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Symptom Profiles and Prediction of Dysphagia Among Older Nursing Home Residents: A Cross-Sectional Study

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Title: Symptom Profiles and Prediction of Dysphagia Among Older Nursing Home Residents: A Cross-Sectional Study

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Abstract

Background: Dysphagia is common among older nursing home residents and may impair daily functioning and quality of life. This study examined its prevalence, symptom profiles, and associated factors and developed a prediction nomogram based on routinely available clinical characteristics.

Methods: This cross-sectional study included 293 nursing home residents aged ≥60 years, assessed between January 2024 and June 2026. Data were collected using a general information questionnaire, a dysphagia symptom questionnaire, the Standardized Swallowing Assessment (SSA), and the Quality of Life Index (QLI). A multivariable logistic regression model included age, sex, BMI, frailty score, stroke history, Parkinson's disease, and Alzheimer's disease and was presented as a nomogram. Missing age and BMI values were handled using multiple imputation. Discrimination, calibration, and decision curve analysis were used to evaluate model performance. Bootstrap validation used 500 resamples within each imputed dataset, and a complete-case sensitivity analysis examined the consistency of the associations.

Results: Dysphagia was identified in 114 residents (38.91%; 95% CI: 33.50%–44.60%). Among residents with dysphagia, severe symptoms were most frequent in the oral-phase (71.05%) and pharyngeal-phase (46.49%) domains. Dysphagia was associated with older age (adjusted OR per year, 1.039; 95% CI: 1.005–1.075), lower BMI (adjusted OR per kg/m² increase, 0.925; 95% CI: 0.856–0.999), and higher frailty scores (adjusted OR per point,

2.142; 95% CI: 1.659–2.765). The apparent AUC was 0.780 (95% CI: 0.720–0.830), and the optimism-corrected AUC was 0.758. The corrected calibration intercept and slope were 0.012 and 0.882, respectively. Decision curve analysis suggested potential net benefit. Residents with dysphagia had lower QLI total scores and lower scores for activity, daily living, and health (P<0.001). The principal associations were consistent in the complete-case analysis.

Conclusions: Dysphagia affected nearly four in ten nursing home residents and was associated with older age, lower BMI, greater frailty, and poorer quality of life. The nomogram may support prioritization of further swallowing assessment.

Trial registration: Not applicable. The authors wish to clarify that the study design is cross-sectional, with data collected and analyzed at a single point in time.

Keywords: Dysphagia; Nursing homes; Older adults; Frailty; Prediction model; Quality of life.

1 Introduction

Oropharyngeal dysphagia is recognized as a geriatric syndrome that compromises the safety and efficiency of oral intake and is associated with malnutrition, dehydration, aspiration pneumonia, and poorer quality of life[1,2]. It also affects how older adults experience everyday meals. A qualitative study of nursing home residents described fear of eating, changes in eating and swallowing habits, and reliance on assistance[3]. Systematic reviews have reported substantial variation in dysphagia prevalence across residential aged care settings[4,5]. A 2024 review identified differences in assessment methods and limited evidence for specific resident subgroups[4]. These gaps warrant closer examination of how common dysphagia is and how its symptoms present in defined nursing home populations.

Identifying residents with dysphagia remains difficult when assessment practices differ between facilities and access to videofluoroscopy or fiberoptic endoscopic evaluation of swallowing is limited[6,7]. A recent survey of residential long-term care settings also documented variation in screening, referral, and management practices[8]. Symptom questionnaires and bedside examinations remain central to assessment. Routinely collected demographic and clinical information may complement these tools by helping staff identify residents who need further evaluation. A prediction model can combine this information into an individual probability estimate, but its usefulness must be evaluated in the population and care setting where it will be used.

Previous studies have developed dysphagia prediction models for community-dwelling older adults and patients with stroke by combining demographic, functional, and clinical characteristics[9,10]. Their applicability to nursing home residents may be affected by differences in health profiles, care needs, and the availability of predictor data. Model evaluation guidance therefore recommends assessing performance in the intended population before applying a model in another setting[11]. For nursing homes, routinely collected information on age, sex, BMI, frailty, and neurological disease history offers a practical basis for developing and evaluating a dysphagia prediction model. Recent methodological guidance also emphasizes selecting predictors available in practice and evaluating model discrimination, calibration, and clinical usefulness. Internal validation is an important component of this process, allowing optimism in model performance to be assessed before further evaluation[12].

Accordingly, this cross-sectional study included 293 older nursing-home residents and aimed

to describe the prevalence and domain-specific symptom profiles of dysphagia. We further sought to develop and internally validate a prediction model incorporating routinely available demographic and clinical characteristics. Quality of life was assessed using the Quality of Life Index (QLI), and total and domain scores were compared between residents with and without dysphagia. By combining symptom characterization, individual probability estimation, and quality-of-life assessment, this study aimed to provide evidence to inform the identification and assessment of dysphagia among older adults in nursing homes.

