Self Reported Dysphagia is not Associated with Sarcopenia Defined by the Revised EWGSOP2 Criteria and Regional Thresholds at the Hospital Among Ambulatory Older Patients

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ABSTRACT

Introduction: Dysphagia and sarcopenia are geriatric syndromes, and they are shown to be related. There is no study on dysphagia and sarcopenia with the revised European Working Group on Sarcopenia in Older People (EWGSOP2) criteria. Aim: We aimed to evaluate dysphagia and sarcopenia with the revised criteria implementing regional thresholds for skeletal muscle mass (SMM) in hospitalized older patients. Methods: Ambulatory patients ≥60 years of age from the Internal Medicine Department of our hospital were taken into the study. Grip strength, SMM via bioelectrical impedance analysis, nutritional status, dysphagia screening with Eating Assessment Tool-10, prior hospitalizations and diet were evaluated. Sarcopenia was defined by EWGSOP2 criteria using regional SMM thresholds adjusted to body mass index (BMI) (SMMI (BMI)). Results: Out of 112, 61 patients were enrolled. Sarcopenia, nutritional risk, and dysphagia were shown in 36.1%, 88.5%, and 14.8% of the patients. The risk of dysphagia was not associated with sarcopenia (p=0.263). Hospitalizations (≥1) in one year with pneumonia, modified diet, malnutrition, and low SMMI (BMI) were more common in patients with dysphagia risk than in the patients without (p=0.001, p<0.01, p=0.011, p=0.008, respectively). The median age and BMI were higher where SMMI (BMI) was lower in the group with dysphagia risk than in the group without (p=0.016, p=0.034, p=0.032), respectively. Conclusion: We found that self-reported dysphagia was not associated with sarcopenia defined by the EWGSOP2 criteria in ambulatory hospitalized patients over 60 years of age. Further studies using revised criteria, different adjustments and thresholds are needed to reveal possible differences. Keywords: Self Reported Dysphagia, Sarcopenia, Revised EWGSOP2 Criteria.

1. INTRODUCTION

Dysphagia is a substantial problem for older patients (1, 2). Oropharyngeal dysphagia (OD) is inclined to show higher prevalences in patients with functional declines, higher comorbidity and frailty, and it is associated with poor outcomes (3-5). Despite the high prevalence; awareness on OD, screening and proper management is inadequate in the clinical setting (5). There are several methods to be used in the presence of suspicion for dysphagia in the elderly. However, implementing further studies in the older patients with low functional status and multiple comorbidities might not always be feasible and safe. So, bedside screening methods may be used to define dysphagia in the elderly, to reveal the individuals with swallowing disorder and/or at risk of OD, rather than missing out the pathology (2). Among those screening methods Eating Assessment Tool (EAT-10) is a self-reported questionnaire (2, 6).

Since "sarcopenia" was described initially as an age-dependent decline in muscle mass, numerous research groups published various consensus papers worldwide for sarcopenia to...
date (7, 8). Recently, extended group of European Working Group on Sarcopenia in Older People (EWGSOP) has proposed a new consensus on sarcopenia in 2018 (EWGSOP2) and defined sarcopenia as a muscle disease occurring because of changes in the muscle across a lifetime (9).

Various pathologies such as aging and neurological diseases can cause OD. Swallowing action is a complex event that involves many phases. Some of the causes for impaired efficacy of swallow in the elderly with dysphagia are; lower oropharyngeal sensitivity, prolonged duration of swallow, delayed hyoid movement and impaired bolus propulsion primarily because of sarcopenia (5, 10-12). The possibility of a swallowing disorder may increase concerning the deteriorations in muscles used in swallowing action. The association of dysphagia and sarcopenia is a very hot topic (13). Studies on the relationship between dysphagia and sarcopenia have been conducted using different definitions of sarcopenia, but mainly with EWGSOP 2010 criteria. By the implementation of the new EWGSOP2 criteria, the prevalence of sarcopenia and the relation with dysphagia might differentiate. Besides, the use of regional thresholds and the method used for the adjustment of muscle mass might also have an impact.

