International Journal of Gerontology 18 (2024) 221–225
https://doi.org/10.6890/IJGE.202410_18(4).0004

International Journal of Gerontology

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

Original Article

Calf Circumference Predicts Whether Elderly Pneumonia Patients Will be Able to Eat a Normal Diet at Discharge

Yosuke Tenpaku [a,b *], Satoshi Watanabe [c], Keisuke Morikawa [d], Hideki Oguro [a], Hiroshi Tatsumi [e]

[a] *Department of Rehabilitation, Nagoya Ekisaikai Hospital, Aichi, Japan,* [b] *Graduate School of Health Science, Aichi Gakuin University, Aichi, Japan,* [c] *Department of Maxillofacial Surgery, School of Dentistry, Aichi Gakuin University, Aichi, Japan,* [d] *Department of Rehabilitation, Matsusaka Municipal Hospital, Mie, Japan,* [e] *Department of Health Science, Aichi Gakuin University, Aichi, Japan*

ARTICLE INFO

Accepted 20 June 2024

Keywords:
aged,
dysphagia,
pneumonia,
sarcopenia

SUMMARY

Background: In this study, we examined whether assessment, including Calf circumference (CC), could predict feeding and swallowing function at discharge in elderly patients hospitalized for pneumonia.
Method: The subjects were selected from pneumonia patients admitted to Matsusaka Municipal Hospital from October 2019 to March 2021. The 120 patients (median age of the subjects: 86 years; male/female ratio: 73/47) who did not meet the discontinuation or exclusion criteria were included. The subjects were classified into the following two groups according to the score on the FOIS at discharge: one group of patients who could not eat a normal diet by the time of discharge (FOIS: 1–5) and another group of patients who could eat a normal diet at discharge (FOIS: 6, 7). Statistical analysis was examined using univariate analysis and logistic regression analysis.
Result: Logistic regression analysis was performed with the patient's ability/inability to eat a normal diet at discharge as the dependent variable and age, cerebrovascular disease, the Mann assessment of swallowing ability (MASA), Mini-mental state examination (MMSE), skeletal muscle mass index (SMI), and CC, which showed significant differences in univariate analysis, as independent variables. Model A identified the odds ratio of having cerebrovascular disease, MMSE, and SMI. Model B identified MMSE and CC as being independent predictors of the ability of the patients to eat a normal diet at discharge.
Conclusion: CC may be a useful predictor of the ability for normal oral dietary intake at discharge in elderly patients hospitalized for pneumonia.

1. Introduction

The aging of the population and the frequent occurrence of pneumonia in the elderly are closely related problems.[1] Pneumonia in the elderly is closely associated with feeding and swallowing dysfunction.[1] Therefore, early evaluation of feeding and swallowing function in elderly patients with pneumonia is essential in pneumonia care. However elderly pneumonia patients often have a variety of comorbidities, including dementia. A previous study[2] reported that two out of three elderly people with end-stage dementia die of complications of pneumonia. It is often difficult to conduct assessments that require a clear understanding of the instructions in pneumonia patients who are cognitively impaired.

Recently, the presence of sarcopenia was reported as a cause of dysphagia in the elderly.[3] The Asian Working Group for Sarcopenia Consensus published in 2019[4] on the diagnosis of sarcopenia first extracted the possibility of sarcopenia from weight loss, chronic disease, calf circumference (CC), and questionnaires. Next, they defined sarcopenia based on the skeletal muscle mass index (SMI), which can be measured, in addition to muscle strength and physical function, using instruments. SMI can be measured by various methods, including CT, MRI, DXA, and BIA. However, CT and MRI are expensive, and DXA and BIA can only be performed at facilities having specialized equipment for these tests. The association between sarcopenia and dysphagia is scattered. Maeda et al.[5] reported that sarcopenia is an independent risk factor for dysphagia in the elderly. Another report by Maeda et al.[6] reported that a decrease in SMI was a risk factor for the development of dysphagia in the elderly.

