Phosphorus Supply per Capita from Food in Japan between 1960 and 1995

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Summary The awareness of phosphorus intake is important because hyperphosphatemia and hypophosphatemia both impair bone metabolism. Phosphorus consumption from food was obtained from values in the Food Balance Sheet (FBS) of Japan from 1960 to 1995. The amounts of phosphorus calculated from the FBS increased gradually from 1,243 mg/d in 1960 to 1,332 mg/d in 1975 and to 1,421 mg/d in 1995. This is explained by the increased consumption of cow's milk and milk products, meat, and chicken eggs. The main foods supplying phosphorus in 1995 were cereals, milk and milk products, fishes and shellfishes, and vegetables; their contributions were 24.4, 1.58, 14.2, and 10.9%, respectively. The phosphorus-to-calcium ratio calculated from the FBS was 3.51 in 1960, which decreased to 2.89 in 1975 and 2.44 in 1995. Therefore total phosphorus consumption in 1995 was presumably more than 1,500 mg/d when imported food containing phosphorus and the consumption of phosphorus-containing food additives in Japan are also considered. These findings suggest that the phosphorus consumption estimated from the FBS is increasing and that more attention should be paid to the maintenance of healthy bones in Japan, where the average amount of calcium intake is less than 600 mg/d.

Key Words phosphorus, calcium, the Food Balance Sheet, diet, bone

Phosphorus is an important nutrient in the processes of glycolysis, gluconeogenesis, energy metabolism, and bone metabolism (1). The daily recommended dietary allowance (RDA) of phosphorus is not strictly determined, but the appropriate amount is thought to be from half to twice the calcium intake (2). Hyperphosphatemia frequently observed in chronic renal failure leads to decreased 25-hydroxyvitamin D-1α-hydroxylase activity and 1,25-dihydroxyvitamin D concentration, which reduces intestinal calcium absorption and stimulates parathyroid hormone excretion (3, 4). Parathyroid hormone accelerates the release of bone mineral and results in osteitis fibrosa and ectopic calcification (5). In contrast, hypophosphatemia, resulting from impaired renal phosphate reabsorption manifesting rickets and osteomalacia, is treated with supplemental vitamin D and phosphorus (6). These findings suggest that the attention to the amount of daily phosphorus is important in the maintenance of healthy bones.

Protein intake, particularly animal protein, has markedly increased because of recent changes in diet in Japan. The use of phosphorus-containing food additives has also increased 17% over the last decade (7). This suggests that the phosphorus intake from food and additives is increasing. In a survey in the United States, phosphorus intake has increased, but the amount of phosphorus as food additives was not completely estimated (8). Several studies on the amount of phosphorus intake in Japanese reported 1,200–1,300 mg/d from 1980 to 1982 (9–12). To understand the situation of Japanese food intake, the National Nutrition Survey (NNS) was conducted by the Ministry of Health and Welfare of Japan. However, the amount of phosphorus intake has not been reported, though the daily calcium intake in adults was reported to be lower than the 600 mg/d of RDA in Japan. The Food Balance Sheet (FBS), which shows the demand and supply of staple foods, was prepared by the Minister’s Secretariat, Ministry of Agriculture, Forestry and Fisheries, according to the form requested by the Food and Agriculture Organization of the United Nations (FAO). The FBS depicts the overall pattern of a nation’s food supply and utilization. Therefore this information is useful for an understanding of the trend in food supply, the level and composition of supplied nutrients, and the pattern of food consumption change year by year. To understand the transition of phosphorus intake in Japan, we therefore calculated the amount of phosphorus from food from the values in the FBS and compared it with those from the NNS for every 5 y from 1960 to 1995.

MATERIALS AND METHODS

The food supply information was obtained from the FBS. All foods in the food consumption database were divided into 16 major food groups according to the major ingredients of the food following the FBS’s food-
grouping classification system. The 16 groups included cereals, potatoes and sweet potatoes, starches, pulses, vegetables, fruits, meats, chicken eggs, cow's milk and milk products, fishes and shellfishes, seaweeds, sugar, fats and oils, miso bean paste, soy sauce. The per capita estimate of each food item was calculated by dividing the total supply of each food available for human consumption by the population of Japan (Table 1). The amounts of calcium and phosphorus content in 100 g of each group were obtained by multiplying the calculated percent contribution of each food in each group shown in Table 1 and the values of calcium and phosphorus content referring to the fourth Japanese Food Composition Table prepared by the Department of Scientific Technology of Japan (13) (Table 2).

