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Dietary patterns and glycated hemoglobin in Japanese men and women

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Objective Dietary patterns in Western populations have been linked to type 2 diabetes, but the role of diet in Japanese remains unclear. We investigated the association between major dietary patterns and glucose tolerance status as measured by glycated hemoglobin (HbA_{1c}) in Japanese adults.

Research Design And Methods Subjects were 3,243 men and 4,667 women who participated in the baseline survey of an on-going cohort study on lifestyle-related diseases in Fukuoka, Japan. Dietary patterns were derived by using principal component analysis of the consumption of 49 food items ascertained by a food frequency questionnaire. Logistic regression analysis was used to estimate sex-specific odds ratios of elevated HbA_{1c} ($\geq$ 5.5%) with adjustment for potential confounding variables.

Results The westernized breakfast pattern characterized by frequent intake of bread but infrequent intake of rice was inversely related to HbA_{1c} concentrations (*P* for trend = 0.02 in each men and women); the multivariate-adjusted odds ratios (95% CI) for the highest versus lowest quintiles were 0.60 (0.43-0.84) and 0.64 (0.46-0.90) for men and women, respectively. The seafood dietary pattern was positively associated with HbA_{1c} concentrations in men only (*P* for trend = 0.01). Neither the healthy nor high-fat dietary pattern was related to HbA_{1c}.

Conclusions A dietary pattern featured by frequent intake of white rice may deteriorate glucose metabolism in Japanese men and women, and the salty seafood dietary pattern may have similar effect in men.

The prevalence of type 2 diabetes is increasing worldwide (1). Likewise, Japanese, who have experience rapid economic growth during the past several decades, now have a high prevalence of type 2 diabetes (2). However, this seems peculiar given that obesity, a strong determinant of the disease (3), is much less common among Japanese than among Western populations (4,5). It has been postulated that Japanese are predisposed to type 2 diabetes due to their low levels of insulin secretion and sensitivity, which may be determined by both genetic and environmental factors (4,5). The investigation of a Japanese diet in relation to type 2 diabetes may provide a clue to the issue.

The relation of specific foods and nutrients such as vegetables (6), dietary fiber (7), and glycemic load (8) to risk of type 2 diabetes has been examined in many studies, but few have addressed the association with dietary patterns. Although the effect of a single nutrient, food, or food group on disease risk and morbid conditions has often been investigated, such an effect is difficult to assess in observational studies because foods and nutrients are consumed in combination, and their complex effects are likely to be interactive or synergistic (9). To overcome problems relating to the close inter-correlation among foods or nutrients, analysis of dietary patterns has gained much interest. A dietary pattern is a comprehensive variable that integrates consumptions of several foods or food groups, and is expected to have a greater impact on disease risk than any single nutrient (9). Studies in Western populations have suggested that risk of type 2 diabetes was associated inversely with prudent or healthy dietary pattern (10-12) and positively with Western dietary pattern (11-14). To the best of our knowledge, however, only one study reported an association between a Japanese dietary pattern and type 2 diabetes (15).

The aim of the present study was therefore to investigate dietary patterns in relation to glucose tolerance status as measured by glycated hemoglobin (HbA_{1c}) concentrations in Japanese adults.

RESEARCH DESIGN AND METHODS

Subjects

The subjects were participants in the baseline survey of the on-going cohort study on lifestyle-related diseases. Details of the study procedure have been described elsewhere (16). In short, eligible persons were residents of the East Ward of Fukuoka City aged 50 to 74 years at the time of referring to the resident registry. Some areas in the ward were excluded with consideration for study efficiency and potential difficulties in the follow-up surveys. Eligible residents were invited to participate in the study by mail. Potential participants were informed of details of the baseline and follow-up surveys. Participants completed a self-administered questionnaire, blood pressure measurements, anthropometric measurements, and venous blood drawing. The questionnaire inquired about smoking, alcohol drinking, physical activity, sleeping, stress, dietary intake, diseases under current or previous treatment, use of drugs and supplements, and parental history of selected diseases. BMI was calculated as weight in kilograms divided by squared height in meters. HbA_{1c} concentrations were measured at an external laboratory (SRL, Hachiohji, Japan) by using latex agglutination turbidimetry on an autoanalyzer (JEOL Ltd., Tokyo, Japan). The study was approved by the ethics committee of Kyushu University Faculty of Medical

Sciences. All the study subjects gave written informed consent prior to their participation in this study.

