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Original article

The risk of dysphagia is associated with malnutrition and poor functional outcomes in a large population of outpatient older individuals

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SUMMARY

Oropharyngeal dysphagia (OD) is a widespread clinical condition among older adults. Although it represents a risk factor for malnutrition, dehydration and aspiration pneumonia, its assessment and contribution to functional decline is often ignored. The aim of the present study was to estimate the prevalence of OD in a large population of non-institutionalized older people and to evaluate its relationship with malnutrition and physical function. 10-item Eating Assessment Tool (EAT-10) and Mini Nutritional Assessment Short Form (MNA-SF) were used to identify the risk of dysphagia and malnutrition. Short Physical Performance Battery (SPPB) and hand-grip strength were used as functional endpoints. The relationship between risk of dysphagia and functional outcomes was tested in a multivariate regression analysis adjusted for age and sex (Model 1) and for other confounders including Mini Mental State Examination (MMSE) and polypharmacy (Model 2). Mean age of 773 subjects (61.3% female) was 81.97 years. The percentage of participants at risk of dysphagia (EAT $\geq$ 3) was 30.1%, 37.8% of subjects was malnourished (MNA-SF < 8), 46.2% was at risk of malnutrition (MNA-SF:8–11). EAT-10 was significantly and negatively associated to MNA-SF ($\beta = -0.47 \pm 0.06$, $p < 0.0001$) and the strength of the relationship was attenuated but still statistically significant in the multivariate model ($\beta = -0.28 \pm 0.07$, $p < 0.0001$). A significant and negative relationship was found between EAT-10 and SPPB and hand-grip strength in Model 1 ($\beta = -0.25 \pm 0.05$, $p < 0.0001$) and Model 2 ($\beta = -0.07 \pm 0.03$, $p < 0.0001$). After categorization of risk of dysphagia in two groups (at risk and not at risk), MNA-SF, SPPB and hand-grip strength were independently associated with higher risk of dysphagia (OR = 0.91, 95%CI = 0.83–0.99, p = 0.03; OR = 0.83, 95%CI = 0.77–0.89, $p < 0.0001$; OR = 0.96, 95%CI = 0.92–0.99, p = 0.02, respectively). In a large group of outpatient older individuals, we observed a significant negative association between risk of dysphagia and nutritional and physical performance, suggesting that the screening of OD, possibly supported by its assessment, should be implemented in the geriatric setting to potentially prevent the functional decline.

1. Introduction

Oropharyngeal dysphagia (OD) is a prevalent and a widespread clinical condition among older adults [1]. OD is classified as a digestive condition by the International Classification of Diseases (ICD) ICD-10, and is included in the International Classification of Functioning, Disability and Health code B5105 of the World Health Organization (WHO). Recently, experts of the Dysphagia Working Group recognized OD as a “geriatric syndrome”, defined by the difficulty to effectively and safely move the alimentary bolus from the mouth to the oesophagus [2,3]. Among general population, prevalence of OD varies between 2.3% and 16%, but it increases with age, with rates between about 30% in people over 65 years living independently and over 40%, in specific settings such as hospitals, nursing homes and geriatric acute care, and getting a prevalence rate over 60% in institutionalized older patients. The prevalence of OD is highest in patients with frailty, up to 47% of frail elderly

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patients hospitalized for acute illness will suffer from OD [2,4,5]. OD affects 8.1–80% of stroke patients, 11–60% of parkinsonian patients, 91% of older community-acquired pneumonia patients and uncertain percentage of Alzheimer's Disease patients [6]. OD is a major cause of mortality and morbidities, due to severe complications including malnutrition and dehydration [7] and aspiration pneumonia [4].

Malnutrition has been defined as a clinical condition of an imbalance of energy, protein, and other nutrients that causes measurable negative effects on body composition, physical function, and clinical outcomes [8]. Malnutrition risk can be screened by several tools, such as the MNA-SF [9] and diagnosed, as suggested by The European Society of Clinical Nutrition and Metabolism (ESPEN). The consensus-based criteria proposed by ESPEN included two options. The first identifies malnutrition for body mass index (BMI) value less than 18.5 kg/m^2, the second one unintentional weight loss >10% indefinite of time, or >5% over the last 3 months together with either BMI < 20 kg/m^2 (when <70 years of age) or BMI < 22 kg/m^2 (when ≥70 years of age) or Fat Free Mass Index (FFMI) < 15 and 17 kg/m^2 in women and men, respectively [10].

