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Probable sarcopenia, depressive symptoms, and nutritional status as independent predictors of dysphagia risk in community-dwelling older adults

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Abstract

Background Dysphagia is a critical geriatric syndrome associated with an increased risk of aspiration pneumonia, malnutrition, and mortality in older adults. The aim of this study was to evaluate the associations between Comprehensive Geriatric Assessment (CGA) parameters and dysphagia risk (EAT-10≥3) in community-dwelling older adults.

Methods This cross-sectional study included 468 community-dwelling older adults presenting to a geriatric outpatient clinic. Participants with severe cognitive impairment, Parkinson's disease, those residing in a nursing home, and those with an acute medical condition were excluded from the study. Dysphagia risk was assessed using the Eating Assessment Tool-10 (EAT-10); probable sarcopenia was defined according to the EWGSOP2 criteria; depressive symptoms were evaluated with the Geriatric Depression Scale-15 (GDS-15); and nutritional status was assessed using the Mini Nutritional Assessment–Short Form (MNA-SF). Independent risk factors were identified using multivariate logistic regression analysis.

Results In the final multivariate regression model, the presence of probable sarcopenia (OR = 2.654, 95% CI: 1.184–5.947, $p = 0.018$) and higher GDS-15 scores (OR = 1.155, 95% CI: 1.063–1.255, $p = 0.001$) were independently and significantly associated with dysphagia risk. In contrast, a one-point increase in the MNA-SF score (indicating better nutritional status), when treated as a continuous variable, was an independent protective factor against dysphagia risk (OR = 0.684, 95% CI: 0.521–0.897, $p = 0.006$).

Conclusions In community-dwelling older adults, probable sarcopenia and depressive symptoms significantly increase the dysphagia risk, whereas good nutritional status plays a protective role. Prior to the development of dysphagia and its associated complications, optimizing muscle strength, mood, and nutritional status in outpatient settings is of importance for maintaining swallowing safety.

Keywords Community-dwelling older adults · Dysphagia · Probable sarcopenia · Depression · Nutrition

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Introduction

The global demographic shift toward an aging population increasingly highlights the clinical significance of physiological and pathological processes associated with aging.[1] Morphological and neuromuscular changes in the stomatognathic system that occur with age directly affect the physiology of swallowing.[2] Dysphagia, now recognized as a significant geriatric syndrome, is defined as an impairment of the safe and effective passage of a food bolus from the oral cavity through the pharynx into the esophagus.[3] Swallowing difficulties in older adults, often perceived as an inevitable physiological consequence of aging and, therefore, potentially overlooked in clinical practice, lead to severe clinical complications such as dehydration, malnutrition, aspiration pneumonia, loss of functional independence, and increased mortality.[3–5].

Sarcopenia is a condition characterized by the progressive loss of skeletal muscle strength and mass that occurs with aging; it affects not only the locomotor system but also the muscle groups involved in chewing, breathing, and swallowing.[6–8] Loss of strength and mass in the oropharyngeal muscle groups responsible for swallowing (e.g., the tongue, geniohyoid, and pharyngeal muscles) is an independent risk factor for dysphagia.[7,9] There is a clear bidirectional interaction between dysphagia and sarcopenia: Difficulty swallowing restricts oral intake, thereby accelerating systemic muscle loss, while progressive muscle loss increases the severity of dysphagia by weakening the swallowing muscles.[8,9].

Nutritional status and mental health parameters are integral components of this complex pathophysiological network.[10] Malnutrition exacerbates the impairment of swallowing function by triggering catabolic processes and muscle protein breakdown.[11] Concurrently, the relationship between depressive symptoms and swallowing function is multifaceted. Loss of appetite, motor slowing, and changes in neural pathways that occur in the presence of depression can negatively affect the swallowing mechanism; conversely, the social isolation and reduced quality of life resulting from dysphagia can also exacerbate depressive symptoms.[2, 3, 10, 12] Furthermore, sarcopenia, malnutrition, and depression share common inflammatory and neuroendocrine mechanisms, creating an intertwined picture of frailty in older adults.[5, 7, 13, 14].

In the literature, researchers have frequently examined the relationships between dysphagia and sarcopenia, nutritional parameters, and mood in frail older adults residing in nursing homes or receiving inpatient care.[2, 7, 9, 12, 15, 16] However, data that evaluate, using a holistic approach, the relationship between dysphagia risk and sarcopenia, depressive symptoms, and nutritional status in community-dwelling older adults who appear functionally independent are quite limited. Identifying early-stage neuromuscular and nutritional changes in older adults during a reversible phase is critically important for planning preventive interventions.

