Original Article

Dietary pattern and its association with blood pressure and blood lipid profiles among Japanese adults in the 2012 Japan National Health and Nutrition Survey

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Background and Objectives: Little is known about the association between dietary patterns and cardiovascular disease risk factors among Japanese adults based on nationally representative data. This study aimed to explore the association between dietary patterns and hypertension or blood lipid profiles among Japanese people. **Methods and Study Design:** De-identified Japan National Health and Nutrition Survey (NHNS) 2012 data with a total of 8721 subjects (3524 men and 5197 women) aged 40-74 years were used. Dietary patterns were derived by principal component analysis (PCA). Generalized linear models and multivariate logistic regression analysis were used to assess the relationship between dietary patterns and blood pressure or lipid profiles. **Results:** We identified four dietary patterns: (a) traditional Japanese, (b) bread-dairy, (c) meat-fat, and (d) noodle patterns. Among these, the traditional Japanese pattern was significantly related to lower blood pressure, lower low-density lipoprotein (LDL)-cholesterol in men and lower high-density lipoprotein (HDL)-cholesterol in women. Bread-dairy pattern was associated with high total cholesterol in women and higher LDL cholesterol in both men and women. Noodle pattern was associated with higher total cholesterol and HDL-cholesterol in men. No significant association was observed between meat-fat pattern and blood pressure or lipid profiles. **Conclusions:** Our study showed that the traditional Japanese pattern with high intake of *miso*, soy-sauce, vegetables, beans, potatoes and mushroom conferred benefits on blood pressure. Our findings have indicated clearly that it is possible to provide useful information on healthy dietary pattern for health promotion from the one-day dietary records of the NHNS.

Key Words: dietary pattern, blood pressure, blood lipid profiles, Japanese, National Health and Nutrition Survey

INTRODUCTION

Investigating the relationship between dietary patterns and blood pressure or blood lipid profiles has gained attention in recent years, as researchers have been attracted to the effect of the combination of foods instead of focusing on its relationship with particular nutrients, such as sodium or saturated fat. Several studies have reported the associations of cardiovascular disease risk such as hypertension or blood lipid profiles with specific foods or nutrients, but results were controversial.[1-4] As dietary habits are influenced by lifestyle; socioeconomic; and environmental factors such as income, prices, individual preferences, and cultural beliefs, traditional single food- or nutrient-based approach may fail to take into consideration the complicated interactions and cumulative effects among nutrients.[5] However, dietary pattern analysis, taking into account the interactions and inter-correlations between nutrients and foods as well as their cumulative effects, has gained attention in the study of the association between health and diseases.[5]

A variety of studies have been implemented to explain the correlations between dietary pattern and cardiovascular risk and hypertension.[2,6] It has been postulated that the Dietary Approaches to Stop Hypertension (DASH) diet and the Mediterranean diet have favorable effects on blood pressure and lipid profiles.[7-10] High intake of fruits and vegetables, vegetarian diet,[11] cosmopolitan patterns (high intake of fried vegetables, salad, rice, chicken, fish, and wine)[12] as well as higher intake of cereals, nuts, low-fat dairy products, and poultry[13] appeared to be effective in lowering blood pressures. A study in Korean adults by Shin et al[14] reported that the dairy and carbohydrate pattern was associated with reduced risk of hypertension. Moreover, studies in Western countries found that greater adherence to a Mediterranean dietary pattern is associated with improved blood lipid profiles.[15] Recently, a study in Northern Chinese adults by Na et al[16] reported that the snack dietary pattern increased the risk of hypercholester-

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olemia. To date, only one cross-sectional study in Japanese people reported on the association between dietary pattern and hypertension or blood lipid profiles,[17] which also found that the Japanese vegetable-rich diet pattern was significantly associated with cardiovascular disease risk factors in women. Most of the above-mentioned studies identified dietary patterns using intake data from semi-quantified food frequency questionnaires (FFQs), on limited populations.

Japan is unique among developed countries in that the prevalence of cardiovascular disease morbidity and mortality is low despite having the same cardiovascular risk factors (such as high serum cholesterol) as other developed countries.[18,19] There is an increasing global interest in the Japanese dietary habits as a possible explanation of whether the nation's healthy diet contribute to the world's highest healthy life expectancy enjoyed in Japan. In fact, a very recent study found that the mortality rates were lower in Japanese adults who followed the government recommended food guide for the nation (the Japanese Spinning Top Food Guide 2005) than those who do not.[20] In another nationwide study in elderly Japanese people, findings showed that improvement in dietary habits, such as yearly increase in vegetables and meat intake, may contribute to decreasing prevalence of anemia.[21] Therefore, the Japanese population-based nationwide dietary data is important to determine the effects of nutrition on health outcomes and to explore the protective factors unique to Japanese longevity.

However, little is known about the association between dietary patterns and blood pressure or blood lipid profiles of the Japanese population based on nationally representative data. To date, no evidence of dietary pattern studies in Japanese adults using the data from Japan National Health and Nutrition Survey (NHNS) have been published. Although the Japan NHNS is based on a single day dietary survey, it is unique because the survey participants are requested to weigh and record all foods consumed. This method may provide more details regarding individual dietary patterns than FFQs. Considering the recent attention to healthy and nutritious diets, poor dietary habits, food choices or unhealthy lifestyle factors are thought to affect blood pressure or blood lipid status.[22-24] Identifying those modifiable dietary and lifestyle risk factors are of great importance for maintaining good health in the population.[25]

This study aimed to explore the dietary patterns and examine their association with hypertension or blood lipid profiles among Japanese people aged 40-74 years, using the data from the NHNS conducted in 2012, while controlling for a wide range of potential confounding factors.

METHODS

Study subjects and data source

Secondary data from de-identified records of the Japan NHNS 2012 were used with the permission of the Ministry of Health, Labor, and Welfare. A total of 8721 subjects, 3524 men and 5197 women (pregnant and lactating mothers were excluded), aged 40-74 years, who had complete data on dietary intake, lifestyle factors, anthropological and blood pressure measurements, and blood lipid profiles [total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C)] were included. The dietary survey was conducted by semi-weighing one-day dietary records of households. Dietary records are weighed by taking an inventory of all food and beverages consumed by a household and assigning approximate proportions of each item to individual household members.[26] The advantage of the method, using the one-day dietary records is that, it can be used to assess the current diet and to obtain the precise portion sizes; it does not also rely on respondents' memory and is open-ended.[27]

Ethics statement

We obtained consent for the secondary use of the 2012 NHNS data from the Ministry of Health, Labor and Welfare. This study was approved by the institutional review board of the National Institute of Health and Nutrition (NIHN).