10-item Eating Assessment Tool (EAT-10) is a symptom-specific tool, commonly used in clinical practice, and useful in documenting subjective evaluation of dysphagia or initial symptom severity. It includes 10 questions, with a maximum total score of 40 points; a score equal or greater than 3 points suggests a potential swallowing problem [11,12]. Furthermore, Arslan et al. [13] investigated the ability of EAT-10 to detect aspiration in a group of neurological patients with different diagnoses, demonstrating that it can be safely used to screen patients with neurologic disorders who are at risk of unsafe airway protection or potentially with OD.

In spite of the severity of these complications, OD is often not detected, not explored as integrated part of Comprehensive Geriatric Assessment and thus not promptly treated. Moreover, the assessment and contribution of OD to the decline in physical performance and low muscle function have not been fully investigated. Thus, the main objective of our study was to explore the risk of dysphagia in a large population of older outpatients, and to investigate its relationship with malnutrition and functional outcomes, cognitive status and number of medications.

2. Materials and methods

2.1. Study design and participants

We consecutively enrolled all outpatients evaluated for the first time at the Cognitive and Motoric Disorders Clinic of Medical-Geriatric-Rehabilitation Department of University-Hospital of Parma from September 2017 to January 2018. Patients were referred to the clinic by their own general practitioners or specialist physicians of Parma University-Hospital, to undergo Comprehensive Geriatric Assessment (CGA) for motoric or memory complaints.

Inclusion criteria were age ≥70 year old, presence of perceived motoric or cognitive decline in the 6 months before the evaluation, presence of a caregiver, willingness to participate to the study and signed informed consent. Exclusion criteria were nursing home residence, active malignancy, presence of acute disease, known disability referred by the patient as inability to walk for more than two blocks, hospitalization in the 2 weeks before the evaluation.

The present study is part of a larger project, called T.R.I.P. (Traumatic Risk Identikit Parma) Study, aimed at identifying the clinical correlates of falls in a large group of geriatric outpatients evaluated for suspected cognitive or motoric frailty. The protocol of the TRIP Study has been approved by the Ethics Committee of Parma province (ID 17262) [14].

2.2. Screening of risk of dysphagia

The screening tool used for the evaluation of dysphagia risk was the 10-item Eating Assessment Tool (EAT-10). An EAT-10 score ≥3 suggests the presence of swallowing difficulties.

2.3. Metabolic and nutritional outcomes

Metabolic and nutritional outcomes considered in the study were Body Mass Index (BMI) and risk of malnutrition, evaluated through administration of Mini Nutritional Assessment Short Form (MNA-SF) questionnaire. BMI was calculated as the ratio between body weight and the squared height (weight/height^2, kg/m2). Body weight was measured to the nearest 0.1 kg by using a high-precision mechanical scale with the subjects wearing light clothing and without shoes. Standing height was measured to the nearest 0.1 cm. MNA-SF is a short, validated nutritional screening tool for free-living and clinically relevant elderly populations, composed by a subset of six questions from the full MNA that had high sensitivity and specificity. The MNA-SF is able to identify older individuals as well nourished (MNA-SF score = 12–14), at risk of malnutrition (MNA-SF score = 8–11) or malnourished (MNA-SF score = 0–7) [9].

2.4. Physical outcomes

The physical performance outcomes considered in the present study were the Short Physical Performance Battery (SPPB) and hand-grip strength measure (hand-grip), as the mean strength of both arms. The SPPB was calculated according to literature standards [15]. The patients were asked to perform three timed tasks: hierarchical assessment of standing balance (balance test), 4-meter walking speed at usual pace, and standing five times from a seated position in a chair (chair-stand test). The timed results of each subtest were rescaled according to predefined cut-points for obtaining a score ranging from 0 (worst performance) to 12 (best performance). For standing balance, participants were asked to remain standing with their feet as close together as possible, then in a semi-tandem position, and finally in a tandem position. Each position had to be held for 10 s (sec). We considered the presence of balance deficit as the inability to maintain tandem position for at least 10 s. Maximal hand-grip strength was also measured, using a hand-held dynamometer (Jamar Plus, Patterson Company, Bolingbrook, IL, US). Both arms were tested three times and the average strength value was considered for the analysis.

2.5. Cognitive status assessment

Cognitive function was evaluated with the Mini-Mental State Examination (MMSE) test as a screening procedure [16]. Briefly, the test is composed by 30 items related to different cognitive areas. Total score may range between 0 and 30, indicating a moderate-severe cognitive impairment when it is ≤18, a mild cognitive impairment when 18< score >24, borderline when = 25, and normal cognitive status when ≥26. The total score is normalized according to age and education level.