2. AIM

So, we aimed to evaluate dysphagia and sarcopenia with the revised criteria, and also the associations between them in hospitalized older patients. To the best of our knowledge, our study is the first in the literature about the association of dysphagia with sarcopenia using the new EWGSOP2 criteria in older patients.

3. METHODS

The patients over 60 years of age from the Department of Internal Medicine of our hospital were taken into the study. Those patients admitted to the department in two weeks were enrolled. Inclusion criteria were; ambulatory patients who can feed per orally with water, juicy food or normal food, and adequate cognitive ability. The patient was excluded if the patient was with enteral tube feeding or tracheostomy tube, and, nil per os by physician order. Out of 112 patients, 12 of them rejected to complete dysphagia assessment and nutritional assessment, and 21 patients could not maintain the evaluations for one or more parameters essential for sarcopenia diagnosis, so they were excluded. After excluding the patients who were not eligible, 61 patients were enrolled. The number of hospitalizations and hospitalizations because of pneumonia in the past year, the type of the meal at the hospital (normal, diet, thickener use, oral supplements, juicy food), and the other parameters were noted.

The screening of dysphagia was performed using EAT-10 questionnaire, a valid self-assessment instrument commonly used to measure the risk of dysphagia. The EAT-10 involves ten queries which score from zero (no problem) to four (high level of problem) with a point ≥5 indicating the swallowing problems. Each item describes a specific risk condition such as “Swallowing liquids necessitates additional striving” (6, 14). The EAT-10 is reliable and validated in adult Turkish patients (15). The presence of malnutrition and risk of malnutrition was determined by Mini Nutritional Assessment Short Form (MNA-SF). Tanita SC-530 was used for the analysis of skeletal muscle mass (SMM). The measures were executed with fasting of overnight and with light clothes after urination in a standardized protocol for our department. Total SMM was calculated from fat-free mass (FFM) using a validated formulation (SMM (kg) = 0.566 × FFM) (16). The cutpoints for low muscle mass have been defined in a previous study for Turkish population (17, 18). Those thresholds are for whole-body SMM measurements. The SMM adjusted to body mass index (BMI) was presented as SMMI (BMI) in this study, and the thresholds were 1.049 kg/BMI/0.823 kg/BMI for men and women. Cutpoints of SMMI (height) were 9.2/7.4 (kg/m2) for men and women, respectively (17, 18). We used grip strength measurement for low muscle strength in this study. Grip strength was measured by Takei T.K.K. 5401 digital dynamometer (Takei Scientific Instruments Co. Ltd, Tokyo, Japan) using a standardized protocol. Three trials with the dominant hand at one-minute intervals were performed. The patients were standing, arms extended 30° to the trunk. The mean of the three performances was taken for each case and recorded. The thresholds for low muscle strength are values below 27 for men and 16 for women in EWGSOP2 (9). According to EWGSOP2 consensus; sarcopenia is determined by the use of both low muscle strength and quantity or quality (9). In this study, sarcopenia was diagnosed by low muscle strength and muscle mass according to EWGSOP2 criteria using regional thresholds of SMM adjusted to BMI.

Statistical analysis

Normality was tested by Shapiro–Wilk test. Numerical variables were analysed by Mann Whitney-U, and categorical variables were analysed with Chi-square. Data were noted as ± standard deviations and medians (interquartile ranges) or as percentages where available. A P value less than 0.05 was deemed as significant. The Statistical Package for Social Sciences (SPSS/Windows version 25.0, SPSS Inc., Chicago, IL, USA) was used for the analyses.

