A Comparative Study of the Sarcopenia Screening in Older Patients with Interstitial Lung Disease

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Abstract

Background: The calf circumference (CalF), the strength, assistance in walking, rising from a chair, climbing stairs, and falls (SARC-F) and the SARC-CalF questionnaires for sarcopenia screening have been used by Asian Working Group for Sarcopenia 2019 (AWGS 2019). The aim of this study was to assess accuracy of these three sarcopenia screening tools in patients with interstitial lung disease**.**

Methods: In this cross-sectional study, stable patients with interstitial lung disease were enrolled. The SARC-F, SARC-CalF, and CalF, used in patients with interstitial lung disease, were compared to the diagnostic criteria proposed by AWGS 2019. The accuracy of screening tools was compared using sensitivity and specificity. Moreover, areas under the receiver operating characteristic curves (AUC) were computed.

Results: Seventy eight patients were analyzed, and sarcopenia was identified in 25 (32.1%) patients with interstitial lung disease by the AWGS 2019 criteria. The sensitivity of the CalF was highest (96%) of the three screening tools, while the specificity was 60%. The sensitivity of SARC-F and SARC-CalF were 24% and 68%, while the specificity were 92% and 66%, respectively. The AUCs of CalF, SARC-F, and SARC-CalF in all patients were 0.78, 0.58, and 0.67, respectively.

Conclusions: The CalF is most suitable for screening sarcopenia in patients with interstitial lung disease, while SARC-F and SARC-CalF are not.

Background

Aging is associated with increased susceptibility to a variety of chronic diseases including lung pathologies, such as ILD[1]. Milne et al. have pointed out that frailty is highly prevalent in ILD patients[2]. Frailty and sarcopenia result in a loss of functional independence, where sarcopenia may be a risk factor for frailty[3, 4]. In brief, sarcopenia directly linked to activity limitation and is particularly a huge concern for older patients. Despite knowledge of these risk factors, evaluation of sarcopenia is not common and little is known about its epidemiology in older patients with ILD[5].

Sarcopenia diagnosis and treatment were defined for Asians in the Asian Working Group for Sarcopenia (AWGS) 2014 consensus, and updated by the AWGS 2019 consensus[6]. In AWGS 2019, either calf circumference (CalF), the strength, assistance in walking, rising from a chair, climbing stairs, and falls (SARC-F) questionnaire or SARC-F combined with CalF (SARC-CalF) questionnaire were utilized for case finding.

The SARC-F was proposed in 2013, and is regarded as a simple questionnaire[7]. This questionnaire is also used in case finding in European Working Group on Sarcopenia in Older People (EWGSOP) 2[8]. This questionnaire offers high specificity to diagnose sarcopenia, but poses the issue of low sensitivity. Moreover, several studies have pointed out that the SARC-F underestimates prevalence[9, 10], which, however, can be measured more accurately with the SARC-CalF that adds a measure of CalF to SARC-F[11]. Important to note, ILD patients experience dyspnea with exertion and SARC-F that includes factors such as

activity limitation through exertion may not be suitable for screening of chronic respiratory diseases including ILD. The most suitable choice to evaluate sarcopenia for chronic respiratory diseases with dyspnea between SARC-F, the SARC-CalF and CalF is unknown.

The present study aimed to assess physical performance screening tools for sarcopenia in patients with ILD including the SARC-F, SARC-CalF and CalF in comparison to the diagnostic criteria proposed by the AWGS 2019. Additionally, we aimed to determine the most effective tool to assess sarcopenia.

Methods

Study design

This was a prospective, cross-sectional observational study that enrolled ILD patients ≥ 60 years of age from January 2020 to May 2021. Subjects gave their written, informed consent, and the study was approved by the Human Ethics Review Committee of Nagasaki University Hospital (approval number: 19121610).

Subjects

Patients with ILD, including idiopathic interstitial pneumonias (IIPs), connective tissue disease-associated interstitial pneumonia, and hypersensitivity pneumonitis were recruited at the Department of Respiratory Medicine, Nagasaki University Hospital. Diagnostic criteria for IIPs and hypersensitivity pneumonitis were consistent with the International Consensus Statement[12]. Subjects were included if they were under the care of a respiratory physician, were ambulant, and were clinically stable with no changes in medication for at least four weeks before enrollment. Exclusion criteria were comorbid conditions affecting exercise performance (e.g., musculoskeletal or neurological disorders, cardiac disease), severe cognitive impairment, pregnancy, recent thoracic surgery, and active cancer treatment.