The aim of this study was to assess the prevalence of dysphagia risk in community-dwelling older adults and identify its independent associations with probable sarcopenia, depressive symptoms, and nutritional status.

Materials and methods

Data collection and comprehensive geriatric assessment (CGA)

This cross-sectional study was conducted between January 2024 and January 2025. The study included adults aged 60 years and older residing in the Ankara, Altındag district who were able to visit the outpatient clinic independently or with minimal assistance. The reporting of this study conforms to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for cross-sectional studies (Additional file 1).

Patients aged 60 years or older who were mobile and provided informed consent, either personally or via a representative or relative, provided consent, were included in the study. Exclusion criteria included severe cognitive impairment preventing cooperation with questionnaires or physical tests; residence in a nursing home or long-term care facility; Parkinson's disease or Parkinson-plus syndromes; an acute medical condition; advanced

neuromuscular or physical disabilities precluding assessments of handgrip strength and physical performance; active malignancy; and conditions preventing reliable bioelectrical impedance analysis (BIA), such as cardiac pacemakers and severe or localized edema.

The sociodemographic characteristics (age, sex, education level), chronic diseases (hypertension, diabetes, coronary artery disease, chronic heart failure, cerebrovascular disease, chronic kidney disease, dementia), and the number of medications used by participants were recorded. Polypharmacy was defined as the use of 5 or more medications per day.[17].

Dysphagia risk and nutritional status

Participants' dysphagia risk was assessed using the Eating Assessment Tool-10 (EAT-10), a 10-item scale designed to evaluate symptoms of swallowing difficulty.[18] Each item is scored on a scale from 0 (no problem) to 4 (severe problem). A total EAT-10 score≥3 was classified as "Dysphagia Risk" among participants. Nutritional status was assessed using the Mini Nutritional Assessment-short form (MNA-SF), which has been validated in the geriatric population, with higher scores indicating better nutrition.[19].

Depressive symptoms, frailty, and functional status

Participants' mood and depressive symptoms were assessed using the Geriatric Depression Scale-15 (GDS-15).[20] Higher scores indicate increased levels of depressive symptoms. Frailty status was evaluated using the 5-item FRAIL scale(comprising Fatigue, Resistance, Ambulation, Illnesses, and Loss of Weight).[21] Physical activity was categorized into three groups based on weekly duration: inactive (0 min/week), minimally active (1–149 min/week), and ≥ 150active (≥150 min/week) [22]. Functional independence was determined using the Katz Index of Independence in Activities of Daily Living (ADL, 0–6 points)[23] and the Lawton-Brody Instrumental Activities of Daily Living Scale (IADL, 0–8 points).[24] Additionally, participants were evaluated for a history of falls over the past year. Unintentional weight loss was defined as a loss of ≥ 5% of total body weight over the past 6 months.

Sarcopenia components, muscle strength, and physical performance

Sarcopenia risk was initially screened using the 5-item SARC-F (Strength, Assistance in walking, Rise from a chair, Climb stairs, and Falls) questionnaire.[25] Sarcopenia parameters were evaluated in accordance with the European Working Group on Sarcopenia in Older People (EWGSOP2) criteria. [6]

Upper extremity muscle strength (handgrip strength (HGS)) was measured in kilograms using a digital hand dynamometer (Takei T.K.K. 5401 Grip-D, Takei Scientific Instruments Co., Ltd., Niigata, Japan). Measurements were performed with the patient seated, the elbow at 90 degrees of flexion, using the dominant hand; the highest value (kg) from three repetitions was included in the analysis. In accordance with the EWGSOP2 framework and using population-specific validated cutoff values for Turkish older adults, low muscle strength (probable sarcopenia) was defined as <14 kg for women and <28 kg for men.[26] Physical performance was assessed using a 4-meter walking speed test; a walking speed of <0.8 m/s was defined as slow.[6].

Anthropometric measurements and bioelectrical impedance analysis (BIA)

Body weight and height were measured using a medical-grade standing body composition scale (Tanita Corp., Tokyo, Japan), and BMI (kg/m²) was calculated from these measurements. Waist circumference was measured with a non-stretchable tape measure at the midpoint between the lowest rib and the iliac crest, and hip circumference was measured at the widest part of the buttocks. The waist-to-hip ratio was then calculated by dividing the waist circumference by the hip circumference.