**RESULTS**

The transition of calcium and phosphorus consumption calculated from the FBS

The daily personal possible consumption of calcium and phosphorus was obtained from the per capita estimate of each food item shown in Table 1 and those contents in 100 g of each food group shown in Table 2 (Tables 3 and 4). The amounts of calcium and phosphorus calculated from the FBS increased gradually from 354 mg/d and 1,243 mg/d in 1960 to 461 mg/d and 1,332 mg/d in 1975 and to 582 mg/d and 1,421 mg/d in 1995, respectively. The percentages of calcium and phosphorus consumption in 1995 was 126% and 107% of those in 1975 and 165% and 114% of those in 1960. In contrast, the amount of calcium intake in the NNS increased from 389 mg/d in 1960 to 552 mg/d in 1975, but it did not change significantly after that and

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**Table 1.** The amounts of daily personal food consumption calculated from the Food Balance Sheet.

| Year | 1960 | 1965 | 1970 | 1975 | 1980 | 1985 | 1990 | 1995 |
|------|------|------|------|------|------|------|------|------|
| Cereals | 408.8* | 397.4 | 351.6 | 339.1 | 309.4 | 295.6 | 283.6 | 278.9 |
| Rice | 314.9 | 306.2 | 260.6 | 240.6 | 216.3 | 204.3 | 191.9 | 185.3 |
| Wheat | 70.6 | 79.4 | 84.3 | 86.1 | 88.3 | 86.9 | 86.9 | 89.6 |
| Barley | 10.6 | 5.4 | 2.0 | 2.7 | 1.4 | 0.8 | 0.5 | 0.6 |
| Rye | 11.6 | 4.5 | 2.3 | 0.4 | 0.4 | 0.3 | 0.2 | 0.2 |
| Corn | 0.4 | 0.6 | 1.1 | 0.9 | 1.5 | 1.8 | 2.5 | 1.5 |
| Others | 1.7 | 1.3 | 1.2 | 1.2 | 1.5 | 1.5 | 1.6 | 1.7 |
| Potatoes and sweet potatoes | 83.5 | 58.5 | 44.2 | 43.6 | 47.3 | 51.0 | 56.4 | 56.6 |
| Sweet potatoes | 40.3 | 19.9 | 11.2 | 11.7 | 10.6 | 13.1 | 14.0 | 12.8 |
| Potatoes | 43.2 | 38.6 | 33.0 | 31.9 | 36.7 | 37.9 | 42.4 | 43.8 |
| Starches | 17.9 | 22.7 | 22.1 | 20.6 | 31.8 | 38.5 | 43.7 | 42.7 |
| Pulses | 27.7 | 26.2 | 27.8 | 25.7 | 23.2 | 24.8 | 25.4 | 24.2 |
| Soybeans | 15.2 | 12.9 | 15.3 | 15.8 | 14.4 | 16.7 | 17.7 | 17.1 |
| Others | 12.5 | 13.3 | 12.5 | 9.9 | 8.8 | 8.1 | 7.7 | 7.1 |
| Vegetables | 273.0 | 296.4 | 312.8 | 299.0 | 306.8 | 320.0 | 293.8 | 288.2 |
| Green/yellow vegetables | 287.2 | 30.1 | 28.8 | 31.0 | 33.7 | 34.2 | 37.6 | 37.6 |
| Others | 247.3 | 268.8 | 282.7 | 270.2 | 275.8 | 268.3 | 259.6 | 250.6 |
| Fruits | 61.3 | 78.0 | 104.3 | 116.3 | 106.4 | 100.7 | 102.6 | 111.2 |
| Mandarin oranges | 16.3 | 19.9 | 37.9 | 51.8 | 39.2 | 31.9 | 21.6 | 17.8 |
| Apples | 19.3 | 23.6 | 20.3 | 16.8 | 17.6 | 16.2 | 21.4 | 25.8 |
| Others | 25.7 | 34.5 | 46.1 | 47.7 | 49.6 | 52.6 | 59.6 | 67.6 |
| Meats | 14.2 | 25.3 | 36.6 | 48.8 | 61.6 | 68.8 | 78.2 | 85.6 |
| Beef | 3.1 | 4.1 | 5.9 | 7.0 | 9.6 | 12.0 | 16.6 | 22.8 |
| Pork | 3.1 | 8.2 | 14.4 | 19.9 | 26.4 | 28.2 | 31.4 | 31.3 |
| Chicken meat | 2.3 | 5.2 | 10.1 | 14.4 | 21.1 | 25.0 | 28.1 | 29.9 |
| Whale meat | 4.5 | 5.7 | 3.3 | 2.6 | 1.1 | 0.7 | 0.1 | 0.1 |
| Others | 1.2 | 2.1 | 2.9 | 4.9 | 3.4 | 2.9 | 2.0 | 1.5 |
| Chicken eggs | 17.2 | 30.9 | 39.8 | 37.5 | 39.2 | 40.8 | 45.1 | 48.0 |
| Cow's milk and milk products | 60.9 | 102.8 | 137.2 | 146.5 | 179.0 | 193.6 | 228.0 | 249.2 |
| Fishes and shellfishes | 76.1 | 77.0 | 86.5 | 95.4 | 95.3 | 98.1 | 101.6 | 104.4 |
| Seaweeds | 1.8 | 2.0 | 2.5 | 3.1 | 3.7 | 3.6 | 3.9 | 3.9 |
| Sugar | 41.2 | 51.4 | 73.7 | 68.5 | 63.9 | 59.4 | 57.5 | 52.3 |
| Fats and oils | 11.9 | 17.7 | 24.5 | 29.7 | 34.6 | 38.2 | 39.0 | 39.8 |
| Miso bean paste | 24.1 | 21.4 | 20.1 | 17.4 | 16.5 | 14.8 | 13.4 | 12.3 |
| Soy sauce | 37.6 | 32.0 | 32.4 | 30.2 | 30.1 | 27.4 | 26.3 | 24.6 |
| Others | — | 4.3 | 5.1 | 8.7 | 7.2 | 8.5 | 10.5 | 11.1 |

