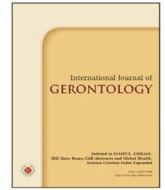




International Journal of Gerontology

journal homepage: <http://www.sgecm.org.tw/ijge/>

Original Article

Association between Frequency of Exercise at Home and Depression during the COVID-19 Epidemic among Japanese Community-Dwelling Older Adults

Takahiro Nishida^{a,b}, Yoshihiko Ide^c, Ayumi Honda^{b,d}, Sumihisa Honda^{b*}^a Sasebo-Yoshii Community Comprehensive Support Center, Sasebo, Japan, ^b Department of Nursing, Nagasaki University Graduate School of Biomedical Sciences, Nagasaki, Japan, ^c Department of Dementia Clinic, Sasebo-Chuo Hospital, Sasebo, Japan, ^d St. Mary's College of Nursing, Kurume, Japan

ARTICLE INFO

Accepted 18 October 2022

Keywords:

COVID-19,
depression,
frailty,
aged

SUMMARY

Objectives: This study aimed to investigate whether exercise frequency at home during the COVID-19 epidemic is associated with worsening depression among community-dwelling older adults.**Methods:** We conducted a questionnaire survey on 127 Japanese community-dwelling older adults in 2020. The questionnaire items included basic attributes, adherence to behaviors for COVID-19, changes in mental/physical conditions and frequency of home exercise during the restrictions on social participation for about 3.5 months.**Results:** The multiple logistic regression analysis showed that the worsening depression group was independently associated with physical fatigue (odds ratio [OR] = 4.50), appetite loss (OR = 7.80), poor sleep quality (OR = 3.48), good compliance with restrictions on going out (OR = 3.30), and poor exercise (OR = 2.61).**Discussion:** Due to the influence of COVID-19, worsening depression has increased significantly among community-dwelling older adults. The frequency of exercise at home during restrictions on social participation due to the COVID-19 epidemic was associated with depression among Japanese community-dwelling older adults.

Copyright © 2023, Taiwan Society of Geriatric Emergency & Critical Care Medicine.

1. Introduction

Frailty prevention programs targeting community-dwelling older adults have been implemented in Japan.¹ The basic strategy for frailty prevention involves the establishment of sociality through group activities to prevent social isolation and resistance training conducted in public halls as voluntary activities to prevent physical frailty.¹ However, due to the COVID-19 epidemic, from around February 2020, local governments in Japan issued an order to halt this frailty prevention strategy temporarily because it involved gatherings in public halls by older people. This was based on advice from several academic societies indicating that the mortality of COVID-19 was very high in older adults.² For example, the Japan Geriatrics Society recommended thorough prevention measures for COVID-19 as well as adequate nutrition, good sleep, simple exercises at home, and the use of telephone-based communications to prevent the progress of frailty and social isolation among community-dwelling older adults during the postponement of voluntary activities at public halls. During the COVID-19 epidemic, participation in community activities (including the frailty prevention program) would be restrained; thus, declines in the mental/physical condition of older adults due to both decreased physical activity and excessive fear of infection became a secondary concern.² The concept of frailty is considered to include not only social and physical, but also psychological

frailty.³ Psychological frailty is typically thought to indicate mental health conditions such as depression.³ COVID-19 could trigger psychological frailty, leading to decreases in all aspects of frailty aspects due to the distress associated with the modifications in behavior related to COVID-19.

Based on the result of an online survey, Yamada et al.² reported that physical activity among Japanese older persons aged ≥ 65 years decreased by about 60 minutes per week during the 3-month period from January 2020 to April 2020, suggesting an increased risk of frailty progression. However, they targeted older adults in urban areas who were proficient Internet users; these participants are not considered to reflect the general characteristics of older adults who tend to participate in frailty prevention programs. In addition, since immediate behavioral changes are required to prevent COVID-19 infection, there are concerns about their impact on the mental health of older people.⁴ Furthermore, older adults, who have a high COVID-19 mortality rate, may be particularly fearful of contracting the disease.⁵ However, to the best of our knowledge, the effects of psychological frailty due to COVID-19, such as depression, on community-dwelling older adults has not been investigated. Some studies have recommended simple exercises at home during the COVID-19 epidemic to maintain physical health.⁶ We hypothesized that conducting simple exercises would also help mitigate depressive symptoms during restrictions on social participation. With this background, the purpose of this study was to investigate the associations between the exacerbation of depression and exercise frequency at home among community-dwelling older people under restrictions on so-

* Corresponding author. Department of Nursing, Nagasaki University Graduate School of Biomedical Sciences, 1-7-1 Sakamoto, Nagasaki 852-8520, Japan.

