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Dietary patterns among Japanese adults: findings from the National Health and Nutrition Survey, 2012

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Running title: Dietary patterns among Japanese adults

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ABSTRACT

Background and Objectives: Recent studies have analyzed dietary patterns to assess overall dietary habits, but there have been no studies of dietary patterns among the contemporary Japanese population nationwide. The objective of this study was to identify dietary patterns based on consumption of food items among Japanese adults, and to examine whether these dietary patterns were associated with nutrient intake, demographic characteristics, and lifestyle factors. **Methods and Study Design:** The study population included 25,754 Japanese adults aged 20 years and older registered in the nationwide National Health and Nutrition Survey database in 2012. Dietary patterns were analyzed by factor analysis of 29 food items from the dietary intake survey and household-based semi-weighed dietary records. **Results:** Five dietary patterns were identified: high-bread and low-rice, high-meat and low-fish, vegetable, wheat-based food, and noodle and alcohol patterns. The lowest quartile of factor scores for high-meat and low-fish, wheat-based food, and noodle and alcohol patterns had higher nutrient intakes, and the highest quartile of factor scores for the vegetable pattern had a higher nutrient intake overall (all $p<0.01$). Dietary pattern scores were associated with demographic and lifestyle factors such as sex, age, region, smoking status, and alcohol intake. **Conclusions:** Five major dietary patterns among Japanese adults were identified by factor analysis. Dietary pattern scores were associated with differences in nutrient intakes and demographic and lifestyle factors. These patterns were further used for examining the association between Japanese diets and health outcomes.

Key Words: dietary patterns, dietary habits, factor analysis, National Health and Nutrition Survey, Japanese

INTRODUCTION

The Japanese diet consists of a wide variety of foods, and it is different from diets consumed in Western countries. Several cohort studies have reported that fruits, vegetables, beans, green tea, and coffee intake are associated with a reduced risk of cardiovascular disease (CVD) and all-cause mortality among Japanese individuals.[1-5] However, more thorough evaluations of dietary patterns are needed to assess the effects of diet on health, because a diet encompasses more than single nutrients and foods.

In a recent meta-analysis that included prospective cohort studies and case-control studies in Western and Asian countries, major common dietary patterns based on food intake were identified from a posteriori via principal component analysis or factor analysis as

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prudent/healthy and Western/unhealthy.[6,7] Nutrition surveys are useful for the identification of dietary patterns. Several national nutrition surveys in different countries have been used to identify dietary patterns, such as the balanced diet, grain/kimchi, and alcohol/noodle patterns from the Korea National Health and Nutrition Examination Survey,[8] the healthy and Swedish traditional pattern from the Swedish National Dietary Survey,[9] and the Western, traditional Northern, and traditional Southern patterns from the China National Nutrition and Health Survey.[10] Epidemiological studies performed in some areas in Japan have identified dietary patterns such as healthy, traditional, and Western and vegetable, animal food, and dairy products.[11,12] However, these previously identified dietary patterns may not reflect dietary patterns of the modern Japanese population, because previous cohort studies have included populations in limited areas and because the evaluation of dietary habits used information collected at baseline.

Therefore, the objectives of this study were to identify dietary patterns among Japanese using nationwide data from the 2012 National Health and Nutrition Survey (NHNS). In addition, we investigated the association between dietary patterns and nutrient intake, and examined whether demographic characteristics and lifestyle factors influenced dietary patterns.

MATERIALS AND METHODS

Data source: the National Health and Nutrition Survey

The NHNS is a cross-sectional survey that has been conducted by the Ministry of Health, Labour and Welfare in Japan every November since 1947. Details of the survey design have been described elsewhere. 13 Briefly, in 2012, the NHNS used a stratified single-stage cluster sample design across 47 prefectures. Census enumeration areas were drawn from each prefecture, and residents aged ≥1 year in all households from 475 selected census enumeration areas were eligible for the survey. The NHNS is composed of three surveys: the dietary intake survey (a self-administered questionnaire including questions on the household population, meal patterns, daily step counts, and dietary records), the lifestyle survey (a self-administered questionnaire including questions on smoking status, alcohol intake, and sleep time) and a physical examination (measurement of height, weight, abdominal circumference, and blood pressure; blood tests; and a medical interview). The 2012 survey sampled 24,555 households and 12,750 households responded (response rate: 51.9%).[13] Based on official application procedures under Article 33 of the Statistics Act, we obtained approval from the Ministry of Health, Labour and Welfare, Japan and used individual-level data from the NHNS

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for this study. In such cases, in accordance with the Ethical Guidelines of Epidemiological Research,[14] our study was exempt from the application of these guidelines, because we only used anonymized data in this study.

Study participants

For the present study, of the 36,408 participants from 12,750 households in the 2012 survey, 5,769 participants aged 1–19 years who did not participate in the lifestyle survey, 136 pregnant women, and 246 breast-feeding women were excluded. In addition, participants who had incomplete data on the dietary intake survey (n=3,896) and participants who had extremely low or high reported total energy intake, defined as consuming less than 50% or more than 150% of the estimated energy requirement for physical activity levels by age and sex based on the Dietary Reference Intakes for Japanese (2015)[15] (n=607), were also excluded. A total of 25,754 participants aged 20 years and older were included in the analysis for this study. We analyzed the results of the present study using the NHNS as a simple random sample.

Dietary assessment

The dietary intake survey, which used semi-weighed household dietary records to assess dietary intake, was conducted on a single day in November, excluding Sundays and public holidays. Trained interviewers visited each household to explain the method of generating dietary records before the survey. Dietary records were weighed by taking an inventory of all food, beverages, food waste, leftovers and foods eaten away from home that were consumed by a household and by assigning approximate proportions of each item to individual household members. Interviewers checked for any missing information and errors during their visit to the households to collect the dietary records.

