The Journal of Physical Therapy Science

S P T S

Original Article

Malnutrition is associated with depression in Japanese older adults requiring long-term care or support

Ryo Sato, RPT, MS[1]*, Yohei Sawaya, RPT, PhD[2], Takahiro Shiba, RPT, MS[3],
Tamaki Hirose, RPT, MS[2], Minami Sato, RPT, MS[1], Masahiro Ishizaka, RPT, PhD[1]

[1] Division of Physical Therapy, Master Program in Health Sciences, Graduate School of Health and
    Welfare Sciences, International University of Health and Welfare: 2600-1 Kitakanemaru, Otawara
    City, Tochigi 324-8501, Japan
[2] Department of Physical Therapy, School of Health Science, International University of Health and
    Welfare, Japan
[3] Nishinasuno General Home Care Center, Department of Day Rehabilitation, Care Facility for the
    Elderly "Maronie-en", Japan

Abstract. [Purpose] To characterize depression related to nutritional status in older adults requiring long-term care. [Participants and Methods] One hundred and six individuals (66 males and 40 females) over the age of 65 who required support level 1/2 or care level 1 and were receiving day care through the long-term care insurance (LTCI) system, were enrolled. The survey items included basic attributes, comorbidities, previous medical history, requiring support/care under Japan's LTCI system, the Mini Nutritional Assessment–Short Form, the Geriatric Depression Scale 15 (GDS-15), and body mass index (BMI). The factors associated with malnutrition/risk of malnutrition were evaluated. In addition, the relationship between nutritional status and the GDS-15 items was evaluated. [Results] Depression, LTCI, BMI, and gender were identified as related factors for malnutrition/risk of malnutrition. Compared with the favorable nutritional status group, the malnutrition/risk of malnutrition group reported GDS-15 items such as "Dropped activities and interests", "Feel that life is empty", "In good spirits most of the time (reversed)", "Afraid of something bad", "Prefer to stay at home", and "Feel full of energy (reversed)". [Conclusion] The results show certain parameters characteristic of depression in Japanese older adults with malnutrition requiring long-term care/support. These data will help guide future research and interventions.
Key words: Requiring long-term care, Malnutrition, Depression

(This article was submitted Mar. 27, 2021, and was accepted May 13, 2021)

INTRODUCTION

Older adults are known to have a high rate of undernutrition[1], and the relationship between nutritional status and frailty[2] is being investigated. Fried et al undernutrition as the core problem leading to frailty in the frailty cycle[3]. Common conditions in older patients, such as stroke[4], orthopedic diseases[5], cancer[6], cardiovascular/respiratory diseases[7], and intractable neurological diseases[8], are often accompanied by malnutrition. Undernutrition makes rehabilitation efforts more difficult[9]; therefore, it is essential to understand the condition and characteristics of the nutritional status in older adults who require long-term care or attend a daycare facility.

Previous reports have suggested that malnutrition is associated with depression in older adults[10–13]. The Geriatric Depression Scale 15 (GDS-15), which is internationally widely used to assess depression, has been reported to be correlated

with the risk of needing care[14]. The GDS-15 evaluates depression by a total score derived from 15 questions. Regarding the relationship between malnutrition and depression, the relationship between malnutrition and a higher total score on the GDS-15 has been reported, but the relationship between malnutrition and the specific question items on the GDS-15 has not been reported. Therefore, this study examined the factors of malnutrition in older adults requiring mild long-term care and the characteristics of depression associated with malnutrition. Given this, clarifying the characteristics of depression in older people who are undernourished and have a need for long-term care, could help us better understand these relationship and ultimately promote better health and care outcomes.

