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Cultural Contexts Meet Clinical Precision: A Systematic Review and Meta-Analysis of Sarcopenia Screening Tools in Global Aging Communities

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Abstract

In an aging world population, prevention is essential because sarcopenia, a loss of muscular mass and function brought on by aging, significantly raises health risks and healthcare expenses. This PRISMA 2020-compliant systematic review (PROSPERO: CRD42024512949) evaluates the diagnostic performance of sarcopenia screening tools for community-dwelling older adults. We analyzed 27 studies (21,271 older adults) assessing eight tools. Databases were searched until February 20, 2024. While questionnaire-only tools performed worse (AUC: 0.68), tools that combined various approaches exhibited the highest accuracy (AUC: 0.89), and the performance of anthropometric instruments was good (AUC: 0.84). The Ishii tool showed the best performance (AUC: 0.89 [0.85–0.92]), and SARC-F the lowest (AUC: 0.68 [0.62–0.73]). Subgroup analysis revealed more studies and greater heterogeneity in Asia, likely due to cultural, lifestyle, and diagnostic criteria. Culturally adapted, multi-method strategies are needed to improve early detection and care.

Keywords: Sarcopenia, Screening Tools, Diagnostic Performance, Meta-Analysis.

Introduction

To highlight the importance of tackling the health issues of aging populations worldwide, the World Health Organization (WHO) declared 2021–2030 the Decade of Healthy Ageing (WHO, 2022). Skeletal muscle mass, strength, and function deteriorate with age; after age 60, muscle mass decreases by 1%, and strength decreases by 2.5–3% yearly (Franceschi et al., 2018; Kirk et al., 2020). In 2016, the WHO formally recognized sarcopenia as a disease, citing this

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physiological decrease as a contributing component. About 9.9% to 40.4% of the aged population suffers from sarcopenia, which is linked to a higher risk of falls, fractures, functional disability, and death (Beaudart et al., 2017; Bruyère et al., 2019; Liu et al., 2023).

Furthermore, because waning strength jeopardizes independence and heightens the fear of becoming a burden, numerous older persons view sarcopenia as more than just a loss of muscle; it is a rupture in identity (Rush et al., 2013; Soares et al., 2023). Research shows that frailty and sarcopenia are related, and older persons correlate sarcopenia to unfavorable perceptions. This demonstrates a larger opposition to being perceived as weak, sick, reliant, or needing medical attention (Lewis et al., 2025). The psychological impact of sarcopenia was highlighted by several older persons who experienced emotional anguish and frustration as a result of it (Thomas et al., 2022). Economic austerity has made these differences even worse; in Europe, aging populations have been disproportionately harmed by pension cuts and disjointed healthcare systems, turning sarcopenia from a medical diagnosis into a social determinant of health (Walsh et al., 2017). With an anticipated cost per person of \$260 in 2019, sarcopenia has a substantial financial impact on the health system, amounting to \$40.4 billion in the US. Ethnicity affects the costs; non-Hispanic Black women pay \$25, whereas Hispanic women pay \$548 (Tagliafico et al., 2022).

Early sarcopenia screening has been promoted as a crucial tactic for prompt intervention to solve this complicated issue. Decreased chance of hospitalization, early mortality, and muscle loss (Cruz-Jentoft et al., 2018; Gallo, 2024; Iragorri & Spackman, 2018). Screening tools now in use include physical performance tests (e.g., handgrip strength, gait speed), anthropometric measurements (e.g., calf circumference (CC)), middle upper arm circumference (AC, MUAC), BMI), and questionnaires (e.g., SARC-F, MSRA5, MSRA7) (Mohd Nawi et al., 2019). Although administering questionnaires is quick and straightforward, memory issues may lower accuracy. Despite their objectivity, physical examinations depend on patient consent and can be biased by the investigator.

Our study examines sarcopenia screening methods through a humanistic, person-centered lens, emphasizing cultural and social factors to promote equity and dignity for older adults while addressing concerns about diagnostic accuracy. These results will help medical practitioners choose the best instruments for specific groups and direct the creation of better screening techniques. This research will help guide public health initiatives and improve the health of community-dwelling older persons.

Methods

Study Protocol

The protocol for our systematic review was registered on the PROSPERO platform (registration number CRD42024512949). Our manuscript was prepared following the guidelines outlined in the PRISMA 2020 statement.

Eligibility Criteria

Inclusion criteria: (1) Community-dwelling adults aged ≥ 60 ; (2) Studies assessing sarcopenia screening tool accuracy with sensitivity, specificity, AUC, PLR, NLR; (3) Standard diagnostic criteria: EWGSOP, EWGSOP2, AWGS, FNIH, or IWGS; (4) Published in English to align with journal submission, though this introduced language bias and excluded non-English studies.

Exclusion criteria: (1) Meeting notes, letters, reviews, comments, editorials, or grey literature, ensuring standardized, peer-reviewed studies; (2) Studies with insufficient/inaccurate data, even

after contacting authors; (3) Duplicates or those without full text; (4) Studies on hospitalized, nursing home, primary care, social center, or outpatient populations, as sarcopenia screening tools focus on early detection in independent older adults, where prevention is more effective. In institutional settings, sarcopenia is often more advanced, requiring different diagnostic approaches.

Search Strategy

A systematic search of PubMed, Embase, Scopus, Google Scholar, and ResearchGate databases was conducted 10 years ago, and the literature retrieval date was February 20, 2024. The search strategy included four components based on the elements of the PIRD (Munn et al., 2018):

(1) **Population (P):** Older people: Elderly OR Aged Senior OR Geriatric OR Older OR Retirees OR Pensioners OR Gerontological

(2) Reference Standard (R): Sarcopenia OR AWGS OR EWGSOP OR IWGS OR FNIH

(3) **Index Test (I)** Sarcopenia screening Tools: Screening OR SPSM OR MSRA OR Ishii score OR SARC-F OR SARC-F-EBM OR SARC-CalF OR U-TEST OR SarSA-Mod OR Calf circumference OR SARCO-GS

(4) **Diagnostic Accuracy (D)**: Sensitivity OR Specificity OR Likelihood Ratios OR PLR OR NLR OR predictive value OR PPV OR NPV OR ROC Curves OR AUC

The search used advanced mode with the Boolean operator "AND" to combine four components. A detailed search strategy for the four databases is in Appendix A. To ensure completeness, references from relevant studies and key journals on sarcopenia and geriatrics were manually screened for missing studies.

Study Selection and Data Extraction

After removing duplicates using EndNote, two independent reviewers (W.S & T.N) screened titles and abstracts using the inclusion and exclusion criteria. Full texts were reviewed when both reviewers deemed a study relevant or uncertain. Disagreements were resolved through discussion, with a third reviewer (H.T.N) making the final decision if necessary. The level of agreement between reviewers was quantified using Cohen's kappa statistic to assess inter-rater reliability. References of included studies were examined for additional eligible records. Three reviewers (H.T.N, A.W, and T.T.N) independently screened titles and abstracts of studies published in English. Full texts were then assessed for eligibility, with reasons for exclusion recorded. To ensure the inclusion of recent and relevant studies, we limited the selection to studies published between January 2014 and February 2024.

Data extraction was performed by three reviewers (H.T.N, C.N.L, and T.N) and verified by (W.S, D.T.N.H, and C.N.L). Extracted information included author names, publication year, country, study population, sample size, age, sex, reference standard for sarcopenia, cutoff values, sensitivity, specificity, PLR, NLR, PPV, NPV, AUC, Kappa statistic, ICC, Cronbach's α , statistical findings, and conclusions. Disagreements during data extraction were quantified using Cohen's kappa statistic, and final decisions were made through discussion with a third reviewer (T.T.N). To minimize bias arising from different diagnostic criteria, we agreed that studies using multiple diagnostic criteria would apply the latest AWGS criteria for Asian countries and the updated EWGSOP criteria for other regions.

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Following PRISMA-DTA recommendations, two reviewers (H.T.N. & C.N.L.) evaluated studies using QUADAS-2, which covers four domains: patient selection, index test, reference standard, and flow and timing. Each domain was rated for risk of bias and applicability as "Low," "High," or "Unclear," with discrepancies resolved by C.S. The COSMIN checklist assessed measurement properties, focusing on content validity, construct validity, reliability, internal consistency, cross-cultural validity, and criterion validity. Scores ranged from 1 (inadequate) to 4 (excellent), with the lowest score in each category determining the overall rating.

Statistical Analysis

Funnel plots were used to detect potential publication bias, while forest plots displayed individual study outcomes, presenting pooled estimates of diagnostic accuracy and confidence intervals. These visual tools provided insights into the consistency of results and the performance of screening tools.

Data Analysis

R software (version 4.3.1) was used for statistical analysis and data synthesis, with the "mada" package for diagnostic test accuracy. Meta-analyses were conducted if at least two studies were available for an index test. Although four studies are typically recommended for robustness, sarcopenia research is still emerging, and excluding tools with fewer studies could overlook promising ones.

Bivariate random-effects models calculated pooled estimates of sensitivity, specificity, PLR, NLR, and AUC. An AUC of ≥ 0.9 indicates high accuracy, 0.7–0.9 moderate, and 0.5–0.7 low. If fewer than two studies were available, individual 2x2 tables were constructed instead. Forest plots showed pooled estimates and heterogeneity (I² statistic), and funnel plots assessed publication bias, with symmetry indicating low risk and asymmetry suggesting bias.

Results

Study Selection



Figure 1. Selection of Studies

Figure 1 presents the PRISMA flow diagram outlining the study selection process. Initially, 9,595 publications were identified. After eliminating duplicates, 8,903 titles were screened, excluding 539 publications based on their abstracts. Subsequently, full-text retrieval was sought for 153 publications, of which 74 were excluded. After assessing 79 studies for eligibility, 47 were excluded for reasons detailed in Figure 1. Ultimately, 32 studies were included in the final review.

1740 Cultural Contexts Meet Clinical Precision: A Systematic Review **Risk of Bias in Studies**



Figure 2. Checking Risk of Bias via QUADAS-2

Among the 32 included studies, 4 had a low risk of bias in all 7 QUADAS-2 items, 15 had a low to moderate risk, and 13 had a moderate to high risk. Patient selection bias was mainly due to convenience sampling and voluntary participation, but systematic selection and well-applied inclusion/exclusion criteria helped to minimize its impact. Reference standard bias was related to using low-frequency (not multi-frequency) BIA machines or predictors of muscle mass by the anthropometric equation. Applicability concerns were generally low, with some unclear risks due to small sample sizes or unrepresentative convenience sampling. Index test bias mainly stemmed from non-predefined thresholds and descriptions of insufficient screening tool measurement methods. After careful consideration, we decided to exclude four studies that did not measure muscle mass by specific machines such as BIA or DEXA to limit selection bias. Because of that, one study was excluded because the MUAC tool had only one study left, which could not be included in the meta-analysis. Finally, 27 studies were included in the further analysis.

