Revista CEFAC

eISSN 1982-0216

DOI: 10.1590/1982-0216/202426511423 | Rev. CEFAC. 2024;26(5):e11423

Original articles

Swallowing symptoms increase the risk of dynapenia in community-dwelling oldest old: A retrospective cohort study

Natália Conessa Ortega[1]
Cinthia Madeira de Souza[1]
Anita Liberalesso Neri[1]
Vinicius Nagy Soares[1]
Lúcia Figueiredo Mourão[1]

[1] Universidade Estadual de Campinas - Unicamp, Faculdade de Ciências Médicas, Campinas, São Paulo, Brasil.

ABSTRACT

Purpose: to investigate the association between swallowing symptoms and dynapenia in Brazilian older adults, of an 8-year follow-up cohort study.

Methods: a retrospective cohort analysis using data from the FIBRA (Brazilian Elderly Frailty) study, at a baseline survey in 2008-2009 and follow-up in 2016-2017. Swallowing complaints were assessed by nine dichotomous questions and dynapenia was assessed using handgrip strength. Principal component analysis was used to determine the swallowing complaints, and logistic regression models were used to associate swallowing complaints at the baseline with dynapenia at the follow-up. Statistical models were adjusted for demographic characteristics, body mass index (BMI), chronic diseases, cognition, and physical performance. Descriptive and comparative statistics were used, considering $p < 0.05$.

Results: 404 older adults were included, predominantly women (68.3%). Principal Component Analysis determined the swallowing symptoms change in taste, difficulty or pain in chewing hard food, difficulty or pain to swallow, and feeling of still or stuck food. According to the logistic regression model, older adults who reported swallowing symptoms at baseline, exhibited risk of developing dynapenia at the follow-up (odds ratio=1.384, 95% CI: 1.119 to 1.713, p=0.003). The difficulty or pain to swallow associated with age, sex, years of education, and number of chronic diseases consisted of self-report, cognitive functioning, and physical performance increased the risk of dynapenia in four times for (OR=5.744; 95% CI: 2.187 to 15.088; p<0.001).

Conclusions: the study revealed that the swallowing symptoms at baseline exhibited risk of developing dynapenia at follow-up in older adults. This research reinforces the importance of longitudinal studies incorporating variables such as swallowing symptoms, sociodemographic aspects, BMI, cognitive decline, and physical performance and muscular strength to better understand the significance of swallowing symptoms in the aging process.

Keywords: Deglutition Disorders; Muscle Strength; Aging

A study conducted at the Faculdade de Ciências Médicas da Universidade Estadual de Campinas - Unicamp, Campinas, SP, Brazil.

Financial support: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) - Process number 88882.435438/2019-01

Conflict of interests: Nonexistent

Corresponding author:
Natalia Conessa Ortega
Rua Minas Gerais, n.376
Postal Code:13911-018 - Jaguariúna, SP, Brazil
E-mail: nataliaconessa@gmail.com

Received on December 17, 2023
Received in a revised form on April 30, 2024
Accepted on July 29, 2024

INTRODUCTION

For more than seven decades, Brazil has demonstrated a decrease in mortality, birth and fertility rates, however, inequality of the process of demographic transition was observed. The increase of the older adult population was more prominent in regions such as Southeast, South and Midwest[1]. Increases in life expectancy and population aging, impact a set of social and physiological changes[2]. The changes of swallowing physiology decrease masticatory strength and the presence of swallowing difficulties are associated with poor diet of older adults[2] and their nutritional status[3].

Swallowing is a process that depends on the neuromuscular integrity of the head and neck structures. The most frequent anatomical and physiological dysfunctions related to aging consist of reduced elasticity of the head and neck structures, alteration of the cervical spine, changes in smell and taste, xerostomia,[4] and decreased tongue pressure,[5] which can impact the safety and efficiency of swallowing. Older adults with swallowing symptoms may present coughing, choking, respiratory difficulties,[6] aspiration pneumonia, dehydration, due to low fluid intake, and low consumption of solid foods[7]. These negative outcomes mainly impair the consumption of proteins and fibrous foods, which require greater effort during swallowing. In addition, low dietary variability combined with decreased caloric intake contributes to low weight and, consequently, malnutrition[8]. Ultimately, lack of energy supply associated with physical inactivity reduces fat and muscle mass reserves, increasing risks of sarcopenia/dypnapenia and frailty syndrome[3].

