The relationship between dietary variety and frailty in Japanese older adult women during the period of restriction on outings due to COVID-19

Naoto Otaki, PhD, 1,2 Megumu Yano, MS, 2 Miyuki Yokoro, PhD, 3 Norikazu Tanino, BS, 1 Keisuke Fukuo, PhD 1, 2

1 Department of Food Sciences and Nutrition, School of Human Environmental Sciences, Mukogawa Women’s University, 2 Research Institute for Nutrition Sciences, Mukogawa Women's University, 3 Department of Dietary Life and Food Sciences, Junior College Division, Mukogawa Women’s University.

Correspondence: Naoto Otaki
Department of Food Sciences and Nutrition, School of Human Environmental Sciences, Mukogawa Women’s University, 6-46 Ikebiraki-cho, Nishinomiya, Hyogo 663-8558, Japan. Email: otk_nao@mukogawa-u.ac.jp
TEL and FAX: +81-798-45-3728

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Abstract

Objective: This study investigated the relationship between diet and frailty in community-dwelling older adults during the period of restriction on outings due to COVID-19. A population of 322 women aged 65 years or older living in the community was recruited for the study, of whom 253 were analyzed.

Method: A mail survey was carried out in May 2020, targeting adults aged 65 years or older. The survey included questions regarding sex, age, height, weight, and social participation. Dietary variety score and frailty score were also calculated.

Results: Mean age for the 253 participants was 80.0±6.4 years. Dietary variety score and frailty score were significantly correlated under linear regression analysis ($\beta : -0.224, P < 0.001$). In multivariate regression analysis, these factors remained significantly correlated in Model 2, which was adjusted for age ($\beta : -0.229, P < 0.001$), and Model 3, which was adjusted for age, BMI, and other confounding factors ($\beta : -0.208, P = 0.001$).

Conclusion: Diet was correlated with frailty in older adults living in the community during the period of restriction on outings due to COVID-19.

Keywords

COVID-2019, frailty, dietary variety
Introduction

Since November 2019, novel coronavirus disease 2019 (COVID-19) has had a profound impact on daily human life (World Health Organization, 2020b). Several countries, such as the United States and France, have been implementing lockdowns at various points to contain the spread of the disease. In Japan, a state of emergency was declared on April 16, 2020, as part of which outings were restricted for a period of approximately one month. Since May 25, 2020, the restrictions on outings are being incrementally relaxed every few weeks. As of August 19, 2020, the total recorded numbers of COVID-19 cases and deaths in Japan were 57,550 and 1,128, respectively. While only 0.1% of individuals in their 20s presented with severe disease in the country, the rates are much higher among those aged in their 60s (5.6%), 70s (7.8%), and 80s or older (4.9%). Further, while the mortality is 0.0% for individuals in their 20s, it is 2.7% for those in their 60s, 8.5% for those in their 70s, and 18.1% for those aged 80 years or older (Ministry of Health, Labour and Welfare, 2020). Thus, older age seems to be associated with COVID-19 severity and mortality. Further, studies conducted in Western countries showed that older adults with comorbid heart disease, diabetes, respiratory disease, kidney disease, cancer, skeletal muscle, or autoimmune disease are at a high risk for COVID-19 (Docherty et al., 2020, Onder, Rezza, & Brusaferro 2020).

It is hypothesized that the panic buying of food, fear, and anxiety pertaining to COVID-19 infection, and exposure to stressors due to restrictions on outings have an impact on people’s food choices and diet quality (Brooks et al., 2020). Recently, the World Health Organization presented information on people’s eating habits during the lockdown (World Health Organization, 2020a). Additionally, several studies have focused on the dietary changes observed during this period. Research conducted in Spain (Rodríguez-Pérez et al., 2020) and Italy (Di Renzo et al., 2020) found that people’s eating habits improved during lockdown periods. However, no corresponding studies have been conducted in Asia.
Frailty is a major health problem in older adults and the risk of frailty increases with age (Fried et al., 2001). Frail older adults are expected to be at a higher risk of developing severe disease if they contract COVID-19. The importance of screening for frailty in older adults during periods of urban lockdown has previously been reported (Hubbard et al., 2020). Other factors, such as the intake of a Mediterranean diet—which largely comprises vegetables, fruits, seafood, and beans (León-Muñoz, Guallar-Castillón, López-García, & Rodríguez-Artalejo, 2014)—are also associated with frailty.