Stability and reliability analysis using SROC curves showed that the Ishii instrument was the most reliable and stable. Generally, combined instruments like Ishii, SARC-CalF + AC, and SARC-CalF performed well, with their composite estimates (red diamond) situated close to the upper left corner (indicating low false positives and high sensitivity) and showing consistent results across studies (small confidence regions). In contrast, the questionnaire-only instrument (MSRA7 > MSRA5 > SARC-F) had the least reliability (Figure 3)



Figure 3. The SROC Curve for Eight Sarcopenia

The funnel plots for sensitivity, specificity, and AUC show symmetry, suggesting no significant publication bias. Although the confidence regions are relatively broad, indicating some variability in precision, there is evidence of heterogeneity in some cases, particularly for sensitivity and AUC. The overall summary estimates for each metric are stable; we further analyze the forest plot for heterogeneity to get a more definitive conclusion. (Appendix E,F,G,H)

The GRADE framework was used to assess the certainty of pooled diagnostic accuracy; only SARC-F+ AC tool showed high-certainty evidence across all diagnostic measures. Most other tools had moderate certainty, with lower PPVs than NPVs, suggesting more substantial rule-out utility (Appendix I)

Study Characteristics

N		Count		Refe	Study	Pr ev	Sai ger	mple nder)	size	(age,
N 0	Author_y ear	ry/ Conti nent	Tool validation	renc e stan dard	desig n	ale nc e of	M a l e	Fe m al e	T ot al	Age (mea n)

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						sar co pe nia				
1	S. W. Huang et al/2023 (Huang et al., 2023)	China/ Asia	AB3C model, CC, SARC-F, IShii	AW GS 2019	Cross - sectio nal	11. 90 %	5 2 2	47 4	99 6	68.7 ± 10.3
2	Li R et al./2020 (Li et al., 2020)	China/ Asia	cSARC- CaIF, SARC-F, SARC-Calf	AW GS 2019	Cross - sectio nal	8.6 0%	5 4 6	46 3	10 09	68.1 ± 6.3
3	Yi-han Mo BSc et al/2020 (Mo et al., 2021)	China/ Asia	CC, SARC- F, SARC- Calf	AW GS 2019	Longi tudina 1 + Cross - sectio nal	25 %	3 4 7	70 3	10 50	70.3 ± 7.5
4	O.Rosas - Carrasco et al/2023 (Rosas- Carrasco et al., 2023)	Mexic o/ South Ameri ca	SARCO- GS, SARC- F, SARC- Calf	EW GSO P2	Cohor t study	54. 60 %	1 6 9	68 3	85 2	68.9 ± 10.21
5	Shinya Ishii /2014 (Ishii et al., 2014)	Japan/ Asia	Ishii	EW GSO P	Cross - sectio nal	14. 20 %	9 7 7	99 4	19 71	≥65
6	J.Zhou et al/ 2022 (Zhou et al., 2022)	China/ Asia	SARC-F, SARC-F + AC, SARC- Calf, SARC- Calf + AC	AW GS 2019	Cross - sectio nal	26. 40 %	1 9 9	20 2	40 1	70.51 ± 6.18
7	Melissa Rose Berlin Piodena- Aportader a et al/ 2022 (Piodena- Aportader a et al., 2022)	Singa pore/ Asia	СС	AW GS 2019	Cross - sectio nal	17. 40 %	4 8	12 8	17 6	66.8 ± 7.1

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8	Feng-Juan Hu et al/2021 (FJ. Hu et al., 2021)	China/ Asia	MUAC, CC	AW GS 2019	Cross - sectio nal	29. 60 %	1 6 1 5	28 94	45 09	≥50
9	Roma Krzymińs ka- Siemaszk o/2020 (Krzymin ska- Siemaszk o et al., 2020)	Polan d/ Europ e	SARC-F, SARC-Calf, SARC-F + EBM	EW GSO P2	Cross - sectio nal	13. 90 %	3 4	81	11 5	74.2 ± 6.7
1 0	Chung- Yao Cheng et al/2020 (Chen et al., 2020)	Taiwa n⁄ Asia	SARC-F, CC, MSRA- 5, SARC- Calf	AW GS 2019	Cross - sectio nal	52 %	9 3	84	17 7	$\begin{array}{c} 78.7 \pm \\ 8.6 \ M \\ 81.1 \ \pm \\ 6.8 \ F \end{array}$
1 1	Ya-Huang Lin/2022 (Lin et al., 2023)	Taiwa n⁄ Asia	SARC-F, CC, SARC- Calf	AW GS 2019	Cross - sectio nal	40. 70 %	6 4	14 5	20 9	77.7 ± 7.2
1 2	Satomi Kusaka, PhD, RPT/2017 (Kusaka et al., 2017)	Japan/ Asia	CC	AW GS	Cross - sectio nal	9.4 0%	0	11 6	11 6	73.1
1 3	Takeshi Kera/2023 (Kera et al., 2023)	Japan/ Asia	SARC-F, RSS	AW GS	Cohor t study	9.2 0%	2 4 9	43 4	68 3	73.9 ± 6.7
1 4	Roma Krzymińs ka- Siemaszk o/2023 (Krzymin ska- Siemaszk o et al., 2023)	Polan d/ Europ e	SARC-F, SARC-Calf, SARC- F+EBM, SARC- F+AC, SARC- CalF+AC	EW GSO P2	Cross - sectio nal	11. 20 %	1 0 2	15 8	26 0	72.1 ± 6.7

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1 5	Ming Yang MD/2018 (Yang et al., 2018)	China/ Asia	SARC-F, SARC-CalF	AW GS	Cross - sectio nal	15. 90 %	1 6 0	22 4	38 4	71.5 ± 5.8
1 6	Xiaoyan Chen/202 1 (Chen et al., 2021)	China/ Asia	Ishii	AW GS 2019	Cross - sectio nal	19. 90 %	4 6 2	47 9	94 1	≥60
1 7	Médéa Locquet/2 018 (Locquet et al., 2018)	Belgiu m⁄ Europ e	SARC-F, IShii	EW GSO P	Cross - sectio nal	16. 70 %	1 2 4	18 2	30 6	74.8± 5.9
1 8	Sunyoung Kim MD/2017 (Kim et al., 2018)	Korea/ Asia	SARC-F	AW GS	Cohor t study	10. 20 %	5 7 7	64 5	12 22	≥70
1 9	Ming Yang MD/2018 _2 (Yang et al., 2019)	China/ Asia	SARC-F, MSRA-7, MSRA-5	AW GS	Cross - sectio nal	15. 90 %	1 6 0	22 4	38 4	71.5 ± 5.8
2 0	Ewa Zasadzka/ 2020 (Zasadzka et al., 2020)	Polan d/ Europ e	SARC-F	EW GSO P2	Cross - sectio nal	20. 90 %	5 4	13	67	≥65
21	R. Krzymins ka- Siemaszk o/2020 (Krzymin ska- Siemaszk o et al., 2021)	Polan d/ Europ e	SARC-F, SARC-Calf, MSRA-7, MSRA-5	EW GSO P2	Cross - sectio nal	17 %	2 1	79	10 0	≥65
2 2	Shi-Teng Lee/2023 (Lee et al., 2023)	Korea n/ Asia	SARC-F, SARC-CalF, SARC- F+AC,	AW GS 2019	Cross - sectio nal	27 %	6 3	16 7	23 0	67.2 ± 7.4

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			SARC- CalF+AC							
2 3	Akihiro Ito/2020 (Ito et al., 2021)	Japan/ Asia	CC, SARC- F, SARC- CalF	AW GS 2019	Cross - sectio nal	12. 90 %	2 5	11 4	13 9	76.7 ± 6.6
2 4	Kasidid Lawongsa /2023 (Lawongs a et al., 2024)	Thaila nd/ Asia	CC, Yubi wakka	AW GS 2019	Cross - sectio nal	(9. 6% M, 20. 4% F)	7 3	15 7	23 0	69 ± 6.0
2 5	Mi- Kyoung KIM/2020 (KIM et al., 2020)	Korea/ Asia	SARC-F	AW GS 2019	Cross - sectio nal	41 %	1 3 4	25 4	38 8	77.80 ± 6.26
2 6	Shuyue Luo/2023 (Luo et al., 2023)	China/ Asia	Ishii	AW GS 2019	Cross - sectio nal	15. 70 %	1 5 0 9	26 68	41 77	≥50
2 7	Thiago Gonzalez Barbosa- Silva/201 6 (Barbosa- Silva et al., 2016)	Brazil/ South Ameri ca	SARC-F	EW GSO P	Cross - sectio nal	8.4 0%	6 9	11 0	17 9	≥60

Table 1. Characteristics of Studies Included in the Systematic and Meta-Analysic Review

The analysis included 27 studies validating 8 sarcopenia screening tools in 21,271 older adults. Among them, 9 studies assessed anthropometric tools (CC: (Chen et al., 2020; F.-J. Hu et al., 2021; Huang et al., 2023; Ito et al., 2021; Kusaka et al., 2017; Lawongsa et al., 2024; Lin et al., 2023; Mo et al., 2021; Piodena-Aportadera et al., 2022)), 24 studies evaluated questionnaireonly tools (19 on SARC-F: (Barbosa-Silva et al., 2016; Chen et al., 2020; Huang et al., 2023; Ito et al., 2021; Kera et al., 2023; KIM et al., 2020; Kim et al., 2018; Krzyminska-Siemaszko et al., 2023; Krzyminska-Siemaszko et al., 2021; Lee et al., 2023; Li et al., 2020; Lin et al., 2023; Locquet et al., 2018; Mo et al., 2021; Rosas-Carrasco et al., 2023; Yang et al., 2018; Zasadzka et al., 2020; Zhou et al., 2022), two on MSRA7: (Krzyminska-Siemaszko et al., 2021; Yang et al., 2018), three on MSRA5: (Chen et al., 2020) (Krzyminska-Siemaszko et al., 2021; Yang et al., 2018)), 20 studies examined combined anthropometric and questionnaire tools (3 on SARC-F + AC: (Krzyminska-Siemaszko et al., 2023; Lee et al., 2023; Zhou et al., 2022), 14 on SARC-Calf: (Barbosa-Silva et al., 2016; Chen et al., 2020; Ito et al., 2021; KIM et al., 2020; Krzyminska-Siemaszko et al., 2023; Krzyminska-Siemaszko et al., 2021; Lee et al., 2023; Li et al., 2020; Lin et al., 2023; Mo et al., 2021; Rosas-Carrasco et al., 2023; Yang et al., 2018; Zhou et al., 2022), three on SARC-calf + AC: (Krzyminska-Siemaszko et al., 2023; Lee et al., 2023;

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Zhou et al., 2022)), and five studies combine multiple methods tools_anthropometric + questionnaire + physical performance test (Ishii: (Chen et al., 2021; Huang et al., 2023; Ishii et al., 2014; Locquet et al., 2018; Luo et al., 2023)). Asia had the most studies (20/27, 19,392 older adults), followed by Europe (5/27, 848 participants) and South America (2 studies, 1,031 participants).

Kind of tools	Tool	nu mb er of stu die s	Stu dy (sa mp le)	Pooled sensiti vity	I ²	Pooled specifi city	I ²	Poo led AU C	I ²	P L R - m ea n	N L R - m ea n
Anthropo metric	Calf circumfer ence	9	7,6 02	0.7 (0.57– 0.83)	9 3 %	0.73 (0.69- 0.77)	9 2 %	0.84 (0.8 - 0.87)	8 6 %	3. 3 4	0. 31
	MSRA5	3	661	0.73 (0.53– 0.93)	9 0 %	0.58 (0.43- 0.72)	9 0 %	0.7 (0.5 3- 0.86)	9 5 %	1. 8 7	0. 57
Questionn	MSRA7	2	484	0.85 (0.77- 0.94)	0 %	0.35 (0.25- 0.45)	7 0 %	0.69 (0.6 5- 0.73)	4 4 %	1. 2 4	0. 56
aire	SARC-F	19	877 7	0.35 (0.22– 0.47)	9 7 %	0.86(0. 79- 0.94)	9 7 %	0.68 (0.6 2- 0.73)	9 5 %	5. 6 5	0. 73
	Sum_Qu est	24	992 2	0.46(0. 33- 0.59)	9 7 %	0.76(0. 66- 0.86)	9 8 %	0.68 (0.6 3- 0.72)	9 5 %	2. 9 2	0. 62
Quest +	SARC-F + AC	3	901	0.8 (0.73– 0.87)	1 3 %	0.69 (0.65- 0.73)	0 %	0.76 (0.6 8- 0.83)	6 9 %	2. 4 8	0. 46
	SARC- Calf	14	5,5 03	0.57 (0.47- 0.67)	9 1 %	0.84 (0.77- 0.91)	9 3 %	0.76 (0.7	9 3 %	4. 5	0. 52