Dynapenia represents the age-related decrease in maximal muscle strength, usually assessed by means of hand dynamometer that estimates isometric strength and muscle power[9].These estimates are important because the aging process first affects muscle strength, signaling for future health problems[10]. Epidemiological studies indicated that malnourished older people have less strength compared to healthy older adults[11], and that dynapenia is associated with disability, morbidity, and mortality[12].

Recent studies have demonstrated the association between swallowing symptoms and muscular strength in older adults[13-15]. Murotani et al.[13] observed that occlusal force and tongue pressure were directly associated with handgrip strength, and that motor integrity of lip and tongue, as well as swallowing function were directly associated with gait speed. Ozer et al.[14] used dysphagia as outcome in regression models, revealing that sarcopenia was a predictor of swallowing symptoms in a sample of older adults hospitalized in geriatric outpatient clinic. Through longitudinal study, Hansen et al.[15] identified that low leg endurance and worse handgrip strength were associated with dysphagia in 56-week follow-up. Conversely, a reverse relationship may also be present, namely, our hypothesis was that swallowing symptoms may be associated with decreased of muscular strength in a cohort study involving older adults. Consequently, this research aimed at analyzing whether swallowing symptoms could predict dynapenia and association of age, sex, and years of education and variation of BMI, cognitive functioning, chronic diseases, and physical performance in an 8-year follow-up cohort study.

METHODS

This is a retrospective cohort based on FIBRA (Brazilian Elderly Frailty) study data, a 2008-2009 baseline survey with follow-up in 2016-2017. Data collection was conducted in the Southeast of Brazil. The present study was approved by the Ethics Committee (no. 3,187,423), with endorsement for data collection at baseline (no. 208/2007) and at follow-up (1,332,651/2015), previously approved by the Research Ethics Committee of the Faculty of Medical Sciences of the State University of Campinas (UNICAMP) at Campinas, SP, Brazil.

Procedures

At baseline, FIBRA data collection was carried out in schools, churches, basic health units, living centers and clubs, by properly trained undergraduate and graduate students. At follow-up, data collection was performed in the homes of the older people who participated in the first phase of FIBRA. In both phases, older adults (≥ 65 years old) were informed about the objectives of the research, voluntary participation, data confidentiality, right to drop out, absence of risks to physical and mental health, among other ethical aspects. More details of inclusion and exclusion criteria are described in Neri et al.[16].

Screening

Mini Mental State Examination (MMSE) was used to exclude older adults who had marked cognitive decline. For this, it was adjusted the cut-off points according to education time: illiterate=17; between 1 and 4 years=22; between 5 and 8 years=24; from 9

years=26[17]. Older adults with permanent or temporary inability to walk; loss of strength and aphasia due to stroke sequelae; motor, verbal or affective impairments associated with advanced Parkinson's disease; severe hearing or visual impairments; and terminal illnesses were not eligible for our study[16].

Independent variable

Swallowing symptoms were identified by means of nine dichotomous questions: 1) Dry mouth in the last 4 weeks 2) Change in taste 3) Difficulty or pain in chewing hard food 4) Difficulty or pain to swallow 5) Feeling of still or stuck food 6) Food returns from the throat to the mouth/nose 7) Do you need to clear your throat after eating something? 8) Do you choke when eating or drinking? 9) Do you need to drink to swallow food? This variable was treated as binary (i.e., yes or no) and converted to continuous by factorial analysis.

Outcome

The outcome consisted of a binary variable referring to dynapenia at follow-up. Initially, handgrip strength was assessed with a hydraulic dynamometer (Lafayette, Indiana, USA), positioned in the dominant hand of the seated participant with the elbow joint flexed at 90 degrees. Three measurements were taken with a 1-minute interval between them, and the final score was defined by the mean of the trials. This study adopted sex-adjusted cut-off points for dynapenia: <27kg (men) and <16 kg (women).[12]Thus, measures below the cut-off points were considered with dypnapenia.

Confounding factors

The age, sex, and years of education and variation of BMI, cognitive functioning, Chronic diseases, and physical performance (Gait speed) over 8 years were included as confound factors. The variation of the variables was calculated by the delta (Δ = follow-up - baseline). The delta was used to estimate changes in Body Mass Index (BMI), chronic diseases, cognitive functioning, and physical performance over 8 years. For BMI calculation, it was divided weight by height squared (kg/m^2). Weight (kg) and height (m) were assessed using a digital scale and a measuring tape. The MMSE test was also used to measure global cognitive performance on a scale of 0 to 30 points (higher is better). A list containing nine chronic diseases was presented to participants, who answered whether their doctor had diagnosed them with any of these diseases. Regarding gait speed, walking time of 4.6 meters at usual pace was recorded. Gait speed (m/s) was defined by the mean obtained over three consecutive attempts. All statistical models were adjusted for dynapenia at baseline.

