doi: 10.2490/prm.20240005 Progress in Rehabilitation Medicine 2024; Vol. 9, 20240005

ORIGINAL ARTICLE

Prognostic Value of Dysphagia for Activities of Daily Living Performance and Cognitive Level after Stroke

Takenori Hamada, SLP [a] Yoshihiro Yoshimura, MD, PhD [b] Fumihiko Nagano, RPT [a] Ayaka Matsumoto, RPh [c] Sayuri Shimazu, RD [d] Ai Shiraishi, DH [e] Takahiro Bise, RPT [a] and Yoshifumi Kido, ORT [a]

Objectives: The purpose of this study was to examine the association between baseline dysphagia and the improvement of activities of daily living performance and cognitive level among inpatients after stroke. **Methods:** This was a retrospective cohort study of patients undergoing convalescent rehabilitation after stroke. Dysphagia was assessed using the Food Intake LEVEL Scale. Outcomes were the motor and cognitive scores of the Functional Independence Measure (FIM) at discharge. Multiple regression analysis was performed to examine the association between dysphagia at admission and these outcomes. **Results:** There were 499 participants with a median age of 74 years. A multiple regression analysis was carried out after adjusting for potential confounders including age and sex. Dysphagia at admission was independently and negatively associated with motor ($\beta=-0.157$, $P<0.001$) and cognitive ($\beta=-0.066$, $P=0.041$) FIM scores at discharge. **Conclusions:** Baseline dysphagia in patients after stroke was negatively associated with improvement in performance of activities of daily living and cognitive level.

Key Words: cognitive function; convalescent rehabilitation; dysphagia; motor function; stroke

INTRODUCTION

Dysphagia is known to be associated with dehydration,[1)] poor nutrition,[2)] cognitive function,[3)] sarcopenia, and physical decline,[4,5)] making it a significant problem. Stroke is significantly related to the occurrence of aspiration pneumonia and accounts for approximately 60% of dysphagia cases that develop into aspiration pneumonia.[6)] Furthermore, dysphagia after stroke has been observed in 29%–67% of patients in the acute phase[7)] and 28%–59% of patients in convalescent wards.[8,9)]

Quality of life for patients after a stroke is directly associated with dysphagia and activities of daily living (ADL).[5)] Dysphagia after a stroke is also associated with increased length of hospital stay, pneumonia, decreased physical independence, high mortality risk,[10)] poor oral hygiene,[11)] nutritional disorders,[12)] and a low rate of discharge to home.[13)] Furthermore, patients are known to have reduced motor and cognitive functions following stroke, resulting in a poorer quality of life.[14)] ADL and cognitive function after a stroke are prognostic predictors of discharge destination,[15)] and it has been shown that low functional independence at discharge is associated with mortality.[16)] Therefore, dysphagia, inability to perform ADL, and cognitive decline after stroke are important issues to be addressed in convalescent wards. Patients who present with dysphagia on admission after a cerebrovascular accident may suffer deleterious effects on their ADL and cognitive function at the time of discharge because of a variety of factors, including compromised nutritional status, in contrast to patients who do not present with dysphagia. Studies on acute care patients have reported that dysphagia at admission is associated with motor and physical

Received: September 6, 2023, Accepted: January 23, 2024, Published online: February 7, 2024
[a] Department of Rehabilitation, Kumamoto Rehabilitation Hospital, Kikuyo, Japan
[b] Center for Sarcopenia and Malnutrition Research, Kumamoto Rehabilitation Hospital, Kikuyo, Japan
[c] Pharmacy Department, Kumamoto Rehabilitation Hospital, Kikuyo, Japan
[d] Department of Nutrition Management, Kumamoto Rehabilitation Hospital, Kikuyo, Japan
[e] Department of Dental Office, Kumamoto Rehabilitation Hospital, Kikuyo, Kikuchi, Japan
Correspondence: Yoshihiro Yoshimura, MD, PhD, 760 Magate, Kikuyo, Kumamoto 869-1106, Japan, E-mail: hanley.belfus@gmail.com

function at discharge.[17]

Few studies have examined whether dysphagia at hospital admission in patients with a stroke is associated with motor, physical, and cognitive functions at discharge. Therefore, the purpose of this study was to determine the association between the presence of dysphagia at admission and ADL performance and cognitive function at discharge in patients admitted to convalescent rehabilitation hospital following stroke. Recognizing that dysphagia on admission correlates with motor and cognitive functioning at the time of discharge can help healthcare professionals improve patient assessment and treatment protocols.

MATERIALS AND METHODS

Patients and Settings

We conducted a retrospective cohort study of 679 patients consecutively admitted to our post-stroke convalescent rehabilitation units from 2015 to 2020. Patients with impaired consciousness as determined by a triple-digit Japan Coma Scale score and those with medically unstable respiratory or circulatory status were excluded because of the difficulty in providing adequate rehabilitation. In addition, patients deemed unsuitable for bioimpedance analysis, such as those with pacemaker implantation, were excluded because of challenges in assessing muscle mass. Finally, a total of 499 patients were included in the analysis (**Fig. 1**).