Nutrient intakes were calculated based on the Standard Tables of Food Composition in Japan, 2010, which were updated from the fifth revised and enlarged edition published in 2005. Food intake was classified into food groups of 17 large (e.g. cereals, vegetables, and fish and shellfish), 33 medium (e.g. rice and rice products, wheat flour and wheat products, green and yellow vegetables, other vegetables, raw fish and shellfish, and seafood and processed products), and 98 small classifications (e.g. rice, bread, tomatoes, carrots, horse mackerels and sardines, and salmon and trout) based on the food group tables in the NHNS.[16]

Statistical analysis

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In this study, most food items were part of 26 medium classifications, excluding seasonings and spices. Wheat flour/wheat flour products, fats/oils, and beverages that are typical Japanese foods comprised 13 items of small classification and 3 items were rearranged. Variables for which the coefficient of variance was 0.3 or lower were excluded because these variables had nearly the same intake values among almost all participants and therefore contributed little to the factor analysis.[17] Finally, 29 food items were included in subsequent factor analysis: rice and rice products; wheat flour; breads and Japanese buns; noodles, buckwheat, and buckwheat products; macaroni and spaghetti; potatoes and potato products; sugars and sweeteners; soybeans and soybean products; green and yellow vegetables; other vegetables; pickles; fruits; mushrooms; algae; raw fish and shellfish; seafood and processed seafood products; beef, pork, ham, and sausage; chicken; eggs; milk and dairy products; butter; margarine; vegetable fats and oils; confectioneries; sake; beer, wines, spirits, and other alcoholic beverages; teas; coffee and cocoa; and other beverages.

Dietary patterns based on energy-adjusted intake using the residual method for food items[18] were analyzed by factor analysis using a varimax rotation. To determine the number of factors to be retained, we considered components with an eigenvalue greater than 1.0, scree test results, and interpretability of the factors. Factor scores were calculated for each of the participants, standardized to a mean value of zero and a standard deviation of one, and each participant was assigned a factor score for every identified pattern.

Participants were divided into four categories based on quartiles of factor scores for dietary patterns to examine the association between dietary patterns and nutrient intake. The mean differences (with standard deviations) in energy-adjusted nutrient intakes obtained using the residual method (per day) for each dietary pattern according to the factor score quartile were determined by one-way analysis of variance.

To investigate relationships between dietary pattern scores (a continuous variable) and demographic and lifestyle factors, least squares mean and 95% confidence intervals adjusted for sex and age were determined using analysis of covariance (ANCOVA). The following demographic characteristics were examined: sex, age (20–29, 30–39, 40–49, 50–59, 60–69, 70–79, or ≥80 years), region (Hokkaido, Tohoku, Kanto I, Kanto II, Hokuriku, Tokai, Kinki I, Kinki II, Chugoku, Shikoku, Kita-Kyusyu, or Minami-Kyusyu), number of household members (1, or ≥2 persons), employment status (works outside the home, homemaker, student, or unemployed), smoking status (never, former, or current smoker) and alcohol intake (never, former, or current drinker). The regions Hokkaido, Tohoku, Kanto I, Kanto II, Hokuriku, Tokai, Kinki I, Kinki II, Chugoku, Shikoku, Kita-Kyusyu, and Minami-Kyusyu are listed in

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order of their location in Japan from north to south. Kanto I includes the Tokyo metropolitan area, and Kinki I includes Osaka. Participants with unknown variables for employment, smoking status, or alcohol intake were excluded from the analysis. All statistical analyses were performed using the SAS statistical package for Windows (version 9.4, SAS). Differences were considered statistically significant at $p<0.05$.

RESULTS

Characteristics of demographic and lifestyle factors are shown in Table 1. Among study participants, a higher proportion was seen of the following characteristics: female, aged 60–69, two or more household members, works outside the home, current smoker, and current drinker.

Five dietary patterns were identified in this study. The factor-loading matrix for dietary patterns and food items is shown in Table 2. The first pattern had higher loadings of breads and Japanese buns, margarine, milk and dairy products, and lower loadings of rice and rice products. The second pattern had higher loadings of beef, pork, ham and sausages, and lower loadings of raw fish and shellfish, fruits, and tea. The third pattern had higher loadings of vegetables, mushrooms, soybeans, and soybean products. The fourth pattern had higher loadings of wheat flour, vegetable fats, and oils, and chicken. The fifth pattern had higher loadings of noodles, beer, wine, spirits, and other alcoholic beverages. These five dietary patterns were labeled as follows: 1) high-bread and low-rice, 2) high-meat and low-fish, 3) vegetable, 4) wheat-based food, and 5) noodle and alcohol. The total cumulative variance of these five dietary patterns was 27.6%.

Table 3 shows median energy-adjusted nutrient intakes for the five dietary patterns by score quartile. The highest quartile for the high-bread and low-rice pattern had higher median intakes of total fat, calcium, and vitamins E, B-1, B-2 and C, whereas the lowest quartile had higher median intakes of total energy, carbohydrate, vitamins D and B-12, and n-3 and -6 polyunsaturated fatty acids. The highest quartile for the high-meat and low-fish pattern had higher median intakes of total fat, vitamin B-1, and n-6 polyunsaturated fatty acids, whereas the lowest quartile had higher median intakes of almost all nutrients. For the vegetable pattern, the highest quartile had higher median intakes of almost all nutrients except for total energy, carbohydrate, and cholesterol. For the wheat-based food pattern, the highest quartile had higher median intakes of total fat, vitamin E, cholesterol, and n-3 and -6 polyunsaturated fatty acids. For the noodle and alcohol pattern, the highest quartile had higher median intakes of

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sodium and vitamin B-12, whereas the lowest quartile had higher median intakes of almost all nutrients.