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							1- 0.8)			
SARC- Calf + AC	3	901	0.75 (0.67- 0.82)	0 %	0.78 (0.67- 0.89)	8 9 %	0.79 (0.7 2- 0.87)	7 5 %	3. 1 1	0. 39
Sum_Qu est +	20	730	0.62(0. 54-	9 1	0.81(0. 75-	9 4	0.76 (0.7	9 1	3. 3	0.
Anthro		5	0.71)	%	0.87)	%	0.8)	%	6	40

Table 2. Summary Diagnostic Performance and Heterogeneity for Sarcopenia Screening Tools

*When $I^2 > 50\%$ indicates a significant difference between studies, the total random effect is the choice for pooling estimates because it considers the actual variation between studies. Low heterogeneity ($I^2 < 50\%$, the difference between studies is not significant; choose total common effect)

Table 2 describes the pooled accuracy of eight screening tools for sarcopenia in communitydwelling older adults, clarified into four groups according to the characteristics of the tools; all studies reported AUC values greater than the "indiscriminate" threshold of 0.5, indicating that these screening tools are effective in identifying sarcopenia in the older adults assessed. The combination of Anthro + Phys + Quest (Ishii) was the most accurate diagnostic tool, with the highest AUC (0.89) and lowest NLR (0.24), the best diagnostic and exclusion tool. The group, including only the anthropometric index (calf circumference), also performed very well (CC) with pool AUC (0.84). When Ouest + Anthro was combined, the accuracy was higher than that of the questionnaire only but lower than that of the anthropometric alone. For example, the pooled AUC of CC is 0.84, but when CC is combined with five questions of SARC-F (pooled AUC: 0.68), the pooled AUC of SARC-Calf is 0.76. The questionnaire was the worst performance tool, with the lowest AUC (0.68), lowest sensitivity (0.46), and highest NLR (0.62). Looking at the individual tools, the tool that showed the highest overall diagnostic performance for sarcopenia was Ishii (AUC: 0.89 (0.84-0.91)) and calf circumference (AUC: 0.84 (0.8-0.87)); the lowest overall performance was the SARC-F tool (AUC: 0.68 (0.62-0.73)), and SARC-F also had the lowest pooled sensitivity (0.35), indicating that only 35% of people with the disease were detected, and the highest NLR (0.73), meaning if a person tested negative, they were still 73% more likely to have the disease.

Contine nts	Tools	nu mb er of stu die s	Stu dy (sa mpl e)	Pooled sensitivit y	I ²	Pooled specificit y	I ²	Pooled AUC	I ²
	СС	9	760 2	0.70 (0.57- 0.83)	9 3 %	0.73 (0.69- 0.77)	92 %	0.84 (0.8- 0.87)	8 6 %
	MSRA5	2	561	0.76 (0.57- 0.83)	9 5 %	0.63 (0.47- 0.79)	85 %	0.73 (0.48- 0.97)	9 7 %
	MSRA7	1	384	0.87 (0.76- 0.94)	-	0.4 (0.34- 0.45)	-	0.7 (0.65- 0.74)	-
	SARC-F	12	688 8	0.33 (0.13- 0.52)	9 8 %	0.86 (0.74- 0.99)	98. 1%	0.65 (0.59- 0.71)	9 6 %
Asia (8	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	0.78(0.65 -0.91)	98. 8 %	0.66(0.6 1-0.72)	9 6 %				
tools)	SARC-F + AC	2	631	-	-	-	-	0.75 (0.64- 0.86)	8 5 %
	SARC-Calf	9	398 7	0.53 (0.4- 0.67)	9 5 %	0.83 (0.71- 0.95)	96 %	0.76 (0.69- 0.82)	9 5 %
	SARC-Calf + AC	2	631	-	-	-	-	0.8 (0.69- 0.9)	8 6 %
	Sum_Ques t + Anthro	13	524 9	0.6 (0.47- 0.73)	9 5 %	0.81(0.72 -0.91)	96. 1 %	0.76(0.7 2-0.81)	9 4 %
	Ishii	4	808 5	-	-	-	-	0.89(0.8 5-0.92)	8 4 %
	MSRA5	1	100	0.65 (0.38- 0.86)	-	0.46(0.35 -0.57)	-	0.62 (0.46- 0.78)	-
Europe (7 tools)	MSRA7	1	100	0.76 (0.5- 0.93)	-	0.29(0.2- 0.4)	-	0.59(0.4 3-0.75)	-
	SARC-F	5	858	0.37 (0.32- 0.42)	0 %	0.87 (0.84- 0.89)	0%	0.77 (0.67- 0.88)	8 6 %

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	Sum_Ques t	7	105 8	0.49(0.36 -0.62)	7 2 %	0.71(0.5- 0.91)	97 %	0.73(0.6 4-0.83)	8 6 %
	SARC-F + AC	1	270	0.71 (0.51- 0.87)	-	0.69 (0.63- 0.75)	-	0.77 (0.66- 0.88)	-
	SARC-Calf	3	485	0.65 (0.52- 0.77)	0 %	0.87 (0.84- 0.9)	0%	0.77 (0.69- 0.85)	0 %
	SARC-Calf + AC	1	270	0.71 (0.51- 0.87)	-	0.72(0.66 -0.78)	-	0.77(0.6 6-0.89)	-
	Sum_Ques t + Anthro	5	102 5	0.68(0.59 -0.77)	0 %	0.81(0.73 -0.89)	88 %	0.77(0.7 1-0.83)	0 %
	Ishii	1	306	0.85 (0.81- 0.88)	-	0.81(0.76 -0.85)	-	0.86 (0.81- 0.91)	-
South	SARC-F	2	103 1	-	-	-	-	0.62 (0.57- 0.66)	0 %
a	SARC-Calf	2	103 1	-	-	-	-	0.69 (0.65- 0.74)	0 %

Table 3. Summary Estimates of Pooled Diagnostic Accuracy by Continents

*When $I^2 > 50\%$ indicates a significant difference between studies, the total random effect is the choice for pooling estimates because it considers the actual variation between studies. Low heterogeneity ($I^2 < 50\%$, the difference between studies is not significant; choose total common effect)

When analyzing the performance of tools by continent, Asia validated eight tools, Europe lacked tools for the anthropometric index (seven tools), and South America had only two validated tools. Asia and Europe showed Ishii as the best tool for overall diagnostic performance, while SARC-F was the least accurate and had the lowest sensitivity across all continents. In the questionnaire group, MSRA5 and MSRA7 performed quite well overall in Asia (AUC > 0.7), with high sensitivity (0.76 and 0.87), but in Europe, they did not perform as a good screening tool (AUC 0.62 and 0.59, respectively). The combined anthropometric and questionnaire groups performed relatively well and were similar in Asia and Europe (AUC = 0.76 and 0.77), while in South America, the pooled AUC of SARC-Calf was 0.69.

If studies had high heterogeneity, $I^2 > 50\%$, the total random effect was chosen to adjust for this difference. When analyzing the continental subgroup, we found that studies in Asia had higher I², which may affect the accuracy of the screening tool in Asia. However, subgroup analysis by sex and age was not performed due to incomplete data from the studies.

Discussion

The analysis of 27 studies revealed a distinct geographical distribution, heavily concentrated in Asia (20), with fewer in Europe (5) and South America (2), and notably absent from North

America, Australia, or Africa. This distribution may be attributed to our inclusion criteria, which focused on community-based studies rather than those conducted in hospitals, nursing homes, or other institutions. This interpretation is bolstered by the cultural contexts of the represented regions: strong traditions favoring family-based care and multigenerational living, supported by values like filial piety in Asia (Rahman, 2013), strong family bonds in Europe and South America, and demographic history in developing regions (Nations, 2023), make community-focused studies more feasible or relevant there. Cultural norms emphasizing respect towards elders in Latin America (Toyokawa et al., 2022) further support community care, contrasting with mainstream Australian culture's greater acceptance of nursing homes, although even there, subcultures like Greek Australians often prefer traditional family care (Fitzgerald et al., 2001), underscoring how a community focus inherently shapes geographical findings.

Questionaire Tools Group

The most widely validated screening method, this group includes 24 studies of SARC-F (19 studies) MSRA-5 (3 studies) and MSRA-7 (2 studies). High sensitivity is crucial for community screening to ensure early disease detection and avoid missed cases (Canada, 2024). Questionnaire-only tools showed the lowest diagnostic accuracy (AUC: 0.68 [0.63–0.72]) and sensitivity (0.46 [0.33–0.59]), making them unsuitable as stand-alone tools. Thus, we believe questionnaires should not be used alone to screen for sarcopenia in community-dwelling elderly. Instead, they should be combined with objective methods like anthropometric or physical performance tests (PPTs), as their accuracy depends on the elderly's memory, comprehension, and cooperation (Chua et al., 2024).

When considering each type of tool separately, the SARC-F is the most widely used but has a low sensitivity (0.35 (0.22-0.47)). According to Barbosa-Silva et al., the low sensitivity of the SARC-F is due to five questions focusing only on muscle function (Strength, Assistance walking, Rise from chair, climbing stairs, and Falls), ignoring the assessment of muscle mass (Barbosa-Silva et al., 2016). In our opinion, the SARC-F is only suitable for hospital screening in subjects with severe sarcopenia affecting motor function but cannot be detected early in the community. MSRA (Mini Sarcopenia Risk Assessment): Developed by Rossi et al. (Li et al., 2025), the MSRA-7 assesses factors including age, number of hospitalizations, physical activity level, meal regularity, milk consumption, protein consumption, and weight loss.8 The MSRA-5 eliminates two questions on milk and protein consumption. The aim of MSRA is to assess general and nutritional risk factors related to sarcopenia, unlike SARC-F, which focuses on function (Chua et al., 2024; Rossi et al., 2017). It is interesting to note that MSRA-7 has two more questions than MSRA-5 with the same five questions, but MSRA5 has a higher screening efficiency than MSRA7, suggesting that the effectiveness of the tool does not depend on the number of questions; adding inappropriate questions may reduce the diagnostic performance of the tool.

By continent, in Asia, SARC-F had lower overall diagnostic performance than MSRA7 and MSRA5 (AUC 0.65, 0.7, and 0.73, respectively), while in Europe, SARC-F outperformed the other two tools (AUC 0.77, 0.59, 0.62, respectively). In our opinion, this difference, in addition to the difference in diagnostic criteria for sarcopenia (AWGS in Asia and EWGSOP in Europe), is also due to differences in cultural characteristics, lifestyle, diet, and body size composition between the two continents. SARC-F was designed in the US (Malmstrom & Morley, 2013), focusing on functional assessment in Western elderly people - a population that often lives independently and tends to proactively recognize and report limitations in daily activities. In

contrast, in Asia, due to differences in physical conditions and cultural factors, this tool is likely to miss potential cases of sarcopenia (Li et al., 2025) (Beaudart et al., 2016). In contrast, in many Asian countries, East Asian culture tends to avoid admitting weakness or dependence. ; some older people may be reluctant to report falls or frailty for fear of becoming a burden (Hinton et al., 2009; Yang et al., 2020). These differences lead to SARC-F underestimating the risk in Asia. In Asia, the elderly often have a sedentary lifestyle, with little physical activity even before sarcopenia. As a result, muscle loss in Asia can progress silently – because they are inherently sedentary, the SARC-F cannot detect changes (because they do not climb stairs much, do not carry heavy loads, etc.) (Zhang et al., 2023). In contrast, the MSRA integrates risk factors that are more appropriate to the Asian context and has questions about exercise habits and weight loss, so it is more sensitive to the sedentary lifestyle and poor nutritional status in Asia (Bhat et al., 2024). MSRA7 performs worse than MSRA5 because of the addition of questions about milk and protein consumption frequency, which are not the same across cultures, and lactose intolerance between ethnic groups, reducing the accuracy of MSRA7 despite having more questions (Chua et al., 2024; Review, 2025).

Although not included in the meta-analysis because of only one study, the rapid muscle atrophy screening questionnaire (RSS) from Japan showed promising diagnostic accuracy (AUC: 0.81) (Kera et al., 2023). The RSS includes four questions on muscle strength and age, as well as major risk factors for muscle atrophy. It shows that questionnaire-only tools can improve diagnostic validity if appropriate questions are included. However, further validation studies are needed.