During the period between February 2004 and July 2006, a total of 10,447 persons (22.9% of 45,634 eligible persons) participated in the survey. The participation rate was higher among persons aged 60 years or older than those in younger ages and among women than men. We excluded 910 subjects with a history of diabetes mellitus and other 1,619 subjects with a history of cardio- and cerebro-vascular disease, cancer, liver disease, chronic renal failure, pancreas disease, adrenal disease, or alcohol addiction. After further exclusion of eight subjects with missing information on covariates, 7,910 subjects (3,243 men and 4,667 women) remained for the analysis.

Dietary assessment

The food frequency questionnaire (FFQ) method was used to assess intakes of 60 items of foods and beverages on average over the past year. Dietary questions were primarily derived from the 47-item FFQ (17), which was validated with 3-day weighted diet records; most of the nutrients showed correlation coefficients 0.4 to 0.6 (18). Frequency of consumption of staple foods (rice, bread, and noodles) was measured on a scale of six categories ranging from almost null to daily for each breakfast, lunch, and supper. Regarding food items other than the staple foods, participants answered consumption frequency by choosing one of eight options ranging from almost null to ≥ 3 times/day. The reported frequency of consuming each food was converted to a frequency of consumption per week, with somewhat conservative values assigned to greater frequency categories: 6.5 to 1 time/day, 10.5 to 2 times/day, and 17.5 to ≥ 3 times/day. Regarding each of the staple foods, values of weekly frequency (0 to 6.5) were summed over the three meals. The amount consumed per occasion was asked for the staple foods, but this information was not used.

Statistical analysis

We performed principal component analysis based on 49 food items to derive dietary patterns; questions of beverages (6 items) and dishes (5 items) were not considered. Principal component analysis is a technique to reduce a number of variables into fewer independent factors. The factors were rotated by orthogonal transformation (varimax rotation) to maintain uncorrelated factors and greater interpretability. We considered eigenvalues, the scree test, and the interpretability of the factors to determine the number of factors to retain. The factors satisfied the criteria for eigenvalues greater than one, and the scree plots dropped substantially after the third factor (from 2.37 to 1.68) and remained similar after the fourth factor (1.47 for the fifth and 1.40 for the sixth factor), thus, we decided to retain four factors. We confirmed that, when the analysis was done separately for men and women, similar dietary patterns were extracted in each sex. Dietary patterns were named according to the food items showing high loading (absolute value) on each of four factors. The factor scores for each dietary pattern and for each individual were calculated by summing intakes of food items weighted by their factor loadings. Factor scores were categorized into quintiles based on the distribution for men and women, separately.

The confounding variables considered were age (year), BMI (< 22.5, 22.5-24.9, 25.0-27.4, and ≥ 27.5 kg/m^2), smoking (lifetime nonsmoker, former smoker, and current smoker with a consumption of < 20 or ≥ 20 cigarettes/day), alcohol consumption (nondrinker, former drinker, and current drinker with a consumption of < 30, 30-59, or ≥ 60 g of ethanol/day), physical activity (quartile of metabolic equivalent hours/week), and parental history of diabetes mellitus (absent or present). The trend was assessed by using Mantel-Haenszel chi-squared test for categorical variables and linear regression analysis for continuous variables, assigning ordinal numbers 0-4 to quintile categories of each dietary pattern.

We defined high levels of HbA_{1c} concentration according to the definition used in the National Health and Nutrition Survey in Japan, in which those with HbA_{1c} concentrations of 5.5 to 6.0 % and of ≥ 6.1% were regarded as having "possible" and "probable" diabetes mellitus, respectively. The cut-off of 5.5% for HbA_{1c} gave a sensitivity of 80.1% and a specificity of 78.5%; and HbA_{1c} of 6.1% corresponded to 2-hour plasma glucose level of 200 mg/dl in an oral glucose tolerance test (19). Multiple logistic regression was performed to estimate the odds ratio and 95% confidence interval (CI) of elevated HbA_{1c} (≥ 5.5%) according to quintiles of scores for each dietary pattern, taking the lowest quintile group as the reference. The first model was adjusted for age only, and the second model was further adjusted for BMI, smoking, alcohol consumption, physical activity, and parental history of diabetes mellitus. Because the results were similar in these models, we presented the fully adjusted results only. Trend association was assessed by assigning ordinal numbers 0-4 to quintile categories of each dietary pattern. We repeated the analysis by using a more specific outcome criteria (HbA_{1c} concentrations of ≥ 6.1%) while excluding subjects who had HbA_{1c} concentrations of 5.5 to 6.0%. Two-sided *P* values less than 0.05 were regarded as statistically significant. All analyses were performed using Statistical Analysis System (SAS) version 8.2 (SAS Institute, Cary N.C., USA)

