Effect of Food Consumption Pattern on Total Serum Cholesterol Level: A Methodological Approach

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Summary The food intake and serum cholesterol levels of 60 healthy, middle-aged inhabitants of Kobe city were surveyed from 1974 to 1981. We attempted to estimate the serum cholesterol level in which food consumption patterns (8-factor scores) were chosen as dietary indicators. Every two years, multiple regression analysis was applied cross-sectionally for males and females, using the eight factor scores as independent variables and the total serum cholesterol level as a dependent variable. The multiple regression coefficients based on the factors were significant for both males and females. Reproducibility of the standard partial regression coefficients, β, for females was also high. We obtained a formula for estimating serum cholesterol level based on the scores of Factor 1 (staple foods), F5 (prepared foods), F6 (traditional Japanese foods), F7 (vegetable oil) and F8 (nutrition-consciousness): multiple regression coefficient R²=0.56 and coefficient of determination R²=0.31. The multiple regression equation indicated that serum cholesterol level increased with the combined effects of the uniformity of the food life, westernized-type food consumption, concern for nutrition and a relatively low intake of vegetable oil.

Key Words food survey, food consumption pattern, serum cholesterol, multiple regression analysis, food habits

Epidemiological studies on food among different communities have shown a positive correlation between intake of nutrients, particularly lipids (the percent of calories from fat), and serum cholesterol level (1). Such a correlation has rarely been noted in a survey carried out on residents in a single community except in that by Connor et al. (2). Although diet intervention studies have shown that strictly controlled diets lower the serum cholesterol level (1,3,4), it is still controversial why...
a significant correlation between serum cholesterol and food intake cannot be found within a community (5–7), and the selection of dietary variables must be considered carefully.

The dietary factor can be examined by two different approaches. One is to study the intake of particular nutrients and the other is to study the intake of foods in groups, taking sociological viewpoints into consideration. So far, several studies have been performed using the first approach, but only a few using the second approach (8).

In 1974, we started a cohort survey to study the effect of dietary habits longitudinally in relation to the incidence of gerontological diseases and their progress. The survey is in progress to analyze dietary characteristics by multivariate analysis, with special attention paid to the pattern of food intake, to clarify dietary phenomena in general.

Previously, we obtained eight factors in a factor analysis based on the correlation matrix using the intake of 25 food groups. The dietary characteristic resulting from these factors was called a “food consumption pattern.”

We have obtained a dietary index for estimating the serum cholesterol level, because a high serum cholesterol level is considered to be a risk factor in atherosclerosis. As indices to estimate serum cholesterol level, we used the food consumption pattern instead of the intake of nutrients or any special food for the following two reasons. First, a single food is usually not eaten alone, but together with other foods, thus producing synergistic or antagonistic effects among various foods. Regularity in choosing foods in daily life may lead to individual food habits. Secondly, we believe that environmental characteristics, i.e., factors influencing individual dietary life and food habits, can scarcely be detected without exploring food consumption patterns.

METHODS

Subjects and methods. Our survey started in 1974 with 95 volunteers living in Kobe, and 37 other volunteers were included in 1975. Since then, some of them have dropped out for various reasons and some have been added. Approximately 100 volunteers have taken part in the survey each year. As a rule, the survey was carried out quarterly and a medical examination was done simultaneously each time. In accordance with the method of the National Nutritional Survey proposed by the Ministry of Health & Welfare, the food intake survey was performed using the actual or estimated amount of food intake for three consecutive days through a careful interview by a trained dietitian. Fasting blood samples were collected on the day after the food intake survey and the serum cholesterol level for each subject was examined using an enzyme method (Kyowa, CT555).

We obtained data on 60 subjects with records of both serum cholesterol levels and intake of various foods, collected for more than 20 seasons in succession. The total number of days spent on the dietary survey during the 8 years was 4,734 days.
Table 1. Number of subjects by sex, age and occupation.

| Age     | Male | Female |
|---------|------|--------|
| 41–45   | 1    | 2      |
| 46–50   | 2    | 11     |
| 51–55   | 9    | 16     |
| 56–60   | 7    | 12     |
| Occupation |      |        |
| Self employed person | 2 | 4      |
| Employees in professional and administrative | 4 | 4 |
| Employees in clerical and manual | 13 | 3 |
| Part-time and unemployed | 0 | 30    |
| No. of subjects | 19 | 41    |

Table 2. Means and standard deviations of the intake of food groups for 48 males and 47 females (1974).

