21.4% were 65 years of age or older. This study was developed and organized by Nagoya City and was supported by the Department of Community Healthcare & Geriatrics of the Nagoya University Graduate School of Medicine. Written informed consent was obtained from all the participants. The city office randomly enrolled 3000 residents of Nagoya City aged 65 and over who had been certified as requiring long-term care and who used at least one type of service provided by the public LTCI in April of 2010, according to the LTCI database of the city (43,250 subjects). A questionnaire was sent to their principal caregivers by mail, and 1835 (61.2%) subjects returned the survey. The investigators obtained the anonymous data from the city office. In this study, the data of 1015 subjects for whom complete sets of data were available were used for the statistical analysis. The questionnaire for the caregivers included the Zarit Burden Scale short version (Zarit-8) (Kumamoto & Arai, 2004) and the following additional questions: (1) Are you satisfied with the services provided by LTCI? (satisfied, somewhat satisfied, somewhat dissatisfied, dissatisfied); and (2) Has the service reduced your care burdens? (reduced greatly, reduced, have not changed, increased, increased greatly). Analysis of variance for the continuous variables and χ^2 analysis for the categorical variance were performed. In the analysis of variance for the continuous variables and the χ^2 analysis, the two additional items were each divided into two categories: satisfied (satisfied and somewhat satisfied) vs. dissatisfied (somewhat dissatisfied and dissatisfied) and reduced (reduced greatly, reduced) vs. not reduced (not changed, increased, increased greatly). Multiple logistic analysis of the factors with p values of <0.2 in the χ^2 analysis of the burden reduction was performed.

3. Results

The results regarding the care burden are shown in Table 1. The caregivers of male care recipients bear a heavier burden than caregivers of female recipients, and female caregivers had higher Zarit-8 scores than males. With respect to the duration of care, longer care was associated with a greater burden. Caregivers of single individuals reported a lighter burden.

We found clear differences in the caregivers' burdens between the support and care levels, with the care burden for care levels 1–5 being significantly higher than that for the support levels 1–2. No significant differences were found within either of the groups by the post-hoc analysis.

Of the caregivers, 28.5% (289 of 1015) were satisfied with the services provided by the insurance, and 58.3% (592) were somewhat satisfied. Only 10.7% (109) and 2.5% (25) were dissatisfied or somewhat dissatisfied with the services, respectively. The degree of satisfaction with the care services was associated with the scores on the Zarit burden scale 8 (Table 1).

The majority of the caregivers indicated that their burden was greatly reduced (n = 98, 9.7%) or reduced (n = 600, 59.1%) as a result of the LTCI services. The burden did not change for 27.9% (n = 283) of the caregivers, whereas 2.5% (25) considered their burden to have increased after the introduction of the LTCI services, and 0.9% (9) thought their burden had increased greatly. The rates of caregivers by type who felt their care burden was reduced (reduced or greatly reduced) are shown in Table 2. Several caregiver groups showed tendencies to feel a reduced burden including the caregivers of older recipients, younger caregivers, and caregivers of patients with more advanced need classifications. Greater satisfaction with the care services was associated with reduction of the burden.

To further investigate the factors associated with reduction of the care burden, a multiple logistic analysis with the factors having p values <0.2 in Table 2 was performed. The analysis showed that the younger age of caregivers, the more advanced levels of need classification, and greater satisfaction with the services provided were independently associated with reduction of the care burden (Table 3). Sixteen types of services were available through LTCI, and adjustment for the number of the types of services used did not change these results.

Table 1
Subjects' characteristics and Zarit Burden Score-8.

		Zarit Burden Score-8	p value
Number	1015		
Number of types of services used (1–16)	2.9 ± 1.8		
Zarit-8 (0–32)		10.8 ± 8.5	
	% in each category		
Age of care recipients			0.074
65–69	6.8	9.8 ± 7.3	
70–74	12.3	12.7 ± 8.9	
75–79	19.8	10.7 ± 8.9	
80–84	17.8	10.0 ± 8.3	
85–89	20.2	10.5 ± 8.7	
90+	23.0	11.3 ± 8.3	
Gender of care recipients			0.043
Male	35.8	11.6 ± 8.5	
Female	64.2	10.5 ± 8.5	
Classification level			<0.001
Support level 1	9.2	6.1 ± 7.4	
Support level 2	10.9	7.3 ± 7.4	
Care need level 1	13.9	11.6 ± 8.6	
Care need level 2	14.4	11.2 ± 8.4	
Care need level 3	18.5	13.2 ± 8.8	
Care need level 4	16.3	11.7 ± 8.3	
Care need level 5	16.6	11.3 ± 8.1	
Age of caregivers			0.418
Under 40	2.0	12.0 ± 9.7	
40–64	45.8	10.5 ± 8.2	
65–74	27.6	11.4 ± 8.4	
75+	24.6	11.2 ± 8.9	
Gender of caregivers			<0.001
Male	30.6	9.3 ± 8.3	
Female	69.4	11.6 ± 8.5	
Family structure of care recipients			0.001
Single	8.4	6.3 ± 7.7	
Couple	29.8	10.8 ± 9.0	
With children	58.6	11.3 ± 8.2	
Other	3.2	12.9 ± 7.3	
Relationship			0.052
Spouse	39.4	11.5 ± 8.8	
Child	36.7	10.1 ± 8.1	
Child-in-law	17.6	12.0 ± 8.3	
Other	6.3	11.2 ± 8.9	
Duration of care			0.011
Less than 1 year	7.4	8.8 ± 8.2	
1–3 years	31.1	9.9 ± 8.1	
3–5 years	22.3	11.6 ± 8.7	
5–10 years	27.3	11.4 ± 8.5	
More than 10 years	11.5	12.1 ± 9.2	
Satisfaction with care services			<0.001
Satisfied	28.5	8.8 ± 7.7	
Somewhat satisfied	58.3	11.0 ± 8.4	
Somewhat dissatisfied	10.7	14.3 ± 9.0	
Dissatisfied	2.5	15.3 ± 10.8	

p value by one-way analysis of variance.
Zarit burden scale 8 scores are shown as mean ± SD.

4. Discussion

In this study almost 70% of the caregivers of the care recipients who used the care services provided by LTCI felt a reduction of the care burden by the introduction of the services. Satisfaction with the services provided by LTCI, a younger age of caregivers, and more advanced care need certification were significantly associated with the reduction of the care burden resulting from the introduction of public LTCI care services.

Table 2
Percent of the subjects whose care burden was reduced.

	Care burden reduced, % (number)	p value
Number	68.8 (698)	
Age of care recipients		0.133
65–69	75.4 (52)	
70–74	62.4 (78)	
75–79	64.8 (118)	
80–84	66.7 (134)	
85–89	70.2 (144)	
90+	73.8 (172)	
Gender of care recipients		0.477
Male	68.4 (245)	
Female	69.1 (444)	
Classification level		0.127
Support level 1	58.1 (54)	
Support level 2 (%)	66.4 (73)	
Care need level 1 (%)	70.0 (98)	
Care need level 2 (%)	68.3 (99)	
Care need level 3 (%)	66.1 (123)	
Care need level 4 (%)	72.6 (119)	
Care need level 5 (%)	74.9 (125)	
Age of caregivers		0.133
Under 40 (*n*)	75.0 (15)	
40–64 (*n*)	71.1 (322)	
65–74 (*n*)	70.0 (191)	
75+ (*n*)	63.8 (155)	
Gender of caregivers		0.408
Male (*n*)	68.3 (207)	
Female (*n*)	69.3 (476)	
Family structure of care recipients		0.809
Single (%)	71.4 (60)	
Couple (%)	66.9 (200)	
With children (%)	59.2 (407)	
Other (%)	71.9 (23)	
Relationship		0.812
Spouse (%)	68.3 (259)	
Child (%)	69.4 (245)	
Child-in-law (%)	72.2 (122)	
Other (%)	67.2 (41)	
Duration of care		0.750
Less than 1 year (%)	63.0 (46)	
1–3 years (%)	68.8 (212)	
3–5 years (%)	70.5 (158)	
5–10 years (%)	69.3 (187)	
More than 10 years (%)	65.8 (75)	
Satisfaction with care services		<0.001
Satisfied (%)	78.2 (226)	
Somewhat satisfied (%)	68.4 (405)	
Somewhat dissatisfied (%)	55.0 (60)	
Dissatisfied (%)	28.0 (7)	

p values by χ^2 analysis were shown.

Previous studies reported that respite services including home help, day care, and residential respite (short stay service) were associated with alleviation of the care burden (Desrosiers et al., 2004; Garcés, Carretero, Ródenas, & Alemán, 2010; Hawranik & Strain, 2000; Hoskins, Coleman, & McNeely, 2005; Shaw et al., 2009; Theis, Moss, & Pearson, 1994; Warren, Kerr, Smith, & Schalm, 2003; Zarit, Gaugler, & Jarrot, 1999; Zarit, 1996, 2002). The reduction of the care burden reported by caregivers in the current survey may be because of the respite services provided by LTCI. The content of the services associated with alleviation of the care burden should be investigated further.

This survey shows that the overall satisfaction of the caregivers of individuals using LTCI services in Japan is relatively high (86.8% of the caregivers were satisfied or somewhat satisfied). According to a report from the USA, the LTCI provided by private insurance companies satisfied approximately two-thirds of the claimants (Cohen et al., 2001), and the current results suggested a comparable satisfaction rate for the Japanese public LTCI. The introduction of care services by public LTCI seemed to contribute to a reduction in the care burden, as previously reported (Kumamoto et al., 2006). The report from the USA showed that 72% of the claimants felt stress was reduced by the introduction of the services (Cohen et al., 2001), a figure that was comparable to the rate of this survey (68.8%). More satisfaction with the care services was associated with the reduction of care burden in the current study. Although the current cross-sectional survey did not elucidate the causal relationship, the provision of services that matched the needs of the care recipients and caregivers would lead to the reduction of the care burden and satisfaction with the program. The detailed assessment of the needs of care recipients and caregivers and providing appropriate services would be critical for the burden reduction of the caregivers. The caregivers of recipients with more advanced care need certifications tended to feel that their burden had been reduced by the introduction of the care services. It is very relevant for many countries with increasing elderly population that public LTCI system could reduce care burden of the caregivers of more advanced care needs. In Japanese LTCI care recipients with more advanced care need certifications are afforded more services. Greater frequency and intensity of care services have been associated with the perception of reduced care burden (Garcés, Carretero, Ródenas, & Sanjosé, 2009). In the current study adjustment by the number of different types of care services used did not change the association of the need classification with the reduction of care burden in the multiple logistic analysis. We only surveyed the number of the types of the services. This survey may not be a good index of the intensity of the service, such that adjustment with this index alone may not have been sufficient.

Younger caregivers tended to perceive a reduction in the care burden by the introduction of care services by LTCI. This perception may be because younger caregivers require more time for personal business, and the introduction of the services allowed them that freedom, which may have led to a reduced burden. If so, the LTCI system could provide chances for the younger caregivers to participate in social activities, which may be a relevant message for the countries with increasing elder populations.

Whereas nearly 70% of the caregivers considered their care burden to have been reduced, the burden of some caregivers was found to have increased. The reasons remain unclear, but might include the psychological distress of the presence of home-helpers, the financial costs and time expenditures resulting from the services could be associated with an increased care burden. The reasons for this increase should be investigated. The rates of satisfaction with the care services provided by LTCI were relatively high, but the factors associated with dissatisfaction with the services should be explored. In Japan "care managers" make "care

Table 3
Multiple logistic analysis for the reduction of care burden.

	B	Odds ratio	95% CI	*p* value
Age of care recipients	0.041	1.042	0.952–1.141	0.371
Age of caregiver	−0.178	0.837	0.709–0.987	0.034
Certified level	0.134	1.143	1.060–1.232	<0.001
Satisfaction with public LTCI (1: dissatisfied greatly; 4: satisfied greatly)	0.688	1.990	1.615–2.452	<0.001

plans" for each care recipient, based on the certification. A system of assessing the care planning would be warranted to reduce the number of dissatisfied and/or heavily burdened caregivers.