E-mail address: honda@nagasaki-u.ac.jp (S. Honda)

cial participation due to the COVID-19 epidemic.

2. Materials and methods

2.1. Procedures and participants

A cross-sectional study was conducted in a rural area of Sasebo City, Nagasaki Prefecture, Japan. Since the number of people infected with COVID-19 was relatively low in Nagasaki Prefecture, the state of emergency issued on April 16 was lifted on May 6. In Sasebo City, self-restrictions on participation in social activities among community-dwelling older adults went into effect to implement a frailty prevention program on February 27, 2020 and were lifted on June 15, 2020. Therefore, the study period was from July 15 to August 19, 2020.

The study participants were consecutively recruited from among community-dwelling older adults aged ≥ 65 years who had participated in a frailty prevention program at a public hall. The inclusion criterion was the absence of confirmed or suspected COVID-19. The exclusion criterion was age < 65 years. The conditions for older adults to participate in the program were as follows: 1) no fever as measured by a thermometer; 2) no cold symptoms (e.g., coughing, sneezing); 3) no travel outside of the prefecture for the previous 2 weeks; and 4) no contact with family or relatives in the COVID-19 epidemic area for the previous 2 weeks. To prevent COVID-19 infection, the usage conditions of the public hall were as follows: 1) open opposing windows to maintain good ventilation; 2) regularly disinfect common items such as doorknobs and chairs with alcohol; 3) require all individuals entering the room to wear a face mask; 4) provide alcohol-based hand sanitizers at the entrance of the public hall; 5) require all individuals to maintain a distance of about 2 m; and 6) require all individuals to not talk in a loud voice.

We enrolled 157 study candidates at 19 public halls, among whom, six declined to participate and 24 with missing values were excluded from the analysis. We therefore analyzed 127 participants (17 men, 110 women; mean age, 77 years) in this study.

This study was approved by the ethics committee of Nagasaki University Graduate School of Biomedical Sciences. Informed consent was obtained from all participants before the study began.

2.2. Measurements

We collected data on basic attributes (e.g., sex, age, height, weight, family structure, physical frailty status) and responses to our original COVID-19 questionnaire.

Age was divided into two categories: 65–74 years (young-old) and ≥ 75 years (old-old). Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared, with 18.5 kg/m^2 used as the cutoff value. Family structure was defined as whether participants were living alone or with others.

2.3. Frailty status

Physical frailty phenotypes were evaluated based on the Cardiovascular Health Study (CHS) criteria, as reported by Fried et al.,⁷ and consisted of the following five domains: slowness, weakness, exhaustion, low activity, and weight loss. In the present study, we adopted the Japanese version of the CHS criteria based on a previous study.¹ One point was assigned for the presence of each of the five domains, and the participants were categorized as follows according to total points based on the CHS phenotype model: frail (3–5 points), pre-frail (1–2 points), and robust (0 points). Anthropometric data

such as hand grip (weakness) and walking speed (slowness) were measured by a public health nurse or physical therapist. The grip dynamometer (Tsutsumi Co., Ltd, Tokyo, Japan) used to measure grip strength was sterilized with alcohol after each use.

2.4. Original COVID-19 questionnaire

An original questionnaire (Supplementary Materials) composed of the following 11 question items was developed: Q1) sources of information about COVID-19; Q2) restrictions on going out; Q3) maintaining physical distance; Q4) wearing face masks when going out; Q5) frequency of handwashing; Q6) degree of change in depression; Q7) degree of change in physical fatigue; Q8) degree of change in appetite; Q9) degree of change in sleep quality; Q10) frequency of exercise at home, and Q11) frequency of telephone communication.

2.5. Statistical analysis

The participants' basic attributes, including age, sex, BMI, family structure, and frailty status, were reported as number and percentage. Similarly, levels of behavioral change for COVID-19, degree of change in mental/physical condition, frequency of exercise at home, and frequency of telephone communication were also expressed as number and percentage.

