Research Article

Dietary Patterns and Incident Dementia in Elderly Japanese: The Ohsaki Cohort 2006 Study

Yasutake Tomata, Kemmyo Sugiyama, Yu Kaiho, Kenji Honkura, Takashi Watanabe, Shu Zhang, Yumi Sugawara, and Ichiro Tsuji

Division of Epidemiology, Department of Health Informatics and Public Health, Tohoku University School of Public Health, Graduate School of Medicine, Sendai, Japan.

Address correspondence to Yasutake Tomata, PhD, Division of Epidemiology, Department of Health Informatics and Public Health, Tohoku University School of Public Health, Graduate School of Medicine, 2-1, Seiryo-machi, Aoba-ku, Sendai, Miyagi 980-8575, Japan. E-mail: y-tomata@med.tohoku.ac.jp

Received June 9, 2015; Accepted June 7, 2016

Decision Editor: Stephen Kritchevsky, PhD

Abstract

Background: Although it has been speculated that the Japanese dietary pattern has a preventive effect against incident dementia, no reported study has yet investigated this issue. The present prospective cohort study investigated the association between dietary patterns and incident dementia in elderly Japanese subjects.

Methods: We analyzed follow-up data covering a 5.7-year period for 14,402 older adults (≥65 years) participating in a community-based, prospective cohort study. Three dietary patterns (Japanese pattern, animal food pattern, and high-dairy pattern) were derived using principal component analysis of the consumption of 39 food and beverage items assessed using a food frequency questionnaire. Data on incident dementia were retrieved from the public Long-term Care Insurance database.

Results: With 71,043 person-years of follow-up, incidence of dementia was 9.0%. The score for the Japanese dietary pattern was associated with a lower risk of incident dementia (hazard ratio of the highest quartile vs the lowest, 0.80; 95% confidence interval: 0.66–0.97; p-trend = .016). The animal food pattern and the high-dairy pattern showed no significant association with incident dementia.

Conclusions: In this population of elderly Japanese individuals, the Japanese dietary pattern was associated with a decreased risk of incident dementia.

Keywords: Dietary pattern—Dementia—Cohort studies—Japanese diet—Japan

With the aging of the populations of developed countries, a rapid increase in the proportion of elderly individuals with disability is imposing a large burden on social security systems worldwide (1), and dementia is the main cause of such disability.

Dietary patterns have been widely employed in studies of the relationship between diet and health (2–5). It has been well demonstrated that the Mediterranean diet is associated with a lower incidence of dementia (6,7). A similar association has been suggested for the Japanese dietary pattern based on ecological observations (8).

Previous epidemiologic observations have indicated that the Japanese diet confers certain health benefits, such as a lower rate of mortality (9–12). Our group have also reported that the Japanese dietary pattern is associated with a lower risk of incident functional disability (13). In this previous study, the Japanese dietary pattern was characterized mainly as high consumption of soybean products, fish, seaweed, vegetables, and green tea. The preventive effect of several components in these food items, such as soy isoflavones and n-3 polyunsaturated fatty acids of fish oil, on cognitive function have been studied (14,15). Although the existing data suggest that a Japanese dietary pattern decreases the incident risk of dementia, to our knowledge, no previous study has yet investigated this issue.

The aim of the present analysis was to determine the association between dietary patterns and incident dementia in elderly individuals in Japan.

Methods

Study Cohort

The design of the Ohsaki Cohort 2006 Study has been described in detail elsewhere (16). In brief, the source population for the baseline
survey comprised all older citizens resident in Ohsaki City, Miyagi Prefecture, Northeastern Japan, on December 1, 2006: 31,694 men and women aged ≥65 years. The survey included questions about the recent average consumption of 39 food items, as well as items on history of disease, blood pressure, education level, smoking, alcohol drinking, body weight, height, psychological distress score, time spent walking per day, motor function score, cognitive function score, and number of remaining teeth.