In this study, female caregivers reported heavier burdens than male caregivers, which is consistent with a report from Finland (Pöysti et al., 2012). Another study found that female caregivers reported lighter burdens than male caregivers (Rosdinom, Zarina, Zanariah, Marhani, & Suzaily, 2013). Gender differences in care burdens may be subject to cultural, social, and biological factors. In this study, the caregivers of male recipients reported a heavier burden. The reasons for the association were unclear, but the physical burden of providing care for male recipients (e.g., moving them) may be greater.

We found a relationship between the Zarit-8 scores and the duration of care. A longer duration of care appears to exhaust caregivers. This finding agreed with a report by Limpawattana, Theeranut, Chindaprasirt, Sawanyawisuth, and Pimporm (2013). Single persons living alone appeared to have relatively preserved function and had lower need classifications (44% of them were at the support levels). The lower burden of their caregivers was most likely caused by the overall lighter burden of their care.

In this survey, the burden reported by caregivers of elderly individuals classified at any of the "care" levels 1–5 was significantly higher than that reported by caregivers of those classified at the support levels 1–2. This finding suggests that the stratification of support and care levels in the Japanese LTCI system is reasonable. Among the "care" levels 1–5, we found no significant differences in terms of the care burden. In the current analysis, the more advanced care levels were associated with care burden reduction. The current cross-sectional analysis did not reveal whether the care burden reduction resulting from the introduction of LTCI services led to the homogenous care burden among each "care" level. A prospective study would be warranted for further clarification.

The major limitation of this study is its cross-sectional design. It is unclear whether the reduced burden reported by satisfied caregivers was caused by their satisfaction or whether the reduction in the care burden induced by the introduction of the LTCI services led to the satisfaction of the caregivers. The caregivers who indicated a reduction in the care burden had lower Zarit-8 scores, but it is not clear that these lower scores were caused by the introduction of the care services. A prospective survey to investigate the changes in the burden scale scores before and after the introduction of the care services would provide more information regarding the association between LTCI and the care burden. The second limitation of the study was the response rate. We analyzed 34% of the randomly selected samples. The non-responders or incomplete responders may have had less satisfaction or greater care burden levels, and caution in the interpretation of this study is warranted.

This study was performed on a relatively large sample of randomly selected cases of elder care services provided by LTCI in an urban area in Japan. We hypothesize that the sample well represents the local characteristics, but it is not clear whether it is applicable to other areas including rural areas of Japan. In this analysis, the subjects with incomplete data sets were excluded. The age, gender, and certified care levels were not significantly different between the included and excluded subjects; the excluded subjects primarily lacked data from the Zarit burden scale. Careful interpretation of the current results is warranted.

The rate of satisfaction with the care services provided by LTCI in Japan was relatively high, and the degree of satisfaction was associated with the reduction of the care burden.

Conflict of interest

None declared.

Acknowledgments

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References

Cohen, M. A., Miller, J., & Weinrobe, M. (2001). Patterns of informal and formal caregiving among elders with private long-term care insurance. *Gerontologist, 41*, 180–187.

Desrosiers, J., Hebert, R., Payette, H., Roy, P.-M., Tousignant, M., Cote, S., et al. (2004). Geriatric day hospital: Who improves the most? *Canadian Journal on Aging, 23*, 21742.

Garcés, J., Carretero, S., Ródenas, F., & Alemán, C. (2010). A review of programs to alleviate the burden of informal caregivers of dependent persons. *Archives of Gerontology and Geriatrics, 50*, 254–259.

Garcés, J., Carretero, S., Ródenas, F., & Sanjosé, V. (2009). Variables related to the informal caregivers' burden of dependent senior citizens in Spain. *Archives of Gerontology and Geriatrics, 48*, 372–379.

Hawranik, L. A., & Strain, P. G. (2000). *Health of informal caregivers: effects of gender, employment and use of home care services*. Winnipeg, Manitoba: University of Manitoba, Centre on Aging.

Hoskins, S., Coleman, M., & McNeely, D. (2005). Stress in carers of individuals with dementia and community mental health teams: An uncontrolled evaluation study. *Journal of Advanced Nursing, 50*, 3255.

Kumamoto, K., & Arai, Y. (2004). Validation of 'personal strain' and 'role strain': Subscales of the short version of the Japanese version of the Zarit Burden Interview (J-ZBI_8). *Psychiatry and Clinical Neurosciences, 58*, 606–610.

Kumamoto, K., Arai, Y., & Zarit, S. H. (2006). Use of home care services effectively reduces feelings of burden among family caregivers of disabled elderly in Japan: Preliminary results. *International Journal of Geriatric Psychiatry, 21*, 163–170.

Kuzuya, M., Enoki, H., Hasegawa, J., Izawa, S., Hirakawa, Y., Shimokata, H., et al. (2011). Impact of caregiver burden on adverse health outcomes in community-dwelling dependent older care recipients. *American Journal of Geriatric Psychiatry, 19*, 382–391.

Limpawattana, P., Theeranut, A., Chindaprasirt, J., Sawanyawisuth, K., & Pimporm, J. (2013). Caregivers burden of older adults with chronic illnesses in the community: A cross-sectional study. *Journal of Community Health, 38*, 40–45.

Nakagawa, Y., & Nasu, S. (2011). Association between components of family caregivers' sense of burden and types of paid care services provided in Japan. *Aging & Mental Health, 15*, 687–701.

Oyama, Y., Tamiya, N., Kashiwagi, M., Sato, M., Ohwaki, K., & Yano, E. (2012). Factors that allow elderly individuals to stay at home with their families using the Japanese long-term care insurance system. *Geriatrics & Gerontology International* (in press).

Ozawa, M. N., & Nakayama, S. (2005). Long-term care insurance in Japan. *Journal of Aging & Social Policy, 17*, 61–84.

Pöysti, M. M., Laakkonen, M. L., Strandberg, T., Savikko, N., Tilvis, R. S., Eloniemi-Sulkava, U., et al. (2012). Gender differences in dementia spousal caregiving. *International Journal of Alzheimer's Disease* http://dx.doi.org/10.1155/2012/162960.

Rosdinom, R., Zarina, M. Z., Zanariah, M. S., Marhani, M., & Suzaily, W. (2013). Behavioural and psychological symptoms of dementia, cognitive impairment and caregiver burden in patients with dementia. *Preventive Medicine* http://dx.doi.org/10.1016/j.ypmed.2012.12.025 pii:S0091-7435(13)00003-0.

Shaw, C., McNamara, R., Abrams, K., Cannings-John, R., Hood, K., Longo, M., et al. (2009). Systematic review of respite care in the frail elderly. *Health Technology Assessment, 13*, 1–224.

Tamiya, N., Noguchi, H., Nishi, A., Reich, M. R., Ilegami, N., Hashimoto, H., et al. (2011). Population ageing and wellbeing: Lessons from Japan's long-term care insurance policy. *Lancet, 378*, 1183–1192.

Theis, S. L., Moss, J. H., & Pearson, M. A. (1994). Respite for caregivers: An evaluation study. *Journal of Community Health Nursing, 11*, 3194.

Tsutsui, T., & Muramatsu, N. (2007). Japan's universal long-term care system reform of 2005: Containing costs and realizing a vision. *Journal of the American Geriatrics Society, 55*, 1458–1463.

Warren, S., Kerr, J. R., Smith, D., & Schalm, C. (2003). The impact of adult day programs on family caregivers of elderly relatives. *Journal of Community Health Nursing, 20*, 209.

Zarit, S. H. (1996). *Families at the crossroads: Caring for disabled older people*. Pennsylvania: Penn Sate University, Gerontology Center, College of Health and Human Development.

Zarit, S. H., Gaugler, J. E., & Jarrot, S. E. (1999). Useful services for families: Research findings and directions. *International Journal of Geriatric Psychiatry, 14*, 165.

Zarit, S. H. (2002). Caregiver's burdens. In S. Andrieu & J. P. Aquino (Eds.), *Family and professional caregivers: Findings lead to action* (pp. 20–). Paris: Serdi Edition and Fondation Médéric Alzheimer.

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REVIEW

Rehabilitation nutrition for sarcopenia with disability: a combination of both rehabilitation and nutrition care management

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Abstract Malnutrition and sarcopenia often occur in rehabilitation settings. The prevalence of malnutrition and sarcopenia in older patients undergoing rehabilitation is 49–67 % and 40–46.5 %, respectively. Malnutrition and sarcopenia are associated with poorer rehabilitation outcome and physical function. Therefore, a combination of both rehabilitation and nutrition care management may improve outcome in disabled elderly with malnutrition and sarcopenia. The concept of rehabilitation nutrition as a combination of both rehabilitation and nutrition care management and the International Classification of Functioning, Disability and Health guidelines are used to evaluate nutrition status and to maximize functionality in the elderly and other people with disability. Assessment of the multifactorial causes of primary and secondary sarcopenia is important because rehabilitation nutrition for sarcopenia differs depending on its etiology. Treatment of age-related sarcopenia should include resistance training and dietary supplements of amino acids. Therapy for activity-related sarcopenia includes reduced bed rest time and early mobilization and physical activity. Treatment for disease-related sarcopenia requires therapies for advanced organ failure, inflammatory disease, malignancy, or endocrine disease, while therapy for nutrition-related sarcopenia involves appropriate nutrition management to increase muscle mass. Because primary and secondary sarcopenia often coexist in people with disability, the concept of rehabilitation nutrition is useful for their treatment. Stroke, hip fracture, and hospital-associated deconditioning are major causes of disability, and inpatients of rehabilitation facilities often have malnutrition and sarcopenia. We review the concept of rehabilitation nutrition, the rehabilitation nutrition options for stroke, hip fracture, hospital-associated deconditioning, sarcopenic dysphagia, and then evaluate the amount of research interest in rehabilitation nutrition.

Keywords Rehabilitation nutrition · Stroke · Hip fracture · Hospital-associated deconditioning · Sarcopenic dysphagia

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1 Introduction

Rehabilitation nutrition is a combination of both rehabilitation and nutrition care management, and this concept is used with International Classification of Functioning, Disability and Health guidelines to evaluate nutrition status and to maximize functionality in the elderly and other people with disability. Rehabilitation nutrition may further improve physical and mental function, activities of daily living, and quality of life. The term "rehabilitation nutrition" is quite different from that of "nutritional rehabilitation." Nutritional rehabilitation usually refers to nutritional improvement of malnourished children in developing countries. In contrast, rehabilitation nutrition not only refers to nutritional improvement but also to rehabilitation in people with disability [1, 2]. Rehabilitation nutrition is similar to sports nutrition. The key aims of rehabilitation nutrition assessment [2] are to assess the following: (1) the presence and cause of malnutrition; (2) the presence and cause of sarcopenia; (3) the presence and cause of dysphagia; (4) the adequacy of nutrition care management with prediction of future nutritional status; and (5) whether rehabilitation for functional improvement, such as resistance training and endurance training, can be conducted.

The prevalence of malnutrition in rehabilitation settings is high. In elderly patients hospitalized for rehabilitation, the prevalence of compromised nutrition status was estimated to be 49–67 % [3]. In Australia, 33 and 51.5 % of patients admitted to rehabilitation hospitals were classified as malnourished and at nutritional risk using the Mini Nutritional Assessment (MNA) and the MNA short-form (MNA-SF) [4]. One study using pooled MNA data found that the prevalence of malnutrition in elderly people was highest in rehabilitation settings (rehabilitation, 50.5 %; hospital, 38.7 %) [5]. Another study using the MNA-SF revealed a 40.8 % prevalence of malnutrition in rehabilitation settings [6]. A systematic review found that malnutrition in older adults admitted for rehabilitation has a negative effect on functional recovery and quality of life following discharge to the community [7]. Furthermore, rehabilitation outcome has been shown to be poor in malnourished patients with stroke [8], hip fracture [9], hospital-associated deconditioning [10, 11], and a variety of other diseases.