From among the question items on the original COVID-19 questionnaire, the response to Q6 were divided into "worsening" and "invariant" depression groups as the main outcome. The worsening depression group was defined as those who answered, "Remarkable decline" and "Slight decline", while the invariant depression group was defined as those who answered, "No change" and "Improved". Responses to the other mental/physical conditions (i.e., physical fatigue, sleep quality, and appetite) were also divided into two groups.

To compare the worsening and invariant depression groups, we examined the associations between basic attributes, level of behavioral changes, other mental/physical conditions (i.e., physical fatigue, appetite, and sleep quality), frequency of home exercise, and frequency of telephone communication using the chi-squared or Cochran-Armitage test. Furthermore, a multiple logistic regression model (Supplementary Materials) was used to determine factors affecting the worsening depression group. Adjusted odds ratios (ORs) and 95% confidence intervals (CIs) were calculated for each covariate in the final model to estimate the associations between changes in depression using the covariates as independent variables.

All statistical analyses were performed using SPSS software (version 23.0; IBM, Tokyo, Japan).

3. Results

Regarding the characteristics of the study participants, women accounted for about 87% and older individuals (age ≥ 75 years) for about 60%. Television was the most popular source of information about COVID-19 for 125 individuals (98.4%), whereas the Internet was the least popular source, reported by only 12 individuals (9.4%).

Supplementary Table 1 shows the changes in mental/physical condition during the restrictions on participating in voluntary circle activities for frailty prevention. The total numbers (percent) of older adults answering "Remarkable decline" for depression, physical fatigue, appetite, and sleep quality were nine (7.1%), 24 (18.9%), and 4 (3.1%), respectively. The total numbers (percent) of older adults answering "Remarkable decline" or "Slight decline" for depression was 51 (40.2%).

Regarding the time during the restrictions on participating in voluntary circle activities for frailty prevention, 31 (24.4%) and 25 (19.7%) older adults engaged in exercise at home “Almost every day” and “3–4 times a week”, whereas 47 (37.0%) and 24 (18.9%) engaged in exercise at home “1–2 times a week” or “Not at all”, respectively. Regarding behavioral changes against COVID-19 infection, 27 (21.3%) and 73 (57.5%) older adults responded that their changes were remarkable or slight in terms of restrictions on going out.

Tables 1 and 2 show the results of the comparison between the worsening and invariant depression groups for all factors, including basic attributes, physical/mental condition, behavioral changes to comply with infection control measures, frequency of exercise at home, and frequency of telephone communication. Increases in physical fatigue and appetite loss and decreases in sleep quality were significantly associated with worsening depression (all $p < 0.001$). In addition, the worsening depression group tended to report significantly higher compliance with the restrictions on going out, wearing a face mask, and handwashing than the invariant group ($p = 0.003$, $p = 0.034$, and $p = 0.017$, respectively). Moreover, compared with the invariant group, the worsening depression group reported exercising significantly less frequently at home during the restrictions on participating in voluntary circle activities ($p = 0.036$). However, no significant associations were found between worsening depression and basic attributes, maintaining physical distance, or frequency of telephone communication.

Furthermore, the results of the multivariate regression analysis showed that worsening depression was independently associated with physical fatigue (OR = 4.50; 95% CI = 1.62–12.46), appetite (OR = 7.80; 95% CI = 1.80–33.77), sleep quality (OR = 3.48; 95% CI = 1.17–10.42), good compliance with restrictions on going out (OR =

3.30; 95% CI = 0.89–12.24), and low levels of exercise (OR = 2.61; 95% CI = 0.97–7.00) (Table 3).

4. Discussion

Balancing measures to control the spread of COVID-19 and prevent frailty, especially psychological frailty as a first step, is an urgent issue for community-dwelling older adults. Our study investigated 127 community-dwelling older adults aged ≥ 65 years with the hypothesis that increasing the frequency of exercise at home during the period of restricted social activities due to COVID-19 measures would help prevent the exacerbation of depression. Our results supported the hypothesis that increasing the frequency of exercise at home during the periods of restricted social activities could reduce depression among community-dwelling older adults.