| Food Group                           | Mean (g/day) | SD  |
|--------------------------------------|--------------|-----|
| 1. Rice (cooked)                     | 403          | 166.1 |
| 2. Breads                            | 45           | 31.0 |
| 3. Noodles                           | 58           | 43.7 |
| 4. Potatoes                          | 33           | 22.0 |
| 5. Sugars and sweeteners             | 22           | 12.8 |
| 6. Sweets                            | 22           | 22.6 |
| 7. Fruits                            | 146          | 108.4 |
| 8. Fish and shellfish                | 80           | 36.6 |
| 9. Beef and pork                     | 40           | 25.4 |
| 10. Other meats                      | 22           | 23.7 |
| 11. Eggs                             | 45           | 20.5 |
| 12. Dairy products                   | 78           | 77.3 |
| 13. Soybean products                 | 53           | 39.0 |
| 14. Animal fat                       | 3            | 3.8  |
| 15. Vegetable oils and others        | 17           | 8.7  |
| 16. Green and yellow vegetables      | 43           | 24.0 |
| 17. Other vegetables                 | 128          | 50.8 |
| 18. Alcohol                          | 17           | 25.1 |
| 19. Pickles                          | 26           | 19.8 |
| 20. Seasonings                       | 9            | 5.9  |
| 21. Seaweed                          | 2.4          | 2.4  |
| 22. Tea and coffee                   | 1.0          | 0.8  |
| 23. Dining out                       | 0.4          | 0.5  |
| 24. Processed foods                  | 0.04         | 0.09 |
| 25. Eutrophics                       | 0.11         | 0.27 |
### Table 3. Factor loading matrix.\(^a\)

Male and Female (\(n=95\)) 1974

| Food groups                  | F1   | F2   | F3   | F4   | F5   | F6   | F7   | F8   | Communityalities |
|------------------------------|------|------|------|------|------|------|------|------|------------------|
| 1. Rice (cooked)             | 0.97 | -0.10| -0.01| 0.13 | 0.02 | 0.13 | -0.04| -0.03| 0.98             |
| 2. Breads                    | -0.52| 0.16 | -0.14| 0.11 | 0.00 | 0.01 | 0.30 | -0.19| 0.45             |
| 3. Noodles                   | -0.32| 0.03 | 0.02 | 0.16 | -0.04| 0.08 | 0.01 | 0.02 | 0.14             |
| 4. Potatoes                  | 0.11 | 0.00 | -0.15| 0.08 | 0.05 | -0.05| 0.04 | 0.03 | 0.05             |
| 5. Sugar and sweeteners      | -0.13| 0.96 | -0.07| 0.14 | 0.06 | 0.00 | 0.04 | -0.03| 0.96             |
| 6. Sweets                    | -0.06| 0.28 | -0.15| -0.26| -0.25| -0.11| -0.14| 0.04 | 0.27             |
| 7. Fruits                    | -0.15| -0.03| -0.24| -0.37| -0.22| 0.17 | 0.09 | 0.13 | 0.31             |
| 8. Fish and shellfish        | 0.10 | -0.14| 0.36 | -0.07| 0.13 | 0.37 | -0.05| -0.13| 0.33             |
| 9. Beef and pork             | -0.01| 0.04 | 0.16 | 0.58 | -0.10| 0.01 | 0.21 | 0.14 | 0.43             |
| 10. Other meats              | -0.09| -0.11| 0.14 | 0.10 | 0.57 | -0.07| 0.10 | -0.06| 0.39             |
| 11. Eggs                     | -0.05| -0.08| -0.12| -0.20| -0.43| 0.28 | 0.17 | 0.03 | 0.36             |
| 12. Dairy products           | 0.06 | 0.19 | 0.04 | -0.10| -0.22| -0.35| 0.08 | 0.30 | 0.32             |
| 13. Soybean products         | 0.20 | -0.40| 0.08 | 0.12 | 0.28 | 0.14 | -0.22| 0.33 | 0.48             |
| 14. Animal fats              | -0.37| 0.16 | -0.19| 0.71 | 0.04 | 0.04 | -0.03| -0.11| 0.71             |
| 15. Vegetable oils           | -0.16| 0.05 | 0.15 | 0.21 | 0.03 | 0.94 | -0.02| 0.97             |
| 16. Green and yellow vegetables | 0.00 | -0.04| 0.07 | 0.11 | 0.14 | 0.10 | 0.00 | 0.79 | 0.68             |
| 17. Other vegetables         | -0.02| 0.01 | 0.09 | 0.01 | 0.18 | 0.26 | 0.23 | 0.06 | 0.21             |
| 18. Alcohol                  | -0.00| -0.02| 0.98 | 0.17 | -0.02| -0.02| -0.04| -0.07| 0.99             |
| 19. Pickles                  | 0.29 | -0.16| 0.03 | -0.19| -0.26| 0.57 | -0.05| 0.12 | 0.56             |
| 20. Seasonings               | -0.09| 0.09 | 0.03 | 0.12 | 0.09 | 0.53 | 0.06 | 0.05 | 0.32             |
| 21. Seaweed                  | 0.22 | -0.05| 0.14 | -0.17| 0.11 | 0.20 | -0.25| 0.03 | 0.22             |
| 22. Tea and coffee           | -0.31| 0.48 | 0.07 | 0.14 | 0.19 | -0.32| 0.00 | -0.24| 0.55             |
| 23. Dining out               | -0.07| 0.23 | 0.12 | 0.17 | -0.10| 0.05 | 0.07 | -0.33| 0.22             |
| 24. Processed foods          | 0.11 | 0.13 | -0.02| -0.01| 0.57 | 0.04 | 0.02 | -0.06| 0.37             |
| 25. Eutrophics               | -0.04| 0.09 | -0.14| 0.03 | 0.01 | 0.10 | -0.08| -0.12| 0.06             |
| Sum of squares               | 1.84 | 1.67 | 1.39 | 1.38 | 1.34 | 1.28 | 1.28 | 1.14 | 11.33            |
| % of Sum-squares             | 7.34 | 6.70 | 5.57 | 5.52 | 5.37 | 5.12 | 5.11 | 4.57 | 45.33            |