The baseline survey was conducted between December 1, 2006 and December 15, 2006, and the follow-up survey was conducted between April 1, 2007 and November 30, 2012. A questionnaire was distributed by the heads of individual administrative districts, and then collected by mail. For this analysis, 23,091 individuals who provided valid responses formed the study cohort (Supplementary Figure 1). We excluded 6,333 individuals who did not provide written consent for review of their Long-term Care Insurance (LTCI) information, 2,102 persons who had already been certified as having a disability by the LTCI before the starting date of follow-up (March 30, 2007), 62 persons who had died or moved before the starting date of follow-up, 188 persons for whom the Doctor’s Opinion Paper had been unavailable, four persons for whom the cognitive status entry on the Doctor’s Opinion Paper had been left blank. Thus, 14,402 responses were analyzed for the purpose of this study.

Only 132 individuals were lost to follow-up because they moved away from the study area, without developing any functional disability; thus, the follow-up rate was 99.1%. From the resulting 71,043 person-years, incident dementia was determined in 1,289 persons (9.0%).

Dietary Assessment
We asked about the average frequency of consumption of each food item using a 39-item FFQ, for which we had previously conducted a validation study in the same region (the precinct of Ohsaki Public Health Center, Miyagi) (17). In brief, 113 participants (55 men and 58 women) provided four 3-day diet records within a 1-year period and subsequently responded to the FFQ, and the data were used to develop a method for calculating food and nutrient intake from the FFQ. The age- and total energy-adjusted Spearman correlation coefficients between the amounts consumed according to the FFQ for 39 food items and the amounts consumed according to the diet records were computed, and the medians (range) of the correlation coefficients were 0.35 (−0.30–0.72) for men and 0.34 (−0.06–0.75) for women.

We calculated the volume of consumption of individual foods. Missing values for the daily consumption volume were substituted using the multiple imputation method by the Proc MI procedure of SAS version 9.3, and 10 output datasets were created. The mean value for these ten output datasets was set as the representative data for each participant. And from this we determined the energy and protein intake using a food composition table that corresponded to the items listed in the questionnaire. This food composition table had been developed based on the Standard Tables of Food Composition published by the Science and Technology Agency of Japan (17).

Dietary Pattern Derivation
As in our previous study, we used two methods to derive dietary patterns: (i) factor analysis (principal component analysis), and (ii) confirmatory factor analysis (13).

The factor analysis was conducted using the daily consumption (weight in grams) of 39 food items from the FFQ. We used the PROC FACTOR procedure in SAS version 9.3 to obtain a three-factor score. To achieve a simpler structure with greater interpretability, the factors were rotated by orthogonal transformation (the varimax rotation function in SAS). This allowed three major dietary patterns to be identified: (i) the Japanese pattern, (ii) the animal food pattern, and (iii) the high-dairy pattern. For each pattern and each participant, we calculated a factor score by summing the consumption of each food item weighted by its factor loading. A positive loading indicates that a food item is positively associated with the dietary pattern, and a negative loading indicates an inverse association with the dietary pattern. That is, food items highly loaded within a dietary pattern are highly correlated with each other.

In order to strengthen our dietary pattern analysis, we also used confirmatory factor analysis, based on a hypothesis-oriented approach. Recently, confirmatory factor analysis has been used increasingly as a major analytical method in studies of dietary patterns, such as the Mediterranean diet (18–20). We identified nine food items that formed the Japanese Diet Index Score: rice, miso soup, seaweeds, pickles, green and yellow vegetables (green vegetables, carrot, pumpkin, tomato), fish (raw fish, fish boiled with soy, roast fish, boiled fish paste, dried fish), green tea, beef and pork (beef, pork, ham, sausage), and coffee. In a previous study based on the dietary record method, these items had been reported to have higher absolute factor scores for the traditional Japanese pattern (21). Another study has also reported that these items are characteristic of the traditional Japanese diet (22). For each of the seven adhering components (rice, miso soup, seaweeds, pickles, green and yellow vegetables, fish, and green tea), participants received one point if their intake was more than or equal to the sex-specific median. For each of the two non-adhering components (beef and pork, and coffee), participants received 1 point if their intake was below the sex-specific median. Thus, the Japanese Diet Index Score ranged from 0 to 9, with higher scores indicating greater dietary conformity.

Covariate
Body mass index was calculated as the self-reported body weight (kg) divided by the square of the self-reported body height (m).

The K6 was used as an indicator of psychological distress (23,24). Using six questions, respondents were asked about their mental status over the last month. Total point scores ranged from 0 to 24. As the optimal cut-off point for mental illness in the validation study, we classified individuals with scores of ≥13 as having psychological distress (24).

