

Development and validation of a sarcopenia screening scale for community-dwelling older adults in China: A risk score model based on multivariate logistic regression

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Abstract

Background

Despite substantial growth in clinical interest in sarcopenia and muscle health in recent years, awareness among Chinese community-dwelling older adults remains very low, largely due to the lack of simple, practical, and efficient screening tools for effectively identifying individuals at high risk. Accordingly, this study developed and validated a simple sarcopenia risk scoring scale for community-dwelling older adults in China, based on the 2025 Asian Working Group for Sarcopenia (AWGS) diagnostic criteria.

Methods

This cross-sectional study used convenience sampling to enroll community-dwelling older adults aged 65–85 years undergoing physical examinations at two medical institutions in Wuhan (May–December 2024). Sarcopenia was diagnosed using the AWGS 2025 criteria as the gold standard. Univariate analysis was used to screen potential factors; multivariable logistic regression was used to identify independent risk factors. A risk scoring scale was constructed by assigning points based on regression coefficients (β). Discrimination was assessed using the receiver operating characteristic (ROC) curve, calibration using the Hosmer–Lemeshow test, internal validation using bootstrap resampling, and clinical net benefit using decision curve analysis (DCA). The area under the ROC curve (AUC) was calculated.

Results

Of 371 participants, the prevalence of sarcopenia was 22.37%. Five factors were identified as independent risk factors (all $P < 0.05$): age, lifting and carrying ability, maximum walking distance, Yubi-wakka (finger-ring) test, and mood status. The total score ranged from 0 to 7, with an ROC-AUC of 0.765 (95% CI: 0.711–0.819). At the optimal cut-off value of 4 points, sensitivity was 75.38%, and specificity was 59.72%. The Hosmer–Lemeshow test ($P > 0.05$) indicated good calibration. Bootstrap internal validation yielded a bias-corrected AUC of 0.756 (95% CI: 0.704–0.809), indicating stable performance. DCA demonstrated a clinical net benefit for threshold probabilities of 3%–51%.

Conclusions

The simple scale developed based on the AWGS 2025 criteria demonstrates good discrimination and calibration, stable internal validation performance, and is suitable for early sarcopenia screening in primary care settings. Future multicenter external validation is warranted.

Introduction

Sarcopenia is an age-related clinical syndrome characterized by progressive loss of skeletal muscle mass and decline in physical function [1]. Since the European Working Group on Sarcopenia in Older People (EWGSOP) first systematically proposed the academic definition of sarcopenia in 2010, diagnostic criteria have undergone multiple revisions. Owing to regional differences in ethnicity and body composition, cut-off values for sarcopenia diagnosis vary across populations. In addition, the development of sarcopenia is influenced by intrinsic factors (e.g., ethnicity) and environmental conditions (e.g., country of residence, lifestyle), resulting in substantial variability in reported prevalence across regions.

At present, the global prevalence of sarcopenia ranges from 5% under the EWGSOP1 criteria to 17% under the International Working Group on Sarcopenia (IWGS) criteria, with a pooled prevalence of 11% [2]. When the AWGS 2019 criteria are applied, prevalence in Asian populations generally ranges from 10% to 20% [3]. Reported rates include 18.4% in China mainland, 13.2% in Japan, 19.9% in Korea, and 17.6% in Taiwan, China [4], while the overall prevalence of possible sarcopenia approaches 30%.

Prevalence increases with age. Data from the National Health and Nutrition Examination Survey (NHANES) indicate an average prevalence of 10%–15% among individuals aged 40–59 years, rising to 20%–30% in those aged 60–80 years, and exceeding 40% in individuals over 80 years [5, 6]. Additional risk factors include low physical activity, malnutrition, chronic inflammation, polypharmacy, and even peak muscle mass attained earlier in life [7]. Sarcopenia is strongly associated with multiple adverse health outcomes, including increased risk of falls, functional impairment, higher hospitalization rates, cardiovascular disease, dementia, long-term care dependence, cognitive and psychological decline, and elevated all-cause mortality [1, 8, 9], establishing it as a major threat to the health of older adults.

Skeletal muscle, traditionally viewed as a contractile tissue responsible for movement and posture, is now recognized as a bona fide endocrine organ that secretes myokines [10]. These myokines serve as key mediators of inter-organ crosstalk, modulating systemic metabolism, energy homeostasis, and neurogenesis [11, 12]. Accordingly, muscle health extends well beyond the traditional domains of strength and mobility and warrants multidimensional evaluation.

In November 2025, the Asian Working Group for Sarcopenia (AWGS) released its latest consensus update, shifting the focus of sarcopenia intervention toward early identification and prevention before functional decline becomes apparent. The update introduced several key refinements, including an optimized screening workflow, a simplified diagnostic algorithm based on the dual-core criteria of “low muscle mass + low muscle strength”, and an expanded diagnostic age range to include middle-aged adults (50–64 years). Notably, the consensus also recommends comprehensive sarcopenia risk assessment for individuals aged ≥ 65 years using validated self-assessment tools [13], which constitutes the primary focus of the present study.

Currently available sarcopenia screening tools include the SARC-F, SARC-CalF, Ishii score, and the Mini Sarcopenia Risk Assessment (MSRA) questionnaire [14]. The SARC-F scale, the most widely used instrument, was initially proposed by Morley et al. at the 2012 International Conference on Sarcopenia Research (ICSR) as a screening tool primarily based on self-rated functional status and fall risk assessment, without inclusion of objective measures such as muscle mass or calf circumference [15]. A notable limitation of the SARC-F scale lies in its high specificity but low sensitivity, which restricts its performance as a screening instrument [16]. The SARC-CalF scale incorporates calf circumference, thereby substantially improving sensitivity [17]; however, its cut-off values for calf circumference are largely derived from European older populations and may not be fully applicable to Asian older adults, who exhibit different body composition characteristics. In addition, its ability to predict muscle mass in individuals with obesity remains limited [18]. The Ishii score integrates three domains—age, grip strength, and calf circumference [19]—thereby encompassing key diagnostic indicators for sarcopenia. As the model was developed using Asian population data, it demonstrates satisfactory sensitivity and specificity [20]; however, its clinical application requires equipment such as a dynamometer, and the scoring formula involves exponential calculations, limiting feasibility for self-assessment among older adults. The MSRA questionnaire incorporates multiple nutrition-related self-report items alongside functional indicators [21]; nevertheless, several items are highly subjective, and the tool was developed based on European population data and earlier diagnostic criteria, resulting in substantial variability in screening performance across Asian countries such as Korea and Singapore [22, 23]. Overall, sarcopenia self-assessment tools specifically designed for community-dwelling older adults in China remain limited. Moreover, under updated Asian diagnostic criteria for sarcopenia, recalibration of cut-off values in existing screening scales against the new reference standard is required. Accordingly, following a comprehensive literature review, risk factors for sarcopenia and their interrelationships were systematically summarized, and a preliminary item pool covering six domains (body composition, functional status, lifestyle, chronic diseases, mood and cognition, and falls) was constructed. Using the AWGS 2025 diagnostic criteria as the reference standard, cross-sectional data from community-dwelling older adults in Wuhan were analyzed to identify independent predictors of sarcopenia. A simple risk scoring scale was subsequently developed and internally validated, aiming to provide an evidence-based tool for early sarcopenia screening in primary care settings.