Dietary variety refers to the intake of a variety of food groups during a specific period and does not pertain to the amount of food consumed (Bernstein et al., 2002). It is an important element of a healthy diet and is considered to improve the level of nutrient adequacy (Foote, Murphy, Wilkens, Basiotis, & Carlson, 2004). In Japan, the dietary variety score has been shown to be associated with walking speed and the prevention of a decline in grip strength (Yokoyama et al., 2016; Yokoyama et al., 2017). Thus, it is important to report on the dietary changes observed in older adults during a period of restriction on outings and clarify the relationship between dietary variety and frailty.

This study aimed to investigate the relationship between diet and frailty in older community-dwelling adults during the period of restriction on outings due to COVID-19 in Japan. The rate of frailty is lower than 10% in individuals aged under 80 years; however, it exceeds 20% in those aged 80 years or older (Kojima et al., 2017). As such, it is hypothesized that the effects of dietary variety differ across these age groups. Additionally, as the risk of frailty increases with age (Fried et al., 2001), we sought to evaluate the relationship between diet and frailty using age-stratified analyses.

Methods
Study participants and study period

This study was conducted in N District of N City in H Prefecture. Luncheon meetings are offered in N District by district welfare officers, child welfare officers, and volunteers as a welfare service for older adults. The aim of these luncheon meetings is the provision of dietary support for community-dwelling older adults. Survey forms were mailed to the 505 community-dwelling older adults living in N District of N City who were participating in this welfare project at the beginning of May 2020. The details of the study were explained in writing and the return of a completed survey form was considered consent for participation in the study. A total of 322 survey forms were returned. This study was approved by the ethics committee of our university.

Survey content

The survey included questions on participant sex, age, height, weight, illness status, eating habits, social participation, and economic status. Economic status was assessed with the question “Please tell us about your current economic status”; an answer was selected from among five choices: “quite secure,” “somewhat secure,” “not secure, but not having trouble with everyday life,” “struggling somewhat”, and “struggling quite a lot.” Among the five choices, “quite secure,” “somewhat secure”” and “not secure, but not having trouble with everyday life” were assigned to the “economically secure” category, while “struggling somewhat” and “struggling quite a lot” were combined into the “economically insecure” category.

Dietary variety score
The dietary variety score was used to assess the food group intake. This score was calculated by the investigation of the frequency with which an individual consumes foods from across ten categories: meats, fish and shellfish, eggs and egg products, soybeans and soybean products, milk and milk products, seaweeds, vegetables, fruits, potatoes, and oils. The total dietary variety score (food) ranges from 0 to 10 points, with the intake of each food group assigned 1 point for a response of “eat almost every day” and 0 for “eat once every two days/eat once or twice a week/eat hardly ever” (Yokoyama et al., 2016).

Frailty score

The following five questions were used for the calculation of the frailty score: “Have you lost 2 to 3 kg or more in the last 6 months?”, “Do you feel like you walk more slowly?”, “Do you exercise at least once per week?”, “Can you remember what happened five minutes ago?”, and “Do you feel tired for no reason?” These five items mandated a “yes” or “no” response. The three questions “Have you lost 2 to 3 kg or more in the last 6 months?”, “Do you feel like you walk more slowly?”, and “Do you feel tired for no reason?” were assigned a score of 1 point for “yes” and 0 for “no.” The questions “Do you exercise at least once per week?” and “Can you remember what happened five minutes ago?” were assigned a score 1 point for “no” and 0 for “yes.” The total score for these five items ranged from 0 to 5 points and was used as the frailty score (Yamada & Arai, 2015).