Definition of hypertension, hyper-LDL and hypo-HDL cholesterolemia

Hypertension was defined as either having a systolic blood pressure (SBP) of ≥140 mmHg or diastolic blood pressure (DBP) of ≥90 mmHg, currently under antihypertensive treatment, or previously diagnosed for hypertension. Subjects with hyper-LDL cholesterolemia were defined as having serum LDL cholesterol level ≥140 mg/dL while subjects with hypo-HDL cholesterolemia were defined as having serum HDL cholesterol level < 40 mg/dL or being on lipid lowering medications for both conditions, according to the guidelines by the Japan Atherosclerosis Society.[28] In the present study, antihyperlipidemia medications included both cholesterol-lowering and triglyceride-lowering medications.

Definition of exercise habits and occupations with high or low physical activity

The total physical activity was calculated by multiplying the duration of exercise per week (hours) by the exercise intensity in Metabolic Equivalents of Task (MET), with 2.0, 4.0, and 6.0 METs assigned to light, moderate, and vigorous exercise intensities, respectively (resulting in a physical activity estimate independent of the body weight, expressed in METs-hours/week). Therefore, subjects with exercise habits were defined as having total physical activities ≥15 METs per week. Subjects with total physical activities <15 METs per week, those without regular exercise, or those in whom exercise was not allowed due to their health conditions were categorized as subjects with no exercise habits. Subjects were classified into having high physical activity levels (if they engage in the following occupations: agriculture, forestry, and fisheries or manufacturing and production industries) and low physical activity levels (if they engage in professional, technical engineering, managerial, or clerical occupations or were unemployed).

Statistical analysis

The dietary patterns were identified using principal component analysis (PCA) based on the 33 food items reorganized from the original 98 food groups. Sampling adequacy and inter-correlation of variables were confirmed

by Kaiser-Meyer-Olkin (KMO) value=0.59 and Bartlett's test of sphericity<0.0001, respectively. Eigenvalue >1.5 was used to determine whether a factor should be considered as a major dietary pattern. Varimax rotation was applied to review the correlations between variables and factors. Food groups with either positive or negative loadings in each pattern indicate the direct or inverse relationships with that pattern. For each subject, the factor scores for each dietary pattern were calculated by summing the food item intakes weighted by their factor loading.[9] Factor scores were then categorized into four groups based on the quartiles of the factor scores among men and women separately. Furthermore, the Diet Quality Index-International (DQI-I) scores were calculated for each individual based on their dietary intake according to the method defined by Kim et al,[29] and the mean DQI-I for each dietary pattern was estimated. The DQI-I has been proved to be beneficial for assessing both the variability within diet and the overall diet quality for individual subject.

Generalized linear models were used to assess the association between adherence to four major dietary patterns with SBP and DBP as well as with the mean concentrations of blood lipid profiles (after excluding subjects on anti-hypertensive or hyperlipidemia treatment). Covariates with significant correlation with blood pressure or blood lipid profiles on univariate analysis were selected as adjustment factors in our association analyses. Multivariate logistic regression analysis was used to assess the relationship between dietary patterns and the risks of hypertension or hyper-LDL cholesterolemia after adjustment for other potential confounding variables such as age in years (1, 40–44; 2, 45–49; 3, 50–54; 4, 55–59; 5, 60–64; 6, 65–69; and 7, 70–74), gender (1, female and 2, male), BMI (1, <18.5; 2, 18.5-24.9; 3, 25.0-29.9; and 4, ≥30), residing prefectures, current smoking, current drinking, exercise habits (1, yes and 2, no), step counts/day (1, <5000; 2, 5000-7499; 3, 7500-9999; 4, 10000-12499; and 5, ≥12500) and, total energy intake (continuous variable). The association analyses were performed separately in men and women. All statistical analyses were performed using the SPSS software (IBM SPSS Statistics, version 22.0; SPSS Inc, Chicago).

RESULTS

Dietary pattern analysis

We identified four dietary patterns by principal component analysis: (a) "traditional Japanese" (greater intake of miso and soy sauce, vegetables, beans, potatoes, mushroom, pickled vegetables, fishes and seafood, tea, seaweeds), (b) "bread-dairy" (greater intake of bread, butter, milk and jam; and low intakes of rice), (c) "meat-fat" (high intake of fat, meat, wheat, and flour products; sauce and mayonnaise) (d) "noodle" (high intake of udon [Japanese style noodle] or Chinese noodles, soba [buckwheat noodle], spices and seasoning) (Table 1). These four dietary patterns accounted for 6.4, 5.8, 5.2 and 4.5% (i.e. explained 21.9%), respectively, of the total variance in food intake.

General characteristics of the subjects by dietary patterns

Table 2 shows the general characteristics of the subjects according to the four dietary patterns. Subjects with lower scores of traditional Japanese diet pattern were younger, with lower BMI, more likely to skip breakfast and were likely to be current smokers in both men and women. For bread-dairy pattern, men with lower scores of were younger, had higher BMI, and were likely to skip breakfast. However, there was no significant difference in step counts, physical activity and exercise habit, between the lower and higher scores of bread-dairy pattern. In women, lower score was associated with younger age, higher BMI, less step counts, more exercise habit, more likely to skip breakfast, and more likely to be current smokers and drinkers. For meat-fat pattern, subjects with lower scores were older with lower step counts, less likely to be current smokers or drinkers, but no differences in physical activity or exercise habit were found. Regarding the noodle pattern, subjects with lower scores had higher proportion of occupation with high physical activity, and were less likely to be current smokers and drinkers in both men and women.

Nutrient intakes across the quartiles of dietary patterns

We explored the relationship between nutrients intake, total DQI-I scores and the dietary pattern scores by generalized linear model analysis (Table 3). For all dietary patterns except noodle pattern, higher scores were associated with higher total energy intake in both men and women. Subjects in the highest quartile of traditional Japanese had the highest protein, fiber, n-3 fatty acid and salt intakes in both men and women, and lowest fat intake in men. The total fat, dietary fiber intakes increased, and total cholesterol intake decreased, with the score increase in bread-dairy pattern in both men and women.