Anthropometric Tools Group

This group of tools included only a simple anthropometric index. However, it was the group of tools that showed the second-best overall screening performance in screening for sarcopenia in community-dwelling older adults (AUC: 0.84) after the three-method combination group (Anthropometry + PPT + Questionnaire) showing that the anthropometric index is a simple, quick, noninvasive, inexpensive tool that is not affected by dementia in the elderly like the questionnaire group and is not affected by subjective, psychological factors of the patient like the physical performance test.

Although only CC had sufficient quantity and quality of studies to be included in the analysis, we also found screening tools that included only one anthropometric index used to screen for sarcopenia in other older adults, divided into two main groups: those reflecting limb muscle mass (CC, MUAC/AC, MAMC/AMA) used to screen for sarcopenia (F. J. Hu et al., 2021) and those reflecting central fat or obesity (BMI, WC, WHR, WHR, WWI) related to sarcopenic obesity (Kim et al., 2023). Of these, CC and MUAC generally performed well in predicting low muscle mass or screening for sarcopenia; the performance between the two indices was similar in men, CC may be slightly better in women, and MUAC was more favorable in the presence of lower limb edema(F. J. Hu et al., 2021). MUAC has an AUC of 0.7–0.86, better sensitivity than CC (0.71–0.88), and specificity (0.7–0.78) (F.-J. Hu et al., 2021; Piotrowicz et al., 2021). Thus, CC is a strong candidate due to its simplicity, good evidence base, and correlation with muscle mass and function, supporting its use as a reliable screening tool for sarcopenia (Ishihara et al., 2024; Kawakami et al., 2015). MUAC also shows a strong correlation with ASMI, accurately reflects lean muscle mass, and is less affected by peripheral edema in the elderly, thus being considered a viable alternative to ASMI with specific diagnostic thresholds (F. J. Hu et al., 2021).

Other anthropometric tools, such as BMI, waist circumference (WC), and the Yubi-Wakka test

(an indirect test that measures CC using a ring made from the patient's thumb and index finger), have also shown promising results (Esteves et al., 2020). Anthropometric indexs have the advantages of being inexpensive, noninvasive, easy to perform, completely objective, unaffected by patient memory or cooperation, and flexible across various contexts, making them particularly useful in resource-poor healthcare settings. However, the accuracy of these measures varies between studies. It may be affected by peripheral adiposity or edema (e.g., MUAC in women, CC in lower-limb edema, BMI in obese individuals) (Cheong et al., 2022; Li et al., 2024). Therefore, it is important to prioritize the use of cutoffs appropriate to each specific population and setting and to be cautious when applying general cutoffs, as significant variability has been reported.

Anthropometric Combined with Questionnaire Group

This group includes 20 eligible studies included in the analysis, including three tools SARC-F + AC (3 studies, SARC-Calf (SARC-F + CC, 14 studies), SARC-Calf + AC (SARC-F + CC + AC, three studies) in addition to the SARC-F + EBM tool not included in the analysis (Krzyminska-Siemaszko et al., 2020; Krzyminska-Siemaszko et al., 2023). In our opinion, this combination has not achieved the desired effect because the SARC-F tool itself has too low sensitivity; when combined with anthropometric measurements, it reduces the overall diagnostic performance accuracy of each anthropometric index (for example, the pooled AUC of CC is 0.84, but when combining CC with SARC-F, the SARC-calf tool has a pooled AUC of only 0.76). This demonstrates that in order to increase diagnostic effectiveness, the questions must be modified to fit the population and make sure they are enough accuracy before being combined with anthropometric indicators; only the combination group also showed that when combined with anthropometric indicators, it will improve the diagnostic performance of the questionnaire group.

Questionnaire Combining Anthropometric and Physical Performance Tools Group

This category includes only the Ishii tool (5 studies), which assesses age, CC, and grip strength. It achieved the highest diagnostic accuracy (AUC: 0.89 (0.85–0.92)) and the best ability to exclude muscle atrophy (NLR: 0.24), demonstrating the value of combining multiple assessment methods. Previously, the diagnosis of sarcopenia was mainly based on loss of skeletal muscle mass as the core feature. However, with recent international consensuses such as EWGSOP2 and AWGS, the focus has shifted to muscle strength, which is considered the main sign and the first step to suspect sarcopenia. Low muscle mass or quality confirms the diagnosis, while poor physical performance helps classify the severity (Cruz-Jentoft et al., 2018; Martone et al., 2019; Sayer & Cruz-Jentoft, 2022). Since muscle strength loss is an early warning sign, an effective screening tool should directly or indirectly assess muscle quality, and a comprehensive assessment of both muscle mass and muscle quality should provide the best diagnostic performance, including anthropometric indices (estimating muscle mass), functional tests (assessing strength), and self-reported questions related to muscle function.

However, Ishii's reliance on handgrip measurement may limit its feasibility in the community setting, especially in areas lacking specialized medical equipment. Standalone physical performance tests (e.g., SPPB, CS-30, and 4mWS) have demonstrated high accuracy (AUC: 0.72–0.84), reinforcing the importance of functional assessments in screening for sarcopenia(Akın et al., 2015; Lee et al., 2021; Pinheiro et al., 2016; Sawada et al., 2021). Therefore, further studies are needed to determine whether incorporating a simple physical

performance test to assess indirect muscle strength in place of handgrip may be more feasible in the community without compromising accuracy in screening for sarcopenia in the elderly. However, performing PPTs also has some disadvantages, such as being time-consuming (e.g., SPPB takes about 10 minutes), requiring suitable space (such as a hallway long enough for a 6meter walk), and some basic equipment (stopwatch, chair, markers, etc.) (Cruz-Jentoft et al., 2018), the results can also be affected by patient cooperation and are not suitable for some subjects such as those with severe motor, balance or cognitive impairment. This highlights how important it is to conduct more research, assess how well PPTs work with various populations, choose more sensitive and specific methods that are appropriate for each population, and successfully supplement strength and muscle mass measurements in both diagnosis and monitoring.

Strengths and Limitations

Our systematic review is the first to comprehensively evaluate screening tools for sarcopenia in community-dwelling older adults. Unlike previous reviews focusing solely on accuracy, we considered factors influencing tool performance. We analyzed studies from the past decade, reviewed reference lists, and consulted experts. Quality was assessed using QUADAS-2, and measurement properties were assessed using COSMIN Rob. To reduce bias, we used Funnel and Forest plots and standardized diagnostic criteria across continents.

Limitations include language restrictions, exclusion of single-study validations, and high heterogeneity across studies, particularly in Asia, which may affect the accuracy of results and reflect the diversity within these geographic regions. Research is most concentrated in Asia, followed by Europe and South America, with no other regions showing geographical differences in research intensity.

Conclusion

Overall, this study demonstrates considerable variability in the diagnostic performance of sarcopenia screening tools, each with its limitations and an important role in clinical practice and public health. Comprehensive assessments of muscle mass and quality (such as Ishii) provide the highest accuracy. However, anthropometric indices that accurately reflect muscle mass (such as CC) are an effective and practical alternative in resource-poor settings. In contrast, questionnaire-based tools, such as the SARC-F, have the lowest performance and inferior sensitivity, making them unsuitable for stand-alone tools in community screening because they miss many cases. Combining a questionnaire with an anthropometric index (such as the SARC-F and CC to form the SARC-Calf) improves performance compared to questionnaires alone (SARC-F). However, it reduces accuracy compared to anthropometric indices alone (CC).

The performance of sarcopenia screening tools varies considerably across continents, reflecting differences in cultural characteristics, lifestyles, diets, body composition, and diagnostic criteria. Tools with high specificity and PPV should be prioritized in low-incidence areas, while in endemic areas, high sensitivity and NPV should be focused on to minimize missed cases (Cruz-Jentoft et al., 2018). Therefore, tools or cutoffs should not be applied mechanically but flexibly adapted to each local context to optimize screening effectiveness. To improve accuracy and feasibility, future studies should consider combining multiple screening methods, limiting dependence on specialized equipment, refining questionnaires, validating PPTs, and developing region-specific anthropometric thresholds. A comprehensive and multifactorial approach will improve early diagnosis, timely intervention, and global quality of life for older adults.

In addition, screening needs to consider the complex interactions between physical health and the sociocultural environment. This is particularly relevant in Asia, where lifestyle factors (e.g., sedentary lifestyle, specific diets) and cultural attitudes (e.g., fear of admitting frailty or becoming a burden) directly influence the detection of sarcopenia. To make screening an engaging, community-based activity that honors cultural identity and advances health equity, we suggest incorporating basic screening procedures into older individuals' everyday communal activities.

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Cultural Contexts Meet Clinical Precision: A Systematic Review and Meta-Analysis of Sarcopenia Screening Tools in Global Aging Communities

Appendix A: Search terms

Appendix B: Database search strategies

Appendix C: List of excluded studies with reasons

Appendix D: COSMIN Risk of bias checklist

Appendix E: Checking publication bias by funnel plot of all studies and SROC Curve for Sarcopenia Screening tools according to kind of tool

Appendix F: Checking heterogeneity and inconsistency of all screening tools by forest plot

Appendix G: Checking heterogeneity and inconsistency of all screening tools by forest plot in Europe and South America

Appendix H: Checking heterogeneity and inconsistency of all screening tools by forest plot in Asia

Appendix I: GRADE framework Assessment of the Certainty of Diagnostic Accuracy for sarcopenia screening tools

Main	Relevant	Final	MeSH term and Syntax
keywords	keywords	keywords	
-		search	
Population	- Elderly	Elderly OR	- Aged[MeSH]
(P)	- Senior	Senior OR	- Elderly *[TIAB]
	- Geriatric	Geriatric OR	- Older*[TIAB]
	- Older	Older OR	- Senior*[tw]
	- Retirees	Retirees OR	- Geriatric*[tw]
	- Pensioners	Pensioners OR	- Older*[tw]
	-	Gerontological	- Retirees*[tw]
	Gerontological		- Pensioners*[tw]
			- Gerontological*[tw]
			(1) Aged[MeSH] OR "Elderly*"[TIAB]
			OR "Older*"[TIAB] OR "Senior*"[tw]
			OR "Geriatric*"[tw] OR "Older*"[tw]
			OR "Retirees*"[tw] OR
			"Pensioners" [tw] OR
			"Gerontological*"[tw]
Index Test	- sarcopenia	Screening tool	- Screen*[TIAB]
(I)	screening tool	OR SPSM OR	- SPSM[tw]
	- SPSM	MSRA OR Ishii	- MSRA[tw]
	- MSRA	score OR	- Ishii score[tw]
	- Ishii score	SARC-F OR	-SARC-F[tw]
	-SARC-F	SARC-F-EBM	- SARC-CalF[tw]
	- SARC-CalF	OR SARC-	- SARC-F-EBM[tw]

Appendix A: Search terms (based on the elements of the PIRD)