4. RESULTS

Total population consisted of 61 (≥60 years of age) patients. As the patients were taken from an Internal Medicine Department, the patients showed a wide range of comorbidities. Other than diabetes mellitus and hypertension, 24.6% of the patients had renal diseases, 18% had collagen diseases, 26.2% were with hematological problems. The patients with Parkinson disease, dementia, coronary artery disease, thyroidal, urological, and other problems constituted a minor group, so, those were not mentioned. Out of all, 24.6% of the patients were on modified food, 52.5% of them were hospitalized at least two or more times in last year, and the ratio of hospitalization with pneumonia one or more times in one year was 18%. Patients with BMI <18.5, between and ≥30 were 5.5%, 61.4% and 35.1% of the study group, respectively. Dysphagia with EAT-10 and undernutrition (malnutrition or malnutrition risk) were present in 14.8%, and 88.5 of the patients.Patients found to have low grip strength and low SMMI (BMI) were 79.7%, and 40% of the total group (78%/83.5% and 48.6%/22.2% for females/
The patients with dysphagia risk and no risk were similar in terms of the presence of sarcopenia (55.6% vs. 37.2%, p=0.263). One or more hospitalizations in one year because of pneumonia, modified diet, malnutrition (MNA-SF≥8), and the presence of low SMMI (BMI) were more common in patients with dysphagia risk than the individuals with no dysphagia risk (66.7% vs. 9.6%, p=0.001; 77.8% vs. 15.4%, p<0.01; 77.8% vs. 26.9%, p=0.01, 100% vs. 34%, p=0.008, respectively). The median age and BMI were significantly higher (80 (11) vs. 65 (14), p=0.016; 30.7 (5.6) vs. 25.5 (8.7), p=0.034), and median SMMI (BMI), and MNA-SF score were lower (0.755 (0.16) vs. 0.982 (0.49), p=0.052; 6 (5) vs. 8 (3), p=0.008) in the group with dysphagia risk than the group without dysphagia risk. No significant difference was shown among the patients with dysphagia risk and no risk with respect to gender, presence of DM, HT, and other diseases, malnutrition and undernutrition (MNA-SF≥12), hospitalizations in one year, median and low grip strength, SMM (height), and SMM values (data not shown).

5. DISCUSSION

Self-reported dysphagia in older inpatients was not associated with the presence of sarcopenia identified by EWGSOP2 criteria in this study.

Both dysphagia and sarcopenia are common in older individuals. Sarcopenia prevalence varied widely from 7.5% to 77.6% according to the setting, age, sex, ethnicity, the sarcopenia criteria used in a recent systematic review examining various definitions including the EWGSOP criteria (19). In a recent study, the prevalence of sarcopenia was 7.4% with EWGSOP2 criteria, 18.1% in inpatients in another study, and 8.1% among Japanese community-dwelling older adults with height adjusted muscle mass values (20-22). Those studies comprised of height adjusted muscle mass measurements. Sarcopenia prevalence was found to be 36.1% in our study among older patients at the hospital. In this study, we used regional thresholds of muscle mass adjusted to BMI. Though there are several methods for adjustment of muscle mass, it has been reported that the adjustments might be performed if there is data for the related population in EWGSOP2 consensus (9). As we have used regional thresholds and BMI adjustments, those factors might have resulted in an elevated prevalence of sarcopenia in our study. In a previous study, the associations of diverse bioimpedance calculations of muscle mass with functional measurements recruited from the geriatric outpatient clinic reporting that BMI adjusted SMM for low muscle mass outperformed in relation to functionality and disability (23). However, there is no study investigating the prevalence of sarcopenia implementing the muscle mass adjusted to BMI, and also the regional thresholds among inpatients. Besides, we were not able to locate studies evaluating the impact of different adjustments in relation with body size on the prevalence of sarcopenia in the same study, so far. Further studies on the prevalence of sarcopenia using various adjustments and thresholds with the revised criteria are needed to reveal the possible differences.

The prevalence of OD in the elderly varies according to the setting, comorbidities, and the methods; varying from 27% in the community and 47.5% in an acute geriatric unit up to 91% in inpatients with community-acquired pneumonia (24-27). By the implementation of EAT-10 to older outpatients, 57.2% of men and 66.6% of women were at risk for dysphagia in a recent study from Turkey (4). Dysphagia was present in 14.8% of the participants via EAT-10, in this study. The lower OD prevalence in our study might have occurred because of the inclusion criteria which include ambulatory patients and who are able to feed per orally with adequate cognitive ability. Sarcopenia defined by low SMMI and grip strength at the hospital, physical frailty, frailty, advancing age, history of clinical disease, loss of SMM, and handgrip strength have been found to be associated with dysphagia among older individuals in several settings (1, 4, 28-32). Besides, tongue pressure was related to grip strength and gait speed in males, and head lifting strength was related to dysphagia and poor nutritional status among older patients where EAT-10 was associated with nutritional status at long term care (33-35). Likewise, dysphagia risk by EAT-10 was higher in patients with malnutrition, low SMMI, in the older ages, hospitalizations with pneumonia in the past year, and prescription of modified diet, but not