2.6. Polypharmacy

As multimorbidity, defined as the co-occurrence of at least two chronic diseases, is highly prevalent, especially in the older population [17], polypharmacy was considered as a potential confounder factor in the present study. The number and type of chronic comorbidities and medications were also systematically assessed, with polypharmacy defined as ≥5 drugs.

2.7. Statistical analysis

Continuous variables were reported as mean ± standard deviation (SD) or as median and interquartile range (IQR), according to the normality of distribution of values.

The relationship between EAT-10 and nutritional, physical, cognitive and motor performance outcomes was estimated through a linear regression model, sex- and age-adjusted. Then, the strength of the association between the risk of dysphagia and metabolic, cognitive and physical outcomes was also tested using multivariate logistic regression models. Age, sex, BMI, MMSE, SPPB, hand-grip strength, MNA-SF and number of medications were considered as possible confounders, since cognitive impairment, reduced physical performance and strength, malnutrition and polypharmacy could all have a role in defining the risk of dysphagia in older people.

All analyses were performed using SAS (v. 9.1, SAS Institute, Inc., Cary, NC), and statistical significance was accepted if p values were less than 0.05.

3. Results

3.1. Study population and prevalence of risk of dysphagia

The older population considered in the study was composed by 773 subjects (38.7% male, 61.3% female), with a mean age of 81.97 ± 7.10 years (Table 1). The estimated prevalence of risk of dysphagia in our population was 30.14%, with a median value of EAT-10 score of 1 and the interquartile range of 0–3. Among metabolic and nutritional outcomes considered in the study, the mean BMI value was 26.97 ± 5.21 kg/m^2, with 9.7% of subjects had BMI less than 18.5 kg/m^2. The percentage of subjects with BMI in the range of 18.5–24 kg/m^2 was 22.12%, and that of participants with BMI > 24 kg/m^2 was 68.18%. A general condition of risk of malnutrition emerged, being the mean score of MNA-SF 10.43 ± 2.65, with 46.18% of subjects were identified as at risk of malnutrition (MNA-SF score = 8–11), 16.04% as malnourished, and 37.77% had a normal nutritional status. At least 50% of participants had a SPPB score of 6, suggesting a general impaired physical function and a status of physical frailty. The muscle function, measured by the mean value of hand-grip strength was 19.14 ± 9.02 kg. The cognitive status of subjects enrolled in the study was assessed through the MMSE, and the mean score was 20.94 ± 6.15 points. We considered the type of chronic comorbidities, finding that about 40% of subjects had Alzheimer's Disease (AD) diagnosis, 27% had Vascular Dementia (VaD), 7% were early phase of Parkinson's Disease (PD) patients, and 26% of participants had other diseases (data not shown). 50.27% of subjects included was regularly taking more than five medications, 13.9% was taking five medications, while 35.83% were taking less than five medications every day.

Table 1
Characteristic of subjects enrolled in the study (n = 773).

	Mean ± SD	Median (%), [interquartile range]	
Females (n, %)		474 (61.3%)	
Age (years)	81.97 ± 7.10		
BMI (kg/m^2)	26.97 ± 5.21		
EAT-10 (score)		1 [0–3]	
MNA-SF (score)	10.43 ± 2.65		
Hand-grip (mean value, kg)	19.14 ± 9.02		
SPBB (score)		6 [2–9]	
MMSE (score)	20.94 ± 6.15		
N° medications (n,%)		0	279 (35.83%)
		1	108 (13.90%)
		2	386 (50.27%)

Footnotes: BMI = Body Mass Index; EAT-10 = 10 Item Eating Assessment Tool; MNA-SF = Mini Nutritional Assessment Short Form; SPBB = Short Physical Performance Battery; MMSE = Mini Mental Status Examination; N° medications: 0 = n°<5 medications, 1 = n°5 medications, 2 = n°>5 medications.

3.2. Correlation among risk of dysphagia and risk of metabolic parameters

Table 2 shows the analysis of univariate approach analysis, age and sex adjusted. In particular, the risk of dysphagia appeared significantly and negatively associated to malnutrition risk (MNA-SF score, β = −0.47 ± 0.06, p < 0.0001), but not to BMI. The number of patients at risk of dysphagia among different nutritional status groups was different, and it increased along with the worsening of nutritional status, with a percentage of individuals at dysphagia risk of 17% in patients not at risk of malnutrition, 33% in those at risk of malnutrition, and 54% in the malnourished group (Fig. 1). As a second step, a multivariate analysis was performed (Table 2), and the strength of the association was lower but still statistically significant supporting the idea that risk of malnutrition increases along with risk of dysphagia (β = −0.28 ± 0.07, p < 0.0001), and that dysphagia may act as risk predictor, of malnutrition independently by the other potential confounders (age, sex, BMI, SPPB, hand-grip strength, MMSE, and number of drugs) introduced in the multivariate model.