Maeda et al. reported that measuring the SMI may be useful in predicting the prognosis of dysphagia and the swallowing function at discharge in hospitalized pneumonia patients. However, as mentioned earlier, SMI can only be measured at facilities with specialized equipment, which makes wide use of this test across various types of medical facilities difficult. Therefore, in this study, we focused on CC, a parameter that extracts the possibility of sarcopenia, as a predictor of swallowing function at discharge in elderly patients hospitalized for pneumonia. Regarding the association between CC and SMI, Kawakami et al.[7] investigated the correlation between CC and SMI as assessed by DXA in middle-aged Japanese men and women and found a positive correlation in both men and women, which led them to conclude that CC could possibly be used as a surrogate marker of muscle mass. Measurement of the CC has the advantage that it does not require specialized equipment and can be used to evaluate patients who have difficulty understanding instructions, which is common in elderly patients with pneumonia. If it can be

* Corresponding author. Department of Rehabilitation, Nagoya Ekisaikai Hospital, 4-66 Syonen-cho, Nakagawa-ku, Nagoya, Aichi, 454-0854, Japan.
E-mail address: palu109291@gmail.com (Y. Tenpaku)

established as a prognostic factor, it could be used widely in the future across all types of medical facilities. However, a search of the literature to the best of our ability failed to yield any studies that have explored the predictive ability of CC for the swallowing function at discharge in elderly patients hospitalized for pneumonia.

In this study, we investigated whether assessment, including CC, can predict swallowing function at discharge in elderly patients with pneumonia.

2. Material and methods

This study was conducted as a single-center, retrospective observational study.

Subjects for this study were selected from among patients with pneumonia who were admitted to Matsusaka Municipal Hospital between October 2019 and March 2021. Of the 163 patients who underwent complete evaluation by a Speech-Language-Hearing therapist after admission, 120 who did not meet the discontinuation criterion (death) or the following exclusion criteria were included in this study: 1) age 60 years or younger; 2) having an implanted pacemaker; 3) unwilling to provide consent for participation in the study; 4) lacking a limb; and 5) incapable of oral intake even prior to hospitalization.

The surveyed items were:

1. General patient information: Age, gender, body mass index (BMI), length of hospital stays, interval until the start of speech and language therapy, comorbidities.
2. Information on pneumonia: A-DROP, type of pneumonia (aspiration pneumonia or other pneumonia), initial admission or re-hospitalization.
3. Nutritional assessment: Geriatric Nutritional Risk Index (GNRI).
4. Assessment of swallowing function: Score on the Mann Assessment of Swallowing Ability (MASA); Score on the Functional Oral Intake Scale (FOIS) at discharge.
5. Neuropsychological examination: Mini-Mental State Examination (MMSE).
6. Anthropometric evaluation: SMI; CC.

A-DROP is a rating scale for the pneumonia severity used in Japan. Based on CURB-65,[8] created for the Japanese. Information on the type of pneumonia was collected retrospectively from the medical records based on the physician's diagnosis. GNRI[9] was calculated using the formula, $(14.89 \times \text{Alb}) + 4.7 \times (\text{BW/IBW})$. MASA[10] is a scale that was developed by Mann et al. to assess the feeding and swallowing function in stroke patients. The evaluation was based on a 24-item 200-point scale. MMSE[11] is a cognitive function test evaluated on a 30-point scale, with lower scores indicating more severe cognitive impairment. FOIS[12] is a 7-point scale, with the score ranging from 1 (no oral intake) to 7 (normal); the higher the score, the higher the level of the dietary form the patient can eat. A research flowchart is shown in Figure 1. The patients were divided into two groups according to the score on FOIS: the patient group without the ability to eat a normal diet at discharge (FOIS score: 1–5) and the patient group with the ability to eat a normal diet at discharge (FOIS score: 6, 7). The authorization to allow the patient to commence oral intake was predicated on the results of a bedside evaluation conducted by a ST and subsequent consent obtained from the attending physician. In addition to the dietary evaluation conducted by the ST, the potential for advancement of the dietary consistency was also examined through a comprehensive assessment of food intake and oral function. SMI[13] is calculated as the muscle mass of the extremities/height squared; In Body (In Body S10 In Body, Tokyo) was used for the measurement. Electrodes were attached to both the upper and lower limbs and the patients were placed in a supine position. CC was measured by the method described in the consensus[4] published by the AWGS, which is to measure the maximum of both calves using an inelastic tape. In other words, the maximum circumference of the calf was measured bilaterally, and the highest value was recorded. Due to the subjects characteristics and comor-