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EBMTESTOR- SarSA-Mod[tw]- U-TESTSarSA-Mod- SARCO-GS[tw]- SarSA-ModORSARCO SarSA-ModORSARCO SarSA-ModORSARCO SarSA-ModORSARCO SARCO-GSGSMSRA[tw] OR Ishii score[tw] OR- SARCO-GSGSMSRA[tw] OR SARC-CalF[tw] OR- SARCO-GSGSSarSA-Mod[tw] OR SARC-CalF[tw] OR- SarcopeniaSarcopenia ORSarSA-Mod[tw] OR SARCO-GS[tw]Standard- AWGSAWGSOR- EWGSOPEWGSOP OR- AWGS[tw]- IWGSIWGSOR- EWGSOP[tw]- FNIHFNIH- IWGS[tw](3)Sarcopenia[MeSH] ORSarcopenia[TIAB] OR AWGS[tw] OR- FNIHFNIH- IWGS[tw]- FNIHFNIH- IWGS[tw]- FNIHFNIH- IWGS[tw]- FNIHFNIH- IWGS[tw]- FNIH- AWGS[tw] OR- FNIH- AWGS[tw] OR
EBMTESTOR- SarSA-Mod[tw]- U-TESTSarSA-Mod- SARCO-GS[tw]- SarSA-ModORSARCO SarSA-ModORSARCO SarSA-ModORSARCO SarCO-GSGSMSRA[tw] OR Ishii score[tw] OR- SARCO-GSGSMSRA[tw] OR SARC-CalF[tw] OR- SarcopeniaSarcopenia ORSarSA-Mod[tw] OR SARCO-GS[tw]Reference- SarcopeniaSarcopenia OR- SarcopeniaSarcopenia OR- Sarcopenia[MeSH](R)- EWGSOPEWGSOP OR- AWGS[tw]- IWGSIWGSOR- EWGSOP[tw]- FNIHFNIH- IWGS[tw](3)Sarcopenia[MeSH]ORSarcopenia[TIAB] OR AWGS[tw] OR- IWGS[tw]- FNIHFNIH- IWGS[tw]- FNIHFNIH- IWGS[tw]- FNIHFNIH- IWGS[tw]- FNIH- Sarcopenia[TIAB] OR AWGS[tw] OR
- U-TESTSarSA-Mod- SARCO-GS[tw]- SarSA-ModORSARCO-(2) Screen*[TIAB] OR SPSM[tw] OR- SARCO-GSGSMSRA[tw] OR Ishii score[tw] OR- SARCO-GSGSMSRA[tw] OR SARC-CalF[tw] ORSARC-F[tw] ORSARC-F-EBM[tw] OR U-TEST[tw] ORSarSA-Mod[tw] OR SARCO-GS[tw]SarSA-Mod[tw] OR SARCO-GS[tw]Reference- SarcopeniaSarcopenia ORStandard- AWGSAWGSOR- EWGSOPEWGSOP OR- Sarcopenia[MeSH](R)- EWGSOPEWGSOP OR- FNIHFNIH- IWGS[tw]- FNIHFNIH- IWGS[tw](3)Sarcopenia[MeSH]ORSarcopenia[TIAB] OR AWGS[tw] OR- Sarcopenia[TIAB] OR AWGS[tw] OR
- SarSA-ModORSARCO-(2) Screen*[TIAB] OR SPSM[tw] OR- SARCO-GSGSMSRA[tw] OR Ishii score[tw] ORSARCO-GSGSMSRA[tw] OR SARC-CalF[tw] ORSARC-FEBM[tw] OR U-TEST[tw] ORSARC-F-EBM[tw] OR U-TEST[tw] ORSarSA-Mod[tw] OR SARCO-GS[tw]SarSA-Mod[tw] OR SARCO-GS[tw]Reference- SarcopeniaSarcopenia ORStandard- AWGSAWGSOR- EWGSOPEWGSOP OR- AWGS[tw]- IWGSIWGSOR- EWGSOP[tw]- FNIHFNIH- IWGS[tw](3)Sarcopenia[MeSH]ORSarcopenia[TIAB] OR AWGS[tw] OROR- FNIHFNIH- IWGS[tw]- FNIH- SARCO-GS[tw]- FNIH- SARCO-GS- FNIH- SARCO-GS
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Reference Standard- SarcopeniaSarcopeniaOR AWGS- Sarcopenia[MeSH](R)- EWGSOP - EWGSOP- EWGSOP OR IWGS- AWGS[tw] - EWGSOP[tw]- AWGS[tw]- FNIHFNIH- IWGS[tw] (3)OR Sarcopenia[TIAB] OR Sarcopenia[TIAB] OR AWGS[tw] OR
Standard (R)- AWGS - EWGSOP - IWGS - FNIHAWGS EWGSOP OR IWGS FNIH- Sarcopenia[TIAB] - AWGS[tw] - EWGSOP[tw] - IWGS[tw] (3)- FNIHFNIH- IWGS[tw] (3)OR Sarcopenia[TIAB] OR AWGS[tw] OR
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(3) Sarcopenia[MeSH] OR Sarcopenia[TIAB] OR AWGS[tw] OR
Sarcopenia[TIAB] OR AWGS[tw] OR
EWGSOPITWI OR IWGSITWI OR
FNIH[tw]
- Sensitivity Sensitivity OR - Sensiti*[tw]
Diagnostic - Specificity Specificity OR - Specific*[tw]
Accuracy - Likelihood Possitive - Likelihood Ratios*[tw]
(D) Ratios Likelihood - ROC Curves*[tw]
- ROC Curves Ratios OR - AUC[tw]
- AUC negative (4) Sensiti*[tw] OR Specific*[tw] OR
Likelihood Likelihood Ratios*[tw] OR ROC
Ratios OR Curves*[tw] OR AUC[tw]
"ROC Curves"
ORAUC

Keyword search: (1) AND (2) AND (3) AND (4)

Medline search: (1) AND (2) AND (3) AND (4)

Appendix B: Database search strategies

Platform	Search command
Scopus	TITLE-ABS-KEY((Elderly OR Senior OR Geriatric OR Older OR Retirees OR Pensioners OR Gerontological) AND ("Screening tool" OR SPSM OR MSRA OR "Ishii score" OR "SARC-F" OR "SARC-F-EBM" OR "SARC- CalF" OR "U-TEST" OR "SarSA-Mod" OR "SARCO-GS") AND (Sarcopenia OR AWGS OR EWGSOP OR IWGS OR FNIH) AND (Sensitivity OR Specificity OR "Positive Likelihood Ratios" OR "Negative Likelihood Ratios" OR "ROC Curves" OR AUC))
PubMed	(((Sarcopenia[MeSH] OR Sarcopenia[TIAB] OR AWGS[tw] OR EWGSOP[tw] OR IWGS[tw]) AND (Screen*[TIAB] OR SPSM[tw] OR MSRA[tw] OR Ishii score[tw] OR SARC-F[tw] OR SARC-CalF[tw] OR SARC-F-EBM[tw] OR U-TEST[tw] OR SarSA-Mod[tw] OR SARCO-

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	GS[tw])) AND (Sensiti*[tw] OR Specific*[tw] OR Likelihood Ratios*[tw] OR ROC Curves*[tw] OR AUROC[tw])) AND (Aged[MeSH] OR "Elderly*"[TIAB] OR "Older*"[TIAB] OR "Senior*"[tw] OR "Geriatric*"[tw] OR "Older*"[tw] OR "Retirees*"[tw] OR "Pensioners*"[tw] OR "Gerontological*"[tw])
ResearchGate	(Elderly OR Senior OR Geriatric OR Older OR Retirees OR Pensioners OR Gerontological) AND ("Screening tool" OR SPSM OR MSRA OR "Ishii score" OR "SARC-F" OR "SARC-F-EBM" OR "SARC-CalF" OR "U- TEST" OR "SarSA-Mod" OR "SARCO-GS") AND (Sarcopenia OR AWGS OR EWGSOP OR IWGS OR FNIH) AND (Sensitivity OR Specificity OR "Positive Likelihood Ratios" OR "Negative Likelihood Ratios" OR "ROC Curves" OR AUC)
Fmbase	(((exp sarcopenia/ OR sarcopenia:ti,ab,kw OR AWGS:ti,ab,kw OR EWGSOP:ti,ab,kw OR IWGS:ti,ab,kw) AND (screen*:ti,ab,kw OR SPSM:ti,ab,kw OR MSRA:ti,ab,kw OR "Ishii score":ti,ab,kw OR "SARC- F":ti,ab,kw OR "SARC-CalF":ti,ab,kw OR "SARC-F-EBM":ti,ab,kw OR "U-TEST":ti,ab,kw OR "SarSA-Mod":ti,ab,kw OR "SARCO- GS":ti,ab,kw))
	AND (sensiti*:ti,ab,kw OR specific*:ti,ab,kw OR "Likelihood Ratios":ti,ab,kw OR "ROC Curves":ti,ab,kw OR AUROC:ti,ab,kw)) AND (exp aged/ OR elderly:ti,ab,kw OR older:ti,ab,kw OR senior:ti,ab,kw OR geriatric:ti,ab,kw OR retirees:ti,ab,kw OR pensioners:ti,ab,kw OR gerontological:ti,ab,kw))
Google Scholar	(Elderly OR Senior OR Geriatric OR Older OR Retirees OR Pensioners OR Gerontological) AND ("Screening tool" OR SPSM OR MSRA OR "Ishii score" OR "SARC-F" OR "SARC-F-EBM" OR "SARC-CalF" OR "U- TEST" OR "SarSA-Mod" OR "SARCO-GS") AND (Sarcopenia OR AWGS OR EWGSOP OR IWGS OR FNIH) AND (Sensitivity OR Specificity OR "Positive Likelihood Ratios" OR "Negative Likelihood Ratios" OR "ROC Curves" OR AUC)

Appendix C: List of excluded studies with reasons

Data	Database	Pub med	Em bas e	Google Schola r	Resea rchGa te	Scop us	T ot al
sources	Date search	20/0 2/20 24	2/2/ 202 4	20/02/2 024	20/02/ 2024	20/0 2/20 24	
Title rejected	Total	331	242	8660	100	262	9 5 9 5

		 neuven ei ui.	1705
	not sarco		9
	not dwelling elderly		2
	not any tools		4
			1
	dublicate		0 8
			1 5
	Read abstract		3
	stu (wrong study type)		
	pub (Wrong publication type)		
	pop (wrong population)		
Abstract	int (wrong intervention or		
reject	no intervetnion)		
	out (wrong outcome)		7
	Abs. rejected		4
			7
	Abs. remaining		9
	Not diagnostic accuracy		0
	(not enough information)		8
	Dublicate		2
	Not community, not		
	Only 1 study could not do		1
Evilleove	meta analysis		2
Funtext	Unable to download		
results	fulltext (only Abstract or		1
i obuito	Poster)		0
	Articles rejected		4 7
	Articles remaining		32
			3
	Articles included		2

Appendix D: Check bias by COSMIN Checklist

Scale	Content validity	Structura l validity	Reliabilit y	Internal consistenc y	Cross- cultural validity	Criterio n validity
Calf	Not	Not	Not	Not	Excellen	Excellent
circumferenc	reported	reported	reported	reported	t	
e (9 studies)						

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		lean I recision	11 Systematic 1		1	
MSRA5 (3	Not	Not	Not	Not	Excellen	Excellent
studies)	reported	reported	reported	reported	t	
MSRA7 (2	Not	Not	Not	Not	Excellen	Excellent
studies)	reported	reported	reported	reported	t	
SARC-F (19	Excellen	Excellent	Excellent	Excellent	Excellen	Excellent
studies)	t				t	
SARC-F +	Excellen	Excellent	Excellent	Excellent	Excellen	Excellent
AC (3	t				t	
studies)						
SARC-Calf	Excellen	Excellent	Excellent	Excellent	Excellen	Excellent
(14 studies)	t				t	
SARC-Calf +	Excellen	Excellent	Excellent	Excellent	Excellen	Excellent
AC (3	t				t	
studies)						
Ishii (5	Not	Not	Not	Not	Excellen	Excellent
studies)	reported	reported	reported	reported	t	

We chose the best results for analysis in this section



Appendix E_a. Checking publication bias by funnel plot of all studies



Appendix \mathbf{E}_{b} . The SROC Curve for Sarcopenia Screening tools according to kind of tool

Sensitivity forest plot for tool validation EUROPE Specificity forest plot for tool validation EUROPE