Methods

Research design

This cross-sectional study adopted convenience sampling to recruit older adults undergoing physical examinations at the Tangjiadun Community Health Service Center and Hubei Provincial Hospital of Integrated Traditional Chinese and Western Medicine between May and December 2024 in Wuhan, Hubei. The study protocol was designed and conducted in accordance with the Declaration of Helsinki. Ethical approval was obtained from the Medical Ethics Committee of Hubei Provincial Hospital of

Integrated Chinese and Western Medicine (Approval No. [2024] Lun-Shen-Zi (007)), and all participants provided written informed consent.

Participants

Eligibility criteria included: (1) age 65–85 years; (2) permanent residency in Wuhan with a residence duration of at least 1 year; (3) voluntary participation with written informed consent; and (4) willingness to cooperate and complete all study procedures. Exclusion criteria comprised: (1) limb paralysis secondary to neurological disorders; (2) severe osteoarthritis or rheumatoid arthritis causing functional disability; (3) presence of implanted metal devices (e.g., cardiac pacemaker, internal fixation); (4) severe cardiopulmonary insufficiency (NYHA class $\geq$ III); (5) cognitive impairment precluding adherence to instructions; and (6) long-term bedridden status or standing balance graded $\leq$ 1. According to the AWGS 2025 consensus diagnostic criteria [13], sarcopenia in individuals aged $\geq$ 65 years was defined by the concurrent presence of: (1) low muscle strength, defined as handgrip strength < 28 kg in men and < 18 kg in women; and (2) low muscle mass assessed by bioelectrical impedance analysis (BIA), defined as either height-adjusted appendicular skeletal muscle mass < 7.0 kg/m² in men and < 5.7 kg/m² in women, or BMI-adjusted appendicular skeletal muscle mass < 0.83 in men and < 0.57 in women. Based on these criteria, participants were classified into sarcopenia and non-sarcopenia groups.

Sample size calculation

Sample size estimation followed the clinical prediction model framework proposed by Riley et al. [24]. The initial questionnaire item pool comprised 16 items, and the final prediction model was prespecified to include 5–7 candidate variables as binary predictors after univariate and multivariate analyses. Prior studies on sarcopenia prediction models have reported AUC values ranging from 0.786 to 0.873 [21, 25]. Given that the present scale is in an early development and validation phase, a conservative expected AUC of 0.786 was adopted to represent anticipated discrimination. A global shrinkage factor of at least 0.9 was required to minimize overfitting. Based on a pilot study, the expected prevalence of sarcopenia in the study population was estimated at approximately 20%. Using the pmsampsize R package (version 1.1.3) and assuming 5–7 candidate predictors, the minimum required sample size for model development was 248–346 participants, with at least 50–69 positive events. Ultimately, 371 participants were included, including 83 individuals with sarcopenia, thereby satisfying the predefined sample size requirements.

Data collection and measurements

This study aimed to develop a simple, practical, self-administered sarcopenia risk screening scale for community-dwelling older adults. The items were designed to avoid reliance on instrumental measurements and to be completed using a combination of subjective and objective questionnaire-

based assessments. Accordingly, the initial item pool incorporated symptoms, clinical signs, and sarcopenia-related risk factors as screening indicators. To enhance the sensitivity of the scale, additional domains—including lifestyle, comorbidities, and emotional and cognitive status—were integrated based on the theoretical framework of established sarcopenia diagnostic pathways, with the goal of achieving a more comprehensive coverage of relevant risk factors. Ultimately, 16 preliminary items were included in the original questionnaire (see Supplementary file for the full questionnaire).

Data were collected via face-to-face interviews and standardized physical performance tests, all administered by trained assessors who underwent uniform training protocols. The procedures were as follows: (1) Demographic characteristics: Information on age, sex, living arrangement, education level, and comorbidities was collected using a standardized case report form. (2) Anthropometric measurements: Height and weight were measured using an InBody u-town automatic height and weight scale (model BSM 370). Calf circumference was measured with a non-elastic tape at the widest point of the non-dominant calf. (3) Muscle strength assessment: Handgrip strength of the dominant hand was measured using an InBody u-town handgrip dynamometer (model BS-HG). Participants stood upright with arms naturally at their sides and exerted maximal grip force on the handle; the maximum value of two consecutive trials was recorded. (4) Muscle mass assessment: Muscle mass was measured using BIA with an InBody 770 device. Appendicular skeletal muscle mass index (ASMI) was calculated as appendicular skeletal muscle mass divided by height squared (kg/m^2), and BMI-adjusted appendicular skeletal muscle mass (ASM/BMI) was calculated as appendicular skeletal muscle mass divided by BMI. (5) SARC-F and SARC-CalF scales: All participants completed both the SARC-F and SARC-CalF questionnaires. (6) Physical performance tests: The 6-meter walking speed test was used to record gait speed (m/s), and the five-times sit-to-stand test was used to record completion time (s). (7) Original sarcopenia screening questionnaire: All participants completed the original sarcopenia risk screening scale via face-to-face interview.

Statistical analysis

Statistical analyses were conducted using SPSS version 26.0 (IBM Corp., Armonk, NY, USA) and R software (version 4.5.3; R Core Team, 2026). The Shapiro–Wilk test was applied to assess data normality. Continuous variables with a normal distribution were expressed as mean $\pm$ standard deviation ($\bar{x} \pm s$), with intergroup comparisons performed using the independent samples t-test. Non-normally distributed continuous variables were presented as median (interquartile range) [M (P25, P75)] and compared using the Mann–Whitney U test. Categorical variables were summarized as frequencies (percentages) and analyzed using the chi-square (χ^2) test.