2 Methods

2.1 Study design and participants

A cross-sectional study was conducted among older adults residing in nursing homes from January 2024 to June 2026. Participating institutions were selected from nursing homes registered with the local civil affairs authority and rated at level II or above. Residents were eligible if they were aged ≥60 years, were conscious and able to communicate, and could understand and complete the questionnaires and swallowing assessments. Residents were excluded if they declined to participate or had cognitive, psychological, psychiatric, or other impairments that prevented participation. The minimum sample size was estimated using the formula for a single population proportion:

$$n = \frac{Z^2_{1-\alpha/2}p(1-p)}{d^2}$$

, where $p = 0.13$, $d = 0.04$, and $\alpha = 0.05$, yielding a minimum requirement of 272 participants. Approximately 300 participants were targeted. Of the 300 records collected, four were excluded because residents were aged <60 years, two were duplicates, and one lacked dysphagia outcome data. The final analysis included 293 participants.

2.2 Data collection

Trained investigators collected data through individual interviews and clinical assessments. A structured questionnaire recorded demographic characteristics, height, weight, and medical history, including stroke, Parkinson's disease, and Alzheimer's disease. BMI was calculated by dividing weight in kilograms by height in meters squared. Standardized instruments were used to assess swallowing function, frailty, and quality of life. Completed forms were reviewed weekly before data entry.

2.3 Assessment instruments and outcome definition

2.3.1 Dysphagia assessment

Dysphagia was assessed using the Chinese version of the Ohkuma questionnaire, which contains 15 items covering five domains: complications, pharyngeal function, oral function, esophageal function, and airway protection[13]. Responses are classified as severe, mild, or no symptoms. Participants reporting at least one severe symptom, corresponding to a grade A response, were classified as having dysphagia; those reporting only mild or no symptoms were classified as not having dysphagia. For domain-specific analyses, severe symptoms were considered present when at least one item within the corresponding domain received a grade A response. Multiple domains could be affected in the same participant.

2.3.2 Frailty assessment

Frailty was assessed using the Chinese version of the Fried frailty phenotype, comprising unintentional weight loss, exhaustion, low physical activity, slow walking speed, and reduced grip strength. Each criterion was scored as 1 if present and 0 if absent, yielding a total score of 0–5. Participants were classified as non-frail, pre-frail, or frail according to scores of 0, 1–2, or 3–5, respectively[14]. The total score was entered as a continuous predictor in the regression models.

2.3.3 Standardized Swallowing Assessment

The Standardized Swallowing Assessment (SSA) was administered by trained speech therapists[15]. The assessment comprised an initial clinical examination, three 5-mL water-swallowing trials, and a 60-mL water-swallowing assessment. Higher total scores indicate poorer swallowing function. SSA total scores were used to compare swallowing function between the dysphagia and non-dysphagia groups and to examine associations with Ohkuma findings.

2.3.4 Quality-of-life assessment

Quality of life was assessed using the Quality of Life Index (QLI). The instrument comprises five items, each scored from 0 to 2, yielding a total score of 0–10, with higher scores indicating better quality of life[16]. Total and domain scores were compared between participants with and without dysphagia.

2.4 Data management and missing data

Participants with missing dysphagia outcome data were excluded. Among the remaining participants, age and BMI were missing for four and ten residents, respectively. Under a missing-at-random assumption, these values were handled using multiple imputation by chained equations with predictive mean matching. Five imputed datasets were generated using five candidate donors and 100 iterations per chain. The imputation model included age, BMI, sex, frailty score, history of stroke, Parkinson's disease, Alzheimer's disease, and dysphagia status. Imputation traces and observed versus imputed distributions were examined.

Descriptive and subgroup analyses used available observed data. For quality-of-life comparisons, three records with missing original domain scores and unverified zero total scores were treated as missing. Available SSA total scores were retained for two participants with incomplete component scores.

2.5 Statistical analysis

Continuous variables were expressed as mean ± standard deviation or median (Q1, Q3), and categorical variables as n (%). Between-group comparisons used Welch's t test, the Mann–Whitney U test, Pearson's chi-square test, or Fisher's exact test, as appropriate. Dysphagia prevalence was reported with Wilson 95% confidence intervals and compared across sex, age, BMI, and frailty categories. Holm adjustment was applied to comparisons of QLI total and domain scores.

Spearman's rank correlation was used to examine associations of SSA total scores with dysphagia status (absent = 0; present = 1) and the number of severe symptoms. The 95% confidence interval for the correlation between dysphagia status and SSA total score was estimated using 5,000 bootstrap resamples. ROC analysis assessed the ability of SSA total scores to distinguish the dysphagia status, with the AUC confidence interval calculated using the DeLong method. These analyses used available paired observations without imputation of SSA scores.

Univariable logistic regression was followed by a multivariable model incorporating all seven candidate predictors: age, sex, BMI, frailty score, history of stroke, Parkinson's disease, and Alzheimer's disease. Estimates from the five imputed datasets were pooled using Rubin's rules and expressed as odds ratios with 95% confidence intervals. Multicollinearity and

potential nonlinear associations were examined before presenting the final model as a nomogram. Performance was evaluated using AUC, calibration plots, the calibration intercept and slope, and the Brier score. Internal validation involved 500 bootstrap resamples within each imputed dataset to estimate optimism-corrected performance. Imputation was not repeated during resampling. Decision curve analysis assessed net benefit, and a complete-case analysis examined the consistency of the main associations. Analyses were performed in R version 4.3.1, with two-sided $P < 0.05$ considered statistically significant.