PARTICIPANTS AND METHODS

One-hundred and six community-dwelling individuals (66 males and 40 females) over the age of 65, who required support/care under Japan's long-term care insurance system (LTCI)[15] (support level 1, level 2, or care level 1) and were receiving day care through the LTCI, were enrolled. Exclusion criteria were as follows: 1) aphasia or people who found the test instructions difficult to understand, 2) individuals diagnosed with dementia, and 3) individuals under the age of 65. During the program, all participants were provided with sufficient information about the purpose and experimental procedures and gave their consent to participate. This study was approved by the International University of Health and Welfare Ethics Review Board (approval number 17-IO-189-7). Information related to basic patient demographics included the participants' age, whether they required support/care under Japan's LTCI system, the presence of any comorbidities, and previous medical history (obtained from our medical records). Height was calculated as described in the methods by Kubo et al.[16], and body mass index (BMI) was calculated based on body weight.

The evaluation items were detailed in the GDS-15 and Mini Nutritional Assessment-Short Form (MNA-SF). The nutritional status was evaluated using the MNA-SF, a questionnaire survey recommended for diagnosing malnutrition among older adult patients. MNA-SF has a total score ranging from 0 to 14 points. Malnutrition/risk of malnutrition was indicated by a score of ≤11, and favorable nutritional status was indicated by a score of 12–14. The participants in this study were classified into two groups: the malnutrition/risk of malnutrition group and the favorable nutritional status group.

The reliability and validity of the MNA-SF have been confirmed in Japan. The sensitivity of the malnutrition test (albumin 3.5 g/L or less) is 0.810 and its specificity is 0.834[17].

GDS-15 was used to evaluate depression by making a printed copy of the questions and asking the participants to answer "yes" or "no" through an interview. Individuals are diagnosed with "no depression" if they had a GDS-15 score of less than five points, are classified as having a tendency for depression if they scored five points or more, and in a depressed state when the score was ten points or more.

The Mann-Whitney test, unpaired t-test, and χ^2 test were performed to test each index between the two groups. In order to clarify which factors related to malnutrition/risk of malnutrition, nutritional status (favorable nutritional status=0, undernutrition/malnutrition or risk of malnutrition=1) was used as the dependent variable, while gender (male=0, female=1), age, LTCI, BMI, GDS-15, osteoporosis (None=0; Yes=1), cerebrovascular disease (None=0; Yes=1), respiratory disease (None=0; Yes=1), cardiovascular disease (None=0; Yes=1), cancer disease (None=0; Yes=1), hypertension (None=0; Yes=1), diabetes (None=0; Yes=1), orthopedic disease (None=0; Yes=1), and intractable neurological disease (None=0; Yes=1) were set as independent variables. Binomial logistic regression analyses (variable increase method) was then performed. SPSS Statistics version 25 (IBM Corp., Armonk, NY, USA) was used for all statistical analyses, and the significance level was set to p<0.05. In addition, a Chi-squared test was performed in both groups to validate the GDS-15 questionnaire items.

RESULTS

Malnutrition or risk of malnutrition was observed in 27 (40.9%) male and in 24 (60.0%) females. Table 1 shows the basic patient demographics. In the malnutrition/risk of malnutrition group, age, care level, and GDS-15 were significantly higher than those in the favorable nutritional status group. Additionally, BMI was significantly lower in the malnutrition/risk of malnutrition group.

Binomial logistic regression analysis was performed to extract factors related to malnutrition/risk of malnutrition: factors for undernutrition and undernutrition risk included GDS-15 score (odds ratio=1.21, 95% CI=1.06–1.38), LTCI (odds ratio=2.05, 95% CI=1.24–3.38), BMI (odds ratio=0.81, 95% CI=0.70–0.94), and gender (odds ratio=2.90, 95% CI=1.11–7.55) (Table 2). GDS-15 was selected as a variable in all models. In addition, the Hosmer-Lemeshow test was employed to examine the goodness of fit in the logistic regression model. As a result, the significance probability was p>0.05, and this model was deemed valid.

We compared the GDS-15 items between the two groups. Significant differences were found in the following items: "Have you dropped many of your activities and interests?" "Do you feel that your life is empty?", "Are you in good spirits most of the time?", "Are you afraid that something bad is going to happen to you?", "Do you prefer to stay at home, rather than going out and doing new things?", "Do you feel full of energy?" (Table 3).