The Kihon Checklist was developed by the Ministry of Health, Labor, and Welfare of Japan to predict functional decline in community-dwelling elderly. With regard to the motor function score in the Kihon Checklist, respondents were asked about their current motor function status by using five binary questions yielding total point scores ranging from 0 to 5. As the optimal cut-off point for functional decline suggested in the validation study, we classified individuals with scores of less than 3 as having better motor function (25). With regard to the cognitive function score in the Kihon Checklist, respondents were asked about their current cognitive function status by using three binary questions yielding total point scores ranging from 0 to 3. The validity of the cognitive function score in the Kihon Checklist had been confirmed in a previous study using the Clinical Dementia Rating as a gold standard (26).

Follow-up (Incident Dementia)
The primary study outcome was incident dementia, defined as disabling dementia according to the criteria of the LTCI system used in Japan (27).
The LTCl is a mandatory form of national social insurance to assist daily activity in the disabled elderly (28–31). Everyone aged ≥40 years pays premiums, and everyone aged ≥65 years is eligible for formal caregiving services under a uniform standard of disability certification. The procedure for disability certification comprises two parts: (i) assessment of the degree of functional disability using a questionnaire developed by the Ministry of Health, Labor, and Welfare, and (ii) reference to the Doctor’s Opinion Paper prepared by the attending physician (32).

Disabling dementia was defined as incident functional disability with dementia according to the LTCl system, whereby the dementia exceeded rank I (rank ≥II) on the Dementia Scale (Degree of Independence in Daily Living for Elderly with Dementia), as entered on the Doctor’s Opinion Paper (33). The Dementia Scale is classified into six ranks (0, I–IV, M. Rank M means that an individual has severe dementia-related behavioral disturbance that requires medical intervention). A rank exceeding I is usually used as an outcome measure of incident dementia because individuals who have mild or moderate dementia are classified as rank II (27,34,35). A previous study has shown that the Dementia Scale is well correlated with the Mini Mental State Examination score (Spearman rank correlation coefficient = −0.736) (36). Additionally, another study has also suggested that the Dementia Scale well reflects dementia as classified by the Clinical Dementia Rating (37).

We obtained a dataset that included information on the LTCl certification, death, or emigration from Ohsaki City based on an agreement. All data were transferred from the Ohsaki City Government under an agreement related to Epidemiologic Research and Privacy Protection.

Ethical Issues
We considered the return of completed questionnaires to imply consent to participate in the study involving the baseline survey data and subsequent follow-up of death or emigration. We also confirmed information regarding LTCl certification status after obtaining written consent along with the questionnaires returned from the subjects at the time of the baseline survey. The Ethics Committee of Tohoku University Graduate School of Medicine (Sendai, Japan) reviewed and approved the study protocol.

Statistical Analysis
We counted the person-years of follow-up for each subject from April 1, 2007 until the date of incident dementia, date of emigration from Ohsaki City, date of death, incident functional disability without dementia, or the end of the study period (November 30, 2012), whichever occurred first. In our analysis, deaths without LTCl certification were treated as censored.

We used the modified adjusted Cox proportional hazards model to calculate the hazard ratios (HRs) and 95% confidence intervals (CIs) for incident dementia according to quartiles of the dietary pattern score. Dummy variables were created for the quartiles of each dietary pattern score, and the lowest quartile of a dietary pattern score was used as a reference category. Multivariate models were adjusted for the following variables. Model 1 was sex- and age-adjusted. To examine whether the dietary patterns are independently associated with dementia when known risk factor of dementia among healthy physical status or other lifestyle factors were considered as confounder, Model 2 was further adjusted for history of stroke, myocardial infarction, hypertension (individuals with self-measured systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg were also defined as hypertensive), arthritis, osteoporosis and fracture, education level, smoking status, alcohol consumption, body mass index, psychological distress score, time spent walking per day, motor function score, cognitive function score, and number of remaining teeth. Furthermore, to examine whether macro-nutritional components explain the association between the dietary patterns and dementia, Model 3 was further adjusted for energy and protein intake.

We also conducted sensitivity analysis that selected only individuals who had no subjective memory complaints assumed as better cognitive function at the baseline. In this analysis, “Cognitive function score in the Kihon Checklist = 0 point” was defined as better cognitive function.