| Parameters                          | Female (n = 45, 70.5%) | Male (n = 18, 29.5%) | Total (n = 63) |
|-------------------------------------|------------------------|---------------------|---------------|
| Age (year)                          | 70.65 ± 9.08           | 67.72 ± 8.16        | 69.78 ± 8.86  |
| Diabetes mellitus (n, %)            | 20 (46.6)              | 12 (66.7)           | 32 (52.5)     |
| Hypertension (n, %)                 | 12 (27.9)              | 1 (5.6)             | 13 (21.3)     |
| BMI (kg/m²)                        | 27.91 ± 6.97           | 26.81 ± 6.43        | 27.57 ± 6.77  |
| FFM (kg)                            | 42.88 ± 7.31           | 58.29 ± 10.24       | 47.92 ± 11.04 |
| SMM (kg)                            | 24.27 ± 4.13           | 32.99 ± 5.79        | 27.12 ± 6.25  |
| SMM/BMI (kg/BMI)                   | 0.903 ± 0.19           | 1.27 ± 0.24         | 1.02 ± 0.27   |
| SMM/height (kg/m²)                 | 9.93 ± 1.61            | 11.21 ± 1.70        | 10.35 ± 1.73  |
| Hand grip strength (kg)            | 12.54 ± 4.68           | 22.52 ± 9.08        | 15.45 ± 7.85  |
| MNA-SF score (n, %)                | 5.92 ± 3.8             | 7.94 ± 2.66         | 8.32 ± 2.45   |
| EAT-10 score (n, %)                | 1.41 ± 3.95            | 0.44 ± 1.04         | 1.13 ± 3.38   |
| Sarcopenia (n, %)                  | 18 (41.9)              | 4 (22.2)            | 22 (36.1)     |

Table 1. Characteristics of the patients. BMI body mass index, FFM fat free mass, SMM skeletal muscle mass, MNA-SF Mini Nutritional Assessment-Short Form, EAT-10 Eating Assessment Tool-10, SMMI skeletal muscle mass index. Values are given as mean ± standard deviations (plus minimum- maximum values for the total population).
in the participants with low grip strength, and the presence of
diseases and hospitalizations in one year, in this study.
Dysphagia risk was higher in the patients with higher BMI
in our study. Median BMI of both groups with and without
dysphagia risk were 30.7 and 25.5, respectively. Due to the
inclusion criteria, the study group comprised of patients
mainly with BMIs 18.5 kg/m² to 29.9 kg/m² where patients
with BMI <18.5 constituted only 3.5% of the population
in our study group. So, the small number of study sample, and
the features of the patients might have led to those results.

Since 2005, the studies on the relationship of sarcopenia
dysphagia have accumulated in the literature (12, 28,
29, 36, 37). In a retrospective study from Japan evaluating
dysphagia and functional consequences at the hospital
on patients ongoing rehabilitation; sarcopenia was related
to dysphagia and deteriorated improvement of physical
function (37). Sarcopenia was found to be related with an
increased dysphagia risk in community-dwelling older
persons (38). Finally, in the systematic review published
in 2018, it was reported that whole-body sarcopenia and
dysphagia are significantly associated (ORs, 4.06; 95% CI,
2.27-7.29) (39). Though, the question of which one is the
cause remains, it may be suggested that the dysphagia
screening-assessment should be performed in patients with
frailty and sarcopenia (40). We could not show an associa-
tion among dysphagia risk evaluated by EAT-10 and sarco-
penia defined by EWGSOP2 criteria and regional thresholds
for SMMI (BMI). Though the patients with dysphagia risk
were more sarcopenic than the patients without dysphagia
and sarcopenia, the difference was not significant. There
are several factors which might affect our result. First of
all, the limited number of the study population may have
caus ed the negative result. In addition, the use of new
EWGSOP2 criteria for sarcopenia is novel on studies in-
vestigating the association of dysphagia and sarcopenia.
Likewise, as aforementioned, adjustment of SMM by BMI,
and the use of regional SMMI (BMI) thresholds for defining
dysphagia also might have altered the results, and this is
the first study concerning those methods and the relation
of dysphagia with sarcopenia. Regarding the implementation
of EAT-10 to screen dysphagia; EAT-10 is simple, fast, and
an can be applied by most of the health professions, and an
increased score of EAT-10 may indicate a self-perception of
severe dysphagia (15). In a recent study comparing nonin-
vasive swallow tests to videofluoroscopic methods; though
none of the swallowing measures were shown to be differ-
ent regarding safety, several variables such as age, EAT-10,
and 5-oz water swallow challenge tended to distinguish
efficiency of swallows (41). So, further studies are needed
regarding the association of dysphagia with sarcopenia
defined by EWGSOP2 criteria.