For all participants, between-group differences in each variable were initially examined using the same univariate methods described above, and variables with $P < 0.10$ were retained for subsequent multivariable analysis. Variance inflation factors (VIFs) were then calculated for the selected variables, with $\text{VIF} < 10$ indicating no significant multicollinearity. Binary logistic regression analysis was subsequently performed, with sarcopenia status (1 = yes, 0 = no) as the dependent variable. Variables

with $P < 0.10$ in univariate analysis were entered into the multivariable logistic regression model to estimate regression coefficients (β), odds ratios (ORs), and 95% confidence intervals (CIs), and independent risk factors for sarcopenia were identified ($P < 0.05$). For continuous variables identified as independent risk factors, receiver operating characteristic (ROC) curve analysis was used to determine optimal cut-off values, and these variables were dichotomized accordingly. All binary independent risk factors were then re-entered into a logistic regression model. Following established approaches such as the Framingham Heart Study [26], points were assigned to each risk factor based on regression coefficients (β). Specifically, the smallest absolute β coefficient in the model was used as the reference; each coefficient was divided by this reference value and rounded to the nearest integer to derive item scores. The total score was calculated as the sum of individual item scores. The discriminative performance of the total score was evaluated using ROC analysis, with the area under the curve (AUC) and corresponding 95% CI reported. The optimal cut-off value was determined using the Youden index, and sensitivity, specificity, positive predictive value, and negative predictive value were calculated accordingly. Risk stratification (low, moderate, high) was defined based on total score thresholds. Model calibration was assessed using the Hosmer–Lemeshow goodness-of-fit test, with $P > 0.05$ indicating acceptable calibration, and calibration plots were generated. Given the limited sample size, no data splitting was performed. Internal validation was conducted using bootstrap resampling with 1,000 replicates drawn with replacement from the original dataset ($n = 371$). In each bootstrap sample, the logistic regression model was refitted, and the AUC was calculated in the original dataset. The bias-corrected mean AUC and its 95% CI were then derived. Decision curve analysis (DCA) was performed to evaluate the clinical net benefit of the model across a range of threshold probabilities, compared with the “treat all” and “treat none” strategies.

Results

Characteristics of the study participants

A total of 371 eligible participants were included in this study, comprising 129 males (34.77%) and 242 females (65.23%). According to the AWGS 2025 diagnostic criteria, 83 participants were identified as having sarcopenia, corresponding to a prevalence of 22.37%. Participant characteristics are summarized in Table 1.

Table 1
Demographic and clinical characteristics of study participants

Characteristic	Total (N = 371)	Sarcopenia (n = 83)	Non-sarcopenia (n = 288)	P value
Gender, n (%)				0.6679
Female	242(65.23%)	52(62.65%)	190(65.97%)	
Male	129(34.77%)	31(37.35%)	98(34.03%)	
Age (y) n (%)				0.0001
65–74	268(72.23%)	45(54.22%)	223(77.43%)	
75–85	103(27.76%)	38(45.78%)	65(22.57%)	
Education n (%)				0.5949
Primary school or below	52(14.01%)	14(16.88%)	38(13.20%)	
Secondary school	227(61.19%)	51(61.45%)	176(61.11%)	
College or above	92(24.80%)	18(21.69%)	74(25.69%)	
BMI (kg/m2), n (%)				0.0061
< 18.5	24(6.47%)	11(13.25%)	13(4.51%)	
18.5–24	195(52.56%)	46(55.42%)	149(51.74%)	
>24	152(40.97%)	26(31.33%)	126(43.75%)	
CC (cm), n (%)				< 0.0001
Male > 34	81(21.83%)	13(15.66%)	68(23.61%)	
Male ≤ 34	48(12.94%)	18(21.69%)	30(10.42%)	
Female > 33	128(34.50%)	40(48.19%)	88(30.56%)	
Female ≤ 33	114(30.73%)	12(14.46%)	102(35.41%)	
SMI (kg/m2), M(P25,P75)	6.40(5.80,7.10)	5.70(5.30,6.40)	6.50(6.00,7.20)	< 0.0001
SARC-F n (%)				1
>4	1(0.27%)	0(0%)	1(0.35%)	
≤ 4	370(99.73%)	83(100%)	287(99.65%)	
SARC-CALF n (%)				0.0033
FTSST time: Five Times Sit-to-Stand Test time				

Characteristic	Total (N = 371)	Sarcopenia (n = 83)	Non-sarcopenia (n = 288)	P value
> 11	28(7.55%)	13(15.66%)	15(5.21%)	
≤ 11	343(92.45%)	70(84.34%)	273((94.79%))	
6-meter walking speed (m/s), M(P25,P75)	1.20(1.04,1.37)	1.03(0.87,1.23)	1.25(1.12,1.42)	< 0.0001
FTSST time(s), M(P25,P75)	11.35(9.59,13.37)	12.34(10.50,14.54)	11.18(9.39,12.88)	< 0.0001
FTSST time: Five Times Sit-to-Stand Test time				

Univariate analysis

Univariate analysis revealed significant differences between the sarcopenia and non-sarcopenia groups in nine variables: age, lifting and carrying ability, maximum walking distance, stair-climbing ability, frequency of hospitalizations, number of chronic diseases, Yubi-wakka (finger-ring) test result, mood status, and cognitive status (all $P < 0.10$). Detailed results are presented in Tables 2 and 3.

Table 2
Preliminary item pool results (continuous variables)

Variables (continuous)	Sarcopenia (n = 83)	Non-sarcopenia (n = 288)	P	U
Age (y)	74(70,78)	70(68,74)	< 0.001*	16076.00
Lifting and carrying (Kg)	7.5(5,10)	10(7,13.75)	0.001*	9133.50
Maximum walking distance (m)	1500(1000,2000)	2000(1125,3000)	< 0.001*	8403.00
Stair climbing	20(6,30)	20(10,30)	0.002*	9302.50
Dairy intake (mL/day)	150(50,250)	200(100,250)	0.495	11375.000
High-quality protein intake (g/day)	100(80,100)	100(75,150)	0.723	11654.50
Daily sleep duration (h)	6(5,7)	6(5,7)	0.718	11646.00
Exercise (times/week)	1(0,6)	2(0,6)	0.577	11497.00
Number of hospitalizations	1(0,3)	1(0,2)	0.080*	13330.500
Chronic diseases	1(0,2)	1(0,1)	0.009*	14076.500
Falls (n)	0(0,0)	0(0,0)	0.467	12466.000
Note: Data are presented as median (interquartile range). The Mann-Whitney U test was used for intergroup comparisons. * indicates a statistically significant difference between groups (p < 0.1).				

Table 3
Preliminary item pool results (categorical variables)

Variables(categorical)	Total	Sarcopenia (n = 83)	Non-sarcopenia (n = 288)	χ ²	P
Yubi-wakka test					
Positive	230	66(28.7%)	164(71.3%)	13.935	< 0.001*
Negative	141	17(12.1%)	124(87.9%)		
Regular exercise					
Yes	201	42(20.9%)	159(79.1%)	0.551	0.458
No	170	41(24.1%)	129(75.9%)		
Abnormal mood					
Yes	125	38(30.4%)	87(69.6%)	6.996	0.008*
No	246	45(18.3%)	201(81.7%)		
Cognitive decline					
Yes	313	76(24.3%)	237(75.7%)	4.202	0.04*
No	58	7(12.1%)	51(87.9%)		
Note: Data are presented as counts (percentages). The percentages in parentheses are row percentages, representing the distribution of sarcopenia/non-sarcopenia within each subgroup of the variable. Pearson’s chi-square test was used to compare differences between the sarcopenia and non-sarcopenia groups, and * indicates a statistically significant difference (p < 0.1). A positive Yubi-wakka test was defined as the presence of a gap or looseness when the ring formed by the thumbs and index fingers of both hands was placed around the thickest part of the non-dominant calf.					