Measurement

ILD-GAP model

The interstitial lung disease-gender, age and lung physiology (ILD-GAP) model was created by adding the ILD subtype variable to the original GAP model[13]. The two lung physiology variables in this model include forced vital capacity (FVC) and diffusion capacity for carbon monoxide (DLco). Points were assigned for each variable to obtain a total point score (range: 0–6). Demographic and clinical information including physical function, biochemistry of blood and pulmonary function test results were obtained from medical records.

The SARC-F Questionnaire, the SARC-CalF Questionnaire, and CalF

The SARC-F Questionnaire was used to measure probable sarcopenia. This questionnaire is composed of five items: strength, assistance in walking, rising from a chair, climbing stairs, and falls[7]. The SARC-F scores range from 0 to 10, with 0 to 2 points for each component [scoring range: 0 (best) to 10 (worst)].

Patients with a total score ≥ 4 were classified as having a risk of sarcopenia[14]. The SARC-CalF questionnaire is a combination of calf circumference and SARC-F, and a score of ≥ 11 points indicates probable sarcopenia. The maximum CalF was measured in a sitting position with hip and knee joint flexed at approximately 90°. CalF was measured at the point of the largest circumference. Calf < 34 cm for males and < 33 cm for females indicated sarcopenia. The CalF item is scored as 0 points if the CalF is > 34 cm for males and >33 cm for females and 10 points if the calf circumference is ≤ 34 cm for males and ≤33 cm for females[11].

Diagnostic Criteria for Sarcopenia

Since the participants were older Japanese patients, they were evaluated according to the AWGS 2019 criteria of sarcopenia[6]. The diagnostic criteria for sarcopenia as used in AWGS 2019 is shown in figure 1. Estimation of sarcopenia at the first stage requires measurement by three screening methods: CalF, SARC-F and SARC-CalF. The second stage involves measurement of gait speed, grip strength, and muscle mass. Based on the AWGS 2019, low muscle strength is defined as handgrip strength < 28 kgf for males and < 18 kgf for females, while low physical performance is characterized as gait speed <1.0 m/s. In addition, body composition and skeletal muscle mass were evaluated in ILD patients using the bioelectrical impedance analysis (BIA) method (InBody 270, InBody Japan, Tokyo, Japan). Low muscle mass diagnosis was defined as skeletal muscle index (SMI) < 7.0 kg/m^2 for males and < 5.7 kg/m^2 for females.

Assessment of peripheral muscle force

Peripheral muscle force was evaluated via measurements of quadriceps and handgrip forces. Peak force developed during a maximal isometric knee extension was used as a measure of quadriceps force (QF). A hand-held dynamometer with a fixing belt (μ-Tas F-1; Anima Corporation, Tokyo, Japan) was used following a standard protocol[15]. The QF for the dominant side was tested in the sitting position with the hip and knee joints flexed at approximately 90°. The handgrip force (HF) was assessed in the dominant hand using a dynamometer (T.K.K.5401; Takei-Kiki-Kogyou Corporation, Niigata, Japan). HF was tested in sitting position with the elbow flexed at 90° and the arms fixed to the body. The average value of three attempts was recorded.

The Short Physical Performance Battery (SPPB)

Physical performance was measured using the SPPB[16], which consists of three measures: walking speed, chair stands, and standing balance. A score from 0 (unable to complete the task) to 4 (best performance possible) was assigned to each measurement. The total score (0–12) was used to estimate overall physical performance level. Similar to previous studies[17-19], patients were separated into low physical performance-related risk (SPPB ≤ 9) or high physical performance-related risk (SPPB > 9).

Functional exercise capacity

The 6-minute walk test was performed based on published guidelines[20, 21]. The greater distance of two attempts was recorded. Oxygen saturation (SpO_2) was monitored continuously throughout both tests

(Konica Minolta Pulsox Me Oximeter, Osaka, Japan). If SpO_2 decreased below 80%, the tests were terminated. Pre-exercise SpO_2 and the lowest SpO_2 during the tests were recorded.