3.3. Correlation among EAT-10 and physical performance indicators

The univariate analysis showed a significant and negative association between EAT-10 and SPPB scores (β = −0.18 ± 0.04, p < 0.0001), and between EAT-10 and mean value of hand-grip strength (β = −0.19 ± 0.02, p < 0.0001) (Table 2). This relationship was confirmed as statistically significant in the multivariate model (Table 2) confirming that the risk of dysphagia increases along with the loss of physical performance (SPPB, β = −0.25 ± 0.05, p < 0.0001) and muscle strength (hand-grip, β = −0.07 ± 0.03, p = 0.005), independently by other covariates (age, sex, BMI, MNA-SF, MMSE and number of medications). Multivariate linear regression models were also used to examine the relationship between EAT-10 score and the subscore of the SPPB scale, the chair-stand time and balance score as expression of muscle or neurological function of participants (Table 4). Higher EAT-10 score was associated with lower time to the chair-stand test (Model 2) (β = −0.04, SE = 0.02, p = 0.02) but not with the balance test.

3.4. Correlation between EAT-10 and cognitive function

A significant and negative relationship emerged by the univariate analysis between the cognitive status assessed by MMSE score and risk of dysphagia (β = −0.13 ± 0.03, p < 0.0001) (Table 2). However, the multivariate approach did not confirm this relationship (β = 0.01 ± 0.03, p = 0.81) (Table 2).

3.5. Correlation between EAT-10 and polypharmacy

The number of medications was positively associated to risk of dysphagia (p < 0.0001), but when confounders were included in the analysis the association did not get the statistical significance (p = 0.40) (Tables 2 and 3).

Table 2
Relationship between EAT-10 and nutritional, cognitive and physical performance outcomes (univariate age- and sex-adjusted and multivariate approaches).

	Model 1		Model 2	
	Univariate Model (age- and sex-adjusted)		Multivariate Model	
	β ± SE[a]	p[a]	β ± SE	p
Sex	−0.47 ± 0.38	0.22	−0.47 ± 0.38	0.22
Age (years)	−0.02 ± 0.02	0.36	−0.02 ± 0.02	0.36
MNA-SF (score)	**−0.47 ± 0.06**	**<0.0001**	**−0.28 ± 0.07**	**<0.0001**
BMI (kg/m^2)	0.04 ± 0.03	0.12	0.03 ± 0.03	0.31
SPPB (score)	**−0.18 ± 0.04**	**<0.0001**	**−0.25 ± 0.05**	**<0.0001**
Hand-grip (mean value, kg)	**−0.19 ± 0.02**	**<0.0001**	**−0.07 ± 0.03**	**0.005**
MMSE (score)	**−0.13 ± 0.03**	**<0.0001**	0.01 ± 0.03	0.81
N° medications	**0.75 ± 0.17**	**<0.0001**	0.14 ± 0.17	0.40

Footnotes: MNA-SF = Mini Nutritional Assessment Short Form; SPBB = Short Physical Performance Battery; MMSE = Mini Mental Status Examination.
Each line is referred to singular dependent variable.
In bold the relationships statistically significant (p < 0.05).
[a] age- and sex-adjusted values.

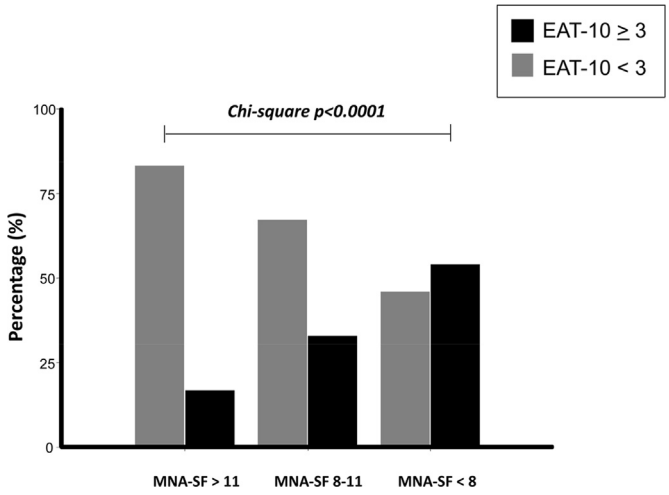

Fig. 1. Distribution of participants at risk of dysphagia using the EAT-10 score, according to the risk of malnutrition using the MNA-SF.