Multicollinearity diagnostics of variables for multivariate analysis

Multicollinearity diagnostics were performed in SPSS version 26.0 for the nine variables identified in the univariate analysis. All VIF values were < 5, indicating no significant multicollinearity (Table 4).

Table 4
Multicollinearity diagnostics for multivariate logistic regression variables

Variables	Tolerance	VIF
Age	0.895	1.118
Lifting and carrying	0.799	1.251
Maximum walking distance	0.685	1.460
Stair climbing	0.648	1.542
Number of hospitalizations	0.764	1.308
Chronic diseases	0.748	1.337
Yubi-wakka test	0.989	1.011
Abnormal mood	0.936	1.069
Cognitive decline	0.924	1.083
Note: Tolerance and variance inflation factor (VIF) were used to assess multicollinearity. VIF < 5 indicated no significant multicollinearity was detected.		

Binary logistic regression analysis of multivariate factors

Sarcopenia status (1 = yes, 0 = no) was used as the dependent variable, and variables with statistically significant differences in univariate analysis were entered into a binary logistic regression model. The results indicated that age, lifting and carrying ability, maximum walking distance, stair-climbing ability, Yubi-wakka test result, and mood status were independent influencing factors for sarcopenia (all $P < 0.05$), among which a positive Yubi-wakka test showed the strongest association with sarcopenia risk (OR = 3.407). Detailed results are presented in Table 5.

Table 5
Multivariate logistic regression analysis of influencing factors for sarcopenia

Variables	β	SE	Wald	P	OR(95% CI)
Age	0.111	0.032	11.586	0.001**	1.117(1.048–1.190)
Lifting and carrying	0.087	0.035	6.163	0.013**	0.917(0.856–0.982)
Maximum walking distance	0.000	0.000	8.148	0.004**	1.000(0.999–1.000)
Stair climbing	0.022	0.011	4.435	0.035**	1.023(1.002–1.044)
Number of hospitalizations	0.018	0.070	0.065	0.799	1.018(0.887–1.168)
Chronic diseases	0.007	1.151	0.002	0.961	1.007(0.749–1.355)
Yubi-wakka test	1.226	0.321	14.568	< 0.001**	3.407(1.816–6.394)
Abnormal mood	0.746	0.295	6.407	0.011**	2.108(1.183–3.757)
Cognitive decline	0.402	0.468	0.738	0.390	1.494(0.598–3.736)
Note: *The Hosmer-Lemeshow test yielded $\chi^2=7.694$, $P = 0.464$, indicating good model fit. * *indicates a statistically significant difference ($p < 0.05$).					

Binary variable transformation and re-regression

To facilitate clinical application, continuous variables were converted into binary variables using predefined cut-offs: age ≥ 72 years was coded as 1 and < 72 years as 0; maximum walking distance ≤ 2000 m was coded as 1 and > 2000 m as 0; stair-climbing ≤ 15 steps was coded as 1 and > 15 steps as 0; for lifting and carrying ability, ≤ 6.5 kg for women and ≤ 12.5 kg for men were coded as 1, and values above these thresholds were coded as 0. These six binary variables were then re-entered into the logistic regression model. The results showed that all variables except stair-climbing remained statistically significant ($P < 0.05$), and the corresponding regression coefficients are presented in Table 6.

Table 6
Multivariate logistic regression analysis of influencing factors for sarcopenia (binary variables)

Variables(binary)	β	SE	Wald	P	OR(95% CI)
Age	0.999	0.285	12.300	0.001***	2.715(1.554–4.743)
Lifting and carrying	0.811	0.295	7.580	0.006***	2.251(1.263–4.010)
Maximum walking distance	0.681	0.336	4.117	0.042***	1.976(1.023–3.816)
Stair climbing	0.266	0.297	0.798	0.372	1.304(0.728–2.336)
Yubi-wakka test	1.226	0.321	14.568	< 0.001***	3.407(1.816–6.394)
Abnormal mood	0.632	0.288	4.821	0.028***	1.881(1.070–3.307)
Note: *The Hosmer-Lemeshow test yielded $\chi^2 = 10.203$, $P = 0.251$, indicating good model fit. ***indicates a statistically significant difference ($p < 0.05$).					

Construction of the simple screening scale

Based on the β coefficients in Table 6, item scores were assigned using the method of multiplying β by 10 and rounding to the nearest integer, thereby constructing a simplified screening scale (Table 7).

Table 7
Simple sarcopenia screening scale for community-dwelling older adults

Item	Criteria	Score
Age	Age $\geq$ 72 years	2
Yubi-wakka test	Positive	2
Lifting and carrying	Men $\leq$ 12.5 kg / Women $\leq$ 6.5 kg	1
Maximum walking distance	$\leq$ 2 000meters	1
Abnormal mood	Yes	1
Note: Total score range: 0–7 points. 0–1 point: low risk; 2–3 points: moderate risk; $\geq$ 4 points: high risk.		

Scale validation and performance evaluation

In the original dataset, the total scale score was calculated for each participant, and an ROC curve was generated using the gold standard diagnosis of sarcopenia as the state variable (Fig. 1). The AUC for discriminating sarcopenia was 0.765 (95% CI: 0.711–0.819, $P < 0.001$). Based on the maximum Youden index, an optimal cut-off value of 4 points was identified, yielding a sensitivity of 75.38%, specificity of 59.72%, positive predictive value of 37.63%, and negative predictive value of 92.97%. When 4 points were used as the cut-off, the prevalence of sarcopenia was 37.6% in the screen-positive group ($\geq$ 4 points) and 7.0% in the screen-negative group ($<$ 4 points), corresponding to a relative risk (RR) of 5.35 (95% CI:

4.94–5.79), indicating that the risk of sarcopenia in the screen-positive group was 5.35 times higher than that in the screen-negative group.

The Hosmer–Lemeshow goodness-of-fit test produced a P value > 0.05, indicating good model calibration. Internal validation of the scale was performed using bootstrap resampling, resulting in a bias-corrected mean AUC of 0.756 (95% CI: 0.704–0.809) with an optimism of 0.017, suggesting limited overfitting and good internal consistency. DCA demonstrated that, within a threshold probability range of 3%–51%, the net benefit of the scale model exceeded that of the “treat-all” strategy, indicating favorable clinical utility across commonly used threshold probabilities. Details are shown in Fig. 2.

Discussion

Our study developed a sarcopenia risk assessment scale comprising five items, with a maximum total score of 7 points. A score of ≥ 4 points was associated with more than a fivefold increase in sarcopenia risk compared with a score of < 4 points.