* g/person per day.
Table 2. The amounts of calcium and phosphorus contents in 100 g of each food group, from the Japanese Food Composition Table.

| Year   | 1960 Calcium | 1960 Phosphorus | 1965 Calcium | 1965 Phosphorus | 1970 Calcium | 1970 Phosphorus | 1975 Calcium | 1975 Phosphorus | 1980 Calcium | 1980 Phosphorus | 1985 Calcium | 1985 Phosphorus | 1990 Calcium | 1990 Phosphorus | 1995 Calcium | 1995 Phosphorus |
|--------|--------------|-----------------|--------------|-----------------|--------------|-----------------|--------------|-----------------|--------------|-----------------|--------------|-----------------|--------------|-----------------|--------------|-----------------|
| Cereals| 10.7*        | 138             | 10.4         | 132             | 10.8         | 129             | 11.1         | 127             | 11.5         | 126             | 11.7         | 126             | 11.9         | 126             | 12.2         | 124             |
| Potatoes and sweet potatoes | 18.1          | 49.7            | 14.2         | 51.3            | 12           | 52.3            | 12.2         | 51.8            | 11           | 52.6            | 12           | 52.2            | 11.7         | 52.3            | 11.1         | 52.5            |
| Starches | 19.6         | 21.2            | 19.4         | 21.1            | 19.5         | 21.3            | 19.4         | 21.4            | 19.5         | 21.1            | 19.5         | 21.3            | 19.7         | 21.3            | 19.7         | 21.3            |
| Pulses  | 157          | 441             | 146          | 433             | 156          | 441             | 164          | 451             | 165          | 451             | 171          | 459             | 175          | 463             | 176          | 464             |
| Vegetables | 30.1         | 50.7            | 30.2         | 50.7            | 30.2         | 50.6            | 28.2         | 51.5            | 28.2         | 51.4            | 28.3         | 51.2            | 32.2         | 53.3            | 32.6         | 53.8            |
| Fruits  | 11.7          | 15.3            | 12.3         | 15.6            | 14.3         | 16.5            | 15.6         | 16.9            | 14.6         | 16.9            | 14.2         | 17.1            | 12.8         | 16.9            | 12.1         | 16.7            |
| Meats   | 4.9           | 156             | 6.3          | 153             | 6.8          | 154             | 7            | 154             | 7.1          | 152             | 7.3          | 152             | 7.2          | 151             | 7.1          | 151             |
| Chicken eggs | 60           | 220             | 60           | 220             | 60           | 220             | 60           | 220             | 60           | 220             | 60           | 220             | 60           | 220             | 60           | 220             |
| Cow's milk and milk products | 100          | 90.1            | 100          | 90             | 100          | 90             | 100          | 90             | 100          | 90             | 100          | 90             | 100          | 90             | 100          | 90             |
| Fishes and shellfishes | 44.2          | 189             | 47.7         | 190             | 47.3         | 187             | 43           | 190             | 50.2         | 193             | 54.2         | 194             | 55.3         | 195             | 45.3         | 193             |
| Seaweeds | 661          | 350             | 655          | 370             | 652          | 400             | 645          | 384             | 641          | 400             | 639          | 392             | 633          | 395             | 628          | 397             |
| Sugar   | 21.1          | 1.9             | 15           | 1               | 9.8          | 0.4             | 10.1         | 0.4             | 9.9          | 0.5             | 10.8         | 0.5             | 9.4          | 0.3             | 9.9          | 0.4             |
| Fats and oils | 0            | 0               | 0            | 0               | 0            | 0               | 0            | 0               | 0            | 0               | 0            | 0               | 0            | 0               | 0            | 0               |
| Miso bean paste | 99.2         | 186             | 99.1         | 186             | 99           | 186             | 98.9         | 186             | 98.8         | 186             | 99.3         | 187             | 99.3         | 187             | 99.2         | 186             |
| Soy sauce | 22.8          | 146             | 22.8         | 146             | 22.8         | 146             | 22.8         | 146             | 22.8         | 146             | 22.8         | 146             | 22.8         | 146             | 22.8         | 146             |
| Others  | --           | --              | 79.1         | 174             | 66.7         | 163             | 70.1         | 164             | 51.4         | 143             | 48.2         | 139             | 44.8         | 135             | 36           | 125             |