J. Phys. Ther. Sci. Vol. 33, No. 8, 2021

586

Table 1. Participant characteristics by nutrition state

		Malnutrition/ risk of malnutrition group (n=51)	Favorable nutritional status group (n=55)	p-value
Gender	Male (%)	27 (52.9)	39 (70.9)	
	Female (%)	24 (47.1)	16 (29.1)	
Age (years)		80.2 ± 7.3	77.3 ± 6.8	*
BMI (kg/m²)		21.0 ± 3.5	23.0 ± 3.0	*
LTCI	Support level 1 (%)	12 (23.5)	26 (47.3)	†
	Support level 2 (%)	8 (15.7)	9 (16.4)	
	Care level 1 (%)	31 (60.8)	20 (36.4)	
GDS-15 (score)		6.9 ± 3.9	4.6 ± 3.2	†
Comorbidities and/or past history	Osteoporosis (%)	5 (9.8)	3 (5.5)	
	Cerebrovascular disease (%)	27 (52.9)	31 (56.4)	
	Respiratory disease (%)	12 (23.5)	7 (12.7)	
	Cardiovascular disease (%)	17 (33.3)	11 (20.0)	
	Hypertension (%)	17 (33.3)	28 (50.9)	
	Cancer disease (%)	14 (27.5)	12 (21.8)	
	Diabetes (%)	12 (23.5)	13 (23.6)	
	Orthopedic disease (%)	34 (66.6)	27 (49.1)	
	Intractable neurological disease (%)	10 (19.6)	6 (10.9)	

*Unpaired t-test, p<0.05.
†Mann-Whitney test, p<0.05.
Mean ± SD.

Table 2. Factors associated with low nutrition and low nutritional risk

	Model I		Model II		Model III		Model IV	
	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI
GDS-15	1.20	1.07–1.35	1.22	1.08–1.38	1.21	1.07–1.37	1.21	1.06–1.38
LTCI			1.96	1.22–3.14	1.95	1.20–3.17	2.05	1.24–3.38
BMI					0.82	0.72–0.95	0.81	0.70–0.94
Gender							2.90	1.11–7.55

OR: Odds ratio; CI: Confidence interval.
Model χ^2 test p<0.05, Hosmer-Lemeshow test p>0.05.
Dependent variable: Nutritional status (favorable nutritional status: 0 malnutrition/ risk of malnutrition: 1).

DISCUSSION

This study examined the factors of malnutrition in older adults with mild long-term care and the characteristics of depression that were associated with malnutrition. It is reported that 31.3%[18] of older adults living independently are at risk of malnutrition. Additionally, a study of older adults requiring long-term care at home reported that 50.8% of the participants were at risk of malnutrition[19]. In this study, the proportion of those with malnutrition/risk of malnutrition was 48.1%. Therefore, older adults in need of long-term care may have a higher rate of malnutrition/risk of malnutrition than older adults who are independent.

GDS-15 score, LTCI, BMI, and gender were related to the risk of malnutrition based on the results of the binomial logistic regression analyses used to extract factors related to malnutrition/risk of malnutrition. In this study, 40.9% were male and 60.0% were female, and the rate of malnutrition/risk of malnutrition was higher in women. Castel H et al.[20] reported a higher risk of malnutrition in older women than that observed in older men. Bates CJ[21] reported gender differences in food choices, energy and nutrient intake, and nutritional blood status index in older adults. Therefore, it was suggested that there might be gender differences in nutritional status, even in older adults who require long-term care. Participants with a higher degree of care than that seen in previous studies reported lower Activities of Daily Living (ADL), and the higher the LTCI, the lower the nutritional status[22]. BMI has also been reported to be associated with malnutrition risk[23]. Therefore, BMI has been In