We applied not only the Japanese Diet Index Score (0–9 point) but also each of the items from the Japanese Diet Index Score as exposure variables.

All data were analyzed using SAS version 9.3 (SAS Inc., Cary, NC). All statistical tests described here were two-sided, and differences at p < .05 were accepted as significant.

Results
Among the 14,402 participants, the proportion of men was 44.8%, mean (SD) age was 73.8 (5.9) years, and mean (SD) body mass index was 23.6 (3.3). The mean (SD) follow-up time was 4.9 (1.5) years. The number of participants for whom any data on the FFQ were missing was 8,439 before multiple imputation.

Supplementary Table 1 shows factor loadings, which are equivalent to simple correlations between the food items and dietary patterns. The higher loading suggested greater contribution to a specific factor (dietary pattern). The Japanese pattern was loaded heavily on fish, vegetables, mushrooms, potato, seaweeds, pickles, soybean, and fruits, whereas the animal food pattern was loaded heavily on various animal-derived foods (beef, pork, ham, sausage, chicken, liver, egg, and butter). The high dairy pattern was heavily loaded on dairy products (yoghurt, cheese, and butter), margarine, and black tea, Chinese tea, and negatively loaded on rice. These three dietary patterns explained 27.8% of the variance.

Table 1 compares the characteristics of participants according to the quartiles of each dietary pattern score. Participants with a higher Japanese pattern score were less likely to be male, to be current smokers and drinkers, and to suffer from psychological distress. Additionally, participants with a higher Japanese pattern score tended to have ≥19 years of education, to walk ≥1 h/d, and to have a greater intake of energy and protein. Conversely, participants with a higher animal food pattern score tended to be male, and to be current smokers and drinkers. Additionally, participants with a higher animal food pattern score tended to walk ≥1 h/d, to have better motor function and to have greater intake of energy and protein, and tended to suffer from psychological distress and to have ≥19 years of education. Participants with a higher dairy pattern score tended to be similar to those with a higher Japanese dietary pattern score, except for psychological distress, time spent walking, and intake of energy and protein.

The association between the dietary patterns and incident dementia, along with HRs and associated 95% CIs, are shown in Table 2. We found that a higher Japanese pattern score was inversely associated with the incident risk of dementia in this analysis (p-trend = .016 in Model 3). This inverse association did not differ statistically between the sexes (p = .481 for interaction with sex; data not shown). However, in other dietary patterns (the animal
no significant association was observed. Even when we used only complete cases without any missing data for 39 food items, and all the adjustment items in Model 3 \( (n = 4,715) \), the point estimations (HRs) for the Japanese pattern score did not change substantially; the multivariate HRs (Model 3) were 1.00 (reference) for Q1 (first quartile), 0.87 (95% CI: 0.64, 1.19) for Q2, 0.91 (95% CI: 0.65, 1.28) for Q3, and 0.77 (95% CI: 0.52, 1.13) for Q4 (data not shown).

To examine possible reverse causality for the association between dietary patterns and incident dementia, we reanalyzed the association after excluding 376 participants who developed incident dementia in the first 2 years of follow-up, but the results for the Japanese pattern score did not change substantially (Supplementary Table 2).

To consider the possibility that cognitive function at the baseline might affect the association between dietary patterns and incident dementia, we also analyzed the association after selecting 8,784 participants who had better cognitive function (Kihon Checklist cognitive function score \( <3 \)). However, the results for the Japanese pattern score did not change substantially as a result; the multivariate HRs (Model 3) were 1.00 (reference) for Q1, 0.86 (95% CI: 0.66, 1.11) for Q2, 0.67 (95% CI: 0.50, 0.90) for Q3, and 0.77 (95% CI: 0.52, 1.13) for Q4 (data not shown).