AUC forest plot for tool validation EUROPE

100	155		1			days and a	common)	random) Effect 95% Cl	N, Fixed + Random, 95% Cl	Study	AUC SE Samp	e size (con	nnon) (rand	om) Effect 95% CI	N, Food + Random, 95% (
100	1.6%			Tool validation = MSRA5 3						Tool validation = MSRA5 3					
	1.010	7.2% 0.65 (0.38; 0.86)		R. Kzyminska-Siemeszko/2020	0.4580 0.0569	100	22%	7.9% 0.46 (0.35, 0.57)	+	R. Krzyminska-Siemeszko/2020	0.5180 0.0606	100	28% 6	05 0.62 (0.46; 0.78)	
170	1.8%	7 7% 0 76 8 50 0 51		Tool validation = MSRA7_2 P. Knyminelia, Samantin 2020	1 2993 0 0520	100	276	805.0201220.040	-	Tool validation = MSRA7_2 9. Krauminska, Stamostice 2000	0.5885-0.0604	100	286 6	WL 0.59 (0.43-0.75)	_
		to a statem and		A style of other states	1200 0140	100	400	ere erelens, and		A mprine of the other	1.200	100		an entenand	
				Tool validation = SARC-F_19		1447	1.00		1	Tool validation = SARC-F_19		1000			
100	1.45	7.0% 0.41 (0.18; 0.67)		R. Krzyminska-Sienaszko/2020	0.8800 0.0885	100	4.95	8.3% 0.88 [0.73; 0.94]		R Krzyminska-Sienaszko/2020	0,7190 0.0714	100	35% 6	75 0.72[058;086]	
115	1.4%	6.9% 0.38 (0.15, 0.65)		KOTE K/ZyTERRJ-SIETERZIO (UZJ	0.8900 0.0383	115	43%	8.3% 0.36 [0.17, 0.52]	1	Mona Krzymeska-Sienekzku/ZiZS	0.8900 0.0/14	115	35% 5	1/% E89[E35;E83]	6 4
2/0	2.4%	84% 045/026,054	-	Hone Krzyminska-Siemeszko (1023	0.8960 0.0236	2/1	13.2%	8.5% 0.87 [0.81; 0.91]		Homa Krzymniska-Siemeszko/2023	0./000 0.0664	2/0	58% 8	10% 0.70[059;081]	
306	23.4%	11.3% 0.36 (0.31; 0.41)	•	Nedea Locquet/2018	0.8710 0.0194	306	19.3%	86% 037(033,034)		Médée Locquet 2018	0.7540 0.0088	305	122% 9	65 0.76[0.69;0.84]	*
67	0.0%	01% 0.55		Ewa Zasaczsa 2020	0.9910	67	0.0%	8.0% 2.96		EN9 28580298/2020	0.9550 0.0024	67	17.5% 10	26 035 [087, 1.00]	
158	34.75	. 0.17 [0.12; 0.42]	•	Total (common effect, 95% CI)		858	42.1%	. 0.87 (0.84; 0.89)		Total (common effect, 95% CI)		858	427%	. 0.82 [0.78; 0.86]	
		33.7% 0.17 (0.12; 0.42)	•	Total (random effect, 95% CI) Helencensky, Tay ² = 0, CV ² = 0,16, d*	= 31P = 036521 1 ² = 05			33.6% 0.87 (0.84; 0.89)		Total (random effect, 99% CI) Heteropereity: Tau ² = 0 (113; CN ² = 2	9.28 d = 4 P < 10001	f=835	. 4	15 0.77 [0.67; 0.88]	•
270	275	87% 071 (0.51; 0.67)		Tool validation = SARC+F + AC_3 Rome Kizynińska-Siemaszko 2023	0.6940 0.0019	270	7.1%	8.4% 0.69(0.63, 0.75)		Tool validation = SARC-F + AC_3 Rona Krzymińska-Sieneszko/2023	0.7670 0.0671	270	58% 7	95 0.77 (0.66 0.88)	-
	1000	000000000000000000000000000000000000000		Tool validation = SARC-Call_14						Tool validation = SNHC-Call_14					
100	1.5%	7.2% 0.65 (0.38, 0.86)		R. Krzyminska-Sienaezko/2020	0.8820 0.0370	100	5,3%	8.3% 0.89 (0.90, 0.95)		R. Krzyminska-Sienastko/2020	0.7920 0.0735	100	34% 6	55 0.79 [065; 034]	
115	1.4%	6.9% 0.63 (0.35; 0.85)		Roma Krzymińska-Siemaszko 2023	0.8700 0.0357	115	5.7%	8.3% 0.87 [0.79, 0.83]		Rona Krzymińska-Sienaszko/2023	0.7700 0.0740	115	3,4% 6	5% 0.77 [0.62; 0.91]	
270	2.65	8.5% 0.66 (0.46; 0.82)		Roma Krzymińska-Siemaszko (2023	0.8610 0.0257	270	12.9%	8.5% 0.86 (0.81, 0.90)		Roma Krzymińska-Sie naszko/2023	0.7570 0.0697	270	52% 7	75 0.76[064,087]	+
485	5.5%	. 0.65 (0.52; 0.77)	•	Total (common effect, 95% CI)		485	23.8%	. 0.87 (0.84; 0.90)	•	Total (common effect, 95% CI)		485	11.9%	. 0.77 [0.69; 0.85]	•
		22.6% 0.65 (0.52; 0.77)	•	Total (random effect, 95% CI)				25.1% 0.87 (0.84; 0.90)	•	Total (random effect, 95% CI)			. 2	16% 0.17 [0.69; 0.85]	•
•				Heterogeneity, Tau ⁷ = 0, Ch ⁷ = 0.5, cf =	2 (P × 0.7797); F = 0%					Helerogeneity: Tau' = 0. Chi' = 0.14, d	f=2 (P=0.5038); f=0	1			
				Tool validation = SARC-Calf + AC_	1					Tool validation = SARC-Call + AC	3				
270	27%	87% 071 (0.51; 0.67)		Roma Kizymińska-Siemaszko 2023	0.7210 0.0311	270	7.5%	8.4% 0.72 (0.66, 0.78)	*	Rona Krzymińska-Sienaszko/2023	0.7710-0.0689	270	53% 7	75 077 [066;089]	1
				Tool validation = lshi_5					100	Tool validation = lshi_5					
336	51.0%	11.5% 0.84 (0.80; 0.88)		Nédéa Locquet/2018	0.8090 0.0224	306	14.4%	8.5% 0.81 (0.76; 0.85)		Médée Locquet 2018	0.8560 0.0253	306	26.8% 10	7% 0.86 [081; 091]	
2385	100.0%	. 0.66 (0.63; 0.69)	•	Total (common effect, 95% CI)		2388	100.0%	. 0.81 (0.80; 0.83)	•	Total (common effect, 99% CI)		2389 1	00.0%	. 0.81 [0.78; 0.83]	
1		100.0% 0.61 [0.50; 0.71]	-	Total (random effect, 55% CI)		1		100.0% 0.76 (0.85; 0.86)	•	Total (random effect, 95% CI)			- 18	10% 0.76 [0.71; 0.82]	•
tit=HB				Heleropeneity: Tau' = 1.0036; Ch' = 19	£80.df=11 (P<0.000)	((1=943%				Heterogeneity: Tau' = 0.0067; Chi' = 4	8.44, df = 12/P < 0.0001	(1=752%			
f#6 P<000	101)	1	0 02 04 06 08	1 Test for subgroup differences (common	effect) Chi" = 192.14 d	=6P<00	E1)		02 04 06 08	Test for subgroup differences (common	r effect); Chi ⁺ = 19.04, di	=========	(41)		0 02 04 06 08
1:EP<000	(01)			Test for subgroup differences (random a	ffeds): Chi ⁴ = 182.14, đ	=5(P<10)	001)			Test for subgroup differences (random	effects); Ch/* = 18.22, df	=6(P=0.00	87)		
	100 115 270 270 270 155 270 455 270 270 270 270 270 270 270 270 270 270	200 1.65 115 1.65 270 2.75 270 2.75 270 2.75 270 2.75 270 2.75 270 2.75 270 2.75 270 2.75 270 2.75 220 2.75 220 2.75 220 2.75 220 2.75 220 2.75 220 2.75 220 2.75 220 2.75 220 2.75 220 2.75 220 2.75 220 2.75 220 2.75 220 2.75 220 2.75 220 2.75 220 2.75 2205 2.75	0 0	00 168 7 155 4 (all (b), t) (b) 15 16 16, 15, 15, 15, 15, 15, 15, 15, 15, 15, 15	1 1	Image: State of the s	Image: Section of the sectio	Image: State	10 10<	Image: State of the s	Composition Composition <thcomposition< th=""> <thcomposition< th=""></thcomposition<></thcomposition<>	Composition Composition <thcomposition< th=""> <thcomposition< th=""></thcomposition<></thcomposition<>	Image: State of the s	Image: State of the s	Constraint Constra



Appendix G: Checking heterogeneity and inconsistency of all screening tools by forest plot in Europe and South America

