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

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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 (β : -0.224, P < 0.001). In multivariate regression analysis, these factors remained significantly correlated in Model 2 , which was adjusted for age (β : -0.229, P < 0.001), and Model 3, which was adjusted for age, BMI, and other confounding factors (β : -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.

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/m^2, 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 χ^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/m^2), 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/m^2. 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 (β : -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.

References

Bernstein, M.A., Tucker, K.L., Ryan, N.D., O'Neill, E.F., Clements, K.M., Nelson, M.E., ... & Fiatarone Singh, M.A. (2002). Higher dietary variety is associated with better nutritional status in frail elderly people. Journal of the American Dietetic Association, 102(8), 1096-1104. https://doi.org/10.1016/S0002-8223(02)90246-4

Brooks, S.K., Webster, R.K., Smith, L.E., Woodland, L., Wessely, S., Greenberg, N., & Rubin, G.J. (2020). The psychological impact of quarantine and how to reduce it: rapid review of the evidence. Lancet (London, England), 395(10227), 912-920. https://doi.org/10.1016/S0140-6736(20)30460-8

Di Renzo, L., Gualtieri, P., Pivari, F., Soldati, L., Attinà, A., Cinelli, G., ... & De Lorenzo, A. (2020). Eating habits and lifestyle changes during COVID-19 lockdown: an Italian survey. Journal of Translational Medicine, 18(1), 229. https://doi.org/10.1186/s12967-020-02399-5

Docherty, A.B., Harrison, E.M., Green, C.A., Hardwick, H.E., Pius, R., Norman, L., ... & Semple, M.G. (2020). Features of 20 133 UK patients in hospital with covid-19 using the ISARIC WHO Clinical Characterisation Protocol: prospective observational cohort study. BMJ (Clinical research ed.), 369, m1985. https://doi.org/10.1136/bmj.m1985

Fried, L.P., Tangen, C.M., Walston, J., Newman, A.B., Hirsch, C., Gottdiener, J., ... & McBurnie, M.A. (2001). Frailty in older adults: evidence for a phenotype. The Journals of Gerontology. Series A, Biological Sciences and Medical Sciences, 56(3), M146-156. https://doi.org/10.1093/gerona/56.3.M146

Foote, J.A., Murphy, S.P., Wilkens, L.R., Basiotis, P.P., & Carlson, A. (2004). Dietary variety increases the probability of nutrient adequacy among adults. The Journal of Nutrition, 134(7), 1779-1785. https://doi.org/10.1093/jn/134.7.1779

Gibson, E.L. (2006). Emotional influences on food choice: sensory, physiological and psychological pathways. Physiology & Behavior, 89(1), 53-61. https://doi.org/10.1016/j.physbeh.2006.01.024

Hubbard, R.E., Maier, A.B., Hilmer, S.N., Naganathan, V., Etherton-Beer, C., & Rockwood, K. (2020). Frailty in the face of COVID-19. Age and Ageing, 49(4), 499-500. https://doi.org/10.1093/ageing/afaa095

Kojima, G., Iliffe, S., Taniguchi, Y., Shimada, H., Rakugi, H., & Walters, K. (2017). Prevalence of frailty in Japan: A systematic review and meta-analysis. Journal of Epidemiology, 27(8), 347-353. https://doi.org/10.1016/j.je.2016.09.008

León-Muñoz, L.M., Guallar-Castillón, P., López-García, E., & Rodríguez-Artalejo, F. (2014). Mediterranean diet and risk of frailty in community-dwelling older adults. Journal of the American Medical Directors Association, 15(12), 899-903. https://doi.org/10.1016/j.jamda.2014.06.013

Ministry of Health, Labour and Welfare. (2020) About Coronavirus Disease 2019 (COVID-19). https://www.mhlw.go.jp/stf/seisakunitsuite/bunya/newpage_00032.html

Onder, G., Rezza, G., & Brusaferro, S. (2020). Case-fatality rate and characteristics of patients dying in relation to COVID-19 in Italy. JAMA, 323(18), 1775-1776. https://doi.org/10.1001/jama.2020.4683

Rodríguez-Pérez, C., Molina-Montes, E., Verardo, V., Artacho, R., García-Villanova, B., Guerra-Hernández, E.J., & Ruíz-López, M.D. (2020). Changes in dietary behaviours during the COVID-19 outbreak confinement in the Spanish COVIDiet Study. Nutrients, 12(6), E1730. https://doi.org/10.3390/nu12061730

World Health Organization. (2020a). Food and nutrition tips during self-quarantine.

https://www.euro.who.int/en/health-topics/health-emergencies/coronavirus-covid-

19/technical-guidance/food-and-nutrition-tips-during-self-quarantine

World Health Organization. (2020b). WHO Coronavirus Disease (COVID-19) Dashboard.

https://covid19.who.int/

Yamada, M., & Arai, H. (2015). Predictive value of frailty scores for healthy life expectancy

in community-dwelling older Japanese adults. Journal of the American Medical Directors