According to the updated 2025 AWGS diagnostic criteria, a screening tool does not need to fully reproduce the diagnostic workflow; instead, it should prioritize simple indicators that are closely associated with muscle strength and muscle mass and can be rapidly applied in primary care settings. In line with this principle, the present study drew on key elements of the classic SARC-F instrument. The three items included in the scale—lifting and carrying, maximum walking distance, and stair climbing—correspond to the core domains of “strength,” “assistance with walking,” and “climbing stairs” in the SARC-F scale [15], thereby enabling direct assessment of muscle health from a functional perspective. In both univariate and multivariate regression analyses, all three items showed statistically significant differences between the sarcopenia and non-sarcopenia groups, as expected. Original participant-level data were collected, and optimal cut-off values for each item were determined objectively using ROC curve analysis and the Youden index. Notably, the cut-off values for these three functional items were higher than those reported in previous studies of the SARC-F scale and its modified versions in Chinese populations. This difference should not be interpreted as arbitrary threshold inflation, but rather as a reflection of the relatively preserved functional capacity of community-dwelling older adults. A substantial body of evidence supports the generally low SARC-F scores observed in this population. A 2025 study of 2,453 Chinese community-dwelling older adults reported a mean SARC-F score of only 0.30 ± 0.85 (maximum score 10) [27]. Similarly, a German study found that only 12% of community-dwelling older adults met the screening threshold for sarcopenia [28]. The low sensitivity of SARC-F has also been consistently demonstrated. In a diagnostic study by Zhou et al. (2021) involving Chinese community-dwelling older adults, the sensitivity of the original SARC-F was approximately 12.26% [29]. In the present sample of 371 participants, only one individual had a SARC-F score > 4 ; application of this threshold for initial screening would have resulted in 83 missed cases of sarcopenia. The primary cause of this limited sensitivity lies in the overly stringent cut-off value used in SARC-F. In recent years, attempts to lower the total score threshold (e.g., defining ≥ 2 as a positive result) have reported improved sensitivity of 78%–87%, with AUC values ranging from 0.77 to 0.81 [28, 30]. However, this modification

has been questioned by some experts, who argue that a cut-off as low as 2 may undermine the value of the questionnaire itself. Collectively, these findings suggest that, for community-dwelling older adults who retain basic self-care ability, appropriately relaxed screening criteria are both reasonable and necessary. Nevertheless, simply lowering the total SARC-F cut-off may not represent an optimal solution; instead, greater emphasis should be placed on identifying screening items or item-specific thresholds with stronger diagnostic performance.

The data from this study further confirm that a substantial proportion of community-dwelling patients with sarcopenia do not present with severe functional limitations in the early stage and continue to maintain relatively good activities of daily living. Accordingly, the cut-off values for handgrip strength are recommended to be increased to 12.5 kg for men and 6.5 kg for women, while the threshold for maximum walking distance is raised to 2000 meters. In contrast, the stair-climbing item did not remain in the final scale in the multivariate analysis. This finding may be explained by several factors. First, stair-climbing performance primarily reflects lower-limb function rather than muscle mass per se. Sarcopenia and knee osteoarthritis (KOA) are highly comorbid in older adults [31], and sarcopenia has been shown to be significantly associated with both radiographic and symptomatic progression of KOA [32]. Knee pain may lead older adults to consciously reduce stair-climbing activity, a change more likely driven by joint-protective behavior than by true reductions in muscle mass or function. A study conducted in an Australian community-dwelling older population reported that the stair-climbing item in the SARC-F scale was significantly associated with the chair stand test (RR = 2.0, 95% CI: 1.1–3.5) and gait speed (RR = 0.40, 95% CI: 0.21–0.76), but showed weak associations with lower-limb muscle strength (RR = 0.83, 95% CI: 0.48–1.4) and handgrip strength (RR = 0.57, 95% CI: 0.32–1.0) [33]. These findings suggest that this item is more strongly influenced by non-myogenic factors such as lower-limb pain and balance impairment. As a result, the stair-climbing item may have been partially replaced or attenuated in the multivariate model by more direct indicators of muscle function, including maximum walking distance and lifting and carrying ability.

Aging represents the most well-established risk factor for sarcopenia. The aging process is characterized by motor neuron loss, mitochondrial dysfunction, reduced levels of anabolic hormones (e.g., testosterone, growth hormone, IGF-1), and chronic low-grade inflammation. In addition, satellite cell exhaustion, myonuclear disorganization, and impaired proteostasis contribute to the core pathophysiological mechanisms underlying sarcopenia [34, 35]. In the present study, multivariate logistic regression analysis indicated that community-dwelling older adults aged ≥ 72 years had a 2.72-fold higher likelihood of sarcopenia compared with those aged < 72 years (OR = 2.72, 95% CI: 1.554–4.743), a finding broadly consistent with previous reports [36]. The use of 72 years as a risk threshold aligns with the aging profile of active community-dwelling Asian populations and may facilitate rapid identification of high-risk individuals by community health personnel.

The Yubi-wakka test is a low-cost, easy-to-administer self-assessment tool that shows a significant correlation with appendicular skeletal muscle mass [37]. Both the AWGS 2019 and AWGS 2025 consensus statements have recommended the Yubi-wakka test as a simple alternative to calf

circumference measurement for community-based sarcopenia screening. The present study further demonstrated that a positive Yubi-wakka test is an independent risk factor for sarcopenia in older adults (OR = 3.407, 95% CI: 1.816–6.394), with the strongest diagnostic performance among all included items. However, the weighting assigned to the Yubi-wakka test in the present scale (2 points) is lower than the relative contribution of calf circumference in other widely used screening instruments. For instance, in the Ishii score, calf circumference is incorporated as a core component of the scoring algorithm alongside age and handgrip strength. In the SARC-CalF scale, calf circumference is allocated 10 points and substantially enhances the sensitivity of the original SARC-F. The relatively lower weighting of the Yubi-wakka test in this study may be explained by several factors. First, evidence from a Singaporean Chinese community study suggests that the diagnostic performance of the Yubi-wakka test is intrinsically inferior to that of calf circumference measurement (AUC: 0.581 for finger–ring test vs. 0.788–0.818 for calf circumference, both $P < 0.001$; sensitivity: 55.6% vs. 57.5%–71.8%) [38], particularly among individuals with abdominal obesity [39]. In individuals with obesity, increased subcutaneous fat may lead to an overestimation of calf circumference, resulting in false-negative findings on the Yubi-wakka test. Conversely, in lean older adults, relatively low subcutaneous fat may reduce calf circumference despite preserved muscle mass, leading to false-positive results. Second, the gold standard applied in this study—the AWGS 2025 diagnostic criteria—introduces ASM/BMI as a supplementary index for muscle mass assessment, thereby partially reducing the influence of body size on muscle mass evaluation. Accordingly, the self-assessment tool developed in this study assigns reduced diagnostic weight to the Yubi-wakka test and instead emphasizes a more comprehensive evaluation incorporating multidimensional factors such as physical function, activity level, and mood status, which may better reflect the complex characteristics of community-dwelling populations.