*From Ref. 9.*
for all 60 subjects, with an average of 78.9 days for a subject. Table 1 shows the distributions of sex, age and occupation at the start of the survey.

Statistical methods. In our previous study (9), 21 food groups and 4 food habit items were examined. Based on the factor analysis of these 25 food groups, eight factors characterizing the food consumption pattern were obtained. The factor scores for each subject were calculated and a mean score of each subject was obtained for each year. Next, multiple regression analysis was separately applied for data on males and females for each of the following four periods: (1) from 1974 to 1975, (2) from 1976 to 1977, (3) from 1978 to 1979 and (4) from 1980 to 1981, using the year-average of serum cholesterol level as a dependent variable and the eight factor scores as independent variables. Table 2 shows the mean and standard deviations of food group intake in the 1974 survey and Table 3 shows the factor loading matrix by means of Varimax rotation, which was used for obtaining the factor scores.

RESULTS

1. Distribution of serum cholesterol level and factor scores

Serum cholesterol levels for males and females had little inter-period variation.
Fig. 2. Histograms of the dietary variable (the 8 factor scores). The distribution is divided into increments of 0.25. Factor scores were normalized to mean 0 and variance 1 independently.

The serum cholesterol level of the males was 135 to 268 mg/100 ml, and that of the females, was 134 to 326 mg/100 ml (Fig. 1). For the 8 years, the mean and standard deviations of serum cholesterol level for males and females was $199 \pm 38$ mg/100 ml and $225 \pm 37$ mg/100 ml, respectively.

Figure 2 shows the histogram of the factor scores during period 2, as the typical period resulting from multiple regression analysis. The factor scores in the 1974 survey were standardized with zero mean and unit variance; thus, zero corresponds to the mean score of 95 persons (48 males and 47 females) studied in 1974. Every factor was defined as shown in Fig. 2. The distribution curve exhibits a sex difference, although it is essentially normal, with slight skewing to the right side. In the females, the scores of all the factors except for factor 2 had little inter-period variation and remained stable over the 8 years. The inter-period variation in males, however, was considerable, especially for factors 1 (staple foods), 2 (sweets), 4 (animal foods) and 7 (vegetable oil).

