A preliminary cross-sectional study to investigate the presence of sarcopenic dysphagia in a Portuguese geriatric population

Susana Portinha,[1] Pedro Sa-Couto,[2] Maria Assunção Matos[3]

[1]Physical Medicine and Rehabilitation Service, Tomar Unit of the Hospital Center Médio Tejo, Tomar; [2]Center for Research and Development in Mathematics and Applications, Department of Mathematics, University of Aveiro; [3]School of Health Sciences (ESSUA), CINTESIS@RISE, University of Aveiro, Portugal

Correspondence: Susana Portinha, Physical Medicine and Rehabilitation Service, Tomar Unit of the Hospital Center Médio Tejo, Av. Maria Lourdes Mello e Castro 2304-909 Tomar, Portugal.
Tel.: +35 1963471735.
E-mail: susana.portinha@gmail.com

Key words: geriatric population; oropharyngeal dysphagia; sarcopenia; sarcopenic dysphagia; malnutrition.

Contributions: SP, conception of the work, acquisition, analysis, and interpretation of data for the work, drafting of the work; PSC, MAM, substantial contributions to the conception of the work and analysis of data, critical revision of the work for important intellectual content. All authors approved the final version to be published and agree to be accountable for all aspects of the work to guarantee that any concerns about its accuracy or integrity are appropriately investigated and resolved.

Conflict of interest: the authors declare no potential conflict of interest.

Ethics approval and consent to participate: this research was approved by an independent ethics committee (N. 602/06-2019) and institutional approval for data collection was obtained.

Informed consent: all participants provided written informed consent.

Funding: this work was supported in part by the Portuguese Foundation for Science and Technology (FCT-Fundação para a Ciência e a Tecnologia), through CIDMA - Center for Research and Development in Mathematics and Applications, within projects UIDB/04106/2020 and UIDP/04106/2020.

Availability of data and materials: data and materials are available by the authors.

Acknowledgments: the authors would like to thank the Portuguese Foundation for Science and Technology (FCT-Fundação para a Ciência e a Tecnologia), and the Center for Research and Development in Mathematics and Applications - CIDMA.

Received: 26 October 2022.
Accepted: 15 March 2023.

Publisher's note: all claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article or claim that may be made by its manufacturer is not guaranteed or endorsed by the publisher.

Licensee PAGEPress, Italy
Geriatric Care 2023; 9:10972
doi:10.4081/gc.2023.10972

Abstract

The objective of this study is to investigate the presence of sarcopenia and the risk of oropharyngeal dysphagia (OD) in a geriatric population and to analyze the relationship between the factors associated with sarcopenic dysphagia. The cross-sectional study was carried out in two nursing homes. The presence of OD was screened using the gugging swallowing screen, and sarcopenia was assessed according to the European working group on sarcopenia in older people criteria. The sample (N=36; 23 women, 13 men) presents a mean age of 88.0±5.6, with 55.6% being at risk of OD, 52.8% with sarcopenia, and 36.1% with probable sarcopenic dysphagia. The score of the simple questionnaire to rapidly diagnose sarcopenia (SARC-F)≥4 was a significant predictor (odds ratio=9.0; confidence interval 95%=1.285-63.025) for the risk of having sarcopenic dysphagia.

It was observed that sarcopenia was associated with higher odds of being at risk of OD. Also, an increase in age, poorly fitting prostheses, a higher level of dependence during activities of daily living, and a risk of malnutrition or malnourishment raised the potential of having probable sarcopenic dysphagia. We suggest including a speech and language therapist in the multidisciplinary geriatric teams to improve the prevention of sarcopenic dysphagia and to avoid its consequences.

Introduction

Oropharyngeal dysphagia (OD) and sarcopenia have been recognized as geriatric syndromes.[1,2] OD was strongly associated with admissions in nursing homes, medical history of dementia and stroke, malnutrition [mini nutritional assessment (MNA)<17], as well as poor functional capacity, with an average Barthel index (BI) score of 24-48/100.[3]

Sarcopenia is associated with an increased risk of OD since it had been considered an independent risk factor for its diagnosis.[4,5] People with an average age of 70.5 years for men and 71.6 years for women are more often affected by it.[6] Its prevalence rate ranges from 1 to 29% in elderly living in a community and from 14 to 33% in institutionalized elderly.[7] Risk factors consistently correlated with sarcopenia include aging, and they increase in people over 80 years old, people in nursing homes, with hip fractures, low body mass index, as well as low physical activity.[8-10]

The swallowing disorder due to sarcopenia is defined as sarcopenic dysphagia (SOD).[11] An increased prevalence of SOD was

observed in older people, that are malnourished or have disuse of the oral muscles, with a prevalence of 32%, and it was independently associated with poor swallowing function at discharge.[11,12] Recently, it has been found that the inflammatory state of COVID-19, combined with malnutrition and low mobility during hospitalization, may predispose the individual to secondary sarcopenia and SOD.[13]

The aging of the world population is an increasingly observed reality, so the close association between aging and difficulty in swallowing is a growing concern regarding the health of elderly people. The incidence of OD and SOD in the geriatric population in Portugal and its inherent characteristics are unknown. Likewise, OD in the elderly is often underdiagnosed. Moreover, the management of SOD is an important current and future public health issue, and further advances in this area are required. This study aims to investigate the presence of sarcopenia and the risk of OD in a geriatric population and to analyze the relationship between the factors associated with SOD.