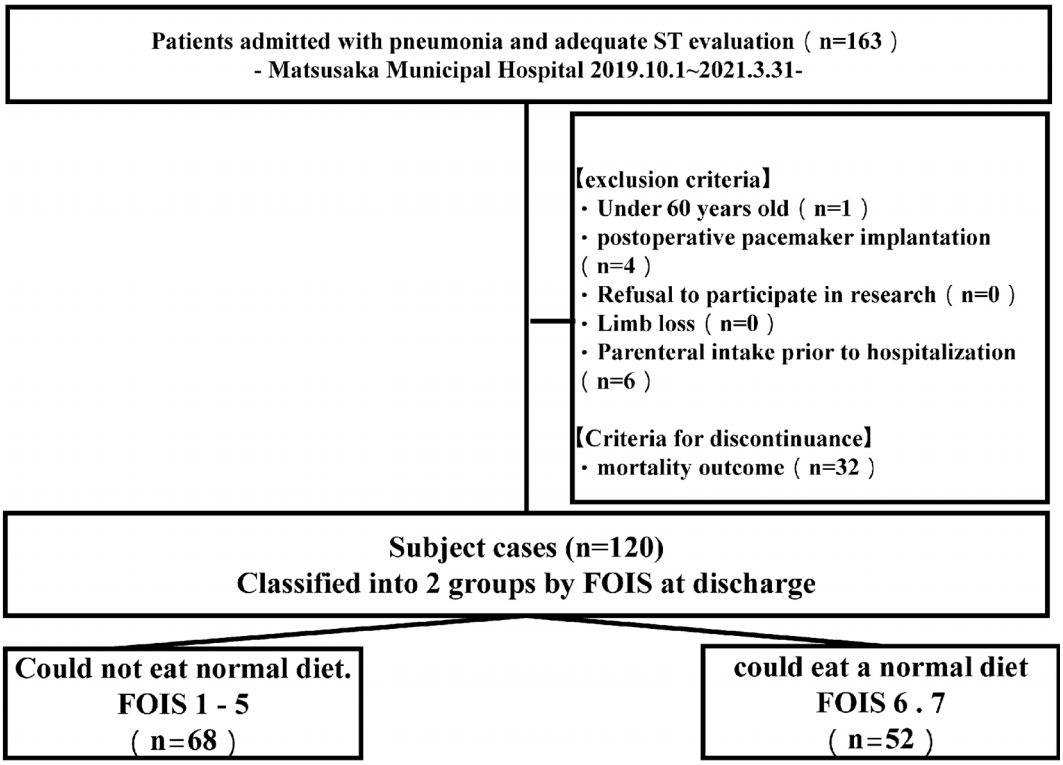

Figure 1. Flow chart.

bidities, the measurements were conducted in the supine position. These evaluations were assessed at the time of the first ST intervention where possible. However, if the acute condition made the evaluation difficult, it was performed after the condition stabilized and when the evaluation was deemed feasible.

For statistical analysis, the Shapiro-Wilk test was performed on all items to examine the normal distribution. Univariate analysis was performed for each item with the FOIS score at discharge as the outcome. Multivariate analysis was performed by entering items that showed significant differences in the univariate analysis. For the univariate analysis, comparisons between groups were conducted using the t-test and Mann-Whitney's U test, depending on the presence or absence of a normal distribution. In addition, the χ^2 test was used for the examination of the nominal scale. Logistic regression analysis (forced entry method) was performed with the item that showed significant differences in the univariate analysis as the dependent variable and whether the patient could eat a normal diet at discharge as the independent variable.

According to a previous study14, a strong correlation exists between the SMI and CC. In this study, both parameters were evaluated as integral components of assessment of the patients' physique. We deemed it highly probable that multicollinearity exists between the two variables. Therefore, when conducting the analysis, two separate models, A and B, were used to account for multicollinearity between SMI and CC. Statistical analysis was conducted using the EZR version 1.55 software.[15]

We declare that the subjects' data will not be used for any purpose other than the purpose of this study and that the results of the study will be published, but the processing will be quantitative, to ensure that the individuals will not be identified. This study is a retrospective observational study. Obtaining written consent was difficult. An opt-out was posted on the hospital website to inform the public. This study was conducted after obtaining approval from the Matsusaka Municipal Hospital Ethics Committee (approval number: J-209-221104-10-10). It was performed in accordance with the Helsinki Declaration of 1975.