2. Multiple regression analysis

Table 4 shows the results of multiple regression analysis. The values of $R$ (the multiple regression coefficient) were significant at the level of 0.01 or 0.05. Little inter-period difference was observed in most of the standard partial regression coefficients for females, reflecting the uniformity of the data; the values were sufficiently reproducible. The coefficients for males, however, were not reproducible.
Table 4. Results of multiple regression analysis based on the eight independent variables and the dependent variable, total serum cholesterol.

| No. of subjects | Variable 1 | Variable 2 | Variable 3 | Variable 4 | Variable 5 | Variable 6 | Variable 7 | Variable 8 | R² | SE | R |
|-----------------|------------|------------|------------|------------|------------|------------|------------|------------|-----|----|---|
| Female          |            |            |            |            |            |            |            |            |     |    |   |
| 1. 1974, 1975   | 0.34       | -0.22      | 0.06       | 0.22       | -0.22      | 0.06       | 0.22       | -0.22      | 0.18 | 0.37 | 0.4 |
| 2. 1976, 1977   | 0.35       | -0.21      | 0.14       | 0.35       | -0.21      | 0.14       | 0.35       | -0.21      | 0.09 | 0.33 | 0.24 |
| 3. 1978, 1979   | 0.30       | -0.23      | 0.07       | 0.30       | -0.23      | 0.07       | 0.30       | -0.23      | 0.11 | 0.32 | 0.57*** |
| 4. 1980, 1981   | 0.23       | -0.06      | 0.05       | 0.23       | -0.06      | 0.05       | 0.23       | -0.06      | 0.09 | 0.51*** | 0.4 |
| Male            |            |            |            |            |            |            |            |            |     |    |   |
| 1. 1974, 1975   | -0.35      | 0.26       | 0.15       | -0.35      | 0.26       | 0.15       | -0.35      | 0.26       | 0.15 | 0.65* | 0.43 |
| 2. 1976, 1977   | -0.14      | 0.15       | 0.28       | -0.14      | 0.15       | 0.28       | -0.14      | 0.15       | 0.10 | 0.66* | 0.43 |
| 3. 1978, 1979   | -0.07      | -0.28      | 0.15       | -0.07      | -0.28      | 0.15       | -0.07      | -0.28      | 0.15 | 0.42 | 0.92 |
| 4. 1980, 1981   | 0.21       | 0.19       | 0.41       | 0.21       | 0.19       | 0.41       | 0.21       | 0.19       | 0.41 | 0.64* | 0.41 |

R: Multiple regression coefficients. R²: Coefficients of determination. SE: The standard error from regression. **p < 0.01, *p < 0.05.
Table 5. The selection of variables for regression.

| Variables | Partial regression coefficients | 1976, 1977 (Female) |
|-----------|--------------------------------|----------------------|
|           | 1     | 2     | 3     | 4     | 5    | 6     | 7     | 8     | Constant | R     | R²     | SE     |
| 1.        | -16.4 |       |       |       |       |       |       |       | 219      | 0.41  | 0.17   | 3.25   |
|           | (-0.41)|       |       |       |       |       |       |       |          |       |        |        |
| 2.        | -17.2 |       |       |       |       |       |       |       | 11.9     | 218   | 0.48   | 0.23   | 3.13   |
|           | (-0.43)|       |       |       |       |       |       |       |          |       |        |        |
| 3.        | -15.3 |       |       |       |       |       | -8.8  |       | 14.7     | 218   | 0.51   | 0.26   | 3.06   |
|           | (-0.38)|       |       |       |       |       | (-0.20)|       |          |       |        |        |
| 4.        | -14.1 |       |       |       |       | 7.7   | -9.2  |       | 12.8     | 217   | 0.54   | 0.29   | 3.00   |
|           | (-0.35)|       |       |       |       | (0.18)| (-0.21)|       |          |       |        |        |
| 5.        | -12.8 |       |       |       |       | 8.8   | -9.3  | -5.1  | 14.2     | 217   | 0.56   | 0.31   | 2.96   |
|           | (-0.32)|       |       |       |       | (0.21)| (-0.21)| (-0.15)|          |       |        |        |
| 6.        | -12.7 |       |       |       | 2.2   | 9.3   | -9.5  | -5.2  | 14.7     | 218   | 0.56   | 0.31   | 2.95   |
|           | (-0.32)|       |       |       | (0.06)| (0.22)| (-0.21)| (-0.15)|          |       |        |        |
| 7.        | -13.1 |       |       | 6.9   |       | 8.1   | -9.0  | -4.8  | 12.6     | 220   | 0.56   | 0.31   | 2.95   |
|           | (-0.33)|       |       | (0.06)|       | (0.19)| (-0.20)| (-0.14)|          |       |        |        |
| 8.        | -13.3 | -3.0  |       |       |       | 9.2   | -8.2  | -4.9  | 14.0     | 217   | 0.56   | 0.31   | 2.95   |
|           | (-0.33)|       |       | (-0.07)|       | (0.21)| (-0.18)| (-0.14)|          |       |        |        |
| 9.        | -13.9 | -3.3  | 17.2  | 4.4   | 8.4   | -7.4  | -4.6  |       | 11.2     | 228   | 0.57   | 0.33   | 2.93   |
|           | (-0.35)|       | (0.14)| (0.11)|       | (0.20)| (-0.17)| (-0.13)|          |       |        |        |