Materials and Methods

Design

A cross-sectional study was conducted in two nursing homes in Tomar (Portugal) between October 2019 and March 2020.

Participants and procedure

Participants are people aged ≥65 years and living in nursing homes. The exclusion criteria comprise cerebrovascular disease, head and neck cancer, and/or underlying neuromuscular diseases, as well as prior orthopedic surgery involving metal implantation, total dependence, and having a pacemaker.

This research was approved by an independent ethics committee (N. 602/06-2019) and institutional approval for data collection was obtained. Before participating in this study, all participants provided written informed consent.

According to the results obtained in the swallowing screening and sarcopenia assessment, the participants were divided into four different groups: i) G1 - without pathology; ii) G2 - only with OD risk; iii) G3 - only with sarcopenia; iv) G4 - with probable SOD.

Outcome measures

Deglutition screening

Deglutition screening was carried out using the European Portuguese version of the gugging swallowing screen (GUSS).[14] If a participant presented an impairment in the efficiency and/or in the safety of swallowing, he/she was considered to be at risk of having OD.

Sarcopenia assessment

Sarcopenia assessment was conducted according to the criteria defined by the second meeting of the European working group on sarcopenia in older people (EWGSOP2):[15] find cases-assess-confirm-severity (F-A-C-S). To identify individuals at risk for sarcopenia (F), a European Portuguese translation of the SARC-F questionnaire was used.[16] To assess for evidence of sarcopenia (A), muscle strength was measured using a handheld Jamar dynamometer (Model Sammons Preston). To confirm sarcopenia (C) by detection of low muscle mass, muscle quantity was calculated using bioelectrical impedance analysis (BIA), with a Tanita body composition monitor (Model Inner Scan V BC-545N; Tanita, Japan). In addition, to evaluate the sarcopenia severity (S), the usual walking speed (meters per second-m/s) on a 4 m course was used as an objective measure of physical performance. The cut-off points indicated in the EWGSOP2 consensus were used.[15]

Measurement of lip and tongue strength

Assessment of maximum tongue and lip strength was carried out using the Iowa Oral Performance Instrument, model 3.1 (IOPI®Medical LLC). The strength of the tongue and lip was measured three times with a 30-second break between each measurement, and the maximum value was recorded.

Nutritional status assessment

Screening for nutritional status was done using the mini nutritional assessment - short form (MNA®-SF).[17] Malnutrition is indicated by a score of ≤7, risk of malnutrition by a score of 8-11, and favorable nutritional status by a score of 12-14.

Independence level assessment

Measuring of ability to successfully carry out activities of daily living (ADLs) was evaluated using the Portuguese version of BI,[18] ordinal assessments (0-100 points), with higher scores representing greater independence.

Other variables

Other possible factors related to SOD such as age, gender, literacy, and dentition status were also assessed. The dentition status was included as a variable because of its possible effect on mastication. It was evaluated considering the absence or presence of the participant's teeth, if they had natural teeth or dental prostheses, and, in this case, what their adaptation state was.

Statistical Analysis

Descriptive statistics are presented in n (%) for qualitative variables and in mean (M)±standard deviation (SD) for quantitative variables. To test the existent association between qualitative variables, the Chi-Square test was used when the requirement of less than 20% of the cells could not have an expected verified value of less than five. Otherwise, the Fisher exact test was used. For gender group analysis, the independent t-test (when normality was present) or the Mann-Whitney test (if otherwise) were carried out. An independent one-way analysis of variance (when the requirements of normality and homogeneity of variance were verified) or the Kruskal-Wallis test (if otherwise) were used to compare the diagnosis of the different groups. The post *hoc* analysis (multiple comparisons) was conducted with the Tukey test. A binary logistic regression analysis was used to establish the univariable predictors for groups G2, G3, and G4 respectively. The results are presented in odds ratio (OR) format with the corresponding 95% confidence intervals (95% CI). Finally, a correlation between the quantitative variables in the study was analyzed using the Spearman Rank test. All the results were produced using IBM SPSS Statistics V25.0 (Armonk, NY), and considered significant if $P<0.05$.

Results

A total of 36 participants (13 males; 23 females) were included in the present study (Table 1). The mean age was 88 years (SD=5.6). The literacy level was lower in women ($P<0.5$); 83.3% of women (n=15) and 16.7% (n=3) of men had low education (<4th grade). Half of the sample (5 males; 13 females) showed

teeth problems. Of these, 25% (2 males; 7 females) had poorly fitting prostheses, and the remaining 25% (3 males; 6 females) had a total absence of teeth. No significant relationship was found between gender and teeth problems (P=0.587). All participants had an oral diet intake. The prevalence of malnutrition based on the MNA-SF scores was 19.4% (2 males; 6 females). Most of the elderly were independent in their ADLs (n=33; 91.7%), with only three dependent females. Overall, 55.6% (n=20) of this study's population were at risk of having OD (10 males; 10 females). The prevalence of sarcopenia was 52.8% (n=19). Moreover, 36.1% (n=13) of all participants were diagnosed with possible SOD (5 males; 8 females). In these parameters, there were no significant differences between men and women (P>0.05).

Isometric measures of lips and tongue strength had an average

Table 1. Sample characterization (quantitative and qualitative variables).