2.6 Ethical considerations

This study was approved by the Ethics Committee of Foshan Second People's Hospital (approval No. (2023)–0093) and conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants.

3 Results

3.1 Characteristics of the study population

A total of 293 older adults residing in nursing homes were included, comprising 114 with dysphagia and 179 without dysphagia. The median age was 78.00 years (Q1–Q3: 71.00–86.00), and 170 participants (58.02%) were women. Compared with residents without dysphagia, those with dysphagia were older, had lower BMI, and had higher frailty and SSA total scores but lower QLI total scores (all $P < 0.001$). A history of stroke was more common in the dysphagia group (57.02% vs. 41.34%, $P = 0.009$). No statistically significant between-group differences were observed in sex or the prevalence of Parkinson's disease or Alzheimer's disease (all $P > 0.05$; Table 1).

Table 1. Demographic and clinical characteristics of participants with and without dysphagia.

Characteristic	Total (n = 293)	Dysphagia (n = 114)	Non-dysphagia (n = 179)	Statistic	P value
Age, years	78.00 (71.00, 86.00)	82.00 (74.75, 88.00)	76.00 (70.00, 84.00)	Z=3.922	<0.001
Sex, n (%)				χ^2=0.877	0.349
Male	123 (41.98)	44 (38.60)	79 (44.13)		

Characteristic	Total (n = 293)	Dysphagia (n = 114)	Non-dysphagia (n = 179)	Statistic	P value
Female	170 (58.02)	70 (61.40)	100 (55.87)		
BMI, kg/m²	22.86 ± 4.06	21.74 ± 4.56	23.56 ± 3.56	t=-3.532	<0.001
Frailty score	3.00 (2.00, 4.00)	3.00 (3.00, 4.00)	2.00 (2.00, 3.00)	Z=6.869	<0.001
SSA total score	21.00 (19.00, 24.00)	24.00 (21.00, 26.00)	20.00 (18.00, 22.00)	Z=7.765	<0.001
QLI total score	7.00 (6.00, 8.00)	7.00 (6.00, 7.00)	8.00 (7.00, 9.00)	Z=-7.022	<0.001
History of stroke, n (%)				χ^2=6.864	0.009
No	154 (52.56)	49 (42.98)	105 (58.66)		
Yes	139 (47.44)	65 (57.02)	74 (41.34)		
Parkinson's disease, n (%)				χ^2=2.959	0.085
No	278 (94.88)	105 (92.11)	173 (96.65)		
Yes	15 (5.12)	9 (7.89)	6 (3.35)		
Alzheimer's disease, n (%)				—	0.755
No	282 (96.25)	109 (95.61)	173 (96.65)		
Yes	11 (3.75)	5 (4.39)	6 (3.35)		

Data are presented as mean ± SD, median (Q1, Q3), or n (%). BMI, body mass index; QLI, Quality of Life Index; SSA, Standardized Swallowing Assessment.

3.2 Prevalence of dysphagia and domain-specific symptom profiles

Dysphagia was identified in 38.91% of older adults residing in the participating nursing homes (95% CI: 33.50%–44.60%). Among residents with dysphagia, severe symptoms were most frequent in the oral-phase domain (71.05%), followed by the pharyngeal-phase (46.49%) and complications (42.11%) domains. Esophageal-phase and airway-protection symptoms were less common, occurring in 9.65% and 8.77%, respectively (Figure 1).

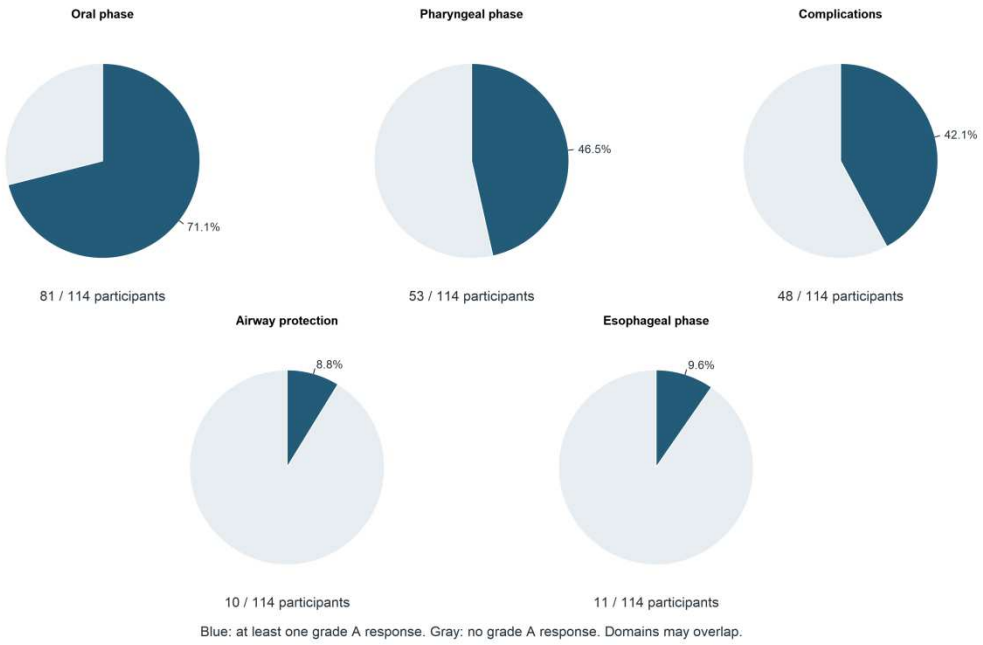


Figure 1. Severe symptoms across Ohkuma questionnaire domains in participants with dysphagia. Blue and gray segments indicate the presence and absence of severe symptoms, respectively. Severe symptoms were defined as at least one grade A response within a domain. Domains are not mutually exclusive.