Activities of daily living

Activities of daily living (ADL) were evaluated using the Kats basic ADL scale[22]. The scale evaluates activities including feeding, ability to transfer, dressing, bathing, shopping and transportation. For each of the 6 activities, a score of 0 (dependent) or 1 (independent) was assigned. The sum of scores was used to obtain a measure of ADL performance.

Health-related quality of life

Health-related quality of life (HRQL) was evaluated using the King's Brief Interstitial Lung Disease (K-BILD) health status Japanese version questionnaire[23]. The K-BILD is an ILD-specific HRQL questionnaire that measures health impairment. It is comprised of 15 items in three domains: breathlessness and activities, chest symptoms, and a psychological health. The K-BILD score ranged from 0 to 100, where higher values indicated better health.

Statistical analysis

Baseline characteristics were summarized with frequencies and percentages for categorical data, while means and standard deviations for continuous data. The Shapiro-Wilk test was used to examine data distribution. Comparisons between male and female groups were made with unpaired *t*-tests, Mann-Whitney U tests, or Fisher's exact test. To evaluate the accuracy of screening by SARC-F, the SARC-CalF, and CalF, sensitivity, specificity, positive predictive value (PV+) and negative predictive value (PV-) were calculated for each screening method. The gold standard for calculating sensitivity and specificity was set at AWGS 2019 criteria. ILD-GAP model was used to evaluate the applicability of the three screening methods to ILD patients. To compare the accuracy among the screening tools, receiver operating characteristic curves (ROC) were constructed and area under ROC curves (AUC) were calculated. ROC and AUC were analyzed as categorical data of the 3 screening methods. The level of significance was 0.05 for all statistical tests. All statistical analyses were performed using JMP 15.0 software (SAS Institute Japan, Tokyo, Japan).

Results

Patients' characteristics

The baseline characteristics of the 78 subjects are presented in Table 1. The mean age of patients was approximately 71 years. In the sarcopenia and non-sarcopenia group, patients had diagnoses of idiopathic pulmonary fibrosis (n=10, n=31), connective tissue disease-associated interstitial pneumonia (n=0, n=7), hypersensitivity pneumonitis (n=2, n=2), and IIPs other than IPF (n=12, n=14), respectively. By gender, pulmonary function tests were similar in both groups. The HF and QF as peripheral muscle force were not significantly different between groups with and without sarcopenia. The CalF and SMI were not

significantly different between groups with and without sarcopenia in comparison of males and females in each group separately. The SARC-F and the SARC-CalF scores were not significantly different between sarcopenia and non-sarcopenia groups. In male group, prevalence of sarcopenia was significantly different in all assessment tools. All patients were independent according to the ADL score. In HRQL, the total score of K-BILD questionnaire was within the average range 50-60% for both groups.

Prevalence of sarcopenia

In our patients, the prevalence of sarcopenia was 32.1% according to the AWGS 2019 criteria: males: 31.4%; females: 33.3%. There were no significant differences in the prevalence of sarcopenia between the two sexes. Overall, 24 (96%) patients screened positive for sarcopenia using CalF, 6 (24%) using SARC-F questionnaire, and 17 (68%) using SARC-CalF questionnaire based on the AWGS 2019 criteria.

Sensitivity, specificity and predictive values of sarcopenia screening

The sensitivity of the SARC-F for the detection of case finding in sarcopenia was 24%; conversely, the specificity was 92% (Table 2). Overall, the sensitivity of the CalF was 96%, the highest amongst the three sarcopenia screening tools. The PV+ of all items were low whereas the PV- were relatively high (> 50%) indicating that the probability of a non-sarcopenic subject being classified as having risk for sarcopenia is greater than 50%. The results of the sensitivity–specificity analysis were not affected by high or low ILD-GAP score groups (ILD severity). Furthermore, climbing stairs and CalF provided better sensitivity than other items of SARC-F and SARC-CalF in patients with ILD (Table 3). The CalF alone had the best sensitivity (AUC) in screening sarcopenia compared to SARC-F and SARC-CalF according to AWGS 2019 criteria (Figure 2).

Discussion

The main findings of the present study are as follows: (1) in ILD patients with normal BMI and mild mMRC dyspnea scale, sarcopenia was identified in 25 (32.1%) patients by the AWGS 2019 criteria; (2) the CalF was the most sensitive in identifying sarcopenia compared to SARC-F and SARC-CalF. These screening tools showed a similar trend regardless of the ILD-GAP score (severity of ILD); (3) climbing stairs and CalF items had better sensitivity in the SARC-CalF. To our knowledge, this is the first report comparing the accuracy of SARC-F, SARC-CalF, and CalF in screening sarcopenia in patients with ILD.