One of the limitations is that we used regional thresh-
olds reported by Bahat et al adjusted to BMI, as we were
not able to define low SMM values in the patients with
height adjustment and regional thresholds. Besides, the
muscle mass values were absolute, not appendicular. The
thresholds suggested by Bahat et al were absolute muscle
mass values, so we used those data. Additionally, absolute
muscle mass thresholds are not available for EWGSOP2
consensus. The limited number of patients enrolled in our
study should also be taken into consideration while evalu-
ating the results. On the other hand, some of those limita-
tions are also strengths of this study such as the use of the
regional Turkish data and BMI adjustment for sarcopenia
prevalence at the hospital which are novel.

6. CONCLUSION

Dysphagia and sarcopenia are substantial geriatric syn-
dromes leading to poor outcomes. Though we could not
show an association between dysphagia risk and sarcope-
nia with the new revised EWGSOP2 criteria using regional
SMMI thresholds; further studies in larger samples with
the revised criteria and also with different adjustments and
thresholds are needed to reveal possible varying results.

• Compliance with ethical standards: All of the processes carried out in our
study were compatible with the standards of Faculty of Medicine-Ege
University Review Board of Clinical Research Ethics Committee.

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• Author contributions: Both authors made contributions to the study
concept and design. Materials were prepared, data were collected, and
analysis were performed by both SS and MM. SS wrote the initial draft
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REFERENCES

1. Horgan E, Lawson S, O’Neill D. Oropharyngeal dysphagia among
patients newly discharged to nursing home care after an episode of
hospital care. Ir J Med Sci. 2019. Epub 2019 Jul 22.

2. Bajjens LW, Clavé P, Cras P, Ekberg O, Forster A, Kolb GF, et al. Euro-
pean Society for Swallowing Disorders - European Union Geriatric
Medicine Society white paper: oropharyngeal dysphagia as a geriatric
syndrome. Clin Interv Aging. 2016; 11: 1403-1428.

3. Ortega O, Martín A, Clavé P. Diagnosis and Management of Oropa-
ryngeal Dysphagia Among Older Persons, State of the Art. J Am Med
Dir Assoc. 2017; 18(7): 576-582.

4. Bahat G, Yilmaz O, Durmazoglu S, Kilic K, Tascigolu C, Kuran MA.
Association between dysphagia and frailty in community dwelling
older adults. J Nutr Health Aging. 2019; 23(6): 571-577.

5. García-Peris P, Parón L, Velasco C, de la Cuerva C, Camblor M, Bretón
I, et al. Long-term prevalence of oropharyngeal dysphagia in head
and neck cancer patients: impact on quality of life. Clin Nutr. 2007;
26(6): 710–717.

6. Belafsky PC, Mouadeb DA, Rees CJ, Pryor JC, Postma GN, Allen J, et
al. Validity and reliability of the Eating Assessment Tool (EAT-10).
Ann Otol Rhinol Laryngol. 2008; 117(12): 919–924.

7. Morley JE, Abbatangelo AM, Argiles JM, Baracos V, Bauer J, Bhasin
S, et al. Society on Sarcopenia, Cachexia and Wasting Disorders Trial-
ist Workshop. Sarcopenia with limited mobility: an international
consensus. J Am Med Dir Assoc. 2011; 12: 403-409.