3.6. Independent predictors of risk of dysphagia

A logistic regression model was performed to identify potential variables able to predict the risk to dysphagia in our population. The analysis described MNA-SF, SPPB score and hand-grip strength (mean value) as independent predictors for EAT-10, with odds ratio of 0.91 (95% CI: 0.83–0.99, p = 0.03), 0.83 (95% CI: 0.77–0.89, p < 0.0001) and 0.96 (95% CI: 0.92–0.99, p = 0.02), respectively.

Table 3
Logistic Regression Multivariate model for risk of dysphagia.

	Odds Ratio (95% IC)	p
Sex	0.89 (0.55–1.45)	0.64
Age (years)	1.00 (0.97–1.04)	0.79
MNA-SF (score)	**0.91 (0.83–0.99)**	**0.03**
BMI (kg/m^2)	0.99 (0.95–1.03)	0.57
SPPB (score)	**0.83 (0.77–0.89)**	**<0.0001**
Hand-grip (mean value, kg)	**0.96 (0.92–0.99)**	**0.02**
MMSE (score)	1.01 (0.97–1.04)	0.68
N° medications	1.14 (0.92–1.43)	0.24

Footnotes: MNA-SF = Mini Nutritional Assessment Short Form; BMI = Body Mass Index; SPBB = Short Physical Performance Battery; MMSE = Mini Mental Status Examination.
In bold the relationships statistically significant (p < 0.05).

4. Discussion

The present study showed that about 62% of a large population of non-institutionalized older outpatients was at risk of malnutrition or malnourished, according to MNA-SF, and that about 30% was at risk of dysphagia, according to EAT-10 screening tool. Dysphagia was significantly and independently associated to malnutrition, as well as to physical outcomes such as SPPB and hand-grip strength, but not to cognitive status and number of medications.

The prevalence of risk of dysphagia in our study was 30.1%, in accordance with other studies conducted in other countries in the same setting [2,4,18–20]. In fact, risk of dysphagia is not only present in long-term facilities, which is an expected finding, but its prevalence is also higher in independently living older adults, with values ranging from 11% to 40% [2,4,19,20], and the highest prevalence was overall seen in older groups [4,18]. The large variability in term of prevalence rates may be explained in part by the different methods used to assess dysphagia.

Almost 50% of individuals were at risk of malnutrition and about 16% were malnourished, according by MNA-SF score. The prevalence was higher than that reported by a recent systematic review [21] conducted in an outpatient setting, where the prevalence of malnutrition, assessed by MNA tool, was about 31%, considering subjects at risk of malnutrition and 6% for real malnourished. The difference can be explained by considering the higher degree of cognitive impairment and physical frailty of subjects of our population. Furthermore, we used MNA-SF as first step of screening of malnutrition risk, according to ESPEN consensus [10], while Cereda et al. [21] performed full MNA,

Table 4
Relationship between EAT-10 and chair-stand and equilibrium tasks of SPPB (multivariate model).

	Model 2		Model 2	
	β ± SE	p	β ± SE	p
Sex	−0.31 ± 0.50	0.50	−0.60 ± 0.38	0.12
Age (years)	−0.06 ± 0.03	0.07	−0.06 ± 0.02	0.83
MNA-SF (score)	**−0.28 ± 0.09**	**0.001**	**−0.36 ± 0.07**	**<0.0001**
BMI (kg/m^2)	0.05 ± 0.04	0.20	0.05 ± 0.03	0.07
Hand-grip (mean value, kg)	**−0.09 ± 0.03**	**0.007**	**−0.11 ± 0.03**	**<0.0001**
MMSE (score)	−0.05 ± 0.04	0.22	−0.01 ± 0.03	0.70
N° medications	0.29 ± 0.21	0.16	0.28 ± 0.17	0.09
Chair-stand (score)	**−0.04 ± 0.02**	**0.02**		
Balance (score)			0.58 ± 0.40	0.15

Footnotes: MNA-SF = Mini Nutritional Assessment Short Form; MMSE = Mini Mental Status Examination; Chair-stand task of SPPB; Balance task of SPPB.
In bold the relationships statistically significant (p < 0.05).

which evaluates in depth nutritional status and can be considered as second step screening tool.