Sarcopenia was identified in 25 (32.1%) patients with ILD by the AWGS 2019 criteria. Although, previous studies have reported the sarcopenia prevalence of 5–25% in older population[6, 24–26], the present study indicated a higher prevalence. This highlights the importance of accurate sarcopenia screening to improve patient outcomes. Improvement in survival rate is expected in ILD patients if their disease progression is suppressed by treatment (e.g., antifibrotic drugs). However, it is speculated that aging associated sarcopenia may pose a problem[27]. Therefore, it is important to screen sarcopenia in patients with ILD as early as possible.

In the present study, the SARC-F had low sensitivity, high specificity, low PV + and high PV-. These results are consistent with those in different populations[28–30]. The poor sensitivity reported in this study and several previous studies may suggest that SARC-F is not a suitable screening test for sarcopenia in ILD patients. The issue of underestimation of accuracy by SARC-F was resolved using SARC-CalF that adds a measure of CalF to SARC-F[9]. Mo et al. pointed out that low-to-moderate sensitivity of the SARC-F is not adequate for population wide screening[24]. Similar conclusion was drawn in this study with a small, yet specific group of ILD patients. Moreover, almost all questions in the SARC-F and SARC-CalF are affected by dyspnea through exertion except CalF. Therefore, it was speculated that the SARC-F and SARC-CalF are not suitable for screening sarcopenia in patients with chronic respiratory diseases including ILD. Conversely, the CalF measurement may be the best screening option as it is simple and convenient. It can be effectively used for early evaluation of sarcopenia in ILD patients. Better screening tools for sarcopenia would help identify frail patients and, thus, prompt more frequent referrals for pulmonary rehabilitation leading to health-related quality of life and exercise tolerance.

In SARC-CalF, climbing stairs and CalF had better sensitivity than other items. Dyspnea during exertion is characteristic of chronic respiratory diseases including ILD (e.g., while climbing stair). In this study, unlike previous studies that examined SARC-F items, the sensitivity was highest for climbing stairs (57.1%) among the items that involve exertion[25]. Based on the results of the present study, development of a new sarcopenia screening tool for chronic respiratory diseases is desirable as SARC-F and SARC-CalF are not suitable.

This study has several limitations. Firstly, the sample size was small and the study was a single-center trial. Larger, multicenter studies are needed to consider the development of a new sarcopenia screening tool. Secondly, in ILD patients excluding IPF, corticosteroids are one of the most common treatment options employed. However, corticosteroids decrease skeletal muscle function in ILD patients with mild symptoms[31] and are an independent risk factor for developing sarcopenia[32]. This suggests that the risk of developing sarcopenia is higher in ILD patients commonly treated by corticosteroids. Since our patients had numerous ILDs for which steroids are not prescribed, relationship between corticosteroid use and sarcopenia could not be evaluated using multivariable analysis. Larger studies are needed to consider the influence of corticosteroid use on developing sarcopenia in ILD patients. Thirdly, when using the SARC-F and the SARC-CalF to screen for sarcopenia according to the AWGS 2019 criteria, it is necessary to adjust the cut-off values that are suitable for chronic respiratory diseases. Finally, we used BIA for the assessment of SMI instead of CT, MRI or DEXA. Although, these methods are more precise, BIA prevents exposure to x-rays and provides a more efficient solution to measuring body composition and skeletal muscle mass. As a result, the AWGS 2019 criteria recommends BIA as an alternative option for muscle measurement.

Conclusion

In conclusion, approximately 30% patients with ILD were found to have sarcopenia based on the AWGS 2019 criteria. Calf circumference had the best sensitivity out of the three screening tools and is, thus, most

suitable for screening sarcopenia in patients with ILD. In the future, development of a new sarcopenia screening tool for chronic respiratory diseases should be considered.