Figure 1 shows sex- and age-adjusted dietary pattern scores of various demographic and lifestyle groups. Males had lower scores for the high-bread and low-rice, vegetable, and wheat-based food patterns, and higher scores for the high-meat and low-fish and noodle and alcohol patterns. With increasing age, participants had higher scores for the high-bread and low-rice, vegetable, and noodle and alcohol patterns and lower scores for the high-meat and low-fish and the wheat-based food pattern; however this correlation did not persist in elderly people. In our analysis of geographic regions, Hokkaido residents had higher scores for the high-meat and low-fish and the noodle and alcohol patterns, Tohoku residents had lower scores for the high-bread and low-rice patterns and higher scores for the vegetable and noodle and alcohol patterns, Kanto residents had higher scores for the vegetable and wheat-based food patterns, Kinki residents had higher scores for the high-meat and low-fish and wheat-based food patterns, and Kyusyu residents had lower scores for the high-bread and low-rice pattern and higher scores for the wheat-based food pattern. Single-person households had higher scores for the high-bread and low-rice, wheat-based food, and noodle and alcohol patterns and lower scores for the high-meat and low-fish and vegetable patterns compared with households with more than one person. People employed outside the home had lower scores for the high-bread and low-rice pattern, unemployed people had higher scores for the high-meat and low-fish pattern, homemakers had higher scores for the vegetable pattern, and students had higher scores for the noodle and alcohol pattern. Current smokers had lower scores for the high-bread and low-rice and vegetable patterns and higher scores for the high-meat and low-fish and noodle and alcohol patterns compared with former smokers and nonsmokers. Current drinkers had lower scores for the high-bread and low-rice pattern and higher scores for the vegetable, wheat-based food, and noodle and alcohol patterns compared with former drinkers and nondrinkers.

DISCUSSION

In this study, we identified five major dietary patterns in a Japanese adult population from national data collected in 2012 using factor analysis: the high-bread and low-rice, high-meat and low-fish, vegetable, wheat-based food, and noodle and alcohol patterns. We observed that the lowest quartile of factor scores for the high-meat and low-fish, wheat-based food, and noodle and alcohol patterns were associated with higher intake of all nutrients, and that the highest quartile of factor scores for the vegetable pattern was associated with higher overall

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nutrient intake. In addition, demographic and lifestyle factors such as sex, age, region, smoking status and alcohol intake were found to influence factor scores for the five dietary patterns.

Of the five dietary patterns identified in this study, the high-bread and low-rice, high-meat and low-fish, and vegetable patterns reflect consumption of foods such as grain-based dishes, fish, meat, and vegetables characteristic of the traditional Japanese-style diet. The Japan Public Health Center-based Prospective Study investigated risk factors for cancer and CVD in the Japanese population and identified three dietary patterns: healthy (higher loadings of vegetables, fruits, soy products, seaweeds, mushroom, milk, beans, and yogurt), traditional (higher loadings of pickled vegetables, salted fish and roe, fish, rice, and miso soup, with a negative loadings for bread and butter) and Western (higher loadings of meat, poultry, cheese, bread and butter).[11] Similarly, the Japan Collaborative Cohort Study investigated the association between lifestyle factors and cancer and CVD, and identified three dietary patterns: vegetable (higher loadings of vegetables, algae, potatoes, tofu, fungi, citrus fruit, fresh fish, and boiled beans), animal food (higher loadings of meat, deep-fried foods, fried vegetables, and dried fish) and dairy products (higher loadings of cheese, yogurt, milk, margarine, coffee, and tea).[12,19] Our findings were inconsistent with previous observations in Japan, as dietary patterns consisting of foods of relatively the same food group were identified in this study, whereas dietary patterns including foods of varied food groups were identified in previous studies. Most studies of dietary patterns use the FFQ, which reflects past dietary habits using a survey.[8,10-12,20-22] However, the NHNS used semi-weighed self-administered dietary records, which may reduce recall bias. Thus it would not be surprising to see differences in dietary patterns between previous studies and the present study due to this difference in dietary survey methods.

We compared our data to those from the Fifth Korea National Health and Nutrition Examination Survey. The high-bread and low-rice and alcohol and noodle patterns identified in our study were similar to two of the three dietary patterns identified from the Korean data: the grain and kimchi pattern (grains, kimchi, and a lack of fast food, noodles, breads, and meat) and the alcohol and noodle pattern (alcohol and noodles and a lack of fruits, whole grains, milk, and dairy products).[8] The China National Nutrition and Health Survey identified Western, traditional Northern, and traditional Southern dietary patterns,[10] and our study was inconsistent with the findings from China. Worldwide, including Western countries, other major dietary patterns have been identified, including so-called prudent/healthy and Western/unhealthy patterns based on food items from the FFQ.[21-25] Dietary patterns based on

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consumption of food items indicated a posteriori via principal component analysis/factor analysis differ depending on the countries, races, and cultures of participants.

Participants who had lower factor scores for the high-meat and low-fish pattern, higher factor scores for the vegetable pattern, and lower factor scores for the alcohol and noodle pattern had higher intakes of almost all nutrients. Some previous studies have shown positive associations between prudent/healthy dietary patterns and the intakes of individual nutrients, such as dietary fiber, iron, folate, and vitamin D,[11,26,27] similar to what we observed for the healthier dietary patterns in the present study. On the other hand, a lower factor score for the high-meat and low-fish pattern and a higher factor score for the vegetable pattern were associated with a higher intake of sodium in the current study. In the Japanese population, higher scores for healthy and traditional dietary patterns were also associated with a higher intake of sodium.[11,26] However, our results indicate that a lower factor score for the high-meat and low-fish pattern and a higher factor score for the vegetable pattern were also associated with a higher intake of potassium and, consequently, a lower sodium-to-potassium ratio. Our data regarding the alcohol and noodles pattern were consistent with a previous observation in the Japanese population that a higher factor score associated with a noodle-based diet was associated with a higher sodium-to-potassium ratio.[28] The healthy dietary patterns in the present study were also consistent with previous observations that a high factor score for healthy dietary patterns is associated with a low ratio of sodium to potassium intake among Japanese populations.[26,29] Thus, healthier dietary patterns have been associated with higher intake of beneficial nutrients in multiple studies of the modern Japanese population.

Factor scores for the five dietary patterns were associated with clear differences in demographic characteristics and lifestyle factors in the present study. Women and older people were more likely to show so-called healthy dietary patterns, such as higher loadings of fish and vegetables and lower loadings of alcohol and noodles, similar to the prudent/healthy pattern in previous studies.[9,11,12,26] Our finding that participants with a healthy lifestyle, i.e. nonsmokers and nondrinkers, had healthier dietary patterns was also consistent with previous findings,[9,11,12,26,27] although their dietary patterns were inconsistent. Lifestyles as well as demographic characteristics have previously been shown to be factors that contribute to dietary patterns among modern Japanese.

