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RESEARCH PAPER

Handgrip strength rather than chair stand test should be used to diagnose sarcopenia in geriatric rehabilitation inpatients: REStORing health of acutely unwell adulTs (RESORT)

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Abstract

Background: according to the revised sarcopenia definition proposed by the European Working Group on Sarcopenia in Older People (EWGSOP2) and revised definition of the Asian Working Group for Sarcopenia (AWGS2019), handgrip strength (HGS) and chair stand test (CST) can be used interchangeably as initial diagnostic measures.
Objective: to assess the agreement between sarcopenia prevalence, using either HGS or CST, and their association with adverse outcomes in geriatric rehabilitation inpatients.
Methods: REStORing health of acutely unwell adulTs is an observational, longitudinal cohort of geriatric rehabilitation inpatients. Cohen's kappa (κ) was used to assess the agreement between sarcopenia prevalence (no, probable and confirmed and severe sarcopenia) according to EWGSOP2 and AWGS2019 using either HGS or CST. Associations between HGS and CST and readmission, institutionalisation and mortality were assessed by binomial regression.
Results: patients ($n = 1{,}250$, 57% females) had a median age of 83.1 years (interquartile range: [77.5–88.3]). There was no agreement between probable sarcopenia prevalence using HGS or CST for EWGSOP2 and AWGS2019, respectively (HGS: 70.9% and 76.2%; CST: 95.5% and 98.4%; $\kappa = 0.08$ and 0.02). Agreement between confirmed and severe sarcopenia prevalence using either HGS or CST was strong to almost perfect. HGS was associated with 3-month institutionalisation and 3-month and 1-year mortality, whereas CST was not associated.
Conclusions: HGS and CST cannot be used interchangeably as diagnostic measures for probable sarcopenia in geriatric rehabilitation inpatients. CST is not useful to predict adverse outcomes in geriatric rehabilitation inpatients.

Keywords: rehabilitation, sarcopenia, diagnosis, muscle strength, aged, older people

Key Points

- HGS and CST cannot be used interchangeably to diagnose probable sarcopenia in geriatric rehabilitation.
- HGS should be used to diagnose sarcopenia in geriatric rehabilitation and not CST.
- HGS is predictive of adverse outcomes while CST is not.

Introduction

Sarcopenia, characterised by low muscle strength, muscle mass and physical performance [1], is prevalent in >50% of geriatric rehabilitation patients [2] and is associated with worse functional outcomes at discharge from rehabilitation [3] as well as mortality [4]. Sarcopenia may be a reversible cause of disability and patients may benefit from early intervention with resistance training and protein supplementation [5]. However, different diagnostic criteria result in a large variation in sarcopenia prevalence [6, 7], which hampers diagnosis in clinical practice.

The revised sarcopenia definition proposed by the European Working Group on Sarcopenia in Older People (EWGSOP2) sets muscle strength at the forefront of the algorithm, which is assessed with handgrip strength (HGS) or chair stand test (CST) [1]. Similarly, the revised definition of the Asian Working Group for Sarcopenia (AWGS2019) recommends to use either HGS or CST as a first step [8] but defines CST as a physical performance rather than muscle strength assessment. Both sarcopenia definitions use muscle mass to confirm the diagnosis of sarcopenia and comprise stages: no sarcopenia, probable sarcopenia (HGS or CST below cut-off points), confirmed sarcopenia and severe sarcopenia. Although HGS and CST are suggested to be both used as a first step to diagnose probable sarcopenia, there is a low agreement between HGS and CST in community-dwelling older people [9], which affects sarcopenia prevalence [10, 11]. This finding is of importance in geriatric rehabilitation patients as upper and lower limb muscle strengths might be differently affected after a period of acute disease [12].

The aims of this study were to determine (i) the agreement between sarcopenia prevalence (EWGSOP2 and AWGS2019) using either HGS or CST; and (ii) the association between HGS and CST using EWGSOP2 and AWGS2019 cut-offs and adverse outcomes (readmission, institutionalisation and mortality) in a large inception cohort of geriatric rehabilitation inpatients.

Material and Methods

Study design and population

REStORing health of acutely unwell adulTs (RESORT) is an observational, longitudinal inception cohort of geriatric rehabilitation inpatients admitted to the department of aged care at the Royal Melbourne Hospital (Melbourne, Victoria, Australia). The physical, cognitive and physiological health statuses of the patient were assessed using standardised assessment tools as part of a Comprehensive Geriatric Assessment (CGA) [13] within 48 hours of admission by physicians, nurses, physiotherapists, occupational therapists and dietitians. RESORT was approved by the Melbourne Health Human Research Ethics Committee (HREC/17/MH/103) and was conducted in accordance with the Declaration of Helsinki [14].