The parenthesized figures are the standard partial regression coefficients. R: Multiple regression coefficients. R²: Coefficients of determination. SE: The standard error from regression.
Fig. 3. Scatter diagrams showing the correlation between the values observed and those predicted from the regression equation. F: Factor. Y: The predicted value for the dependent variable. (A) The predicted value obtained by the regression equation based on factors 1 (staple foods), 5 (processed foods), 6 (traditional Japanese foods), 7 (vegetable oil) and 8 (nutrition-consciousness). (B) The predicted value obtained by the regression equation based on factor 1 (staple foods) alone.

because of a great inter-period variation of the data. The data for females in period 2, for which the multiple regression coefficient was significantly high and the standard partial regression coefficient was reproducible, were chosen, and variables were selected by excluding those with a low contribution ratio.

Table 5 shows some of the selected variables. The figures in parentheses show standard partial regression coefficients excluding the dependency on the units in which the original variables were measured. In line 9 of Table 5, the values were calculated from the complete regression equation based on all the 8 factors. The values for $R$ increased when factors 8 (line 2), 6 (line 3), 5 (line 4) and/or factor 7 (line 5) were added, but the addition of factors 4, 3 and/or 2 did not increase the $R$ values.
Table 6. The correlation matrix of each variable (n=82).

| Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|----------|---|---|---|---|---|---|---|---|
| 1        | -0.10 | 0.08 | 0.21 | 0.27 | 0.35 | 0.07 | 0.10 | -0.08 |
| 2        | -0.41** | -0.13 | 0.14 | 0.20 | 0.23** | -0.03 | 0.10 | -0.08 |
| 3        | 0.23* | -0.58** | -0.09 | -0.36** | -0.23** | -0.07 | 0.11 | 0.07 |
| 4        | -0.01 | -0.53** | -0.32** | -0.08 | -0.21** | 0.08 | 0.19 | 0.07 |
| 5        | 0.11 | 0.08 | -0.04 | -0.01 | -0.10** | -0.01 | 0.19 | 0.11 |
| 6        | -0.12 | 0.01 | 0.17 | 0.01 | 0.24** | 0.25** | -0.23** | 0.12 |
| 7        | -0.26* | -0.57** | -0.13 | -0.22** | -0.23** | 0.27** | -0.38** | 0.15 |
| 8        | -0.35** | -0.05 | -0.10 | -0.09 | -0.10** | 0.21** | -0.17 | 0.21 |

Right-upper triangle: simple correlation coefficients. Left-lower triangle: partial correlation coefficients. **p<0.01, *p<0.05.

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The t-values of the partial regression coefficient for all the factors except for factor 7 were significant, in the order of factor 1 > factor 8 > factor 5 > factor 6 > factor 7. Thus independent variables with relatively high contribution comprised the following 4 factors: factor 1 (staple foods), factor 5 (prepared foods), factor 6 (traditional Japanese foods) and factor 8 (nutrition-consciousness). From the above results, we obtained in Fig. 3(A) the formula for estimating the serum cholesterol level based on the scores of the factors 1, 5, 6, 8 and also 7, thus obtaining a multiple correlation coefficient $R=0.56$ and coefficient of determination $R^2=0.31$. Figure 3(B) shows the formula based on factor 1 alone, which resulted in $R=0.41$ and $R^2=0.17$.

Table 6 shows the results of the correlation analysis of the 9 variables on 41 female subjects during period 2. The serum cholesterol level was significantly correlated with factor 1 ($r=-0.41$), factor 3 ($r=0.23$), factor 5 ($r=0.27$) and factor 8 ($r=0.22$), while the partial correlation coefficient was significant only between serum cholesterol level and factor 1.

DISCUSSION

1. Materials. The food intake pattern of the groups in our study has already been confirmed to be categorized into that of the urban block (10) where less rice and fish is eaten, but more wheat-flour products such as bread and noodles, meats, oil and fat and dairy products are eaten than in other regions in Japan. Considering the serum cholesterol level and the dietary state in the group, the subjects of our study might be regarded as healthy middle-aged people, characteristic of large-city inhabitants in Japan.

2. Factor interpretation. The results of factor analysis were presented by Iizumi (1980), but we shall summarize them to provide enough information for interpreting the results of multiple regression analysis.