Abbreviations

ADL: activities of daily living; AUC: area under receiver operating characteristic curves; AWGS: the Asian Working Group for Sarcopenia; BIA: bioelectrical impedance analysis; BMI: body mass index; CalF: calf circumference; DL_{CO}: diffusion capacity for carbon monoxide; EWGSOP: European Working Group on Sarcopenia in Older People; $\%FEV_1$: percentage of forced expiratory volume in one second; FEV_1 / FVC: forced expiratory volume in one second / forced vital capacity; HF: handgrip force; HRQL: health-related quality of life; IIPs: idiopathic interstitial pneumonias; ILD: interstitial lung disease; ILD-GAP model: interstitial lung disease-gender, age, lung physiology; IPF: idiopathic pulmonary fibrosis; K-BILD: King's Brief Interstitial Lung Disease; mMRC dyspnea; modified Medical Research Council dyspnea; 6MWD: 6-minute walking distance; $PaCO_2$: partial pressure of carbon dioxide; PaO_2: partial pressure of oxygen; PV+: positive predictive value; PV-: negative predictive value; %pred: percent predicted; QF: quadriceps force; ROC: receiver operating characteristic curves; SARC-F: strength, assistance in walking, rising from a chair, climbing stairs, and falls; SARC-CalF: SARC-F combined with calf circumference; SMI: skeletal muscle index; SpO_2: oxygen saturation SPPB: Short Physical Performance Battery; %FVC: percentage of forced vital capacity

Declarations

Ethics approval and consent to participate

The subjects gave their written, informed consent. The study was approved by the Human Ethics Review Committee of Nagasaki University Hospital (approval number: 19121610) and was conducted in accordance with the amended Declaration of Helsinki.

Consent for publication

Not applicable.

Availability of data and materials

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Authors' contribution

MH, NS, HI, HT, HM, and RK planned the study. MH, HI, TM, MO, HN, and RT collected the data. MH, NS, YK, SS, SAH, YI, and RK performed the statistical analysis and drafted the manuscript. MH, NS, HI, SAH, YI, HT, HM, and RK participated in the design and coordination of study. All authors read and approved the final manuscript.

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Tables

Table 1. Patients' characteristics

	Overall	Male (n=51)			Female (n=27)		
	(n = 78)	Sarcopenia (n = 16)	Non-sarcopenia (n = 35)	p-value	Sarcopenia (n = 9)	Non-sarcopenia (n = 18)	p-value
Age, years	71 (67 to 77)	73 (68 to 77)	71 (67 to 79)	0.528	72 (66 to 76)	71 (64 to 77)	0.641
BMI, kg/m^2	24 (20 to 26)	23 (20 to 28)	25 (22 to 26)	0.631	23 (18 to 31)	23 (18 to 27)	0.734
Diagnosis, IIPs / other ILDs	49 / 29	11 / 5	27 / 8	0.730	4 / 5	7 / 11	1.000
Corticosteroid, %	12 (15.4)	3 (18.8)	2 (5.7)	0.309	4 (22.2)	3 (33.3)	0.653
Antifibrotic drugs, %	16 (20.5)	3 (18.8)	9 (25.8)	0.730	1 (11.1)	3 (16.7)	1.000
Long-term oxygen therapy, %	11 (14.1)	5 (31.3)	4 (11.4)	0.118	0	2 (11.1)	0.539
ILD-GAP score (point)	3 (2 to 4)	3 (2 to 4)	3 (3 to 4)	0.824	2 (1 to 5)	2 (1 to 2)	0.522
mMRC dyspnea scale (grade)	2 (1 to 2)	2 (1 to 3)	1 (1 to 2)	0.495	1 (1 to 2)	1 (1 to 2)	0.563
$PaCO_2$ at rest, mmHg	41 (38 to 46)	39 (36 to 42)	42 (38 to 51)	0.098	43 (41 to 59)	41 (37 to 59)	0.487
PaO_2 at rest, mmHg	80 (63 to 91)	87 (73 to 95)	73 (61 to 88)	0.178	83 (75 to 87)	80 (48 to 98)	0.938
FVC, %	85 (68 to 97)	85 (65 to 89)	87 (71 to 97)	0.368	76 (56 to 117)	83 (71 to 103)	0.641
FEV_1, %pred	90 (75 to 101)	92 (77 to 101)	91 (79 to 99)	0.932	75 (56 to 123)	86 (70 to 110)	0.641
FEV_1 / FVC, %	78 (72 to 86)	81 (72 to 88)	77 (71 to 84)	0.374	79 (69 to 86)	84 (73 to 86)	0.771
DL_{CO}, %	64 (45 to 80)	74 (66 to 83)	60 (53 to 78)	0.090	50 (36 to 88)	61 (40 to 84)	0.771
KL-6, U/ml	715 (451 to 1165)	663 (519 to 1255)	794 (399 to 1118)	1.000	629 (305 to 1127)	711 (422 to 1491)	0.501
HF, kgf	26 (20	27 (22 to	29 (26 to	0.152	19 (13 to	19 (16 to	0.504