Subjects in the highest quartile of meat-fat pattern score had the highest intakes of total fat, saturated fat, n-6 fatty acid, total cholesterol and salt as well as the lowest intake of carbohydrate and n-3 fatty acid in both men and women. The lowest total protein intake was observed in the lowest quartile of traditional pattern in men and the lowest quartile of noodle pattern in women. For noodle pattern, higher scores were associated with lower saturated fat in men, lower total cholesterol intake in women and lower carbohydrate intake in both men and women, while higher scores were related to higher fat, dietary fiber and salt intake in both men and women. Subjects in the highest quartile of traditional Japanese pattern score had the highest total DQI-I score among the four dietary patterns, in both men and women. Total DQI-I score decreased as the bread-dairy, meat-fat and noodle diet scores increased, in both men and women.

Association of each dietary pattern with blood pressure and blood lipid profiles

Table 4 shows the mean blood pressure and blood lipid profiles adjusted for confounding variables (age category, BMI category, residing prefectures, current smoking, current drinking, exercise habits, category of step counts/day, and total energy intake), according to quartiles of each dietary pattern. The multivariable adjusted geometric

Table 1. Factor-loading matrix for 4 major dietary patterns identified by principal component analysis[†]

Food groups [Food classification no.]	Traditional Japanese	Bread-dairy	Meat-fat	Noodle
	Pattern 1	Pattern 2	Pattern 3	Pattern 4
Miso and soy sauce [93, 96]	0.66	-0.17		
Vegetables [25-35]	0.58	0.11	0.17	
Beans [18-23]	0.39		-0.14	
Potatoes [13-16]	0.36		0.13	-0.14
Mushroom [46]	0.35			0.24
Sugar and sweeteners [17]	0.35	0.23	0.19	
Salted or pickled vegetables [37-38]	0.28	-0.13		
Fish and seafood (except processed seafood) [48-55]	0.27			
Tea [89]	0.26		-0.12	-0.16
Seaweeds [47]	0.24			
Processed fish [56-60]	0.22		-0.11	-0.17
Nuts and seeds [24]	0.15	0.13		
Pasta [8]	-0.14		0.11	
Bread and Danish [4-5]	-0.25	0.64		
Butter and Margarine [76-77]	-0.19	0.52	0.25	
Rice and rice products [1-2]	0.29	-0.49	0.14	-0.41
Milk and milk products [71-75]	0.13	0.48		
Fresh fruits [39-43]	0.41	0.42	-0.16	
Jam [44]		0.41		
Alcohol drinks [86-88]		-0.29	0.24	0.19
Confectionaries [81-85]		0.26		
Coffee and cocoa [90]	-0.14	0.25	0.21	
Vegetable juice [36]		0.14		
Fat and oil (except butter and margarine) [78-80]			0.66	
Meat [61-69]			0.58	
Wheat and flour products [3, 9]			0.50	
Sauce, Mayonnaise [92, 95]			0.44	
Eggs [70]	0.14	-0.12	0.28	-0.11
Other drinks (Soda, cola, cider, barley tea etc.) [91]			0.15	
Fruit juice [45]				
Corn products and other grains [11-12]				
Noodles (including *soba*) [6, 7, 10]				0.77
Spices and seasonings [94, 97, 98]	0.15			0.71
Variance explained (%)	6.4	5.8	5.2	4.5

[†]Values are factor loading; absolute value <0.10 are not shown for simplicity.
A detailed description of food groups used in NHNS was shown in the following link: on page 61-67 (Table 1) (http://www.nibiohn.go.jp/eiken/english/research/pdf/nhns2012.pdf).

mean for SBP (p<0.001) and DBP (p<0.001) were significantly lower among subjects in the highest quartile than among those in the lowest quartile of traditional Japanese pattern in men (Table 4-1), while the mean LDL-C (in men) (p=0.043) and HDL-C (in women) (p=0.019) were significantly lower among subjects in the highest quartile than among those in the lowest quartile (Table 4-1, 4-2). Moreover, the mean LDL-C in both men (p=0.047) and women (p=0.047) and mean TC (p=0.002) in women increased according to the quartiles of bread-dairy pattern score. For noodle pattern, higher score was associated with higher TC (p=0.041) and HDL-C (p=0.014) in men. However, there was no significant relationship between meat-fat pattern and blood pressure or blood lipid profiles in both men and women.

Association between each dietary pattern with hypertension and hyper-LDL or hypo-HDL cholesterolemia

In men, only traditional Japanese pattern was related to a lower prevalence of hypertension. The lowest through the highest multivariate-adjusted odds ratio (OR), (95% confidence interval [CI]) of the traditional Japanese pattern quartiles was 1.00 (reference), 0.81 (0.55-1.19), 0.50 (0.34-0.75), and 0.51 (0.33-0.78), respectively (p=0.012). No statistically significant relationship, between the other three dietary patterns and hypertension or dyslipidemia, was observed in men.

For dyslipidemia, only the bread-dairy pattern was associated with hyper-LDL cholesterolemia in women. The multivariate-adjusted ORs (95% CI) comparing the highest quartile to the lowest were 0.63 (0.45-0.89), 0.77 (0.56-1.05), and 1.04 (0.77-1.39), respectively (p=0.043). There was no statistically significant relationship between the traditional Japanese, meat-fat and noodle patterns with dyslipidemia in both men and women (Table 5-1, 5-2).

DISCUSSION

Although several studies have reported the benefits of the Mediterranean diet or the DASH diet on blood pressure or serum cholesterol levels, there is limited evidence on hypertension and dyslipidemia related to the dietary patterns in the Japanese population. In this cross-sectional analysis of the Japan NHNS 2012 data, four dietary patterns were identified. Among these, the traditional Japanese pattern (characterized by higher intake of miso and soy sauce, vegetables, beans, potatoes, mushroom, pickled vegetables, fish and seafood, tea, seaweeds), was significantly

Table 2. General characteristics of subjects in the lowest and highest quartiles of dietary pattern scores