RESULTS

We identified four dietary patterns by principal component analysis (Table 1). The first factor was named a healthy dietary pattern because it represented frequent consumption of vegetables, fruit, soy products, fish, and yogurt. The second factor was characterized by frequent consumption of fried food, meat, processed meat, mayonnaise, and egg, and thus it was named a high-fat dietary pattern. The third factor represented frequent consumption of a variety of seafoods including shellfish, salted fish guts, fish roe, and fish paste products, and the pattern was named a seafood dietary pattern. The fourth factor was a westernized breakfast pattern characterized by frequent consumption of bread, margarine, and coffee and infrequent consumption of rice and miso soup. The first to fourth dietary patterns accounted for 16.8%, 5.5%, 4.8%, and 3.4%, respectively, of the variance in food intakes and totally explained 30.5% of the variability.

The characteristics according to quintile categories of dietary pattern scores are shown in Table 2. In both men and women, participants with a higher score of the healthy dietary pattern were more likely to be older and physically active in leisure time and were less likely to be a smoker and alcohol drinker. Participants with a higher score of the high-fat dietary pattern were on average younger and more likely to be a smoker. The high-fat dietary pattern was also associated positively with BMI and inversely with physical activity in leisure time in women. Both men and women with a higher score of the seafood dietary pattern tended to drink alcohol more frequently and have higher BMI. Women, but not men, with a higher score of the westernized breakfast pattern were younger and had lower BMI, and they were more likely to be a smoker and physically active. The westernized breakfast pattern was positively associated with the frequency of alcohol drinking in women, whereas the opposite was observed in men.

Odds ratio of elevated HbA_{1c} ($\geq$ 5.5%) according to quintile categories of each dietary pattern score are shown in Table 3. Four hundred forty-two men (13.6%) and 514 women (11.0%) were identified as having elevated HbA_{1c} concentrations. The westernized breakfast pattern was significantly and inversely related to the prevalence of elevated HbA_{1c} in both men and women. Multivariate-adjusted odds ratios (95% CI) of elevated HbA_{1c} for the highest versus lowest quintile of the westernized breakfast pattern score were 0.60 (0.43-0.84) and 0.64 (0.46-0.90) for men and women, respectively. The seafood dietary pattern was positively related to the prevalence of elevated HbA_{1c} in men. The odds of having elevated HbA_{1c} for the fourth quintile of the seafood dietary pattern score was increased by more than 70% compared to the lowest quintile. Such association was not observed in women. The healthy and high-fat dietary patterns were not statistically significantly related to the prevalence of elevated HbA_{1c}.

In an additional analysis using a stricter definition of outcome (HbA_{1c} $\geq$ 6.1%), the associations with the seafood and westernized breakfast patterns were strengthened in men. Multivariate-adjusted odds ratio (95% CI) for elevated HbA_{1c} for the second, third, fourth, and fifth quintiles versus the lowest quintile of the seafood dietary pattern were 1.22 (0.62-2.40), 1.92 (1.03-3.59), 2.08 (1.10-3.93), and 2.25 (1.20-4.19), respectively (P for trend = 0.003). The corresponding values for the westernized breakfast pattern were 0.60 (95% CI 0.35-1.05), 0.77 (0.45-1.31), 0.49 (0.27-0.88), and 0.51 (0.29-0.90), respectively (P for trend = 0.02). The associations with other dietary patterns in men and those with any pattern in women were not statistically significant.

CONCLUSIONS

We investigated the relationship between major dietary patterns and glucose tolerance status as measured by HbA_{1c} concentrations in Japanese adults. Of the four dietary patterns we identified, the westernized breakfast pattern was inversely related to HbA_{1c} concentrations in both men and women, and the seafood dietary pattern was positively related to HbA_{1c} concentrations in men but not in women.