Sensitivity forest plot for tool validation ASIA

1

Specificity forest plot for tool validation ASIA

AUC forest plot for tool validation ASIA

Study	Sensitivity	SE Sam	ple size (c	Weight (norma)	Reight random) Effect 95% Cl	IV, Fixed + Rand	ion, 91	Study	Specificity	SE Sample s	We ize (comm	ncu) (s	Weight Indom) Effect 95% Cl	N, Fixed + Random, 95% Cl	Study AUC SE S	angle size (*	Neight common) (Weight random) Effect 99% Cl	IV, Fixed + Random, 99% Cl
Tool validation = Call circumference 9					1.5			Tool validation = Call circumference 9						1	Tool validation = Call circumference 8				
Akhiro Ita/2020	0.8330		139	0.0%	0.0% 0.83			Akhiro Ita/2020	0.6290	13 3	39 (0.0%	0.0% 0.63		Akhiro to 2023 0.6000 0.0963	139	0.15	195 040(047,072)	
Yi-han No BSc et al/2020	0.8100 0	0255	1050	98%	4.0% 0.81 10 76:0.861		4	Yi-han No BSc et al/2020	0,7700.0	0153 10	160	3.1%	4 0% 0.77 10 74 0 801		16-han No-BSc et al/2020 0.7900 0.0128	1056	175	255 0.79 0.77 0.82	
Satomi Kusaka, PhD, RPT/2017	0.7300		116	0.0%	0.0% 0.73			Satom Kusaka, PhD, RPT/2017	0.8000		116 1	0.0%	0.0% 0.80	14	Satom Kusaka, PhD, RPT(2017 0.7820 .	116	40%	0.0% 0.79	
S.W. Huano et al/2023	0.3900 0	0459	996	3.0%	3.9% 0.39 10 30: 0.481	-+-		S.W. Huano et al/2023	0.7800 0	0128 9	296	4.5%	4 0% 0 78 10 75 0 801		S. W. Huang et al/2023 0.5820 .	996	0.0%	00% 058	
Feno-Juan Hu et al 2021 (male)	0.7500 0	0255	1615	9.8%	4.0% 0.75 10.70:0.808			Fero-Juan Hu et al(2)21 (male)	0,7000 0	0077 16	S15 1	2.4%	4.0% 0.70 10 68: 0.711		Feng-Juan Hulet al (2021 (male) 0.8700 0.0377	1815	1235	255 487 (085, 088)	
Feno-Juan Hu et al/2021 (female)	0.6900 0	0689	2894	1.4%	37% 0691054:0811		+	Feno-Juan Hu et al 2021 (female)	0.6800 0	0077 28	10	2.4%	4.0% 0.68 (0.67:0.70)	1	Peng-Juan Hurel al 2021 (remain) U 6800 1 2001	177	22.1%	225 430 (481, 489)	
Churo-Yao Chero et al/2020	0.8040.0	9436	177	3.4%	3.9% 0.80 (0.71:0.88)		-	Chuno-Yao Chero et al/2020	0,7180.0	0510 1	177 1	0.3%	3 6% 0.72 10 61:0.81		Talianti (2002) Indep of States Cases Cases	64	145	225 232 (232 (232 (267)	1
Ya-Huang Lin/2022 (male)	0.8670		64	0.0%	0.0% 0.87			Ya-Huang Lin/2022 (male)	0.8300		64 1	0.0%	0.0% 0.83		Ta-Huero Lin 2022 (Instala) 0.6800 0.0306	145	645	235 0.88 0.82 0.94	1
Ya-Huano Lin/2022 (female)	0.8600		145	0.0%	0.0% 0.86			Ya-Huano Liv/2022 (female)	0.6300	- S - A	145 1	0.0%	0.0% 0.63		Kasidd Lavonpa 2023 (male) 0.5400 0.0791	73	0.15	1.7% 0.84 [0.68, 0.99]	
Kasidid Lawongsa/2023 (male)	0.8600		73	0.0%	0.0% 0.86			Kasidd Lavongsa(2023 (male)	0.8250		73 1	0.0%	0.0% 0.82	1	Kasidel Laworgsa/2023 (female) 0.8500 0.0434	157	0.75	22% 0.85 (0.78, 0.93)	+
Kasidid Lawongsa/2023 (female)	0.8100		157	0.0%	0.0% 0.81			Kasidid Lawongsa(2023 (female)	0.5800		157 1	0.0%	0.0% 0.88		Melissa Rose Berlin Piodena-Aportadera et al 2022 0.8200 0.0383	176	245	23% 0.82[0.74, 0.89]	+
Melissa Rose Berlin Pipdena-Aportadera et al 2022	0.7500.0	1079	176	0.6%	3.4% 0.7510.48:0.911		-	Mekssa Rose Berlin Picdena-Aportadera et al/ 2022	0.7540.0	0944 1	76 1	0.1%	3.0% 0.75 10.55 0.921		Total (common effect, 95% CI)	7902	365	. 0.87 [0.86; 0.87]	1
Total (common effect, 95% CI)			7602	28.0%	. 0.74(0.71; 0.77)		٠	Total (common effect, 95% CI)		7	SC2 3	2.8%	. 0.71 (0.70; 0.72)	1	Total (random effect, WI% CI)			22.4% 0.84 [0.80; 0.87]	•
Total (random effect, 95% CI)					22.8% 0.70 (0.57; 0.83)		٠	Total (random effect, 95% CI)					22.5% 0.73 (0.69; 0.77)	•	neardenetic ratio month out control on a bis stored to date				
Heterogeneity: Tau ² = 0.0340; Chi ² = 68.38; df = 5 (P < 0	1 0001), I ¹ + 92.1	76						Hoterogeneity: Tau ² = 0.0019; Chi ² = 62.8; df = 5 (P < 0)	0001); 1 ² + 82%						Tool validation = MSRA5_3	-33			
Total undefinition = MEDAE 1								Tool unlighting = MERAS 1							Chung-Yao Cheng et al 2020 0,6000 0,0083 0,6000 0,0083 0,0000 0,0083	177	645	235 460 (052 0.67)	- 1
Tool Kallaston - Norka J	A 4675 A	15.41	177	2.08		1 1		Chara Via Chara et al 2000	A 5456.0	1000		0.00	1.01 1.01 1.1.1.0.00		Total Income affect 200 Ct	304	185	245 235 [251, 0.09]	
Mine Visio MD/2018	0.0000.0	5474	104	105	2.04 0.01 11 20-0.021			Man Visio HD/2018	0.7620.0	0000	50.8	4.482	2.00 0.74 83.00-0.701		Total (random effect, 95% CI)			475 073 1048-0571	-
Tabl (common effect 95% CT)	0.2469.0	19401	561	5.0 /0	4 75 00 23 - 6 001			Total Incompany allocations	47000.0	100	504 504	4 38	8 CE 10 E3 - 8 70		Herarcosreb: Tay = 0.0002 Ch2 = 2020. d = 1 (P < 0.0001) P = 97%				
Table (contrast effect SEX C)			001	0.0 %	7.79 4.79 0.10, 100			Total (control chief, 55% Ci)			201	1.4.78	7 40 8 65 10 47 8 781	-					
listerentite Tar a COSTO Core to S1 dia 1/0 / 1	1 0000 F . 044				rue eneleter, red			Hadamarake Ta 2 + 1111 (12 + 0.07 - 0.07	1000 P . 05 M				ties applied and	· · · · ·	Tool validation = MSRAT_2	- 33		0.000000000	
manifesti in energia envia en a	and the second							recordinate res - source - contra - rit - so							Wing Yang MD(2018 0.7000 0.0230	384	1.15	2.4% 0.70 [0.65, 0.74]	-
Tool validation = MSRA7_2								Tool validation = WSRA7_2							Tool validation = SARC-F_19				
Ming Yang WD/2018	0.8690 0	0489	384	2.9%	3.9% 0.87 (0.76; 0.94)		10	Ming Yang MD/2018	0.3960 0	0278 3	384 (0.9%	3.9% 0.40 (0.34; 0.45)	+	S. W. Huang et al/2023 0.7700 .	996	0.0%	0.0% 0.77	
															15-han No BSc et al/2020 0.5800 0.0179	1058	195	255 158 [0.52 0.53]	•
Tool validation = SARC-F_19								Tool validation = SARC-F_19							12hou et al 2022 0.6500 0.0245	401	105	24% \$65(0.60,0.70)	+ ;
S. W. Huang et al/2023	0.7200 0	0434	996	3.4%	3.9% 0.72 (0.63; 0.80)		+	S. W. Huang et al/2023	0.8300 0	0128 5	86 A	4.5%	4.0% 0.83 (0.80; 0.85)		Chung-hao Cheng et al 2020 0.5600 0.083	117	245	2.3% 0.58 [0.50,0.65]	-
Yi-han Mo BSc et al/2020	0.1800 0	1255	1050	9.8%	4.0% 0.18 [0.13;0.23]	+		Yi-han No BSc et al/2020	0.9400 0	0077 10	050 13	2.4%	4.0% 0.94 (0.92; 0.95)		Tarrelang United 2000 10283	105	4.65	235 069(05),076	
J Zhou et al/ 2022	0.1230 0	0342	401	5.5%	3.9% 0.12 [0.07; 0.20]	+		J.Zhou et al/ 2022	0.9560 0	0128 4	101 4	4.5%	4.0% 0.96 [0.93; 0.98]		Mint Yang MD/2018 0.5900 0.0153	384	285	255. 0.89 10.80 0.971	
Chung-Yao Cheng et al/2020	0.1090 0	0865	177	0.9%	3.6% 0.11 (0.19; 0.53)	-		Chung-Yao Cheng et al/2020	0.9160 0	0327 1	177 1	0.7%	3.8% 0.92 (0.84; 0.97)	-	Service Ker MD/2017 0.6670 0.0255	1222	0.95	245-1478-42072	
Ya-Huang Lin/2022	0.5400		209	0.0%	0.0% 0.54			Ya-Huang Lin/2022	0.7000	~ N 3	209 (0.0%	0.0% 0.70		Shi Terg Lee 2023 0.5700 0.0434	230	0.25	22% 0.57 10-49 0.66	
Takeshi Kera/2023	0.1300 0	9663	683	1.5%	3.8% 0.13 (0.04; 0.30)	+		Takeshi Kera/2023	0.9700 0	0128 6	83 4	4.5%	4.0% 0.97 (0.94; 0.99)		Airhiro to 2023 0.5000 0.0740	139	61%	1.8% 0.50 (0.38; 0.65)	
Ming Yang MD/2018	0.2950 0	0615	384	1.7%	3.8% 0.29 [0.18; 0.43]	-+-		Ming Yang MD/2018	0.9810 0	0084 3	384 11	0.3%	4.0% 0.98 (0.96; 0.99)		M6-Kyoung KITM2020 0.6450 0.0250	388	10%	245 084 [059,089]	-
Sunyoung Kim MD(2017	0.2400		1222	0.0%	0.0% 0.24			Sunyoung Kim MD/2017	0.9150	. 12	222 1	0.0%	0.0% 0.92		LIR et al./2020 0.6700 0.0153	1009	28%	255 267 [0.64, 0.70]	
Shi-Teng Lee/2023	0.0000		230	0.0%	0.0% 0.00			Shi-Teng Lee/2023	1.0000	12 3	230 1	0.0%	0.0% 1.00		Total (common effect, BES CI)	6858	11.65	. 0.69 [0.67; 0.76]	
Akthiro Ito/2020	0.1110		139	0.0%	0.0% 0.11			Akihiro Ito/2020	0.9170		139 1	0.0%	0.0% 0.92		Total (random effect, 96% CI)			25.2% 0.65 [0.59; 0.71]	•
Mi-Kyoung KIM/2020	0.7960 0	0332	388	5.8%	3.9% 0.80 [0.73; 0.86]		+	Mi-Kyoung KIM/2020	0,4190 0	0334 3	388 (0.7%	3.8% 0.42 0.35; 0.49	+ 1	newopenely 182" + 0.0041, CN" + 2806, d + 10 (P + 0.0011); T + 98, 14				
Li R et al./2020	0.2300 0	0474	1009	2.8%	3.9% 0.23 [0.15; 0.33]	+		Li R et al./2020	0.8810 0	0110 10	009 1	6.1%	4.0% 0.88 (0.86; 0.90]		Tool volidation = SARC.F = 4C 1				
Total (common effect, 95% CI)			6888	31.4%	. 0.35 [0.32; 0.38]	•		Total (common effect, 95% CI)		68	4	3.5%	. 0.93 (0.92; 0.93)		17mm et al 2022 0.8500 0.0204	401	145	245 930875 034	1
Total (random effect, 95% CI)					30.7% 0.33 [0.13; 0.52]	-		Total (random effect, 95% CI)					31.5% 0.86 (0.74; 0.99)	•	Shi Terg Lev 2023 0.6900 0.0383	230	645	225 0.69 (0.61 0.76)	+
Helerogenety: Tex ² = 0.0752; Chi ² = 368.74; dl = 7 (P <	0.0001); 1 = 98	1%						Heterogeneity: Tax ² = 0.0330; Chi ² = 367.12; dl = 7 (P <	<0.0001); r = 98	115					Total (common effect, 85% CI)	631	1.95	. 0.78 [0.74: 0.81]	2
Test of the second second second								Test states a state to an a							Total (random effect, 95% CI) Internet and Tay? + 0.00% CA? + 0.41 after 1 (2 + 0.00%) ² + 0.4 %.			475 0.75 [0.64; 0.86]	•
17by at all 2022	0.8200.0	1000	401	175	3 64, 0 83 10 73-0 80		1	1001 Validation = Securit + Mile 3	0.6850.0	0773	(H)	0.0%	105, 043 (151-072)	+	conduct on constant of a second second				
Di Tana Lan 2022	0.0000 0	2000	220	4.2.0	0.00 0.00			Shi Tangi an 2000	0.0000 0	intro .	100	0.05	0.00 0.00 0.00 0.00		Tool validation = SARC-Calf_14				
dil-reig cercoco	0.0070		200	0.0%	0.0% 0.39			Sil-rang Law 2025	A 0396		100 1	0.0%	0.0% 0.0+		15-han No BSc et al/2020 0.7000 0.0153	1050	285	25% 0.70(0.67, 0.73)	•
Test unlitedies = \$100 Call 14								Tool universe - SIGC Call 14							12hoc et al 2022 0.8110 0.0202	401	155	245 081 [0.77,0.85]	
Victors Me BCr at si7777	0.4800.0	8222	1050	6.05	104 0.49 10 41-0.64			Vi has bla BCs at si20150	0.0000.0	8400 10	NO 1	7.0%	104.001000.0041		Chung-Yao Cheng et al (2020 0.7300 0.0357	117	625	22% 0,73 [0.66; 0.80]	
17hai mubou wanzaza	0.4750.0	0012	404	2.01	2.04 0./7 0 17-0.57			17hourd of 2020	0.0000 0	3174 1	01	2.010	4.00 0.00 0.00 0.00 0.00		Here New MIC/2022 0.0000 0.0201	209	170	245 285 [216,089]	1.
Change Van Change at al 2020	0.1010.0	0003	177	2.50	3.5% 0.4% (0.27, 0.3%)	- C.		Chara Van Chara et al 2020	0.0100 0	A60 4	77 1	0.25	3.2% 0.85 (2.00, 0.54)		Shi Tana Lan (1971) 0.700 0.500	204	145	275.470.042.076	
Validade Ling 6 and 200	0.0000 0	1000	200	0.06	0.04 0.00 (0.20, 0.40)	1.1		Va Husen Lie 2001	0.0000 0	19430		0.0210	0.04 0.72	10	Altino to 2023 0.5300 0.0589	138	815	185.05310.40.067	
Max View MD2018	0.0033.0	8803	200	4.05	2.00 0.01 10 /7.0 70			New York HD 2012	4.0478-0	anti	201 1	0.035	0.018 0.00 0.48 0.45 0.47 0.298		Mi-Kutoure MIN 2020 0.7250 0.0252	398	175	245 072 0 68 0 77	
thing tang wurzone	0.0450	9033	200	1.370	3.0% up p.4r, u.3			Shi Tana Las 2002	0.2470.0	10000	100	0.08	3.4% 0.55 (0.47, 0.73)		L/R et al.(2020 0.7900 0.0128	1008	17%	255 0.79 (0.78, 0.81)	
Silvin be 2020	0.2100		200	0.0%	0.0% 0.21			Shi-Yeng Lebezoca	0.0000	10 1	100 1	0.0%	0.0% 0.20		Total (common effect, 95% CI)	3987	14.3%	0.88 [0.79: 0.81]	
ANTEO ID 2020	0.00/0	mai	108	0.0%	0.0% 0.07			ARTIC ID2020	0.0100		100 1	0.0%	0.0% 0.52		Total (random effect, 95% CI)			2125 0.76 [0.68; 0.82]	•
w-kjourg www.ccc	0.0300 0	0311	300	0.070	3.3% 0.63 (0.76, 0.66)		÷.	NH-Kyoung Kimizoza	4 0500 0	0000 000	200 1	0.0%	3.0% U24 (2.47, 0.00)		Hearogenety: Tau" + 0.0098; Ch" + 168.69; d + 8 (P < 0.0001); i" + 55.5%				
LI R et aluguzo		1040	1008	2178	3.0% (141 (0.31, 0.32)			U Ketauguga	0.0000 0	1911 1	10	5,3%	4.0% 0.00 (0.00, 0.00)						
Total (common enect, 95% Ci)			3961	2013.2	. 0.56 [0.55; 0.62]			Total (common effect, 95% Ci)			1001 1	2.2.2	. 0.00 [0.07; 0.09]	1	Tool validation = SARC-Call + AC_3	-			
Total (random effect, sons Ci)		-			5752 #20(0.40; #20)			Total (tandom effect, so's Cij					22.3% #00 (0.71; #30)	-	2200 E.B. 2022 0.040 0.0 04	901	105	245 280 (281, 0.08)	1
meterogenety: 181" = 0.0261; UN" = 101.8; df = 5 (P < 0	1 0001 (1 = 30)	2						Helerogenery: 184" = 0.0219; Chi" = 128; Ct = 5 (P < 0.0	JULTS (* 96 TH	•					Total Iconnon effect. BTS CI	631	2.25	0.63 10 79 0.861	
Total and an								Test and an a part of a							Total (random effect, 95% CI)	1.00	-	475 0.80 [0.68: 0.90]	+
ION KENDEDER * SAMU-GER * AU_3			101					1001 VERSEDON + SAND-CER + AC_3				1.00	A		Hearoperety: Tax" = 0.0051; Ch" = 7.21; df = 1 (P = 0.0072); f" = 86.2%				
Shi Tana Lan 2002	0.0000	9400	220	0.970	0.5% 0.56 0.66			Shi Tana Lan 2002	0.0000	1669	101 100 I	0.08	0.010 0.000		and the second se				
day and metors	0.0012		230	0.0%	0.9% 0.90			distant matters	0.0000	11 1	COU 1	0.0.0	0.0% 0.10		Tool valdation = lobil_5				
Tool validation = Ishii 5								Tool validation = Ishii 5							a.m. manget sk2x22 0.7340 . Shinya khii 0014 (maki n.6400 n.6400	376	585	255 094 (092 1040	1.
S W Huano et al/2023	0 7200 0	0434	996	345	39% 0721063-080		+	S W Huann et al/2023	0.7500.0	0153 5	26	315	405 075 072 078		Shove bhi 0014 (kesale) 0.9100 0.0108	994	175	255 091 0.88 0 93	
Shinva late (2014 (male)	0.8490		977	0.0%	0.0% 0.85			Shinya Ishii /2014 (male)	0.6620		177	0.0%	0.0% 0.88		Xiaoyan Chen/2021 (male) 0.8100 0.0281	452	0.85	245 0.81 (0.75 0.86)	-
Shinya lahii (2014 (fenale)	0.7550		994	0.05	0.0% 0.76			Shinya lahii (2014 (lemale)	0.9200		394	0.0%	0.0% 0.92		Xiaryon Chen/2521 (lensie) 0.8400 0.0250	479	1.1%	245 0.84 (0.80, 0.89)	+
Xiaovan Chen/2021 (male)	0.7100		462	0.0%	0.0% 0.71			Xiaoyan Cheri(2021 (male)	0,8100	- 21	162	0.0%	0.0% 0.81		Shuyue Luci2023 (male) 0.8990 0.0102	1509	585	255 0.90 (0.88, 0.92)	
Xianvan (hen/2021 (female)	0.7500		479	0.05	0.0% 0.75			Xiahuse (hen/2121 (female)	0.8000	- 2	179	0.0%	0.0% 0.80		Shuyue Luci2823 (female) 0.9950 0.0077	2958	12.2%	25% 0.90 [0.89, 0.92]	
Share (un)2023 (male)	0.8950		1509	0.0%	0.0% 0.90			Shave Lun(2023 Insis)	0 7710	15	579	0.0%	0.0% 0.77		Total (common effect, 95% CI)	8365	27.45	. 0.91 [0.90; 0.92]	
Shuyue Luo/2023 (female)	0.5000		2668	0.0%	0.0% 0.90			Shuyue Luo/2023 (female)	0.7700	26	868	0.0%	0.0% 0.77		rocal pandom effect, 95% CI) Heterocenetic Tay ² = 0.0017 Ch ² = 31 HS, dt = 5 (P = 3.0007) (P = 34.0%)			14.0% (U.S.) (U.S.)	•
10.0000000000000										11 123					and an example of the second second second second				
Total (common effect, 95% CI)			28769	100.0%	. 0.59 [0.58; 0.61]			Total (common effect, 95% CI)		287	109 10	0.0%	. 0.83 (0.83; 0.84)	4	Total (common effect, 87% CI)	21768	100.0%	. 0.84 [0.84; 0.85]	1
rotar (randoff effect, 35% Ci)				1	100.0% 0.26 [0.46; 0.56]		-	rotal (tandoit) effect, 35% Cij					101.05 0.15 (0.12; 0.84)	•	row parallel effect, still up			service on a level (1986)	
Hererogenety: Tau" = 0.0651; Chi" = 1063,89, df = 25 (F	<10001);(**	BC75						Hererogeneity: Tau" + 0 0258; Chi" + 2168.56; df + 25 (P	**官「*郑野						Test for subsence differences (instruct affect) (201 - 124 - 129)	én l			07 04 06 08 ·
test for subgroup ormanices (common effect); Chill = 50	10.34, d = T (P	0.0001)				v uz 0,4 0	10 0	rest to subgroup otherences (common effect); Chi" = 16	0211,0=7(9	= (0 =			0	02 04 05 08	Test for subgroup differences (random effects), Ch ² = 74.88, df = 7.1P < 10	10			
iez is andionò queleices (rautou euecis). Chi, e 3	s/a,α≈/{P<	20007)						rest to: subgroup offerences (random entects) (Ch? = 1)	n.n,#+(P	e 61000)									