The present study has some limitations. First, approximately half (52%) of the households in the NHNS participated in the survey. Furthermore, the exact response rate at the individual level is not known. Thus, the possibility of selection bias cannot be ruled out. However, this study was conducted in a large number of study participants using nationwide data

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representative of all geographic regions in Japan, and the findings will benefit public health in Japan. Second, we evaluated dietary patterns using factor analysis from dietary records of households with proportional distribution within the house. Reliance on household representatives to record dietary intakes in the survey may have resulted in misreporting of various foods, since Japanese working-age men typically eat out for lunch during the week. A previous study investigated the validity of determining consumption by individual family members through household-based and individual-based food weighing methods and showed that total energy and macronutrient consumption of individual participants showed a high level of agreement among the household-based and individual-based food weighing methods.[30] Therefore, dietary records from households with proportional distribution is a valid method to estimate individual intake in the NHNS, which is a large-scale survey. Third, dietary records may not reflect average individual dietary habits, because this survey used dietary records from a single weekday. Also, individual habitual dietary intake naturally varies from weekdays to weekends. Thus, estimated dietary intake values may be underestimated or overestimated, although this survey is able to assess the habitual dietary intake of a population. Finally, the factor analysis approach involved several arbitrary but important considerations, including the consolidation of food items into food groups, number of factors to extract, method of rotation, and labelling of the factor components.[31, 32] It is possible that different populations exhibit different dietary patterns, because diets are likely to vary according to sex, socioeconomic status, ethnicity, and culture.[31] Thus, further research in diverse populations is needed.

Conclusion

Our study indicates the presence of five major dietary patterns in the Japanese population as determined by factor analysis: the high-bread and low-rice, high-meat and low-fish, vegetable, wheat-based food, and noodle and alcohol patterns. Lower factor scores for high-meat and low-fish, wheat-based food, and noodle and alcohol patterns and higher factor scores for the vegetable pattern were associated with higher intake levels of beneficial nutrients. Demographic and lifestyle factors were associated with differences in factor scores for the five dietary patterns. Further studies are required to examine the association between Japanese diets and health outcomes using dietary patterns.

AUTHOR DISCLOSURE

All authors declare that there are no conflicts of interest.

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Table 1. Demographic and lifestyle characteristics of the participants in the Japan National and Nutrition Survey, 2012 (n=25,754)

	n	%
Sex		
Male	11982	46.5
Female	13772	53.5
Age, years		
20-29	2055	8.0
30-39	3290	12.8
40-49	3816	14.8
50-59	4053	15.7
60-69	5757	22.4
70-79	4495	17.5
≥80	2288	8.9
Region[†]		
Hokkaido	415	1.6
Tohoku	3788	14.7
Kanto I	1981	7.7
Kanto II	3820	14.8
Hokuriku	2387	9.3
Tokai	1831	7.1
Kinki I	1264	4.9
Kinki II	1470	5.7
Chugoku	2575	10.0
Shikoku	2031	7.9
Kita-Kyusyu	2114	8.2
Minami-Kyusyu	2078	8.1
Household members		
Single person	2601	10.1
≥2 persons	23153	89.9
Employment		
Works outside the home	15083	58.6
Homemaker	5517	21.4
Student	4750	18.4
Unemployed	343	1.3
Unknown	61	0.2
Smoking status		
Never smoker	4924	19.1
Former smoker	5452	21.2
Current smoker	14904	57.9
Unknown	474	1.8
Alcohol intake		
Never drinker	12301	47.8
Former drinker	628	2.4
Current drinker	12444	48.3
Unknown	381	1.5

[†]Tohoku: Aomori, Iwate, Miyagi, Akita, Yamagata, Fukushima; Kanto I: Saitama, Chiba, Tokyo, Kanagawa; Kanto II: Ibaraki, Tochigi, Gunma, Yamanashi, Nagano; Hokuriku: Niigata, Toyama, Ishikawa, Fukui; Tokai: Gifu, Aichi, Mie, Shizuoka; Kinki I: Kyoto, Osaka, Hyogo; Kinki II: Nara, Wakayama, Shiga; Chugoku: Tottori, Shimane, Okayama, Hiroshima, Yamaguchi; Shikoku: Tokushima, Kagawa, Ehime, Kochi; North Kyushu: Fukuoka, Saga, Nagasaki, Oita; South Kyushu: Kumamoto, Miyazaki, Kagoshima, Okinawa.

Not Proof Read

Table 2. Factor loadings matrix for the five dietary patterns from the Japan National and Nutrition Survey, 2012 (n=25,754)

	High-bread and low-rice	High-meat and low-fish	Vegetable	Wheat-based food	Noodle and alcohol
Rice and rice products	-0.64	0.01	-0.33	-0.31	-0.36
Wheat flour	-0.06	-0.14	0.01	0.59	-0.03
Breads and Japanese buns	0.71	0.12	-0.13	0.05	-0.02
Noodles	0.13	0.08	0.13	-0.03	0.54
Macaroni and spaghetti	0.10	0.16	0.02	0.24	0.02
Potatoes and potato products	-0.06	-0.05	0.22	-0.02	-0.35
Sugars and sweeteners	0.18	-0.26	0.04	0.06	-0.21
Soybeans and soybean products	-0.08	-0.15	0.34	-0.21	0.10
Green and yellow vegetables	0.01	-0.18	0.47	0.01	-0.28
Other vegetables	-0.11	0.10	0.65	-0.01	-0.11
Pickles	-0.13	-0.24	0.06	-0.23	0.01
Fruits	0.31	-0.42	0.32	-0.12	-0.14
Mushrooms	-0.06	0.00	0.55	0.00	0.14
Algae	-0.05	-0.17	0.12	-0.08	-0.07
Raw fish and shellfish	-0.11	-0.53	0.01	0.14	0.30
Seafood and processed seafood products	-0.09	-0.12	0.01	-0.34	-0.08
Beefs, pork, ham, and sausage	-0.02	0.71	0.26	0.00	-0.04
Chicken	-0.13	-0.06	-0.16	0.34	-0.08
Eggs	-0.11	0.09	-0.07	0.09	-0.16
Milk and dairy products	0.44	-0.22	0.12	0.05	-0.15
Butter	0.19	0.05	0.00	0.33	-0.05
Margarine	0.51	0.15	-0.13	-0.01	-0.04
Vegetable fats and oils	-0.21	0.13	-0.04	0.68	-0.09
Confectioneries	0.32	-0.13	-0.11	-0.10	-0.03
Sake	-0.08	-0.15	-0.03	-0.11	0.29
Beer, wines, spirits, and other alcoholic beverages	-0.16	0.06	-0.04	0.05	0.59
Tea	-0.02	-0.35	0.04	-0.13	-0.20
Coffee and cocoa	0.31	0.12	-0.06	0.04	0.08
Other beverages	0.02	0.20	-0.10	0.08	-0.06
Eigenvalue	2.00	1.90	1.42	1.38	1.30
Factor variance explained, %	6.9	6.6	4.9	4.8	4.5
Factor variance cumulative, %	6.9	13.5	18.4	23.1	27.6