Regarding mental health, the results of this study showed approximately a 40% decrease in depression, as well as decreases of 58%, 28%, and 20% in physical fatigue, sleep quality, and appetite loss, respectively. In addition, worsening depression was significantly associated with the other three conditions. Although these values do not represent the current prevalence of mental/physical conditions, the deterioration rate appears to be rapid and substantial in the short term. News on severe COVID-19 cases and deaths in many European countries and the United States was also reported in Japan. Although the number of infections in Japan is much lower than those in above countries, COVID-19 continues to spread regionally and remains difficult to control.⁸ Moreover, the COVID-19 epidemic was ongoing on July 19, 2020, at the end of the survey period. Daily television coverage of negative news is a cause of long-term stress exposure, which is thought to affect the exacerbation rate of depression.

Table 1

Associations of basic attributes and changes in mental/physical health conditions with depression in community-dwelling older adults.

Variables	Depression						p
	Total (n = 127)		Invariant group (n = 76)		Worsening group (n = 51)		
	n	%	n	%	n	%	
Basic attributes							
Sex							0.133 ^a
Male	17	13.4	13	17.1	4	7.8	
Female	110	86.6	63	82.9	47	92.2	
Age, years							0.733 ^a
65–74 (young-old)	50	39.4	29	38.2	21	41.2	
≥ 75 (old-old)	77	60.6	47	61.8	30	58.8	
Family structure							0.099 ^a
Living together	83	65.4	54	71.1	29	56.9	
Living alone	44	34.6	22	28.9	22	43.1	
BMI, kg/m ²							0.992 ^a
≥ 18.5	117	92.1	70	92.1	47	92.2	
< 18.5	10	7.9	6	7.9	4	7.8	
Frailty status							0.437 ^b
Robust	54	42.5	35	46.1	19	37.3	
Pre-frail	63	49.6	35	46.1	28	54.9	
Frail	10	7.9	6	7.9	4	7.8	
Changes in mental/physical condition							
Physical fatigue							$< 0.001^a$
Invariant group	54	42.5	47	61.8	7	13.7	
Worsening group	73	57.5	29	38.2	44	86.3	
Appetite							$< 0.001^a$
Invariant group	102	80.3	73	96.1	29	56.9	
Worsening group	25	19.7	3	3.9	22	43.1	
Sleep quality							$< 0.001^a$
Invariant group	91	71.7	67	88.2	24	47.1	
Worsening group	36	28.3	9	11.8	27	52.9	

^a: chi-squared test. ^b: Cochran-Armitage test.

BMI: body mass index.

Table 2
Associations of COVID-19 infection control adherence and healthy behaviors at home with depression in community-dwelling older adults.

Variables	Depression						p
	Total (n = 127)		Invariant group (n = 76)		Worsening group (n = 51)		
	n	%	n	%	n	%	
COVID-19 infection control adherence							
Going out restrictions							0.001 ^b
Remarkably reduced	27	21.3	9	11.8	18	35.3	
Slightly reduced	73	57.5	46	60.5	27	52.9	
No change	25	19.7	19	25.0	6	11.8	
Increased	2	1.6	2	2.6	0	0	
Physical distancing							0.504 ^b
Always maintain a good distance	20	15.7	11	14.5	9	17.6	
Almost always maintain a good distance	85	66.9	51	67.1	34	66.7	
No change	21	16.5	13	17.1	8	15.7	
Shorter distance	1	0.8	1	1.3	0	0	
Wearing a face mask							0.034 ^b
Always	104	81.9	58	76.3	46	90.2	
Almost always	20	15.7	15	19.7	5	9.8	
Not very often	2	1.6	2	2.6	0	0	
Never	1	0.8	1	1.3	0	0	
Handwashing							0.017 ^b
Remarkably increased	77	60.6	39	51.3	38	74.5	
Slightly increased	43	33.9	32	42.1	11	21.6	
No change	7	5.5	5	6.6	2	3.9	
Reduced	0	0	0	0	0	0	
Healthy behaviors at home during restrictions on social participation							
Frequency of exercise at home							0.036 ^b
Almost every day	31	24.4	25	32.9	6	11.8	
3–4 times a week	25	19.7	13	17.1	12	23.5	
1–2 times a week	47	37.0	25	32.9	22	43.1	
Never	24	18.9	13	17.1	11	21.6	
Frequency of telephone communication							0.332 ^b
Almost every day	22	17.3	14	18.4	8	15.7	
More than once a week	31	24.4	15	19.7	16	31.4	
2–3 times a month	59	46.5	35	46.1	24	47.1	
Never	15	11.8	12	15.8	3	5.9	

^b Cochran-Armitage test.

Table 3
Independent predictors of worsening depression due to the coronavirus disease 2019 (COVID-19) epidemic among community-dwelling older adults.