	to 33)	36)	36)		22)	23)	
QF, kgf	28 (19 to 35)	31 (20 to 39)	34 (27 to 37)	0.350	17 (12 to 23)	19 (14 to 26)	0.217
SMI (kg/m^2)	7 (6 to 7)	7 (6 to 7)	7 (7 to 8)	0.410	6 (4 to 6)	6 (6 to 7)	0.400
SPPB (point)	11 (11 to 12)	12 (10 to 12)	12 (11 to 12)	0.614	12 (11 to 12)	12 (11 to 12)	0.633
Calf circumference (cm)	33 (30 to 35)	34 (30 to 37)	34 (31 to 35)	0.699	31 (29 to 36)	33 (30 to 35)	0.589
SARC-F (point)	1 (0 to 2)	1 (0 to 4)	1 (0 to 2)	0.891	2 (1 to 4)	2 (0 to 3)	0.581
SARC-CalF (point)	2 (0 to 11)	4 (0 to 12)	1 (0 to 2)	0.415	12 (1 to 14)	8 (0 to 13)	0.320
Prevalence of sarcopenia, %							
CalF	24 (53.3)	15 (93.8)	10 (28.6)	< 0.001	9 (100)	11 (61.1)	0.030
SARC-F	19 (27.9)	4 (25.0)	2 (5.7)	0.047	2 (7.4)	2 (11.1)	0.582
SARC-CalF	8 (18.6)	10 (62.5)	8 (22.9)	0.006	7 (77.8)	10 (55.6)	0.260
6MWD, m	424 (355 to 500)	405 (252 to 497)	445 (392 to 500)	0.251	392 (352 to 532)	421 (361 to 523)	0.959
ADL score	6 (6 to 6)	6 (6 to 6)	6 (6 to 6)	0.619	6 (6 to 6)	6 (6 to 6)	0.480
K-BILD	54 (47 to 64)	55 (44 to 69)	55 (49 to 62)	0.992	50 (43 to 64)	53 (46 to 64)	0.486
Psychological symptoms	51 (43 to 63)	55 (43 to 72)	52 (41 to 59)	0.512	45 (41 to 58)	48 (42 to 62)	0.817
Breathlessness and activities	44 (34 to 53)	40 (33 to 55)	44 (38 to 53)	0.448	38 (29 to 51)	50 (35 to 53)	0.267
Chest symptoms	73 (64 to 85)	73 (54 to 85)	73 (64 to 85)	0.471	64 (38 to 79)	73 (64 to 76)	0.125

Notes: Categorical variables were analyzed using Fisher's exact test, while continuous variables with unpaired t-tests and Mann-Whitney U test . Values are median (interquartile range) or numbers (percentage) of subjects.

Abbreviations: ADL score: activities of daily living score; BMI: body mass index; CalF: calf circumference; DLCO: diffusion capacity for carbon monoxide; %FEV1: percentage of forced expiratory volume in one second; FVC: forced vital capacity; HF: handgrip force; IIPs: idiopathic interstitial pneumonias; ILD-GAP: interstitial lung disease-gender, age, lung physiology score; K-BILD: King's Brief Interstitial Lung Disease: KL-6: Krebs von den Lungen-6; mMRC: modified Medical Research Council; 6MWD: six-minute walking distance; PaCO2: partial pressure of carbon dioxide; PaO2: partial pressure of oxygen; %pred: percent predicted; QF: quadriceps force; the SARC-F: the strength, assistance in walking, rising from a chair, climbing stairs, and falls; SARC-CalF: SARC-F combined with calf circumference; SMI: skeletal muscle index; SPPB: Short Physical Performance Battery; %VC: percentage of volume capacity.

Table 2. Sensitivity, specificity and predictive values of three sarcopenia screening in patients with ILD.