3. Result

Median age of the subjects: 86 years; male/female ratio: 73/47; median interval to ST enrollment: 1 day. Univariate analysis identified significant differences in the age ($p = 0.007$), BMI ($p < 0.001$), length of hospital stay ($p = 0.006$), proportion of patients with aspiration pneumonia ($p = 0.003$), and proportion of patients with cerebrovascular disease (comorbidity) ($p = 0.006$), MASA score ($p < 0.001$), MMSE score ($p < 0.001$), SMI ($p < 0.001$), and CC ($p < 0.001$) between the two groups divided according to the scores on FOIS (Tables 1 and 2). Results are expressed as medians (interquartile ranges).

Table 1
Results of general patient information.

	All (n = 120)	Could not eat normal diet (n = 68)	Could eat normal diet (n = 52)	p value
Patient information				
Age (years) [a]	86 (80, 90)	87 (83, 91)	85 (77, 89)	*0.007***
Gender (male/female) [b]	73/47	43/25	30/22	0.575
BMI (kg/m^2) [a]	18.6 (16.2, 21.7)	17.1 (15.5, 18.8)	21.5 (17.9, 23.5)	*0.001***
Length of hospital stay (day) [a]	26 (14, 43)	32 (19, 45)	20 (12, 39)	*0.006***
Days to ST intervention (day) [a]	1 (0, 3)	1 (0, 3)	2 (1, 3)	0.451
Comorbidity				
Cancer [b]	29 (24%)	15 (22%)	14 (27%)	0.667
Cerebrovascular disease [b]	37 (31%)	28 (41%)	9 (17%)	*0.006***
Respiratory disease [b]	68 (57%)	37 (54%)	31 (59%)	0.583
Cardiac disease [b]	63 (53%)	35 (51%)	28 (54%)	0.855
Renal disease [b]	20 (17%)	9 (13%)	11 (21%)	0.324
Diabetes [b]	21 (18%)	10 (15%)	11 (21%)	0.468

[a] Median (Quartile range). [b] χ^2 test.
BMI: body mass index; ST: speech-language-hearing therapist.
* $p > 0.05$. ** $p > 0.01$.

Table 2
Results of various evaluations.

	All (n = 120)	Could not eat normal diet (n = 68)	Could eat normal diet (n = 52)	p value
Pneumonia information				
A-DROP (point) [a]	2 (2, 3)	2 (2, 3)	2 (2, 3)	0.218
Classification of pneumonia [b] (aspiration pneumonia/other pneumonia)	56/64	40/28	16/36	*0.003***
Recurrence of pneumonia [b] (primary/recurrent)	70/50	36/32	34/18	0.194
Swallowing assessment				
MASA (point) [a]	125 (105, 151)	114 (100, 130)	151 (123, 162)	*0.001***
Nutritional assessment				
GNRI (point) [a]	85 (77, 91)	83 (79, 88)	89 (77, 94)	0.152
Neuropsychological examination				
MMSE (point) [a]	10 (0, 23)	5 (0, 11)	25 (11, 27)	*0.001***
Anthropometric evaluation				
SMI (kg/m^2) [a]	4.9 (4.2, 5.8)	4.6 (3.8, 5.3)	5.7 (4.7, 6.3)	*0.001***
CC (cm) [a]	25.8 (23.0, 28.4)	23.6 (22.0, 25.5)	28.4 (26.5, 31.1)	*0.001***

[a] Median (quartile range). [b] χ^2 test.
CC: calf circumference; GNRI: Geriatric Nutritional Risk Index; MASA: the Mann assessment of swallowing ability; MMSE: Mini-Mental State Examination; SMI: Skeletal Muscle Mass Index.
* $p > 0.05$. ** $p > 0.01$.

Logistic regression analysis using model A identified a higher odds ratio for cerebrovascular disease (odds ratio: 0.224; 95% confidence interval: 0.078–0.764; p = 0.015), score on the MMSE (odds ratio: 1.130; 95% confidence interval: 1.050–1.220; p = 0.002), and SMI (odds ratio: 2.310; 95% confidence interval: 1.410–3.780; p < 0.001). Analysis using Model B identified the MMSE score (odds ratio: 1.140; 95% confidence interval: 1.040–1.240; p = 0.003) and CC (odds ratio: 1.710; 95% confidence interval: 1.360–2.140; p < 0.001) as independent predictors of the ability of the patients to eat a normal diet at discharge (Table 3).

Table 3
Results of logistic regression analysis.