Data Collection

Basic patient information collected at admission included age, sex, stroke type, Food Intake LEVEL Scale (FILS)[18] at admission and discharge, the duration from the onset of stroke, and length of hospital stay. The presence of sarcopenia was diagnosed according to the criteria of the Asian Working Group for Sarcopenia 2019.[19] Specifically, muscle mass was assessed by bioelectrical impedance analysis, muscle strength was assessed by grip strength, and sarcopenia was assessed if a decline was observed. In addition, total daily convalescent units (1 unit=20 min) were calculated for therapy performed by physical therapists, occupational therapists, and speech-language therapists (units/day). ADL performance was assessed using the motor and cognitive domains of the Functional Independence Measure (FIM),[20] nutritional status was assessed using the Geriatric Nutritional Risk Index (GNRI),[21] pre-onset ADL performance was assessed using the modified Rankin Scale (mRS),[22] and comorbidity severity was assessed using the Charlson Comorbidity Index (CCI).[23]

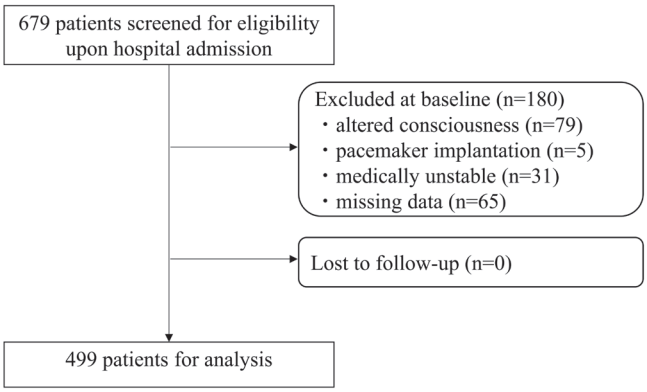

Fig. 1. Flowchart of participant screening, inclusion criteria, and follow-up.

Dysphagia Assessment

Dysphagia was assessed on the day of admission using the FILS after a speech-language pathologist observed the patient's actual eating condition and reported to a rehabilitation physician with over a decade of experience. The FILS is an ordinal scale with ten levels of feeding status: 1–3 indicates no oral intake, 4–6 indicates combined oral intake and alternative nutrition, 7–9 indicates oral intake only, and 10 is considered normal.[18] Participants with a FILS score of less than 7 at admission were placed in the group for oral intake with supportive nutrition (SN group), whereas participants with a FILS score of 7 or more were placed in the group for oral intake without supportive nutrition (ON group).

Outcomes

The primary outcome was the motor FIM score at discharge, and the secondary outcome was cognitive FIM score at discharge. The FIM consists of a motor domain with 13 sub-items and a cognitive domain with 5 sub-items. Each sub-item is rated on a seven-point ordinal scale ranging from full caregiving to full independence. Scores range from 18 to 126 for the FIM overall, from 13 to 91 for motor FIM, and from 5 to 35 for cognitive FIM. Lower scores indicate lower levels of patient independence.

Convalescent Rehabilitation

The convalescent rehabilitation program was tailored to each patient's function and weaknesses (up to 3 h/day).[24] The program was implemented in collaboration with multiple specialists including physiatrists, physical therapists, occupational therapists, speech-language therapists, nurses, pharmacists, dental staff, and registered dietitians. Patients

admitted to the convalescent rehabilitation hospital were divided into three categories according to their disease etiology: stroke, musculoskeletal disorders, and hospital-associated deconditioning. All patients with stroke were transferred from the stroke care unit of acute care hospitals in the local medical cooperation system.

Physical and occupational therapy included facilitation of paralyzed limbs, range of motion training, basic movement training, gait training, resistance training (e.g., chair-stand exercise),[24,25] and ADL training.[26] Therapy was administered according to each patient's functional abilities and weaknesses.

Nutritional management consisted of nutrition screening and assessment for eligible patients. Active nutritional support, such as high-energy and high-protein diets, was also implemented. Nutritional management was also tailored to each patient's condition and nutritional needs, including the adjustment of energy and protein contents according to changes in rehabilitation time and load.[27]

Rehabilitation for dysphagia included oral management and indirect and direct swallowing training with collaboration between speech-language pathologists, dental hygienists, and ward nurses. Rehabilitation was conducted according to each patient's swallowing ability and function.[28,29]

Medication management was handled by a multidisciplinary team that included a pharmacist. Measures were taken to reduce or discontinue polypharmacy and potentially inappropriate medications (PIMs), as well as to adjust or taper medications that affect swallowing and cognitive levels.[30,31]

Sample Size Calculation

The sample size was calculated using data from our previous study,[32] the results of which showed that the motor FIM score of patients admitted to the hospital was normally distributed with a standard deviation of 26. For a true difference in means between those with and without dysphagia of 17,[33] a sample size of at least 65 participants was needed in each group to reject the null hypothesis with a power of 0.8 and an alpha error of 0.05, which would support the validity of our results.