Data collection and analysis

Survey responses were received from 322 participants. The mean age of the 322 respondents was 80.5±6.2 years. The participants’ mean height, weight, and body mass index (BMI) were
152.2±6.5 cm, 52.6±8.0 kg, and 22.7±3.2 kg/m², respectively. Totally, 155 (48.1%) of the respondents had at least two illnesses, 13 (4.0%) skipped breakfast, 16 (5.0%) were economically insecure, and 56 (17.4%) had no social participation. As the number of male respondents was very low (n=35), they were excluded from the analysis. Further, 34 respondents were excluded due to missing data necessary for the calculation of either the dietary variety score or frailty score. Thus, a total of 253 responses were analyzed.

The results of the categorical analysis are shown as the number and percentage of respondents. Continuous variables are shown as the mean and standard deviation. Age, height, weight, and BMI were analyzed with t-tests, while the other continuous variables were analyzed using nonparametric tests. Categorical data were analyzed with the $\chi^2$ test. Linear regression analysis was used to examine the relationship between the frailty score and dietary variety score. In the multivariate linear regression analysis, Model 1 was adjusted for age (80 years or older) while Model 2 was adjusted for age (80 years or older), BMI (lower than 18.5 kg/m²), number of illnesses (two or more), social participation, and economic status. Statistical analyses were performed using IBM SPSS 24.0, with significance set at a level lower than 5%.

Results

Table 1 shows the attributes of the analyzed participants. The mean participant age was 80.0±6.4 years and mean BMI was 22.7±3.1 kg/m². The median frailty score was 1.0 (quartile range: 0.0–2.0), while the median dietary variety score was 5.0 (quartile range: 3.0–6.0).
Table 2 shows the relationship between the frailty score and dietary variety score; a significant correlation was observed ($\beta : -0.224$, $P < 0.001$). The significant correlation persisted in Model 1, which was adjusted for age, and Model 2, which was adjusted for age, BMI, number of illnesses, economic status, and social participation. Age-stratified analyses were also performed. The frailty score and dietary variety were significantly correlated both in participants aged 80 years or older and in those aged under 80 years.

Discussion

In this study, which investigated the relationship between frailty and dietary habits among community-dwelling women aged 65 years or older during a period of restriction on outings, dietary habits were found to be correlated with frailty. Further, age-stratified analyses demonstrated that this correlation persisted regardless of age. Changes in daily life due to COVID-19 are expected to have an impact on diet. The formulation of public health measures to monitor and maintain or improve the diet of older adults in extraordinary circumstances, such as outing restrictions during an infection outbreak or disaster, is essential.

Previous studies have reported that the Mediterranean and DASH diets are correlated with frailty (Zaslavsky et al., 2017) while the dietary variety score has been found to be correlated with skeletal muscle, grip strength, and walking speed (Yokoyama et al., 2016; Yokoyama et al., 2017). Similar to the results of previous studies, the present research also found that the intake of a high-quality diet is associated with frailty. Like in the case of the Mediterranean and DASH diets, a high dietary variety score is considered to indicate a higher consumption level of protein and antioxidant vitamins C and E. This study revealed that the dietary variety score during a period of restriction on outings is correlated with frailty. In Italy and Spain, an
improvement in people’s eating habits was observed during lockdowns. As the present study did not survey people’s eating habits prior to the restriction on outings in Japan, the changes that occurred due to these restrictions cannot be discussed. The performance of a mid- to long-term survey of eating habits and subsequent consideration of dietary changes are essential.