Table 3. Comparison of GDS-15 items in nutritional status

		Malnutrition/ risk of malnutrition group		Favorable nutritional status group		p-value
		n (%)		n (%)		
1) Are you basically satisfied with your life?	yes (n=35)	21	(41.2)	14	(25.5)	
	no (n=71)	30	(58.8)	41	(74.5)	
2) Have you dropped many of your activities and interests?	yes (n=42)	29	(56.9)	13	(23.6)	‡
	no (n=64)	22	(43.1)	42	(76.4)	
3) Do you feel that your life is empty?	yes (n=34)	23	(45.1)	11	(20)	‡
	no (n=72)	28	(54.9)	44	(80)	
4) Do you often get bored?	yes (n=30)	17	(66.7)	13	(23.6)	
	no (n=76)	34	(33.4)	42	(76.4)	
5) Are you in good spirits most of the time?	yes (n=20)	15	(29.4)	5	(9.1)	‡
	no (n=86)	36	(70.6)	50	(90.9)	
6) Are you afraid that something bad is going to happen to you?	yes (n=43)	27	(52.9)	16	(29.1)	‡
	no (n=63)	24	(47.1)	39	(70.9)	
7) Do you feel happy most of the time?	yes (n=24)	13	(25.5)	11	(20)	
	no (n=82)	38	(74.5)	44	(80)	
8) Do you often feel helpless?	yes (n=63)	32	(62.7)	31	(56.4)	
	no (n=43)	19	(37.3)	24	(43.6)	
9) Do you prefer to stay at home, rather than going out and doing new things?	yes (n=50)	31	(60.8)	19	(34.5)	‡
	no (n=56)	20	(39.2)	36	(65.5)	
10) Do you feel you have more problems with memory than most?	yes (n=36)	18	(35.3)	18	(32.7)	
	no (n=70)	33	(64.7)	37	(67.3)	
11) Do you think it is wonderful to be alive now?	yes (n=40)	22	(43.1)	18	(32.7)	
	no (n=66)	29	(56.9)	37	(67.3)	
12) Do you feel pretty worthless the way you are now?	yes (n=42)	24	(47.1)	18	(32.7)	
	no (n=64)	27	(52.9)	37	(67.3)	
13) Do you feel full of energy?	yes (n=74)	41	(80.4)	33	(60.0)	‡
	no (n=32)	10	(19.6)	22	(40.0)	
14) Do you feel that your situation is hopeless?	yes (n=41)	21	(41.2)	20	(36.4)	
	no (n=65)	30	(58.8)	35	(63.6)	
15) Do you think that most people are better off than you are?	yes (n=35)	20	(39.2)	15	(27.3)	
	no (n=71)	31	(60.8)	40	(72.7)	

‡χ^2 test p<0.05: GDS-15 item.

this study, depression was selected in all models examining factors related to malnutrition/risk of malnutrition. Previous studies have shown that depression can lead to changes in appetite and weight resulting in malnutrition, and malnutrition predispositions older individuals to upset mental illness (depression, agitation, irritability)[24]. In addition, depression in elderly people requiring nursing care is associated with sarcopenia[25], and since sarcopenia and malnutrition are strongly related[26], sarcopenia may be indirectly related to the relationship between malnutrition and depression in Japanese older adults requiring long-term care or support.

We compared the GDS-15 items in the malnutrition/risk of malnutrition group and the favorable nutritional status groups. It was suggested that "Dropped activities and interests", "Feel that life is empty", "In good spirits most of the time (reversed)", "Afraid of something bad", "Prefer to stay at home", and "Feel full of energy (reversed)" may be indicators of depression in undernourished older adults. Compared to other GDS-15 results from previous research, there are reproducible factors such as factor I: "energy loss and pessimistic outlook"; factor II: "positive mental status (reversed)"; and factor III: "empty feeling"[27]. The related GDS-15 items in this study corresponded to these three factors.

The participants of this study were found to be associated with nutrition and depression, and those with malnutrition may exemplify the depressive items observed objectively. These questions may help screen nutritional status, and nutritional status may need to be noted, if applicable.