Body composition and the phase angle, an indicator of cellular health and body cell mass, were measured using a multi-frequency BIA device (Bodystat QuadScan 4000, Bodystat Ltd., Isle of Man, UK). Measurements were performed in accordance with standard procedures, using electrodes placed on the right hand and right ankle after patients had rested supine for at least 15 min.

Based on the resistance () measured at 50 kHz by the Bodystat QuadScan 4000, total skeletal muscle mass (SMM, kg) was calculated using Janssen's equation:[]

(where height is in cm; R is BIA resistance at 50 kHz *in ohms; gender is* 0 *for females and* 1 *for males; and age is in years)* (Janssen et al., 2000). To adjust for body size, the Skeletal Muscle Mass Index (SMI, kg/m^2) was calculated as total skeletal muscle mass divided by height squared ($SMM/height^2$). Low muscle mass was defined using Turkish population-specific SMI cutoff values of $< 5.70\ kg/m^2$ for women and $< 8.33\ kg/m^2$ for men.[26].

Statistics

All statistical analyses were performed using SPSS (Statistical Package for the Social Sciences) version 25.0 (IBM Corp., Armonk, NY, USA). The normality of continuous variables was assessed using visual methods (histograms and Q-Q plots) and by examining the skewness and kurtosis coefficients. Continuous variables were presented as mean ± standard deviation (Mean ± SD) or median and interquartile range (Q1–Q3; 25th–75th percentiles), depending on their distribution characteristics. Categorical variables were expressed as frequencies and percentages [n (%)]. For comparisons between the groups with and without dysphagia risk (defined as EAT-10 ≥ 3 and EAT-10 < 3, respectively), an independent-samples t-test was used to analyze continuous variables that were normally distributed (e.g., age, body mass index, grip strength). The Mann-Whitney U test was used to compare continuous variables and scale scores (e.g., GDS-15, MNA-SF, FRAIL, SARC-F, KATZ, Lawton, Charlson Comorbidity Index) that did not follow a normal distribution.

Differences in proportions between groups for categorical variables (e.g., sex, education level, probable sarcopenia, risk of falling, comorbidities) were examined using the chi-square test or Fisher's exact test.

Spearman's rank correlation was used to evaluate bivariate relationships between the EAT-10 score and the Comprehensive Geriatric Assessment (CGA) scales (GDS-15, MNA-SF, FRAIL), as well as HGS. Because HGS may be influenced by sex, a sex-adjusted partial correlation analysis was applied to examine the independent relationship between the EAT-10 score and HGS.

Multivariate backward stepwise logistic regression was used to identify independent predictors of dysphagia risk. The following covariates, which showed statistical significance or clinical trends in univariate analyses (age, sex, education level, risk of falling, dementia, FRAIL Score, MNA-SF Score, GDS-15 Score, and probable sarcopenia), were included in the initial model (Step 1). The model's goodness-of-fit was assessed, and the odds ratios (ORs) with 95% confidence intervals (95% CIs) for the remaining variables in the final model (Step 7) were reported.

Two-tailed p-values were calculated for all statistical analyses, and values of $p < 0.05$ were considered statistically significant.

Results

Of the 781 older adults initially assessed for eligibility, 132 were excluded based on clinical criteria and 181 due to incomplete assessments, resulting in 468 participants included in the final analysis (Fig. 1). The distribution of demographic, clinical, and CGA parameters of the study participants by dysphagia risk (EAT-10 ≥ 3) is presented in Table 1. No statistically significant differences were found between the groups with dysphagia risk ($n = 37$) and without dysphagia risk ($n = 431$) in terms of age (68.57 ± 6.14 years vs. 67.87 ± 5.74 years; $p = 0.479$) and sex