Dysphagia prevalence varied across age, BMI, and frailty categories (all overall $P < 0.001$; Table 2). More than half of residents aged 80–89 years and ≥90 years had dysphagia (52.13% and 55.17%, respectively), compared with 28.57% and 28.18% of those aged 60–69 and 70–79 years. Across BMI categories, prevalence was highest among underweight residents (BMI <18.5 kg/m²; 65.85%) and lowest among those with a BMI of 24.0 to <28.0 kg/m² (21.95%). Prevalence increased across frailty categories, from 7.14% in non-frail residents to 20.35% in pre-frail residents and 54.22% in frail residents. No significant difference was observed between women and men (41.18% vs. 35.77%, $P = 0.349$).

Table 2. Prevalence of dysphagia across prespecified subgroups.

Subgroup	Dysphagia / N	Prevalence, %	95% CI, %	P value
Overall	114/293	38.91	33.50–44.60	—
Sex				0.349
Female	70/170	41.18	34.05–48.69	

Subgroup	Dysphagia / N	Prevalence, %	95% CI, %	P value
Male	44/123	35.77	27.85–44.56	
Age, years				<0.001
60–69	16/56	28.57	18.42–41.48	
70–79	31/110	28.18	20.62–37.21	
80–89	49/94	52.13	42.15–61.94	
≥90	16/29	55.17	37.55–71.59	
BMI, kg/m²				<0.001
<18.5	27/41	65.85	50.55–78.44	
18.5 to <24.0	52/133	39.10	31.22–47.59	
24.0 to <28.0	18/82	21.95	14.36–32.05	
≥28.0	11/27	40.74	24.51–59.27	
Frailty status				<0.001
Non-frail (0)	1/14	7.14	1.27–31.47	
Pre-frail (1–2)	23/113	20.35	13.96–28.69	
Frail (3–5)	90/166	54.22	46.63–61.61	

P values indicate overall comparisons across categories within each stratification variable. BMI, body mass index; CI, confidence interval.

We analyzed the correlation between SSA total scores and dysphagia status. SSA total scores were positively correlated with dysphagia status (Spearman's ρ=0.455, 95% CI: 0.357–0.545; P<0.001) and the number of severe symptoms (ρ=0.512; P<0.001). SSA total scores distinguished the dysphagia and non-dysphagia groups with an AUC of 0.768 (95% CI: 0.712–0.824; Supplementary Table S1 and Figure S1).

3.3 Factors associated with dysphagia

In univariable analyses, older age, lower BMI, higher frailty scores, and a history of stroke were associated with dysphagia (Figure 2A). After simultaneous adjustment for all seven predictors, age, BMI, and frailty score remained statistically significant (Figure 2B). Each additional year of age was associated with higher odds of dysphagia (adjusted OR=1.039, 95% CI: 1.005–1.075; P=0.023), as was each one-point increase in frailty score (adjusted OR = 2.142, 95% CI: 1.659–2.765; P<0.001). Higher BMI was associated with lower odds of dysphagia (adjusted OR per 1-kg/m² increase = 0.925, 95% CI: 0.856–0.999; P=0.047). The association with stroke history was attenuated after adjustment and was no longer statistically significant (P = 0.112). Sex, Parkinson's disease, and Alzheimer's disease were not significantly associated with dysphagia in the adjusted model.