Characteristic	Total, n=36	Male, n=13 (36.1%)	Female, n=23 (63.9%)	Statistical resultsa
Age, (years), M±SD	88.0±5.6	88.0±5.6	88.0±5.8	t(34)=0.0 P=0.983
MNA-SF, (no units), M±SD	12.0±1.5	12.4±1.0	11.8±1.7	t(34)=1.2 P=0.245
BI, (no units), M±SD	84.5±14.8	90.0±9.8	81.8±16.5	t(34)=1.6 P=0.112
SARC-F, (no units), M±SD	3.4±2.9	1.9±2.5	4.2±2.7	U=74 P=0.012*
Lips strength, (kPa), M±SD	19.5±5.3	18.9±6.3	19.9±4.7	t(34)=-0.6 P=0.567
Tongue strength, (kPa), M±SD	33.8±14.0	35.8±16.1	32.7±13.0	t(34)=0.6 P=0.530
ASM, (Kg), M±SD	15.4±3.7	18.8±4.0	13.4±1.5	U=28.5 P<0.001**
Maximum grip strength, (Kg), M±SD	18.5±5.9	22.7±6.6	16.1±3.9	U=53.5 P=0.002**
Gait speed, (m/s) M±SD	0.55±0.25	0.68±0.22	0.48±0.24	t(34)=2.6 P=0.01**
Literacy, n (%)				
<4th grade	18 (50.0)	3 (16.7)	15 (83.3)	$\chi^2(1)=5.9$
≥4th grade	18 (50.0)	10 (55.6)	8 (44.4)	P=0.015*
Dentition status, n (%)				
Natural teeth/prostheses w. a.	18 (50.0)	8 (44.4)	10 (55.6)	
Poorly fitting prostheses	9 (25.0)	2 (22.2)	7 (77.8)	Fisher=1.4
Absence of teeth	9 (25.0)	3 (33.3)	6 (66.7)	P=0.587
Nutritional status (MNA-SF), n (%)				
Normal	28 (77.8)	11 (39.3)	17 (60.7)	$\chi^2(1)=0.550$
Risk malnutrition/Malnourished	8 (19.4)	2 (25.0)	6 (75.0)	P=0.682
Physical function, n (%)				
Dependent	3 (8.3)	0 (0.0)	3 (100)	$\chi^2(1)=0.550$
Independent	33 (91.7)	13 (36.1)	20 (60.6)	P=0.682
Sarcopenia risk screening (SARC-F), n (%)				
Yes (cut-off)	16 (44.4)	3 (18.8)	13 (81.3)	$\chi^2(1)=3.8$
No	20 (55.6)	10 (50.0)	10 (50.0)	P=0.052*
Low muscle quantity, n (%)				
Yes (cut-off)	26 (72.2)	7(26.9)	19 (73.1)	$\chi^2(1)=3.4$
No	10 (27.8)	6 (60.0)	4 (40.0)	P=0.119
Low muscle strength, n (%)				
Yes (cut-off)	22 (61.1)	10 (45.5)	12 (54.5)	$\chi^2(1)=2.1$
No	14 (38.4)	3 (21.4)	11 (78.6)	P=0.143
Low performance, n (%)				
Yes (cut-off)	31 (86.1)	9 (29.0)	22 (71.0)	n.a.
No	5 (13.9)	4 (80.0)	1 (20.0)	
Sarcopenia, n (%)				
Yes	19 (52.8)	7 (36.8)	12 (63.2)	$\chi^2(1)=0.009$
No	17 (47.2)	6 (35.3)	11 (64.7)	P=1.00
Risk of OD, n (%)				
Yes (cut-off)	20 (55.6)	6 (30.0)	14 (70.0)	$\chi^2(1)=0.73$
No	16 (44.4)	7 (43.8)	9 (56.3)	P=0.493
Probable SOD, n (%)				
Yes	13 (36.1)	5 (38.5)	8 (61.5)	$\chi^2(1)=0.049$
No	23 (63.9)	8 (34.8)	15 (65.2)	P=1.00

M, mean; SD, standard deviation; ASM, appendicular skeletal muscle mass; MNA-SF, mini nutritional assessment–short form; BI, Barthel index; SARC-F, simple questionnaire to rapidly diagnose sarcopenia; kPa, kilopascals; Kg, kilograms; n, sample size; Prostheses w.a., prostheses well adapted; n.a., not available/not applicable; OD, oropharyngeal dysphagia; SOD, sarcopenic dysphagia. [a]P value from T-test (t), Mann-Whitney test (U), Fisher exact test (Fisher), or Chi-square test(χ^2). *P≤0.05; **P≤0.01.

score of 19.5±5.3 KPa, and 33.8±14.0 KPa respectively, but they did not differ significantly between males and females (P>0.05). There were significant differences between genders regarding the sarcopenia risk screening (SARC-F scores), appendicular skeletal muscle mass (ASM), maximum grip strength, and gait speed scores (all P<0.01). All scores had worse results in women. Further details are reported in Table 1.

The studied population was included in G1 if they did not present any pathology (n=10, 27.8%), in G2 if they were at risk of OD (n=7, 19.4%), in G3 if they had a diagnosis of sarcopenia (n=6, 16.7%), and in G4 if they had a probable diagnosis of SOD (risk of OD and sarcopenia) (n=13, 36.1%).

The different group comparison diagnoses (Table 2) just showed a significant relationship between SARC-F results [F(3;32)=4.1; P=0.014]. The post *hoc* analysis revealed that it was possible to distinguish the groups that are at the extremities: the group without pathology (G1) statistically differed from the group with probable SOD (G4).