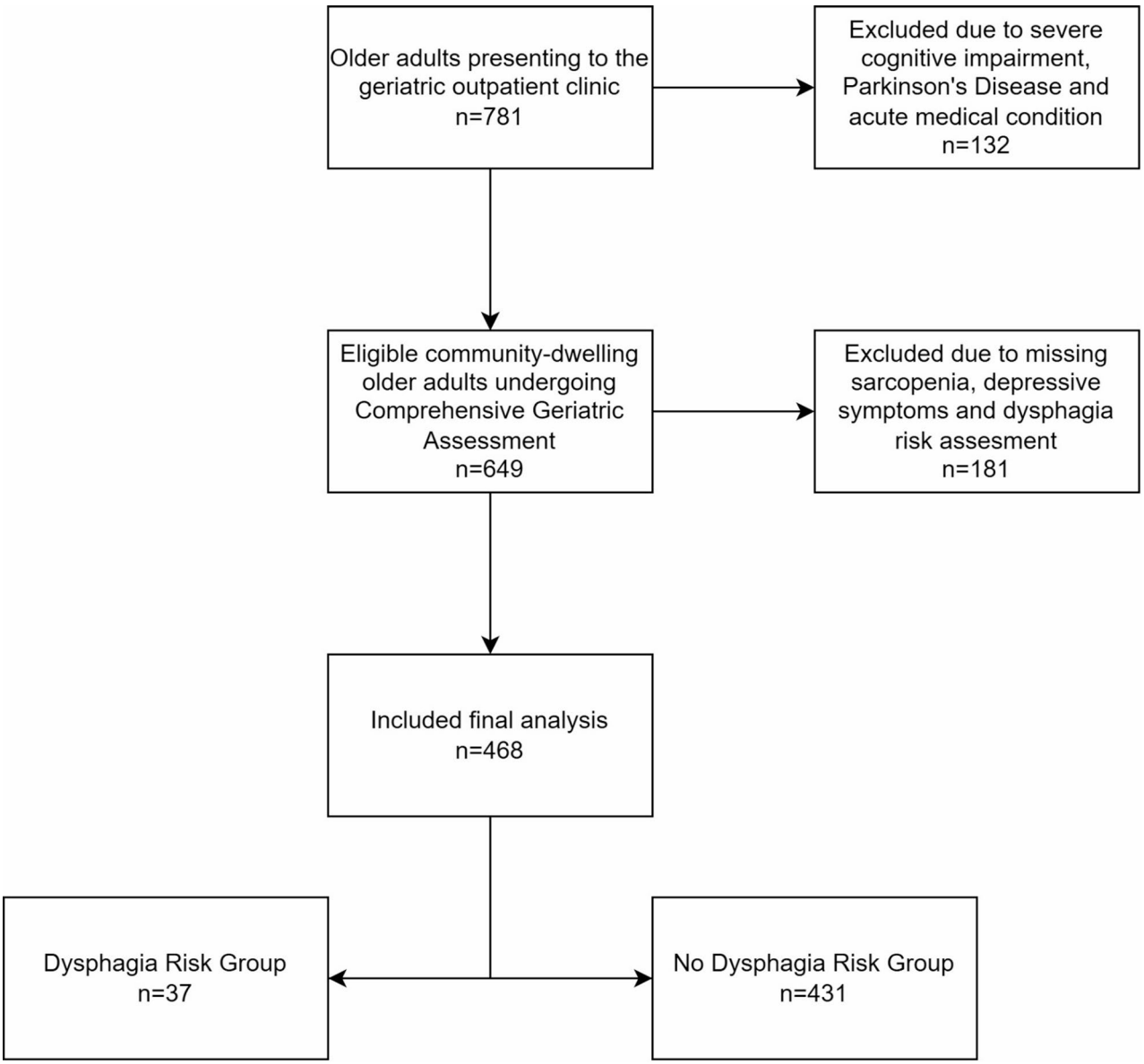

Fig. 1 STROBE flow diagram of participants

(male: 40.5% vs. female: 35.7%; $p=0.559$). The percentage of participants with at least a middle school education was significantly lower in the dysphagia risk group (16.2% vs. 33.4%; $p=0.032$).

When CGA parameters were examined, the median GDS-15 score in the group at risk for dysphagia was [3.00 (1.00–5.00) vs. 1.00 (0.00–3.00); $p<0.001$], the FRAIL score [1.00 (0.00–2.00) vs. 0.00 (0.00–1.00); $p<0.001$], and the SARC-F score [1.00 (0.00–4.00) vs. 0.00 (0.00–1.00); $p=0.001$] were found to be significantly higher; the MNA-SF score [13.00 (12.00–14.00) vs. 14.00 (13.00–14.00); $p<0.001$] and BMI (29.06±4.61 kg/m² vs. 31.18±5.64 kg/m²; $p=0.027$) were found to be significantly lower. Regarding clinical and functional parameters, the presence of probable sarcopenia (35.1% vs. 16.2%; $p=0.004$), the risk of falls (74.3% vs. 56.5%; $p=0.040$), and the diagnosis of dementia (11.4% vs. 3.0%; $p=0.032$) were observed at a significantly higher frequency in the dysphagia risk group.