In the present study, the EAT-10 score was significantly and negatively associated to MNA-SF score. The number of patients at risk of dysphagia among different nutritional status groups was different, and it increased along with the worsening of nutritional status, with higher percentage of individuals at dysphagia risk in patients in the malnourished group. The association between the risk of dysphagia and malnutrition was independent from confounders and was confirmed by logistic regression, consistently with data from peer-reviewed literature [22–28]. However, to our knowledge, no study has previously investigated this relationship in a representative sample of European non-institutionalized older outpatients. Overall, previous findings support our results, and with the exception of Sakai and colleagues, the majority of studies focused on swallowing disturbances with malnutrition as a common sequela [29,30], or dysphagia as a prevalent risk factor for malnutrition [7,22,24,25,31]. We hypothesized dysphagia as the dependent variable, and malnutrition as one of the independent factors. Japanese researches pointed out the importance of malnutrition as independent risk for dysphagia, finding that EAT-10 score was independently associated with MNA-SF score, in acute hospital setting and community-dwelling [23]. Significant associations between swallowing problems, detected by EAT-10, and malnutrition risk, by means of MNA-SF, in older individuals at hospital admission were described by Chatindiara et al. [22] and Popman et al. [24], respectively. Similar to these findings, Sakai et al. [26] showed that dysphagia, defined as reduced of maximum tongue pressure (MTP), was independently associated with MNA-SF in a group of older inpatients of a rehabilitation hospital.

Another important result from the present study is the association between the risk of swallowing difficulties and low physical performance. We found a negative association between score of EAT-10 and the overall SPPB score in sex- and age-adjusted model. The relationship was independent of BMI, MNA-SF, MMSE and number of medications suggesting that the risk of dysphagia increased along with the loss of physical performance. Since SPPB is a battery of tests examining lower limb function (muscle strength and balance), we considered the subscores of chair-stand task as expression of muscle function, and balance task, as proxy of neurological function. We found an independent association between EAT-10 and the chair-stand time but not between EAT-10 and balance task.

Cerebrovascular disorders and severe neurological diseases may cause both dysphagia and physical function impairment. Dysphagia can cause nutrition-related sarcopenia, increasing the risk of adverse outcomes, such as physical frailty, disability, and death [23]. Given that EAT-10 was correlated to chair-stand test, but not to balance task, we may speculate that the muscle function, rather than the neurological task of physical frailty, is more closely associated with risk of dysphagia. Studies from literature described significant relationship between tongue strength or tongue pressure and grip strength [26,32–34], even in some cases the association was not independent [32]. However, a significant relationship between decline of swallowing function, by means of tongue strength, and overall SPPB or gait speed or chair rise time has not been described [32].

In this study EAT-10 score was significantly and negatively associated to cognitive status, but the relationship was not independent of other confounders, suggesting that cognitive function alone does not influence EAT-10. Yokota et al. [35] described MMSE as an independent predictor of dysphagia in patients with acute exacerbation of heart failure, and also the group of Chatindiara et al. [22] showed a significant association between EAT-10 and decline in cognition assessed by Montreal Cognitive Assessment (MoCA). Available literature demonstrates that dysphagia is a frequent comorbidity of dementia and other neurological diseases, such as Parkinson's Diseases [6]; however, subjects enrolled in the present study presented mild cognitive impairment, and those with neurological diseases diagnosis were at early stages. Furthermore, the score of balance task of SPPB was not significantly related to EAT-10, suggesting the involvement of muscle function rather than neurological function in determining dysphagia risk. Whether medications and comorbidities are well documented factors associated with malnutrition, evidences on impact of medications on the swallowing function is still scarce. In the present study, we considered polypharmacy as a covariate, finding a significant but not independent association between this parameter and EAT-10 at univariate model (age- and sex-adjusted).

The present study has strengths and potential implications in public health. According to our results, early detection of dysphagia risk should be a priority in healthcare systems because of its not-negligible prevalence among outpatient older adults, assessed and followed for not acute diseases. Risk of malnutrition, poor physical function and reduced muscle strength are possibly contributing factors to increased dysphagia risk. The percentage of free-living older outpatients at risk of dysphagia in a large and representative population ($n = 773$) was 30%. Furthermore, this peculiar setting is composed by individuals independently living who are neither institutionalized nor dependent in daily activities. Therefore, the present findings support the introduction of EAT-10 in clinical practice and in the CGA, as a screening method to detect early swallowing difficulties. The strength of EAT-10 is that it is self-administered (or easily administered by a caregiver for people with cognitive impairment) and rapid, and should be followed by proper assessment, when necessary. Moreover, given the relative short time required to perform the whole CGA, all these tests, including dysphagia, can be easily performed and adapted in all Geriatric Labs. To our knowledge, no specific relationship has been described between dysphagia and SPPB in aged population, but some studies showed a significant association between dysphagia and frailty measurements [22,32,36], or activities of daily living (ADL) [23].