Numerous studies have confirmed a significant bidirectional association between sarcopenia and depressive status [40, 41]. A systematic review and meta-analysis published in 2025 reported that the risk of depression was significantly higher in individuals with sarcopenia (OR = 2.40, 95% CI: 1.87–3.08). Conversely, the risk of sarcopenia was also increased in patients with depression (OR = 1.90, 95% CI: 1.44–2.50), while even depressive symptoms were associated with a higher risk of sarcopenia (OR = 1.38, 95% CI: 1.25–1.53) [42]. A similarly strong longitudinal association has been observed between sarcopenia and cognitive impairment [41, 43–46]. A systematic review and meta-analysis by Amini et al., including 77 studies and 92,058 participants aged ≥ 50 years, demonstrated a significant association between sarcopenia and mild cognitive impairment (MCI) (pooled OR = 1.58, 95% CI: 1.42–1.76) [41]. Sarcopenia and cognitive impairment may share common pathophysiological mechanisms, including chronic inflammation, mitochondrial dysfunction, oxidative stress, and gut microbiota dysbiosis [47]. Based on this evidence, the initial item pool in the present study innovatively incorporated both mood and cognition domains. However, in binary logistic regression analysis, the cognition-related item did not reach statistical significance. This finding may be explained by the high prevalence of subjective memory complaints among community-dwelling older adults; age-related perceived memory decline is common even in the absence of clinically significant cognitive impairment, resulting in low specificity of this item and limited ability to distinguish true MCI cases. Although more precise cognitive assessment tools such

as the MoCA scale could improve diagnostic accuracy, they are not suitable for inclusion as single items in a rapid screening instrument. Ultimately, the mood-related factor was retained as a statistically significant component. Low mood, particularly depressive status, may contribute to elevated cortisol levels through overactivation of the hypothalamic–pituitary–adrenal (HPA) axis, thereby promoting skeletal muscle protein catabolism [48]. In addition, depressive status is often accompanied by reduced physical activity and decreased appetite, which may further accelerate muscle loss. Conversely, functional decline, reduced mobility, and diminished social participation associated with sarcopenia may exacerbate depressive symptoms, forming a vicious cycle of “functional decline–mood deterioration–reduced activity.” Accordingly, incorporation of mood status as a screening indicator for sarcopenia is considered clinically meaningful in the present study.

The univariate analysis in this study showed that both the number of hospitalizations and the number of chronic diseases differed significantly between the sarcopenia and non-sarcopenia groups; however, neither variable entered the final multivariate logistic regression model. In the univariate analysis, a recent history of hospitalization was associated with a higher risk of sarcopenia. The restricted activity, prolonged bed rest, and catabolic state induced by acute illness during hospitalization may all contribute to accelerated muscle loss. Nevertheless, the loss of statistical significance in the multivariate model may be explained by several factors. First, the effect of hospitalization history may be mediated through other variables, such as reduced physical activity and inadequate nutritional intake, and thus be partially captured by activity- and nutrition-related indicators already included in the model. Second, hospitalization history is highly prevalent in older populations, and its effect may overlap with age-related factors and comorbidity burden, reducing its independent explanatory value. Despite this, recent hospitalization should still be considered a clinically relevant risk marker, as it identifies a subgroup of older adults at higher risk of sarcopenia. Comorbidities—particularly cardiovascular disease, chronic obstructive pulmonary disease, and diabetes—have been closely linked to the development and progression of sarcopenia [49–51]. Although the total number of chronic diseases was statistically significant in univariate analysis, it did not remain in the multivariate model. This may be because comorbid conditions contribute to sarcopenia indirectly through pathways involving nutritional status, physical activity, and systemic inflammation, effects that are already reflected in the final model through variables such as reduced maximum walking distance and low mood. In addition, reliance on self-reported chronic disease data may have introduced reporting bias, and the lack of detailed information regarding disease type and severity may have further weakened its independent association.

Based on the initial literature search, dairy intake, high-quality protein intake, weekly frequency of aerobic exercise, and exercise habits in young adulthood were included in the candidate item pool, as these variables have been reported as important risk factors for sarcopenia in previous studies. However, none of these four variables showed statistically significant differences between the sarcopenia and non-sarcopenia groups in univariate analysis, nor did any enter the final multivariate regression model. This finding does not contradict the established protective role of nutrition and exercise in sarcopenia, but rather highlights the inherent difficulty of capturing their long-term, cumulative, and context-dependent effects using relatively crude indicators derived from a single cross-sectional retrospective survey.

From a measurement perspective, all of these variables rely on self-reported recall, and older adults are particularly prone to systematic recall bias when reporting dietary intake, recent physical activity, and even exercise habits from decades earlier. Such non-random measurement error may attenuate true associations between exposure and outcome, thereby obscuring potentially meaningful effects in multivariate analysis.

A more fundamental explanation lies in the fact that the protective effects of nutrition and exercise on sarcopenia do not follow simple linear dose–response relationships, but instead reflect complex biological processes modulated by multiple contextual factors. With regard to nutrition, the acute anabolic response to protein intake varies in magnitude and duration depending on factors such as timing, dose, amino acid composition, and delivery pattern [52]. As a result, single indicators such as “daily high-quality protein intake (g)” or “daily dairy intake (mL)” are unable to capture this multidimensional variability, limiting their ability to predict muscle outcomes.

With respect to exercise, a simple measure of “weekly frequency of moderate-intensity aerobic exercise lasting > 30 minutes” fails to reflect the overall complexity of physical activity exposure. Evidence indicates that higher total physical activity levels, rather than frequency alone, are significantly associated with reduced sarcopenia risk (cross-sectional OR = 0.49, 95% CrI 0.37–0.62) [53]. Even within moderate-to-vigorous aerobic activity, a frequency-based metric does not capture variability in intensity and energy expenditure per session, which may further dilute observed associations. Moreover, resistance training—rather than aerobic exercise—is a central component in sarcopenia prevention. Given that most Chinese community-dwelling older adults do not engage in regular resistance training or structured high-intensity exercise, no related items were included in the present scale.

In summary, although these non-retained variables did not demonstrate independent predictive value in multivariate analysis, they may still represent important contributing factors to sarcopenia in clinical practice and existing literature. The present model prioritizes the selection of direct, easily assessable screening indicators and does not negate the potential role of these factors in the development and progression of sarcopenia. It should also be noted that the target population of this scale is community-dwelling older adults who are able to live independently. For frail individuals who are bedridden, hospitalized, or residing in long-term care facilities, the cut-off values derived from this community-based sample may not be directly applicable due to substantially lower baseline functional status.