Univariate analysis (Table 3) was used to individually screen the measured variables for an association between a pathology (G2 or G3 or G4) and the control group (G1). The odds risk (OR) analysis for probable SOD showed that the SARC-F questionnaire score was a significant predictor (OR=9.0, 95% CI=1.285-63.025, P<0.05). The OR for sarcopenia did not show significant predictors among the variables examined. In addition, the OR for OD indicated that the use of poorly fitting prostheses was a significant predictor (OR=30.0; 95% CI=1.471-611.797, P<0.05) of being at risk of having OD. However, the upper and lower limits of the confidence interval showed a large amplitude. So, with due reservations for the small sample size in the interpretation of odds ratios, the likelihood of being at risk for OD was 30 times higher if the elderly have poorly fitting prostheses as opposed to natural teeth or well-adjusted prostheses. There was no significant relationship between the remaining parameters.

To examine the relationship between being at risk of OD and sarcopenia, the sample data was analyzed and the participants who were diagnosed with sarcopenia were crossed with the elderly who were at risk of having OD (Table 4). 52.8% of participants had sarcopenia and 68.4% of these had an associated risk of OD. The odds of being at risk of OD was 3 times higher (OR=3.095; CI 95%=0.789-12.144, P>0.05) where the 95% CI spans across 1 on either side and hence P>0.05, though the odds ratio shows an association.

Table 5 presents a bivariate correlation analysis for the quantitative variables studied for the 4 groups according to their diagnosis. In the healthy elder group (G1), a strong negative correlation between ASM and SARC-F (r=-0.841, P<0.01) and a positive correlation among ASM and BI (r=0.646, P<0.05) were reported. In the elderly at risk of OD group (G2), strong and significant negative correlations between age and tongue strength (r=-0.847, P<0.05), age and ASM (r=-0.775, P<0.05), as well as age and maximum grip strength (r=-0.784, P<0.05) were observed. In addition, ASM had a strong and significant positive correlation with maximum grip strength (r=0.767, P<0.05), and there was a strong and significant positive correlation between gait speed (m/s) and BI scores (r=0.815, P<0.05). For the group with sarcopenia (G3), the increase in tongue strength was associated with the decrease in the MNA scores (r=-0.941, P<0.01), and the increase in age is associated with the decrease in BI scores (r=-0.833, P<0.05). There were also strong and significant positive correlations between ASM and BI scores (r=0.833, P<0.05). Finally, the study of the group with probable SOD (G4) shows significant and strong negative correlations between SARC-F scores and BI scores (r=-0.808, P<0.01), and among SARC-F and gait speed (r=-0.677, P<0.05). Therefore, the

Table 2. Results for the different group comparison diagnosis.

Characteristic	Groups G1 n=10 (27.8%)	G2 n=7 (19.4%)	G3 n=6 (16.7%)	G4 n=13 (36.1%)	Statistical results	Post *hoc* analysis by Tukey test
Gender, n (%)						
Male	5 (38.5)	1 (7.7)	2 (15.4)	5 (38.5)	Fisher=2.299	n.a.
Female	5 (21.7)	6 (26.1)	4 (17.4)	8 (34.8)	P=0.541	
Literacy, n (%)						
<4th grade	3 (16.7)	4 (22,2)	3 (16.7)	8 (44.4)	Fisher=2.484	n.a.
≥4th grade	7 (38.9)	3 (16.7)	3 (16,7)	5 (27.8)	P=0.515	
Dentition status, n (%)						
N. teeth/ prostheses w.a.	6 (33.3)	1 (5.6)	4 (22.2)	7 (38.9)	Fisher=8.712	n.a.
Poorly fitting prostheses	1 (11.1)	5 (55.6)	1 (11,1)	2 (22.2)	P=0.165	
Absence of teeth	3 (33.3)	1 (11.1)	1 (11.1)	4 (44.4)		
Age, (years), M±SD	86.2±5.7	85.6±6.6	91.5±4.8	89.0±4.9	F (3;32)=1.8 P=0.168	n.s.
MNA-SF, (no units), M±SD	12.7±1.0	11.3±2.3	11.7±2.0	12.0±1.5	F (3;32)=1.5 P=0.245	n.s.
BI, (no units), M±SD	89.0±13.3	89.3±15.4	86.7±11.7	78.2±16.1	F (3;32)=1.4 P=0.252	n.s.
SARC-F, (no units), M±SD	1.6±1.8	3.4±2.9	2.3±2.6	5.2±2.8	F (3;32)=4.1 P=0.014**	G1=G2=G3 G2=G3=G4
Lips strength, (kPa), M±SD	19.4±6.5	20.4±1.8	21.1±6.2	18.4±5.3	F (3;32)=0.5 P=0.722	n.s.
Tongue strength, (kPa), M±SD	32,4±15.9	34.1±13.7	36.3±13.5	33.0±14.4	F (3;32)=0.1 P=0.944	n.s.

n, sample size; n.a., not available/not applicable; N. teeth, natural teeth; prostheses w.a., prostheses well adapted; M, mean; SD, standard deviation; n.s., not significant; MNA-SF, mini nutritional assessment–short form; BI, Barthel index; SARC-F, simple questionnaire to rapidly diagnose sarcopenia; kPa, kilopascals. [a]P value from Fisher exact test (Fisher) or One-way analysis of variance (F). G1, control group (without pathology); G2, OD risk group; G3, sarcopenia group; G4, probable SOD group. **P≤0.01.

greater the SARC-F scores, the lower the functional capacity (BI) and physical performance were. There was also a significant and strong positive correlation between ASM and physical performance (gait speed) (r=0.572, P<0.05). Therefore, an increase in ASM was related to an increase in gait speed.