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Table 3. Daily energy-adjusted nutrient intakes across the five dietary patterns according to the factor score quartile from the Japan National and Nutrition Survey, 2012 (n=25,754)

	High-bread and low-rice				High-meat and low-fish				Vegetable			
	Q1 (Low)		Q4 (High)		Q1 (Low)		Q4 (High)		Q1 (Low)		Q4 (High)	
	Mean	SD	Mean†	SD	Mean	SD	Mean†	SD	Mean	SD	Mean†	SD
Total energy (kcal/day)	2002	556	1971	512	2001	510	2003	559	1990	562	1964	515
Protein (% energy)	14.6	3.2	14.5	2.7	15.8	3.2	14.0	2.8	13.7	2.9	15.9	3.0
Total fat (% energy)	22.8	7.1	27.3	6.9	22.6	6.8	28.6	7.1	23.7	7.4	26.0	7.3
Carbohydrate (% energy)	56.9	9.5	56.0	8.2	58.2	8.9	53.2	8.4	57.7	9.0	55.5	9.2
Sodium (mg)	4252	3125	4075	2789	4811	3113	3856	2801	3372	2753	5138	3144
Potassium (mg)	2005	1472	2629	1633	3380	1714	1647	1235	1301	1105	3656	1666
Calcium (mg)	318	378	671	498	719	513	327	391	281	381	756	497
Magnesium (mg)	237	150	267	155	346	165	186	124	173	122	357	165
Iron (mg)	7.9[a]	5.2	7.6	5.0	10.4	5.8	6.3	4.4	5.3	4.3	11.2	5.6
Vitamin A (μgRE)	454	1419	576	1109	752	1459	356	1139	283	1134	848	1345
Vitamin D (μg)	9.7	19.6	6.1	16.4	16.2	21.3	1.1	12.3	7.3	18.1	10.1	18.8
Vitamin E (mg)	5.8	6.0	8.1	6.2	9.0	7.0	5.3	5.2	5.1	5.5	9.2	7.1
Vitamin K (μg)	286	368	197	335	340	406	176	306	88	265	452	422
Vitamin B-1 (mg)	0.77	1.17	0.99	1.22	0.87	1.18	1.12	1.25	0.62	1.37	1.26	1.07
Vitamin B-2 (mg)	0.98	1.23	1.38	1.33	1.59	1.24	0.96	1.33	1.02	1.47	1.45	1.16
Vitamin B-6 (mg)	1.2[b]	1.7	1.2	1.7	1.7	1.5	1.0	1.9	0.9	2.1	1.7	1.5
Vitamin B-12 (μg)	7.7	15.6	5.2	12.0	13.2	17.0	1.6	9.4	6.6	14.4	7.0	13.9
Folate (μg)	295[c]	302	311	262	446	305	201	234	155	226	494	288
Vitamin C (mg)	67	122	132	185	185	189	46	116	28	120	191	182
Saturated fatty acid (g)	5.3	2.0	7.9	2.7	5.7	2.3	7.8	2.5	6.2	2.6	6.8	2.5
Monounsaturated fatty acid (g)	8.0	3.1	9.1	3.0	7.3	2.8	10.3	3.0	8.3	3.2	8.7	3.1
Polyunsaturated fatty acid (% energy)	5.7	2.0	5.5	1.9	5.5	2.0	5.7	1.9	5.2	1.9	5.8	2.0
Cholesterol (mg)	355	374	280	315	339	354	321	348	350	374	293	329
Dietary fiber (g)	12.7	11.6	17.2	12.4	20.2	14.1	11.7	10.0	5.9	7.4	26.9	12.7
n-3 polyunsaturated fatty acid (g)	1.1	0.6	1.0	0.6	1.3	0.7	0.8	0.4	1.0	0.6	1.1	0.6
n-6 polyunsaturated fatty acid (g)	4.4[d]	1.8	4.4	1.7	4.1	1.7	4.7	1.7	4.1	1.7	4.7	1.7

Q1: first quartile; Q4: fourth quartile; SD: standard deviation.

†Mean differences in total energy and energy-adjusted nutrient intakes obtained using the residual method according to factor score quartiles were determined by one-way analysis of variance. First and fourth quartiles are shown.

p values were all <0.001 except for the following: [a]0.001, [b]0.679, [c]0.002, [d]0.010 and [e]0.009.

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Table 3. Daily energy-adjusted nutrient intakes across the five dietary patterns according to the factor score quartile from the Japan National and Nutrition Survey, 2012 (n = 25,754) (cont.)