Statistical analysis

Descriptive statistics were used to characterize the variables. Categorical variables were compared using McNamar's change test. Quantitative variables were compared using the paired t-test. Principal Component Analysis was used to reduce the dimensionality of swallowing symptoms. After this, it was fixed the extraction in three components with Oblimin rotation. As assumptions, it was analyzed Bartlett's test of sphericity, and the KMO test for factorial adequacy.

This analysis was performed logistic regression models considering swallowing symptoms at baseline as independent variables, and dynapenia at follow-up as outcome. After univariate analyses, this study performed analyses adjusted for confounding factors such as age, sex, years of education, and number of chronic diseases consisted of self-report, cognitive functioning, and physical performance (Gait speed) measures. The level of statistical significance adopted was 5%.

RESULTS

The initial database had 508 participants, of whom 93 were excluded for having cognitive deficits and 11 for not responding to swallowing symptoms at baseline. Thus, 404 older adults were included, with a higher prevalence for women (68.3%). At baseline, participants were on average 72.6 years old (SD=4.93) and 4.35 years of education (SD=3.79). The median of BMI was classified as overweight, and the variation was healthy weight and overweight. The BMI decreased (Δ=-0.41; SD=3.46) in the comparison of baseline and follow-up. As shown in Table 1, paired comparisons revealed worsening in the MMSE test (Δ=-1.67; SD=3.21), increased prevalence of high blood pressure and diabetes, unlike arthritis and osteoporosis which decreased. Despite these differences, there was no change in the total of chronic diseases (Δ=-0.06; SD=1.39). Regarding physical performance, there was decreased gait speed (Δ=-0.24; SD=0.29) and handgrip strength (Δ=-3.61; SD=8.94), and increased prevalence of dynapenia at follow-up.

Table 1. Paired comparisons of quantitative and qualitative variables from baseline to follow-up. Cohort of 404 older adults from the FIBRA study, SP, Brazil

VARIABLES	BASELINE		FOLLOW-UP	P
MMSE, mean (SD)	25.52	(2.72)	23.85 (4.06)	**<0.001**
BMI (kg/m²), mean (SD)	27.53	(4.55)	27.12 (4.87)	**0.019**
DIAGNOSIS OF CHRONIC DISEASES				
Cardiovascular disease, n (%)	91	(22.5)	86 (21.5)	0.842
High blood pressure, n (%)	261	(64.6)	284 (70.6)	**0.005**
Stroke, n (%)	37	(9.2)	35 (8.7)	0.871
Diabetes, n (%)	88	(21.8)	110 (27.4)	**0.003**
Lung disease, n (%)	42	(10.4)	37 (9.3)	0.784
Cancer, n (%)	43	(10.6)	30 (7.5)	0.080
Arthritis, n (%)	176	(43.6)	146 (36.5)	**0.008**
Osteoporosis, n (%)	112	(27.8)	107 (26.8)	0.691
Depression, n (%)	88	(21.8)	64 (16.0)	**0.015**
Number of chronic diseases, mean (SD)	2.32	(1.52)	2.25 (1.34)	0.326
Gait speed (m/s), mean (SD)	0.98	(0.21)	0.74 (0.28)	**<0.001**
Handgrip strength (kg), mean (SD)	25.72	(9.04)	22.11 (10.45)	**<0.001**
Dynapenia, n (%)	51	(12.6)	149 (36.9)	**<0.001**

Captions: MMSE = Mini Mental State Examination; BMI = Body Mass Index; SD = standard deviation; N and % = absolute and relative frequencies, respectively.
Note: Follow-up indicates repeated measurements after approximately 8 years.

In logistic regression models (Table 2), univariate analyses revealed a statistically significant difference only for component 2. This result suggests that older adults with component 2 (swallowing symptoms) have a higher risk of developing dynapenia compared to those without swallowing symptoms.