Appendix H: Checking heterogeneity and inconsistency of all screening tools by forest plot in Asia

					Decrease GRADE		
					(Risk of		
		0			Bias,	GRADE	
		Quantit			Consistency	01 Evidence	
		y and Type of		Stortin	, Directiless, Precision	Evidenc o for	
Screening		Evidenc	Finding	σ	Publication	Outcom	Overall
Tool	Outcome	e	s (%)	Grade	Bias)	e	GRADE
Calf	0 4000		5 (70)	01000	-1	•	0121212
circumferenc	Sensitivit				(concistency		Moderat
e	y	9 DIAG	70%	High		-1	e
	Specificit				-1 (Moderat
	y	9 DIAG	73%	High	concistency)	-1	e
					-1		
					(concistency		Moderat
	PPV	9 DIAG	0.48	High)	-1	e
					-1 (Moderat
	NPV	9 DIAG	0.91	High	concistency)	-1	e
					-2 (risk of		
	Sensitivit				bias,		_
MSRA5	У	3 DIAG	73%	High	concistency)	-2	Low
	G .C				-2 (risk of		
	Specificit	2 DIAC	500/	TT: - 1	bias,		τ
	У	3 DIAG	58%	High	concistency)	-2	LOW
					-2 (TISK OI		
	PDV	3 DIAG	0.30	High	concistency)	_2	Low
	11 V	JDIAU	0.39	Ingn	-2 (risk of	-2	LUW
					bias		
	NPV	3 DIAG	0.8	High	concistency)	-2	Low
	Sensitivit	0 2 1 1 0	010	1.1.8.1	-1 (risk of	-	Moderat
MSRA7	y	2 DIAG	85%	High	bias)	-1	e
	Specificit				-1 (risk of		Moderat
	y	2 DIAG	35%	High	bias)	-1	e
					-1 (risk of		Moderat
	PPV	2 DIAG	0.2	High	bias)	-1	e
					-1 (risk of		Moderat
	NPV	2 DIAG	0.9	High	bias)	-1	e
					-1		
	Sensitivit				(concistency		Moderat
SARC-F	У	19 DIAG	35%	High)	-1	e
	a .a				-1		
	Specificit	10 DI 1 C	7.00	TT: 1	(concistency	1	Moderat
	У	19 DIAG	76%	Hıgh)	-1	e

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					-1		
					(concistency		Moderat
	PPV	19 DIAG	0.44	High)	-1	e
					-1		
		10 514 6	0.00	*** 1	(concistency		Moderat
GADGE	NPV	19 DIAG	0.82	High)	-1	e
SARC-F +	Sensitivit		200/	11.1		0	TT' - 1-
AC	y Smaaifiait	3 DIAG	80%	High	0	0	High
	v	3 DIAG	69%	High	0	0	High
	PPV	3 DIAG	0.44	High	0	0	High
	NPV	3 DIAG	0.82	High	0	0	High
				0	-1		
	Sensitivit				(concistency		Moderat
SARC-Calf	у	14 DIAG	57%	High)	-1	e
					-1		
	Specificit				(concistency		Moderat
	У	14 DIAG	84%	High)	-1	e
					-1		
					(concistency		Moderat
	PPV	14 DIAG	0.54	High)	-1	e
					-1		
			0.04	11.1	(concistency	1	Moderat
GADG G 16	NPV	14 DIAG	0.84	High)	-1	e
SARC-Calf +	Sensitivit		750/	High	0	0	II: ala
AC	У	5 DIAG	/5%	High	0	0	High
	Spacificit				-1		Moderat
	specificit	3 DIAG	78%	High	(concistency	_1	Niouerat
	y	5 DINO	7070	Ingn		-1	
					(concistency		Moderat
	PPV	3 DIAG	0.44	High	(concisioney	-1	e
					-1		
					(concistency		Moderat
	NPV	3 DIAG	0.9	High) j	-1	e
	Sensitivit				-1 (risk of		Moderat
Ishii	у	5 DIAG	79%	High	bias)	-1	e
	Specificit				-1 (risk of		Moderat
	У	5 DIAG	78%	High	bias)	-1	e
					-1 (risk of		Moderat
	PPV	5 DIAG	0.46	High	bias)	-1	e
			0.07		-1 (risk of		Moderat
	NPV	5 DIAG	0.95	Hıgh	bias)	-1	e

Appendix I: GRADE Framework Assessment of the Certainty of Diagnostic Accuracy For Sarcopenia Screening Tool

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