Patients were included at admission to geriatric rehabilitation wards and were excluded if they had no capacity to consent and had no nominated proxy to consent, or if the patients were palliative at admission. For the analysis, patients admitted from 16 October 2017 and discharged by 18 March 2020 (Waves 1–3) were eligible for inclusion. Of the 2,692 patients admitted, 446 patients were excluded, and 356 patients refused consent, which resulted in the inclusion of 1,890 patients. A total of 640 patients were excluded from the present analysis due to missing sarcopenia diagnostic measures (patient characteristics are shown in Supplementary Appendix 1), which left 1,250 patients. Institutionalisation data were available for 1,052 patients, and readmission and mortality data were available for all patients.

Patient characteristics

Age, sex, primary reason for admission and length of stay in geriatric rehabilitation were retrieved from medical records. Ethnicity data were collected through a patient survey. Disease burden was documented by a physician using the 56-point Cumulative Illness Rating Scale (CIRS) [15] and the 37-point Charlson Comorbidity Index (CCI) [16] in which higher points indicate higher morbidity. Frailty was measured by a physician using the Clinical Frailty Scale (CFS) on a scale from 1 (very fit) to 9 (terminally ill) [17]. Cognitive impairment was assessed by the diagnosis of dementia or by a cognitive score below cut-off values for one of the following tests: Mini-Mental State Examination (MMSE) <24 point [18], Montreal Cognitive Assessment (MoCA) <26 points [19] or the Rowland Universal Dementia Assessment Scale (RUDAS) <23 points [20]. Anthropometric measurements were performed by a nurse. Standing height without footwear was measured when the patient was able to stand, up to the nearest 0.1 cm. If the patient was unable to stand, knee height was measured using a sliding calliper between knee and ankle joints positioned at 90°, and height was estimated with the Chumlea equation for Caucasians [21]. Weight was measured on a calibrated standing weighing scale, weighing chair or hoist without shoes or heavy clothes, measured to the nearest 0.1 kg. Body mass index

(BMI) was calculated by dividing the body weight by height squared (kg/m^2). The risk of malnutrition was assessed by a nurse with the Malnutrition Screening Tool (MST), ranging from 0 to 5 points, with higher scores indicating a higher risk of malnutrition [22]. Risk of malnutrition was defined by an MST score $\geq$2. Functional independence status was assessed by an occupational therapist using the Katz index for Activities of Daily Living (ADL) [23] and the Lawton and Brody scale for Instrumental Activities of Daily Living (IADL) [24]. ADL and IADL scores range between 0 and 6 and 0 and 8 points, respectively, with higher scores indicating higher levels of independence.

Sarcopenia diagnosis

Muscle strength and physical performance were assessed by a physiotherapist. HGS was assessed using a handheld hydraulic dynamometer (JAMAR; Sammons Preston, Inc., Boling-brook, IL, USA) in a sitting position, elbow bent at 90° to the body, exerting maximum force. HGS was measured six times, alternating for both hands, and the maximum value was used for analysis [25] and was expressed in kilogrammes. Physical performance was assessed with the Short Physical Performance Battery (SPPB) with a score from 0 to 12 points, where a higher score indicates better physical performance [26]. The SPPB consists of three tests: standing balance test, CST and 4-m walk test (gait speed). For the CST, patients were asked to rise from a chair five times with their arms folded across their chest, and time was recorded in seconds from the beginning of the first rise until seated again after the fifth rise [26]. Gait speed, expressed in m/s, was measured twice at usual pace with or without walking aid and the fastest time was used for analysis.

Muscle mass was measured by direct-segmental multi-frequency bio-electrical impedance analysis (DSM-BIA, InBody S10, Biospace Co., Ltd, Seoul, South Korea). DSM-BIA has been validated for assessing segmental and whole-body composition against dual energy X-ray absorptiometry [27]. Patients were measured in a supine position. DSM-BIA was not performed in patients with (i) an electronic internal medical device or implant such as a pacemaker; (ii) plasters or bandages that interfered with the placement of the electrodes; (iii) an amputation or (iv) admission under contact isolation/precautions. Muscle mass was expressed appendicular lean mass (ALM) in kilogrammes and ALM index (ALMI, kg/m^2) was calculated by dividing ALM by height squared (m^2) [28].

EWGSOP2 and AWGS2019 definitions and cut-offs were used for sarcopenia diagnosis [1, 8]. The EWGSOP2 algorithm includes (i) low muscle strength: HGS $<$27 kg for males and $<$16 kg for females or CST $>$15 s or failing the pre-test (not able to rise from the chair without using the arms); (ii) low muscle mass: ALMI $<$7.0 kg/m^2 and $<$5.5 kg/m^2 for males and females, respectively; (iii) low physical performance: gait speed $\leq$0.8 m/s or inability to walk. AWGS2019 includes: (i) low muscle strength: HGS $<$28 kg for males and $<$18 kg for females; (ii) low muscle mass: ALMI $<$7.0 kg/m^2 and $<$5.7 kg/m^2 for males and females, respectively, and (iii) low physical performance: CST $\geq$12 s or failing the pre-test. Sarcopenia stages were determined for both definitions, once using HGS and once using CST cut-offs, as shown in Figure 1.