Table 2. Swallowing symptoms at baseline associated with dynapenia at follow-up. Cohort of 404 older adults from the FIBRA study, SP, Brazil

PREDICTOR	ODDS RATIO	95% CONFIDENCE INTERVAL		P
		Lower	Upper	
UNIVARIATE ANALYSIS				
Component 1	0.969	0.785	1.196	0.771
Component 2	1.384	1.119	1.713	**0.003**
Component 3	0.957	0.772	1.187	0.682
COMPONENT 2 ADJUSTED ANALYSIS FOR				
Model 1 (age, sex, and years of education)	1.513	1.202	1.907	**< 0.001**
Model 2 (variation in BMI)	1.377	1.112	1.704	**0.003**
Model 3 (variation in MMSE)	1.360	1.098	1.685	**0.005**
Model 4 (variation in chronic diseases)	1.440	1.157	1.791	**0.001**
Model 5 (variation in gait speed)	1.410	1.135	1.751	**0.002**
Model 6 (age, sex, and years of education and variation in BMI, MMSE, Chronic diseases, Gait speed)	1.544	1.220	1.956	**< 0.001**

Model 1 adjusted for age, sex, and years of education. Model 2 adjusted for variation in Body Mass Index (BMI). Model 3 adjusted for variation in Mini Mental State Examination (MMSE). Model 4 adjusted for variation in chronic diseases. Model 5 adjusted for variation in gait speed. Model 6 adjusted for all variables. All models were adjusted for dynapenia at baseline.
Note: Description of the components in Figure 1.

In Table 3, the analysis was performed logistic regression using the isolated swallowing symptoms as independent variables. In both univariate and adjusted models, the change in taste (except in model adjusted for MMSE) and difficulty swallowing increased risk of dynapenia at follow-up.

Regarding the symptom, difficulty or pain to swallow adjusted analysis for confounders (Table 3), in model 1, there was a statistically significant difference for sex, age and years of education (OR=4.207; 95% CI:1.703 to 10.375; p=0.002) and BMI and Dynapenia (OR=3.150; 95% CI: 1.343 to 7.389; p=0.008), in the model 2. In model 3, an inverse association was observed between MMSE and dynapenia (OR=3.117; 95% CI: 1.328 to 7.389; p=0.009), and, in the model 4 was observed between chronic disease and dynapenia (OR=3.909; 95% CI: 1.612 to 9.475; p=0.003). In model 5, there was an inverse association between gait speed and dynapenia (OR=3.495; 95% CI: 1.481 to 8.521; p=0.004). In the model 6, the risk of difficulty or pain to swallow associated of age, sex, years of education, and number of chronic diseases consisted of self-report, cognitive functioning, and physical performance was four times higher for dynapenia in follow-up (OR=5.744; 95% CI: 2.187 to 15.088; p<0.001).

Table 3. Change in taste, difficulty or pain in chewing hard food and felling of still or stuck food (Components 2) at baseline associated with dynapenia at follow-up. Cohort of 404 older adults from the FIBRA study, SP, Brazil

PREDICTOR	ODDS RATIO	95% CONFIDENCE INTERVAL		P
		Lower	Upper	
UNIVARIATE ANALYSIS				
Change in taste	1.919	1.031	3.573	**0.040**
Difficulty or pain in chewing hard food	1.157	0.747	1.794	0.514
Difficulty or pain to swallow	3.255	1.391	7.619	**0.007**
Feeling of still or stuck food	1.310	0.753	2.280	0.340
"CHANGE IN TASTE" ADJUSTED ANALYSIS FOR				
Model 1 (age, sex, and years of education)	2.001	1.037	3.861	**0.039**
Model 2 (variation in Body Mass Index)	1.901	1.021	3.542	**0.043**
Model 3 (variation in Mini Mental State Examination)	1.772	0.945	3.325	0.075
Model 4 (variation in chronic diseases)	2.041	1.082	3,848	**0.027**
Model 5 (variation in gait speed)	2.044	1.086	3.850	**0.027**
Model 6 (age, sex, and years of education and variation in BMI, MMSE, Chronic diseases, Gait speed)	2.247	1.121	4.506	**0.023**
"DIFFICULTY OR PAIN TO SWALLOW" ADJUSTED ANALYSIS FOR				
Model 1 (age, sex, and years of education)	4.207	1.703	10.375	**0.002**
Model 2 (variation in Body Mass Index)	3.150	1.343	7.389	**0.008**
Model 3 (variation in Mini Mental State Examination)	3.117	1.328	7.314	**0.009**
Model 4 (variation in chronic diseases)	3.909	1.612	9.475	**0.003**
Model 5 (variation in gait speed)	3.495	1.481	8.251	**0.004**
Model 6 (age, sex, and years of education and variation in BMI, MMSE, Chronic diseases, Gait speed)	5.744	2.187	15.088	**< 0.001**

Model 1 adjusted for age, sex, and years of education. Model 2 adjusted for variation in Body Mass Index (BMI). Model 3 adjusted for variation in Mini Mental State Examination (MMSE). Model 4 adjusted for variation in chronic diseases. Model 5 adjusted for variation in gait speed. Model 6 adjusted for all variables. All models were adjusted for dynapenia at baseline.