Statistical Analysis

The eligible patients were classified into two groups according to the presence or absence of supplementary nutrition, and basic information and outcomes were compared between the groups. Statistical analysis was performed using the unpaired *t*-test, the Mann–Whitney U test, and the chi-square test according to variables and normality. To assess the association between dysphagia on admission and outcome, clinically important confounding factors for outcome were considered and adjustment variables were selected. Confounders included age, sex, sarcopenia status, motor and cognitive FIM scores on admission, daily convalescent ward attendance, GNRI, length of hospital stay, CCI, and pre-admission mRS. The dependent variables were the motor and cognitive FIM scores at discharge. SPSS version 21 (IBM, Armonk, NY, USA) was used for statistical analysis, and $P<0.05$ was considered to indicate statistical significance.

Ethical Considerations

This study was conducted in accordance with the Declaration of Helsinki and was approved in advance by the Ethics Review Committee of Kumamoto Rehabilitation Hospital (Approval No. 179–211117). In addition, the study protocol was disclosed on the hospital website, and an opt-out method was used to present patients with the opportunity to refuse participation.

RESULTS

The study population consisted of 499 patients with a median age of 74.0 years [interquartile range (IQR), 63.0–82.0 years]. Of the 499 patients, 269 (53.9%) were male. The median FILS score was 8 (IQR, 7–10), and 104 (20.8%) patients had a FILS score less than 7. The results of univariate analysis between the two groups according to basic patient information at admission and the presence or absence of supplemental nutrition are summarized in **Table 1**. The SN group had a higher prevalence of sarcopenia, lower motor and cognitive FIM scores at admission, lower GNRI scores, longer hospital stays, and higher CCI scores than the ON group.

A comparison of the motor and cognitive FIM scores at discharge between the two groups with and without supplemental nutrition is presented in **Table 2**. The SN group had significantly lower motor ($P<0.001$) and cognitive ($P<0.001$) FIM scores at discharge.

The results of multiple regression analysis for motor and cognitive FIM scores at discharge are presented in **Table 3**. Because the variance inflation factor of all variables was less than 3.560, we considered all of them acceptable as independent factors in the multiple regression analysis. Dysphagia was independently associated with motor ($\beta=-0.157$, $P<0.001$) and cognitive ($\beta=-0.066$, $P=0.041$) FIM scores at discharge.

Table 1. Comparison between patient groups by patient background and with or without supportive nutrition on admission

	Total n=499	SN group n=104	ON group n=395	P value
FILS at admission	8 (7–10)	2 (2–2)	10 (7–10)	<0.001[a]
Age (years)	74 (63–82)	74.5 (63–83)	73 (63–81)	0.460[b]
Sex				
Male	269 (53.9%)	53 (50.9%)	216 (54.6%)	0.509[c]
Female	230 (46.1%)	51 (49.0%)	179 (45.3%)	
Stroke type				
Cerebral infarction	313 (62.7%)	49 (47.1%)	264 (66.8%)	<0.001[c]
Cerebral hemorrhage	146 (29.2%)	48 (46.1%)	98 (24.8%)	
Subarachnoid hemorrhage	40 (8.0%)	7 (6.7%)	33 (8.3%)	
Sarcopenia				
Yes	216 (43.3%)	71 (68.2%)	145 (36.7%)	<0.001[c]
No	283 (56.7%)	33 (31.7%)	250 (63.2%)	
Motor FIM at admission	47 (20–69)	13 (13–15)	57 (34–73)	<0.001[b]
Cognitive FIM at admission	22 (14–28)	8 (6–15)	24 (17–30)	<0.001[b]
Rehabilitation units per day	8.2 (7.7–8.5)	8.2 (7.2–8.5)	8.2 (7.7–8.5)	0.443[b]
Time from onset to hospital admission (days)	14 (10–22)	17 (12–25)	13 (10–21)	<0.005[b]
GNRI	96.8 (88.7–105.3)	88.8 (81.0–96.3)	99.2 (91.1–106.0)	<0.001[a]
CCI	3 (1–4)	3 (2.2–4)	3 (1–3)	<0.001[b]
Premorbid mRS	0 (0–1)	0 (0–2)	0 (0–1)	0.376[b]

Data given as number (percentage) or median (interquartile range).
[a] *t*-test; [b] Mann–Whitney U test; [c] chi-square test.

Table 2. Comparison of outcomes and patient characteristics between patient groups with and without supportive nutrition on admission

	Total n=499	SN group n=104	ON group n=395	P value[a]
FILS at discharge	10 (9–10)	8 (4.2–9)	10 (9–10)	<0.001
Length of hospital stay (days)	91 (53–142)	142 (107–158)	81 (47–122)	<0.001
Rehabilitation units per day	8.2 (7.7–8.5)	8.2 (7.2–8.5)	8.2 (7.7–8.5)	0.443
Motor FIM at discharge	82 (56–89)	46 (17.2–74.5)	85 (74–90)	<0.001
Cognitive FIM at discharge	30 (22–34)	18.5 (10–29.7)	31 (25–34)	<0.001

Data given as median (interquartile range).
[a] Mann–Whitney U test.

