



## Original article

# Association between board-certified physiatrist involvement and functional outcomes in sarcopenic dysphagia patients: a retrospective cohort study of the Japanese Sarcopenic Dysphagia Database

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## Abstract

**Objective:** Dysphagia rehabilitation is an important area in geriatric nutrition due to the commonality of sarcopenic dysphagia in older adults. However, there have been no reports on the efficacy of treatment by board-certified physiatrists (BCP) in patients with sarcopenic dysphagia. This study therefore aimed to investigate whether intervention by board-certified physiatrists affects the functional prognosis of patients with sarcopenic dysphagia.

**Materials and Methods:** Of 467 patients enrolled in the Japanese Sarcopenic Dysphagia database between November 2019 and March 2021, 433 met the study eligibility criteria. The patients were divided into two groups based on whether or not they received intervention by a BCP. The clinical characteristics and outcomes of the two groups were compared. Statistical analyses were performed by inverse probability weighting (IPW).

**Results:** BCPs were involved in the management of 57.0% of patients with sarcopenic dysphagia. These patients had a significantly higher increase in the Barthel index both before and after IPW correction than those not managed by a BCP ( $P=0.001$  and  $P=0.016$ , respectively). However, sarcopenic dysphagia significantly improved in the non-BCP group before IPW correction ( $P<0.001$ ), although there was no significant difference after IPW correction ( $P=0.301$ ).

**Conclusion:** BCP management was significantly associated with higher activities of daily living (ADL), but not with an improvement in sarcopenic dysphagia. To provide and manage effective rehabilitation, it is necessary to familiarize patients with the management and training of sarcopenic dysphagia rehabilitation for BCP in order to cope in regions with few rehabilitation units.

**Key words:** board-certified physiatrists, dysphagia, functional prognosis

(J Rural Med 2023; 18(1): 21–27)

## Introduction

Dysphagia rehabilitation is an important area of geriatric nutrition due to the commonality of dysphagia in older

people. Dysphagia has many causes, including organic diseases such as laryngeal cancer, inflammation and sarcopenia<sup>1, 2</sup>, and functional causes such as cerebrovascular diseases, neuromuscular diseases (e.g., Parkinson's disease<sup>3, 4</sup>), and psychogenic diseases such as depression and anorexia<sup>5</sup>. Dysphagia is a common cause of aspiration pneumonia in frail elderly individuals in Japan<sup>6–8</sup>. This condition can be diagnosed by either observation or screening involving instrumental swallowing examinations, such as videofluoroscopy and video-endoscopy, the latter of which is further performed to determine the severity of functional abnormalities and treatment prognosis<sup>9, 10</sup>. The effectiveness of rehabilitation for dysphagia with direct and indirect therapies is generally observed sporadically with and without food, respectively. Swallowing rehabilitation has been shown to

Received: May 28, 2022

Accepted: October 7, 2022

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be effective and can be used in conjunction with compensatory techniques<sup>11, 12</sup>.

Rehabilitation for sarcopenic dysphagia should involve treatments for both dysphagia and sarcopenia. Therefore, rehabilitation for sarcopenic dysphagia should be performed by an interdisciplinary team. Within this team, the involvement of a board-certified physiatrist (BCP) led to improvements in some rehabilitation outcomes, although the effect of their involvement in patients with dysphagia has not yet been evaluated. BCPs are certified by a governance board after verification of their knowledge and skills in rehabilitation medicine. In Japan, BCP is one of the basic domain specialties established by the Japanese Association of Rehabilitation Medicine. To be certified as a BCP, the doctor needs to have completed training over three years, given two presentations at the society congress, be in charge of rehabilitation of 100 cases, and have prepared 30 case reports. They also needed to pass the examination conducted by the Japanese Association of Rehabilitation Medicine<sup>13</sup>. The role of the BCP is to improve functional prognosis, plan rehabilitation programs, assess risks, and set goals for therapists. BCP involvement increases the efficiency of a team approach, and has the benefits of improving the quality of clinical practice, ensuring the appropriate management of comorbidities, safe management of rehabilitation, and better functional outcomes.