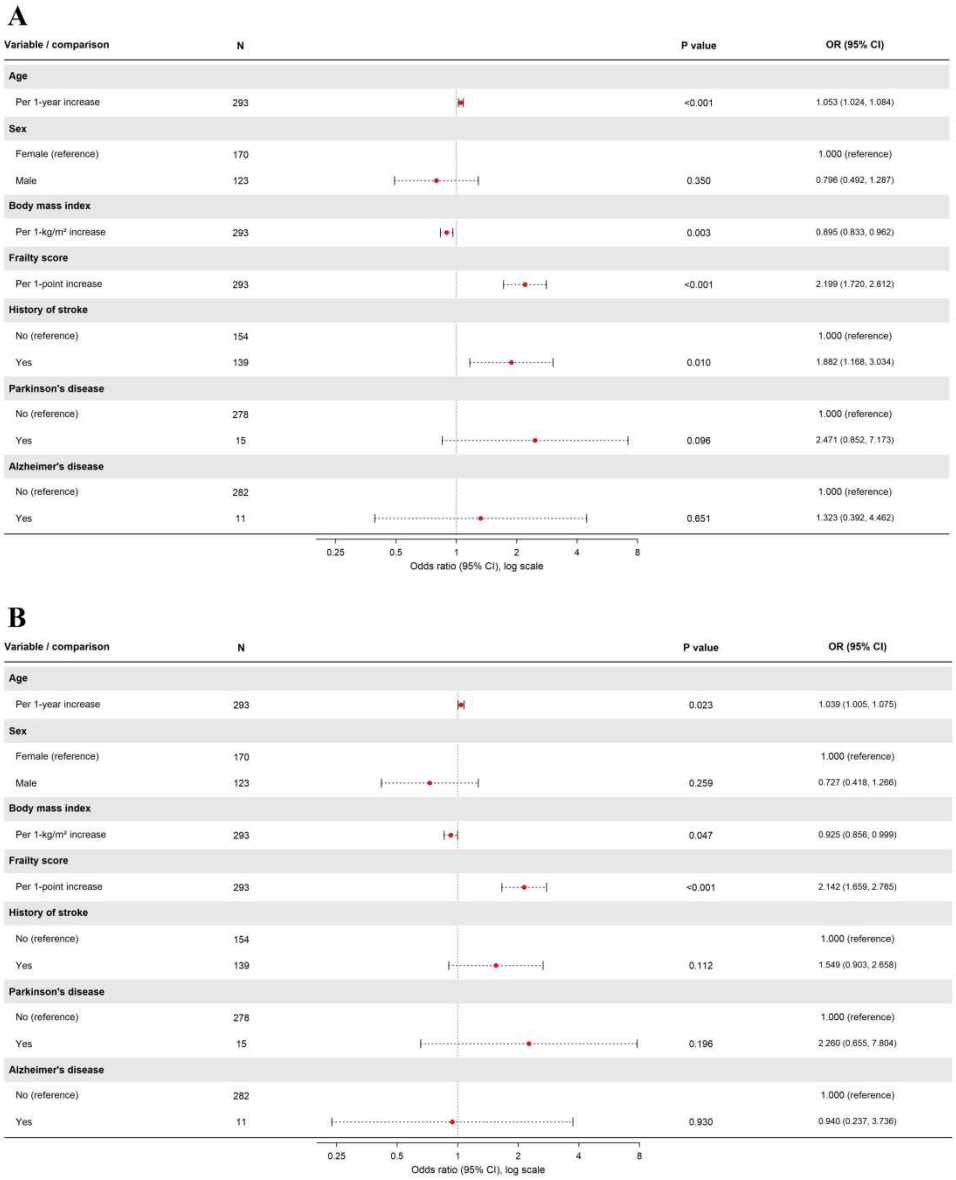


Figure 2. Univariable and multivariable logistic regression analyses of factors associated with dysphagia. (A) Univariable analyses. (B) Multivariable analysis. Red circles and horizontal lines represent ORs and 95% CIs, respectively. The vertical dashed line indicates OR = 1. OR, odds ratio; CI, confidence interval.

3.4 Development of the dysphagia prediction nomogram

To facilitate individual estimation of dysphagia probability, the seven-variable logistic regression model was presented as a nomogram (Figure 3A). Points assigned to age, sex, BMI, frailty score, history of stroke, Parkinson's disease, and Alzheimer's disease are summed and translated into a predicted probability, the model was expressed as follows:

$$logit(P) = -3.99376 + 0.038706 \times Age - 0.318683 \times Male - 0.078262 \times BMI$$
$$+ 0.761579 \times Frailty\ score + 0.437655 \times Stroke$$
$$+ 0.815488 \times Parkinson's\ disease - 0.061423 \times Alzheimer's\ disease,$$

where P denotes the predicted probability of dysphagia and is calculated as $P = 1/[1 + exp\{-logit(P)\}]$. Age is expressed in years, BMI in kg/m², and frailty score in points. Sex is coded as 1 for male and 0 for female. Stroke history, Parkinson's disease, and Alzheimer's disease are each coded as 1 if present and 0 if absent.

The model is presented as a nomogram in Figure 3A. Each predictor contributes a point score, and the total is converted into a predicted probability of dysphagia. Figure 3B shows a hypothetical 80-year-old woman with a BMI of 22 kg/m², a frailty score of 3, and a history of stroke, but no Parkinson's disease or Alzheimer's disease. Her total score of 135.3 points corresponds to an estimated dysphagia probability of 52.6%.