This study has several limitations. First, the sample size was small. In addition to the low survey response rate, there were several cases with missing data. Thus, the generalizability of our results are low. Second, the relationship between diet and frailty was not explored in men. Third, for the assessment of diet, the survey conducted in this study was administered in early May 2020; the eating habits before the period of restriction on outings were not assessed. Thus, the authors were unable to discuss the changes in the participants’ eating habits. Fourth, diet was assessed using a dietary variety score. The assessment of dietary variety does not include the quantitative evaluation of the food items or nutrients consumed; it is essential to assess these factors in detail in the future. Further, as the social impacts of COVID-19 are expected to be of a mid-to-long-term nature, the level of dietary variety is likely to decrease (Gibson., 2006). Going forward, it is necessary to perform continuous assessments of the mid-to-long-term changes in the dietary variety of older adults living in the community.

In conclusion, this study, which investigated the relationship between diet and frailty in community-dwelling women aged 65 years or older during a period of restriction on outings found the two to be correlated. It is important to conduct a mid-to-long-term survey of older people’s eating habits and examine the correlation between diet and frailty in future research.
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Table 1. Participant characteristics

|               | age < 80 y, n=112 | age >= 80 y, n=141 |
|---------------|------------------|-------------------|
|               | M               | M                | M                |
| ea            | ea              | ea               | ea               |
| n             | n               | n                | n                |
| or            | or              | or               | or               |
| SD            | SD              | SD               | SD               |
| M             | M               | M                | M                |
| ed            | ed              | ed               | ed               |
| ia            | ia              | ia               | ia               |
| n             | n               | n                | n                |
| or 25 75     | or 25 75        | or 25 75         |
| or per 25 75 | or per 25 75    | or per 25 75     |
| n ce til 80  | n ce til 74 6.4 | n ce til 84 3.7  |
| or nt 15 1.5 | or nt 15 3 3.8  | or nt 14 9 4.9   |
| or nt 1 1.5  | or nt 3 3 4     | or nt 4 4        |

*P < 0.001
|                |   |   |   |   |
|----------------|---|---|---|---|
| Weight (kg)    | 51| 53| 50|   |
|                | 7.7| 7.0| 8.0|   |
|                | .8| .0| .8|   |
| *P*            | =| =| =| 0.0 |
| BMI (kg/m²)    | 22| 22| 22|   |
|                | 3.1| 2.8| 3.4|   |
|                | .7| .5| .8|   |
| *P*            | =| =| =| 0.4 |
| BMI <18.5      | 13| 7| 6|   |
|                | 5.1| 6.3| 4.3|   |
| *P*            | =| =| =| 0.4 |
| Number of      | 12|   |   |   |
| illnesses      | 49.0| 57.0| 42.0|   |
|                | 64| 60| 6|   |
| *P*            | =| =| =| 0.0 |
| *P*            | =| =| =| 21 |
| Skipping       | yes| 10|   |   |
| breakfast      | 4.0| 3| 7|   |
|                | 2.7| 5.0| 0.3|   |
|                | 54|
| no             | 24| 10| 13|   |
|                | 96.| 97.| 95.|   |
|                          | Social participation | Economic status |
|--------------------------|----------------------|----------------|
| yes                      | 20 82. 96 3 1 99    | 23 91. 10 4 9. 7 23 99    |
| no                       | 9 6 96 3 1 13. 12 1 23 9 | 35 13. 11. 16. 8 1 23 9 |
| P                        | 0.1                  | 0.1            |

|                         | Frail score          | Dietary variety |
|-------------------------|----------------------|----------------|
| 1. 0. 2. 1. 0. 2. 2. 1. 2. | 1. 0. 2. 1. 0. 2. 2. 1. 2. | 5. 3. 6. 4. 3. 6. 5. 3. 6. |
| 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | 5. 3. 6. 4. 3. 6. 5. 3. 6. |
| *P*                     | ≤ 0.01               | = 0.9          |

|                        | Meat consumption    |
|------------------------|---------------------|
| Almost every day       | 37. 44. 32.         |
| every day              | 96 50 46 6           |
| day                    | 9 6 6 0.0            |