Kinoshita *et al.*<sup>14</sup> and Momosaki *et al.*<sup>15</sup> previously analyzed the Japan Rehabilitation Database and showed that BCP involvement was an effective management strategy. The involvement of a BCP led to an improvement in activities of daily living (ADL), shortened the hospitalization period, and improved the rate of discharge of patients to their homes. A study using data from the traumatic brain injury model system in the United States further reported that the ADL of patients with brain trauma was improved by the involvement of a BCP<sup>16</sup>. Kato *et al.* evaluated the association between the number of BCP and the volume of rehabilitation, and identified regional disparities in the number of BCPs, as well as a correlation between the number of BCPs and the provision of rehabilitation units<sup>17</sup>. However, as yet there have been no reports on the efficacy of BCP in patients with sarcopenic dysphagia. Therefore, this study aimed to investigate the association between BCP involvement and rehabilitation outcomes, such as ADL and swallowing function, in patients with sarcopenic dysphagia.

## Material and Methods

### Study design and participants

This retrospective, observational cohort study analyzed the Japanese Sarcopenic Dysphagia Database (JSDD) constructed by the Rehabilitation Nutrition Database Committee of the Japanese Association of Rehabilitation Nutrition

and the Japanese Working Group on Sarcopenic Dysphagia<sup>18</sup>. The data were registered between November 2019 and March 2021. Sarcopenic dysphagia patients aged 20 years and older with available data on the Food Intake Level Scale (FILS) were included in the study. FILS is a method used to evaluate dysphagia with the patients' level of food intake observed and divided into the following 10 categories: levels 1–3, no oral intake; levels 4–6, oral intake and alternative nutrition; levels 7–9, only by ingestion; and level 10, normal<sup>19</sup>. Patients with levels <8 were included in the study database. The inclusion criteria were registration in the JSDD. The only exclusion criterion was loss of follow-up data due to death or other reasons.

All potential care settings were included in the study, including acute care, rehabilitation or long-term care hospitals, other facilities, and home-visit rehabilitation. The database included data on basic patient information, ADL assessment, evaluation of dysphagia, information on facilities, and whether a BCP was involved in patient management. The database was constructed by the Research Electronic Data Capture (REDCap) using free electronic data capture<sup>20</sup>. The patients were divided into two groups (BCP and non-BCP) according to BCP involvement. Informed consent was obtained using a consent/explanation document approved by the institutional ethics committee, and after confirming that the patient fully understood the contents, consent to participate was obtained in writing. The ethics committee of Nihon University Hospital approved this study (approval number: 20190907).

### Measurements

#### Variables and outcomes

The following information was extracted from the registry: age, sex, comorbidity severity (Charlson comorbidity index [CCI]), nutritional status (Global Leadership Initiative on Malnutrition [GLIM] criteria), FILS, Barthel index (BI), physical findings (body mass index [BMI], hand grip strength, and calf circumference), cause of dysphagia, dwelling (acute care hospital, rehabilitation hospital, long-term care hospital, others), and staff involvement (physical therapist, occupational therapist, speech-language pathologist, pharmacist, nurse, registered dietitian, dental hygienist, dentist, or physician other than a BCP).

Comorbidities were assessed using the CCI<sup>21</sup>, an indicator of the presence of multiple comorbidities, including diabetes with chronic complications, heart failure, kidney disease, liver disease, chronic lung disease, dementia, hemiplegia or paraplegia, malignancy, and acquired immunodeficiency syndrome/human immunodeficiency virus infection. This index classifies patients according to the presence of one, two, three, four, five, or  $\geq$  five comorbidities. The GLIM is a diagnostic criterion for undernutrition constructed in 2018 by representatives of four major interna-

tional academic societies on nutrition<sup>22</sup>). The GLIM assesses phenotypic criteria, including body weight change, thinness (low BMI), and reduced muscle mass, as well as etiologic criteria, including poor nutritional intake and disease burden. The causes of disease were classified as cancer, dementia, Parkinson's disease, cerebral hemorrhage, subarachnoid hemorrhage, stroke, and sarcopenic dysphagia.