DISCUSSION

We investigated whether dysphagia at the time of admission was associated with ADL performance and cognitive level at the time of discharge in patients admitted to convalescent rehabilitation hospital after stroke. Our results showed that dysphagia at admission was negatively associated with ADL performance and cognitive level at discharge.

In recovering stroke patients, dysphagia at admission was associated with lower ADL performance and cognitive level at discharge. Other studies have shown that patients with dysphagia at admission in the acute phase are likely to have a poorer prognosis for motor function,[17,34] and it has been indicated that patients who retain motor and cognitive functions at admission tend to have a better prognosis for dysphagia.[35–37]

This study focused on patients with post-stroke dysphagia. Based on previous research, it was hypothesized that improvements in dysphagia during rehabilitation could contribute to improvements in ADL performance and cognitive

Table 3. Multivariate analysis with motor FIM at discharge and cognitive FIM at discharge as dependent variables

	Multiple regression analysis: forced entry method (n=499)							
	Motor FIM at discharge				Cognitive FIM at discharge			
	B (95% CI)	SE	β	P value	B (95% CI)	SE	β	P value
Dysphagia (FILS<7)	−9.588 (−13.603, −5.574)	2.043	−0.157	<0.001	−1.365 (−2.676, −0.054)	0.667	−0.066	0.041
Age	−0.052 (−0.175, 0.072)	0.063	−0.027	0.412	−0.057 (−0.097, −0.016)	0.021	−0.089	0.006
Sex (female0, male1)	0.976 (−1.720, 3.671)	1.372	0.02	0.477	−0.398 (−1.279, 0.482)	0.448	−0.024	0.375
Sarcopenia (yes 1)	−2.927 (−6.237, 0.384)	1.685	−0.059	0.083	−0.533 (−1.615, 0.548)	0.550	−0.031	0.333
Motor FIM at admission	0.450 (0.354, 0.546)	0.049	0.463	<0.001	0.040 (0.008, 0.071)	0.016	0.121	0.013
Cognitive FIM at admission	0.505 (0.289, 0.721)	0.11	0.184	<0.001	0.592 (0.521, 0.663)	0.036	0.636	<0.001
Rehabilitation units/day	−0.068 (−0.627, 0.491)	0.285	−0.007	0.812	0.030 (−0.150, 0.215)	0.093	0.009	0.726
GNRI	0.187 (0.058, 0.317)	0.066	0.097	0.005	0.030 (−0.012, 0.072)	0.021	0.045	0.164
Hospital stay	0.065 (0.028, 0.102)	0.019	0.127	0.001	0.027 (0.015, 0.039)	0.006	0.154	<0.001
CCI	−0.489 (−1.334, 0.356)	0.43	−0.033	0.256	−0.109 (−0.385, 0.167)	0.140	−0.022	0.437
Premorbid mRS	−3.003 (−4.185, −1.822)	0.601	−0.153	<0.001	−0.880 (−1.266, −0.494)	0.196	−0.132	<0.001
	R2=0.65				R2=0.68			

CI, confidence interval; SE, standard error.

level. Factors associated with improvements in post-stroke motor and cognitive functions include the severity of the stroke,[38] stroke characteristics such as bilateral damage, previous stroke, and lesion location,[38,39] and the time from onset to hospital admission.[40] Stroke severity has been shown to correlate with dysphagia,[41] but there are also reports of no association between stroke severity and dysphagia when compared with another factor.[42] The results of this study suggest that dysphagia at admission is related to ADL and cognitive levels at discharge. However, previous research indicates that factors such as history of stroke, lesion type, damage site, and severity of stroke in the SN and ON groups may also have had an impact. This is further supported by the fact that the SN group had lower admission FIM scores than the ON group, suggesting a possible association.

It has also been shown that decreases in muscle strength and muscle mass on the nonparalyzed side occur in patients after stroke and contribute to their level of physical function.[43] In addition, dysphagia caused by sarcopenia has recently received attention, and cases of dysphagia have been reported in the absence of stroke or other central nervous system diseases. In these cases, reduced muscle strength and mass were contributing factors.[44] The relationship between sarcopenia and dysphagia is well recognized; cases are known in which dysphagia can lead to malnutrition and systemic sarcopenia and vice versa where systemic sarcopenia can lead to dysphagia.[45] In the current study, which focused on post-stroke patients with dysphagia, it was difficult to attribute dysphagia solely to sarcopenia. However, patients with dysphagia at admission had significantly lower motor FIM scores at admission and at discharge, suggesting an association between dysphagia and motor function.