The prevalence of sarcopenia in rehabilitation settings is also high: 10–30 % in community-dwelling elderly [12] and 40 % in ambulatory rehabilitation facility-dwelling elderly 60 years and older [13]. Another study revealed that 46.5 % patients admitted to a subacute geriatric care unit who underwent a rehabilitation intervention met the diagnostic criteria for sarcopenia [14].

The European Working Group on Sarcopenia in Older People categorized sarcopenia into primary sarcopenia (age-related sarcopenia) and secondary sarcopenia (i.e., activity-, disease-, or nutrition-related sarcopenia) [15]. Assessment of the multifactorial causes of primary and secondary sarcopenia is indispensable because rehabilitation nutrition for sarcopenia differs depending on its etiology. Treatment of age-related sarcopenia includes resistance training, protein and amino acid supplementation, smoking cessation, and pharmaceutical therapies [16, 17]. Pharmaceutical therapy of sarcopenia is likely to advance in the near future because our understanding of the role of regulators in sarcopenia has increased [18, 19]. Early ambulation, exercise, and avoiding bed rest are important for preventing and treating activity-related sarcopenia. Treatment of disease-related sarcopenia includes therapies for advanced organ failure, inflammatory disease, malignancy, and endocrine disease, while treatment of nutrition-related sarcopenia includes appropriate nutrition management to increase muscle mass [16, 17]. In cases of age-, activity-, disease-, and nutrition-related sarcopenia, rehabilitation nutrition can be used to maximize functionality.

Stroke, hip fracture, and hospital-associated deconditioning are major causes of disability in inpatient rehabilitation facilities. In the USA, the six largest diagnostic impairment categories receiving inpatient rehabilitation include stroke, lower extremity fracture, lower extremity joint replacement, debility, neurologic disorders, and brain dysfunction [20]. Hip fracture is a leading cause of disability in lower extremity fracture patients, and debility is synonymous with hospital-associated deconditioning. In Japan, common causes of inpatient rehabilitation in convalescent rehabilitation wards are stroke (47.9 %); orthopedic diseases, including hip fracture (35.2 %); disuse syndrome (10.5 %); and traumatic brain and spinal cord injury (5.4 %) [21]. Disuse syndrome is synonymous with hospital-associated deconditioning. These data indicate that management of patients with stroke, hip fracture, and hospital-associated deconditioning is an important part of inpatient rehabilitation. The term "sarcopenic dysphagia" refers to difficulty swallowing due to sarcopenia of generalized skeletal muscles and swallowing muscles [22, 23]. Age-related loss of the tongue and geniohyoid muscle mass has been studied in the elderly [24, 25]. Sarcopenic dysphagia is an important current and future public health issue, because it is common in the elderly and can lead to aspiration pneumonia, the prevalence of which is increasing with the aging of society [23]. Therefore, we review rehabilitation nutrition for stroke, hip fracture, hospital-associated deconditioning, and sarcopenic dysphagia, and then assess the level of research interest in rehabilitation nutrition.

2 Stroke

Stroke is the leading cause of disability in Western and East Asian countries. More than 60 % of patients remain disabled, 50 % of patients suffer from hemiparesis, and 30 % remain unable to walk without assistance [26]. As the benefits of rehabilitation are beyond doubt, rehabilitation strategies play center stage in optimizing functional recovery after stroke [27, 28].

Both malnutrition and obesity are nutritional problems in stroke. According to a recent systematic review, malnutrition and dysphagia respectively occur in 8.2–49.0 % and 24.3–52.6 % of subjects following stroke [29]. In subgroup analysis, the odds of malnutrition were significantly increased during the rehabilitation stage (odds ratio (OR), 2.445; 95 % confidence interval (CI), 1.009–5.925) [29]. Tissue wasting, sarcopenia, and cachexia may impair and delay poststroke rehabilitation and worsen the prognosis, and increasing evidence suggests that patients who are overweight and mildly obese may actually have a better outcome [30]. Analysis of data from the China National Stroke Registry on patients grouped according to their body mass index (BMI) into underweight (<18.5 kg/m^2), normal weight (18.5–22.9 kg/m^2), overweight (23–27.4 kg/m^2), obese (27.5–32.4 kg/m^2), or severely obese (≥32.5 kg/m^2) [31] found that overweight was independently associated with favorable 3-month functional recovery (OR, 1.24; 95 % CI, 1.12–1.38), but severe obesity was independently associated with higher 3-month mortality (OR, 2.01; 95 % CI, 1.10–3.69) [31]. In stroke

patients admitted to a rehabilitation hospital, the underweight group had the lowest functional independence measure (FIM) efficiency, followed by the obese and normal-weight subgroups [32]. The overweight group had the highest FIM efficiency (p=0.05) when compared with the obese subgroup [32]. These results indicate that outcome is better in overweight stroke patients than in underweight stroke patients. However, the obesity paradox seems not to be applicable to poststroke rehabilitation.

Skeletal muscles are the main effector organs impacted by disability in stroke, but little attention is paid to structural, metabolic, and functional alterations of muscle tissue after stroke [27, 28]. Stroke-induced sarcopenia is difficult to differentiate from hemiparesis in terms of evaluating muscle strength and physical performance. Therefore, diagnosis of stroke-induced sarcopenia is a challenging task. In a systematic review of loss of skeletal muscle mass after stroke [33], lean tissue mass was significantly less in the paretic than the nonparetic lower limb (median, 342.3 g; 95 % CI, 247.0–437.6 g) and upper limb (median, 239.9 g; 95 % CI, 181.7–298.2 g), and midthigh muscle cross-sectional area (median, 15.4 cm^2; 95 % CI, 13.8–16.9 cm^2) was significantly less in individuals at least 6 months poststroke. Mechanisms of muscle wasting in stroke-related sarcopenia include disuse atrophy, spasticity, inflammation, denervation, reinnervation, impaired feeding, and intestinal absorption [28]. Further research will be required to diagnose and treat stroke-induced sarcopenia.

Nutritional supplements can improve outcomes in poststroke rehabilitation [34]. A randomized study comparing intensive nutritional supplementation to routine nutritional supplementation was performed in 116 undernourished stroke inpatients [34]. Compared with those on standard nutritional supplements, patients receiving intensive nutritional supplementation improved more on measures of motor function (total FIM, FIM motor subscore, 2 and 6-min timed walk tests, p<0.002) [34]. In a randomized, controlled trial comparing routine care with individualized, nutritional care aiming to prevent weight loss in acute stroke patients at nutritional risk [35], 20.7 % of the intervention group lost ≥5 % weight compared with 36.4 % of the control group (p= 0.055) at follow-up. The intervention group had a significantly higher increase in QoL score (p=0.009) and in handgrip strength (p=0.002) [35]. In a Cochrane Database of Systematic Review [36], nutritional supplementation in acute and subacute stroke was associated with reduced frequency of pressure sores (OR: 0.56; 95 % CI: 0.32–0.96), and increased energy intake (mean differences (MD), 430.18 kcal/day; 95 % CI, 141.61–718.75) and protein intake (MD, 17.28 g/day; 95 % CI, 1.99–32.56). These results indicate that nutrition support for stroke rehabilitation patients at malnutrition or nutritional risk seems to improve nutrition intake and rehabilitation outcome.

3 Hip fracture

Hip fractures are associated with more disability, health care costs, and mortality than all other osteoporotic fractures combined [37]. In 2005, hip fractures in the USA were estimated to account for 14 % of total fractures but 72 % of total fracture-related health care costs [37]. Compared with its pre-fracture level, post-fracture function is deteriorated in 60 % of patients with hip fracture [38]. The demographic trend worldwide is that more and more people are suffering from hip fracture. The number of hip fractures is expected to rise from 1.6 million in 2000 up to 6.3 million in 2050 [37]. Hip fracture is the most common condition requiring geriatric musculoskeletal rehabilitation.

The prevalence of malnutrition in hip fracture depends on the method of nutrition assessment. Malnutrition prevalence was lowest when assessed by BMI (13 %), followed by MNA-SF (27 %), International Classification of Disease, 10th Revision, Australian Modification (ICD10-AM) (48 %), albumin (53 %), and geriatrician individualized assessment (55 %) [39]. Malnutrition prevalence in hip fracture was 37.5 % using ICD10-AM criteria in another study [40]. Nutrition status assessed by MNA in one hip fracture study revealed that 8.8 % of elderly patients were undernourished, 43.7 % at risk of malnutrition, and 47.5 % well-nourished [41]. Nutrition status in another hip fracture study revealed that 11.6 % were malnourished, 44.2 % at risk of malnutrition, and 44.2 % were well-nourished [42]. MNA predicted gait status and mortality 6 months after hip fracture [43]. Serum albumin level (p= 0.0004; OR, 5.8541) and BMI (p=0.0192; OR, 1.1693) significantly influenced mortality after hip fracture [44]. Malnutrition and being at risk for malnutrition are common in patients with hip fracture and seem to affect rehabilitation outcome.

The prevalence of sarcopenia in patients with hip fracture is high. In the Sarcopenia and Hip Fracture study [45], 71 % of participants were sarcopenic. Another study in women with hip fracture revealed that 58 % were sarcopenic [46]. Using normative data from the New Mexico Elder Health Study [47], 64.0 % of female hip fracture inpatients and 95.0 % of male hip fracture inpatients admitted to rehabilitation wards had sarcopenia. Analysis of other data revealed that 21.8 % of female hip fracture patients and 86.7 % of male hip fracture patients had sarcopenia [47]. In 357 Japanese patients immediately after hip fracture, 44.7 % of women and 81.1 % of men had sarcopenia, and the presence of sarcopenia was independently associated with the occurrence of hip fracture [48]. On the other hand, only 4 of the 71 hip fracture patients (5.6 %) were identified as cachectic [49]. Sarcopenia not cachexia seems to be common in elderly patients with hip fracture.

A Cochrane Database Systematic Review of nutritional supplementation in elderly patients with hip fracture found weak evidence for the effectiveness of protein and energy

supplements [50]. One trial of multinutrient intravenous feeding followed by oral supplements found a reduction in the number of participants with complications (RR, 0.21; 95 % CI, 0.10–0.46), but not in mortality rate (RR, 0.11; 95 % CI, 0.01–2.00) [50]. A controlled prospective cohort study in patients with hip fracture found a significant association of multidisciplinary postoperative nutritional care with a decline in the number of malnourished patients and a decline in the EuroQol (p=0.004) after 3 months of the intervention [51]. In a randomized, controlled study [52], nutritional support actively supervised by a dietician and guided by repeated measurements of resting energy requirements was achievable and improved outcomes in geriatric patients following surgery for hip fractures. Multidisciplinary nutritional care reduced nutritional deterioration during admission (5.4 vs. 20.5 %; p= 0.049), and increased the rate of discharge directly back to the community (48.0 vs. 17.6 %; p=0.012) in a pragmatic intervention study [53]. A high-protein nutritional intervention-based study on β-hydroxy-β-methylbutyrate, vitamin D3, and calcium in obese and lean aged patients with hip fractures and sarcopenia will be implemented [54]. These results indicate that nutrition support for hip fracture patients may improve nutrition status and rehabilitation outcome.

4 Hospital-associated deconditioning

Hospital-associated deconditioning is characterized by the functional decline that occurs during acute hospitalization due to illness or injury, or both, and is unrelated to a specific neurological or orthopedic insult, or both [55]. Several concepts have been proposed to explain the consequences of inactivity and disuse in the hospital, and include debility [20], disuse syndrome [10, 21], hospital-associated deconditioning [11, 55], hospitalization-associated disability [56], and post-hospital syndrome [57]. During hospitalization, patients are commonly deprived of sleep, experience disruption of normal circadian rhythms, are nourished poorly, have pain and other discomfort, confront a baffling array of mentally challenging situations, receive medications that can alter cognition and physical function, and become deconditioned by bed rest or inactivity [57]. Hospitalization-associated disability occurs in approximately one-third of patients older than 70 years of age and may be triggered even when the illness that necessitated the hospitalization is successfully treated [56]. Therefore, hospital-associated deconditioning represents an important condition in geriatric rehabilitation medicine [11].