The table below shows the baseline characteristics according to dietary pattern score quartiles:

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>1 (low)</th>
<th>2</th>
<th>3</th>
<th>4 (high)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japanese pattern</td>
<td>74.2 (6.2)</td>
<td>73.6 (5.9)</td>
<td>73.4 (5.7)</td>
<td>74.2 (5.7)</td>
</tr>
<tr>
<td>Animal food pattern</td>
<td>74.0 (6.1)</td>
<td>73.9 (5.9)</td>
<td>73.6 (5.7)</td>
<td>73.9 (5.8)</td>
</tr>
<tr>
<td>High dairy pattern</td>
<td>74.3 (5.8)</td>
<td>74.1 (6.0)</td>
<td>73.6 (5.9)</td>
<td>73.3 (5.8)</td>
</tr>
<tr>
<td>Male (%)</td>
<td>58.2</td>
<td>51.0</td>
<td>39.2</td>
<td>30.8</td>
</tr>
<tr>
<td>Education until age ≥19 y (%)</td>
<td>19.7</td>
<td>25.4</td>
<td>29.4</td>
<td>33.3</td>
</tr>
<tr>
<td>Current smoker (%)</td>
<td>44.8</td>
<td>42.7</td>
<td>36.3</td>
<td>28.3</td>
</tr>
<tr>
<td>Body mass index (kg/m²), mean (SD)</td>
<td>23.5 (3.5)</td>
<td>23.5 (3.3)</td>
<td>23.7 (3.3)</td>
<td>23.6 (3.2)</td>
</tr>
<tr>
<td>Psychological distress (%)*</td>
<td>6.9</td>
<td>4.9</td>
<td>3.8</td>
<td>3.0</td>
</tr>
<tr>
<td>Time spent walking ≥1 h/d (%)</td>
<td>26.2</td>
<td>26.1</td>
<td>28.0</td>
<td>30.7</td>
</tr>
<tr>
<td>Better motor function (%)†</td>
<td>77.2</td>
<td>79.1</td>
<td>79.8</td>
<td>79.0</td>
</tr>
<tr>
<td>Energy (kcal), mean (SD)‡</td>
<td>1,197 (464)</td>
<td>1,377 (384)</td>
<td>1,474 (368)</td>
<td>1,579 (391)</td>
</tr>
</tbody>
</table>

Note: *Kessler six-item psychological distress scale ≥13.
†Motor function score in Kihon Checklist <3.
‡Except energy intake from alcohol drinking.

food pattern and the high dairy pattern), no significant association was observed.

Even when we used only complete cases without any missing data for 39 food items, and all the adjustment items in Model 3 \( (n = 4,715) \), the point estimations (HRs) for the Japanese pattern score did not change substantially; the multivariate HRs (Model 3) were 1.00 (reference) for Q1 (first quartile), 0.87 (95% CI: 0.64, 1.19) for Q2, 0.91 (95% CI: 0.65, 1.28) for Q3, and 0.77 (95% CI: 0.52, 1.13) for Q4 (data not shown).

To examine possible reverse causality for the association between dietary patterns and incident dementia, we reanalyzed the association after excluding 376 participants who developed incident dementia in the first 2 years of follow-up, but the results for the Japanese pattern score did not change substantially (Supplementary Table 2).

To consider the possibility that cognitive function at the baseline might affect the association between dietary patterns and incident dementia, we also analyzed the association after selecting 8,784 participants who had better cognitive function (Kihon Checklist cognitive function score <3). However, the results for the Japanese pattern score did not change substantially as a result; the multivariate HRs (Model 3) were 1.00 (reference) for Q1, 0.86 (95% CI: 0.66, 1.11) for Q2, 0.67 (95% CI: 0.50, 0.90) for Q3,
Table 2. Association Between Dietary Pattern Scores and Incident Dementia (n = 14,402)