DISCUSSION

This study aimed to analyze whether swallowing symptoms could be associated with dynapenia in an 8-year follow-up cohort. As main findings, they confirmed our initial assumptions by observing that swallowing symptoms can anticipate worsening muscular strength in older adults, it also found that some individual questions were able to predict dynapenia, moreover this result should be discussed carefully.

Regarding differences from baseline to follow-up, they consider that the sample aged according to an expected pattern, since previous studies had already shown that the aging process is associated with decreased cognitive functioning,[18] increased prevalence of chronic diseases such as diabetes and hypertension,[19,20] and decreased physical performance[21]. The most pronounced change occurred in muscle strength, as the number of older adults with dynapenia at follow-up was approximately three times higher compared to baseline. The lower prevalence of rheumatoid arthritis at follow-up may indicate disease remission, adaptation to health conditions, or memory bias. The same justifications may apply to depression, which also showed lower prevalence at follow-up.

To verify whether swallowing symptoms at baseline could be associated with dynapenia at follow-up, the analysis first grouped the symptoms into factors. Among the factors generated, the only one that predicted dynapenia was made up of the following symptoms: (i) change in taste, (ii) difficulty or pain in chewing hard food, (iii) difficulty or pain to swallow, and (iv) feeling of still or stuck food. The first interpretation is that this group of symptoms is related to changes in the preparatory and oral phases of swallowing[4,22,23]. In addition, the findings related with swallowing symptoms in this study were close to that cross-sectional study with 1447 residents of the urban area of Pelotas, South region of Brazil, aged 65 and over, the prevalence of dysphagia perception was (8.1%; 95% CI 6.8; 9.6) and it was also higher in women (9.4%; 95% CI 7.8; 11.4), which assessed in a similar way (self-report)[2] and also in an international study in the United States, swallowing difficulties were found in 5% of the 1065 older adults (60 years or older)[24]. The change in taste can happen due to reduced gustatory receptors, decreasing the capacity to detect sweet and salty flavors[22,23]. It can also be caused by changes in the speed of sensory afferent impulses, which can be aggravated by drug treatment, compromising the sensory system and saliva production[25].

Older adults may report difficulty or pain in swallowing hard foods due to factors such as decreased chewing strength, atrophy of the tongue muscles, ejection difficulty, low salivation,[4,22,23] ill-fitting dentures, and missing teeth[4]. Difficulty or pain when chewing, in addition to the mechanisms already described, may be related to difficulty in manipulating the food bolus,[5,22] due to loss of muscle fibers in the head and neck region, reducing the functionality of the swallowing process. The presence of food stuck in the pharynx can also be justified by inefficient chewing, difficulty in transporting the food bolus, reduced pharyngeal contraction, as well as a possible lack of oral control characterized by the displacement of food into the oropharyngeal region while chewing still occurs, leading to the accumulation of food in the pharyngeal region and the feeling of food sticking.

Regarding logistic regression models, they were identified that swallowing symptoms at baseline increased risk of dynapenia at follow-up by 1.38 times (Table 2). When adjusted for different confounding factors, the association remained statistically significant, with the odds ratio ranging from 1.36 to 1.54. The interpretation of these effect sizes has little practical relevance since the nature of the variable was changed from binary to continuous through the factorial analysis. Most important is to note the directionality of the association, in which swallowing symptoms increased risk of dynapenia in an 8-year follow-up cohort. Our results corroborate previous studies, which demonstrated association between lower tongue strength and dynapenia,[26] between oral hypofunction and dynapenia/sarcopenia,[27] and between dysphagia and frailty syndrome in older adults[28].

As a possible mechanism, swallowing dysfunctions make it difficult to eat solid and fibrous foods, reducing nutritional variability[7,8,22]. Insufficient intake of micro and macronutrients impairs the functioning of the body systems, whose effects tend to be worse in old age. This means that aging gradually depletes physical and cognitive reserves, reducing the adaptive capacity in response to negative events[21].For this reason, when the first swallowing symptoms appear in older adults, the remission of symptoms should be quickly sought, since insufficient food intake will have repercussions on physical performance, muscle tissue,[3] and cognitive functioning[29]. It is already well established that physical losses reduce functionality, independence, mobility

in the places of everyday life, and negatively affect social roles, increasing sedentary behavior and, consequently, inflammatory processes[30,31]. In turn, physical inactivity and the release of pro-inflammatory cytokines such as C-reactive protein (CRP), interleukin 6 (IL-6), and Tumoral Necrosis Factor Alpha (TNF-α) are associated with reduced protein synthesis, worsening sarcopenia and dynapenia[32]. Therefore, it assumes that inadequate dietary intake can accentuate catabolic, inflammatory, and neurodegenerative processes, with serious repercussions on the quality of life and survival of older people.