Sarcopenic dysphagia was diagnosed using a reliable and validated diagnostic algorithm that divided patients into three categories: probable, possible, or no sarcopenic dysphagia<sup>23</sup>). To assess improvements in dysphagia, Shimizu *et al.* used an increase in FILS of  $\geq 2$  points to indicate that swallowing function had improved<sup>24</sup>). The current study also defined improved swallowing function as an increase in FILS of  $\geq 2$  points. The ability to perform ADL was evaluated using the BI, which comprises 10 items with the sum of their scores, producing a possible total of 100 points. These ten items were eating, moving, grooming, toilet use, bathing, walking, going upstairs and downstairs, changing clothes, bowel control, and bladder control. An increase in BI was defined as the difference in total BI between admission and discharge<sup>25</sup>). The primary outcome of the study was an increase in BI, and the secondary outcome was the FILS score at the end of follow-up.

### Statistical analysis

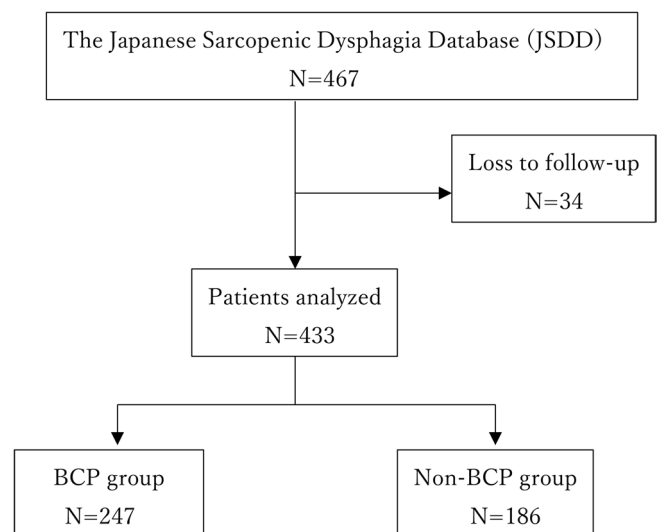
Statistical analyses were performed using IBM SPSS Statistics version 23 (IBM Corporation, Armonk, NY, USA). Normally distributed variables are expressed as the mean  $\pm$  standard deviation (SD), and variables with a skewed distribution are expressed as the median and interquartile range. Inverse probability weighting (IPW) was performed to minimize the effect of selection bias<sup>26</sup>). Propensity scores were estimated by logistic regression analysis using the baseline covariates of age, sex, BMI, FILS on admission, CCI, dwelling, BI at admission, number of drugs, cause of dysphagia, staff involvement, and BI on admission. IPW uses propensity scores to calculate the weighting of data. The effect of BCP involvement on the outcomes was analyzed using a generalized linear model after adjusting for the IPW propensity score. A BCP-group and non-BCP groups with no differences in baseline covariates in IPW were generated. The two groups were subsequently compared using Student's t-test and  $\chi^2$ -test. The BCP group was weighted by the inverse of the propensity score, whereas the non-BCP group was weighted by the inverse of 1 minus the propensity score. All patients were evaluated with or without IPW adjustment of data. Generalized estimating equations (GEE) were used to estimate the propensity scores to compensate for differences between institutions<sup>27</sup>). Statistical significance was set at  $P < 0.05$ .

## Results

Of the 467 patients in the JSDD group, 433 met the eligibility criteria (Fig. 1). Table 1 shows the demographic and clinical characteristics of the eligible subjects and the data adjusted by IPW. Of the 433 remaining patients, 247 (52.9%) were managed using BCP. The mean age of the patients was  $>80$  years, and 48.7 were female. At admission, the median BI was 25, and the median FILS score was 7. The unadjusted results showed that the FILS score was significantly higher in the BCP group ( $P < 0.001$ ), and the  $\chi^2$  test showed significant differences ( $P < 0.001$ ) between the two groups in terms of dwelling and CCI. After adjustment of the data using IPW, the demographic and clinical characteristics were matched between the BCP and non-BCP groups.

The percentage of staff involvement in the BCP and non-BCP groups is shown in Table 2. In the unadjusted results, the involvement of speech-language pathologists, registered dietitians, and physicians other than a BCP was significantly higher in the non-BCP group ( $P < 0.001$ ,  $P = 0.002$ , and  $P < 0.001$ , respectively), while the involvement of pharmacists, dentists, and occlusion therapists was significantly higher in the BCP group ( $P < 0.001$ ,  $P < 0.001$ , and  $P = 0.012$ , respectively). The percentage of staff involvement between the two groups was adjusted after the IPW.