<table>
<thead>
<tr>
<th>Dietary Pattern Score Quartiles</th>
<th>1 (low)</th>
<th>2</th>
<th>3</th>
<th>4 (high)</th>
<th>p-Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Japanese pattern</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of event</td>
<td>411</td>
<td>318</td>
<td>279</td>
<td>281</td>
<td></td>
</tr>
<tr>
<td>Person-years</td>
<td>17,052</td>
<td>17,693</td>
<td>18,123</td>
<td>18,175</td>
<td></td>
</tr>
<tr>
<td>Model 1*</td>
<td>1.00 (reference)</td>
<td>0.83 (0.72–0.96)</td>
<td>0.70 (0.60–0.82)</td>
<td>0.62 (0.53–0.73)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Model 2†</td>
<td>1.00 (reference)</td>
<td>0.91 (0.78–1.06)</td>
<td>0.81 (0.69–0.95)</td>
<td>0.79 (0.67–0.92)</td>
<td>.001</td>
</tr>
<tr>
<td>Model 3‡</td>
<td>1.00 (reference)</td>
<td>0.95 (0.81–1.11)</td>
<td>0.85 (0.71–1.01)</td>
<td>0.80 (0.66–0.97)</td>
<td>.016</td>
</tr>
<tr>
<td><em>Animal food</em> pattern</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of event</td>
<td>344</td>
<td>324</td>
<td>313</td>
<td>308</td>
<td></td>
</tr>
<tr>
<td>Person-years</td>
<td>17,590</td>
<td>17,741</td>
<td>17,934</td>
<td>17,777</td>
<td></td>
</tr>
<tr>
<td>Model 1*</td>
<td>1.00 (reference)</td>
<td>0.95 (0.82–1.11)</td>
<td>0.95 (0.82–1.12)</td>
<td>0.91 (0.77–1.07)</td>
<td>.286</td>
</tr>
<tr>
<td>Model 2†</td>
<td>1.00 (reference)</td>
<td>1.02 (0.88–1.19)</td>
<td>1.02 (0.87–1.19)</td>
<td>0.99 (0.84–1.17)</td>
<td>.925</td>
</tr>
<tr>
<td>Model 3‡</td>
<td>1.00 (reference)</td>
<td>1.09 (0.93–1.28)</td>
<td>1.13 (0.95–1.33)</td>
<td>1.12 (0.92–1.36)</td>
<td>.216</td>
</tr>
<tr>
<td>High dairy pattern</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of event</td>
<td>344</td>
<td>328</td>
<td>329</td>
<td>288</td>
<td></td>
</tr>
<tr>
<td>Person-years</td>
<td>17,524</td>
<td>17,723</td>
<td>17,873</td>
<td>17,923</td>
<td></td>
</tr>
<tr>
<td>Model 1*</td>
<td>1.00 (reference)</td>
<td>0.92 (0.79–1.07)</td>
<td>0.99 (0.85–1.15)</td>
<td>0.91 (0.78–1.07)</td>
<td>.445</td>
</tr>
<tr>
<td>Model 2†</td>
<td>1.00 (reference)</td>
<td>0.92 (0.79–1.07)</td>
<td>1.04 (0.89–1.21)</td>
<td>1.00 (0.85–1.18)</td>
<td>.615</td>
</tr>
<tr>
<td>Model 3‡</td>
<td>1.00 (reference)</td>
<td>0.88 (0.76–1.03)</td>
<td>0.99 (0.84–1.16)</td>
<td>0.97 (0.83–1.15)</td>
<td>.896</td>
</tr>
</tbody>
</table>

Note: * Adjusted for age (65–69, 70–74, 75–79, 80–84, and ≥85 y) and sex.
† Adjusted for Model 1 + history of disease (stroke, myocardial infarction, hypertension, arthritis, osteoporosis, fracture [yes, no]), education level (age at final graduation from school <16, 16–18, ≥19 y, missing), smoking (never, former, current, missing), alcohol drinking (never, former, current, missing), body mass index (in kg/m²: <18.5, 18.5–24.9, ≥25.0, missing), psychological distress score (<13, ≥13, missing), time spent walking (<30 min/d, 30 min to 1 h/d, ≥1 h/d, missing), motor function score (<3, ≥3, missing), cognitive function score (0, 1, 2, 3, or missing), and number of remaining teeth (0, 1–19, ≥20, missing).
‡ Adjusted for Model 2 + intake of specific decile categories and protein intake (sex-specific tertile categories).
§ Hazard ratio (95% confidence interval).

and 0.69 (95% CI: 0.50, 0.95) for Q4 (p-trend = .013; data not shown).

Supplementary Table 3 shows the results of incident dementia according to the quartiles of the Japanese Diet Index Score. Significant inverse association between the Japanese Diet Index Score and incident dementia was observed. The multivariate HRs (Model 3) were 1.00 (reference) for Q1 (the first quartile), 0.88 (95% CI: 0.74, 1.05) for Q2, 0.87 (95% CI: 0.73, 1.04) for Q3, and 0.79 (95% CI: 0.66, 0.95) for Q4 (p-trend = .015). Supplementary Table 4 shows the multivariate HRs of incident dementia according to each item from the Japanese Diet Index Score. A significant inverse association was observed for both seaweed and green tea.