Performance and clinical utility of the developed scale

The discriminative ability of the scale (AUC = 0.765) indicates that, when one older adult with sarcopenia and one without sarcopenia are randomly selected, correct differentiation is achieved with a probability of approximately 76.5%. Although this level of performance is lower than that of comprehensive diagnostic tools requiring specialized equipment, it remains clinically meaningful for a fully self-reported questionnaire without instrumental support, as it clearly exceeds random classification (50%). At the optimal cut-off value of 4 points, sensitivity reaches 75.38%, indicating that more than three-quarters of

community-dwelling older adults with sarcopenia are correctly identified. In the context of screening, maximizing sensitivity to minimize missed cases represents the primary objective, which aligns with the intended purpose of the present scale—ensuring that most individuals with potential sarcopenia are captured and directed toward further diagnostic evaluation. Specificity of 59.72% suggests that approximately 40% of non-sarcopenic individuals may be classified as positive at the screening stage; however, these false-positive cases can be excluded during subsequent confirmatory testing. Given that confirmatory procedures (e.g., handgrip strength assessment and BIA-based muscle mass measurement) are low-cost and feasible in community settings, this level of false-positive rate is acceptable for large-scale screening programs. In contrast, reliance on tools with very high specificity but low sensitivity, such as SARC-F, may result in substantial underdetection of true cases, thereby limiting public health impact. Good calibration, as indicated by the Hosmer–Lemeshow test ($P > 0.05$), reflects agreement between predicted risk and observed outcomes without evidence of systematic deviation. This supports stable estimation of sarcopenia probability when individuals are classified as “high risk” (≥ 4 points), thereby enhancing the reliability of clinical interpretation across populations. Internal validation yielded an optimism value of 0.009, suggesting minimal overfitting during model development and strong reproducibility of performance in similar cohorts, which supports future external application. DCA demonstrated that, within a threshold probability range of 3%–51%, the net benefit of applying the scale exceeds that of both “treat-all” and “treat-none” strategies. This range encompasses most practical decision thresholds used in community-based screening and early intervention, indicating that the scale demonstrates not only statistical discrimination but also clinically relevant decision utility.

Based on the total score, a three-level risk stratification framework can be derived (low risk: 0–1 point; moderate risk: 2–3 points; high risk: ≥ 4 points), providing a structured basis for management pathways. Low-risk individuals may be managed through health education without immediate intervention. Moderate-risk individuals may benefit from lifestyle modifications, such as increased physical activity and improved nutritional intake, with periodic reassessment recommended annually. High-risk individuals should be referred promptly to specialized services for confirmatory evaluation using standard measures of muscle strength and muscle mass. This stratified approach directly links screening outcomes to actionable follow-up strategies, avoids the limitation of “screening without subsequent action,” and improves both feasibility and adherence in community implementation.

Strengths and novelty

Compared with existing screening tools, the present scale demonstrates several notable clinical and technical advantages. First, the item set is more comprehensive and incorporates a psychological dimension. The inclusion of a mood component reflects a biopsychosocial framework consistent with the holistic assessment of geriatric syndromes. Second, the items are objective or easily administered. For instance, the Yubi-wakka (finger–ring) test and lifting-and-carrying ability consist of either objective indicators or semi-objective self-assessments, thereby minimizing subjective bias. In addition, the assessment procedures are simple and can be completed by participants themselves or by community

health workers following brief training. Third, the gold standard applied in this study is based on the most recent diagnostic criteria, ensuring contemporary relevance and diagnostic accuracy. Fourth, the scale demonstrates relatively high sensitivity. The sensitivity at the optimal cut-off value is 75.38%, which exceeds that of several mainstream subjective questionnaires (e.g., SARC-F). This characteristic enhances its ability to identify community-dwelling individuals with sarcopenia who might otherwise remain undetected, thereby providing an important window for early intervention. Fifth, the scale enables risk stratification into three levels (low, moderate, and high), allowing more intuitive interpretation and supporting informed decision-making regarding subsequent health interventions.

Limitations and future directions

Although the proposed screening scale demonstrates satisfactory performance, several limitations should be acknowledged. First, the study sample was drawn from only two medical institutions in Jiangnan District, Wuhan, which may introduce selection bias and limit generalizability. Validation in broader geographic regions and more diverse populations is therefore required. Second, the sample size was relatively limited, meeting only the minimum requirement for prediction model development; larger cohorts are needed in future studies. Third, external validation was not performed. Although internal validation using bootstrap resampling was conducted, further evaluation in independent multicenter cohorts is necessary to confirm robustness. Fourth, certain potentially relevant variables were not retained in the final model. As discussed previously, factors such as hospitalization history and number of chronic diseases, although not statistically significant in the final model, may still have clinical relevance and warrant further investigation using larger samples and more refined measurement approaches. Fifth, the cognitive function item showed limited specificity. Future work may consider incorporating brief validated cognitive screening tools (e.g., Mini-Cog) to improve the performance of the cognitive dimension without substantially increasing assessment burden.

Conclusions

In conclusion, based on the AWGS 2025 diagnostic criteria, a simple sarcopenia screening scale for community-dwelling older adults was developed, consisting of five objective and easily administered items: age, lifting and carrying ability, maximum walking distance, Yubi-wakka test, and mood status. The scale demonstrates good discriminative ability ($AUC = 0.765$), ease of administration, and relatively high sensitivity (75.38%), supporting its applicability in primary care and community settings. Future research should focus on multicenter external validation and further exploration of longitudinal associations with clinical outcomes such as falls, fractures, and disability, thereby providing stronger evidence to support early prevention and management of sarcopenia.

Abbreviations

ASM/BMI Appendicular Skeletal Muscle Mass adjusted by BMI

ASMI Appendicular skeletal muscle mass index

AUC Area under the ROC curve

AWGS Asian Working Group for Sarcopenia

BMI Body mass index

DCA Decision curve analysis

EWGSOP European Working Group on Sarcopenia in Older People

FTSST Five Times Sit-to-Stand Test

HPA Hypothalamic–pituitary–adrenal

ICSR International Conference on Sarcopenia Research

IWGS International Working Group on Sarcopenia

KOA Knee osteoarthritis

MCI Mild cognitive impairment

MSRA Mini Sarcopenia Risk Assessment

NHANES National Health and Nutrition Examination Survey

ORs Odds ratios

ROC Receiver operating characteristic

RR Relative risk

SARC-F Simple Questionnaire for Rapid Sarcopenia Screening

SARC-CalF SARC-F + Calf Circumference

VIFs Variance inflation factors

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from the Medical Ethics Committee of Hubei Provincial Hospital of Integrated Chinese and Western Medicine (Approval No. [2024] Lun-Shen-Zi (007)), and all participants provided written informed consent.

Consent for publication

Not applicable.

Availability of data and materials

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Competing interests

The authors declare no competing interests.

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Authors' contributions

Study design: JX, CD, WgX, MY ; Study conduct: all authors; Data collection: XS, LzW; Statistical analysis: JX, ZIL, CD; Data interpretation: JX, ZIL, CD; Manuscript drafting: JX, CD, CjZ; All authors read and approved the final manuscript.