Regarding the prognosis of post-stroke dysphagia, factors such as the level of consciousness,[41] the severity of the stroke,[46] and specific stroke characteristics (including brainstem lesions, bilateral damage, history of stroke, and stroke location)[41,46] have been identified. Reports on the relationship between stroke type and dysphagia are conflicting, with one study finding an association and others not.[47–50] In the present study, the SN group had significantly lower

cognitive FIM scores at both admission and discharge, in addition to higher dysphagia severity, when compared with the ON group. These observations suggest that variations in consciousness and specific characteristics of cerebrovascular events may have contributed to these results. The pathophysiology of dysphagia following a stroke is multifaceted, involving both motor output issues, such as tongue movement and chewing strength, and sensory challenges, such as the initiation of swallowing and cough reflexes. Research focusing on individuals with severe post-stroke dysphagia has highlighted the importance of factors associated with the recovery of oral intake, including motor and cognitive FIM, the presence of aspiration, and pharyngeal residue.[51] Instrumental assessments such as videofluoroscopy (VF) and videoendoscopy (VE) provide detailed assessments of dysphagia. Given the correlation between dysphagia at the time of hospitalization and subsequent motor and cognitive outcomes, understanding the pathophysiology of dysphagia is considered important.

This study has shown that dysphagia affects ADL performance and cognitive levels, and when combined with previous research, it suggests a bidirectional causal relationship between post-stroke dysphagia and these factors. Consequently, it is suggested that stroke patients with dysphagia at admission require not only dysphagia rehabilitation but also a comprehensive approach to enhance ADL performance and cognitive function.

Supporting patients with dysphagia after stroke is an important issue. Several approaches have been shown to improve ADL performance and dysphagia, such as indirect and direct swallowing training, chair-stand exercises,[25] improvement of oral problems,[52] personalized nutritional support,[27] and appropriate pharmacotherapy.[31] Improvements in dysphagia have been shown to contribute to improvements in ADL performance. A multidisciplinary approach to dysphagia after stroke is important and may contribute not only to improvements in dysphagia but also to improvements in ADL performance and cognitive level. For patients with dysphagia, such as those in this study, detailed assessments of swallowing function should be performed using VF and VE tests. In addition, a multidisciplinary approach that includes dysphagia rehabilitation, oral function rehabilitation, and nutritional support is essential. Furthermore, it is important to recognize the possibility that baseline dysphagia may be associated with rehabilitation outcomes and this understanding should be shared by the entire multidisciplinary team.

This study has several limitations. First, this study was conducted at a single institution, which may limit its generalizability. Second, this was a retrospective study; therefore, there may be unexplored confounding factors. Third, factors such as impaired consciousness, type of cerebrovascular accident, interval from stroke onset to hospital admission, stroke severity, stroke characteristics, comprehensive dysphagia assessment, rehabilitation motivation, and sensory impairment may potentially influence patients' post-stroke dysphagia, ADL performance, and cognitive level.

CONCLUSION

Dysphagia at admission was associated with lower ADL performance and cognitive level at discharge in convalescent patients after stroke. We suggest that patients with post-stroke dysphagia should receive early evaluation of swallowing function through a comprehensive multidisciplinary approach to improve ADL performance and cognitive level.

ACKNOWLEDGMENTS

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

REFERENCES

1. Thiyagalingam S, Kulinski AE, Thorsteinsdottir B, Shindelar KL, Takahashi PY: Dysphagia in older adults. Mayo Clin Proc 2021;96:488–497. https://doi.org/10.1016/j.mayocp.2020.08.001, PMID:33549267
2. Burgos R, Bretón I, Cereda E, Desport JC, Dziewas R, Genton L, Gomes F, Jésus P, Leischker A, Muscaritoli M, Poulia KA, Preiser JC, Van der Marck M, Wirth R, Singer P, Bischoff SC: ESPEN guideline clinical nutrition in neurology. Clin Nutr 2018;37:354–396. https://doi.org/10.1016/j.clnu.2017.09.003, PMID:29274834
3. Jo SY, Hwang JW, Pyun SB: Relationship between cognitive function and dysphagia after stroke. Ann Rehabil Med 2017;41:564–572. https://doi.org/10.5535/arm.2017.41.4.564, PMID:28971040