	Sensitivity, %	Specificity, %	PV+	PV-
All patients				
Calf circumference	96.0	60.0	53.3	97.0
SARC-F	24.0	92.0	60.0	72.1
SARC-CalF	68.0	66.0	48.6	81.4
Low ILD-GAP score < 3				
Calf circumference	100	41.0	47.4	100
SARC-F	11.1	94.0	50.0	66.7
SARC-CalF	77.8	53.0	46.7	81.8
High ILD-GAP score ≥ 3				
Calf circumference	91.7	72.0	57.9	95.5
SARC-F	33.3	93.0	66.7	77.1
SARC-CalF	58.3	72.0	46.7	80.8

Abbreviations: ILD: interstitial lung disease; ILD-GAP: interstitial lung disease-gender, age, lung physiology score; PV+: positive predictive value, PV-: negative predictive value; SARC-F: the strength, assistance in walking, rising from a chair, climbing stairs, and falls; SARC-CalF: SARC-F combined with calf circumference.

Table 3. Sensitivity, specificity and predictive values of items of the SARC-F and calf circumference in screening for sarcopenia in patients with ILD.

SARC-CalF	Positive screening	Sarcopenia AWGS 2019			
	n (%)	Sensitivity, %	Specificity, %	PV+	PV-
Strength	29 (34.5)	33.3	69.0	36.0	66.0
Assistance in walking	8 (9.5)	71.4	72.0	20.0	96.2
Rising from a chair	11 (13.1)	44.4	70.0	16.0	90.1
Climbing stairs	48 (57.1)	34.1	71.0	60.0	45.3
Falls	16 (19.0)	33.3	68.0	20.0	81.1
Calf circumference	48 (57.1)	100	51.0	50.0	100

Abbreviations: AWGS: the Asian Working Group for Sarcopenia; ILD: interstitial lung disease; PV+: positive predictive value, PV-: negative predictive value; SARC-F: strength, assistance in walking, rising from a chair, climbing stairs, and falls; SARC-CalF: the SARC-F combined with calf circumference.