Discussion

This study, involving 36 elderly people living in nursing homes, found that the prevalence of being at risk of having OD and presenting sarcopenia was 55.6% (n=20) and 52.8% (n=19), respectively, and that the prevalence of having probable SOD was 36.1% (n=13). Although slightly higher, both OD and SOD obtained prevalence are in line with the existing literature, which shows a prevalence in institutionalized elderly of 51%,[1] and 32%,[11] respectively. However, the prevalence rate found in our population is higher than the one in institutionalized elderly reported in the previous studies, which was 14 to 33%.[7] The studied elderly population has an average age of 88 years (SD=5.6), which reflects the increasingly aging trend of the Portuguese and world population.[19] On the other hand, the literature reported that sarcopenia patients are, on average, 70.5 years old for men and 71.6 years old for women.[6] As the sample mean of this study was significantly higher than the average, this may explain the prevalence values of sarcopenia that were found.

We observed significantly worse results (P=0.01) in women, for the SARC-F and we saw that women have a higher risk of suffering from sarcopenia than men (P=0.05). These results suggest a trend towards a higher prevalence of sarcopenia in females than in males. However, the majority of the previous investigations do not observe significant gender differences.[20]

The educational qualifications of our sample showed a low educational level, with significant gender differences, with 83.3% (n=15) women and 16.7% (n=3) men with low educational levels (P<0.05). On the other hand, half of our sample (n=18) had poor oral health. These values were expected, as Portugal has oral health indicators below the European average,[21] with a high rate of elderly people with less than 20 natural teeth and a high number of lost teeth, apparently associated with the lack of interventions to fight periodontal disease.[22] It is known that average levels of health literacy are highly related to educational qualifications.[23] Therefore, our results show that low schooling, poor health knowledge, and skills seem to have significant implications for oral health.

Table 3. Univariable predictors for the oropharyngeal dysphagia risk, sarcopenia group and probable sarcopenic dysphagia group (reference group - control group: without any pathology).

	Univariate analysis					
	Probable SOD group (n=13)		Sarcopenia group (n=6)		OD risk group (n=7)	
Variables	Odds ratio	95% CI	Odds ratio	95% CI	Odds ratio	95% CI
Gender						
Male (Ref.gr.)	1		1		1	
Female	1.600	[0.302;8.490]	2.000	[0.244;16.352]	6.000	[0.516;69.754]
Literacy						
<4th grade	3.733	[0.646;21.577]	2.333	[0.287;18.965]	3.111	[0.414;23.393]
≥4th grade (Ref.gr.)	1		1		1	
Dentition status						
Natural teeth/prostheses w. a. (Ref.gr.)	1		1		1	
Poorly fitting prostheses	1.714	[0.123;23.939]	1.500	[0.71;31.575]	30.000*	[1.471;611.797]
Absence of teeth	1.143	[0.179;7.283]	0.500	[0.037;6.683]	2.000	[0.090;44.350]
Nutritional Status (MNA-SF)						
Normal (Ref.gr.)	1		1		1	
Risk malnutrition/malnourished	1.636	[0.127;21.104]	4.500	[0.310;65.229]	6.750	[0.526;86.561]
Sarcopenia risk screening (SARC-F)						
Yes (≥4)	9.000*	[1.285;63.025]	2.00	[0.201;19.914]	3.000	[0.348;25.870]
No (Ref.gr.)	1		1		1	
Variables						
Age (years)	1.115	[0.939;1.325]	1.257	[0.954;1.656]	0.981	[0.829;1.161]
Lips strength (kPa)	0.968	[0.836;1.122]	1.050	[0.886;1.245]	1.045	[0.854;1.278]
Tongue strength (kPa)	1.003	[0.947;1.062]	1.020	[0.948;1.097]	1.014	[0.947;1.086]
MNA-SF (no units)	0.353	[0.106;1.177]	0.549	[0.214;1.412]	0.518	[0.213;1.257]
BI (no units)	0.94	[0.883;1.013]	0.984	[0.905;1.070]	1.002	[0.931;1.077]

SOD, sarcopenic dysphagia; OD, oropharyngeal dysphagia; CI, confidence interval; Prostheses w.a., prostheses well adapted; Ref.gr., reference group; MNA-SF, mini nutritional assessment–short form; SARC-F, simple questionnaire to rapidly diagnose sarcopenia; kPa, kilopascals; BI, Barthel index. *P<0.05.

Table 4. The association between Sarcopenia and being at risk of oropharyngeal dysphagia. Data are expressed as n (%).

	Risk for OD		
Sarcopenia	Yes (with OD risk)	No (without OD risk)	Total
Yes (Risk group)	13 (68.4)	6 (31.6)	19 (52.8)
No (Reference group)	7 (41.2)	10 (58.8)	17 (47.2)
Total	20 (55.6)	16 (44.4)	36 (100)

OD, oropharyngeal dysphagia; odds ratio=3.095; confidence interval 95%=[0.789;12.144].

Table 5. Correlation analysis between age, simple questionnaire to rapidly diagnose sarcopenia scores, lips strength, tongue strength, muscle quantity (appendicular skeletal muscle mass), maximum grip strength, physical performance (gait speed), mini nutritional assessment–short form scores, Barthel index scores and gugging swallowing screen scores for the different groups (only significant values P<.05). Values in italic identify moderate to strong correlations.