Major strengths of the present study include large sample size, adjustment of known and suspected risk factors of type 2 diabetes, and the use of measured HbA_{1c} concentrations as the outcome. Our study had also some limitations. First, an association derived from cross-sectional study does not necessarily indicate causality. However, we excluded participants in such health conditions that might affect dietary habit or HbA_{1c} concentrations so as to minimize the possibility of reverse causality. Second, the present study was based on data from baseline survey of a cohort study, in which one-fourth of the eligible persons participated. We had no information about lifestyle characteristics of non-participants, but compared with the National Health and Nutrition Survey (20), the study participants had lower smoking prevalences (< 5%) as well as lower means of HbA_{1c} levels (0.2 to 0.3 point) in virtually all sex- and age-groups. This may suggest that participants had on average healthier lifestyles and better physical condition than non-participants. However the differences appear to be moderate and thus unlikely to account for the present association. Nevertheless, the low participation rate may have somewhat distorted the diet-HbA_{1c} associations. We infer that, in case of a high participation rate, more pronounced associations would have been observed because of a presumably greater variation in both the exposure and the outcome among the study population. Third, estimation of total energy and nutrient intakes from the present questionnaire has yet not been completed. Since a higher score on a dietary pattern is probably related to greater energy intake and thus may confer type 2 diabetes risk, the lack of adjustment for energy intake might be an explanation for the positive association for the seafood dietary pattern or for the null finding for the healthy dietary pattern. However, energy adjustment should strengthen, rather than diminish, the inverse association between the westernized breakfast pattern and HbA_{1c}, the major finding of the present study. Finally, there are limitations inherent to principal component analysis due to arbitrary decisions in determining the number of factors to retain, in choosing the method of rotation of the initial factors, and in labeling the dietary patterns (9,21). In this regard, it is notable that dietary patterns extracted in the present study have also been identified elsewhere in Japan (15).

The westernized breakfast pattern, characterized by frequent intake of bread, margarine, and coffee and infrequent intake of rice and miso soup, was inversely related to the prevalence of elevated HbA_{1c}. This finding is in line with our previous observation in male self-defense officials (15). The quantity and quality of carbohydrate affect glucose and insulin responses (22). The glycemic index of bread and rice are comparable (23) and thus simple replacement of rice by bread does not affect the index. However, bread is usually consumed with other western foods like butter, milk, and cheese that have relatively high fat content, which likely reduce overall glycemic index of the diet. Therefore, a lower glycemic impact of bread-based breakfast compared with rice-based one could be an explanation for the decreased HbA_{1c} concentrations among persons with a higher score of this dietary pattern. The inverse association with this pattern may also be ascribed in part to frequent intake of coffee, a beverage consistently associated with lower risk of type 2 diabetes (24).

The seafood dietary pattern, characterized by frequent consumption of shellfish, salted fish guts, and fish paste products, was related to higher prevalence of elevated HbA_{1c} in men. We previously found a suggestion of a positive association between this dietary pattern and serum levels of C-reactive protein (CRP) (16), a marker of systemic inflammation, which may be involved in the pathogenesis of insulin resistance and type 2 diabetes and has been a predictor of type 2 diabetes (25). However, additional adjustment for CRP did not alter the results materially, indicating that the association with this dietary pattern is independent of inflammation. Higher scores of this dietary pattern likely accompany greater consumption of salt. There is evidence in humans diets high in salt deteriorate insulin metabolism (26). A cohort study in Finland (27) also demonstrated that high salt intake independently predicted risk of type 2 diabetes. Although the underlying mechanism is unclear, our result based on an analysis of dietary pattern appears to be consistent with these data.

Healthy and prudent dietary patterns, characterized by high intakes of vegetables and fruit, have been shown to be associated with a reduced risk of type 2 diabetes (10-12,15) and glucose tolerance abnormality (15). Moreover, we previously found a significant, inverse association between the healthy dietary pattern and CRP concentrations (16). In the present analysis, however, the healthy pattern was not associated with HbA_{1c} concentrations, a finding consistent with the results of studies that reported either null (28) or non-linear (29) association between similar dietary patterns and HbA_{1c} concentrations. It should be clarified why the discrepant findings were observed among studies that used a different measure of glucose tolerance abnormality.

The high-fat dietary pattern, characterized by frequent consumption of fried food, meat, processed meat, mayonnaise, and egg, was not appreciably associated with HbA_{1c} concentrations in the present study. Comparable dietary patterns in Western populations, named Western dietary pattern, have been consistently shown to be associated with higher risk of type 2 diabetes (11-14), although the relation to HbA_{1c} concentrations has been inconsistent (28,29). The lack of an association in the present study may have been ascribed to relatively high loadings of certain vegetables to the high-fat dietary pattern. Alternatively, fat and meat consumption in Japanese is largely under the level above which confers diabetes risk. Fat-derived energy intakes were 26-37% in the Health Professionals Follow-up Study in the United States (13), whereas fat intake accounted for roughly 25% of total energy intake in Japan (20).