	Odds ratio	95% confidence interval	p value
Model A			
Age	0.992	0.923–1.070	0.828
Cerebrovascular disease	0.224	0.078–0.764	*0.015***
MMSE	1.130	1.050–1.220	*0.002***
MASA	0.999	0.972–1.030	0.952
SMI	2.310	1.410–3.780	*0.001***
Model B			
Age	0.956	0.878–1.040	0.289
Cerebrovascular disease	0.312	0.086–1.130	0.076
MMSE	1.140	1.040–1.240	*0.003***
MASA	0.985	0.954–1.020	0.336
CC	1.710	1.360–2.140	*0.001***

CC: calf circumference; MASA: the Mann assessment of swallowing ability; MMSE: Mini-mental state examination; SMI: Skeletal Muscle Mass Index.
* p > 0.05. ** p > 0.01.

4. Discussion

In this study, factors, including the CC, that could potentially predict the swallowing function at discharge were explored in elderly patients hospitalized for pneumonia. The results showed significant differences in the age, BMI, length of hospital stay, percentage of patients diagnosed as having aspiration pneumonia, percentage of patients with underlying cerebrovascular disease (comorbidities), score on MASA, score on MMSE, SMI, and CC between the groups with the ability and inability for normal oral dietary intake at discharge. Logistic regression analysis identified the presence of cerebrovascular disease, CC, SMI, and score on MMSE as independent predictors of the ability of the patients to eat a normal diet at discharge.

A comparison of the general information about the patients revealed that the mean age of the patient group with the ability for a normal dietary intake at discharge was 85 years, while that in the group without the ability for normal dietary intake at discharge was 87 years, being significantly higher in the latter group. Nishikubo et al.[16] compared the swallowing function, as evaluated by videofluoroscopy, in healthy volunteers of different age groups, which revealed that older patients showed delayed swallowing reflexes and omitted esophageal inlet opening as compared with younger patients. Utanohara et al.[17] performed tongue pressure measurements to compare the tongue function in subjects of different age groups with no history of dysphagia and no molar defects, which revealed that the tongue pressure decreased with advancing age. These reports suggest that the swallowing function declines physiologically with advancing age. This study found that aging affects food forms.

The group that could eat a normal diet at discharge had a significantly lower percentage of patients with aspiration pneumonia, shorter hospital stays, lower BMI, and a higher MASA score than the group that could not eat a normal diet at discharge. The MASA consists of 24 items with a maximum score of 200 points. A low value for this score evaluates severe dysphagia and a high risk of aspiration. Patients with high MASA scores are presumed to have only mild dysphagia and consequently, can eat a normal diet. We also believe that the absence of aspiration pneumonia is associated with a reduced length of hospital stay. Regarding low BMI, low body weight has been reported[18] as a factor that delays the start of oral intake in patients with aspiration pneumonia. In addition, we consider the difference to be significant because poor swallowing and dysphagia can easily lead to low body weight because of inadequate oral intake and other nutritional problems.

Logistic regression analysis identified cerebrovascular disease, and score on the MMSE, SMI, and CC as independent factors associated with the ability of the patient for normal oral dietary intake.

There are many research reports in the literature regarding cerebrovascular disease and dysphagia. Mann et al.[19] followed stroke patients for 6 months and reported that about half of them had residual dysphagia and that in about 10% the pre-onset eating patterns were not restored. Maeshima et al.[20] also studied the dietary patterns of acute stroke patients at the time of their discharge from the hospital. They reported that approximately 20% required adjustment of the dietary form. The association between cerebrovascular disease and dysphagia is well known. Based on the results of previous studies and the present study, it is possible that patients with cerebrovascular disease need to adjust their eating patterns due to feeding and swallowing dysfunction even in the absence/before the onset of pneumonia. This may have had an impact on the recovery of the swallowing function of the patients in our study.

There are a few previous reports on the relationship between cognitive function and feeding/swallowing dysfunction in the literature. Maniaci et al.[21] demonstrated in elderly patients undergoing videofluoroscopic examination of swallowing, that poor performance in cognitive function tests was significantly correlated with poor feeding/swallowing function. Yokota et al.[22] demonstrated that the score on the MMSE was an independent predictor of the presence of dysphagia in elderly patients with congestive heart failure. In other words, the score on the MMSE may also be a predictor of feeding and swallowing function in the elderly.