	Age	SARC-F	Lips strength	Tongue strg.	ASM	Max. g. strg.	Gait speed	MNA	BI	GUSS
For the control group (n=10)										
Age (years)	1	0.360	*-0.500*	0.232	-0.274	-0.246	0.086	0.349	*-0.568*	-
SARC-F		1	0.028	0.159	*-0.841***	-0.469	-0.481	-0.092	*-0.607*	-
Lips strength (kPa)			1	0.344	-0.152	0.351	-0.468	-0.451	-0.079	-
Tongue strg. (kPa)				1	0.172	0.227	-0.352	-0.168	-0.153	-
ASM (Kg)					1	0.465	0.474	0.229	*0.646**	-
Max. g. strg. (Kg)						1	0.475	0.285	0.434	-
Gait speed (m/s)							1	*0.564*	0.453	-
MNA-SF (no u.)								1	-0.197	-
BI (no u.)									1	-
GUSS (no u.)	-	-	-	-	-	-	-	-	-	-
	Age	**SARC-F**	**Lips strength**	**Tongue strg.**	**ASM**	**Max. g. strg.**	**Gait speed**	**MNA**	**BI**	**GUSS**
For OD risk group (n=7)										
Age (years)	1	0.183	-0.318	*-0.847**	*-0.775**	*-0.784**	-0.288	0.345	-0.318	-0.183
SARC-F(no u.)		1	-0.100	-0.455	-0.473	-0.191	-0.400	-0.495	*-0.698*	0.278
Lips strength (kPa)			1	*0.512*	-0.118	0.031	-0.256	0.169	0.225	-0.311
Tongue strg. (kPa)				1	*0.643*	*0.636*	0.179	-0.054	0.371	-0.036
ASM (Kg)					1	0.767*	0.750	0.054	*0.630*	0.473
Max. g. strg. (Kg)						1	*0.617*	-0.113	0.466	0.200
Gait speed (m/s)							1	*0.523*	0.815*	*0.564*
MNA-SF(no u.)								1	*0.692*	0.165
BI (no u.)									1	0.189
GUSS (no u.)										1
	Age	**SARC-F**	**Lips strength**	**Tongue strg.**	**ASM**	**Max. g. strg.**	**Gait speed**	**MNA**	**BI**	**GUSS**
For the sarcopenia group (n=6)										
Age (years)	1	-0.087	*0.667*	-0.257	*-0.714*	-0.058	0.429	0.395	-0.833*	-
SARC-F (no u.)		1	0.088	*0.580*	-0.116	*-0.765*	*-0.609*	-0.462	-0.391	-
Lips strength (kPa)			1	-0.116	-0.493	0.015	0.116	0.370	*-0.626*	-
Tongue strg. (kPa)				1	0.429	-0.464	0.029	*-0.941***	0.185	-
ASM (Kg)					1	0.464	-0.143	*-0.638*	*0.833**	-
Max. g. strg. (Kg)						1	0.145	0.277	0.423	-
Gait speed (m/s)							1	0.030	0.062	-
MNA-SF(no u.)								1	-0.361	-
BI (no u.)									1	-
GUSS (no u.)	-	-	-	-	-	-	-	-	-	-
	Age	**SARC-F**	**Lips strength**	**Tongue strg.**	**ASM**	**Max. g. strg.**	**Gait speed**	**MNA**	**BI**	**GUSS**
For the probable SOD group (n=13)										
Age (years)	1	-0.069	0.092	0.162	-0.138	0.054	-0.041	0.484	0.106	-0.160
SARC-F (no u.)		1	-0.465	-0.084	-0.182	-0.484	*-0.677**	0.227	*-0.808***	-0.111
Lips strength (kPa)			1	0.436	0.345	0.363	0.145	0.144	0.273	-0.192
Tongue strg. (kPa)				1	0.364	0.155	0.055	0.003	0.141	-0.276
ASM (Kg)					1	0.437	*0.572**	-0.114	-0.094	-0.321
Max. g. strg. (Kg)						1	*0.540*	0.107	0.244	0.124
Gait speed (m/s)							1	-0.183	0.452	0.230
MNA-SF (no u.)								1	-0.137	-0.196
BI (no u.)									1	-0.013
GUSS (no u.)										1

SARC-F, simple questionnaire to rapidly diagnose sarcopenia; kPa, kilopascals; no u., no units; ASM, appendicular skeletal muscle mass; Kg, kilograms; m/s, meters per second; MNA-SF, mini nutritional assessment–short form; BI, Barthel index; GUSS, gugging swallowing screen; Tongue strg., tongue strength; Max.g.strg., maximum grip strength. **P<0.01; *P<0.05.

The mechanism behind SOD has been related to complications, such as poor nutritional state, aspiration pneumonia, accumulation of waste in the oropharyngeal cavity, hydroelectrolytic disorders, poorer quality of life, and longer hospitalization stays.[5,11,24,25] Our sample has shown a prevalence of malnutrition risk of 19.4% (25% males; 75% females), was mostly independent in ADLs (91.7%), and has an average BI score of 84.5/100 (SD=14.8). The whole sample had an oral diet; however, most of them reported difficulty in preparing the bolus, having to cut the meat and other harder foods into small sizes, or eating only the accompaniment excluding the meat. In this sense, the elderly who cannot achieve full oral intake without additional nutrition are not able to obtain adequate energy contents from food, with a consequent decrease in nutrition support. Therefore, this leads to weight loss and disrupted synthesis of skeletal muscles, which subsequently results in the further development of sarcopenia.[24] Thus, a vicious cycle of sarcopenia and OD eventually becomes inevitable. In this sense, recent studies recommended that care for SOD requires a multidisciplinary strategy,[2] and an aggressive nutrition therapy combined with dysphagia rehabilitation.[24] Additionally, recent evidence shows that interventions to break the vicious circle between OD and malnutrition must include: i) swallowing muscle strengthening, like lingual resistance exercises, breathing training, and tongue exercises; ii) nutrition support, with an energy intake of approximately 35 kcal/kg/day based on ideal body weight along with dysphagia rehabilitation; iii) texture modification of foods, that should be incorporated to improve the safety and efficiency of oral eating in elderly with SOD.[2,24,25]