The outcomes of the BCP and non-BCP groups are presented in Table 3. The median increase in BI was higher in the BCP group before ( $P = 0.001$ ) and after ( $P = 0.016$ ) IPW adjustment. At the end of the follow-up, the median FILS of the unadjusted data was significantly higher in the BCP group ( $P = 0.001$ ). However, the median FILS showed no significant difference between the BCP and non-BCP groups after adjusting for IPW ( $P = 0.791$ ).



**Figure 1** Flowchart of the study participant selection process. BCP: board-certified physiatrists.

**Table 1** Demographic and clinical characteristics of all the subjects and data adjusted by IPW

	Total (n=433)	All subjects			Data adjusted by IPW		
		BCP (n=247)	Non-BCP (n=186)	<i>P</i> -value	BCP (n=247)	Non-BCP (n=186)	<i>P</i> -value
Mean age ± SD, y	80.3 ± 11.3	80.3 ± 11.1	80.4 ± 11.7	0.933 <sup>a</sup>	81.8 ± 11.9	80.7 ± 8.1	0.701 <sup>a</sup>
Sex, female, (%)	48.7	44.5	54.3	0.044 <sup>b</sup>	52.7	47.3	0.499 <sup>b</sup>
BMI ± SD, (kg/m <sup>2</sup> )	20.3 ± 3.8	20.3 ± 3.7	20.3 ± 3.9	0.917 <sup>a</sup>	20.3 ± 3.3	19.1 ± 2.7	0.079 <sup>a</sup>
CCI, (%)				<0.001 <sup>b</sup>			0.147 <sup>b</sup>
0	25.6	32.0	17.2		20.1	12.4	
1	7.2	8.5	5.4		4.6	2.4	
2	29.3	32.4	25.3		36.2	10.1	
3	12.5	8.5	17.7		5.9	9.5	
>4	25.4	18.6	34.4		33.1	65.6	
Nutrition status							
GLIM malnutrition, (%)	64	63.2	65.1	0.906 <sup>a</sup>	68.3	84.5	0.199 <sup>a</sup>
Number of drugs on admission, [IQR]	6 [4,8]	6 [4,9]	6 [3,8]	0.022 <sup>a</sup>	6 [4,8]	5 [3,8]	0.880 <sup>a</sup>
Hand grip strength, kg	13.3 ± 9.3	13.6 ± 9.2	12.8 ± 9.4	0.363 <sup>a</sup>	12.4 ± 9.2	11.6 ± 6.4	0.540 <sup>a</sup>
CC, cm,	28.4 ± 4.0	28.7 ± 4.1	28.0 ± 4.0	0.076 <sup>a</sup>	28.0 ± 4.1	28.3 ± 2.6	0.693 <sup>a</sup>
Sarcopenia, (%)	87.1	87.4	86.6	0.786 <sup>b</sup>	84.1	94.5	0.118 <sup>b</sup>
Cause of dysphagia, (%)				0.001 <sup>b</sup>			0.275 <sup>b</sup>
Cancer	1.6	0.4	3.2		5.7	1.0	
Dementia	2.8	2.8	2.7		2.7	1.2	
Parkinson's disease	3.2	4.0	2.2		4.1	2.7	
Cerebral hemorrhage	4.4	5.7	2.7		3.3	0.7	
Subarachnoid hemorrhage	2.1	2.8	1.1		1.7	0.3	
Cerebral infarction	16.9	17.0	16.7		11.7	6.4	
Sarcopenic dysphagia	61.4	64.0	58.1		69.4	83.1	
Others	7.6	3.2	13.4		2.3	6.4	
Barthel index on admission, [IQR]	25 [25,50]	30 [10,50]	20 [5,50]	0.605 <sup>a</sup>	15 [0,45]	20 [5,50]	0.051 <sup>a</sup>
FILS score on admission, [IQR]	7 [3,8]	7 [7,8]	6 [1,7]	<0.001 <sup>a</sup>	7 [3,7]	7 [4,8]	0.201 <sup>a</sup>
Dwelling, (%)				<0.001 <sup>b</sup>			0.816 <sup>b</sup>
Acute care hospital	43.0	21.9	71.0		41.3	33.1	
Rehabilitation hospital	46.9	77.7	5.9		58.5	3.7	
Long term care hospital	9.5	0	22.0		0	10.8	
Others	0.7	0.4	1.6		0.2	52.4	