The association of SMI with feeding and dysphagia is discussed earlier in this article.[5,6] There are also scattered reports in the literature on the relationship between CC and feeding/swallowing dysfunction. Kurosawa et al.[23] demonstrated CC as an independent predictor of the presence of dysphagia in elderly patients requiring long-term care. Matuo et al.[24] used CC to assess the muscle mass in elderly acutely ill patients and investigated its association with dysphagia. The results of these previous studies showed the independent association of the CC with feeding/swallowing dysfunction. In addition, both studies referred to above, like the present study, were conducted in elderly subjects, and it is possible that in this age group, dysphagia is often caused by a generalized loss of muscle mass, which could be predicted from a decrease in the CC. We believe that the results of these previous studies lend support to the results of our present study.

There were several limitations exist in this study. First, the study included patients with acute pneumonia, and we did not rule out the contribution of edema to the measured CC in our study. Second, this study was conducted at an acute care hospital and cannot be useful in the post-acute phase. In the future, it is necessary to expand the research and examine the practicability of using the CC as a predictor of normal dietary intake in the post-acute phase of illnesses. Third, this was a single-center, retrospective observational study, with the

potential for selection bias. Prospective studies are warranted in the future. Despite these limitations, measurement of CC measured early after admission to the hospital as a predictor of the ability for normal dietary intake allows for an approach to dysphagia. In addition, it makes it possible to consider early nutritional intervention, if necessary, for patients whose nutritional needs cannot be met by oral intake alone. The above are very important in the care of elderly pneumonia patients. The results of this study suggest that even patients hospitalized for pneumonia can smoothly return to their prehospital dietary intake patterns after discharge from the hospital if their overall muscle mass is maintained. Future research endeavors include determining the cutoff value of CC that would allow the influence of edema to be excluded and accurate prediction of the feasibility of normal dietary oral intake at discharge in elderly patients hospitalized for pneumonia.

In this study, predictors of the ability of elderly patients hospitalized for pneumonia at an acute care hospital to eat a normal diet at discharge were examined. The results suggest that cerebrovascular disease, score on the MMSE, SMI, and CC may be useful predictors of the ability for a normal oral dietary intake at discharge in elderly patients hospitalized for pneumonia.

Acknowledgements

We also thank International Medical Information Center for English language editing this manuscript.

Declaration of any potential financial and non-financial conflicts of interest

The authors did not receive support from any organization for the submitted work. The authors declare that they have no competing interest.