Figures

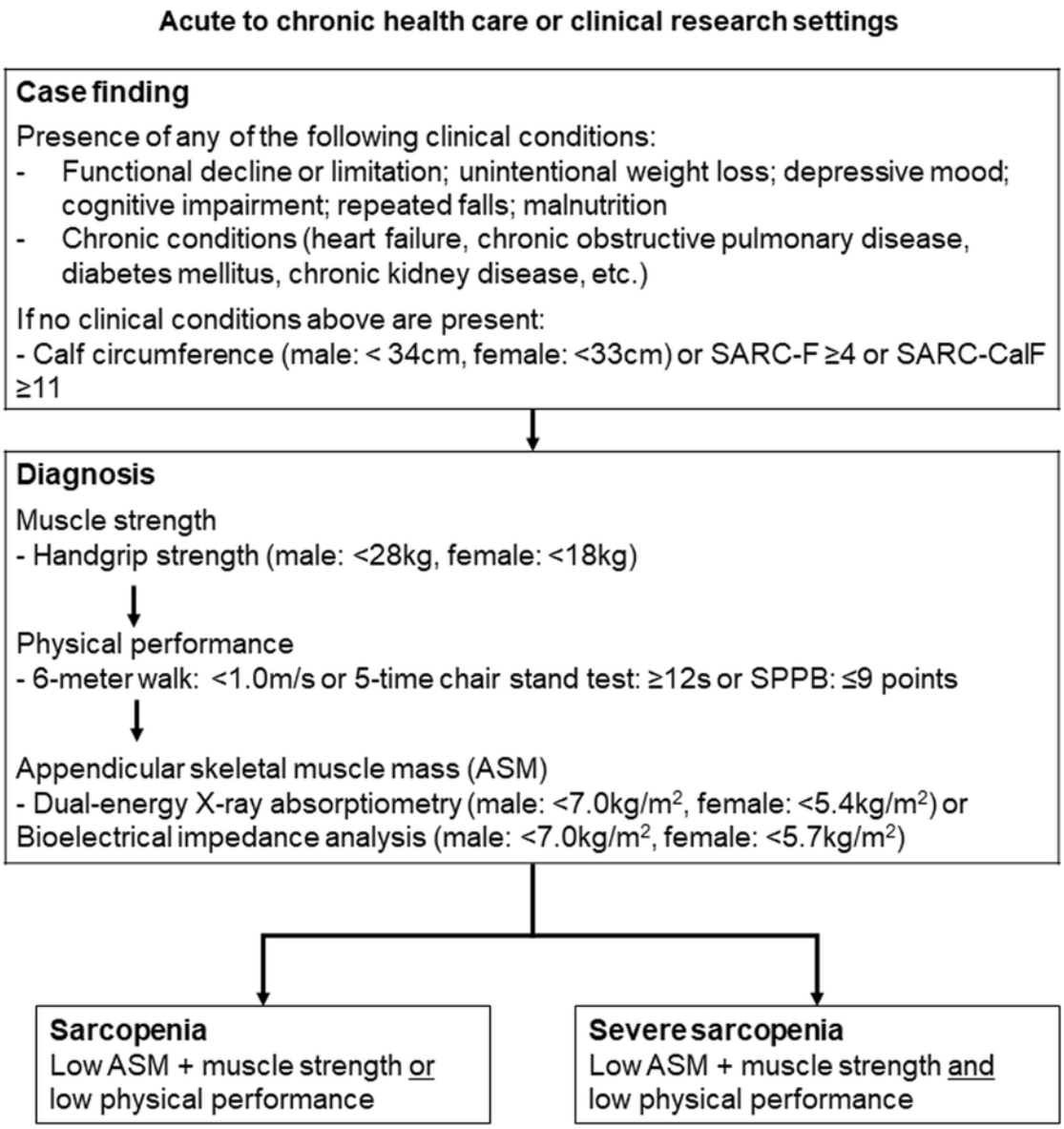

Figure 1

The diagnostic criteria for sarcopenia used by the Asian Working Group for Sarcopenia 2019
Abbreviations: the SARC-F: the strength, assistance in walking, rising from a chair, climbing stairs, and falls; the SARC-CalF: the SARC-F combined with calf circumference; SPPB: short physical performance battery.

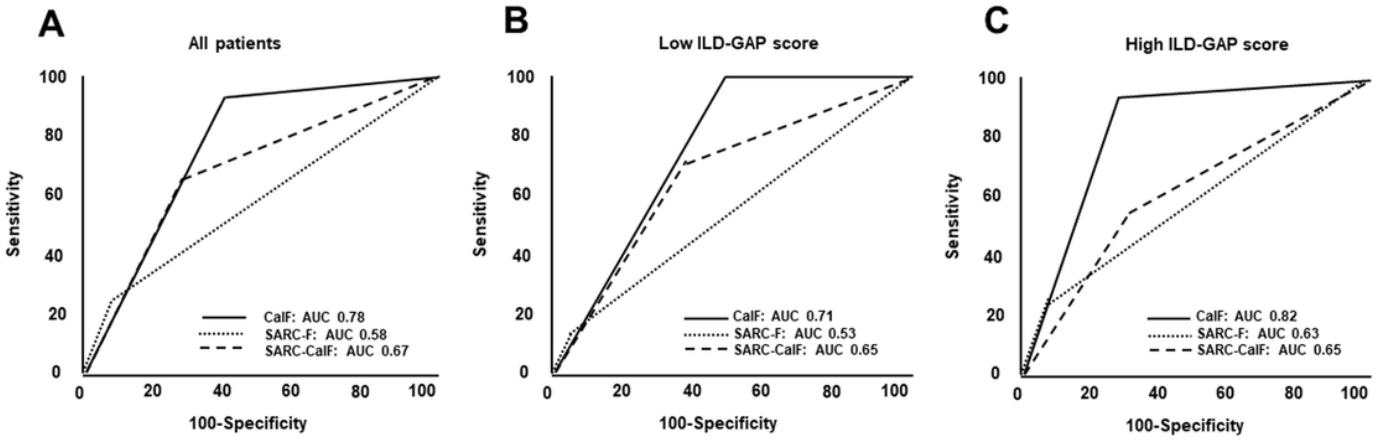

Figure 2

The ROC curves of three screening methods according to AWGS 2019. A) All patients, B) Low ILD-GAP score group, C) High ILD-GAP score group. Abbreviations: AUC: area under the curve; CalF: calf circumference; ROC: receiver operating characteristic; the SARC-F: the strength, assistance in walking, rising from a chair, climbing stairs, and falls; the SARC-CalF: the SARC-F combined with calf circumference.