IPW: inverse probability weighting; BCP: board-certificated physiatrists; SD: standard deviation; BMI: body mass index; CCI: Charlson co-morbidity index; GLIM: global leadership initiative on malnutrition; IQR: interquartile range; CC: calf circumference, FILS: food intake level scale. <sup>a</sup>: \*Definition?\*, <sup>b</sup>: \*Definition?\*

**Table 2** Percentage of staff involvement in the BCP and non-BCP groups

	Total (n=433)	All subjects			Date adjusted by IPW		
		BCP (n=247)	Non-BCP (n=186)	<i>P</i> -value	BCP (n=247)	Non-BCP (n=186)	<i>P</i> -value
Staff involvement, (%)							
Physical therapist	97.5	98.0	96.8	0.313 <sup>a</sup>	98.2	96.5	0.238 <sup>a</sup>
Occupational therapist	75.5	79.8	69.9	0.012 <sup>a</sup>	59.1	33.7	0.268 <sup>a</sup>
Speech-language pathologist	70.4	62.3	81.2	<0.001 <sup>a</sup>	77.1	89.2	0.191 <sup>a</sup>
Pharmacist	82.4	89.9	72.6	<0.001 <sup>a</sup>	87.0	34.3	0.176 <sup>a</sup>
Nurse	97.0	96.4	97.8	0.411 <sup>a</sup>	92.5	98.0	0.220 <sup>a</sup>
Registered dietitian	91.2	87.4	96.2	0.002 <sup>a</sup>	87.0	43.6	0.050 <sup>a</sup>
Dental hygienist	56.6	56.7	56.5	0.520 <sup>a</sup>	44.9	25.3	0.301 <sup>a</sup>
Dentist	53.8	61.1	44.1	<0.001 <sup>a</sup>	37.4	22.2	0.338 <sup>a</sup>
Physicians other than BCP	85.7	75.7	98.9	<0.001 <sup>a</sup>	88.1	46.0	0.062 <sup>a</sup>

BCP: board-certificated physiatrists; IPW: inverse probability weighting. <sup>a</sup>Unpaired t-test.

**Table 3** Outcomes in the BCP and non-BCP groups

	BCP (n=247)	Non-BCP (n=186)	P-value
Unadjusted data (n=433)			
Barthel index score, [IQR]			
At the end of follow-up	55 [30,80]	45 [10,70]	0.026 <sup>a</sup>
Barthel index increase	20 [5,35]	5 [0,25]	0.001 <sup>a</sup>
FILS score, [IQR]			
At the end of follow-up	8 [7,8]	7 [6,8]	0.001 <sup>a</sup>
Improvement in FILS $\geq$ 2 points, (%)	28.7	46.8	<0.001 <sup>a</sup>
Data adjusted by IPW (n=433)			
Barthel index score, [IQR]			
At the end of follow-up	35 [20,80]	35 [20,80]	0.562 <sup>a</sup>
Barthel index increase	20 [5,25]	20 [0,25]	0.016 <sup>a</sup>
FILS score, [IQR]			
At the end of follow-up	7 [6,8]	6 [7,8]	0.791 <sup>a</sup>
Improvement in FILS $\geq$ 2 points, (%)	41.3	33.7	0.301 <sup>a</sup>

BCP: board-certificated physiatrists; IQR: interquartile range; FILS: food intake level scale; IPW: inverse probability weighting. <sup>a</sup>Unpaired t-test.

## Discussion

The three major findings of this study confirmed the efficacy of BCP in patients with sarcopenic dysphagia. First, the improvement in ADL was significantly higher when BCP was involved in the management of such patients; second, there was no difference in the improvement of swallowing function between patients with and without BCP involvement; third, 43% of patients with sarcopenic dysphagia were managed without involvement of a BCP. To the best of our knowledge, this is the first study to demonstrate a relationship between BCP involvement and functional prognosis in patients with dysphagia.