	Pattern 1: Traditional Japanese					Pattern 2: Bread-Dairy				
	Q1 (Lowest)		Q4 (Highest)		*p*-value†	Q1 (Lowest)		Q4 (Highest)		*p*-value†
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Men										
N	881		881			881		881		
Age (yrs)‡	57.1	10.1	63.3	8.5	<0.001	58.6	9.6	62.1	9.0	<0.001
BMI (kg/m^2)‡	23.7	3.3	24.3	3.0	<0.001	24.1	3.3	23.7	3.0	0.028
Step counts/ day‡	6930	4364	7260	3980	0.094	7027	5198	7227	4374	0.433
Total physical activity/week (METs)‡	6.8	5.7	6.4	4.6	0.710	6.6	5.2	6.6	5.3	0.942
Exercise habits (%)	7.1		4.8		0.543	5.9		5.6		0.892
Skipping breakfast (%)	5.8		1.2		<0.001	5.0		1.1		<0.001
Smoking habit (%)										
Current smoker	40.6		22.2		<0.001	37.9		27.5		<0.001
Drinking habit (%)										
Current drinker	51.3		46.5		0.167	66.9		34.7		<0.001
Occupation (high physical activity level) (%)	29.9		37.9		0.001	45.3		22.5		<0.001
Women										
N	1299		1299			1299		1299		
Age (yrs)‡	54.8	9.9	63.1	7.9	<0.001	58.2	10.2	59.9	9.0	<0.001
BMI (kg/m^2)‡	22.7	3.7	23.1	3.4	0.032	23.3	3.8	22.5	3.3	<0.001
Step counts/ day‡	6621	3655	6847	3946	0.031	6459	3679	6941	3633	0.003
Total physical activity/week (METs)‡	6.3	5.6	5.5	3.7	0.006	5.7	4.9	5.6	3.3	0.773
Exercise habits (%)	5.8		3.2		0.018	6.4		2.1		0.019
Skipping breakfast (%)	3.8		0.3		<0.001	2.6		0.6		<0.001
Smoking habit (%)										
Current smoker	11.8		2.9		<0.001	9.1		7.0		<0.001
Drinking habit (%)										
Current drinker	17.6		7.4		<0.001	17.7		8.9		<0.001
Occupation (high physical activity level)§ (%)	11.5		15.1		0.003	16.1		8.8		<0.001

†By chi-square test

‡*p* values were from generalized linear model analysis for continuous variables.

§Occupation with high physical activity level was classified as the subjects who engaged in the agriculture, forestry, and fisheries or manufacturing and production industries.

Table 2. General characteristics of subjects in the lowest and highest quartiles of dietary pattern scores (cont.)

	Pattern 3: Meat-fat					Pattern 4: Noodle				
	Q1 (Lowest)		Q4 (Highest)		*p*-value†	Q1 (Lowest)		Q4 (Highest)		*p*-value†
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Men										
N	881		881			881		881		
Age (yrs)‡	63.5	8.7	57.0	9.6	<0.001	60.4	9.7	60.4	9.3	0.723
BMI (kg/m^2)‡	23.9	3.3	24.0	3.3	0.590	23.8	3.1	24.1	3.1	0.005
Step Counts/ day‡	6458	4075	7451	4327	<0.001	7217	4480	7077	4302	0.078
Total physical activity/week (METs)‡	6.7	5.7	6.4	5.8	0.262	7.1	6.3	7.0	5.3	0.017
Exercise habits (%)	5.3		5.6		0.158	7.5		6.3		0.129
Skipping breakfast (%)	3.6		2.5		0.158	2.4		3.3		0.352
Smoking habit (%)										
Current smoker	25.8		39.0		<0.001	30.1		33.7		0.002
Drinking habit (%)										
Current drinker	41.7		57.5		<0.001	36.9		57.4		<0.001
Occupation (high physical activity level) (%)	29.5		36.8		0.012	41.4		26.8		<0.001
Women										
N	1299		1299			1299		1299		
Age (yrs)‡	62.5	8.7	56.3	9.7	<0.001	60.0	9.8	59.0	9.3	0.001
BMI (kg/m2)‡	22.8	3.3	22.8	3.7	0.993	23.0	3.5	22.7	3.5	0.573
Step counts/ day‡	6404	3839	7077	3789	<0.001	6589	3863	6702	3595	0.138
Total physical activity/week (METs)‡	5.6	4.1	5.8	4.2	0.285	5.9	4.8	5.3	3.5	0.256
Exercise habits (%)	4.1		2.9		0.722	5.7		2.4		0.114
Skipping breakfast (%)	1.7		1.1		0.478	0.9		1.8		0.100
Smoking habit (%)										
Current smoker	4.9		9.7		<0.001	5.1		8.4		0.003
Drinking habit (%)										
Current drinker	7.7		17.6		<0.001	7.6		14.8		<0.001
Occupation (high physical activity level)§ (%)	12.3		13.3		0.305	17.2		9.8		<0.001

†By chi-square test
‡*p* values were from generalized linear model analysis for continuous variables.
§Occupation with high physical activity level was classified as the subjects who engaged in the agriculture, forestry, and fisheries or manufacturing and production industries.

Table 3. Nutrient intakes and total DQI-I scores of subjects in the lowest and highest quartiles of dietary pattern scores

Nutrients intake (per 1000kcal/d)	Pattern 1: Traditional Japanese					Pattern 2: Bread-Dairy				
	Q1 (Lowest)		Q4 (Highest)		Trend *p*-value	Q1 (Lowest)		Q4 (Highest)		Trend *p*-value
	Mean†	SE	Mean†	SE		Mean†	SE	Mean†	SE	
Men										
Total energy intake (kcal)	1902.4	31.0	2557.0	25.6	<0.001	2214.7	33.9	2293.1	23.9	<0.001
Protein (g)	33.8	0.5	38.3	0.4	<0.001	35.6	0.6	36.6	0.4	0.486
Fat (g)	27.5	0.5	25.8	0.4	0.022	22.9	0.6	29.1	0.4	<0.001
Carbohydrate (g)	135.9	1.5	140.1	1.2	0.150	139.4	1.6	138.2	1.2	0.801
Fiber (g)	6.1	0.2	9.6	0.2	<0.001	6.7	0.2	8.8	0.1	<0.001
Saturated fat (g)	7.4	0.2	6.4	0.1	<0.001	5.5	0.2	8.0	0.1	<0.001
Total cholesterol (mg)	161.1	6.2	162.4	5.1	0.997	168.4	6.8	147.0	4.8	0.016
n-3 fatty acid	1.1	0.1	1.4	0.1	<0.001	1.2	0.1	1.2	0.0	0.859
n-6 fatty acid	4.6	0.1	4.8	0.1	0.160	4.3	0.2	4.9	0.1	0.014
Salt intake	9.1	0.3	15.3	0.2	<0.001	11.7	0.3	11.9	0.2	0.394
Total DQI-I score	56.4	0.3	62.2	0.3	<0.001	60.6	0.3	57.7	0.3	<0.001
Women										
Total energy intake (kcal)	1482.0	23.2	2033.8	17.4	<0.001	1648.4	23.3	1896.8	19.1	<0.001
Protein (g)	37.3	0.5	40.9	0.4	<0.001	38.9	0.5	37.8	0.4	0.027
Fat (g)	29.1	0.5	28.2	0.4	0.467	26.5	0.5	30.3	0.4	<0.001
Carbohydrate (g)	141.5	1.3	142.1	1.0	0.844	142.5	1.3	142.3	1.1	0.993
Fiber (g)	7.9	0.2	11.3	0.1	<0.001	8.6	0.2	10.0	0.2	<0.001
Saturated fat (g)	7.9	0.2	7.3	0.1	0.045	6.4	0.2	8.6	0.1	<0.001
Total cholesterol (mg)	171.7	6.1	175.2	4.6	0.267	181.4	6.1	150.5	5.0	<0.001
n-3 fatty acid	1.1	0.0	1.4	0.0	<0.001	1.3	0.0	1.2	0.0	0.638
n-6 fatty acid	5.0	0.1	5.2	0.1	0.408	5.0	0.1	5.0	0.1	0.620
Salt intake	7.3	0.2	13.2	0.2	<0.001	10.5	0.1	10.0	0.1	0.527
Total DQI-I score	56.1	0.4	62.5	0.4	<0.001	59.7	0.3	57.3	0.3	<0.001