In conclusion, a dietary pattern characterized by frequent consumption of bread and margarine but infrequent consumption of rice and miso soup was associated with decreased HbA_{1c} concentrations in Japanese men and women, whereas a dietary pattern characterized by frequent intake of shellfish, salted fish guts, and fish paste products was related to increased HbA_{1c} concentrations in men. These findings suggest that adherence to some traditional dietary patterns in Japanese featured by white rice or salty seafoods may be related to deterioration of glucose metabolism and may explain at least in part why Japanese have a high prevalence of type 2 diabetes in spite of their relatively lean body mass. The present cross-sectional associations must be confirmed in prospective studies and the underlying mechanisms needs be clarified.

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Table 1—*Factor loading matrix for major dietary patterns identified by principal component analysis**

	Healthy pattern	High-fat pattern	Seafood pattern	Westernized breakfast pattern
Green leaves vegetables	0.67	0.16	–	–
Carrots	0.66	0.28	–	–
Mushrooms	0.66	0.19	–	–
Other green-yellow vegetables	0.65	0.22	–	–
Other vegetables	0.65	0.35	–	–
Seaweeds	0.63	–	–	–0.16
Daikon (Japanese radish)	0.61	0.17	–	–0.15
Potatoes	0.61	0.25	–	–
Other fruits	0.60	–	–	0.23
Pumpkin	0.57	–	–	–
Cabbage	0.55	0.35	–	–
Citrus fruits	0.54	–	–	0.15
Broccoli	0.49	–	–	–
Burdock/bamboo shoot	0.46	0.15	0.19	–
Bone-edible small fish	0.46	–	0.34	–0.15
Natto and soybean	0.46	–	–	–
Tofu products	0.44	0.20	0.21	–
Yogurt	0.42	–0.19	–	0.25
Fish	0.37	–	0.31	–
Kiriboshi-daikon†	0.35	–	0.26	–
Tofu (soybean curd)	0.35	–	0.22	–
Japanese confectioneries	0.32	–	–	0.16
Deep fried foods	–	0.59	0.25	–
Beef/pork	–	0.58	–	–
Stirred foods	0.29	0.57	–	–
Mayonnaise	–	0.54	0.16	–
Chicken	–	0.49	–	–
Ham, sausage, and bacon	–	0.43	0.16	0.25
Egg	–	0.35	0.22	–
Squid/octopus and shrimp/crab	–	–	0.61	–
Shellfish	0.20	–	0.60	–
Fish roe	–	–	0.52	–
Salted fish guts	–	–	0.43	–
Fish paste products	–	0.31	0.39	–
Tsukudani‡	–	–	0.37	–
Bread	–	–	–	0.79
Margarine	–	–	–	0.56
Coffee	–	0.21	–	0.31
Miso soup	0.30	–	–	–0.47
Rice	–	–	–	–0.74

*Factor loadings less than ±0.15 were represented by a dash for simplicity. Omitted in the table were food items with factor loadings less than ±0.30 for all dietary patterns (green tea, peanut/almond, garlic, canned tuna, milk, liver, Western-style confectioneries, butter, and noodles); †Dried strips of daikon (Japanese radish); ‡Seafoods simmered in soy and sugar.

Table 2—*Characteristics according to quintile categories of dietary pattern scores*