The results of the correlation analysis between the EAT-10 score and the CGA parameters and grip strength are presented in Table 2. Positive correlations were observed between the EAT-10 score and the GDS-15 score (r_s =

Table 1 Comparison of demographic, clinical, and comprehensive geriatric assessment (CGA) characteristics between older adults with and without dysphagia risk

Variable	Total Sample	No Dysphagia Risk ($n=431$)	Dysphagia Risk ($n=37$)	Test Method	p
Demographic Characteristics					
Age (years), Mean ± SD	67.92 ± 5.76	67.87 ± 5.74	68.57 ± 6.14	t-test	0.479
Sex (Male), n (%)	169 (36.1)	154 (35.7)	15 (40.5)	Chi-Square	0.559
Education (Middle School or Higher), n (%)	148 (32.0)	142 (33.4)	6 (16.2)	Chi-Square	**0.032***
Comprehensive Geriatric Assessment (CGA) and Nutrition					
KATZ ADL Score, Median (Q1–Q3)	6.00 (5.00–6.00)	6.00 (5.00–6.00)	6.00 (5.00–6.00)	Mann-Whitney U	0.106
Lawton IADL Score, Median (Q1–Q3)	8.00 (8.00–8.00)	8.00 (8.00–8.00)	8.00 (8.00–8.00)	Mann-Whitney U	0.132
GDS-15 Score, Median (Q1–Q3)	—	1.00 (0.00–3.00)	3.00 (1.00–5.00)	Mann-Whitney U	**< 0.001***
MNA-SF Score, Median (Q1–Q3)	14.00 (13.00–14.00)	14.00 (13.00–14.00)	13.00 (12.00–14.00)	Mann-Whitney U	**< 0.001***
FRAIL Score, Median (Q1–Q3)	0.00 (0.00–1.00)	0.00 (0.00–1.00)	1.00 (0.00–2.00)	Mann-Whitney U	**< 0.001***
SARC-F Score, Median (Q1–Q3)	0.00 (0.00–1.00)	0.00 (0.00–1.00)	1.00 (0.00–4.00)	Mann-Whitney U	**0.001***
Probable Sarcopenia, n (%)	83 (17.7)	70 (16.2)	13 (35.1)	Chi-Square	**0.004***
Low Muscle Mass, n (%)	12 (2.6)	11 (2.6)	1 (2.7)	Fisher's Exact	1.000
Handgrip Strength (HGS, kg), Mean ± SD	24.20 ± 8.04	24.36 ± 8.07	22.30 ± 7.58	t-test	0.135
Slow Gait Speed (< 0.8 m/s), n (%)	238 (50.9)	219 (50.8)	19 (51.4)	Chi-Square	0.950
Weight Loss in Past 6 Months, n (%)	70 (15.3)	61 (14.5)	9 (25.0)	Chi-Square	0.091
Fall Risk, n (%)	266 (57.8)	240 (56.5)	26 (74.3)	Chi-Square	**0.040***
Physical Activity Level, n (%)				Chi-Square	0.329
– Inactive	85 (20.0)	74 (19.0)	11 (31.4)		
– Minimally Active	188 (44.3)	176 (45.2)	12 (34.3)		
– Active	150 (35.4)	138 (35.5)	12 (34.3)		
Anthropometric and Bioelectrical Impedance (BIA) Parameters					
Body Mass Index (BMI, kg/m²), Mean ± SD	31.01 ± 5.58	31.18 ± 5.64	29.06 ± 4.61	t-test	**0.027***
Waist-to-Hip Ratio, Median (Q1–Q3)	0.91 (0.86–0.98)	0.91 (0.86–0.97)	0.93 (0.88–0.99)	Mann-Whitney U	0.338
Phase Angle (°), Median (Q1–Q3)	6.40 (5.60–7.20)	6.40 (5.60–7.20)	6.20 (5.75–7.35)	Mann-Whitney U	0.848
Comorbidities					
Charlson Comorbidity Index (CCI), Median (Q1–Q3)	3.00 (2.00–4.00)	3.00 (2.00–4.00)	3.00 (2.00–4.00)	Mann-Whitney U	0.702
Polypharmacy, n (%)	48 (13.3)	44 (13.3)	4 (13.3)	Fisher's Exact	1.000
Diabetes Mellitus (DM), n (%)	134 (29.1)	128 (30.1)	6 (17.1)	Chi-Square	0.104
Hypertension (HT), n (%)	259 (56.3)	238 (56.0)	21 (60.0)	Chi-Square	0.647
Coronary Artery Disease (CAD), n (%)	75 (16.3)	66 (15.5)	9 (25.0)	Chi-Square	0.139
Chronic Heart Failure (CHF), n (%)	9 (2.0)	7 (1.6)	2 (5.7)	Fisher's Exact	0.145
Dementia, n (%)	17 (3.7)	13 (3.0)	4 (11.4)	Fisher's Exact	**0.032***
Cerebrovascular Disease (CVD), n (%)	9 (2.0)	7 (1.6)	2 (5.7)	Fisher's Exact	0.145
Chronic Kidney Disease (CKD), n (%)	6 (1.3)	4 (0.9)	2 (5.7)	Fisher's Exact	0.070