Malnutrition is associated with poor rehabilitation outcome in hospital-associated deconditioning. In an acute rehabilitation setting, obese patients with deconditioning show greater improvement in FIM scores, compared with patients whose BMI is in the normal range or lower (BMI 18.5) [58]. This lower BMI group shows the smallest increase in FIM motor scores with rehabilitation [58]. In elderly patients with deconditioning, admission Norton scale scores were correlated with discharge walking FIM scores (r=0.32; p=0.003), discharge transfer FIM scores (r=0.30; p=0.005), and length of rehabilitation (r=−0.37; p<0.0001) [59]. In our previous prospective cohort study [11], 87.6 % of patients were malnourished, 12.4 % were at risk for malnutrition, and there were none with normal nutritional status. In multiple regression analysis, the MNA-SF score, albumin level, and cachexia status were significantly associated with the Barthel Index score at discharge [11]. These results indicated that patients with hospital-associated deconditioning may experience not only activity-related sarcopenia but also nutrition-related and disease-related sarcopenia [11]. Nutrition management and sarcopenia treatment in patients with hospital-associated deconditioning may lead to improvement of disability, although further studies are required.

5 Sarcopenic dysphagia

Sarcopenic dysphagia is characterized by the loss of swallowing muscle mass and function associated with generalized loss of skeletal muscle mass and function. The prevalence of dysphagia has been reported to be 11.4–38 % in community-dwelling elderly individuals [60–64] and 40–68 % in nursing home residents [65–67]. Dysphagia management is important because dysphagia is common in the elderly and increases the risk of related complications such as aspiration pneumonia, choking, dehydration, malnutrition, and a lower quality of life following the loss of the joy of eating. Furthermore, sarcopenic dysphagia is not only the result of aspiration pneumonia, but also an important cause of recurrent aspiration pneumonia [23]. Sarcopenic dysphagia may be common in elderly subjects with sarcopenia and dysphagia [23].

Age-related loss of swallowing muscles has been studied [24, 25]. Swallowing muscles include the intrinsic muscle of the tongue and the mimic, masticatory, suprahyoid, infrahyoid, palatal, pharyngeal, and esophageal muscles. Tamura et al. [24] evaluated thickness of the central part of the tongue in the elderly using ultrasonography and showed mid-arm muscle area and age were associated independently with tongue thickness. These results indicate that tongue muscle mass is associated with generalized skeletal muscle mass and aging. Feng et al. [25] assessed the geniohyoid muscle in healthy older adults using computed tomography. A decrease in the cross-sectional area of the geniohyoid muscle has been shown to occur with increasing age, with this area being significantly smaller in aspirators compared with non-aspirators, but only in older men [25]. These findings suggest that geniohyoid muscle atrophy may be a component of

Table 1 Number of PubMed entries retrieved in a search of seven rehabilitation journals for the terms "nutrition" and "sarcopenia." Accessed on 25 April 2014 from www.pubmed.gov

Journal name	Total no. of entries	Nutrition	Sarcopenia
Archives of Physical Medicine and Rehabilitation	11,856	96	2
Clinical Rehabilitation	1,768	10	1
Journal of Rehabilitation Medicine	1,499	6	0
European Journal of Physical and Rehabilitation Medicine	523	5	5
American Journal of Physical Medicine and Rehabilitation	3,123	30	0
Disability and Rehabilitation	3,638	27	0
International Journal of Rehabilitation Research	1,807	11	0
Total	24,214	185 (0.8 %)	8 (0.03 %)

decreased swallowing safety and aspiration in older adults with presbyphagia or frailty of swallowing.

Mid-upper arm circumference and calf circumference were correlated with dysphagia [22, 68]. The circumference of the mid-upper arm in older Japanese adults with suspected swallowing disorders was correlated significantly with swallowing function [22]. This finding suggested that swallowing impairment was related to thinness. It is likely that the general reduction in lean body mass, including the swallowing muscle mass, is responsible for the association between mid-upper arm circumference and swallowing function, and indicates the presence of sarcopenic dysphagia [22]. Another study revealed that swallowing measures had significant correlations with the functional and nutritional measures including serum albumin levels, mid-upper arm circumference, and calf circumference but not with age [68]. Given that sarcopenia is exacerbated by disease, inactivity, and malnutrition, sarcopenia involving the swallowing muscle mass and its function may account for this result [68].

Malnutrition can cause dysphagia [69, 70]. Malnutrition results in both increased adductor pollicis muscle fatigability and an altered pattern of muscle contraction and relaxation which are reversible by nutritional supplementation [71]. No experimental evidence shows that malnutrition would affect the loss of swallowing muscle fibers. However, deglutition muscles that have a moderate to high percentage of type II fibers may be among the first to atrophy at malnutrition because malnutrition affects type II muscle fibers to a much greater extent than it does type I fibers [69, 70]. Furthermore, malnutrition was associated with dysphagia and head lifting strength which reflects the strength of the suprahyoid muscles in frail older adults [72].

Therapy for sarcopenic dysphagia includes dysphagia rehabilitation, treatment of sarcopenia, and nutrition improvement. The core components of dysphagia rehabilitation are oral health care, rehabilitative techniques, and food modification. Malnutrition contributes to the etiology of secondary sarcopenia and sarcopenic dysphagia. Therefore, nutrition management to increase muscle mass is indispensable for sarcopenic dysphagia rehabilitation, and the concept of rehabilitation nutrition is useful. Further research on sarcopenic dysphagia is required, although consensus diagnostic criteria for sarcopenic dysphagia have been proposed [23].

6 Research interest in rehabilitation nutrition

The rehabilitation medicine literature lacks research focused on nutrition and sarcopenia. We searched seven major rehabilitation journals cited in the article "Publishing in physical and rehabilitation medicine" [73] and indexed by PubMed. These rehabilitation journals were the Archives of Physical Medicine and Rehabilitation, Clinical Rehabilitation, Journal of Rehabilitation Medicine, the European Journal of Physical and Rehabilitation Medicine, the American Journal of Physical Medicine and Rehabilitation, Disability and Rehabilitation, and International Journal of Rehabilitation Research. Of 24,214 PubMed entries for these seven journals, 185 (0.8 %)

Table 2 Number of Japan Medical Abstracts Society Database entries retrieved in a search of four Japanese rehabilitation journals for the words "nutrition" and "sarcopenia." Accessed on 25 April 2014 from http://www.jamas.or.jp/about/english.html

	Entire period			From 2010		
Journal name	Total	Nutrition	Sarcopenia	Total	Nutrition	Sarcopenia
The Japanese Journal of Rehabilitation Medicine	24,457	545	17	4,419	136	15
Sogo Rihabiriteshon	7,759	136	8	1,100	31	5
Journal of Clinical Rehabilitation	4,602	180	9	839	53	8
Medical Rehabilitation	2,080	231	21	778	97	20
Total	38,898	1,092 (2.8 %)	55 (0.1 %)	7,136	317 (4.4 %)	48 (0.7 %)

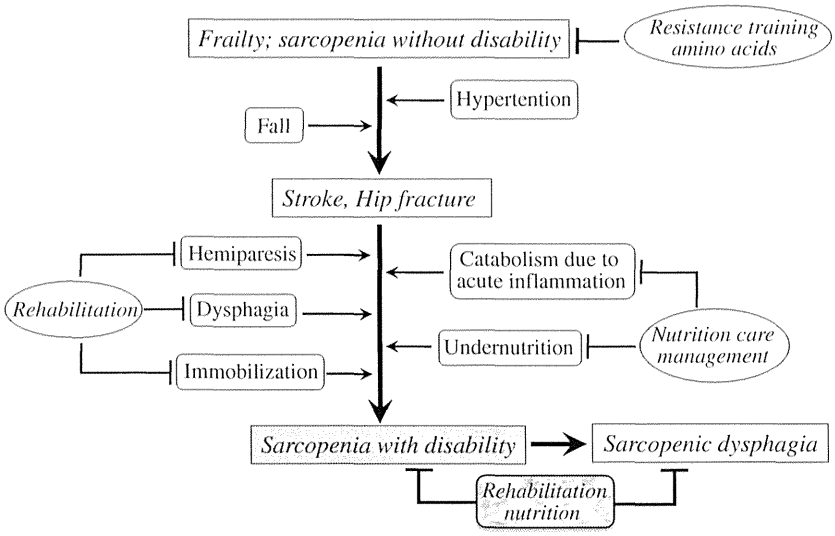

Fig. 1 Mechanism of sarcopenia with disability in frail elderly with stroke and hip fracture. Frail elderly with stroke or hip fracture becomes sarcopenia with disability because of hemiparesis, dysphagia, immobilization, catabolism due to acute inflammation, and undernutrition. Rehabilitation for hemiparesis, dysphagia, immobilization, and nutrition care management for catabolism due to acute inflammation and undernutrition are usually provided separately. Sarcopenia with disability induces sarcopenic dysphagia which is characterized by the loss of swallowing muscle mass and function associated with generalized loss of skeletal muscle mass and function. Rehabilitation nutrition can be used to improve functionality in people with sarcopenic dysphagia and sarcopenia with disability

and 8 (0.03 %), respectively, contained the words "nutrition" and "sarcopenia" on 25 April 2014 (Table 1). Four articles (one editorial and three reviews) published in the European Journal of Physical and Rehabilitation Medicine contained the word "sarcopenia" and were about sarcopenia and muscular modifications in disabling pathologies [74–77]. Though the importance of nutrition in rehabilitation was already recognized in the 1940s [78], interest in nutrition and sarcopenia in rehabilitation medicine has remained very low.

In Japan, interest in rehabilitation nutrition has increased in recent years. Using the Japan Medical Abstracts Society Database, we searched for articles in four major Japanese rehabilitation journals including the Japanese Journal of Rehabilitation Medicine, Sogo Rihabiriteshon, Journal of Clinical Rehabilitation, and Medical Rehabilitation. Of the 38,898 entries of these four journals, 1092 (2.8 %) and 55 (0.1 %), respectively, contained the words "nutrition" and "sarcopenia" on 25 April 2014 (Table 2). When the search was limited to entries after 2010, 4.4 and 0.7 %, respectively, contained the words "nutrition" and "sarcopenia".

We established the Japanese Association of Rehabilitation Nutrition in 2011; its membership in April 2014 had increased to more than 3300 people and included physical therapists, registered dietitians, speech-language-hearing therapists, etc. Moreover, 629 people attended the 3rd Congress of the Japanese Association of Rehabilitation Nutrition held in 2013.

Interest in rehabilitation nutrition is increasing in Japan because of the emergence of a rapidly aging society, high number of convalescent rehabilitation beds, and high number of nutrition support teams in hospitals. The aging rate in Japan is the highest in the world (i.e., 25.1 % in October 2013). The number of convalescent rehabilitation beds available under the Japanese Medical Insurance System has increased since 2000 to 68,316 in March 2014. The mean age of the patients in convalescent rehabilitation wards is 73.0 years [21]. These data suggest that the number of disabled elderly with malnutrition and sarcopenia is increasing at an accelerated pace. The number of hospitals that have nutrition support teams certified by the Japan Council for Nutritional Therapy was 1001 in 2013. Many physical therapists, occupational therapists, and speech-language-hearing therapists are actively involved in nutrition support teams and interested in nutrition care management. Collaborative studies of rehabilitation nutrition have been undertaken by the Japanese Association of Rehabilitation Nutrition [72]. Furthermore, the Japanese Society for Sarcopenia, Cachexia and Wasting Disorders was established in 2014. Further, more focused, research on rehabilitation nutrition will be needed because the number of elderly with disability is expected to increase in developed countries as the population ages [79, 80].