Variable		OR	95% CI	p
Physical fatigue	Worsening group	4.50	1.62–12.46	0.004
Appetite	Worsening group	7.80	1.80–33.77	0.006
Sleep quality	Worsening group	3.48	1.17–10.42	0.026
Restrictions on going out	Good compliance group	3.30	0.89–12.24	0.075
Home exercise frequency	Poor exercise group	2.61	0.97–7.00	0.057

CI: confidence interval, OR: odds ratio.

Therefore, another concern is that COVID-19-related psychological burdens, such as worsening depression in older people, may lead to physical frailty. In particular, restrictions on going out and social participation are considered to increase the risk of developing depression. Previous studies have pointed out that the onset of frailty in older adults may be triggered by social and psychological aspects, such as loneliness and depression.⁹ In the present cross-sectional survey, no association was found between worsening depression and physical frailty status; however, worsening physical fatigue was reported by as many as 58% of the older adults, and if restrictions on going out continue as a preventive measure against COVID-19 infection, the amount of physical activity can be expected to decrease and the degree of physical frailty can be expected to increase in the near future.

In this study, increases were observed in four types of adherence measures against COVID-19 infection. However, the results

showed that more compliance in adhering to COVID-19 measures, except for physical distancing, led to worse depressive symptoms. Implementing restrictions on going out is considered to be an excellent measure against community spread during an epidemic, but this policy is in conflict with the prevention of frailty because of the frequent social participation among community-dwelling older adults. Surprisingly, our results revealed that nearly 20% of older adults who had been engaging in resistance training for 30 minutes a week before the epidemic stopped exercising at home during the study period. Furthermore, the results of the multivariate logistic regression model indicated that exercising at home more than 3–4 times per week ameliorated worsening depression during the restrictions on social participation among community-dwelling older adults. These findings suggest that increasing the frequency of exercising at home during the COVID-19 epidemic would be an effective frailty prevention measure.

Despite the fear and panic caused by COVID-19, previous studies have suggested that people should strive to prevent infection through utilizing sufficient knowledge, attitudes, and practices.¹⁰ Therefore, to promote appropriate behavioral modifications among community-dwelling older adults during the COVID-19 epidemic, a program that can mitigate mental health problems and provide new, evidence-based information about COVID-19 is needed. Previous studies have reported that exercise provides many benefits for older adults, including the prevention of depression, improved sleep quality, increased appetite, and enhanced immunity.^{11–13} In the near future, it will be important to learn and practice behavioral modifications and proper strategies for COVID-19 infection prevention, as well as to gain an adequate understanding of the benefits of exercise at home among older people. To encourage older people to modify their lifestyle, public health nurses and physical therapists should design exercise programs that can be practiced at home and disseminate these widely; this would provide balance between COVID-19 infection control and frailty countermeasures.

4.1. Limitations

This study had some limitations. First, since this was a cross-sectional study, no causal relationships could be identified. Second, this study did not use random sampling and had only a small sample size. A continuous survey was conducted after the restrictions on social activities were lifted, but the possibility of a selection bias cannot be ruled out. However, the characteristics of the participants in this study were similar to those of participants in studies on frailty prevention in Japan,^{1,14} so we considered them acceptable to some extent in terms of being representative of participants in frailty prevention programs in Japan. Third, an original questionnaire survey was used to measure the degree of worsening depression; therefore, it will be necessary to conduct questionnaire survey, such as the 15-item Geriatric Depression Scale,³ to confirm the reliability and validity of our results. Fourth, this study did not include an investigation of the previous psychiatric history, such as mood disorder. These are potentially confounding factors and therefore our findings should be interpreted with caution. Finally, the question item on the frequency of exercise at home in this study did not ask about the type or duration of exercise. In the future, it would be desirable to clarify these issues. In the future, if the COVID-19 epidemic continues, it will be necessary to plan a randomized controlled trial (RCT) with a large sample size and to include a history of mental illness and other possible confounding factors.

5. Conclusion

In conclusion, approximately 40% of the community-dwelling older adults in this study perceived experiencing worsening depressive symptoms during restrictions on participating in voluntary circle activities for about 3.5 months. In addition, worsening depression was associated with changes in mental/physical condition, such as physical fatigue, appetite, and sleep quality, as well as compliance with restrictions on going out as a behavioral modification against COVID-19 measures. The frequency of exercise at home was also associated with depression. In the future, if restrictions on social participation are again requested because of regional COVID-19 outbreaks, immediate mental health interventions, including those to prevent depression, could be necessary.