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Authors' information (optional)

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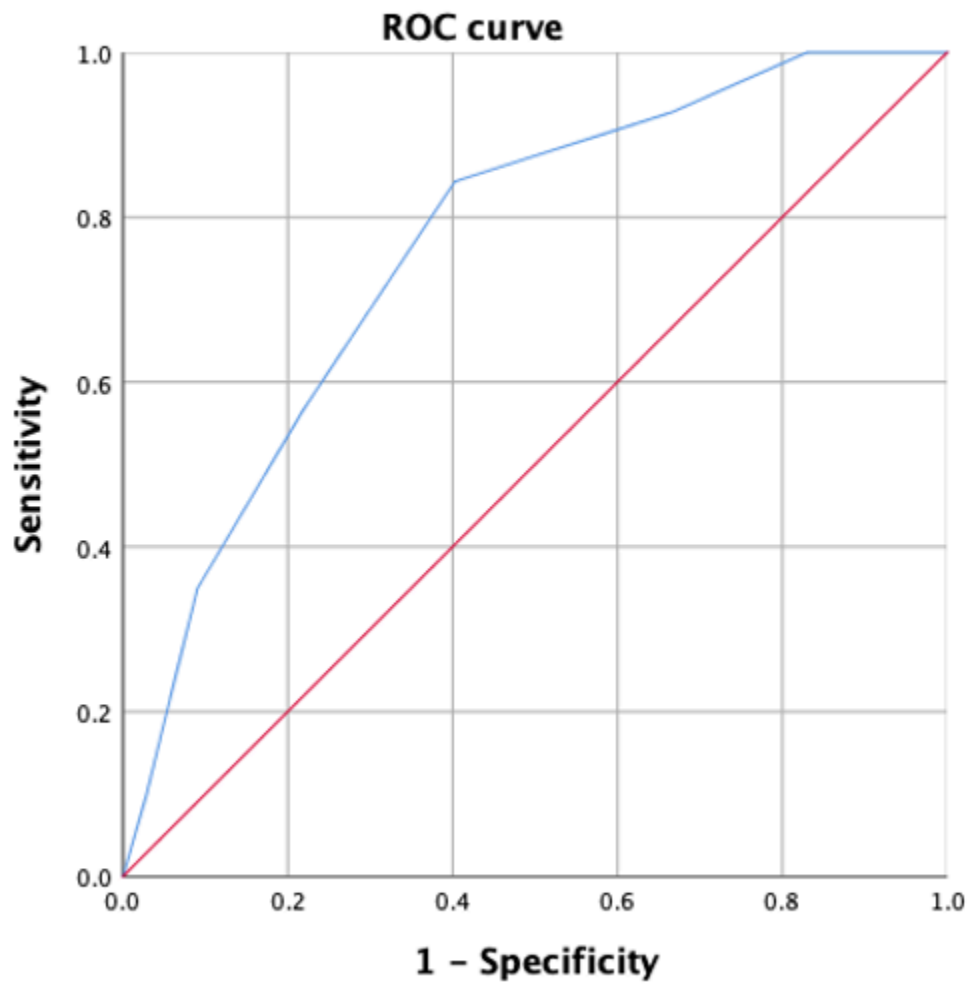
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Figures



The diagonal segment is generated from the bound values.

Figure 1

Receiver operating characteristic (ROC) curve of the sarcopenia screening scale.

Decision Curve Analysis

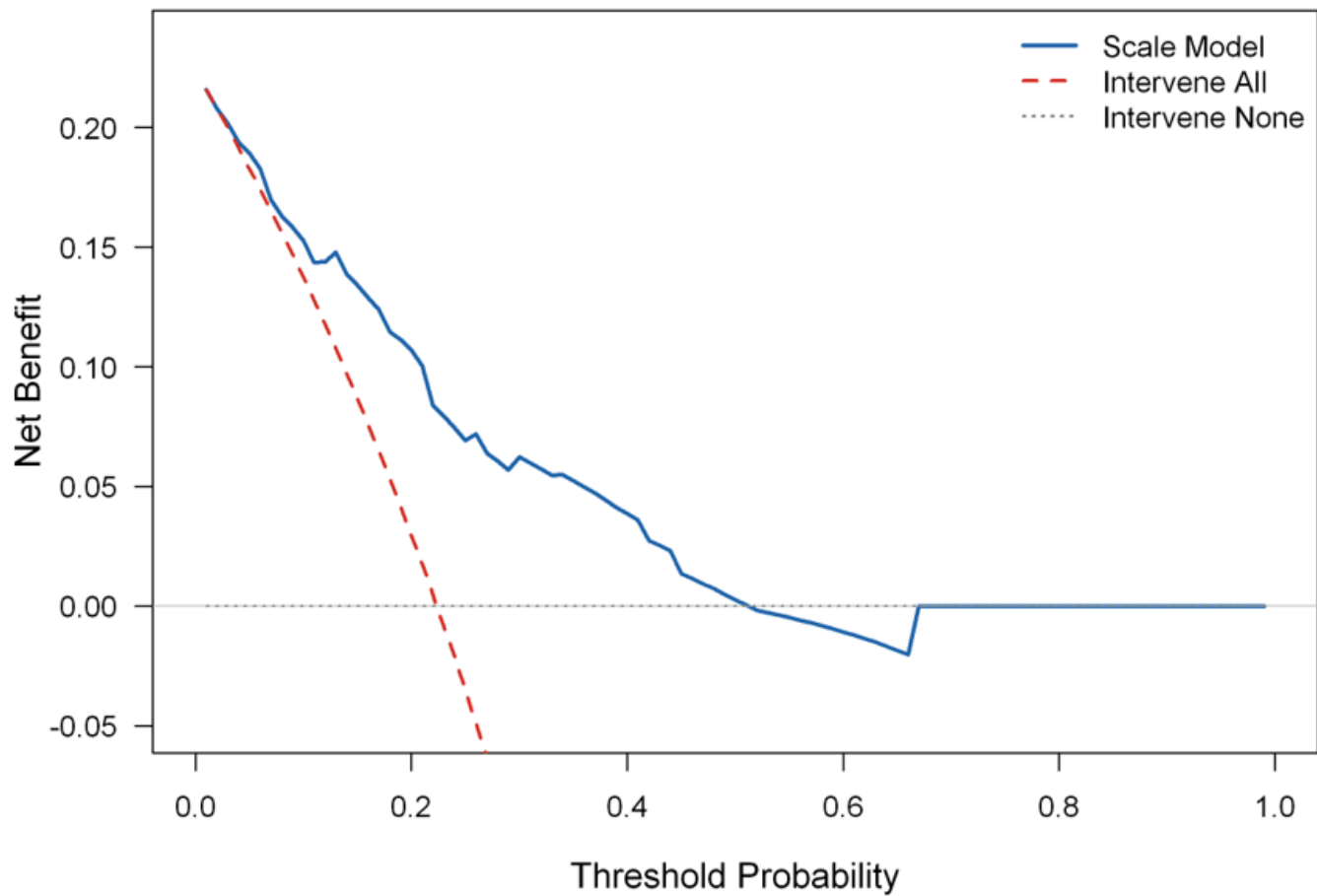


Figure 2

Decision curve analysis (DCA) of the sarcopenia screening scale

Supplementary Files

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- [OriginalQuestionnaireoftheSarcopeniaScreeningScaleforthecommunity.docx](#)