Association, 16(11), 1002.e7-11. https://doi.org/10.1016/j.jamda.2015.08.001

Yokoyama, Y., Nishi, M., Murayama, H., Amano, H., Taniguchi, Y., Nofuji, Y., ... &

Shinkai, S. (2016). Association of dietary variety with body composition and physical

function in community-dwelling elderly Japanese. The Journal of Nutrition, Health & Aging,

20(7), 691-696. https://doi.org/10.1007/s12603-015-0632-7

Yokoyama, Y., Nishi, M., Murayama, H., Amano, H., Taniguchi, Y., Nofuji, Y., ... &

Shinkai, S. (2017). Dietary variety and decline in lean mass and physical performance in

community-dwelling older Japanese: A 4-year follow-up study. The Journal of Nutrition,

Health & Aging, 21(1), 11-16. https://doi.org/10.1007/s12603-016-0726-x

Zaslavsky, O., Zelber-Sagi, S., Hebert, J.R., Steck, S.E., Shivappa, N., Tabung, F.K., ... &

Tinker, L.F. (2017). Biomarker-calibrated nutrient intake and healthy diet index associations

with mortality risks among older and frail women from the Women's Health Initiative. The

American Journal of Clinical Nutrition, 105(6), 1399-407.

https://doi.org/10.3945/ajcn.116.151530

Table 1. Participant characteristics

		n=253			age < 80 y, n=112			age >= 80 y, n=141			P value
		Mean or Median or n	SD or percent or percentile	25%tile	75%tile	Mean or Median or n	SD or percent or percentile	25%tile	75%tile	Mean or Median or n	SD or percent or percentile	25%tile	75%tile	
Age	y	80.0	6.4			74.2	3.8			84.7	3.7			*P < 0.001
Height	cm	151.1	5.6			153.3	4.9			149.4	5.5			*P < 0.001

								*P = 0.028
Weight	kg	51.8	7.7	53.0	7.0	50.8	8.0	
BMI	kg/m^2	22.7	3.1	22.5	2.8	22.8	3.4	P = 0.476
BMI <18.5		13	5.1	7	6.3	6	4.3	P = 0.475
Number of illnesses	<2	124	49.0	64	57.1	60	42.6	P = 0.021
	≥2	129	51.0	48	42.9	81	57.4	
Skipping breakfast	yes	10	4.0	3	2.7	7	5.0	P = 0.354
	no	24	96.	10	97.	13	95.	

		3	0		9	3		4	0			
Social participation	yes	209	82.6		96	88.9		113	83.1			P = 0.199
	no	35	13.8		12	11.1		23	16.9			
Economic status	secure	232	91.7		104	97.2		128	93.4			P = 0.177
	insecure	12	4.7		3	2.8		9	6.6			

Frail score		1.0	0.0	2.0	1.0	0.0	2.0	2.0	1.0	2.0		*P < 0.001
Dietary variety score		5.0	3.0	6.0	4.0	3.0	6.0	5.0	3.0	6.0		P = 0.985
Meat	Almost every day	96	37.9		50	44.6		46	32.6			P = 0.050

Food	Frequency	n	%	n	%	n	%	P value
	Once every 2 days or less	157	62.1	62	55.4	95	67.4	
Fish and shellfish	Almost every day	42	16.6	13	11.6	29	20.6	P = 0.057
	Once every 2 days or less	211	83.4	99	88.4	112	79.4	
Egg and egg products	Almost every day	144	56.9	64	57.1	80	56.7	P = 0.948
	Once every 2 days or less	109	43.1	48	42.9	61	43.3	
Soybeans and soybean	Almost every day	136	53.8	60	53.6	76	53.9	P = 0.958

products	Once every 2 days or less	117	46.2	52	46.4	65	46.1	
Milk and milk products	Almost every day	208	82.2	88	78.6	120	85.1	P = 0.177
	Once every 2 days or less	45	17.8	24	21.4	21	14.9	
Seaweeds	Almost every day	51	20.2	20	17.9	31	22	P = 0.416
	Once every 2 days or less	202	79.8	92	82.1	110	78	
Vegetables	Almost every day	167	66.0	74	66.1	93	66	P = 0.985

		n	%	n	%	n	%	P
	Once every 2 days or less	86	34.0	38	33.9	48	34	
Fruits	Almost every day	177	70.0	80	71.4	97	68.8	P = 0.650
	Once every 2 days or less	76	30.0	32	28.6	44	31.2	
Potatoes	Almost every day	24	9.5	9	8	15	10.6	P = 0.483
	Once every 2 days or less	229	90.5	103	92	126	89.4	
Oils	Almost every day	128	50.6	57	50.9	71	50.4	P = 0.932
	Once every 2	124	49.	55	49.	70	49.	

days or less	5	4		1		6

*p<0.05. SD, standard deviation; BMI, body mass index

Table 2. Relationship between dietary variety score and frailty score

	Unstandardized coefficients	Unstandardized coefficients 95% CI		Standardized coefficients	Significance level
		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