	Wheat-based food				Noodle and alcohol			
	Q1 (Low)		Q4 (High)		Q1 (Low)		Q4 (High)	
	Mean	SD	Mean[†]	SD	Mean	SD	Mean[†]	SD
Total energy (kcal/day)	2041	530	1966	541	2057	509	1965	562
Protein (% energy)	14.6	3.0	14.8	3.0	14.1	2.6	15.0	3.4
Total fat (% energy)	21.6	7.0	28.9	6.9	24.9	7.2	24.0	7.3
Carbohydrate (% energy)	60.0	8.9	52.3	8.3	59.5	8.1	52.8	9.6
Sodium (mg)	4837	3216	3858	2757	4150	2840	4743	3088
Potassium (mg)	2582	1705	2203	1515	2911	1724	2056	1451
Calcium (mg)	581	507	429	434	579	507	444	436
Magnesium (mg)	292	167	228	141	270	159	260	154
Iron (mg)	9.2	5.7	7.1	4.8	9.0	5.5	7.5	5.3
Vitamin A (μgRE)	491[e]	1193	552	1291	781	1290	355	1450
Vitamin D (μg)	11.0	19.8	5.9	17.0	6.2	16.1	9.7	19.9
Vitamin E (mg)	5.6	6.4	8.7	6.3	7.8	6.7	6.1	6.2
Vitamin K (μg)	276	390	229	337	319	399	200	335
Vitamin B-1 (mg)	0.97	1.27	0.86	1.18	0.94	1.26	0.93	1.26
Vitamin B-2 (mg)	1.27	1.35	1.14	1.27	1.36	1.36	1.13	1.31
Vitamin B-6 (mg)	1.3	1.9	1.2	1.7	1.4	1.9	1.2	1.6
Vitamin B-12 (μg)	7.5	14.4	5.8	13.3	4.0	10.6	9.2	17.1
Folate (μg)	354	298	267	264	392	298	254	285
Vitamin C (mg)	127	179	86	142	158	180	61	136
Saturated fatty acid (g)	5.8	2.4	7.4	2.6	6.6	2.5	6.2	2.5
Monounsaturated fatty acid (g)	7.0	2.8	10.4	3.0	8.6	3.1	8.1	3.0
Polyunsaturated fatty acid (% energy)	5.0	1.9	6.6	2.0	5.4	1.9	5.5	2.0
Cholesterol (mg)	245	340	390	349	363	355	286	348
Dietary fiber (g)	17.4	13.5	13.7	11.7	19.1	13.6	13.1	11.4
n-3 polyunsaturated fatty acid (g)	1.1	0.6	1.2	0.6	1.0	0.5	1.1	0.7
n-6 polyunsaturated fatty acid (g)	3.8	1.6	5.3	1.8	4.4	1.7	4.3	1.7

Q1: first quartile; Q4: fourth quartile; SD: standard deviation.
[†]Mean differences in total energy and energy-adjusted nutrient intakes obtained using the residual method according to factor score quartiles were determined by one-way analysis of variance. First and fourth quartiles are shown.
p values were all <0.001 except for the following: [a]0.001, [b]0.679, [c]0.002, [d]0.010 and [e]0.009.