References

1. Teramoto S, Yamamoto H, Yamaguchi Y, et al. Lower respiratory tract infection outcomes are predicted better by an age > 80 years than by CURB-65. *Eur Respir J*. 2008;31(2):477–478. doi:10.1183/09031936.00120807
2. van der Steen JT, Lane P, Kowall NW, Knol DL, Volicer L. Antibiotics and mortality in patients with lower respiratory infection and advanced dementia. *J Am Med Dir Assoc*. 2012;13(2):156–161. doi:10.1016/j.jamda.2010.07.001
3. Fujishima I, Fujiu-Kurachi M, Arai H, et al. Sarcopenia and dysphagia: Position paper by four professional organizations. *Geriatr Gerontol Int*. 2019;19(2):91–97. doi:10.1111/ggi.13591
4. Chen LK, Woo J, Assantachai P, et al. Asian Working Group for Sarcopenia: 2019 Consensus update on sarcopenia diagnosis and treatment. *J Am Med Dir Assoc*. 2020;21(3):300–307.e2. doi:10.1016/j.jamda.2019.12.012
5. Maeda K, Akagi J. Sarcopenia is an independent risk factor of dysphagia in hospitalized older people. *Geriatr Gerontol Int*. 2016;16(4):515–521. doi:10.1111/ggi.12486
6. Maeda K, Takaki M, Akagi J. Decreased skeletal muscle mass and risk factors of sarcopenic dysphagia: A prospective observational Cohort study. *J Gerontol A Biol Sci Med Sci*. 2017;72(9):1290–1294. doi:10.1093/gerona/glw190
7. Kawakami R, Murakami H, Sanada K, et al. Calf circumference as a surrogate marker of muscle mass for diagnosing sarcopenia in Japanese men and women. *Geriatr Gerontol Int*. 2015;15(8):969–976. doi:10.1111/ggi.12377
8. Lim WS, van der Eerden MM, Laing R, et al. Defining community acquired pneumonia severity on presentation to hospital: an international derivation and validation study. *Thorax*. 2003;58(5):377–382. doi:10.1136/thorax.58.5.377
9. Cereda E, Pedrolli C, Zagami A, et al. Nutritional screening and mortality in newly institutionalised elderly: a comparison between the Geriatric Nutritional Risk Index and the Mini Nutritional Assessment. *Clin Nutr*. 2011;30(6):793–798. doi:10.1016/j.clnu.2011.04.006
10. Carnaby-Mann G, Lenius K. The bedside examination in dysphagia. *Phys Med Rehabil Clin N Am*. 2008;19(4):747–768. doi:10.1016/j.pmr.2008.05.008
11. Folstein MF, Folstein SE, McHugh PR. "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. *J Psychiatr Res*. 1975;12(3):189–198. doi:10.1016/0022-3956(75)90026-6
12. Crary MA, Mann GD, Groher ME. Initial psychometric assessment of a functional oral intake scale for dysphagia in stroke patients. *Arch Phys Med Rehabil*. 2005;86(8):1516–1520. doi:10.1016/j.apmr.2004.11.049
13. Baumgartner RN, Koehler KM, Gallagher D, et al. Epidemiology of sarcopenia among the elderly in New Mexico [published correction appears in Am J Epidemiol 1999 Jun 15;149(12):1161]. *Am J Epidemiol*. 1998;147(8):755–763. doi:10.1093/oxfordjournals.aje.a009520
14. Kawakami R, Miyachi M, Sawada SS, et al. Cut-offs for calf circumference as a screening tool for low muscle mass: WASEDA's Health Study. *Geriatr Gerontol Int*. 2020;20(10):943–950. doi: 10.1111/ggi.14025
15. Kanda Y. Investigation of the freely available easy-to-use software 'EZR' for medical statistics. *Bone Marrow Transplant*. 2013;48(3):452–458. doi:10.1038/bmt.2012.244
16. Nishikubo K, Mise K, Ameya M, Hirose K, Kobayashi T, Hyodo M. Quantitative evaluation of age-related alteration of swallowing function: Videofluoroscopic and manometric studies. *Auris Nasus Larynx*. 2015;42(2):134–138. doi:10.1016/j.anl.2014.07.002
17. Utanohara Y, Hayashi R, Yoshikawa M, Yoshida M, Tsuga K, Akagawa Y. Standard values of maximum tongue pressure taken using newly developed disposable tongue pressure measurement device. *Dysphagia*. 2008;23(3):286–290. doi:10.1007/s00455-007-9142-z
18. Momosaki R, Yasunaga H, Matsui H, Horiguchi H, Fushimi K, Abo M. Predictive factors for oral intake after aspiration pneumonia in older adults. *Geriatr Gerontol Int*. 2016;16(5):556–560. doi:10.1111/ggi.12506
19. Mann G, Hankey GJ, Cameron D. Swallowing function after stroke: prognosis and prognostic factors at 6 months. *Stroke*. 1999;30(4):744–748. doi:10.1161/01.str.30.4.744
20. Maeshima S, Osawa A, Miyazaki Y, et al. Influence of dysphagia on short-term outcome in patients with acute stroke. *Am J Phys Med Rehabil*. 2011;90(4):316–320. doi:10.1097/PHM.0b013e31820b13b2
21. Maniaci A, Lechien JR, La Mantia I, et al. Cognitive impairment and mild to moderate dysphagia in elderly patients: A retrospective controlled study. *Ear Nose Throat J*. 2022:1455613211054631. doi:10.1177/01455613211054631
22. Yokota J, Ogawa Y, Yamanaka S, et al. Cognitive dysfunction and malnutrition are independent predictor of dysphagia in patients with acute exacerbation of congestive heart failure. *PLoS One*. 2016;11(11):e0167326. doi:10.1371/journal.pone.0167326
23. Kurosawa Y, Hara K, Tohara H, et al. Calf circumference is a useful index for assessing dysphagia among community dwelling elderly recipients of long-term care. *Tohoku J Exp Med*. 2019;248(3):201–208. doi:10.1620/tjem.248.201
24. Matsuo H, Yoshimura Y. Calf circumference is associated with dysphagia in acute-care inpatients. *Geriatr Nurs*. 2018;39(2):186–190. doi:10.1016/j.gerinurse.2017.08.003