4. Cha S, Kim WS, Kim KW, Han JW, Jang HC, Lim S, Paik NJ: Sarcopenia is an independent risk factor for dysphagia in community-dwelling older adults. Dysphagia 2019;34:692–697. https://doi.org/10.1007/s00455-018-09973-6, PMID:30612233
5. Yoshimura Y, Wakabayashi H, Bise T, Nagano F, Shimazu S, Shiraishi A, Yamaga M, Koga H: Sarcopenia is associated with worse recovery of physical function and dysphagia and a lower rate of home discharge in Japanese hospitalized adults undergoing convalescent rehabilitation. Nutrition 2019;61:111–118. https://doi.org/10.1016/j.nut.2018.11.005, PMID:30710883
6. Ministry of Health, Labour and Welfare: Response to the increasing number of diseases caused by the aging of the population [in Japanese]. Tokyo: Ministry of Heath, Labour and Welfare. 2016. https://www.mhlw.go.jp/file/05-Shingikai-10801000-Iseikyoku-Soumuka/0000135467.pdf. Accessed 2 Aug 2022.
7. Martino R, Foley N, Bhogal S, Diamant N, Speechley M, Teasell R: Dysphagia after stroke: incidence, diagnosis, and pulmonary complications. Stroke 2005;36:2756–2763. https://doi.org/10.1161/01.STR.0000190056.76543.eb, PMID:16269630
8. Gottlieb D, Kipnis M, Sister E, Vardi Y, Brill S: Validation of the 50 ml^3 drinking test for evaluation of post-stroke dysphagia. Disabil Rehabil 1996;18:529–532. https://doi.org/10.3109/09638289609166040, PMID:8902426
9. DePippo KL, Holas MA, Reding MJ, Mandel FS, Lesser ML: Dysphagia therapy following stroke: a controlled trial. Neurology 1994;44:1655–1660. https://doi.org/10.1212/WNL.44.9.1655, PMID:7936292
10. Bath PM, Lee HS, Everton LF: Swallowing therapy for dysphagia in acute and subacute stroke. Cochrane Libr 2018;10:CD000323. https://doi.org/10.1002/14651858.CD000323.pub3, PMID:30376602
11. Matsuo K, Sekimoto Y, Okamoto M, Shibata S, Otaka Y: Association between oral health status and oral food intake level in subacute stroke patients admitted to a convalescent rehabilitation unit. Gerodontology 2022;39:67–73. https://doi.org/10.1111/ger.12586, PMID:34448242
12. Foley NC, Martin RE, Salter KL, Teasell RW: A review of the relationship between dysphagia and malnutrition following stroke. J Rehabil Med 2009;41:707–713. https://doi.org/10.2340/16501977-0415, PMID:19774302
13. Sunahara T, Yoshimura Y, Bise T, Shimazu S: Swallowing function and nutritional status affect discharge home after convalescent rehabilitation [in Japanese]. JSPEN 2020;2:262–269.
14. Gunaydin R, Karatepe AG, Kaya T, Ulutas O: Determinants of quality of life (QoL) in elderly stroke patients: a short-term follow-up study. Arch Gerontol Geriatr 2011;53:19–23. https://doi.org/10.1016/j.archger.2010.06.004, PMID:20598382
15. Meijer R, Ihnenfeldt DS, van Limbeek J, Vermeulen M, de Haan RJ: Prognostic factors in the subacute phase after stroke for the future residence after six months to one year. A systematic review of the literature. Clin Rehabil 2003;17:512–520. https://doi.org/10.1191/0269215503cr644oa, PMID:12952157
16. Springer MV, Skolarus LE, Feng C, Burke JF: Functional impairment and postacute care discharge setting may be useful for stroke survival prognostication. J Am Heart Assoc 2022;11:e024327. https://doi.org/10.1161/JAHA.121.024327, PMID:35232223
17. Matsuo H, Yoshimura Y, Fujita S, Maeno Y: Dysphagia is associated with poor physical function in patients with acute heart failure: a prospective cohort study. Aging Clin Exp Res 2020;32:1093–1099. https://doi.org/10.1007/s40520-019-01287-3, PMID:31368089
18. Kunieda K, Ohno T, Fujishima I, Hojo K, Morita T: Reliability and validity of a tool to measure the severity of dysphagia: the Food Intake LEVEL Scale. J Pain Symptom Manage 2013;46:201–206. https://doi.org/10.1016/j.jpainsymman.2012.07.020, PMID:23159683
19. Chen LK, Woo J, Assantachai P, Auyeung TW, Chou MY, Iijima K, Jang HC, Kang L, Kim M, Kim S, Kojima T, Kuzuya M, Lee JS, Lee SY, Lee WJ, Lee Y, Liang CK, Lim JY, Lim WS, Peng LN, Sugimoto K, Tanaka T, Won CW, Yamada M, Zhang T, Akishita M, Arai H: Asian Working Group for Sarcopenia: 2019 consensus update on sarcopenia diagnosis and treatment. J Am Med Dir Assoc 2020;21:300–307. https://doi.org/10.1016/j.jamda.2019.12.012, PMID:32033882
20. Ottenbacher KJ, Hsu Y, Granger CV, Fiedler RC: The reliability of the functional independence measure: a quantitative review. Arch Phys Med Rehabil 1996;77:1226–1232. https://doi.org/10.1016/S0003-9993(96)90184-7, PMID:8976303