As shown in Table 3, factor 1 is highly correlated (factor loading) with staple foods, and thus it is considered to be a factor that evidently reflects a staple food pattern. Rice and pickles are positively but negatively correlated with bread and cereals. Therefore the first factor reflects a dimension of the Japanese traditional rice-eating pattern versus the westernized food pattern. Thus, factor 1 is the staple foods factor. Factor 2 is highly correlated with sugar and sweeteners, tea, coffee and sweets, and is the sweets factor. Factor 3 is highly correlated with alcoholic beverages (alcohol), fish and shellfish, and is the alcoholic beverage factor. Factor 4 is highly correlated with animal fat, beef and pork, and is the animal foods factor. Factor 5 represents a dimension of prepared foods which may lead to an index for the distribution of food life uniformity, and is the prepared foods factor. Factor 6 is positively correlated with pickles, seasonings, fish and shellfish and other vegetables, while it is negatively correlated with dairy products, tea and coffee; it is the factor of traditional Japanese foods. Factor 7 mainly consists of only vegetable oil and bread.
and thus has a poor correlation with the other food groups. We referred to this factor as "the vegetable oil factor." Factor 8 is positively correlated with green and yellow vegetables, soybean products and dairy products, and is negatively correlated with dining out. This factor reflects a dimension of nutrition-consciousness, because foods positively correlated with this factor are recommended for improvement of health, and this is the nutrition-consciousness factor.

As mentioned above, the signs of correlation between each factor and food groups reveal the contrast between the mass of food groups showing westernized or traditional food habits.

3. Multiple regression analysis. Multiple regression coefficients based on factors F1-F8 were significant for males and females, and thus this regression equation proved to be useful in estimating the serum cholesterol level.

The multiple regression equation resulting from variable selections for the females is given in Fig. 3(A), and the five factors out of the above-mentioned 8 factors were related to the serum cholesterol level. It should be noted, however, that these results do not exclude the possibility of other factors that may influence the serum cholesterol level. Furthermore, we note that the factors are not independent. Statistically, a standard partial regression coefficient for each of the independent variables is reduced to the simple correlation coefficient, provided that correlations among the independent variables are zero. Actually, such a case seldom occurs, and therefore, the interpretation of partial regression coefficients required further investigation. Theoretically, partial regression coefficients are used to express the relationship of the dependent variable in terms of the set of the independent variables employed in the regression equation, and thus they should not be interpreted separately for each of the independent variables.

We shall now interpret the regression equation, with which the serum cholesterol level can be estimated using the following five factors: F1 (staple food pattern), F5 (prepared foods), F6 (traditional Japanese foods), F7 (vegetable oil) and F8 (nutrition-consciousness) obtained for females. Noting that the multiple correlation coefficient was 0.56 and that partial regression coefficients were significant, the serum cholesterol level can be thought to have increased with the combined effects of the uniformity of the food life, a westernized-type food pattern, concern for nutrition and a relatively low intake of vegetable oil.

The above-mentioned interpretation is in agreement with the established results. That is, serum cholesterol levels were higher in urban areas than in rural areas. However, even in some rural areas the rapid advance of urbanization has caused an increase in the serum cholesterol level (11), and further it has changed food habits into the wheat-eating pattern (12). Concern for and knowledge of nutrition have surely led to health-oriented behavior, which resulted in the wide variety of food consumed but also in overeating. The level of serum cholesterol might have been elevated by overnourishment.

The regression equation may differ with different populations, since important factors in a population are dependent on the food consumption pattern of a whole
population. For instance, factor 3 is shown to be important for males in our study (Table 4).

Toyokawa (8), Akabane et al. (13), Yamagami et al. (14) and Iizumi et al. (9) insisted on the importance of the food consumption pattern as a dietary index. Schwerin et al. (15) reported a relationship between eating pattern and the state of nutritional health. Toyokawa (16) and Schwerin et al. (15) suggested that a food consumption pattern model is useful in studying the effects of foods on the incidence and progress of disease. The present study shows that the food consumption pattern is useful for predicting the serum cholesterol level.

We would like to emphasize the value of the factor scores as diet indices of daily food intake. By using the factor scores, each individual can be located on the factor axes that reflect several dimensions of the food consumption pattern, thus discriminating individuals in a group that consists of similar subjects with respect to daily food consumption patterns. As the present results represent the actual situation of the food consumption pattern within a community, they are useful for preventing an increase in serum cholesterol level.

Further studies are required to determine the relationship between food consumption pattern and incidence of disease or risk factors.

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