Associations between simple questions and dynapenia need to be interpreted with caution. After all, cognitive changes seem to better explain dynapenia than subjective perception of change in taste. Perceived difficulty to swallow was a statistically significant predictor in all models, but the confidence intervals highlight the imprecision of the estimates due to low number of positive cases in our sample. Regardless, it emphasizes that swallowing difficulty is a simple and easily understood question that can be explored in future studies.

The analysis of logistic regression models presented on the Table 3, revealed that the difficulty or pain to swallow associated with sociodemographic aspects, BMI, cognitive, physical performance and muscular strength decline increases the risk of dynapenia in an 8-year follow-up. About confounding factors, it is already well established that physical performance decreases with increasing age, which corroborates the current literature[12]. Handgrip strength follows a relatively similar course between sexes, with more pronounced peaks among men, followed by a period of maintenance and decline in old age[12]. Considering the normal course of handgrip strength,[12] such marked differences between sexes were not expected, which may have been due to low prevalence of men in our sample. The association between dynapenia and cognitive performance was expected, since neural damage and neurodegenerative processes can impair muscle fiber recruitment, with negative repercussions on physical abilities[33]. The association between gait speed and dynapenia was also already expected since both are influenced by sarcopenia and decrease over time. Dynapenia is a modifiable condition, which makes it inappropriate, from a theoretical perspective, to exclude positive cases at the beginning of the study. For this reason, this study prefers to adjust all models for dynapenia at baseline, increasing the theoretical validity of our estimates.

As limitations, assessments at baseline were conducted in fixed locations while at follow-up they were conducted in residential settings. Although the application conditions were not the same, evaluators were instructed to look for a room without interference from noise, family members, and ground unevenness. Furthermore, self-report is not a specific measure for the diagnosis of dysphagia and is highly susceptible to adjustment to health conditions. In this regard, it is believed that the exclusion of older adults with cognitive impairment may have mitigated this limitation by increasing confidence in self-report measures.

CONCLUSIONS

Swallowing symptoms can be associated with decline in muscular strength in older adults. Symptoms such as change in taste, difficulty or pain gave rise to a factor, which revealed an increased risk of dynapenia in an 8-year follow-up cohort. The association of difficulty to swallow with age, sex, years of education, chronic disease, MBI, MNSE, gait speed increases the risk for dynapenia in four times.

These and other questions can be included in health systems to promote more appropriate swallowing management and it should be a public health concern, reducing the risk of negative health outcomes for older adults. This study advanced discussions about the association between dysphagia and muscular strength, especially in understanding the directionality of this association, something little approached in previous studies.

ACKNOWLEDGEMENTS

We would like to thank the financial support received by the Brazilian grant from CAPES (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior), Process n◦88882.435438/2019-01.

REFERENCES

1. Vasconcelos AMN, Gomes MMF. Transição demográfica: a experiência brasileira. Epidemiol Serv Saúde. 2012;21(4):539-48. http://dx.doi.org/10.5123/S1679-49742012000400003

2. Mello RP, Xavier MO, Tomasi E, Gonzalez MC, Demarco FF, Bielemann RM. Dysphagia perception among community-dwelling older adults from a municipality in Southern Brazil. Dysphagia. 2022;37(4):879-88. https://doi.org/10.1007/s00455-021-10347-8 PMID: 34319457.

3. Cruz-Jentoft AJ, Kiesswetter E, Drey M, Sieber CC. Nutrition, frailty, and sarcopenia. Aging Clin Exp Res. 2017;29(1):43-8. https://doi.org/10.1007/s40520-016-0709-0 PMID: 28155181.

4. Di Pede C, Mantovani ME, Del Felice A, Masiero S. Dysphagia in the elderly: Focus on rehabilitation strategies. Aging Clin Exp Res. 2016;28(4):607-17. https://doi.org/10.1007/s40520-015-0481-6 PMID: 26589905.

5. 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. https://doi.org/10.1007/s40520-019-01128-3 PMID: 30671866.

