the range of 250–700 mg per person per day, only 6 of 93 values reported were above the RDA of 600 mg. No significant correlation between calcium intake and the age of the population was observed.

As milk is one of the good dietary sources of calcium, we also reviewed 17 reports which appeared between 1970 and 1982, on the consumption of milk and its products by the elderly Japanese. These reports include data of 23 populations. The total number of individuals surveyed was 1,500; about 30% were men and 70% were women. Figure 2 shows the average of the consumption of milk and its products of each population surveyed plotted against the year in which the values were reported. Although the averages of consumption of milk and its products were in the range of 20–200 g per person per day, 29 of 37

Fig. 1. Intake of calcium in various populations reported between 1970 and 1984. ○, male; △, female; □, both; ●, ▲, ■, institutionalized or disabled. Solid line indicates RDA.

values reported were below 100 g per person per day. The solid line indicates the slight increase in the average of the consumption of milk and its products in our country per person per day during this period.

In 1982, consumption of milk and its products in our country is still 124.2 g per person per day and it is estimated that 20.7% of total calcium intake is from milk. Thus, increasing consumption of milk and its products seems to be a wise measure to increase the calcium intake of the elderly in Japan.

A trial for improvement of calcium intake of healthy elderly volunteers

Our laboratory has been conducting a longitudinal trial which is designed to determine the prevalence of subclinical malnutrition among the aged and to improve it by nutrition education. This report presents the nutritional status of the participants, with regard to calcium, and the results of the trials, and their improvement after one year of the nutrition counseling program.

Subjects and methods. Sixty-one men ($n=27$) and women ($n=31$) from Nagano-city area were recruited for the trial. Only volunteers 60 years of age or older without known medical illness, except hypertension or adult-onset diabetes mellitus, which were well controlled, were selected. Average ages were 67.2 ± 1.6 (62–72) for men and 66.9 ± 1.7 (63–71) for women.

All food items and portions consumed 3 successive weekdays were recorded by participants on

Fig. 2. Consumption of milk and its products in various populations reported between 1970 and 1982. ○, male; △, female; □, both; ■, institutionalized or disabled. Solid line indicates consumption of milk and its products per person per day in Japan.

a standard form. At the end of the three days' recording period, all participants were interviewed by dietitians as outpatients in the Center for Health Promotion in Nagano-city. At this time, food records were subjectively evaluated for completeness and accuracy, with participants being asked to provide additional information about any unclear food items, using commercial plastic food models in judging portion size. All food records were analyzed for nutrient consumption, using a food composition table (5). Consumption of milk and its products were also estimated from the food records.

Fasting blood samples were drawn at the visit of the Center for Health Promotion. The biochemical analysis of the blood, with regard to calcium nutrition and bone health, includes serum concentrations of Ca, P, and the activity of alkaline phosphatases.

Coefficient of bone density of phalanx 5-2, in relation to the thickness of a standard aluminum step wedge, was measured densitometrically from a finger X-ray film, according to the methods of Albanese (6).

After the initial health and nutrition examination survey, a nutrition counseling program was started. The counseling was conducted three times a year, based on the data of each participant, obtained from analyses of nutrients intake, anthropometrical measures and biochemical findings.

Table 1. Pre- and posteducational values of mean daily intake of selected nutrients.

Nutrients	Male		Female	
	Before	After	Before	After
Energy (kcal)	1,959(501)	1,907(411)	1,609(324)	1,659(287)
Ca (mg)	676(296)	752(326)	608(202)	682(161)
Protein (g)	76(20)	74(18)	68(14)	69(13)
Mean (SD).				

Table 2. Percentage of men and women receiving less than 100 and 75% RDA.

Nutrients	Male				Female			
	Before		After		Before		After	
	<100	<75	<100	<75	<100	<75	<100	<75
Energy	56	26	63	15	61	19	61	19
Ca	41	22	37	4	58	23	39	9
Protein	33	7	33	4	26	7	16	3

Table 3. Changes in consumptions of milk and its products.