†Adjusted means for age, BMI, prefectures, current smoker, current drinker, exercise habits, step counts/day and, total energy intake by generalized linear model analysis.

Table 3. Nutrient intakes and total DQI-I scores of subjects in the lowest and highest quartiles of dietary pattern scores (cont.)

Nutrients intake (per 1000kcal/d)	Pattern 3: Meat-fat					Pattern 4: Noodle				
	Q1 (Lowest)		Q4 (Highest)		Trend *p*-value	Q1 (Lowest)		Q4 (Highest)		Trend *p*-value
	Mean†	SE	Mean†	SE		Mean†	SE	Mean†	SE	
Men										
Total energy intake (kcal)	1943.0	28.5	2530.9	29.7	<0.001	2288.2	30.5	2155.8	26.9	0.006
Protein (g)	37.5	0.5	35.0	0.5	0.004	34.8	0.5	36.8	0.5	0.004
Fat (g)	22.8	0.5	29.8	0.5	<0.001	24.9	0.5	25.5	0.5	<0.001
Carbohydrate (g)	148.5	1.4	130.3	1.4	<0.001	146.8	1.5	137.1	1.3	<0.001
Fiber (g)	8.6	0.2	7.0	0.2	<0.001	7.0	0.2	8.7	0.2	<0.001
Saturated fat (g)	6.0	0.2	7.4	0.2	<0.001	8.7	0.2	6.6	0.2	0.022
Total cholesterol (mg)	133.2	5.7	184.6	5.9	<0.001	173.5	6.1	151.9	5.4	0.064
n-3 fatty acid	1.4	0.1	1.1	0.1	0.005	1.3	0.1	1.1	0.0	0.007
n-6 fatty acid	4.1	0.1	5.4	0.1	<0.001	4.5	0.1	4.6	0.1	0.090
Salt intake	11.1	0.3	12.4	0.3	<0.001	4.8	0.1	6.1	0.1	<0.001
Total DQI-I score	59.3	0.3	57.1	0.3	<0.001	60.8	0.3	58.4	0.3	<0.001
Women										
Total energy intake (kcal)	1575.4	18.5	2006.5	22.9	<0.001	1859.8	22.6	1724.2	19.5	<0.001
Protein (g)	40.2	0.4	37.8	0.5	0.001	37.2	0.5	40.4	0.4	<0.001
Fat (g)	25.1	0.4	33.0	0.5	<0.001	27.1	0.5	28.2	0.4	0.001
Carbohydrate (g)	149.6	1.0	132.7	1.3	<0.001	148.2	1.3	141.1	1.1	<0.001
Fiber (g)	10.2	0.2	8.7	0.2	<0.001	8.3	0.2	10.2	0.2	<0.001
Saturated fat (g)	6.8	0.1	8.3	0.2	<0.001	7.3	0.2	7.4	0.2	0.048
Total cholesterol (mg)	144.5	4.8	190.1	6.0	<0.001	185.8	5.9	161.4	5.1	0.003
n-3 fatty acid	1.4	0.1	1.2	0.1	0.001	1.3	0.1	1.1	0.0	0.010
n-6 fatty acid	4.4	0.1	6.1	0.1	<0.001	4.8	0.1	5.3	0.1	0.104
Salt intake	9.2	0.1	11.8	0.1	<0.001	8.9	0.1	11.6	0.1	<0.001
Total DQI-I score	59.2	0.4	57.5	0.4	0.060	60.0	0.4	58.2	0.3	<0.001

†Adjusted means for age, BMI, prefectures, current smoker, current drinker, exercise habits, step counts/day and, total energy intake by generalized linear model analysis.

Table 4. Geometric means (95 % CI) of blood pressure and blood lipid profiles by quartiles of dietary pattern score

Parameter	Men†					Women‡				
	Q1 (Low)	Q2	Q3	Q4 (High)	*p* for trend§	Q1 (Low)	Q2	Q3	Q4 (High)	*p* for trend§
	Adjusted mean (95% CI)	Adjusted mean (95% CI)	Adjusted mean (95% CI)	Adjusted mean (95% CI)		Adjusted mean (95%)	Adjusted mean (95% CI)	Adjusted mean (95% CI)	Adjusted mean (95% CI)	
Pattern 1: Traditional Japanese										
SBP (mmHg)	142.4 (139.2-145.6)	137.5 (134.6-140.4)	133.1 (130.3-135.8)	132.3 (129.3-135.3)	<0.001	127.7 (125.0-130.4)	127.3 (124.7-129.8)	127.3 (125.1-129.4)	127.2 (127.0-129.9)	0.997
DBP (mmHg)	86.2 (84.2-88.2)	84.8 (83.0-86.7)	81.1 (79.4-82.9)	79.5 (77.5-81.4)	<0.001	77.9 (76.2-79.6)	77.0 (75.4-78.6)	78.1 (76.8-79.5)	77.6 (76.3-79.0)	0.743
TC (mg/dL)	198.4 (192.9-203.8)	202.7 (197.8-207.6)	199.5 (195.0-204.1)	196.1 (191.3-200.9)	0.198	212.9 (208.0-217.8)	209.7 (205.2-214.2)	210.6 (206.8-214.5)	209.9 (206.1-213.7)	0.663
HDL-C (mg/dL)	56.4 (54.0-58.8)	55.8 (53.6-58.0)	54.6 (52.6-56.6)	55.8 (53.7-58.0)	0.759	65.9 (63.7-68.0)	66.6 (64.5-68.6)	65.5 (63.8-67.3)	62.8 (61.1-64.5)	0.019
LDL-C(mg/dL)	118.7 (113.7-123.6)	119.8 (115.4-124.3)	118.3 (114.2-122.5)	111.6 (107.2-116.0)	0.043	122.8 (118.5-127.2)	120.3 (116.3-124.3)	121.4 (117.9-124.8)	122.8 (119.4-126.2)	0.787
Pattern 2: Bread-dairy										
SBP (mmHg)	137.9 (134.5-141.4)	136.4 (133.5-139.3)	137.4 (134.7-140.1)	133.4 (131.0-135.7)	0.055	129.2 (1266-131.8)	128.0 (125.7-130.4)	125.2 (123.1-127.4)	127.1 (124.9-129.2)	0.333
DBP (mmHg)	82.8 (80.6-85.0)	84.2 (82.4-86.1)	82.5 (80.7-84.2)	82.0 (80.5-83.4)	0.086	78.2 (76.6-79.8)	76.8 (75.4-78.3)	77.3 (75.9-78.6)	78.4 (77.1-79.8)	0.273
TC (mg/dL)	194.3 (188.8-199.9)	202.2 (197.4-207.0)	200.5 (196.1-204.8)	199.8 (195.7-204.0)	0.208	204.8 (200.1-209.5)	208.6 (204.5-212.7)	214.0 (210.2-217.8)	215.7 (211.9-219.6)	0.002
HDL-C (mg/dL)	56.0 (53.5-58.5)	54.0 (51.8-56.1)	55.9 (54.09-57.9)	56.6 (54.8-58.5)	0.235	64.2 (62.1-66.3)	65.0 (63.1-66.8)	66.5 (64.8-68.1)	65.1 (63.4-66.8)	0.444
LDL-C(mg/dL)	111.6 (106.5-116.7)	120.6 (116.2-124.9)	117.3 (113.3-121.3)	119.0 (115.2-122.7)	0.047	117.5 (113.3-121.6)	119.0 (115.3-122.7)	124.3 (121.0-127.7)	126.5 (123.1-129.9)	0.003