Acknowledgments

We are grateful to all the participants for their valuable contributions to this study. We would also like to thank Mr. Jun Nozoe from the Sasebo Municipal Office for support with the data collection.

Conflicts of interest

The authors have no conflicts of interest to declare.

Supplementary materials

Supplementary materials for this article can be found at <http://www.sgecm.org.tw/ijge/journal/view.asp?id=26>.

References

- Makizako H, Shimada H, Doi T, Tsutsumimoto K, Suzuki T. Impact of physical frailty on disability in community-dwelling older adults: A prospective cohort study. *BMJ Open*. 2015;5(9):e008462. doi:10.1136/bmjopen-2015-008462
- Yamada M, Kimura Y, Ishiyama D, et al. Effect of the COVID-19 epidemic on physical activity in community-dwelling older adults in Japan: A cross-sectional online survey. *J Nutr Health Aging*. 2020;24(9):948–950. doi:10.1007/s12603-020-1424-2
- Nishida T, Nakao R, Nishihara M, Kawasaki R, Honda A, Honda S. The relationship between mindfulness and depression in community-dwelling frail elderly. *Int J Gerontol*. 2019;13(4):273–277. doi:10.6890/IJGE.201912_13(4).0002
- Zhang W, Yang X, Zhao J, et al. Depression and psychological-behavioral responses among the general public in China during the early stages of the COVID-19 pandemic: survey study. *J Med Internet Res*. 2020;22(9):e22227. doi:10.2196/22227
- Woolford SJ, D'Angelo S, Curtis EM, et al. COVID-19 and associations with frailty and multimorbidity: a prospective analysis of UK Biobank participants. *Aging Clin Exp Res*. 2020;32(9):1897–1905. doi:10.1007/s40520-020-01653-6
- Jiménez-Pavón D, Carbonell-Baeza A, Lavie CJ. Physical exercise as therapy to fight against the mental and physical consequences of COVID-19 quarantine: Special focus in older people. *Prog Cardiovasc Dis*. 2020;63(3):386–388. doi:10.1016/j.pcad.2020.03.009
- Xue QL, Bandeen-Roche K, Varadhan R, Zhou J, Fried LP. Initial manifestations of frailty criteria and the development of frailty phenotype in the women's health and aging study II. *J Gerontol A Biol Sci Med Sci*. 2008;63(9):984–990. doi:10.1093/gerona/63.9.984
- Shimizu K, Wharton G, Sakamoto H, Mossialos E. Resurgence of COVID-19 in Japan. *BMJ*. 2020;370:m3221. doi:10.1136/bmj.m3221
- Zhang W, Yang X, Zhao J, et al. Depression and psychological-behavioral responses among the general public in China during the early stages of the COVID-19 pandemic: survey study. *J Med Internet Res*. 2020;22(9):e22227. doi:10.2196/22227
- Puspitasari IM, Yusuf L, Sinuraya RK, Abdulrah R, Koyama H. Knowledge, attitude, and practice during the COVID-19 pandemic: A review. *J Multidiscip Healthc*. 2020;13:727–733. doi:10.2147/JMDH.S265527
- Schuch FB, Vancampfort D, Rosenbaum S, et al. Exercise for depression in older adults: a meta-analysis of randomized controlled trials adjusting for publication bias. *Braz J Psychiatry*. 2016;38(3):247–254. doi:10.1590/1516-4446-2016-1915
- Witard OC, McGlory C, Hamilton DL, Phillips SM. Growing older with health and vitality: a nexus of physical activity, exercise and nutrition. *Biogerontology*. 2016;17(3):529–546. doi:10.1007/s10522-016-9637-9
- Simpson RJ, Kunz H, Agha N, Graff R. Exercise and the regulation of immune functions. *Prog Mol Biol Transl Sci*. 2015;135:355–380. doi:10.1016/bs.pmbts.2015.08.001
- Takeuchi K, Aida J, Ito K, Furuta M, Yamashita Y, Osaka K. Nutritional status and dysphagia risk among community-dwelling frail older adults. *J Nutr Health Aging*. 2014;18(4):352–357. doi:10.1007/s12603-014-0025-3