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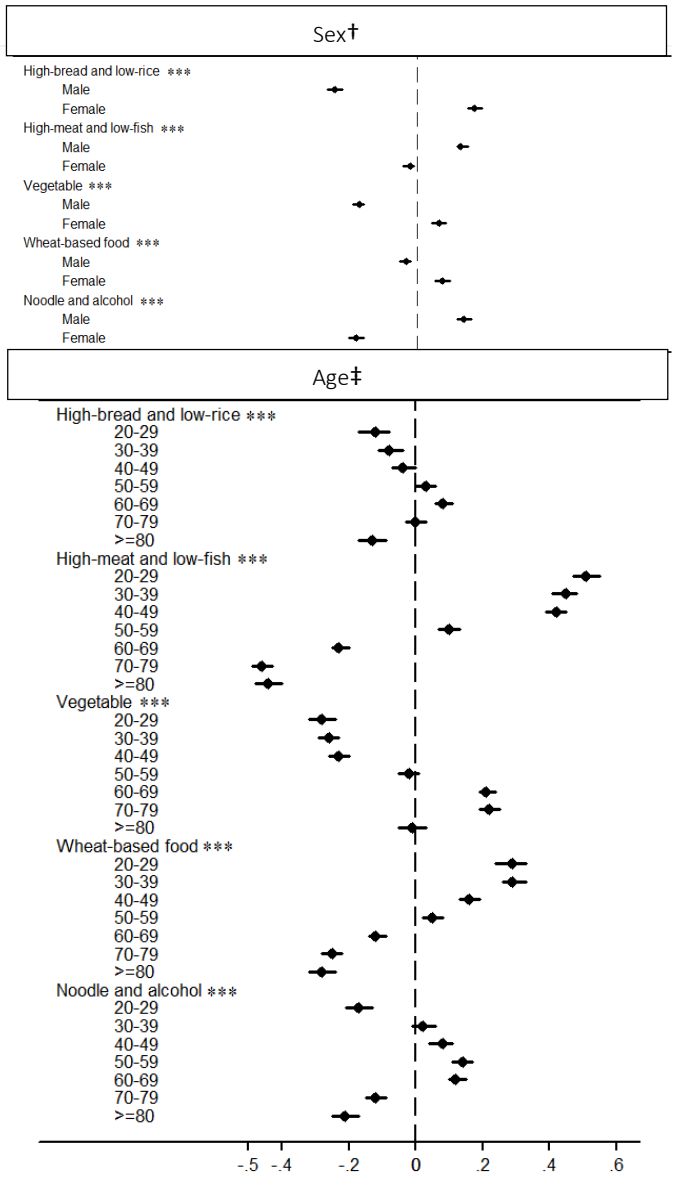
Sex†
High-bread and low-rice ***
Male
Female
High-meat and low-fish ***
Male
Female
Vegetable ***
Male
Female
Wheat-based food ***
Male
Female
Noodle and alcohol ***
Male
Female
Age‡
High-bread and low-rice ***
20-29
30-39
40-49
50-59
60-69
70-79
>=80
High-meat and low-fish ***
20-29
30-39
40-49
50-59
60-69
70-79
>=80
Vegetable ***
20-29
30-39
40-49
50-59
60-69
70-79
>=80
Wheat-based food ***
20-29
30-39
40-49
50-59
60-69
70-79
>=80
Noodle and alcohol ***
20-29
30-39
40-49
50-59
60-69
70-79
>=80
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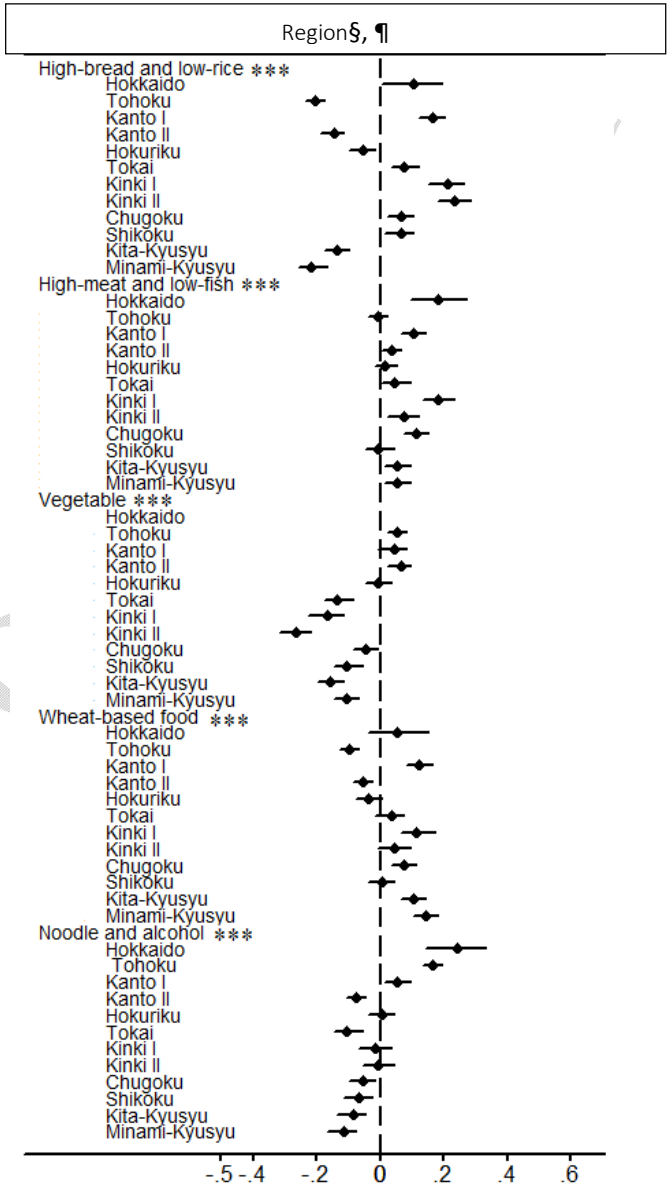
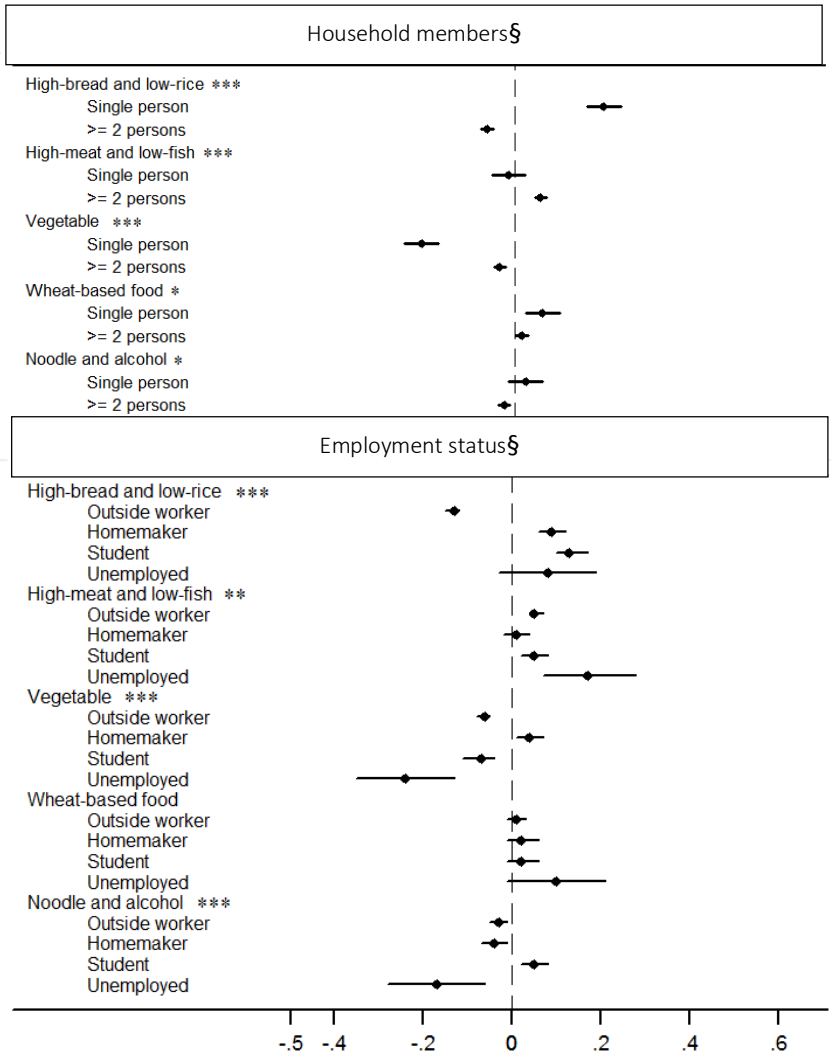

Region§, ¶
High-bread and low-rice ***
Hokkaido
Tohoku
Kanto I
Kanto II
Hokuriku
Tokai
Kinki I
Kinki II
Chugoku
Shikoku
Kita-Kyusyu
Minami-Kyusyu
High-meat and low-fish ***
Hokkaido
Tohoku
Kanto I
Kanto II
Hokuriku
Tokai
Kinki I
Kinki II
Chugoku
Shikoku
Kita-Kyusyu
Minami-Kyusyu
Vegetable ***
Hokkaido
Tohoku
Kanto I
Kanto II
Hokuriku
Tokai
Kinki I
Kinki II
Chugoku
Shikoku
Kita-Kyusyu
Minami-Kyusyu
Wheat-based food ***
Hokkaido
Tohoku
Kanto I
Kanto II
Hokuriku
Tokai
Kinki I
Kinki II
Chugoku
Shikoku
Kita-Kyusyu
Minami-Kyusyu
Noodle and alcohol ***
Hokkaido
Tohoku
Kanto I
Kanto II
Hokuriku
Tokai
Kinki I
Kinki II
Chugoku
Shikoku
Kita-Kyusyu
Minami-Kyusyu
-.5 -.4 -.2 0 .2 .4 .6