A limitation of this study is that a variable increase method was used as opposed to the forced input method. This was

J. Phys. Ther. Sci. Vol. 33, No. 8, 2021

588

because the number of independent variables the participants was too large to be used in binomial logistic regression analysis. Since this was a cross-sectional survey, it makes it challenging to examine a causal relationship. Since nutrients such as folic acid[28] and vitamin[29] have been reportedly associated with depression, it would be ideal to measure nutrients at the same time. In addition, this study does not fully explain the meaning of each item; therefore, further research is needed using more variables. In the future, it will be necessary to reexamine the relationship between nutritional status and depressive characteristics, including dietary intake and nutrients. Further it would be necessary to follow the participants longitudinally and examine the causal relationship between depression and nutritional status.

Funding
None.

Conflict of interest
The author declares no conflict of interest.

REFERENCES

1)   Kaiser MJ, Bauer JM, Rämsch C, et al. Mini Nutritional Assessment International Group: Frequency of malnutrition in older adults: a multinational perspective using the mini nutritional assessment. J Am Geriatr Soc, 2010, 58: 1734–1738. [Medline] [CrossRef]

2)   Soysal P, Veronese N, Arik F, et al.: Mini Nutritional Assessment Scale-Short Form can be useful for frailty screening in older adults. Clin Interv Aging, 2019, 14: 693–699. [Medline] [CrossRef]

3)   Fried LP, Tangen CM, Walston J, et al. Cardiovascular Health Study Collaborative Research Group: Frailty in older adults: evidence for a phenotype. J Gerontol A Biol Sci Med Sci, 2001, 56: M146–M156. [Medline] [CrossRef]

4)   Foley NC, Salter KL, Robertson J, et al.: Which reported estimate of the prevalence of malnutrition after stroke is valid? Stroke, 2009, 40: e66–e74. [Medline] [CrossRef]

5)   Kieffer WK, Rennie CS, Gandhe AJ: Preoperative albumin as a predictor of one-year mortality in patients with fractured neck of femur. Ann R Coll Surg Engl, 2013, 95: 26–28. [Medline] [CrossRef]

6)   Bozzetti F, Arends J, Lundholm K, et al. ESPEN: ESPEN Guidelines on Parenteral Nutrition: non-surgical oncology. Clin Nutr, 2009, 28: 445–454. [Medline] [CrossRef]

7)   Anker SD, John M, Pedersen PU, et al. DGEM (German Society for Nutritional Medicine) ESPEN (European Society for Parenteral and Enteral Nutrition): ESPEN guidelines on enteral nutrition: cardiology and pulmonology. Clin Nutr, 2006, 25: 311–318. [Medline] [CrossRef]

8)   Barichella M, Cereda E, Pezzoli G: Major nutritional issues in the management of Parkinson's disease. Mov Disord, 2009, 24: 1881–1892. [Medline] [CrossRef]

9)   Chevalier S, Saoud F, Gray-Donald K, et al.: The physical functional capacity of frail elderly persons undergoing ambulatory rehabilitation is related to their nutritional status. J Nutr Health Aging, 2008, 12: 721–726. [Medline]

10)   Velázquez-Alva MC, Irigoyen-Camacho ME, Cabrer-Rosales MF, et al.: Prevalence of malnutrition and depression in older adults living in nursing homes in Mexico City. Nutrients, 2020, 12: 2429. [Medline] [CrossRef]

11)   German L, Feldblum I, Bilenko N, et al.: Depressive symptoms and risk for malnutrition among hospitalized elderly people. J Nutr Health Aging, 2008, 12: 313–318. [Medline] [CrossRef]

12)   Yoshimura K, Yamada M, Kajiwara Y, et al.: Relationship between depression and risk of malnutrition among community-dwelling young-old and old-old elderly people. Aging Ment Health, 2013, 17: 456–460. [Medline] [CrossRef]

13)   Kaburagi T, Hirasawa R, Yoshino H, et al.: Nutritional status is strongly correlated with grip strength and depression in community-living elderly Japanese. Public Health Nutr, 2011, 14: 1893–1899. [Medline] [CrossRef]