21. Bouillanne O, Morineau G, Dupont C, Coulombel I, Vincent JP, Nicolis I, Benazeth S, Cynober L, Aussel C: Geriatric Nutritional Risk Index: a new index for evaluating at-risk elderly medical patients. Am J Clin Nutr 2005;82:777–783. https://doi.org/10.1093/ajcn/82.4.777, PMID:16210706
22. Banks JL, Marotta CA: Outcomes validity and reliability of the modified Rankin scale: implications for stroke clinical trials: a literature review and synthesis. Stroke 2007;38:1091–1096. https://doi.org/10.1161/01.STR.0000258355.23810.c6, PMID:17272767
23. Charlson ME, Pompei P, Ales KL, MacKenzie CR: A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. J Chronic Dis 1987;40:373–383. https://doi.org/10.1016/0021-9681(87)90171-8, PMID:3558716
24. Nagano F, Yoshimura Y, Bise T, Shimazu S, Shiraishi A: Muscle mass gain is positively associated with functional recovery in patients with sarcopenia after stroke. J Stroke Cerebrovasc Dis 2020;29:105017. https://doi.org/10.1016/j.jstrokecerebrovasdis.2020.105017, PMID:32807432
25. Yoshimura Y, Wakabayashi H, Nagano F, Bise T, Shimazu S, Shiraishi A: Chair-stand exercise improves post-stroke dysphagia. Geriatr Gerontol Int 2020;20:885–891. https://doi.org/10.1111/ggi.13998, PMID:32772455
26. Kido Y, Yoshimura Y, Wakabayashi H, Momosaki R, Nagano F, Bise T, Shimazu S, Shiraishi A: Sarcopenia is associated with incontinence and recovery of independence in urination and defecation in post-acute rehabilitation patients. Nutrition 2021;91-92:111397. https://doi.org/10.1016/j.nut.2021.111397, PMID:34364264
27. Shimazu S, Yoshimura Y, Kudo M, Nagano F, Bise T, Shiraishi A, Sunahara T: Frequent and personalized nutritional support leads to improved nutritional status, activities of daily living, and dysphagia after stroke. Nutrition 2021;83:111091. https://doi.org/10.1016/j.nut.2020.111091, PMID:33388653
28. Shiraishi A, Wakabayashi H, Yoshimura Y: Oral management in rehabilitation medicine: oral frailty, oral sarcopenia, and hospital-associated oral problems. J Nutr Health Aging 2020;24:1094–1099. https://doi.org/10.1007/s12603-020-1439-8, PMID:33244566
29. Yoshimura Y, Shiraishi A, Tsuji Y, Momosaki R: Oral management and the role of dental hygienists in convalescent rehabilitation. Prog Rehabil Med 2022;7:20220019. https://doi.org/10.2490/prm.20220019, PMID:35495548
30. Matsumoto A, Yoshimura Y, Nagano F, Bise T, Kido Y, Shimazu S, Shiraishi A: Polypharmacy and potentially inappropriate medications in stroke rehabilitation: prevalence and association with outcomes. Int J Clin Pharm 2022;44:749–761. https://doi.org/10.1007/s11096-022-01416-5, PMID:35578145
31. Yoshimura Y, Matsumoto A, Momosaki R: Pharmacotherapy and the role of pharmacists in rehabilitation medicine. Prog Rehabil Med 2022;7:20220025. https://doi.org/10.2490/prm.20220025, PMID:35633757
32. Yoshimura Y, Wakabayashi H, Nagano F, Matsumoto A, Shimazu S, Shiraishi A, Kido Y, Bise T: The applicability of the ESPEN and EASO-defined diagnostic criteria for sarcopenic obesity in Japanese patients after stroke: prevalence and association with outcomes. Nutrients 2022;14:4205. https://doi.org/10.3390/nu14194205, PMID:36235857
33. Beninato M, Gill-Body KM, Salles S, Stark PC, Black-Schaffer RM, Stein J: Determination of the minimal clinically important difference in the FIM instrument in patients with stroke. Arch Phys Med Rehabil 2006;87:32–39. https://doi.org/10.1016/j.apmr.2005.08.130, PMID:16401435
34. Matsuo H, Yoshimura Y, Ishizaki N, Ueno T: Dysphagia is associated with functional decline during acute-care hospitalization of older patients. Geriatr Gerontol Int 2017;17:1610–1616. https://doi.org/10.1111/ggi.12941, PMID:27910255
35. Ito Y, Goto T, Huh JY, Yamamura O, Hamano T, Kikuta KI, Hayashi H: Development of a scoring system to predict prolonged post-stroke dysphagia remaining at discharge from a subacute care hospital to the home. J Stroke Cerebrovasc Dis 2021;30:105804. https://doi.org/10.1016/j.jstrokecerebrovasdis.2021.105804, PMID:33906072
36. Maeshima S, Osawa A, Hayashi T, Tanahashi N: Factors associated with prognosis of eating and swallowing disability after stroke: a study from a community-based stroke care system. J Stroke Cerebrovasc Dis 2013;22:926–930. https://doi.org/10.1016/j.jstrokecerebrovasdis.2013.04.003, PMID:23680686
37. Kojima A, Imoto Y, Osawa Y, Fujieda S: Predictor of rehabilitation outcome for dysphagia. Auris Nasus Larynx 2014;41:294–298. https://doi.org/10.1016/j.anl.2013.12.009, PMID:24560094