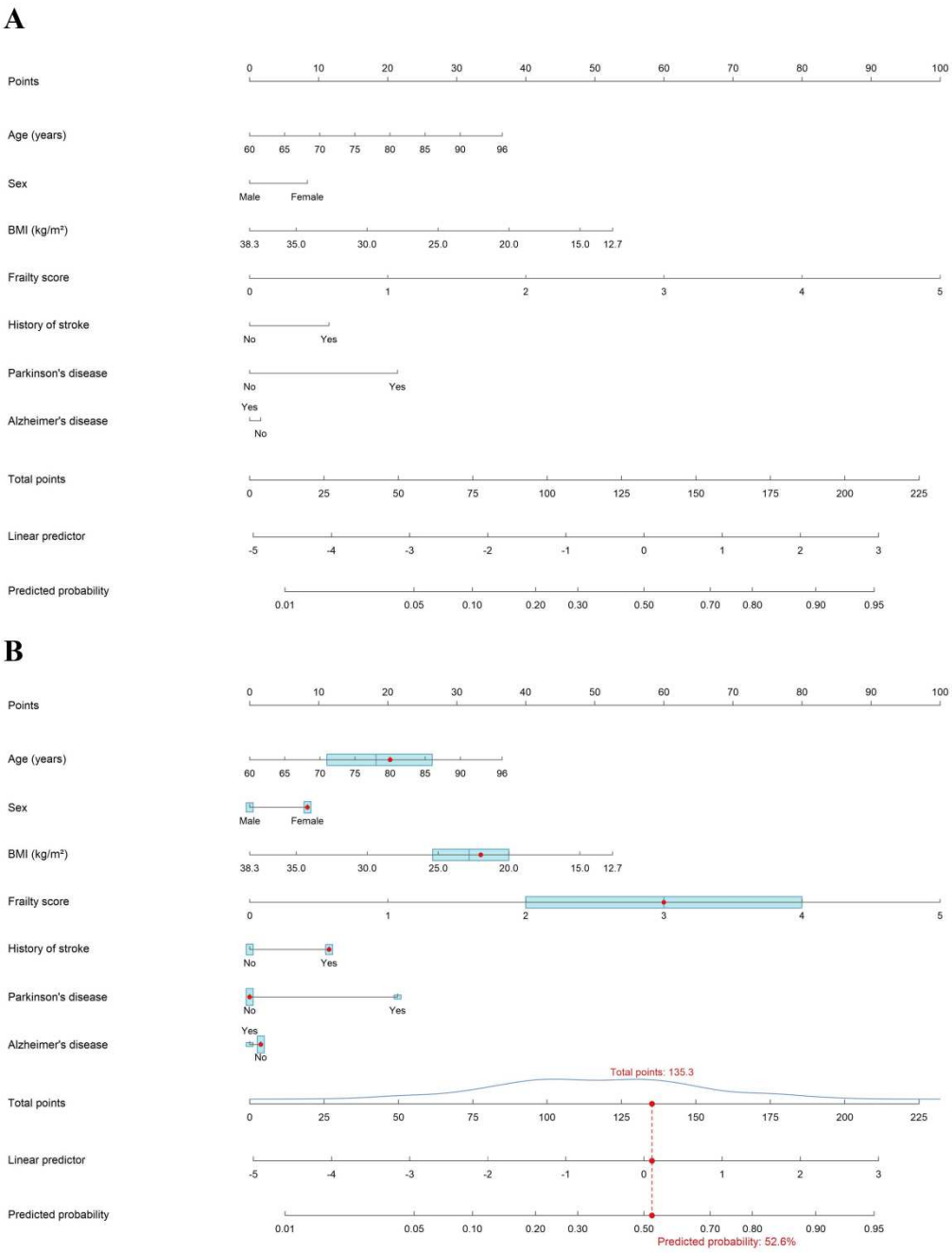


Figure 3. Nomogram for predicting dysphagia and an illustrative prediction. (A) Prediction nomogram. (B) An illustrative prediction with an estimated probability of 52.6%, indicated by red markers. Blue boxes summarize predictor distributions, and the density curve shows the distribution of total points. BMI, body mass index.

3.5 Model performance and internal validation

Internal validation used 500 bootstrap resamples within each of the five imputed datasets. The pooled apparent AUC was 0.780 (95% CI: 0.720–0.830), and the optimism-corrected AUC

was 0.758 (Figure 4A). The calibration plot compares predicted probabilities with observed proportions of dysphagia across risk deciles (Figure 4B). After optimism correction, the calibration intercept was 0.012, the calibration slope was 0.882, and the Brier score was 0.194. Decision curve analysis showed that the optimism-corrected model had greater net benefit than the intervene-in-all and intervene-in-none strategies at threshold probabilities of approximately 0.16–0.78, suggesting potential value in guiding further swallowing assessment (Figure4C).

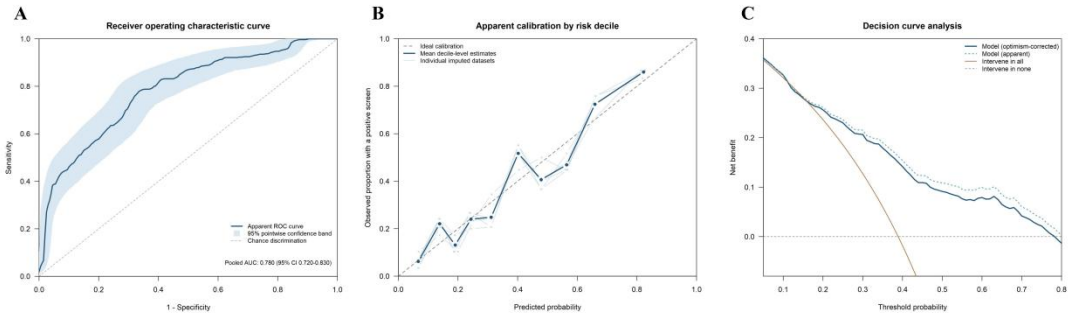


Figure 4. Discrimination, calibration, and decision curve analysis of the dysphagia prediction model. (A) ROC curve with pointwise 95% confidence intervals shown by shading. (B) Calibration plot; dark-blue and light-blue curves represent mean decile-level estimates and estimates from individual imputed datasets, respectively. The dashed diagonal indicates ideal calibration. (C) Decision curves showing apparent and optimism-corrected model net benefit compared with the intervene-in-all and intervene-in-none strategies. ROC, receiver operating characteristic; AUC, area under the ROC curve.