Despite its strengths, the present study has some limitations. Diagnosis of sarcopenia was not performed and oral health was not considered as confounding variable. The study design was cross-sectional, thus it is not possible to draw conclusions about the nature of relationships between dysphagia and malnutrition and between dysphagia and physical function. Further studies, with longitudinal design, may elucidate the causal relationship and causality among these clinical conditions.

Conflicts of interest

There are no conflicts of interest.

References

[1] Rofes L, Arreola V, Romea M, Palomera E, Almirall J, Cabré M, et al. Pathophysiology of oropharyngeal dysphagia in the frail elderly. Neuro Gastroenterol Motil 2010;22(8). 851–e230, https://doi.org/10.1111/j.1365-2982.2010.01521.x.
[2] Baijens LW, Clave 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.
[3] Clave P, Terre R, de Kraa M, Serra M. Approaching oropharyngeal dysphagia. Rev Esp Enferm Dig 2004;96(2):119–31.
[4] Wirth R, Dziewas R, Beck AM, Clave P, Hamdy S, Heppner HJ, et al. Oropharyngeal dysphagia in older persons – from pathophysiology to adequate intervention: a review and summary of an international expert meeting. Clin Interv Aging 2016;11:189–208. https://doi.org/10.2147/CIA.S97481.
[5] Lin LC, Wu SC, Chen HS, Wang TG, Chen MY. Prevalence of impaired swallowing in institutionalized older people in Taiwan. J Am Geriatr Soc 2002;50(6):1118–23. https://doi.org/10.1046/j.1532-5415.2002.50270.x.
[6] Takizawa C, Gemmell E, Kenworthy J, Speyer R. A systematic review of the prevalence of oropharyngeal dysphagia in stroke, Parkinson's disease,