SBP: systolic blood pressure, DBP: diastolic blood pressure, TC: total cholesterol, HDL-C: high-density lipoprotein cholesterol, LDL-C: low-density lipoprotein cholesterol.

†Subjects for blood pressure analysis N=2423 (subjects with anti-hypertensive medication were excluded.); Subjects for blood lipid profiles analysis N=3048 (Subjects with lipid lowering medication were excluded.)

‡Subjects for blood pressure analysis N=3956 (subjects with anti-hypertensive medication were excluded.); Subjects for blood lipid profiles analysis N=4271 (Subjects with lipid lowering medication were excluded.).

§Adjusted variables: age in years (1: 40-44, 2: 45-49, 3: 50–54, 4: 55–59, 5: 60–64, 6: 65–69, 7: 70–74), BMI (1:<18.5, 2:18.5-24.9, 3:25.0-29.9, 4: ≥30), prefectures, current smoker, current drinker, exercise habits (1: yes, 2: no), step counts/day (1: <5000, 2:5000-7499, 3:7500-9999, 4:10000-12499, 5: ≥12500) and, total energy intake (continuous variable).

Table 4. Geometric means (95 % CI) of blood pressure and blood lipid profiles by quartiles of dietary pattern score (cont.)

Parameter	Men†					Women‡				
	Q1 (Low)	Q2	Q3	Q4 (High)	*p* for trend§	Q1 (Low)	Q2	Q3	Q4 (High)	*p* for trend§
	Adjusted mean (95% CI)	Adjusted mean (95% CI)	Adjusted mean (95% CI)	Adjusted mean (95% CI)		Adjusted mean (95% CI)	Adjusted mean (95% CI)	Adjusted mean (95% CI)	Adjusted mean (95% CI)	
Pattern 3: Meat-fat										
SBP (mmHg)	133.7 (130.7-136.7)	136.4 (133.9-139.6)	137.4 (134.7-140.1)	133.4 (131.0-135.7)	0.109	127.7 (125.3-130.0)	129.5 (127.2-131.7)	126.9 (124.6-129.3)	125.2 (122.6-127.8)	0.164
DBP (mmHg)	82.8 (80.6-85.0)	84.2 (82.4-86.1)	82.5 (80.7-84.2)	82.0 (80.5-83.4)	0.744	77.5 (76.0-78.9)	78.7 (77.3-80.1)	78.5 (77.0-80.0)	76.0 (74.4-77.6)	0.171
TC (mg/dL)	200.1 (195.2-204.9)	198.0 (193.5-202.5)	200.2 (195.4-204.9)	198.6 (193.3-203.9)	0.894	212.2 (208.3-216.0)	212.0 (208.1-215.9)	211.0 (206.6-215.4)	207.9 (203.2-212.6)	0.849
HDL-C (mg/dL)	56.7 (54.5-58.8)	54.9 (52.8-56.9)	56.0 (53.9-58.1)	55.0 (52.7-57.4)	0.756	64.6 (62.9-66.3)	64.4 (62.6-66.1)	64.9 (62.9-66.8)	66.9 (64.8-69.0)	0.178
LDL-C(mg/dL)	116.4 (112.0-120.8)	118.0 (113.9-122.2)	117.8 (113.5-122.2)	116.2 (111.4-121.1)	0.981	123.3 (119.8-126.7)	122.9 (119.4-126.3)	121.8 (117.9-125.7)	119.4 (115.2-123.6)	0.984
Pattern 4: Noodle										
SBP (mmHg)	136.0 (132.9-139.0)	134.4 (131.5-137.4)	138.1 (135.3-140.8)	136.4 (133.6-139.2)	0.449	128.7 (126.2-131.2)	128.2 (125.9-130.5)	126.0 (123.9-128.2)	126.6 (124.4-128.7)	0.292
DBP (mmHg)	82.4 (80.4-84.3)	82.5 (80.7-84.4)	82.8 (81.1-84.6)	83.7 (81.9-85.4)	0.884	78.0 (76.4-79.6)	77.5 (76.1-78.9)	77.3 (75.9-78.6)	78.0 (76.6-79.3)	0.884
TC (mg/dL)	193.0 (188.0-198.0)	198.8 (194.0-203.6)	201.4 (196.9-206.0)	203.1 (198.5-207.7)	0.041	209.8 (205.4-214.3)	211.5 (207.4-215.6)	211.0 (207.1-214.8)	210.9 (207.0-214.7)	0.334
HDL-C (mg/dL)	53.1 (50.9-55.3)	58.3 (56.1-60.4)	55.9 (53.8-57.9)	55.2 (53.1-57.2)	0.014	63.5 (61.5-65.5)	65.4 (63.6-67.2)	65.9 (64.1-67.6)	65.9 (64.1-67.6)	0.096
LDL-C(mg/dL)	114.5 (109.9-119.0)	114.4 (110.0-118.8)	118.8 (114.7-123.0)	120.4 (116.2-124.7)	0.111	121.4 (117.4-125.4)	122.8 (119.2-126.5)	121.9 (118.4-125.4)	121.2 (117.8-124.7)	0.550

SBP: systolic blood pressure, DBP: diastolic blood pressure, TC: total cholesterol, HDL-C: high-density lipoprotein cholesterol, LDL-C: low-density lipoprotein cholesterol.