3.6 Quality of life according to dysphagia status

Quality of life was assessed using the Quality of Life Index (QLI), with higher scores indicating better quality of life. Residents with dysphagia had a lower median total score than those without dysphagia [7.00 (6.00, 7.00) vs. 8.00 (7.00, 9.00), $P < 0.001$]. Domain-level comparisons revealed lower scores for activity, daily living, and health in the dysphagia group. Differences in the total score and these three domains remained statistically significant after Holm adjustment (all adjusted $P < 0.001$), whereas no significant differences were observed in support or physical condition (both adjusted $P = 0.217$; Table 3).

Table 3. Comparison of QLI total and domain scores between participants with and without dysphagia.

Measure	Total (n = 290)	Dysphagia (n = 114)	Non-dysphagia (n = 176)	Z	P value	Holm P
QLI total score	7.00 (6.00, 8.00)	7.00 (6.00, 7.00)	8.00 (7.00, 9.00)	-7.022	<0.001	<0.001
Activity	1.00 (0.00, 1.00)	0.00 (0.00, 1.00)	1.00 (0.00, 1.00)	-6.251	<0.001	<0.001
Daily living	1.00 (1.00, 1.00)	1.00 (0.00, 1.00)	1.00 (1.00, 2.00)	-5.947	<0.001	<0.001
Health	2.00 (1.00, 2.00)	2.00 (1.00, 2.00)	2.00 (2.00, 2.00)	-3.760	<0.001	<0.001
Support	2.00 (2.00, 2.00)	2.00 (2.00, 2.00)	2.00 (2.00, 2.00)	-1.382	0.167	0.217
Physical condition (a)	2.00 (2.00, 2.00)	2.00 (2.00, 2.00)	2.00 (2.00, 2.00)	-1.605	0.108	0.217

Data are presented as median (Q1, Q3). P values were adjusted for six comparisons using the Holm method. QLI, Quality of Life Index.

3.7 Complete-case sensitivity analysis

To examine whether the main findings were sensitive to the handling of missing data, the same seven-variable logistic regression model was fitted to 279 residents with complete predictor data. The associations of age, BMI, and frailty score with dysphagia were consistent with those obtained after multiple imputation. The adjusted ORs were 1.038 (95% CI: 1.004 – 1.073; P = 0.030) for age, 0.910 (95% CI: 0.847 – 0.978; P = 0.010) for BMI, and 2.176 (95% CI: 1.657 – 2.859; P < 0.001) for frailty score. The remaining predictors did not reach statistical significance (Table 4). These findings support the consistency of the principal associations across the two approaches to handling missing data.

Table 4. Comparison of adjusted odds ratios from multiple-imputation and complete-case analyses.

Predictor	Multiply imputed Adjusted OR (95% CI)	Complete cases Adjusted OR (95% CI)	Complete-case P value
Age, per year	1.039 (1.005, 1.075)	1.038 (1.004, 1.073)	0.030

Predictor	Multiply imputed Adjusted OR (95% CI)	Complete cases Adjusted OR (95% CI)	Complete-case P value
Male vs female	0.727 (0.418, 1.266)	0.692 (0.391, 1.225)	0.206
BMI, per kg/m²	0.925 (0.856, 0.999)	0.910 (0.847, 0.978)	0.010
Frailty score, per point	2.142 (1.659, 2.765)	2.176 (1.657, 2.859)	<0.001
History of stroke, yes vs no	1.549 (0.903, 2.658)	1.517 (0.869, 2.647)	0.143
Parkinson's disease, yes vs no	2.260 (0.655, 7.804)	2.516 (0.694, 9.117)	0.160
Alzheimer's disease, yes vs no	0.940 (0.237, 3.736)	0.474 (0.095, 2.365)	0.363

Both models included the same seven predictors. P values refer to the complete-case analysis. BMI, body mass index; OR, odds ratio; CI, confidence interval.

4 Discussion

This study characterized dysphagia among older nursing home residents in terms of symptom profiles, associated factors, and individual probability estimation. Approximately four in ten residents had dysphagia, with severe symptoms most often reported in the oral- and pharyngeal-phase domains. Age, BMI, and frailty score remained associated with dysphagia in the multivariable analysis. The model combined seven routinely available clinical characteristics and retained discriminatory ability after validation. Residents with dysphagia also had poorer quality of life, particularly in activity, daily living, and health. Together, these findings support considering residents' overall functional status alongside swallowing symptoms when identifying those who need further assessment.