There is evidence to suggest that ADLs in patients with dysphagia can be significantly improved by BCP. Greiss *et al.* described the effectiveness of BCP involvement using data from 148 cases in a traumatic brain injury model system and suggested that early involvement of BCP was effective at improving ADL<sup>16</sup>. Similarly, Kinoshita *et al.* verified the effectiveness of BCP involvement in acute stroke patients and found that it shortened the length of hospital stay and improved ADL<sup>14</sup>. In our study, several different institutions were included, with different rehabilitation outcomes and clustering observed between the institutions. Following adjustment of the data using IPW propensity scores calculated using generalized estimating equations, ADL in the BCP group was found to be significantly improved. The reason for this improvement was that BCP involvement increased the quality of rehabilitation and risk assessment, while appropriate and high rehabilitation goal setting and a team approach led to improvements in ADL. Momosaki *et al.* previously described how the involvement of a BCP improved

ADL, and suggested that an efficient team approach, safety management, and management of comorbidities maintained good physical conditions and rehabilitation<sup>15</sup>. The same reason may explain why the involvement and characteristics of the BCPs in the current study may have influenced ADL improvement in patients with dysphagia.

We found no difference in the improvement in swallowing function between patients with and without BCP involvement. Sura *et al.* emphasized the importance of team events in swallowing management and stated that the involvement of many professionals may contribute to the management of dysphagia symptoms in a given patient<sup>28</sup>. Yoshimura *et al.* previously reported the prevalence of sarcopenia and its association with ADL and dysphagia and showed that ADL and dysphagia were independently associated with sarcopenia<sup>29</sup>. It has also been suggested that sarcopenia with disabilities should be assessed in all patients in rehabilitation settings<sup>30</sup>. In our study, sarcopenic dysphagia was observed in 61.4% of patients before the data were adjusted using IPW. Interdisciplinary rehabilitation nutrition aimed at improving malnutrition, sarcopenia, and function may all be useful in treating sarcopenic dysphagia<sup>31</sup>. Therefore, BCPs should consider the diagnosis and treatment of sarcopenia and implement rehabilitation nutrition during their daily clinical practice.

Our study showed that a BCP was not involved in the management of 43% of patients with sarcopenic dysphagia. It is estimated that approximately 4,000 BCPs are required in Japan; however, the current number remains only around 2,000<sup>32</sup>. Kato *et al.* previously referred to the regional disparities in the number of BCPs in Japan. The level of rehabilitation provided correlates with the number of BCPs,

which indicates that more BCP need to be trained<sup>17)</sup>. In addition, there are insufficient numbers of BCPs and educational opportunities for this clinical discipline. Martin *et al.* previously stated that a significant number of problems warranting critical self-analysis of all aspects of this educational endeavor existed, and increased productivity was required because of the shortage of BCPs in this specialty<sup>33)</sup>. These results suggest that BCPs should be trained in the management of rehabilitation nutrition for sarcopenic dysphagia, by providing appropriate diagnosis, goal setting, and interventions.

Overall, the results of this study suggest that it is necessary to familiarize BCPs with the management and training of dysphagia rehabilitation to allow them to cope in regions with few rehabilitation units.

This study has several limitations which should be mentioned. First, it is unclear how BCPs performed dysphagia rehabilitation and ADL improvement at different hospitals. Second, we did not evaluate any rehabilitation program for patients with sarcopenic dysphagia. Further detailed studies are required to assess the effectiveness of BCP involvement and rehabilitation programs.

## Conclusion

The improvement in ADL in patients with sarcopenic dysphagia was significantly higher when a BCP was involved in their management. However, we found no differ-

ence in the improvement of swallowing function between patients with and without BCP involvement. BCPs were not involved in 43% of patients with sarcopenic dysphagia. Engaging in rehabilitation nutrition with the aim of improving malnutrition, sarcopenia symptoms, and function using a team approach including a BCP may improve the swallowing function in patients with sarcopenic dysphagia.

**Ethics:** This study was performed in accordance with the ethical standards established in the 1964 Declaration of Helsinki and its amendments and was approved by the ethics committee of Nihon University Hospital (approval number: 20190907).

**Conflict of interest:** Hidetaka Wakabayashi was funded by a grant from the Japan Society for the Promotion of Science (grant number19H03979). Takako Nagai, Shinta Nishioka, and Ryo Momosaki have no conflicts of interest to disclose.

## Acknowledgments

We would like to acknowledge the Rehabilitation Nutrition Database Committee of the Japanese Association of Rehabilitation Nutrition and the Japanese Working Group on Sarcopenic Dysphagia, which constructed the Japanese sarcopenic dysphagia database used in this study.

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