	Age (y) mean ± SD	BMI (kg/m^2) mean ± SD	Smoking % current	Alcohol use % current	Physical activity* %	Parental history of diabetes %
Men						
Healthy dietary pattern						
Q1 (low)	58.6 ± 6.1	23.6 ± 2.9	51.1	77.8	8.6	10.2
Q5 (high)	65.2 ± 6.4	23.4 ± 2.5	21.0	69.1	22.4	11.0
P for trend†	<0.01	0.60	<0.01	<0.01	<0.01	0.73
High-fat dietary pattern						
Q1	63.3 ± 6.5	23.5 ± 2.8	28.9	72.8	15.7	9.3
Q5	60.3 ± 7.0	23.6 ± 2.9	35.6	74.7	14.4	12.2
P for trend	<0.01	0.30	<0.01	0.11	0.55	0.17
Seafood dietary pattern						
Q1	61.7 ± 6.8	23.3 ± 2.7	32.6	64.8	15.0	11.4
Q5	62.4 ± 6.9	23.8 ± 3.0	34.3	80.1	15.6	12.3
P for trend	0.14	<0.01	0.62	<0.01	0.78	0.53
Westernized breakfast pattern						
Q1	62.5 ± 6.4	23.7 ± 2.8	29.8	79.2	15.6	11.4
Q5	62.2 ± 7.0	23.6 ± 2.7	33.5	70.4	15.9	11.1
P for trend	0.36	0.09	0.11	<0.01	0.63	0.76
Women						
Healthy dietary pattern						
Q1 (low)	58.7 ± 6.3	22.6 ± 3.3	14.5	33.9	7.3	15.2
Q5 (high)	64.3 ± 6.6	22.6 ± 3.0	2.0	23.0	20.5	12.4
P for trend	<0.01	0.85	<0.01	<0.01	<0.01	0.02
High-fat dietary pattern						
Q1	63.4 ± 6.4	22.4 ± 2.9	5.0	25.2	16.4	14.0
Q5	60.0 ± 6.9	22.7 ± 3.0	8.5	27.8	11.1	15.5
P for trend	<0.01	0.03	<0.01	0.06	<0.01	0.14
Seafood dietary pattern						
Q1	60.6 ± 6.5	22.3 ± 3.0	5.6	23.2	13.3	14.9
Q5	63.3 ± 7.1	22.9 ± 3.1	6.1	29.3	16.3	11.7
P for trend	<0.01	<0.01	0.31	<0.01	0.04	0.02
Westernized breakfast pattern						
Q1	62.8 ± 6.6	22.8 ± 3.3	5.7	25.3	10.9	12.4
Q5	60.8 ± 6.9	22.1 ± 2.8	7.5	31.0	16.4	13.6
P for trend	<0.01	<0.01	0.04	0.02	<0.01	0.38

*High recreational physical activity of more than 21 metabolic equivalent hours per week; †Based on the Mantel-Haenszel chi-squared test for categorical variables and linear regression analysis for continuous variables, assigning ordinal numbers 0-4 to quintile categories of each dietary pattern.

Table 3—*Multivariate-adjusted* odds ratio (95% CI) of elevated glycated hemoglobin (more than 5.5%) according to quintile categories of dietary pattern scores*

	Quintiles of dietary pattern scores					
	Q1 (low)	Q2	Q3	Q4	Q5 (high)	*P* for trend†
Men						
Healthy dietary pattern	1.00	0.86 (0.62-1.21)	0.75 (0.53-1.06)	1.11 (0.80-1.54)	0.84 (0.59-1.20)	0.89
High-fat dietary pattern	1.00	0.86 (0.62-1.18)	1.08 (0.80-1.48)	0.76 (0.55-1.06)	0.74 (0.53-1.04)	0.07
Seafood dietary pattern	1.00	1.13 (0.80-1.61)	1.31 (0.92-1.84)	1.77 (1.26-2.47)	1.34 (0.95-1.89)	0.01
Westernized breakfast pattern	1.00	0.70 (0.51-0.97)	0.80 (0.58-1.09)	0.80 (0.59-1.10)	0.60 (0.43-0.84)	0.02
Women						
Healthy dietary pattern	1.00	1.37 (1.00-1.89)	1.10 (0.80-1.53)	1.21 (0.87-1.67)	1.38 (1.00-1.91)	0.18
High-fat dietary pattern	1.00	0.96 (0.71-1.30)	1.18 (0.88-1.58)	1.02 (0.75-1.37)	0.95 (0.70-1.30)	0.93
Seafood dietary pattern	1.00	1.18 (0.87-1.59)	1.13 (0.84-1.54)	1.18 (0.87-1.59)	0.86 (0.63-1.18)	0.40
Westernized breakfast pattern	1.00	1.13 (0.84-1.50)	1.24 (0.93-1.65)	1.03 (0.77-1.38)	0.64 (0.46-0.90)	0.02

*Adjusted for age (year), body mass index (< 22.5, 22.5-24.9, 25.0-27.4, and ≥ 27.5 kg/m^2), smoking (lifetime nonsmoker, former smoker, and current smoker with a consumption of < 20 or ≥ 20 cigarettes/day), alcohol consumption (nondrinker, former drinker, and current drinker with a consumption of < 30, 30-59, or ≥ 60 g of ethanol/day), physical activity (quartile of metabolic equivalent hours/week), and parental history of diabetes mellitus (absent or present); †Based on multiple logistic regression analysis, assigning ordinal numbers 0-4 to quintile categories of each dietary pattern.