* mg/100 g.
was 585 mg/d in 1995 (Fig. 1).

The actual amounts of calcium intake in the NNS were 110% in 1960, 120% in 1975, and 101% in 1995 of those of the FBS. The main foods supplying calcium from the FBS in 1995 were cow’s milk and milk products, vegetables, fishes and shellfishes, and pulses, and their percent contributions were 42.8, 16.2, 8.1, and 7.3%, respectively (Table 3). The main food supplying phosphorus from the PBS in 1995 were cereals, cow’s milk and milk products, fishes and shellfishes, and vegetables, and their percent contributions were 24.4, 15.8, 14.2, and 10.9%, respectively (Table 4).

**Table 3. The amounts of calcium intake from each food.**

| Year | 1960 | 1965 | 1970 | 1975 | 1980 | 1985 | 1990 | 1995 |
|------|------|------|------|------|------|------|------|------|
| Cereals | 43.8* | 41.2 | 38.1 | 36.7 | 35.7 | 34.5 | 33.7 | 34.0 |
| Potatoes and sweet potatoes | 15.1 | 8.3 | 5.3 | 5.3 | 5.2 | 6.1 | 6.6 | 6.3 |
| Starches | 3.5 | 4.4 | 4.3 | 4.0 | 6.2 | 7.5 | 8.6 | 8.4 |
| Pulses | 43.1 | 38.8 | 43.3 | 42.1 | 38.2 | 42.5 | 44.4 | 42.6 |
| Vegetables | 82.3 | 89.4 | 94.6 | 84.2 | 86.6 | 85.5 | 94.7 | 94.0 |
| Fruits | 7.2 | 9.6 | 14.9 | 18.1 | 15.5 | 14.3 | 13.1 | 13.5 |
| Meats | 0.7 | 1.6 | 2.5 | 3.4 | 4.4 | 5.0 | 5.6 | 6.1 |
| Chicken eggs | 10.3 | 18.5 | 23.9 | 22.5 | 23.5 | 24.5 | 27.1 | 28.8 |
| Cow’s milk and milk products | 60.9 | 103 | 137 | 147 | 179 | 194 | 228 | 249 |
| Fishes and shellfishes | 33.6 | 36.7 | 40.9 | 41.0 | 47.8 | 53.2 | 56.2 | 47.3 |
| Seaweeds | 11.9 | 13.1 | 16.3 | 20.0 | 23.7 | 23.0 | 24.7 | 24.5 |
| Sugar | 8.7 | 7.7 | 7.2 | 6.9 | 6.3 | 6.4 | 5.4 | 5.2 |
| Fats and oils | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Miso bean paste | 23.9 | 21.2 | 19.9 | 17.2 | 16.3 | 14.7 | 13.3 | 12.2 |
| Soy sauce | 8.6 | 7.3 | 7.4 | 6.9 | 6.9 | 6.2 | 6.0 | 5.6 |
| Others | — | 3.4 | 3.4 | 6.1 | 3.7 | 4.1 | 4.7 | 4.0 |
| **Total** | **354** | **404** | **459** | **461** | **499** | **521** | **572** | **582** |

* mg/person per day.