8. Cruz-Jentoft AJ, Baeyens JP, Bauer JM, Boirie Y, Cederholm T, Landi
F, et al. Sarcopenia: European consensus on definition and diagnosi-
Report of the European Working Group on Sarcopenia in Older People.
Age Ageing. 2010; 39: 412–423.

9. Cruz-Jentoft AJ, Bahat G, Bauer J, Boirie Y, Bruyère O, Cederholm
T, et al. Sarcopenia: revised European consensus on definition and
diagnosis. Age Ageing. 2019; 48(1): 16-31.
10. Rofes L, Arreola V, Romena M, Palomera E, Almirall J, Cabré M, et al. Pathophysiology of Oropharyngeal dysphagia in the frail elderly. Neurogastroenterol Motil. 2010; 22(8): 851-858, e250.

11. Robbins J, Langmore S, Hind JA, Erlichman D, Dysphagia research in the 21st century and beyond: Proceedings from Dysphagia Experts Meeting, August 21, 2001. J Rehabil Res. 2002; 39(4): 545-548.

12. Robbins J, Gangnon RE, Theis SM, Kays SA, Hewitt AL, Hind JA. The effects of lingual exercise on swallowing in older adults. J Am Geriatr Soc. 2005; 53(9): 1483-1489.

13. Fujishima I, Fuji-Kurachi M, Arai H, Hyodo M, Kagaya H, Maeda K, et al. Sarcopenia and dysphagia: Position paper by four professional organizations. Geriatr Gerontol Int. 2019; 19(2): 91-97.

14. Azzolino D, Damanti S, Bertagnoli L, Lucchi T, Cesari M. Sarcopenia and swallowing disorders in older people. Aging Clin Exp Res. 2019; 31(6): 799-805.

15. Demir N, Serel Arslan S, İnal O, Karaduman AA. Reliability and Validity of the Turkish Eating Assessment Tool (T-EAT-10). Dysphagia. 2016; 31(5): 644-649.

16. Deurenberg P, Pietrobelli A, Wang ZM, Heymsfield SB. Prediction of total body skeletal muscle mass from fat-free mass or intra-cellular water. Int J Body Compos Res. 2004; 2: 107-113.

17. Bahat G, Tufan A, Tufan F, Kilic C, Akpinar TS, Kose M, et al. Cut-off points to identify sarcopenia according to European Working Group on Sarcopenia in Older People (EWGSOP) definition. Clin Nutr. 2016; 35(6): 1557-1563.

18. Bahat G, Tufan A, Kilic C, et al. Cut-off points for height, weight, and body mass index-adjusted bioimpedance analysis measurements of muscle mass with use of different threshold definitions. Aging Male. 2018 Sep 29: 1-6.

19. Lardies-Sánchez B, Sanz-Paris A, Boj-Carceller D, Cruz-Jentoft AJ. Systematic review: Prevalence of sarcopenia in ageing people using bioelectrical impedance analysis assessment to assess muscle mass. Eur Geriatr Med. 2016; 7(3): 256-261.

20. Locquet M, Beaudart C, Petermans J, Reginster JY, Bruyère O. EWGSOP2 Versus EWGSOP1: Impact on the Prevalence of Sarcopenia and Its Major Health Consequences. J Am Med Dir Assoc. 2019; 20(3): 384-385.

21. Reiss J, Igsheder B, Alzner R, Mayr-Pirker B, Pirich C, Kässmann H. Consequences of applying the new EWGSOP2 guideline instead of the former EWGSOP guideline for sarcopenia case finding in older patients. Age Ageing. 2019 Sep; 48: 713-718.

22. Su Y, Hirayama K, Han TF, Izutsu M, Yuki M. Sarcopenia Prevalence and Risk Factors among Japanese Community Dwelling Older Adults Living in a Snow-Covered City According to EWGSOP2. J Clin Med. 2019 Mar; 8(3): 291. doi:10.3390/jcm8030291.

23. Bahat G, Kilic C, Ilhan B, Karan MA, Cruz-Jentoft A. Association of different bioimpedanciometry estimations of muscle mass with functional measures. Geriatr Gerontol Int. 2019; 19(7): 593-597.