6. Mourão LF, Xavier DAN, Neri AL, Luchesi KF. Association study between natural chronic diseases of aging and swallowing changes referred by community elderly. Audiol., Commun. Res. 2016;21:e1657. https://doi.org/10.1590/2317-6431-2015-1657

7. Ney DM, Weiss JM, Kind AJH, Robbins J. Senescent swallowing: Impact, strategies, and interventions. Nutr Clin Pract. 2009;24(3):395-413. https://doi.org/10.1177/0884533609332005 PMID: 19483069.

8. Baijens LW, Clavé P, Cras P, Ekberg O, Forster A, Kolb GF et al. European Society for Swallowing Disorders - European Union Geriatric Medicine Society white paper: Oropharyngeal dysphagia as a geriatric syndrome. Clin Interv Aging. 2016;11:1403-28. https://doi.org/10.2147/cia.s107750 PMID: 27785002.

9. Clark BC, Manini TM. Sarcopenia ≠ Dynapenia. J Gerontol A Biol Sci Med Sci. 2008;63A(8):829-34. https://doi.org/10.1093/gerona/63.8.829 PMID: 18772470.

10. Goodpaster BH, Park SW, Harris TB, Kritchevsky SB, Nevitt M, Schwartz AV et al. The loss of skeletal muscle strength, mass, and quality in older adults: The health, aging and body composition study. J Gerontol A Biol Sci Med Sci. 2006;61(10):1059-64. https://doi.org/10.1093/gerona/61.10.1059 PMID: 17077199.

11. Norman K, Stobäus N, Gonzalez MC, Schulzke JD, Pirlich M. Hand grip strength: Outcome predictor and marker of nutritional status. Clin Nutr. 2011;30(2):135-142. https://doi.org/10.1016/j.clnu.2010.09.010 PMID: 21035927.

12. Dodds RM, Syddall HE, Cooper R, Benzeval M, Deary IJ, Dennison EM et al. Grip strength across the life course: Normative data from twelve British studies. PLoS One. 2014;9(12):e113637. https://doi.org/10.1371/journal.pone.0113637 PMID: 25474696.

13. Murotani Y, Hatta K, Takahashi T, Gondo Y, Kamide K, Kabayama M et al. Oral functions are associated with muscle strength and physical performance in old-old Japanese. Int J Environ Res Public Health. 2021;18(24):1-8. https://doi.org/10.3390/ijerph182413199 PMID: 34948808.

14. Fırat Ozer F, Akın S, Soysal T, Gokcekuyu BM, Erturk Zararsız G. Relationship between dysphagia and sarcopenia with comprehensive geriatric evaluation. Dysphagia. 2021;36(1):140-6. https://doi.org/10.1007/s00455-020-10120-3 PMID: 32342177.

15. Hansen T, Nielsen RL, Houlind MB, Tavenier J, Rasmussen LJH, Jorgensen LM et al. Dysphagia prevalence, time course, and association with probable sarcopenia, inactivity, malnutrition, and disease status in older patients admitted to an emergency department: A secondary analysis of cohort study data. Geriatrics (Basel). 2021;6(2):1-14. https://doi.org/10.3390/geriatrics6020046 PMID: 33926079.

16. Neri AL, Yassuda MS, Araújo LF, Eulalio MC, Cabral BE, Siqueira MEC et al. Methodology and social, demographic, cognitive, and frailty profiles of community-dwelling elderly from seven Brazilian cities: The FIBRA study. Cad Saude Publica. 2013;29(4):778-92. https://doi.org/10.1590/S0102-311X2013000400015 PMID: 23568307.

17. Brucki SM, Nitrini R, Caramelli P, Bertolucci PH, Okamoto IH. Suggestions for utilization of the mini-mental state examination in Brazil. Arq Neuropsiquiatr. 2003;61(3b):777-81. https://doi.org/10.1590/s0004-282x2003000500014 PMID: 14595482.

18. Lipnicki DM, Makkar SR, Crawford JD, Thalamuthu A, Kochan NA, Lima-Costa MF et al. Determinants of cognitive performance and decline in 20 diverse ethno-regional groups: A COSMIC collaboration cohort study. PLoS Med. 2019;16(7):e1002853. https://doi.org/10.1371/journal.pmed.1002853 PMID: 31335910.

19. Mills KT, Bundy JD, Kelly TN, Reend JE, Kearney PM, Reynolds K et al. Global disparities of hypertension prevalence and control: A systematic analysis of population-based studies from 90 countries. Circulation. 2016;134(6):441-50. https://doi.org/10.1161/circulationaha.115.018912 PMID: 27502908.