7 Conclusion

The prevalence of malnutrition and sarcopenia in physically disabled elderly patients who undergo rehabilitation is high. In contrast, the amount of research focused on nutrition and sarcopenia in rehabilitation medicine is very low. The major causes of disability in inpatients of rehabilitation facilities, including stroke, hip fracture, and hospital-associated deconditioning, are often complicated by malnutrition and sarcopenia. Sarcopenic dysphagia is common in the elderly

population and is not only the result of aspiration pneumonia, but also an important cause of recurrent aspiration pneumonia. Because primary and secondary sarcopenia often coexist in people with disability, rehabilitation nutrition can be used to improve their functionality (Fig. 1). Further studies on rehabilitation nutrition are important in a rapidly aging society, where the number of elderly with disability is expected to increase.

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Conflict of interest Hidetaka Wakabayashi and Kunihiro Sakuma declare that they have no conflict of interest.

References

1. Wakabayashi H. Seamless community coordination of rehabilitation nutrition care management in patients with dysphagia. Gan To Kagaku Ryoho. 2010;37:198–200 [Article in Japanese].
2. Wakabayashi H. Rehabilitation and clinical nutrition. Jpn J Rehabil Med. 2011;48:270–81 [Article in Japanese].
3. Strakowski MM, Strakowski JA, Mitchell MC. Malnutrition in rehabilitation. Am J Phys Med Rehabil. 2002;81:77–8.
4. Charlton KE, Nichols C, Bowden S, Lambert K, Barone L, Mason M, et al. Older rehabilitation patients are at high risk of malnutrition: evidence from a large Australian database. J Nutr Health Aging. 2010;14:622–8.
5. Kaiser MJ, Bauer JM, Rämsch C, Uter W, Guigoz Y, Cederholm T, et al. Frequency of malnutrition in older adults: a multinational perspective using the mini nutritional assessment. J Am Geriatr Soc. 2010;58:1734–8.
6. Kaiser MJ, Bauer JM, Uter W, Donini LM, Stange I, Volkert D, et al. Prospective validation of the modified mini nutritional assessment short-forms in the community, nursing home, and rehabilitation setting. J Am Geriatr Soc. 2011;59:2124–8.
7. Marshall S, Bauer J, Isenring E. The consequences of malnutrition following discharge from rehabilitation to the community: a systematic review of current evidence in older adults. J Hum Nutr Diet. 2014;27:133–41.
8. Davis JP, Wong AA, Schluter PJ, Henderson RD, O'Sullivan JD, Read SJ. Impact of premorbid undernutrition on outcome in stroke patients. Stroke. 2004;35:1930–4.
9. Anker SD, John M, Pedersen PU, Raguso C, Cicoira M, Dardai E, et al. ESPEN guidelines on enteral nutrition: cardiology and pulmonology. Clin Nutr. 2006;20:311–8.
10. Wakabayashi H, Sashika H. Association of nutrition status and rehabilitation outcome in the disuse syndrome: a retrospective cohort study. Gen Med. 2011;12:69–74.
11. Wakabayashi H, Sashika H. Malnutrition is associated with poor rehabilitation outcome in elderly inpatients with hospital-associated deconditioning a prospective cohort study. J Rehabil Med. 2014;46:277–82.
12. Fielding RA, Vellas B, Evans WJ, Bhasin S, Morley JE, Newman AB, et al. Sarcopenia: an undiagnosed condition in older adults. Current consensus definition: prevalence, etiology, and consequences. International Working Group on Sarcopenia. J Am Med Dir Assoc. 2011;12:249–56.
13. Yaxley A, Miller MD, Fraser RJ, Cobiac L, Crotty M. The complexity of treating wasting in ambulatory rehabilitation: is it starvation, sarcopenia, cachexia or a combination of these conditions? Asia Pac J Clin Nutr. 2012;21:386–93.
14. Sánchez-Rodríguez D, Marco E, Miralles R, Fayos M, Mojal S, Alvarado M, et al. Sarcopenia, physical rehabilitation and functional outcomes of patients in a subacute geriatric care unit. Arch Gerontol Geriatr. 2014. doi:10.1016/j.archger.2014.02.009.
15. Cruz-Jentoft AJ, Baeyens JP, Bauer JM, Boirie Y, Cederholm T, Landi F, et al. Sarcopenia: European consensus on definition and diagnosis: report of the European Working Group on sarcopenia in older people. Age Ageing. 2010;39:412–23.
16. Wakabayashi H, Sakuma K. Comprehensive approach to sarcopenia treatment. Curr Clin Pharmacol. 2014;9:171–80.
17. Wakabayashi H, Sakuma K. Nutrition, exercise, and pharmaceutical therapies for sarcopenic obesity. J Nutr Ther. 2013;2:100–11.
18. Sakuma K, Yamaguchi A. Sarcopenia and cachexia: the adaptations of negative regulators of skeletal muscle mass. J Cachexia Sarcopenia Muscle. 2012;3:77–94.
19. Sakuma K, Aoi W, Yamaguchi A. Current understanding of sarcopenia: possible candidates modulating muscle mass. Pflugers Arch. 2014. doi:10.1007/s00424-014-1527-x
20. Ottenbacher KJ, Karmarkar A, Graham JE, Kuo YF, Deutsch A, Reistetter TA, et al. Thirty-day hospital readmission following discharge from postacute rehabilitation in fee-for-service Medicare patients. JAMA. 2014;311:604–14.
21. Miyai I, Sonoda S, Nagai S, Takayama Y, Inoue Y, Kakehi A, et al. Results of new policies for inpatient rehabilitation coverage in Japan. Neurorehabil Neural Repair. 2011;25:540–7.
22. Kuroda Y, Kuroda R. Relationship between thinness and swallowing function in Japanese older adults: implications for sarcopenic dysphagia. J Am Geriatr Soc. 2012;60:1785–6.
23. Wakabayashi H. Presbyphagia and sarcopenic dysphagia: association between aging, sarcopenia, and deglutition disorders. J Frailty Aging 2014;3:97–103.
24. Tamura F, Kikutani T, Tohara T, Yoshida M, Yaegaki K. Tongue thickness relates to nutritional status in the elderly. Dysphagia. 2012;27:556–61.
25. Feng X, Todd T, Lintzenich CR, Ding J, Carr JJ, Ge Y, et al. Aging-related geniohyoid muscle atrophy is related to aspiration status in healthy older adults. J Gerontol A Biol Sci Med Sci. 2013;68:853–60.
26. Kelly-Hayes M, Beiser A, Kase CS, Scaramucci A, D'Agostino RB, Wolf PA. The influence of gender and age on disability following ischemic stroke: the Framingham study. J Stroke Cerebrovasc Dis. 2003;12:119–26.
27. Scherbakov N, Doehner W. Sarcopenia in stroke-facts and numbers on muscle loss accounting for disability after stroke. J Cachexia Sarcopenia Muscle. 2011;2:5–8.
28. Scherbakov N, von Haehling S, Anker SD, Dirnagl U, Doehner W. Stroke induced sarcopenia: muscle wasting and disability after stroke. Int J Cardiol. 2013;170:89–94.
29. Foley NC, Martin RE, Salter KL, Teasell RW. A review of the relationship between dysphagia and malnutrition following stroke. J Rehabil Med. 2009;41:707–13.
30. Scherbakov N, Dirnagl U, Doehner W. Body weight after stroke: lessons from the obesity paradox. Stroke. 2011;42:3646–50.
31. Zhao L, Du W, Zhao X, Liu L, Wang C, Wang Y, et al. Favorable functional recovery in overweight ischemic stroke survivors: findings from the China National Stroke Registry. J Stroke Cerebrovasc Dis. 2014;23:e201–6.
32. Burke DT, Al-Adawi S, Bell RB, Easley K, Chen S, Burke DP. Effect of body mass index on stroke rehabilitation. Arch Phys Med Rehabil. 2014. doi:10.1016/j.apmr.2014.01.019.