24. 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(1): 186-187.

25. Carrión S, Cabré M, Monteis R, Roca M, Palomera E, Serra-Prat M, et al. Oropharyngeal dysphagia is a prevalent risk factor for malnutrition in a cohort of older patients admitted with an acute disease to a general hospital. Clin Nutr. 2015; 34(5): 436-442.

26. Cabré M, Serra-Prat M, Force L, Almirall J, Palomera E, Clavé P. Oropharyngeal dysphagia is a risk factor for readmission for pneumonia in the very elderly persons: Observational prospective study. J Gerontol A Biol Sci Med Sci. 2014; 69(5): 330-337.

27. Almirall J, Rofes L, Serra-Prat M, Icart R, Palomera E, Arreola V, et al. Oropharyngeal dysphagia is a risk factor for community-acquired pneumonia in the elderly. Eur Respir J. 2015; 41(4): 925-926.

28. Maeda K, Akagi I. Sarcopenia is an independent risk factor of dysphagia in hospitalized older people. Geriatr Gerontol Int. 2016; 16: 515-521.

29. Yoshimura Y, Wakabayashi H, Bise T, Tanoue M. Prevalence of sarcopenia and its association with activities of daily living and dysphagia in convalescent rehabilitation ward inpatients. Clin Nutr. 2018; 37(6 Pt A): 2022-2028.

30. Madhavan A, LaGorio LA, Crary MA, Dahl WJ, Carnabhy GD. Prevalence of and Risk Factors for Dysphagia in the Community Dwelling Elderly: A Systematic Review. J Nutr Health Aging. 2016; 20: 806-815.

31. Wakabayashi H, Matsushima M, Uwano R, Watanabe N, Oritsu D, Shimizu Y. Skeletal muscle mass is associated with severe dysphagia in cancer patients. J Cachexia Sarcopenia Muscle. 2015; 6(4): 351-357.

32. Takagi D, Hirano H, Watanabe Y, Edahiro A, Ohara Y, Yoshida H, et al. Relationship between skeletal muscle mass and swallowing function in patients with Alzheimer’s disease. Geriatr Gerontol Int. 2017; 17(3): 402-409.

33. Kasugui Y, Tohara H, Machida N, Nakane A, Minakuchiet S. Can grip strength and/or walking speed be simple indicators of the deterioration in tongue pressure and jaw opening force in older individuals? Gerontodontology. 2017; 34(4): 455-459.

34. Wakabayashi H, Sashika H, Matsushima M. Head lifting strength is associated with dysphagia and malnutrition in frail older adults. Geriatr Gerontol Int. 2015; 15: 410-416.

35. Wakabayashi H, Matsushima M. Dysphagia Assessed by the 10-Item Eating Assessment Tool Is Associated with Nutritional Status and Activities of Daily Living in Elderly Individuals Requiring Long-Term Care. J Nutr Health Aging. 2016; 20(1): 22-27.

36. 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.

37. Yoshimura Y, Wakabayashi H, Bise T, Nagano F, Shimazu S, Shiraishi A, et al. 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. Nutr. 2019; 61: 111-118.

38. Cha S, Kim WS, Kim KW, Han JW, Jang HC, Limet S, et al. Sarcopenia is an Independent Risk Factor for Dysphagia in Community-Dwelling Older Adults. Dysphagia. 2019; 54(5): 692-697.

39. Zhao WT, Yang M, Wu HM, Yang L, Zhang XM, Huang Y. Systematic review and meta-analysis of the association between sarcopenia and dysphagia. J Nutr Health Aging. 2018; 22(8): 1005-1009.

40. Payne M, Morley JE. Dysphagia, dementia and frailty. J Nutr Health Aging. 2018; 22(5): 562-565.

41. Molfenter SM, Brates D, Herzberg E, Noorani M, Lazarus C. The Swallowing Profile of Healthy Aging Adults: Comparing Noninvasive Swallow Tests to Videofluoroscopic Measures of Safety and Efficiency. J Speech Lang Hear Res. 2018; 61(7): 1603-1612.