* Statistical significance at $p < 0.05$. SD: Standard Deviation, Q1–Q3: Interquartile Range(25th–75th percentiles), CGA: Comprehensive Geriatric Assessment, GDS-15: Geriatric Depression Scale-15, MNA-sf: Mini Nutritional Assessment-short form, HGS: Handgrip Strength, BMI: Body Mass Index, BIA: Bioelectrical Impedance Analysis, ADL: Activities of Daily Living, IADL: Instrumental Activities of Daily Living, CCI: Charlson Comorbidity Index

**Percentages represent valid percentages calculated after excluding missing data for individual variables

Table 2 Correlation analysis of EAT-10 score with comprehensive geriatric assessment scales and handgrip strength

Variable	Spearman Correlation (r_s)	*p*
GDS-15 Score	0.230	**< 0.001****
MNA-SF Score	-0.162	**0.001****
FRAIL Score	0.198	**< 0.001****
Handgrip Strength (HGS, kg)	-0.123	**0.008****

* EAT-10: Eating Assessment Tool-10; GDS-15: Geriatric Depression Scale-15; MNA-SF: Mini Nutritional Assessment-short form; HGS: Handgrip Strength

A partial correlation analysis was additionally conducted for Handgrip Strength (HGS) to adjust for potential confounding by biological sex. The inverse correlation between EAT-10 score and HGS persisted and remained statistically significant after adjusting for sex (rpartial = -0.113, $p = 0.014$)

Table 3 Multivariate backward stepwise logistic regression analysis for predictors of dysphagia risk(EAT-10≥3)

Variable	B	S.E.	Wald	*p*	Odds Ratio (OR)	95% C.I.
Initial Model (Step 1)						
Age (years)	-0.062	0.043	2.117	0.146	0.940	0.865–1.022
Sex (Male)	0.674	0.461	2.144	0.143	1.963	0.796–4.841
Education (Middle School or Higher)	-0.582	0.550	1.118	0.290	0.559	0.190–1.643
Fall Risk	0.567	0.500	1.286	0.257	1.764	0.662–4.701
Dementia	1.072	0.700	2.346	0.126	2.923	0.741–11.529
FRAIL Score	0.307	0.178	2.992	0.084	1.360	0.960–1.926
MNA-SF Score	-0.305	0.151	4.066	0.044*	0.737	0.548–0.992
GDS-15 Score	0.121	0.047	6.604	0.010*	1.129	1.029–1.239
Probable Sarcopenia	0.857	0.467	3.363	0.067	2.356	0.943–5.890
Final Model (Step 7)						
GDS-15 Score	**0.144**	**0.042**	**11.564**	**0.001***	**1.155**	**1.063–1.255**
MNA-SF Score	**-0.380**	**0.139**	**7.528**	**0.006***	**0.684**	**0.521–0.897**
Probable Sarcopenia	**0.976**	**0.412**	**5.622**	**0.018***	**2.654**	**1.184–5.947**

* Statistical significance at $p < 0.05$. Dependent variable: Dysphagia risk(EAT-10≥3).Model covariates adjusted in Step 1: Age, sex, education level, fall risk, dementia, FRAIL score, MNA-SF score, GDS-15 score, and probable sarcopenia. OR: Odds Ratio; C.I.: Confidence Interval; S.E.: Standard Error; GDS-15: Geriatric Depression Scale-15; MNA-SF: Mini Nutritional Assessment-short form

0.230, $p < 0.001$) and the FRAIL score ($r_s = 0.198$, $p < 0.001$); while negative, statistically significant correlations were found between the MNA-SF score ($r_s = -0.162$, $p = 0.001$) and HGS ($r_s = -0.123$, $p = 0.008$). In the partial correlation analysis of HGS by sex, the negative relationship between the EAT-10 score and HGS remained significant ($r_{partial} = -0.113$, $p = 0.014$).