33. English C, McLennan H, Thoirs K, Coates A, Bernhardt J. Loss of skeletal muscle mass after stroke: a systematic review. Int J Stroke. 2010;5:395–402.
34. Rabadi MH, Coar PL, Lukin M, Lesser M, Blass JP. Intensive nutritional supplements can improve outcomes in stroke rehabilitation. Neurology. 2008;71:1856–61.
35. Ha L, Hauge T, Spenning AB, Iversen PO. Individual, nutritional support prevents undernutrition, increases muscle strength and improves QoL among elderly at nutritional risk hospitalized for acute stroke: a randomized, controlled trial. Clin Nutr. 2010;29:567–73.
36. Geeganage C, Beavan J, Ellender S, Bath PM. Interventions for dysphagia and nutritional support in acute and subacute stroke. Cochrane Database Syst Rev. 2012;10, CD000323.
37. Ensrud KE. Epidemiology of fracture risk with advancing age. J Gerontol A Biol Sci Med Sci. 2013;68:1236–42.
38. Iki M. Epidemiology of osteoporosis in Japan. Clin Calcium. 2012;22:797–803 [Article in Japanese].
39. Bell JJ, Bauer JD, Capra S, Pulle RC. Concurrent and predictive evaluation of malnutrition diagnostic measures in hip fracture inpatients: a diagnostic accuracy study. Eur J Clin Nutr. 2014;68:358–62.
40. Bell JJ, Bauer JD, Capra S. The malnutrition screening tool versus objective measures to detect malnutrition in hip fracture. J Hum Nutr Diet. 2013;26:519–26.
41. Pérez Durillo FT, Ruiz López MD, Bouzas PR, Martín-Lagos A. Nutritional status in elderly patients with a hip fracture. Nutr Hosp. 2010;25:676–81 [Article in Spanish].
42. Koren-Hakim T, Weiss A, Hershkovitz A, Otzrateni I, Grosman B, Frishman S, et al. The relationship between nutritional status of hip fracture operated elderly patients and their functioning, comorbidity and outcome. Clin Nutr. 2012;31:917–21.
43. Gumieiro DN, Rafacho BP, Gonçalves AF, Tanni SE, Azevedo PS, Sakane DT, et al. Mini nutritional assessment predicts gait status and mortality 6 months after hip fracture. Br J Nutr. 2013;109:1657–61.
44. Miyanishi K, Jingushi S, Torisu T. Mortality after hip fracture in Japan: the role of nutritional status. J Orthop Surg (Hong Kong). 2010;18:265–70.
45. Fiatarone Singh MA, Singh NA, Hansen RD, Finnegan TP, Allen BJ, Diamond TH, et al. Methodology and baseline characteristics for the sarcopenia and Hip fracture study: a 5-year prospective study. J Gerontol A Biol Sci Med Sci. 2009;64:568–74.
46. Di Monaco M, Vallero F, Di Monaco R, Tappero R. Prevalence of sarcopenia and its association with osteoporosis in 313 older women following a hip fracture. Arch Gerontol Geriatr. 2011;52:71–4.
47. Di Monaco M, Castiglioni C, Vallero F, Di Monaco R, Tappero R. Sarcopenia is more prevalent in men than in women after hip fracture: a cross-sectional study of 591 inpatients. Arch Gerontol Geriatr. 2012;55:e48–52.
48. Hida T, Ishiguro N, Shimokata H, Sakai Y, Matsui Y, Takemura M, et al. High prevalence of sarcopenia and reduced leg muscle mass in Japanese patients immediately after a hip fracture. Geriatr Gerontol Int. 2013;13:413–20.
49. Villani AM, Miller MD, Cameron ID, Kurrle S, Whitehead C, Crotty M. Development and relative validity of a new field instrument for detection of geriatric cachexia: preliminary analysis in hip fracture patients. J Cachexia Sarcopenia Muscle. 2013;4:209–16.
50. Avenell A, Handoll HH. Nutritional supplementation for hip fracture aftercare in older people. Cochrane Database Syst Rev. 2010;1, CD001880.
51. Hoekstra JC, Goosen JH, de Wolf GS, Verheyen CC. Effectiveness of multidisciplinary nutritional care on nutritional intake, nutritional status and quality of life in patients with hip fractures: a controlled prospective cohort study. Clin Nutr. 2011;30:455–61.
52. Anbar R, Beloosesky Y, Cohen J, Madar Z, Weiss A, Theilla M, et al. Tight calorie control in geriatric patients following hip fracture decreases complications: a randomized, controlled study. Clin Nutr. 2014;33:23–8.
53. Bell JJ, Bauer JD, Capra S, Pulle RC. Multidisciplinary, multi-modal nutritional care in acute hip fracture inpatients—results of a pragmatic intervention. Clin Nutr. 2013. doi:10.1016/j.clnu.2013.12.003.
54. Malafarina V, Uriz-Otano F, Gil-Guerrero L, Iniesta R, Zulet MA, Martinez JA. Study protocol: high-protein nutritional intervention based on β-hydroxy-β-methylbutirate, vitamin D3 and calcium on obese and lean aged patients with hip fractures and sarcopenia. The HIPERPROT-GER study. Maturitas. 2013;76:123–8.
55. Kortebein P. Rehabilitation for hospital-associated deconditioning. Am J Phys Med Rehabil. 2009;88:66–77.
56. Covinsky KE, Pierluissi E, Johnston CB. Hospitalization-associated disability: "She was probably able to ambulate, but I'm not sure". JAMA. 2011;306:1782–93.
57. Krumholz HM. Post-hospital syndrome—an acquired, transient condition of generalized risk. N Engl J Med. 2013;368:100–2.
58. Jain NB, Al-Adawi S, Dorvlo AS, Burke DT. Association between body mass index and functional independence measure in patients with deconditioning. Am J Phys Med Rehabil. 2008;87:21–5.
59. Guy N, Lerman Y, Justo D. Admission Norton scale scores (ANSS) correlate with rehabilitation outcome and length in elderly patients with deconditioning. Arch Gerontol Geriatr. 2012;54:381–4.
60. Bloem BR, Lagaay AM, van Beek W, Haan J, Roos RA, Wintzen AR. Prevalence of subjective dysphagia in community residents aged over 87. BMJ. 1990;300:721–2.
61. Kawashima K, Motohashi Y, Fujishima I. Prevalence of dysphagia among community-dwelling elderly individuals as estimated using a questionnaire for dysphagia screening. Dysphagia. 2004;19:266–71.
62. Roy N, Stemple J, Merrill RM, Thomas L. Dysphagia in the elderly: preliminary evidence of prevalence, risk factors, and socioemotional effects. Ann Otol Rhinol Laryngol. 2007;116:858–65.
63. Serra-Prat M, Hinojosa G, López D, Juan M, Fabré E, Voss DS, et al. Prevalence of oropharyngeal dysphagia and impaired safety and efficacy of swallow in independently living older persons. J Am Geriatr Soc. 2011;59:186–7.
64. Holland G, Jayasekeran V, Pendleton N, Horan M, Jones M, Hamdy S. Prevalence and symptom profiling of oropharyngeal dysphagia in a community dwelling of an elderly population: a self-reporting questionnaire survey. Dis Esophagus. 2011;24:476–80.
65. Steele CM, Greenwood C, Ens I, Robertson C, Seidman-Carlson R. Mealtime difficulties in a home for the aged: not just dysphagia. Dysphagia. 1997;12:43–50. discussion 51.
66. Park YH, Han HR, Oh BM, Lee J, Park JA, Yu SJ, et al. Prevalence and associated factors of dysphagia in nursing home residents. Geriatr Nurs. 2013;34:212–7.
67. Nogueira D, Reis E. Swallowing disorders in nursing home residents: how can the problem be explained? Clin Interv Aging. 2013;8:221–7.
68. Kuroda Y. Relationship between swallowing function, and functional and nutritional status in hospitalized elderly individuals. Int J Speech Lang Pathol Audiol. 2014;2:20–6.
69. Veldee MS, Peth LD. Can protein-calorie malnutrition cause dysphagia? Dysphagia. 1992;7:86–101.
70. Hudson HM, Daubert CR, Mills RH. The interdependency of protein-energy malnutrition, aging, and dysphagia. Dysphagia. 2000;15:31–8.
71. Lopes J, Russell DM, Whitwell J, Jeejeebhoy KN. Skeletal muscle function in malnutrition. Am J Clin Nutr. 1982;36:602–10.
72. Wakabayashi H, Sashika H, Matsushima M. Head lifting strength is associated with dysphagia and malnutrition in frail older adults. Geriatr Gerontol Int. 2014. doi:10.1111/ggi.12283.
73. Franchignoni F, Ozçakar L, Michail X, Vanderstraeten G, Christodoulou N, Frischknecht R. Publishing in physical and rehabilitation medicine. An update on the European point of view. Eur J Phys Rehabil Med. 2013;49:711–4.
74. Invernizzi M, Cisari C. Sarcopenia and muscular modifications in disabling pathologies of the elderly from the physical and

rehabilitation medicine: point of view. Eur J Phys Rehabil Med. 2013;49:107–9.
75. Cederholm T, Cruz-Jentoft AJ, Maggi S. Sarcopenia and fragility fractures. Eur J Phys Rehabil Med. 2013;49:111–7.
76. Carda S, Cisari C, Invernizzi M. Sarcopenia or muscle modifications in neurologic diseases: a lexical or patophysiological difference? Eur J Phys Rehabil Med. 2013;49:119–30.
77. Montero-Fernández N, Serra-Rexach JA. Role of exercise on sarcopenia in the elderly. Eur J Phys Rehabil Med. 2013;49:131–43.
78. Nutrition in convalescence and rehabilitation. Nutr Rev. 1945;3:59–61.
79. Palacios-Ceña D, Jiménez-García R, Hernández-Barrera V, Alonso-Blanco C, Carrasco-Garrido P, Fernández-de-Las-Peñas C. Has the prevalence of disability increased over the past decade (2000–2007) in elderly people? A Spanish population-based survey. J Am Med Dir Assoc. 2012;13:136–42.
80. Annual report on government measures for persons with disabilities (Summary) 2012. In: cabinet office. 2012. http://www8.cao.go.jp/shougai/english/annualreport/2012/pdf/s6.pdf Accessed 25 Apr 2014.

原著

摂食嚥下障害スクリーニング質問紙票EAT-10の日本語版作成と信頼性・妥当性の検証*

keywords：EAT-10、感度、特異度

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【目的】摂食嚥下障害スクリーニング質問紙票であるEAT-10の日本語版を作成し、信頼性・妥当性を検証する。【対象及び方法】EAT-10英語版の順翻訳、逆翻訳、英語原版と逆翻訳の整合性の検討を行い、EAT-10日本語版を作成した。次に摂食嚥下障害もしくは摂食嚥下障害疑いの要介護高齢者393人を対象にEAT-10日本語版を実施した。信頼性を内的整合性であるクロンバッハのα係数で、妥当性を臨床的重症度分類とスペアマンの順位相関係数でそれぞれ検討した。【結果】EAT-10日本語版を実施できたのは237人(60%)であった。クロンバッハのα係数は0.946であった。EAT-10を実施できない場合、摂食嚥下障害と誤嚥を有意に多く認めた。EAT-10と臨床的重症度分類に有意な負の相関(r=-0.530、p<0.001)を認めた。EAT-10で3点以上の場合、誤嚥の感度0.758、特異度0.749であった。【結論】EAT-10日本語版の信頼性・妥当性が検証された。EAT-10日本語版は、摂食嚥下障害スクリーニングに有用な質問紙票である。

【目的】

栄養管理で目標とする投与ルートは、経口摂取である。経口摂取を目指す上で、摂食嚥下障害の存在は大きな問題となる。摂食嚥下障害に適切に対応しないと誤嚥性肺炎、窒息、低栄養、脱水といった生命に関わる合併症だけでなく、食べる楽しみの喪失も生じる。そのため、適切な摂食嚥下機能の評価が大切である。

摂食嚥下障害のスクリーニングには、水飲みテスト、食物テスト、反復唾液嚥下テストといったスクリーニングテストだけでなく、質問紙票がある。2002年に大熊らは、15項目の質問で構成される嚥下障害スクリーニングの質問紙を開発した[1)]。この質問紙は、肺炎の既往、栄養状態、口腔・咽頭・食道機能、声門防御機構などが反映される構造で、「A＝重い症状」、「B：軽い症状」、「C：症状なし」の3段階で回答する。「Aの回答あり」を嚥下障害ありと考えると、特異度90.1%、感度92%といずれも高く、摂食嚥下障害のスクリーニングに有用である。

一方、2008年にBelafskyらはEating Assessment Tool-10(以下、EAT-10と略)を開発した[2)]。EAT-10は10項目の質問で構成され、それぞれ5段階(0点：問題なし、4点：ひどく問題)で回答し、合計点数が3点以上であれば異常と判定する。クロンバッハのα係数は0.960と高く、信頼性および基準関連妥当性が検証された。

海外ではスペイン語への翻訳とその妥当性について報告されている[3)]。近年、国際的に摂食嚥下障害の臨床研究で使用されつつある[4)~7)]。一方、日本語版の作成、報告はされていない。本研究の目的は、EAT-10の日本語版を作成して、その信頼性と妥当性を検証することである。

Translation, reliability, and validity of the Japanese version of the 10-item Eating Assessment Tool (EAT-10) for the screening of dysphagia.
受付日：2013年6月27日　　採用決定日：2013年9月10日

【対象及び方法】

1.EAT-10日本語版の作成

第1段階として、著者らで協議の上、EAT-10英語版から日本語のEAT-10順翻訳版を作成して、予備テストを実施した。第2段階として、EAT-10の使用権を有するネスレ日本株式会社で専門家のチェックを受けた後、日本語のEAT-10順翻訳版を英語に逆翻訳した。第3段階として、英語原版と逆翻訳版の整合性を検討し、順翻訳版を修正した。第4段階として、予備テストを再度行い、EAT-10日本語版を完成させた。

2.信頼性・妥当性の検証

次に、完成した日本語版EAT-10(イート・テン)(以下、単にEAT-10と略)を実際の患者で実施し、その信頼性と妥当性を検証した。対象は、摂食嚥下障害もしくは摂食嚥下障害疑いの要介護高齢者とした。取り込み基準は、2012年8月から12月に摂食嚥下障害もしくは摂食嚥下障害疑いを認める65歳以上の要介護高齢者とした。除外基準は設定しなかった。信頼性は、内的整合性であるクロンバッハの α 係数で検証した。

妥当性は、臨床的重症度分類(Dysphagia Severity Scale、以下DSSと略)との比較で基準関連妥当性を検証した。DSSは、摂食嚥下障害の重症度を7段階(7:正常範囲、6:軽度問題、5:口腔問題、4:機会誤嚥、3:水分誤嚥、2:食物誤嚥、1:唾液誤嚥)で評価する重症度分類である[8]。DSSが軽度問題以下(6:軽度問題、5:口腔問題、4:機会誤嚥、3:水分誤嚥、2:食物誤嚥、1:唾液誤嚥のいずれかの場合)であれば摂食嚥下障害あり、機会誤嚥以下(4:機会誤嚥、3:水分誤嚥、2:食物誤嚥、1:唾液誤嚥のいずれかの場合)であれば誤嚥ありと判断した。臨床で摂食嚥下障害に関わり対象者を担当している医療職が、臨床場面の観察からDSSで摂食嚥下機能を評価した。医療職がDSSを評価した後に、対象者がEAT-10を実施した。つまり、EAT-10の点数を考慮せずにDSSで評価した。

EAT-10の実施の可否とDSSの関連をカイ2乗検定で、EAT-10を実施できた場合の得点とDSSの関連をスペアマンの順位相関係数でそれぞれ検討した。次にEAT-10とDSSで軽度問題以下(摂食嚥下障害の有無)および機会誤嚥以下(誤嚥の有無)のReceiver Operating Characteristic 曲線(以下、ROC曲線と略)を作成した。また、DSSのカットオフ値を軽度問題以下、機会誤嚥以下とした場合の、EAT-10の実施困難時と3点以上の感度、特異度を検討した。