|                         | *P*                 |
|-------------------------|---------------------|
| 37. 44. 32.            | ≤ 0.01              |
| 96 50 46 6             | = 0.0               |
| 9 6 6 0.0              | ≤ 0.50              |
| Food Category          | Frequency | Percentage |
|-----------------------|-----------|------------|
| Fish and shellfish    | Almost    | P = 0.057  |
|                       | every 2   | 16.15      |
|                       | days or   | 62.55      |
|                       | less      | 67.46      |
|                       | every 42  | 11.13      |
|                       | day       | 66.6       |
|                       |           | 57.0       |

| Egg and egg products  | Almost    | P = 0.948  |
|                       | every 4   | 14.64      |
|                       | day       | 57.64      |
|                       |           | 56.8       |

| Soybeans and soybean | Almost    | P = 0.958  |
|                      | every 6   | 13.60      |
|                      | day       | 53.6       |
|                      |           | 53.53      |

|                       | P =       | 58         |
| Product                | Frequency | Days or Less | 2 Days or Less | Probability |
|-----------------------|-----------|--------------|----------------|-------------|
| Milk and milk products| Almost    | 20 8.2       | 88 6.7         | 0.1         |
|                       | every day | 8 2.2        | 6 0.1          |             |
| Seaweeds              | Almost    | 20 1.7       | 51 1.9         | 0.4         |
|                       | every day | 8 2.2        | 4 0.1          |             |
| Vegetables            | Almost    | 16 5.9       | 74 2.6         | 0.9         |
|                       | every day | 7 0.0        | 1 0.0          |             |
| Category    | Frequency | Days or less | P  |
|-------------|-----------|--------------|----|
| Fruits      | Almost    | 17 70.       | 68.06 |
|             | every day | 7 0          | 8  |
| Potatoes    | Almost    | 24 9.5       | 10.04 |
|             | every day | 22 9.5       | 10 |
| Oils        | Almost    | 12 50.       | 50.09 |
|             | every day | 8 6          | 71 |

Note: The table shows the frequency of consumption with the days or less category indicating the number of days per week the item is consumed. The P values are calculated based on the number of days or less.
| days or | 5 | 4 | 1 | 6 |
|--------|---|---|---|---|
| less   |   |   |   |   |

*p<0.05. SD, standard deviation; BMI, body mass index
Table 2. Relationship between dietary variety score and frailty score

|                      | Unstandardized coefficients | 95% CI | Standardized coefficients | Significance level |
|----------------------|-----------------------------|--------|---------------------------|-------------------|
|                      | Unstandardized coefficients |        |                           |                   |
|                      |                             | Min    | max                       |                   |
| All participants     |                             |        |                           |                   |
| (n=252)              |                             |        |                           |                   |
| Crude                | -0.123                      | -0.190 | -0.057                    | -0.224 *P < 0.001 |
| Model 1              | -0.126                      | -0.190 | -0.062                    | -0.229 *P < 0.001 |
| Model 2              | -0.115                      | -0.181 | -0.050                    | -0.212 *P = 0.001 |
| age < 80 y           |                             |        |                           |                   |
| (n=112)              |                             |        |                           |                   |
| Crude                | -0.165                      | -0.259 | -0.072                    | -0.317 *P = 0.001 |
| Model 3              | -0.135                      | -0.232 | -0.039                    | -0.261 *P = 0.006 |
| age >= 80 y          |                             |        |                           |                   |
| (n=141)              |                             |        |                           |                   |
| Crude                | -0.104                      | -0.192 | -0.017                    | -0.196 *P = 0.020 |
| Model 3              | -0.096                      | -0.188 | -0.005                    | -0.183 *P = 0.039 |
Model 1:
Adjusted for age

Model 2: Adjusted for age, BMI, number of illnesses, skipping breakfast, social participation, and economic status

Model 3: Adjusted for BMI, number of illnesses, skipping breakfast, social participation, and economic status

*P<0.05. BMI, body mass index; CI, confidence interval