The speech and language therapist (SLT) is the professional responsible for developing an exercise program tailored to the abnormal phases of the swallowing process through the practice of the best techniques available and good clinical judgment. Likewise, it is important to promote multidisciplinary work between SLT, nutritionist, physiotherapist, and nurse, to improve the prevention of OD, malnutrition, and sarcopenia. This multidisciplinary work should be carried out systematically in all institutions that provide care to the elderly, because it contributes to a multidisciplinary approach and developing a rehabilitative approach, characterized by several interventions including functional training, compensatory maneuvers, postural adjustments, swallowing maneuvers, and diet modifications.[26]

As in previous studies,[1,27] the results of this investigation point out that as age increases, the likelihood of being at risk of having OD is also higher. We also found that the use of poorly fitting prostheses was a significant predictor ($P<0.05$) of the risk of OD. Although it was not possible to find any information related to these results in previous studies, these are easily perceived due to the importance of the integrity and good functioning of intraoral structures for correct and safe swallowing.

In agreement with the literature,[5,20,25] we found that sarcopenia increased the odds of being at risk of OD, although this result was not statistically significant as expected; we believe it is most likely due to the small size of our sample.

The strength of the tongue and lips are a useful predictor of SOD,[28] with a strong correlation between the diagnosis of SOD and the measures of tongue and lips strength. However, our results (1.003, $P>0.05$ for tongue strength; 0.968, $P>0.05$ for lips strength) do not indicate it (Table 3), which may be, once again, related to the small size of our sample. Even though the isometric measures of the tongue were not very noticeable, an increase in the strength of the lips associated with the decreased risk of probable SOD was observed in 3.2%. Found average lips and tongue strength was 19.5±5.3 KPa, and 33.8±14.0 KPa, respectively. We also have verified that an increase in age, poorly fitting prostheses, a higher level of dependence during ADLs, and risk of malnutrition or malnourishment rise the potential to have probable SOD. These outcomes are in line with previous results from different studies.[4,5,8,11,25]

Our data also showed that parameters such as gender (female) and low educational level are associated with higher odds of having probable SOD; however, no information from previous studies was found that allowed us to compare results. The SARC-F questionnaire was the only significant predictor of probable SOD ($P<0.05$), indicating that the likelihood of presenting this condition increases relevantly if the elderly have a final score in this tool equal to or greater than four.

Study limitations

Due to the Covid-19 pandemic, data collection had to be stopped in March 2020, which led to a small sample size. Moreover, this study was conducted in just two nursing homes, resulting in an unrepresentative sample. Therefore, these results are limited and must be interpreted carefully. The OD was not confirmed with a clinical assessment performed by a SLT or with an instrumental examination. This may have affected the accuracy of the OD and SOD diagnosis. Furthermore, medications that can affect swallowing function have not been investigated and considered. This might have resulted in bias for OD and SOD results in the study. The use of BIA for muscle mass assessment presents some disadvantages, mainly due to the hydration problems usually observed in older people, possibly resulting in an underestimation of body fat and an overestimation of fat-free mass.

Conclusions

This study reports a survey of the prevalence of probable SOD in 36 Portuguese elderly living in two nursing homes, with a mean age of 88 years, to understand the relationship between OD, sarcopenia, and the frequency of these pathologies in the studied population.

We have found a prevalence of OD risk, sarcopenia, and probable SOD which is slightly higher than in previous studies. Likewise, we have found that as age increases, the level of ADL dependence of the elderly, the risk of malnutrition or malnourishment, and the odds of being at risk of having OD and present sarcopenia increase as well. Thus, we suggest including a SLT in the multidisciplinary geriatric teams to improve the prevention of OD, sarcopenia, and SOD and to avoid their consequences.

Female gender, low educational level, and SARC-F≥4 score on the screening test are associated with higher odds of being at risk of OD, sarcopenia, and even probable SOD. The SARC-F questionnaire (score≥4) was the only significant predictor of probable SOD ($P<0.05$). The use of poorly fitting prostheses increases the odds of sarcopenia by 50%, and this condition was a significant predictor ($P<0.05$) of the risk of OD.

Despite the observed data, future studies are warranted to have a more representative sample and to research for evidence to support a transdisciplinary approach to sarcopenic dysphagic elderly.

References

1. Ortega O, Martín A, Clavé P. Diagnosis and management of oropharyngeal dysphagia among older persons, state of the art. J Am Med Dir Assoc 2017;18:576-82.
2. Chen KC, Jeng Y, Wu WT, et al. Sarcopenic dysphagia: a narrative review from diagnosis to intervention. Nutrients 2021;13:4043.
3. Payne M, Morley JE. Dysphagia, dementia and frailty. J Nutr Health Aging 2018;22:562-5.