すべての統計学的解析で危険率を $\alpha=0.05$ とした。統計ソフトはSPSS20.0を使用した。倫理的配慮として、当院倫理審査委員会の承認を取得し、被験者には文書で同意を得た。

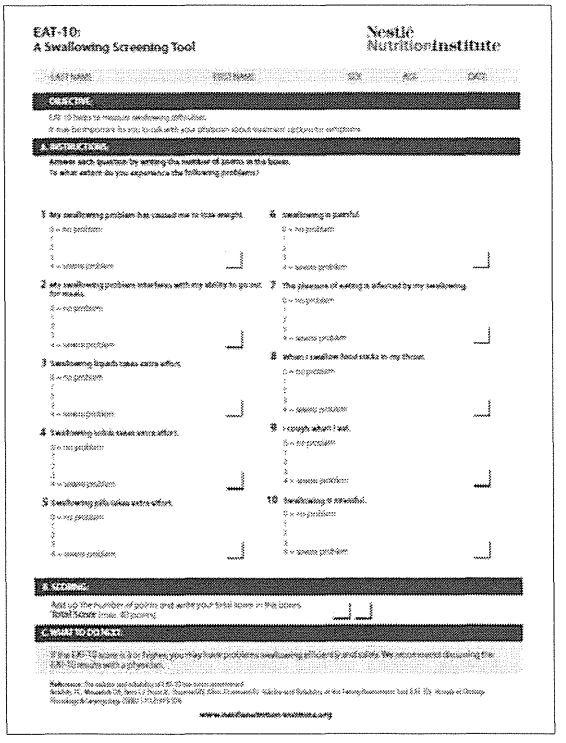
【結果】

1.EAT-10日本語版の完成

翻訳・逆翻訳の整合性の工程および予備テストを2回行い、日本語版の翻訳を完成させた。EAT-10英語版を**図1**に、EAT-10日本語版を**図2**にそれぞれ示す。

2.信頼性・妥当性

2012年8月から12月に調査を実施できた対象者は393人であった。平均年齢は83歳、男性130人、女性263人。セッティングは老人保健施設200人、急性期病院67人、


EAT-10:
A Swallowing Screening Tool

Nestlé Nutrition Institute

図1　EAT-10英語版

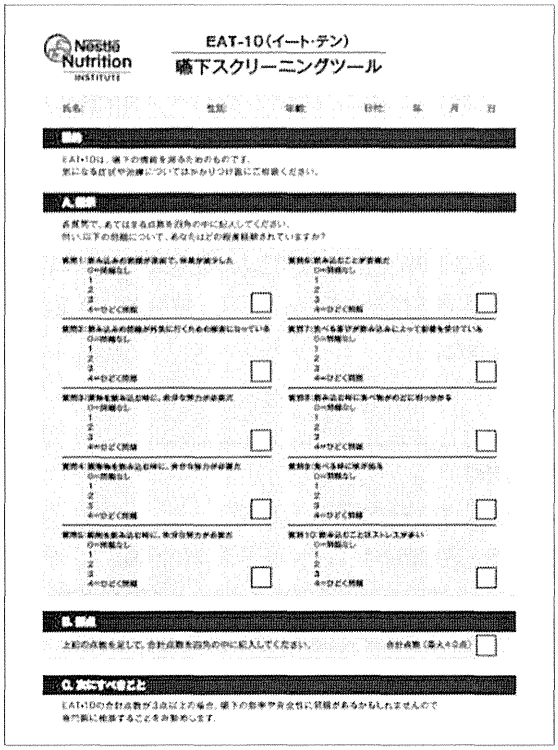

EAT-10(イート・テン)
嚥下スクリーニングツール

図2　EAT-10日本語版

在宅126人。主な疾患は脳血管障害216人、心不全68人、慢性肺疾患(慢性閉塞性肺疾患、気管支喘息、肺気腫、間質性肺炎など) 44人、パーキンソン病38人、悪性腫瘍23人であった(重複あり)。介護度は要支援1：4人、要支援2：15人、要介護1：32人、要介護2：33人、要介護3：51人、要介護4：107人、要介護5：124人、未申請27人。DSSは正常範囲82人、軽度問題86人、口腔問題53人、機会誤嚥59人、水分誤嚥50人、食物誤嚥38人、唾液誤嚥25人であった。

表1　EAT-10の実施可否とDSS軽度問題以下のクロス集計表

	DSS軽度問題以下	DSS正常範囲
EAT-10実施不可	152	4
EAT-10実施可能	159	78

カイ2乗52.5、p<0.001
感度：152÷(152+159) =0.489、特異度：78÷(4+78) =0.951

表2　EAT-10の実施可否とDSS機会誤嚥以下のクロス集計表

	DSS機会誤嚥以下	DSS口腔問題以上
EAT-10実施不可	110	46
EAT-10実施可能	62	175

カイ2乗75.2、p<0.001
感度：110÷(110+62) =0.640、特異度：175÷(46+175) =0.792

EAT-10を実施できたのは393人中237人(60％)であった。信頼性の検討では、クロンバッハの α 係数は0.946であった。妥当性の検討では、EAT-10を実施できなかった場合、軽度問題以下および機会誤嚥以下の摂食嚥下障害が有意に多かった(表1、表2)。EAT-10を実施できなかった場合の感度、特異度を表1、表2より計算すると、軽度問題以下で感度0.489、特異度0.951、機会誤嚥以下で感度0.640、特異度0.792であった。軽度問題以下の特異度が高く、EAT-10を実施できない場合、軽度問題以下の嚥下障害を認める可能性が高い。

次に、EAT-10を実施できた237人でDSSとの関連を検討した。平均年齢82歳、男性90人、女性147人。DSSは正常範囲78人、軽度問題64人、口腔問題33人、機会誤嚥29人、水分誤嚥26人、食物誤嚥3人、唾液誤嚥4人であった。EAT-10は、3点以上が101人、2点以下が136人で、中央値は1点(25パーセンタイル0点、75パーセンタイル9点)であった。

EAT-10とDSSに有意な負の相関(r=-0.530、p<0.001)を認めた。EAT-10とDSSで軽度問題以下および機会誤嚥以下のROC曲線を図3、図4に示す。機会誤嚥以下の場合、EAT-10で3点以上をカットオフ値としたときに、ROC曲線が左上隅に最も近かった。EAT-10を実施できた場合、EAT-10で3点以上の感度、特異度、ROC曲線下面積は、軽度問題以下で感度

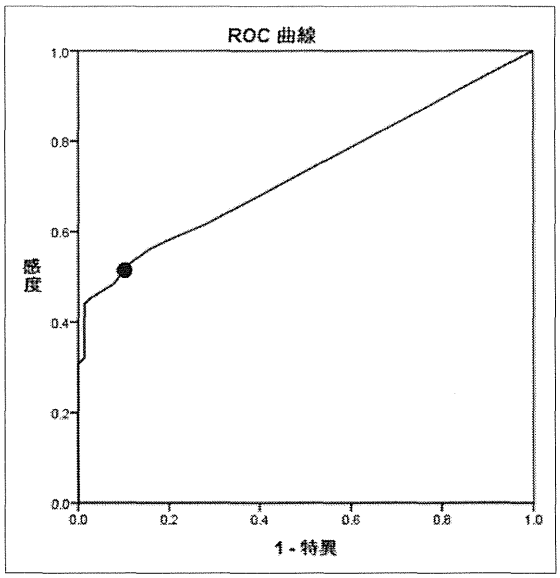


図3　EAT-10とDSS軽度問題以下のROC曲線
黒丸はEAT-10が3点以上の場合の感度・特異度

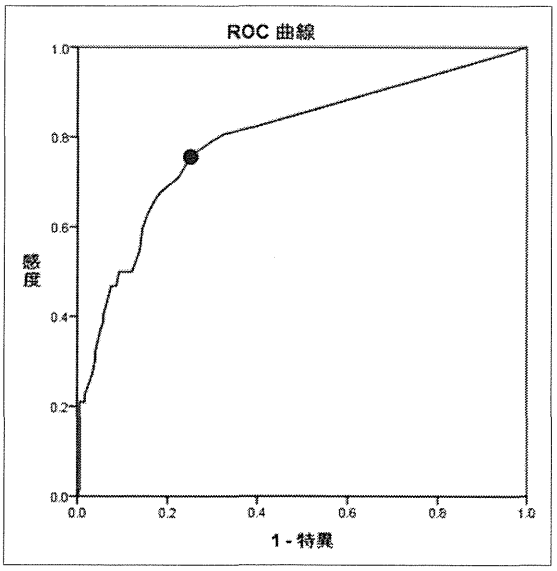


図4　EAT-10とDSS機会誤嚥以下のROC曲線
黒丸はEAT-10が3点以上の場合の感度・特異度

0.522、特異度0.897、ROC曲線下面積0.730、機会誤嚥以下で感度0.758、特異度0.749、ROC曲線下面積0.797であった。軽度問題以下の特異度が高く、EAT-10を実施できて3点以上の場合、軽度問題以下の嚥下障害を認める可能性が高い。

【考察】

海外で開発された質問紙票を日本語に翻訳する際には、順翻訳、逆翻訳、英語原版と逆翻訳の整合性の検討が必要である。この手順を踏んでEAT-10日本語版を作成した。

信頼性の検定では、クロンバッハのα係数は0.946と、EAT-10英語版の0.960と同様に高い値を示した。クロンバッハのα係数は0.8以上であれば内的整合性が良好とされており、内的整合性の高いことが検証された。ただし、クロンバッハのα係数が0.9以上と高すぎる場合、同じことを尋ねている質問項目が多く、いくつかの質問項目は不必要である[9]。そのため、質問項目を少なくしたEAT-10の改訂版を作成できる可能性がある。

妥当性の検定では、EAT-10とDSSに有意な負の相関を認め、基準関連妥当性が検証された。機会誤嚥以下では、EAT-10で3点以上のときにROC曲線が左上隅に最も近くなった。つまり、3点以上が誤嚥の有無を判定するカットオフ値として適当であることが示された。

質問紙票は認知症や失語症などを認める場合、実施困難なことが少なくない。今回の研究でも実施できたのは60%のみであった。しかし、EAT-10を実施できなかった場合に摂食嚥下障害を認めることが多く、EAT-10の実施可否が摂食嚥下障害スクリーニングとなることが示された。軽度問題以下の特異度が高いため、EAT-10を実施できない場合もしくはEAT-10で3点以上の場合、摂食嚥下機能に問題を認める可能性が高い。

一方、EAT-10で2点以下の場合、軽度問題以下の感度が0.522と低く、摂食嚥下障害がないとは判断しにくい。摂食嚥下障害の認識がまったくない患者の場合、EAT-10は0点となる。そのため、摂食嚥下障害の認識がない患者では、質問紙票以外の摂食嚥下スクリーニングの実施や食事場面の観察が必要である。

本研究には限界がいくつかある。最初にEAT-10日本語版を2回実施する再テスト法で信頼性を検討していない。本研究ではEAT-10を2回実施することは困難であり、クロンバッハのα係数で信頼性を検証した。しかし、要介護高齢者が対象者であり、再テスト法による信頼性は高くない可能性がある。今後、再テスト法による信頼性の検証が求められる。

次に摂食嚥下機能を嚥下造影検査ではなく、DSSという臨床場面の観察からの評価を用いた点である。今回の対象者は老人保健施設や在宅の要介護高齢者が多く、全員に嚥下造影検査を実施することは困難であった。摂食嚥下障害のゴールドスタンダードは嚥下造影検査であり、嚥下造影検査とEAT-10日本語版で妥当性を検証することが望ましい。しかし、臨床目的で嚥下造影検査を実施した方のみを研究対象とすると、摂食嚥下障害のない場合には当然、嚥下造影検査を実施しない。そのため、対象者のほぼ全員に摂食嚥下障害を認めることになり、妥当性の検証が難しい。一方、研究目的で摂食嚥下障害のない方に嚥下造影検査を実施することには、被曝による倫理的な問題がある。以上より、今回は臨床場面の観察によるDSSで、EAT-10日本語版の妥当性を検証した。