38. Meyer MJ, Pereira S, McClure A, Teasell R, Thind A, Koval J, Richardson M, Speechley M: A systematic review of studies reporting multivariable models to predict functional outcomes after post-stroke inpatient rehabilitation. Disabil Rehabil 2015;37:1316–1323. https://doi.org/10.3109/09638288.2014.963706, PMID:25250807
39. Senda J, Ito K, Kotake T, Mizuno M, Kishimoto H, Yasui K, Nakagawa-Senda H, Katsuno M, Nishida Y, Sobue G: Association between National Institutes of Health Stroke Scale and Functional Independence Measure scores in patients with ischemic stroke from convalescent rehabilitation outcomes. Nagoya J Med Sci 2023;85:428–443. https://doi.org/10.18999/nagjms.85.3.428, PMID:37829489
40. Miyazaki Y, Kawakami M, Kondo K, Tsujikawa M, Honaga K, Suzuki K, Tsuji T: Comparing the contribution of each clinical indicator in predictive models trained on 980 subacute stroke patients: a retrospective study. Sci Rep 2023;13:12324. https://doi.org/10.1038/s41598-023-39475-x, PMID:37516806
41. Liu CH, Huo M, Qin HH, Zhao BL: Critical prognostic factors for poststroke dysphagia: a meta-analysis. Eur Rev Med Pharmacol Sci 2022;26:610–622. https://doi.org/10.26355/eurrev_202201_27888, PMID:35113437
42. Ikenaga Y, Nakayama S, Taniguchi H, Ohori I, Komatsu N, Nishimura H, Katsuki Y: Factors predicting recovery of oral intake in stroke survivors with dysphagia in a convalescent rehabilitation ward. J Stroke Cerebrovasc Dis 2017;26:1013–1019. https://doi.org/10.1016/j.jstrokecerebrovasdis.2016.12.005, PMID:28108097
43. 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. https://doi.org/10.1016/j.ijcard.2013.10.031, PMID:24231058
44. Kuroda Y, Kuroda R: Relationship between thinness and swallowing function in Japanese older adults: implications for sarcopenic dysphagia. J Am Geriatr Soc 2012;60:1785–1786. https://doi.org/10.1111/j.1532-5415.2012.04123.x, PMID:22985156
45. Fujishima I, Fujiu-Kurachi M, Arai H, Hyodo M, Kagaya H, Maeda K, Mori T, Nishioka S, Oshima F, Ogawa S, Ueda K, Umezaki T, Wakabayashi H, Yamawaki M, Yoshimura Y: Sarcopenia and dysphagia: position paper by four professional organizations. Geriatr Gerontol Int 2019;19:91–97. https://doi.org/10.1111/ggi.13591, PMID:30628181
46. Li Y, Xu Z, Zhang X, Ma D, Meng X, Zhang M, Sun J: Predictors of complete oral feeding resumption after feeding tube placement in patients with stroke and dysphagia: a systematic review. J Clin Nurs 2023;32:2533–2546. https://doi.org/10.1111/jocn.16404, PMID:35676778
47. Fernández-Pombo A, Seijo-Raposo IM, López-Osorio N, Cantón-Blanco A, González-Rodríguez M, Arias-Rivas S, Rodríguez-Yáñez M, Santamaría-Nieto A, Díaz-Ortega C, Gómez-Vázquez E, Martínez-Olmos MÁ: Lesion location and other predictive factors of dysphagia and its complications in acute stroke. Clin Nutr ESPEN 2019;33:178–182. https://doi.org/10.1016/j.clnesp.2019.05.019, PMID:31451257
48. Jørgensen HS, Nakayama H, Raaschou HO, Olsen TS: Intracerebral hemorrhage versus infarction: stroke severity, risk factors, and prognosis. Ann Neurol 1995;38:45–50. https://doi.org/10.1002/ana.410380110, PMID:7611724
49. Crisan D, Shaban A, Boehme A, Dubin P, Juengling J, Schluter LA, Albright KC, Beasley TM, Martin-Schild S: Predictors of recovery of functional swallow after gastrostomy tube placement for dysphagia in stroke patients after inpatient rehabilitation: a pilot study. Ann Rehabil Med 2014;38:467–475. https://doi.org/10.5535/arm.2014.38.4.467, PMID:25229025
50. Jang S, Yang HE, Yang HS, Kim DH: Lesion characteristics of chronic dysphagia in patients with supratentorial stroke. Ann Rehabil Med 2017;41:225–230. https://doi.org/10.5535/arm.2017.41.2.225, PMID:28503455
51. Calvo I, Pizzorni N, Gilardone G, Mayer F, Vanacore N, Buraschi V, Gilardone M, Corbo M: Predictors of oral feeding resumption after stroke in a rehabilitation hospital: a retrospective study. J Stroke Cerebrovasc Dis 2019;28:1958–1970. https://doi.org/10.1016/j.jstrokecerebrovasdis.2019.03.040, PMID:30981584
52. Shiraisi A, Yoshimura Y, Wakabayashi H, Nagano F, Bise T, Shimazu S: Improvement in oral health enhances the recovery of activities of daily living and dysphagia after stroke. J Stroke Cerebrovasc Dis 2021;30:105961. https://doi.org/10.1016/j.jstrokecerebrovasdis.2021.105961, PMID:34247054