Table 3 presents the results of the multivariable backward stepwise logistic regression analysis identifying independent predictors of dysphagia risk. The initial model included the following variables: age, sex, education level, risk of falling, dementia, FRAIL score, MNA-SF score, GDS-15 score, and probable sarcopenia. In the final model reached after the backward elimination steps (Step 7), a higher GDS-15 score (OR = 1.15, 95% CI: 1.063–1.255, $p = 0.001$) and the presence of probable sarcopenia (OR = 2.654, 95% CI: 1.184–5.947, $p = 0.018$) were identified as independent risk factors for dysphagia risk. A high MNA-SF score, on the other hand, was identified as an independent protective factor against dysphagia risk (OR = 0.684, 95% CI: 0.521–0.897, $p = 0.006$).

Discussion

In this study, the relationships between CGA parameters and dysphagia risk in community-dwelling older adults were examined. Our main findings indicate that probable sarcopenia and higher GDS-15 scores are independently and significantly associated with dysphagia risk. In contrast, a higher MNA-SF score, indicating better nutritional status, was independently associated with a reduced dysphagia risk.

From the perspective of the muscle–swallowing axis, sarcopenia directly affects not only skeletal muscles but also oropharyngeal muscle groups (including the tongue and suprahyoid muscles) as well as structures such as the pharynx and esophagus, which play critical roles in swallowing physiology.[11, 28] A decrease in HGS, termed probable sarcopenia, reliably reflects systemic loss of muscle strength.[6] Losses of tongue thrust force and pharyngeal constrictor muscle strength, which constitute the fundamental motor power of swallowing, impair control of the food bolus during the oral phase and delay the swallowing reflex, thereby increasing the risk of dysphagia. This clinical condition, described in the literature as "sarcopenic dysphagia," indicates that swallowing function may be impaired in older adults even before significant muscle mass loss develops (during the probable sarcopenia stage).[7] Our findings support that loss of muscle strength, assessed by HGS, is a crucial clinical indicator for early detection of dysphagia risk, even among community-dwelling older adults who appear functionally independent.

The finding in our study that the prevalence of probable sarcopenia was significantly higher than that of low muscle mass is consistent with the literature, which reports that the initial loss during aging occurs in muscle strength rather than muscle mass.[29] Indeed, this early decline in muscle strength stems more from qualitative factors, such as motor unit loss and impaired neural activation, than from mass loss.[30] Since the act of swallowing also requires precise neuromuscular coordination and muscle contraction, the reduction in HGS may reflect a parallel functional decline in the oropharyngeal muscles, thereby explaining the independent association between probable sarcopenia and dysphagia risk.

Another noteworthy finding of our study was that high GDS-15 scores were independently associated with dysphagia risk. This relationship between depressive symptoms and swallowing function can be explained by both neurobiological and behavioral mechanisms. Psychomotor slowing, frequently observed in mood disorders, can delay the oral and pharyngeal phases of the swallowing reflex, which require motor planning and coordination.[2] Furthermore, anhedonia, loss of appetite, and loss of motivation, which arise in depression, negatively affect patients' eating behavior.[31] A bidirectional relationship exists between these two clinical conditions. Difficulty eating due to dysphagia can lead to avoidance of eating in social settings and to social isolation, thereby exacerbating depressive symptoms.[2] Conversely, high depression scores may increase the risk of dysphagia by impairing muscle quality and neuromuscular transmission through shared neuroendocrine and inflammatory pathways.[14, 32, 33] Our findings demonstrate that mood assessment in older adults seeking outpatient care is an integral component of assessments of both mental health and swallowing safety.

In our study, higher MNA-SF scores, reflecting better nutritional status, were inversely associated with dysphagia risk. Malnutrition, or risk thereof, triggers catabolic processes, leading to systemic protein breakdown and negative nitrogen balance.[7, 13] This condition reduces the motor strength and endurance of the swallowing mechanism by accelerating the loss of fast-twitch (Type II) muscle fibers, particularly in the oropharyngeal region.[8] Generalized muscle weakness and muscle atrophy resulting from inadequate nutrition reduce the effectiveness of the swallowing reflex and increase the risk of aspiration.[34] In our study, including the MNA-SF score as a continuous rather than a categorical variable in the analysis demonstrated that even a 1-point increase in the score was associated with a significantly decreased dysphagia risk. This finding highlights the critical importance of identifying and supporting older adults not only when they develop malnutrition but also when they experience subclinical nutritional insufficiency to preserve swallowing function. Optimizing nutritional status can serve as a significant protective barrier against the development of dysphagia by maintaining swallowing muscle mass and function.