Alzheimer's disease, head injury, and pneumonia. Dysphagia 2016;31(3):434–41. https://doi.org/10.1007/s00455-016-9695-9.
[7] Carrion S, Cabre 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(3):436–42. https://doi.org/10.1016/j.clnu.2014.04.014.
[8] Vandewoude MF, Alish CJ, Sauer AC, Hegazi RA. Malnutrition-sarcopenia syndrome: is this the future of nutrition screening and assessment for older adults? J Aging Res 2012;2012:651570. https://doi.org/10.1155/2012/651570.
[9] Kaiser MJ, Bauer JM, Ramsch C, Uter W, Guigoz Y, Cederholm T, 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(9):782–8. https://doi.org/10.1007/s12603-009-0214-7.
[10] Cederholm T, Bosaeus I, Barazzoni R, Bauer J, Van Gossum A, Klek S, et al. Diagnostic criteria for malnutrition – an ESPEN consensus statement. Clin Nutr 2015;34(3):335–40. https://doi.org/10.1016/j.clnu.2015.03.001.
[11] Schindler A, Mozzanica F, Monzani A, Ceriani E, Atac M, Jukic-Peladic N, et al. Reliability and validity of the Italian eating assessment tool. Ann Otol Rhinol Laryngol 2013;122(11):717–24. https://doi.org/10.1177/000348941312201109.
[12] 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):919–24. https://doi.org/10.1177/000348940811701210.
[13] Arslan SS, Demir N, Kilinc HE, Karaduman AA. The ability of the eating assessment tool-10 to detect aspiration in patients with neurological disorders. J Neurogastroenterol Motil 2017;23(4):550–4. https://doi.org/10.5056/jnm16165.
[14] Lauretani FMM, Ticinesi A, Tana C, Prati B, Gionti L, Nouvenne A, et al. Muscle weakness, cognitive impairment and their interaction on altered balance in elderly outpatients. Results from the TRIP Observational Study. Clin Int Aging 2018;13:1437–43.
[15] Guralnik JM, Ferrucci L, Simonsick EM, Salive ME, Wallace RB. Lower-extremity function in persons over the age of 70 years as a predictor of subsequent disability. N Engl J Med 1995;332(9):556–61. https://doi.org/10.1056/nejm199503023320902.
[16] Folstein MF, Folstein SE, McHugh PR. "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res 1975;12(3):189–98.
[17] Gomes F, Schuetz P, Bounoure L, Austin P, Ballesteros-Pomar M, Cederholm T, et al. ESPEN guidelines on nutritional support for polymorbid internal medicine patients. Clin Nutr 2018;37(1):336–53. https://doi.org/10.1016/j.clnu.2017.06.025.
[18] Inui A, Takahashi I, Kurauchi S, Soma Y, Oyama T, Tamura Y, et al. Oral conditions and dysphagia in Japanese, community-dwelling middle- and older-aged adults, independent in daily living. Clin Interv Aging 2017;12:515–21. https://doi.org/10.2147/cia.s132637.
[19] Maeda K, Takaki M, Akagi J. Decreased skeletal muscle mass and risk factors of sarcopenic dysphagia: a prospective observational cohort study. J Gerontol A Biol Sci Med Sci 2017;72(9):1290–4. https://doi.org/10.1093/gerona/glw190.
[20] Clave P, Shaker R. Dysphagia: current reality and scope of the problem. Nat Rev Gastroenterol Hepatol 2015;12(5):259–70. https://doi.org/10.1038/nrgastro.2015.49.
[21] Cereda E, Pedrolli C, Klersy C, Bonardi C, Quarleri L, Cappello S, et al. Nutritional status in older persons according to healthcare setting: a systematic review and meta-analysis of prevalence data using MNA®. Clin Nutr 2016;35(6):1282–90. https://doi.org/10.1016/j.clnu.2016.03.008.
[22] Chatindiara I, Allen J, Popman A, Patel D, Richter M, Kruger M, et al. Dysphagia risk, low muscle strength and poor cognition predict malnutrition risk in older adults athospital admission. BMC Geriatr 2018;18(1):78. https://doi.org/10.1186/s12877-018-0771-x.
[23] Wakabayashi H. Presbyphagia and sarcopenic dysphagia: association between aging, sarcopenia, and deglutition disorders. J Frailty Aging 2014;3(2):97–103. https://doi.org/10.14283/jfa.2014.8.
[24] Popman A, Richter M, Allen J, Wham C. High nutrition risk is associated with higher risk of dysphagia in advanced age adults newly admitted to hospital. Nutr Diet 2018;75(1):52–8. https://doi.org/10.1111/1747-0080.12385.
[25] Saito T, Hayashi K, Nakazawa H, Yagihashi F, Oikawa LO, Ota T. A Significant association of malnutrition with dysphagia in acute patients. Dysphagia 2018;33(2):258–65. https://doi.org/10.1007/s00455-017-9855-6.
[26] Sakai K, Nakayama E, Tohara H, Maeda T, Sugimoto M, Takehisa T, et al. Tongue strength is associated with grip strength and nutritional status in older adult inpatients of a rehabilitation hospital. Dysphagia 2017;32(2):241–9. https://doi.org/10.1007/s00455-016-9751-5.
[27] Namasivayam AM, Steele CM. Malnutrition and dysphagia in long-term care: a systematic review. J Nutr Gerontol Geriatr 2015;34(1):1–21. https://doi.org/10.1080/21551197.2014.1002656.
[28] Takeuchi K, Aida J, Ito K, Furuta M, Yamashita Y, Osaka K. Nutritional status and dysphagia risk among community-dwelling frail older adults. J Nutr Health Aging 2014;18(4):352–7. https://doi.org/10.1007/s12603-014-0025-3.
[29] Hudson HM, Daubert CR, Mills RH. The interdependency of protein-energy malnutrition, aging, and dysphagia. Dysphagia 2000;15(1):31–8. https://doi.org/10.1007/s004559910007.
[30] Paterson WG. Dysphagia in the elderly. Can Fam Physician 1996;42:925–32.
[31] Serra-Prat M, Hinojosa G, Lopez D, Juan M, Fabre 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):186–7. https://doi.org/10.1111/j.1532-5415.2010.03227.x.
[32] Hathaway B, Vaezi A, Egloff AM, Smith L, Wasserman-Wincko T, Johnson JT. Frailty measurements and dysphagia in the outpatient setting. Ann Otol Rhinol Laryngol 2014;123(9):629–35. https://doi.org/10.1177/0003489414528669.
[33] 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.
[34] Butler S, Stuart A, Leng X, Wilhelm E, Rees C, Williamson J, et al. The relationship of aspiration status with tongue and handgrip strength in healthy older adults. J Gerontol A Biol Sci Med Sci 2011;66(4):452–8. https://doi.org/10.1093/gerona/glq234.
[35] Yokota J, Ogawa Y, Yamanaka S, Takahashi Y, Fujita H, Yamaguchi N, et al. Cognitive dysfunction and malnutrition are independent predictor of dysphagia in patients with acute exacerbation of congestive heart failure. PLoS One 2016;11(11), e0167326. https://doi.org/10.1371/journal.pone.0167326.
[36] Wakabayashi H, Matsushima M, Ichikawa H, Murayama S, Yoshida S, Kaneko M, et al. Occlusal support, dysphagia, malnutrition, and activities of daily living in aged individuals needing long-term care: a path analysis. J Nutr Health Aging 2018;22(1):53–8. https://doi.org/10.1007/s12603-017-0897-0.