	Male		Female	
	Before	After	Before	After
Milk and its products (g)	110(141)	186(133)	131(92)	200(98)
Ca from milk (%)	13(15)	20(16)	17(13)	25(14)
Fat from milk (%)	7(9)	12(10)	7(6)	11(7)
Mean (SD).				

Table 4. Pre- and posteducational values for selected anthropometrical and biochemical indices.

	Male		Female	
	Before	After	Before	After
Height (cm)	159.6(6.7)	159.5(6.3)	147.2(5.0)	147.3(4.9)
Weight (kg)	56.2(9.9)	55.1(9.8)	50.3(8.6)	49.7(8.4)
BMI	22.0(2.7)	21.5(2.6)	23.2(3.5)	22.9(3.5)
Triglyceride (mg/dl)	119.4(104.5)	121.6(117.2)	121.1(61.6)	114.5(56.9)
Cholesterol (mg/dl)	182.0(42.1)	178.2(33.8)	202.8(25.8)	205.2(28.1)
Ca (mg/dl)	9.8(0.8)	9.4(0.6)	9.5(1.2)	9.2(0.7)
Alkaline phosphatase ^a	69.3(27.0)	70.0(27.2)	82.6(24.5)	82.6(19.5)

^a According to Bessey-Lowry (mu/ml). Mean (SD).

Participants were allowed to remain on self-selected diets. Nutrition education, being intended for increasing the consumption of good sources of calcium, especially milk, without excessive energy intake, was conducted for all the participants.

Results. Average values of the coefficient of bone density of the participants were 3.39 ± 0.40 and 2.89 ± 0.34 mm of aluminum for men and women, respectively. These values were 119 ± 14 and $124 \pm 15\%$ for men and women, respectively, of the values reported for normal healthy Americans, age 65–75 (6).

Table 1 gives mean intakes of energy, calcium and protein before and after the one year of nutrition education. Before the education, mean calcium intake was $113 \pm 49\%$ and $101 \pm 34\%$ of the RDA for men and women, respectively. After the education, these values were $125 \pm 54\%$ and $114 \pm 27\%$ for men and women, respectively.

Table 2 gives the percentage of men and women receiving these three nutrients, which are less than 100% and 75% of the RDA's. After the education, percentage of the participants receiving less than 75% of the RDA for calcium markedly decreased. No increase in intake of energy was observed. Table 3 shows the values of the consumption of milk and its products before and after the nutrition education. Before the education, the consumption of milk and its products per day was less than 100 g for 48% of men and 36% of women. After the education these values decreased to 26% for men and 10% for women. In this table, changes in percentages of calcium and fat from milk are also presented. As shown in Table 4 no tendency of increasing in BMI or concentrations of serum lipids was observed after the one year of nutrition education.

Discussion. It is well recognized that marginal deficiencies of various nutrients, including calcium, are prevailing among the elderly. Although increasing consumption of milk and its products is one of good measures to improve cal-

cium nutrition in the elderly, there is some limitations in this measure in our country. First, milk and its products are not necessarily a popular food item among the elderly Japanese. Second, prevalence of lactase deficiency is relatively high in our country. In the trial described above, increasing the consumption of milk and its products and improvement in the calcium intake of the population were observed after one year of nutrition education. But the consumption of milk and its products is still less than 100 g per day per person, in 26% of men and 10% of women.

In intervention trials designed to improve the nutritional status of the elderly by nutrition education or counseling, it is important to avoid an unnecessary increase in energy intake, because there is a tendency to increase the percentage of body fat with increasing age, and excessive accumulation of fat probably is associated with a number of diseases in some way. The results of anthropometrical measures and biochemical analyses of the participants in this trial suggest that the one year of nutrition education was effective in improving their calcium intake without increasing energy intake.

To confirm the effect of the nutrition education on bone health of this population, a follow-up study is now in progress.

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