†Subjects for blood pressure analysis N=2423 (subjects with anti-hypertensive medication were excluded.); Subjects for blood lipid profiles analysis N=3048 (Subjects with lipid lowering medication were excluded.)

‡Subjects for blood pressure analysis N=3956 (subjects with anti-hypertensive medication were excluded.); Subjects for blood lipid profiles analysis N=4271 (Subjects with lipid lowering medication were excluded.).

§Adjusted variables: age in years (1: 40-44, 2: 45-49, 3: 50–54, 4: 55–59, 5: 60–64, 6: 65–69, 7: 70–74), BMI (1:<18.5, 2:18.5-24.9, 3:25.0-29.9, 4: ≥30), prefectures, current smoker, current drinker, exercise habits (1: yes, 2: no), step counts/day (1: <5000, 2:5000-7499, 3:7500-9999, 4:10000-12499, 5: ≥12500) and, total energy intake (continuous variable).

related to lower blood pressure, lower LDL-C in men.

With regards to blood pressure, several studies have reported that the traditional Japanese diet with higher intake of miso, fish, vegetables, and fruits pattern were significantly associated with favorable cardiovascular disease risk factors, such as lower blood pressure.[11, 12,17,30-32] Likewise, our study also observed that traditional Japanese diet with higher intake of miso and soy sauce, vegetables, beans, potatoes, mushroom, pickles, fishes and seafood, was associated with lower blood pressure. This may suggest the reproducibility of the dietary patterns identified by the one-day dietary records' method used in our study. Moreover, a high quality of diet composition (high DQI-I score) was also observed in the highest quartile of traditional Japanese pattern. Our study seems to support the evidence that traditional Japanese pattern has benefits in lowering blood pressure in Japanese men.

However, the traditional Japanese diet in our study was associated with low LDL-C in men and low HDL-C in women. This may be due to the significantly low saturated fat intake[33] in the highest quartile of traditional Japanese pattern in both men and women (Table 3). Furthermore, our findings are consistent with those from other studies, which reported that the high consumption of vegetable-containing foods[34] and ovo-lacto-vegetarian diet rich in fruits, vegetables, nuts, grains, dairy, and egg products[35] were related to lower LDL-C level and HDL-C level.

The bread-dairy pattern identified in our study, similar to previously reported westernized breakfast pattern,[36] was related to dyslipidemia in both men and women. This may be due to the high intake of total fat, especially saturated fat and butter[37] in the highest quartile of bread-dairy pattern.[38]

Our results regarding the meat-fat pattern are in some ways consistent with previous reports on meat and fast-food dietary pattern (e.g., less rice, but rich in meat, soda, bread, cookies, and ice cream), which were related to the high TC and high HDL-C in the Korean population.[4, 39]

Our results regarding noodle pattern, characterized by the higher intake of udon, soba (buckwheat) or Chinese noodles, and dyslipidemia were consistent with previous report of increased TC and HDL-C in men.[39] Interestingly, there was a simultaneous increase in both TC and HDL cholesterol with the higher noodle pattern score in men. It has been reported that the average HDL-C levels are indeed high among Japanese people in general, due to genetic deficiency of cholesteryl ester transfer protein (CETP).[40] In spite of the high HDL-C levels; we speculate that certain number of subjects with CETP deficiency had increased risk of dyslipidemia. In addition, this direct association between increased HDL-C with the noodle pattern might be mediated by reduced carbohydrates[41-43] intakes among those in the highest quartile of the noodle pattern. Although it was not significant, higher HDL-C was also observed in the highest quartile of noodle pattern in women.

However, the present study has some limitations. First, as the association between dietary patterns and blood pressure or lipid profiles was derived from a cross-sectional study, the causal relationship between dietary patterns and blood pressure or lipid profiles could not be determined; and may have the possibility of reverse causality. Awareness of previously diagnosed hypertension or dyslipidemia can alter dietary patterns, such as an increase in the consumption of vegetables in hypertensive subjects.[44] Rather, the significant association persisted after excluding subjects on medication for hypertension (28.8%) and hyperlipidemia (15.5%) from the analysis of blood pressure and blood lipid profiles. Second, as the Japan NHNS is usually conducted in November, the observed dietary patterns may vary according to seasonal variations in food intake and availability. Third, the dietary intake was collected through a self-reported dietary record data; bias resulting from the subjective interpretation of the actual intake may be present. Finally, we could not exclude the potential influence of menopause transition on blood lipid profiles in women of peri-menopausal age, because, related information on menstrual status was not available in our data. Despite these limitations, our study was based on a large-scale, nationally representative health and nutrition survey data, which was highly standardized, in obtaining socio demographic and lifestyle characteristics as well as biological cardiovascular risk factors.

Conclusion

Our study showed that the traditional Japanese pattern with high intake of miso and soy sauce, vegetable, and fishes conferred benefits on blood pressure. The bread-dairy and noodle patterns also significantly influenced the likelihood of developing dyslipidemia in both men and women. Dietary patterns derived from the one-day weighted dietary records were consistent with prior studies using FFQs. Our findings have made it clear that it is possible to provide useful information on healthy dietary pattern for health promotion from one-day dietary records of the National Health and Nutrition Examination Survey. Further large-scale prospective studies are needed to explore these associations.