Discussion

In this population-based cohort study, we investigated the association between dietary patterns and incident dementia using the same method as that adopted for deriving the three dietary patterns in a previous study (13). We found that the Japanese dietary pattern was significantly associated with a decreased risk of incident dementia. Additionally, sensitivity analysis using the Japanese Diet Index Score yielded a similar result for the Japanese pattern. It is unlikely that the missing data for food items or adjustment items would have been a potential source of bias because the point estimations (HRs) for the Japanese pattern score did not change substantially, even when complete-case analysis was conducted. No apparent inverse association was observed for either the animal food pattern or the high-dairy pattern. To our knowledge, this is the first study to have proved a potential source of bias because the point estimations (HRs) for the missing data for food items or adjustment items would have been similar.

Because the Japanese dietary pattern includes a variety of foods and probably requires more time for preparing meals, any individual who already has weaker cognitive function might find it difficult to adhere to the Japanese pattern. Therefore, we also considered the effects of reverse causality. However, even after excluding individuals who developed incident dementia in the first 2 years of follow-up, the inverse association between the Japanese pattern and incident dementia persisted. Additionally, even after selecting only individuals who had better cognitive function at the baseline, the HRs for each category were also almost the same. The above findings suggest that the present results are unlikely to be attributable to reverse causality.

The preventive effect of the Japanese dietary pattern against dementia might be due to a combination of food and micro-nutritional components. Although the Japanese pattern score was positively correlated with energy intake (Table 1), the results did not change substantially even when energy intake, protein intake and body mass index were included in the multivariate model. Therefore, the inverse association seems difficult to explain in terms of only macro-nutritional components (energy and protein). Because the Japanese pattern included a variety of foods that accounted for 14.8% of the overall variance (Supplementary Table 1), this pattern is likely to include various micro-nutritional components and provide a good nutrient balance.

This inverse association between the Japanese dietary pattern and dementia is consistent with previous studies of the Mediterranean diet (6,7). The Japanese pattern has some characteristics in common with the Mediterranean diet (eg, high intake of vegetables, fruits, legumes and fish, and low intake of meat and dairy products) (9,38,39). Thus, the mechanism of this dietary effect might be similar to that reported for the Mediterranean diet. Several previous studies have...
also examined the impact of individual Japanese foods and their nutritional components on dementia, including soybeans, green tea and seaweeds (39–41). In our tentative analysis using each item from the Japanese Diet Index Score as an exposure variable, a significant inverse association was observed for seaweeds and green tea, and all of the HRs were less than 1.00 except for coffee (Supplementary Table 4). Further study focusing on each type of Japanese food will be needed in order to understand the mechanism.

This study had several limitations. First, not all potential confounding factors were considered. In particular, it cannot be ruled out that the cooking and shopping for the Japanese diet might have maintained cognitive function because the Japanese pattern included a variety of foods. Genetic risk factors for dementia and medication were also not considered. Second, because not all candidates applied for LTCI certification, this study may not have been completely free from detection bias. The degree of such bias remains to be verified. Third, because information about clinical diagnosis of dementia was not considered, we did not evaluate the types of dementia, such as Alzheimer’s disease or vascular dementia. Therefore, the mechanism remained unidentified. Fourth, the proportion of subjects included in the present study was not high. Among the source population of 31,694, the valid response rate in the baseline survey was 72.9% (n = 23,091). Additionally, the number of study subjects included in the present analysis was 14,402 (62.4%), and the number of those who were not included was 8,689 (37.6%). Mortality between December 1, 2006 and November 30, 2012 was lower in the study subjects (12.4%) than in the non-study subjects (27.5%). Thus, the present study would have been biased toward healthier people in the community.

In conclusion, this study has shown that the Japanese dietary pattern is associated with a decreased risk of incident dementia in Japanese elderly individuals. This suggests that the Japanese dietary pattern may have a preventive effect against dementia.

**Supplementary Material**

Please visit the article online at [http://gerontologist.oxfordjournals.org/](http://gerontologist.oxfordjournals.org/) to view supplementary material.

**Funding**

This work was supported by Research Grants from the Honjo International Scholarship Foundation, and Health Sciences Research grants (nos. H24-Choju-Ippan-005) from the Ministry of Health, Labour and Welfare of Japan.

**Acknowledgments**


**Conflict of Interest**

There are no potential conflicts of interest that relate to the manuscript.

**References**