In this study, the prevalence of dysphagia among older nursing home residents was 38.91%. This was lower than the pooled prevalence reported by Roberts et al. (56.11%)[4], but higher than the 13.4% reported by Streicher et al. in the nutritionDay study[5]. Differences across studies may reflect assessment methods, classification criteria, and resident health profiles[17,18]. For example, nursing staff recorded dysphagia status using standardized questionnaires in the nutritionDay study, whereas our study classified residents according to the presence of at least

one severe symptom on the Ohkuma questionnaire. Moreover, our eligibility criteria required residents to understand and complete the questionnaires and assessments, limiting representation of those with severe cognitive or communication impairments. Differences in prevalence should therefore be considered in the context of assessment methods and population characteristics. In our sample, severe symptoms were most common in the oral- and pharyngeal-phase domains. Routine observation should thus include difficulties with handling and swallowing food, as well as coughing during drinking. Residents with dysphagia had lower quality-of-life scores for activity, daily living, and health, consistent with reports linking swallowing difficulties to functional limitations and poorer quality of life[19]. Qualitative studies describe how fear of eating, changes in eating habits, and reliance on caregiver assistance affect daily life[20]. Our quality-of-life comparisons were not adjusted for confounding, so differences in age, frailty, and comorbidities may also contribute to these findings. Variation in screening and subsequent management practices[21,22] points to a need for more consistent swallowing assessment in nursing homes, with attention to residents' daily functioning and eating experiences as well as their symptoms.

Frailty score remained associated with dysphagia after adjustment for age, sex, BMI, and neurological disease history, with an adjusted odds ratio of 2.142 per one-point increase. Previous studies have also linked frailty to swallowing dysfunction, possibly through shared mechanisms such as neuromuscular decline and reduced physiological reserve[9,23]. Assessing frailty may therefore help identify nursing home residents who need further swallowing evaluation. Older age and lower BMI were also associated with dysphagia after adjustment. The relationship between BMI and swallowing function may operate in both directions: inadequate nutritional reserves may accompany impaired swallowing, while swallowing difficulties may limit intake and contribute to weight loss. Evidence on the independent associations of nutritional status and neurological conditions with dysphagia remains mixed[24,25]. In our study, the association with stroke history weakened after adjustment, and neither Parkinson's disease nor Alzheimer's disease showed a statistically significant association. The small numbers of residents with these conditions and wide confidence intervals leave uncertainty about their associations with dysphagia. These results support assessing swallowing function alongside frailty and nutritional status when determining

residents' care needs.

The nomogram combined age, sex, BMI, frailty score, and neurological disease history to estimate the probability of dysphagia. Its apparent AUC was 0.780 and its bootstrap-corrected AUC was 0.758, indicating that discrimination was largely maintained after validation. The need for accessible assessment tools is evident in nursing homes, where a systematic review reported a pooled dysphagia prevalence exceeding 50%[26,27]. The model brings together information on overall function, nutritional status, and disease history that can be collected through routine interviews, measurements, and clinical assessments. By converting this information into a points-based probability estimate, the nomogram may complement bedside swallowing assessments[28]. The corrected calibration intercept of 0.012 suggested little overall prediction bias, while the slope of 0.882 indicated that predicted probabilities were more extreme than warranted. Decision curve analysis showed greater estimated net benefit over a range of thresholds than further assessment for all or no residents, suggesting a potential role in prioritizing swallowing evaluations[10]. The model could therefore help nursing home staff identify residents more likely to have existing dysphagia and allocate assessment resources accordingly. Whether its use improves early identification and resident health outcomes should be evaluated in routine care[29,30].

This study examined symptom profiles, associated factors, and quality of life among older nursing home residents with and without dysphagia. Multiple imputation addressed missing data, while bootstrap validation and complete-case sensitivity analysis assessed model performance and the consistency of the main associations. Several limitations remain. First, the cross-sectional design cannot establish temporal or causal relationships between frailty, BMI, and dysphagia. The model estimates the probability of existing dysphagia rather than future onset. Second, although the Ohkuma questionnaire is useful for screening[13,31], and was supplemented by SSA assessment, the absence of confirmation by videofluoroscopy or fiberoptic endoscopic evaluation of swallowing leaves the possibility of misclassification. Third, the limited sample size and small numbers of residents with certain neurological conditions may have reduced estimation precision. The model also requires validation in other nursing homes. Larger, independent multicenter studies should assess its generalizability and clinical utility[10,28]. Prospective studies incorporating instrumental assessments could clarify

the temporal relationships between associated factors and dysphagia and determine whether model-guided assessment and intervention improve resource allocation and resident health outcomes.

5 Conclusion

This study investigated the prevalence and symptom profiles of dysphagia among older nursing home residents, identifying a substantial burden and an association with poorer quality of life. A nomogram incorporating routinely available clinical characteristics was developed and validated, showing potential to support the identification of residents requiring further swallowing assessment. Future studies should recruit larger samples, conduct multicenter validation, and evaluate the model's value in routine care.

Author contributions

Qinqin Song: Conceptualization, Methodology, Investigation, Data curation, Formal analysis, Writing–original draft. Yunxiong Ye: Investigation, Data curation, Writing–review & editing. Miaoling Liu: Investigation, Validation, Writing–review & editing. Yuying Yu: Conceptualization, Methodology, Supervision, Project administration, Writing–review & editing. All authors reviewed and approved the final manuscript and agreed to be accountable for the work.

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Data availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request, subject to applicable ethical and privacy restrictions.

Conflict of interest

The authors declare that they have no conflicts of interest.

Ethics statement

This study was approved by the Ethics Committee of Foshan Second People's Hospital (approval No. 2023-0093) and conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants.

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