Household members§
High-bread and low-rice ***
Single person
>= 2 persons
High-meat and low-fish ***
Single person
>= 2 persons
Vegetable ***
Single person
>= 2 persons
Wheat-based food *
Single person
>= 2 persons
Noodle and alcohol *
Single person
>= 2 persons
Employment status§
High-bread and low-rice ***
Outside worker
Homemaker
Student
Unemployed
High-meat and low-fish **
Outside worker
Homemaker
Student
Unemployed
Vegetable ***
Outside worker
Homemaker
Student
Unemployed
Wheat-based food
Outside worker
Homemaker
Student
Unemployed
Noodle and alcohol ***
Outside worker
Homemaker
Student
Unemployed
-.5 -.4 -.2 0 .2 .4 .6

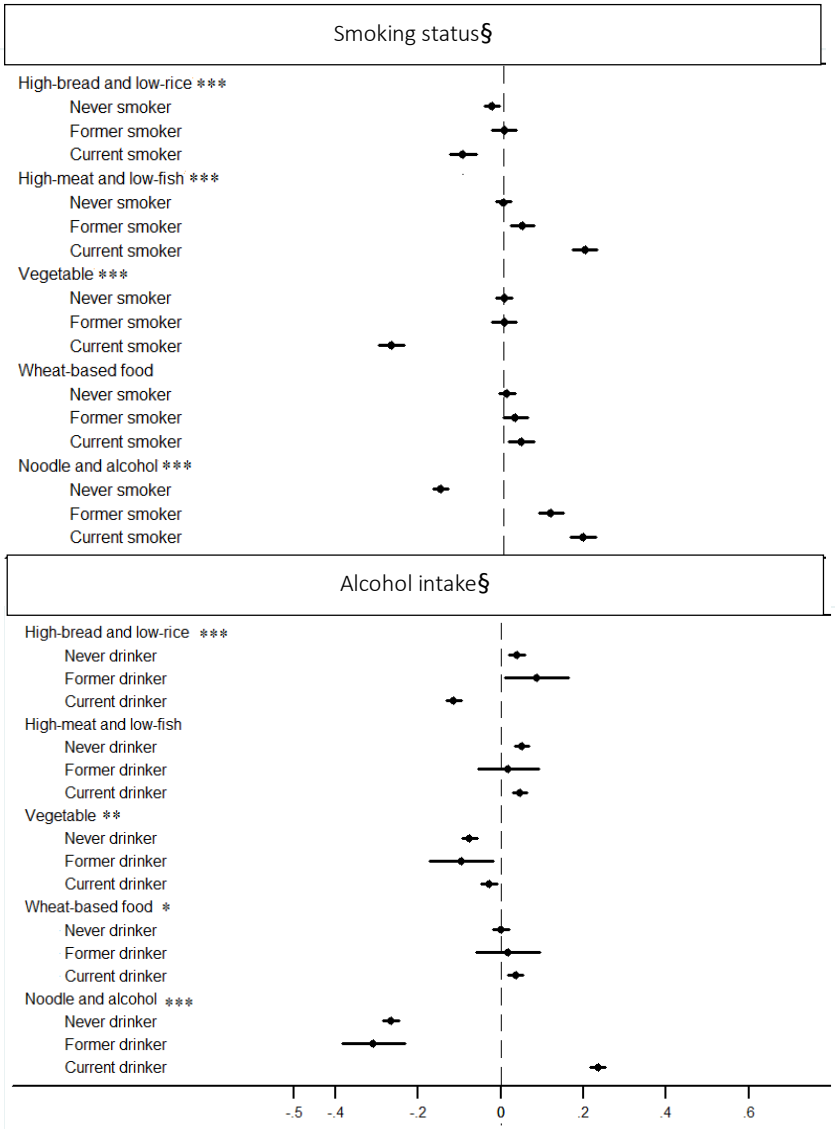

Smoking status§
High-bread and low-rice ***
Never smoker
Former smoker
Current smoker
High-meat and low-fish ***
Never smoker
Former smoker
Current smoker
Vegetable ***
Never smoker
Former smoker
Current smoker
Wheat-based food
Never smoker
Former smoker
Current smoker
Noodle and alcohol ***
Never smoker
Former smoker
Current smoker
Alcohol intake§
High-bread and low-rice ***
Never drinker
Former drinker
Current drinker
High-meat and low-fish
Never drinker
Former drinker
Current drinker
Vegetable **
Never drinker
Former drinker
Current drinker
Wheat-based food *
Never drinker
Former drinker
Current drinker
Noodle and alcohol ***
Never drinker
Former drinker
Current drinker
-.5 -.4 -.2 0 .2 .4 .6

Figure 1. Adjusted means (with 95% confidence intervals) of five dietary pattern scores according to demographic and lifestyle factors. †Adjusted for age. ‡Adjusted for sex. §Adjusted for sex and age. ¶Tohoku: Aomori, Iwate, Miyagi, Akita, Yamagata, Fukushima; Kanto I: Saitama, Chiba, Tokyo, Kanagawa; Kanto II: Ibaraki, Tochigi, Gunma, Yamanashi, Nagano; Hokuriku: Niigata, Toyama, Ishikawa, Fukui; Tokai: Gifu, Aichi, Mie, Shizuoka; Kinki I: Kyoto, Osaka, Hyogo; Kinki II: Nara, Wakayama, Shiga; Chugoku: Tottori, Shimane, Okayama, Hiroshima, Yamaguchi; Shikoku: Tokushima, Kagawa, Ehime, Kochi; North Kyushu: Fukuoka, Saga, Nagasaki, Oita; South Kyushu: Kumamoto, Miyazaki, Kagoshima, Okinawa. Adjusted mean differences in the demographic and lifestyle factors according to the factor score were determined by ANCOVA. * $p<0.05$, ** $p<0.01$, *** $p<0.001$.

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