4. Zhao WT, Yang M, Wu HM, et al. Systematic review and meta-analysis of the association between sarcopenia and dysphagia. J Nutr Health Aging 2018; 22:1003-9.
5. Cha S, Kim WS, Kim KW, et al. Sarcopenia is an independent risk factor for dysphagia in community-dwelling older adults. Dysphagia 2019;34:692-7.
6. Batsis JA, Mackenzie TA, Lopez-Jimenez F, Bartels SJ. Sarcopenia, sarcopenic obesity, and functional impairments in older adults: national health and nutrition examination surveys 1999-2004. Nutr Res 2015;35:1031-9.
7. Cruz-Jentoft AJ, Landi F, Schneider SM, et al. Prevalence of and interventions for sarcopenia in ageing adults: a systematic review. Report of the international sarcopenia initiative (EWGSOP and IWGS). Age Ageing 2014;43:748-59.
8. Bianchi L, Abete P, Bellelli G, et al. Prevalence and clinical correlates of sarcopenia, identified according to the EWGSOP definition and diagnostic algorithm, in hospitalized older people: the GLISTEN study. J Gerontol A Biol Sci Med Sci 2017;72:1575-81.
9. Mijnarends DM, Koster A, Schols JMGA, et al. Physical activity and incidence of sarcopenia: the population-based AGES–Reykjavik Study. Age Ageing 2016;45:614-20.
10. Senior HE, Henwood TR, Beller EM, et al. Prevalence and risk factors of sarcopenia among adults living in nursing homes. Maturitas 2015;82:418-23.
11. Wakabayashi H, Takahashi R, Murakami T. The prevalence and prognosis of sarcopenic dysphagia in patients who require dysphagia rehabilitation. J Nutr Health Aging 2019;23:84-8.
12. Hara K, Tohara H, Kobayashi K, et al. Age-related declines in the swallowing muscle strength of men and women aged 20-89 years: a cross-sectional study on tongue pressure and jaw-opening force in 980 subjects. Arch Gerontol Geriatr 2018;78:64-70.
13. Can B, İsmagulova N, Enver N, et al. Sarcopenic dysphagia following COVID-19 infection: a new danger. Nutr Clin Pract 2021;36:828-32.
14. Almeida J, Amaral C, Lucas I, et al. GUSS; 2017. Available from: https://gussgroupinternational.files.wordpress.com/2019/01/portuguese-1.pdf. Accessed July 7, 2019.
15. Cruz-Jentoft AJ, Bahat G, Bauer J, et al. Sarcopenia: revised European consensus on definition and diagnosis. Age Ageing 2019;48:16-31.
16. Faria A, Sousa-Santos AR, Mendes J, Limas de Sousa AS, Amaral TF. Development of the Portuguese versions of FRAIL Scale and SARC-F: screening tools for physical frailty and sarcopenia [Article in Portuguese]. Acta Portuguesa de Nutrição 2021;26:90-4.
17. Kaiser MJ, Bauer JM, Ramsch C, et al. Validation of the mini nutritional assessment short-form (MNA®-SF): a practical tool for identification of nutritional status. J Nutr Health Aging 2009;13:782-8.
18. Jesus L, Marques A, Roberto M, Rosa M, Patrício B. Barthel Index (BI) – Versão Portuguesa. University of Aveiro, Portugal. In Press. Available from: MAPI Research Trust PROQOLID database http://www.proqolid.org.
19. Pordata. Censos 2021: conheça Portugal. Available from: https://www.pordata.pt/Portugal/Quadro+Resumo/Portugal-255606. Accessed on: May 20, 2022.
20. Du Y, Wang X, Xie H et al. Sex differences in the prevalence and adverse outcomes of sarcopenia and sarcopenic obesity in community dwelling elderly in East China using the AWGS criteria. BMC Endocr Disord 2019;19:109.
21. Lourenço A, Barros P. Cuidados de saúde oral. Nova healthcare initiative-research/ Universidade Nova de Lisboa; 2016. Available from https://www.omd.pt/content/uploads/2017/12/cuidados-saude-oral.pdf.
22. Espanha R, Ávila P. Health literacy survey Portugal: a contribution for the knowledge on health and communications. Procedia Computer Science 2016;100:1033-41.
23. DGS - Direção Geral de Saúde. Programa nacional de promoção da saúde oral - iii estudo nacional de prevalência das doenças orais. Available from: https://www.dgs.pt/documentos-e-publicacoes/iii-estudo-nacional-de-prevalencia-das-doencas-orais-pdf.aspx Accessed on: February 2022
24. Mizuno S, Wakabayashi H, Wada F. Rehabilitation nutrition for individuals with frailty, disability, sarcopenic dysphagia, or sarcopenic respiratory disability. Curr Opin Clin Nutr Metab Care 2022;25:29-36.
25. Patino-Hernandez D, Borda MG, Venegas Sanabria LC, et al. Disfagia sarcopénica. Rev Col Gastroenterol 2017;31:418-23.
26. Sire A, Ferrillo M, Lippi L, et al. Sarcopenic dysphagia, malnutrition, and oral frailty in elderly: a comprehensive review. Nutrients 2022,14:982.
27. Warnecke T, Dziewas R, Wirth R, et al. Dysphagia from a neurogeriatric point of view: pathogenesis, diagnosis and management. Z Gerontol Geriat 2019;52:330-5.
28. Sakai K, Nakayama E, Tohara H, et al. Diagnostic accuracy of lip force and tongue strength for sarcopenic dysphagia in older inpatients: a cross-sectional observational study. Clinical Nutrition 2019;38:303-9.