20. Hosseini Z, Whiting SJ, Vatanparast H. Type 2 diabetes prevalence among Canadian adults - dietary habits and sociodemographic risk factors. Appl Physiol Nutr Metab. 2019;44(10):1099-104. https://doi.org/10.1139/apnm-2018-0567 PMID: 31386561.

21. Morley JE, Vellas B, Van Kan GA, Anker SD, Bauer JM, Bernabei R et al. Frailty consensus: A call to action. J Am Med Dir Assoc. 2013;14(6):392-7. https://doi.org/10.1016/j.jamda.2013.03.022 PMID: 23764209.

22. Humbert IA, Robbins J. Dysphagia in the elderly. Phys Med Rehabil Clin N Am. 2008;19(4):853-66. https://doi.org/10.1016/j.pmr.2008.06.002 PMID: 18940645.

23. Feinberg MJ. A perspective on age-related changes of the swallowing mechanism and their clinical significance. Dysphagia. 1996;11(3):185-6. https://doi.org/10.1007/bf00366382 PMID: 8755462.

24. Mann T, Heuberger R, Wong H. The association between chewing and swallowing difficulties and nutritional status in older adults. Aust Dent J. 2013;58(2):200-6. https://doi.org/10.1111/adj.12064 PMID: 23713640.

25. Närhi TO. Prevalence of subjective feelings of dry mouth in the elderly. J Dent Res. 1994;73(1):20-25. https://doi.org/10.1177/00220345940730010301 PMID: 8294614.

26. Buehring B, Hind J, Fidler E, Krueger D, Binkley N, Robbins J. Tongue strength is associated with jumping mechanography performance and handgrip strength but not with classic functional tests in older adults. J Am Geriatr Soc. 2013;61(3):418-22. https://doi.org/10.1111/jgs.12124 PMID: 23379330.

27. Kugimiya Y, Iwasaki M, Ohara Y, Motokawa K, Edahiro A, Shirobe M et al. Relationship between oral hypofunction and sarcopenia in community-dwelling older adults: The Otassha study. Int J Environ Res Public Health. 2021;18(12):1-12. https://doi.org/10.3390/ijerph18126666 PMID: 34205795.

28. Bahat G, Yilmaz O, Durmazoglu S, Kilic C, Tascioglu C, Karan MA. Association between dysphagia and frailty in community dwelling older adults. J Nutr Health Aging. 2019;23(6):571-7. https://doi.org/10.1007/s12603-019-1191-0 PMID: 31233080.

29. Kwan RYC, Leung AYM, Yee A, Lau LT, Xu XY, Dai DLK. Cognitive frailty and its association with nutrition and depression in community-dwelling older people. J Nutr Health Aging. 2019;23(10):943-8. https://doi.org/10.1007/s12603-019-1258-y PMID: 31781723.
30. Murdaca G, Setti M, Brenci S, Fenoglio D, Lantieri P, Indiveri F et al. Modifications of immunological and neuro-endocrine parameters induced by anti orthostatic bed-rest in human healthy volunteers. Minerva Med. 2003;94(6):363-78. PMID: 14976465.
31. Damiot A, Pinto AJ, Turner JE, Gualano B. Immunological implications of physical inactivity among older adults during the COVID-19 Pandemic. Gerontology. 2020;66(5):431-8. https://doi.org/10.1159/000509216 PMID: 32585674.
32. Tuttle CSL, Thang LAN, Maier AB. Markers of inflammation and their association with muscle strength and mass: A systematic review and meta-analysis. Ageing Res Rev. 2020;64:101185. https://doi.org/10.1016/j.arr.2020.101185 PMID: 32992047.
33. Shaughnessy KA, Hackney KJ, Clark BC, Kraemer WJ, Terbizan DJ, Bailey RR et al. A narrative review of handgrip strength and cognitive functioning: Bringing a new characteristic to muscle memory. J Alzheimers Dis. 2020;73(4):1265-78. https://doi.org/10.3233/JAD-190856 PMID: 31929158.

Author contributions:

NCO: Data curation; Formal analysis; Investigation; Methodology; Visualization; Writing - Original draft; Writing - Review & editing.

CMS: Writing - Original draft; Writing - Review & editing.

ALN: Data curation; Funding acquisition; Investigation; Methodology; Project administration; Supervision; Visualization; Writing - Original draft; Writing - Review & editing.

VNS: Formal analysis.

LFM: Data curation; Formal analysis; Methodology; Supervision; Visualization; Writing - Original draft; Writing - Review & editing.

Data sharing statement:

The authors declare that they are not going to share the data.