It must be strongly emphasized that nutritional status, depressive symptoms, and probable sarcopenia do not act independently but rather, as parts of a shared pathophysiological cycle, directly influence one another.[7] Malnutrition and depression are mutually reinforcing through reduced food intake, micronutrient deficiencies, and disruptions in neurotransmitter synthesis.[10] While malnutrition accelerates probable sarcopenia, probable sarcopenia and depression negatively affect each other through systemic inflammation, oxidative stress, and neuroendocrine dysfunction.[35] This close interaction among CGA parameters indicates that the development of

dysphagia in community-dwelling older adults reflects a holistic geriatric frailty syndrome rather than a single, isolated cause.[36, 37].

These findings provide actionable insights for daily clinical practice in primary care and outpatient geriatric settings. Our results highlight the potential value of integrating routine CGA-based screening that specifically evaluates muscle strength, depressive symptoms, and nutritional status into outpatient assessment, rather than reserving dysphagia screening solely for institutionalized, frail, or hospitalized older adults. Identifying early neuromuscular, mood, and nutritional vulnerabilities in community-dwelling older adults may provide a valuable window of opportunity for preventive interventions before overt dysphagia and its associated complications develop.

This study has several notable strengths. A major strength lies in its focus on community-dwelling, ambulatory older adults, a population far less frequently evaluated in dysphagia research than institutionalized or hospitalized cohorts. Highlighting these relationships in a functionally independent population provides a key clinical window for preventive strategies during a reversible phase before irreversible functional decline ensues. Furthermore, the comprehensive evaluation of nutritional status, muscle strength, and mood parameters using validated, standardized CGA tools enhances the rigor and reliability of our data.

However, our study has some limitations. First, because the study employed a cross-sectional design, causality cannot be established between the variables examined and the risk of dysphagia. In addition, the presence of dysphagia risk was assessed using a validated screening scale, such as the EAT-10, rather than by objective, invasive, gold-standard methods, such as videofluoroscopy or fiberoptic endoscopic evaluation. Furthermore, the relatively small number of participants with dysphagia risk and the resulting group imbalance represent a notable limitation that may reduce statistical power. Finally, the single-center design may limit the generalizability of our findings to broader populations of older adults. Future large-scale prospective studies are needed to clarify causal relationships and changes over time among these variables.

Conclusions

Probable sarcopenia and higher depressive symptoms are independently associated with dysphagia risk in community-dwelling older adults, whereas better nutritional status is associated with a reduced risk. These findings suggest that swallowing function is closely linked to physical, mood, and nutritional health, even in functionally independent individuals. In outpatient older adults, routine CGA may provide a comprehensive framework to address interconnected muscle, mood, and nutritional risks, potentially offering a critical window for early intervention to maintain swallowing safety.

Abbreviations

ADL	Activities of Daily Living
BIA	Bioelectrical Impedance Analysis
BMI	Body Mass Index
CAD	Coronary Artery Disease
CCI	Charlson Comorbidity Index
CGA	Comprehensive Geriatric Assessment
CHF	Chronic Heart Failure
CI	Confidence Interval
CKD	Chronic Kidney Disease
CVD	Cerebrovascular Disease
DM	Diabetes Mellitus
EAT-10	Eating Assessment Tool-10

EWGSOP2	European Working Group on Sarcopenia in Older People 2
FRAIL	Fatigue, Resistance, Ambulation, Illness, and Loss of Weight Scale
GDS-15	Geriatric Depression Scale-15
HGS	Handgrip Strength
HT	Hypertension
IADL	Instrumental Activities of Daily Living
MNA-SF	Mini Nutritional Assessment-Short Form
OR	Odds Ratio
R	Resistance
SARC-F	Strength, Assistance with walking, Rise from a chair, Climb stairs, and Falls Scale
SD	Standard Deviation
SMM	Skeletal Muscle Mass
SMI	Skeletal Muscle Mass Index

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Declarations

Ethics, Consent to Participate, and Consent to Publish declarations This study was approved by the Ethics Committee of Ankara University Faculty of Medicine (Date: November 21, 2024; Decision No: 10-785-24). The study was conducted in accordance with the Declaration of Helsinki.

Consent for publication Written informed consent was obtained from all participants or their legal representatives prior to inclusion in the study.

Competing interests The authors declare no competing interests

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