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AUTHOR DISCLOSURES

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Table 5. Odds ratios for hypertension and hypercholesterolemia based on dietary pattern scores

Parameter	Men					Women				
	Q1 (Low)	Q2	Q3	Q4 (High)	*p* for trend†	Q1 (Low)	Q2	Q3	Q4 (High)	*p* for trend†
Pattern 1: Traditional Japanese										
Hypertension										
Prevalence: n (%)	534 (60.6)	539 (61.2)	534 (60.6)	555 (63.0)	0.012	534 (60.6)	539 (61.2)	534 (60.6)	555 (63.0)	0.012
OR† (95% CI)	1 (ref)	0.81 (0.55-1.19)	0.50 (0.34-0.75)	0.51 (0.33-0.78)		1 (ref)	0.81 (0.55-1.19)	0.50 (0.34-0.75)	0.51 (0.33-0.78)	
Hyper-LDL cholesterolemia										
Prevalence: n (%)	302 (34.3)	305 (34.6)	279 (31.7)	268 (30.4)	0.506	302 (34.3)	305 (34.6)	279 (31.7)	268 (30.4)	0.506
OR† (95% CI)	1 (ref)	1.02 (0.71-1.46)	0.85 (0.59-1.23)	0.78 (0.52-1.18)		1 (ref)	1.02 (0.71-1.46)	0.85 (0.59-1.23)	0.78 (0.52-1.18)	
Hypo-HDL cholesterolemia										
Prevalence: n (%)	213 (24.2)	210 (23.8)	224 (25.4)	229 (26.0)	0.577	213 (24.2)	210 (23.8)	224 (25.4)	229 (26.0)	0.577
OR† (95% CI)	1 (ref)	0.90 (0.73-1.12)	0.91 (0.73-1.13)	0.88 (0.70-1.09)		1 (ref)	0.90 (0.73-1.12)	0.91 (0.73-1.13)	0.88 (0.70-1.09)	
Pattern 2: Bread-dairy										
Hypertension										
Prevalence: n (%)	562 (63.8)	557 (63.2)	526 (59.7)	517 (58.7)	0.223	562 (63.8)	557 (63.2)	526 (59.7)	517 (58.7)	0.223
OR† (95% CI)	1 (ref)	1.02 (0.71-1.46)	0.85 (0.59-1.23)	0.78 (0.52-1.18)		1 (ref)	1.02 (0.71-1.46)	0.85 (0.59-1.23)	0.78 (0.52-1.18)	
Hyper-LDL cholesterolemia										
Prevalence: n (%)	254 (28.8)	280 (31.8)	300 (34.1)	320 (36.3)	0.364	254 (28.8)	280 (31.8)	300 (34.1)	320 (36.3)	0.364
OR† (95% CI)	1 (ref)	1.21 (0.82-1.78)	1.06 (0.72-1.55)	1.16 (0.79-1.69)		1 (ref)	1.21 (0.82-1.78)	1.06 (0.72-1.55)	1.16 (0.79-1.69)	
Hypo-HDL cholesterolemia										
Prevalence: n (%)	186 (21.1)	205 (23.3)	235 (26.7)	250 (28.4)	0.655	186 (21.1)	205 (23.3)	235 (26.7)	250 (28.4)	0.655
OR† (95% CI)	1 (ref)	1.21 (0.82-1.78)	1.06 (0.72-1.55)	1.16 (0.79-1.69)		1 (ref)	1.21 (0.82-1.78)	1.06 (0.72-1.55)	1.16 (0.79-1.69)	
Pattern 3: Meat-fat										
Hypertension										
Prevalence: n (%)	554 (62.9)	559 (63.5)	513 (58.2)	536 (60.8)	0.068	554 (62.9)	559 (63.5)	513 (58.2)	536 (60.8)	0.068
OR† (95% CI)	1 (ref)	1.62 (1.14-2.320)	1.16 (0.81-1.672)	1.57 (1.03-2.41)		1 (ref)	1.62 (1.14-2.32)	1.16 (0.81-1.67)	1.57 (1.03-2.41)	
Hyper-LDL cholesterolemia										
Prevalence: n (%)	282 (32.0)	284 (32.2)	303 (34.4)	285 (32.3)	0.518	282 (32.0)	284 (32.2)	303 (34.4)	285 (32.3)	0.518
OR† (95% CI)	1 (ref)	1.14 (0.81-1.60)	1.35 (0.95-1.92)	1.22 (0.81-1.84)		1 (ref)	1.14 (0.81-1.60)	1.35 (0.95-1.92)	1.22 (0.81-1.84)	
Hypo-HDL cholesterolemia										
Prevalence: n (%)	264 (30.0)	226 (25.7)	208 (23.6)	178 (20.2)	0.240	264 (30.0)	226 (25.7)	208 (23.6)	178 (20.2)	0.240
OR† (95% CI)	1 (ref)	1.14 (0.81-1.60)	1.35 (0.95-1.92)	1.22 (0.81-1.84)		1 (ref)	1.14 (0.81-1.60)	1.35 (0.95-1.92)	1.22 (0.81-1.84)	
Pattern 4: Noodles										
Hypertension										
Prevalence: n (%)	518 (58.8)	527 (59.8)	548 (62.2)	569 (64.6)	0.815	518 (58.8)	527 (59.8)	548 (62.2)	569 (64.6)	0.815
OR† (95% CI)	1 (ref)	1.05 (0.72-1.54)	1.08 (0.74-0.58)	1.10 (0.76-1.60)		1 (ref)	1.05 (0.72-1.54)	1.08 (0.74-0.58)	1.10 (0.76-1.60)	
Hyper-LDL cholesterolemia										
Prevalence: n (%)	271 (30.8)	311 (35.3)	291 (33.0)	281 (31.9)	0.556	271 (30.8)	311 (35.3)	291 (33.0)	281 (31.9)	0.556
OR† (95% CI)	1 (ref)	1.28 (0.88-1.86)	1.32 (0.91-1.92)	1.44 (1.00-2.07)		1 (ref)	1.28 (0.88-1.86)	1.32 (0.91-1.92)	1.44 (1.00-2.07)	
Hypo-HDL cholesterolemia										
Prevalence: n (%)	228 (25.9)	208 (23.6)	204 (23.2)	236 (26.8)	0.348	228 (25.9)	208 (23.6)	204 (23.2)	236 (26.8)	0.348
OR† (95% CI)	1 (ref)	1.28 (0.88-1.86)	1.32 (0.91-1.92)	1.44 (1.00-2.07)		1 (ref)	1.28 (0.88-1.86)	1.32 (0.91-1.92)	1.44 (1.00-2.07)	

LDL: low-density lipoprotein; HDL: high-density lipoprotein; OR (95% CI): adjusted odds ratio (95% confidence interval).
†Adjusted variables: age in years (1: 40–44, 2: 45–49, 3: 50–54, 4: 55–59, 5: 60–64, 6: 65–69, 7: 70–74), BMI (1: <18.5, 2:18.5-24.9, 3:25.0-29.9, 4: ≥30), prefectures, current smoker, current drinker, exercise habits (1: yes, 2: no), step counts/day (1: <5000, 2:5000-7499, 3:7500-9999, 4:10000-12499, 5: ≥12500) and, total energy intake (continuous variable).

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