14)   Ohmori-Matsuda K, Hozawa A, Sone T, et al.: [Depression and the risk of long-term care insurance certification: the Tsurugaya project]. Nippon Koshu Eisei Zasshi, 2010, 57: 538–549 (in Japanese, English abstract). [Medline]

15)   Ministry of Health, Labour and Welfare. Long-term care insurance system of Japan. https://www.mhlw.go.jp/english/policy/care-welfare/care-welfare-elderly/dl/ltcisj_e.pdf (Accessed Apr. 27, 2021)

16)   Kubo A, Keiri H: Estimating height from forearm and lower leg lengths of elderly persons. Rigakuryoho Kagaku, 2007, 22: 115–118 (in Japanese, English abstract). [CrossRef]

17)   Kuzuya M, Kanda S, Koike T, et al.: Evaluation of Mini-Nutritional Assessment for Japanese frail elderly. Nutrition, 2005, 21: 498–503. [Medline] [CrossRef]

18)   Tominaga K, Ando Y: The relationship between nutritional intake and mastication based on elderly people's practice of preparing meals. J Dent Hlth, 2013, 63: 328–336 (in Japanese, English abstract).

19)   Dewake N, Hamasaki T, Soh I, et al.: Association between sense of coherence and nutritional and oral status in elderly individuals requiring care. J Dent Hlth, 2014, 64: 278–283 (In Japanese, English abstract).

20)   Castel H, Shahar D, Harman-Boehm I: Gender differences in factors associated with nutritional status of older medical patients. J Am Coll Nutr, 2006, 25: 128–134. [Medline] [CrossRef]

21)   Bates CJ, Prentice A, Finch S: Gender differences in food and nutrient intakes and status indices from the National Diet and Nutrition Survey of people aged 65 years and over. Eur J Clin Nutr, 1999, 53: 694–699. [Medline] [CrossRef]

22)   Enoki H, Kuzuya M, Masuda Y, et al.: [Anthropometric measurements as a predictor of mortality of community-dwelling Japanese elderly: the Nagoya Longitudinal Study of Frail Elderly (NLS-FE)]. Nippon Ronen Igakkai Zasshi, 2007, 44: 212–218 (in Japanese, English abstract). [Medline] [CrossRef]

23)   Crogan NL, Pasvogel A: The influence of protein-calorie malnutrition on quality of life in nursing homes. J Gerontol A Biol Sci Med Sci, 2003, 58: 159–164.

[Medline] [CrossRef]

24) Al-Rasheed R, Alrasheedi R, Al Johani R, et al.: Malnutrition in elderly and its relation to depression. Int J Community Med Public Health, 2018, 5: 2156–2160. [CrossRef]

25) Sato R, Sawaya Y, Shiba T, et al.: Relationship between depression and sarcopenia in Japanese elderly with mild long-term care or support needs. Rigakuryoho Kagaku, 2020, 35: 673–677 (In Japanese, English abstract). [CrossRef]

26) Beaudart C, Sanchez-Rodriguez D, Locquet M, et al.: Malnutrition as a strong predictor of the onset of sarcopenia. Nutrients, 2019, 11: 2883. [Medline] [CrossRef]

27) Imai H, Yamanaka G, Ishimoto Y, et al.: Factor structures of a Japanese version of the Geriatric Depression Scale and its correlation with the quality of life and functional ability. Psychiatry Res, 2014, 215: 460–465. [Medline] [CrossRef]

28) Gilbody S, Lightfoot T, Sheldon T: Is low folate a risk factor for depression? A meta-analysis and exploration of heterogeneity. J Epidemiol Community Health, 2007, 61: 631–637. [Medline] [CrossRef]

29) Anglin RE, Samaan Z, Walter SD, et al.: Vitamin D deficiency and depression in adults: systematic review and meta-analysis. Br J Psychiatry, 2013, 202: 100–107. [Medline] [CrossRef]

J. Phys. Ther. Sci. Vol. 33, No. 8, 2021

590