【結論】

EAT-10日本語版を作成し、信頼性・妥当性が検証された。EAT-10日本語版は、摂食嚥下障害スクリーニングに有用な質問紙票である。EAT-10を実施できない場合もしくはEAT-10で3点以上の場合、摂食嚥下機能に問題を認める可能性が高い。

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参考文献

1) 大熊るり, 藤島 一郎, 小島 千枝子ほか. 摂食・嚥下障害スクリーニングのための質問紙の開発. 日摂食嚥下リハ会誌6：3-8, 2002.
2) Belafsky PC, Mouadeb DA, Rees CJ, et al: Validity and reliability of the Eating Assessment Tool (EAT-10). Ann Otol Rhinol Laryngol 117(12): 919-24, 2008.
3) Burgos R, Sarto B, Segurola H, et al. Translation and validation of the Spanish version of the EAT-10 (Eating Assessment Tool-10) for the screening of dysphagia. Nutr Hosp 27: 2048-2054, 2012.
4) Ercilla M, Ripa C, Gayan M, et al. Prevalence of dysphagia in the older using 'Eating Assessment Tool-10' . Eur J Hosp Pharm 19: 205-206, 2012.
5) Lauret CD, Garnier PL, Borel S, et al. Understanding the use of self-evaluation questionnaires when assessing a patient's swallowing capacity and performing follow-up activities. Rev Laryngol Otol Rhinol (Bord) 133: 19-26, 2012.
6) Kelly EA, Koszewski IJ, Jaradeh SS, et al. Botulinum toxin injection for the treatment of upper esophageal sphincter dysfunction. Ann Otol Rhinol Laryngol 122: 100-108, 2013.
7) Belafsky PC, Plowman EK, Mehdizadeh O, et al. The upper esophageal sphincter is not round: a pilot study evaluating a novel, physiology-based approach to upper esophageal sphincter dilation. Ann Otol Rhinol Laryngol 122: 217-221, 2013.
8) 才藤栄一. 平成11年度厚生科学研究費補助金(長寿科学総合研究事業)「摂食・嚥下障害の治療・対応に関する統合的研究」総括研究報告書. 摂食・嚥下障害の治療・対応に関する統合的研究. 平成11年度厚生科学研究費補助金研究報告書 .p1-18, 1999.
9) 奥田千恵子. 医薬研究者のための評価スケールの使い方と統計処理. 金芳堂, 京都, 2007, p100-101.

Translation, reliability, and validity of the Japanese version of the 10-item Eating Assessment Tool (EAT-10) for the screening of dysphagia.

Keywords : EAT-10, sensitivity, specificity

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Objective: The 10-item Eating Assessment Tool (EAT-10) is specifically designed to address the clinical need for a rapidly self-administered and easily-scored questionnaire to assess dysphagia symptom severity. An EAT-10 score above 3 is abnormal and indicates the presence of swallowing difficulties. We translated the EAT-10 into Japanese, and studied the reliability and validity of the Japanese version of the EAT-10.

Method: Translation of EAT-10 was implemented in iterative process including forward translation, expert panel back-translation, and pre-testing. A cross-sectional study was performed in 393 elderly aged 65 years and above with dysphagia or suspected dysphagia. Severity of dysphagia was assessed by the Dysphagia Severity Scale (DSS). For assessment of reliability, we used Cronbach' s alpha coefficient. Validity was evaluated by examining the associations between the EAT-10 score and the DSS by Spearman's rank correlation coefficient. The sensitivity and specificity of the EAT-10 for dysphagia were also assessed.

Results: A total of 237 patients (60%) responded to the EAT-10. Cronbach' s alpha coefficient was 0.946. Elderly who could not respond to the EAT-10 were likely to have dysphagia. Median EAT-10 score of 237 respondents was 1 (0, 9), and 101 respondents were more than 3. There were significant correlations between the EAT-10 score and the DSS ($r=-0.530$、$p<0.001$). The sensitivity and specificity of EAT-10 with a score 3 or above for dysphagia were 0.522 and 0.897, for dysphagia with aspiration were 0.758 and 0.749, respectively.

Conclusion: The Japanese version of the EAT-10 is a useful swallowing screening tool.

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Head lifting strength is associated with dysphagia and malnutrition in frail older adults

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Aim: The purpose of the present study was to assess the association between head lifting strength, dysphagia and malnutrition in frail older adults.

Methods: A cross-sectional study was carried out in 386 frail older adults aged 65 years and older with dysphagia or suspected dysphagia. Head lifting strength was assessed by the Medical Research Council score. The severity of swallowing and nutritional status was evaluated using the Dysphagia Severity Scale and the Mini-Nutritional Assessment Short Form, respectively. Univariate and logistic regression analyses were applied to examine the associations between head lifting strength, dysphagia and malnutrition.

Results: There were 129 men and 257 women. The mean age was 83 years. The median Barthel Index score was 30 (interquartile range 5–65). A total of 189 (49%) older adults could independently lift their head. Based on the Dysphagia Severity Scale, 79 participants had no dysphagia, 138 had dysphagia without aspiration and 169 had dysphagia with aspiration. The Mini-Nutritional Assessment Short Form showed that 175 older adults were malnourished, 171 were at risk for malnutrition and 40 had a normal nutritional status. The Medical Research Council score in men was higher compared with women. Head lifting strength was significantly correlated with age ($r = -0.256$), the Barthel Index ($r = 0.540$), the Dysphagia Severity Scale ($r = 0.458$) and the Mini-Nutritional Assessment Short Form ($r = 0.331$). In logistic regression analysis, the Medical Research Council score was independently associated with both dysphagia with aspiration and malnutrition.

Conclusions: Head lifting strength is associated with dysphagia with aspiration and malnutrition in frail older adults. **Geriatr Gerontol Int 2014; ••: ••–••.**

Keywords: deglutition disorders, frailty, malnutrition, presbyphagia, sarcopenia.

Introduction

Dysphagia is common in older adults. The prevalence of dysphagia has been reported to range between 11.4–38% in community-dwelling elderly individuals,[1–5] and 40–68% in nursing home residents.[6–8] Dysphagia management is regarded as an important current and future public health issue in geriatric rehabilitation medicine as a result of the increased risk of complications, such as aspiration pneumonia, choking, dehydration, malnutrition and reduction in quality of life accompanying the loss of enjoyment during eating. Although dysphagia is primarily caused by stroke, presbyphagia and sarcopenic dysphagia can occur commonly in frail and sarcopenic older adults.[9]

Presbyphagia refers to age-related changes in the swallowing mechanism in older adults associated with a frailty in swallowing.[9] Presbyphagia differs from dysphagia, and can present with several findings, such as a lack of muscle strength complicating bolus propulsion, diminished lingual pressure, obstructing bolus driving or halting of the bolus while swallowing, which leads to more difficult cleansing of residues. Other manifestations include a decline in taste and smell that makes it more difficult to initiate swallowing, difficulty in controlling the bolus from the anticipatory phase, and entry of the bolus into the lower airway. Finally, lack of teeth and wearing or not wearing complete dentures can also influence chewing.[8]

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Sarcopenic dysphagia is characterized by difficulty in swallowing as a result of sarcopenia of the general skeletal muscles and swallowing muscles.[9–11] Sarcopenia has been described as a syndrome marked by progressive and generalized loss of skeletal muscle mass and strength. According to the European Working Group on Sarcopenia in Older People,[12] this syndrome has been associated with a risk of adverse outcomes, such as physical disability, poor quality of life and death. Similar to the European Working Group on Sarcopenia in Older People recommendation for evaluating sarcopenia, which includes the assessment of muscle mass, muscle strength and physical performance,[12] the examination for sarcopenic dysphagia entails an evaluation of the swallowing muscle mass, swallowing muscle strength and swallowing function.

Age-related loss of swallowing muscle mass in the tongue and geniohyoid muscle has been previously studied.[13,14] Methods for assessing swallowing function include the use of a dysphagia screening questionnaire, such as the 10-item Eating Assessment Tool[15,16] bedside dysphagia screening tests, such as a water test combined with pulse oximetry,[17] observation of the individual during eating, videofluoroscopy and videoendoscopic evaluation of swallowing. Quantitatively, swallowing function can be evaluated using the Functional Oral Intake Scale,[18] the Food Intake Level Scale[19] and the Dysphagia Severity Scale (DSS).[20] In contrast, few methods for measuring swallowing muscle strength exist. Tongue pressure has been primarily studied as an assessment tool for swallowing muscle strength. Tongue pressure, reduced by aging, has been associated with symptoms of dysphagia.[21,22] The jaw-opening force test might be a useful screening tool for predicting pharyngeal residue.[23] However, evaluating tongue pressure and jaw-opening force quantitatively requires a tongue pressure measurement device and a sthenometer, which might not be readily utilized in daily clinical practice. It is therefore important to develop a simple tool for assessing swallowing muscle strength in frail older adults with presbyphagia and sarcopenic dysphagia.

Head lifting strength can reflect the strength of the suprahyoid muscles, a group of four swallowing-related muscles. A systematic review of the effects of head lift exercise on swallowing function reported beneficial effects, including an increase in the anterior excursion of the larynx and anteroposterior diameter of the upper esophageal sphincter opening, which was associated with elimination of dysphagic symptoms.[24] Although head lifting strength appeared to be associated with dysphagia, this systematic review included only patients who could independently lift their head. Measuring the genio-sternum distance grade (GS grade) is a method for assessing suprahyoid muscle strength.[25] The patient is placed in the supine position with the neck passively and fully flexed, and is directed to maintain this position with the chin down. Support is then withdrawn and the level to which the head drops is evaluated in four steps.[25] GS grade can be readily used in daily clinical practice, but is only suitable for patients who can independently lift their head. Some frail older adults cannot lift their head by themselves, and there were no studies investigating the association between the ability of head lifting strength and dysphagia. Therefore, whether head lifting strength is associated with the severity of dysphagia is yet to be determined. Whereas older adults with dysphagia are often malnourished, and dysphagia has been associated with malnutrition in nursing home and stroke patients in systematic reviews,[26,27] the relationship between head lifting strength and malnutrition is unknown. The current study aimed to investigate the association between head lifting strength, dysphagia and malnutrition in frail older adults.

Methods

A cross-sectional study was carried out in 386 frail older adults, aged 65 years and older, residing in three geriatric health services facilities, two acute hospitals, and community-dwellings between August and December 2012. Study participants were recruited by research collaborators involved in dysphagia rehabilitation at the Japanese Association of Rehabilitation Nutrition. The inclusion criteria selected individuals aged at least 65 years who were eligible for the long-term care insurance program as a result of frailty or disability, and carried a diagnosis of dysphagia or suspected dysphagia. Individuals with terminal-stage malignancy were excluded. The ethics committee of the Yokohama City University Medical Center approved the study. All participants or their legal representatives provided informed consent before enrolment.

Data were collected at geriatric health service facilities, acute hospitals or the participants' homes by 24 research collaborators, including doctors, dentists, nurses, speech therapists, physical therapists, occupational therapists, dental hygienists and registered dietitians. To maximize consistency in data collection across different settings, only researchers involved in dysphagia rehabilitation in daily clinical practice were designated as study collaborators. A study group was assembled to discuss data collection methods, which entailed the use of standardized questionnaires and a manual for implementing the questionnaires.

The research collaborators assessed variables, such as head lifting strength, the severity of dysphagia, activities of daily living and nutritional status. Head lifting strength was manually tested by placing the chin downwards toward the sternum, and scored using the Medical Research Council (MRC) scale.[28] Applying a six-point ordinal scale, MRC scores ranging from 0 to 5