**Table 4. The amounts of phosphorus intake from each food.**

| Year | 1960 | 1965 | 1970 | 1975 | 1980 | 1985 | 1990 | 1995 |
|------|------|------|------|------|------|------|------|------|
| Cereals | 562* | 525 | 455 | 422 | 391 | 372 | 357 | 347 |
| Potatoes and sweet potatoes | 41.5 | 30.0 | 23.1 | 22.6 | 24.9 | 26.6 | 29.5 | 29.7 |
| Starches | 3.8 | 4.8 | 4.7 | 4.4 | 6.7 | 8.2 | 9.3 | 9.1 |
| Pulses | 122 | 113 | 123 | 136 | 105 | 114 | 117 | 112 |
| Vegetables | 158 | 120 | 158 | 154 | 158 | 155 | 157 | 155 |
| Fruits | 9.4 | 12.2 | 17.2 | 19.6 | 18.0 | 17.2 | 17.3 | 18.6 |
| Meats | 22.2 | 39.2 | 56.2 | 75.1 | 93.6 | 104.2 | 118.0 | 129.0 |
| Chicken eggs | 37.8 | 68.0 | 87.6 | 82.5 | 86.2 | 89.8 | 99.2 | 105.6 |
| Cow’s milk and milk products | 54.8 | 92.5 | 124 | 82.5 | 161 | 174 | 205 | 224 |
| Fishes and shellfishes | 144 | 146 | 161 | 132 | 184 | 190 | 198 | 201 |
| Seaweeds | 6.3 | 7.4 | 10.0 | 18.1 | 14.8 | 141.0 | 15.4 | 15.5 |
| Sugar | 0.8 | 0.5 | 0.3 | 11.9 | 0.3 | 0.3 | 0.2 | 0.2 |
| Fats and oils | — | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Miso bean paste | 44.9 | 39.9 | 37.4 | 32.4 | 30.7 | 27.6 | 25.0 | 22.9 |
| Soy sauce | 54.9 | 46.7 | 47.3 | 44.1 | 43.9 | 40.0 | 38.4 | 35.9 |
| Others | 7.5 | 8.3 | 14.3 | 10.3 | 11.8 | 14.2 | 13.9 |
| **Total** | **1,243** | **1,283** | **1,312** | **1,332** | **1,327** | **1,345** | **1,400** | **1,421** |

* mg/person per day.

The transition of calcium and phosphorus amounts in food calculated from the FBS

As shown in Table 1, the consumption of starches, meat, chicken eggs, and cow milk and milk products increased 2.4- to 6.3-fold from 1960 to 1995; in contrast, cereals in 1995 decreased and reached 68% of consumption in 1960. The amount of calcium from cow’s milk and milk products increased to 241% in 1975 and to 409% in 1995 in comparison with 1960. The supply of phosphorus from cow’s milk and milk products, meat, and chicken eggs respectively increased to 151, 338, and 218% in 1975, and to 409, 581, and 279%...
Fig. 1. The amounts of calcium and phosphorus intake calculated from the Food Balance Sheet and the National Nutrition Survey. □: The phosphorus intake calculated from the Food Balance Sheet in the present study. ■: The calcium intake calculated from the Food Balance Sheet. ▣: The calcium intake reported in the National Nutrition Survey.

Fig. 2. Transition of the phosphorus-to-calcium ratios calculated from the Food Balance Sheet.

in 1995, compared with 1960. However, phosphorus from cereals decreased to 75% in 1975 and to 62% in 1995 in comparison with 1960. Thus the increased amounts of calcium and phosphorus mainly reflected an increased consumption of cow's milk and milk products. In contrast, the increased amounts of other foods such as meat and chicken eggs mainly contributed to the increased phosphorus amounts, but not to the calcium amount (Tables 3 and 4).

The transition of phosphorus-to-calcium ratio in food calculated from the FBS

The ratios of phosphorus to calcium content in meat, cereals, chicken eggs, pulses, and fishes and shellfishes were in the 20–35, 15–20, 2–5 range, respectively. The ratio in vegetables was less than 2 and in cow's milk and milk products, the primary source of calcium in the diet, it was 0.9. The average ratio calculated from the FBS was 3.51 in 1960 and decreased to 2.89 in 1975 and to 2.44 in 1995 (Fig. 2). Thus the gradual decrease in the ratio year by year was reflected by the increased cow's milk and milk product consumption and by the decreased cereal intake.

DISCUSSION

The findings from the FBS estimate the food available for human consumption at the national level, taking into account production, foreign trade, storage, losses through processing, industrial uses, and farm inputs. The database of NNS contained 1 or 3 d dietary intake data from 15,000 to 20,000 people of all ages and both genders selected from a multistage probability sample drawn from 47 prefectures to provide estimates of the Japanese population. In the present study, the amounts of calcium intake calculated from the FBS were similar to those in the NNS. This indicated that the information concerning phosphorus consumption obtained from the FBS might be reliable.

Because phosphorus affects the regulation of calcium metabolism, the balance of these nutrients is important. The desired ratio of phosphorus to calcium intake was suggested to be from 0.5 to 2.0 (2). The present findings showed that the actual ratios from 1960 to 1995 were above this level in Japan. Previous findings indicated that phosphorus-to-calcium ratios of lower calcium consumers were much higher than those of higher calcium consumers (8). This basic finding agrees with nutritional scientists of many countries, though the daily RDA of phosphorus was not determined by designed experiments (14). Phosphorus-containing food additives are used extensively in the processing of foods (15). More than 45 phosphorus-containing compounds are now approved for use in food processing as nutrients or dietary supplements or for functional purposes, such as preserving moisture or color, and as emulsifiers or sequestrants (9). As a consequence, phosphorus intake has probably been increasing, which is in contrast to the low calcium intake in Japanese.

In previous studies of Japanese phosphorus intake, adult males consumed approximately 1,200 mg/d from 1975 to 1979; this was calculated from the amount of recommended food intake (9). Hirata et al. showed that phosphorus amount calculated from the amount of calcium intake in the NNS was 1,300 mg/d in 1979 (10). The amount from food intake and food additives was predicted as 1,200–1,300 mg/d in 1979 (11). Another study reported that each Japanese consumed 1,330 mg/d of phosphorus from food and 58.2 mg/d from food additives (12).

In the present study, the average amounts of calcium and phosphorus consumption from food in 1995 reached 582 mg/d and 1,421 mg/d; these values were 165% and 114% of those in 1960. Although food additives containing calcium are also available, the true amount of its consumption has not been reported. Companies in the United States produced 28.8 kg of phosphorus in 1973, which is the equivalent of 375 mg of phosphorus additives per person per day. This indicated that more than 30% of the...
phosphorus intake came from food additives in the U.S. (16). Because the amount of phosphorus intake has not been correctly investigated, more phosphorus than reported might be consumed (17). Therefore the sum of per capita Japanese phosphorus consumption in 1995 is presumably more than 1,500 mg/d when imported food consumption of phosphorus and phosphorus-containing food additives are accounted for.

The effects of excess phosphorus on humans have not been sufficiently clarified. Calcium absorption was not affected when phosphorus intake was from 550 mg/d to 1 g/d, but the calcium balance became negative when more than 2 g/d of phosphorus was administered to healthy adult males (18). Two grams of phosphorus in a 700 mg calcium diet reduced the serum calcium concentration and urinary calcium excretion, and it increased urinary hydroxyproline and CAMP excretion, which indicated hyperparathyroidism (19). A long-term administration of 1 g/d of phosphorus besides regular food to postmenopausal women induced decreased bone formation and increased bone resorption (20). A high phosphorus (1,700 mg/d) and low calcium (400 mg/d) diet in young women impaired the adaptation to hypocalcemia because of continuous hyperparathyroidism (21, 22). These findings clearly showed that high phosphorus and moderately low calcium intake produced hormonal changes of mild secondary hyperparathyroidism in humans, and with prolonged intake lower calcitriol concentrations, the body’s main homeostatic mechanism for adaptation to low dietary calcium. Thus it is thought that excess amounts of phosphorus intake for long periods are a strong factor in bone impairment. Phosphorus-containing food increased approximately 17% for the decade until 1993 (7), and the use of phosphorus as food additives may continue to increase. Therefore passive calcium intake and also a restriction of phosphorus intake are important to maintain healthy bones. Therefore, human lifestyle must be changed, especially on food the consumption habits in regard to specifically processed foods.

In conclusion, Japanese phosphorus consumption estimated from the FBS is increasing and more attention should be paid to the maintenance of bone health. However, Nougyou-Hakusyo reported in 1999 that a large amount (19.3 million tons) of food had been discarded in 1996. Therefore further studies on the amount and the source of phosphorus intake is important, particularly in regard to the amount of phosphorus from Japanese processed foods, imported foods, and phosphorus-containing food additives.

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