Readmission, institutionalisation and mortality

Unplanned 3-month readmissions to the Royal Melbourne Hospital were obtained from the hospital administrative system. Three-month readmissions to other hospitals were obtained during a follow-up phone call with the patient or caregiver. Planned admissions after discharge were excluded, including elective admission for follow-up surgical or medical treatments such as scheduled dialysis or chemotherapy. Three-month institutionalisation was obtained during a follow-up phone call with the patient or caregiver. Patients already institutionalised before admission, deceased in hospital or at follow-up were excluded. All-cause mortality was assessed at 3-month and 1-year post-discharge from geriatric rehabilitation through the Registry of Births, Deaths and Marriages Victoria and through medical records.

Statistical analysis

Patient characteristics were reported with descriptive statistics. Continuous variables were reported as mean with standard deviation (SD) when normally distributed and else as median with interquartile range (IQR). Categorical variables were reported as frequency (n) with percentages (%). Cohen's Kappa (κ) was used to determine the level of agreement between sarcopenia stages using either HGS or CST according to EWGSOP2 and AWGS2019. Coefficients were interpreted as follows: 0.00–0.20 representing no agreement, 0.21–0.39 representing minimal, 0.40–0.59 representing weak, 0.60–0.79 representing moderate, 0.80–0.90 representing strong and $>$0.90 representing almost perfect agreement [29]. Binomial logistic regression analyses of the association between HGS and CST, dichotomised as normal or low/abnormal values by EWGSOP2 and AWGS2019 cut-offs, and readmission, institutionalisation and mortality were performed. Analyses were adjusted for age and sex. Additionally, analyses were adjusted for co-morbidity (CCI score) and cognitive impairment as they are associated with both muscle strength [30, 31] and readmission, institutionalisation and mortality [32, 33]. Effect modification of sex was tested by introducing interaction terms. Results were presented as odds ratios (ORs) and 95% confidence intervals (CIs). P-values $<$ 0.05 were considered to be statistically significant. All statistical analyses were performed using the Statistical Package for Social Sciences (IBM SPSS Advanced Statistics 26.0, Armonk, NY: IBM Corp.).

Results

Table 1 shows the patient characteristics at admission. Median age was 83.1 years (IQR: 77.5–88.3); 56.6% were females; median length of stay was 19.7 days (IQR: 13.0–30.0). Prevalence of cognitive impairment was 64.4%;

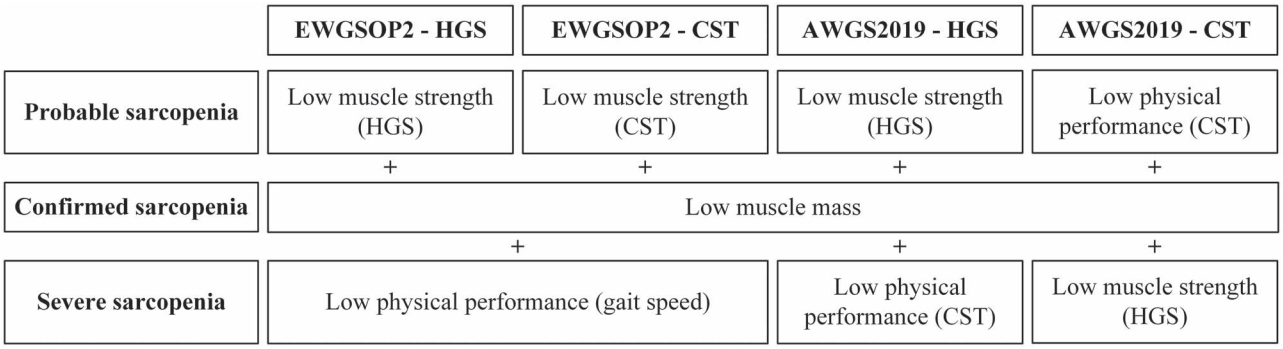

Figure 1. Flowchart of EWGSOP2 and AWGS2019 algorithms for diagnosis of sarcopenia.

median frailty score was 6 (IQR: 5–7). Mean HGS was 13.4 ± 7.8 and 21.6 ± 7.8 kg for females and males, respectively; 7.4% was unable to perform the test. Median CST time was 20.5 s (IQR: 16.1–27.6_; 76.8% was unable to perform the test.

Prevalence of probable sarcopenia was 70.9 and 76.2% using HGS and was 95.5 and 98.4% using CST for EWGSOP2 and AWGS2019, respectively, indicating no agreement (EWGSOP2: $\kappa = 0.08$, 95% CI = 0.04–0.12; AWGS2019: $\kappa = 0.02$, 95% CI = −0.01 to 0.05, Figure 2). Agreement between the prevalence of confirmed sarcopenia using HGS (20.4%) or CST (22.6%) was strong according to EWGSOP2 ($\kappa = 0.90$, 95% CI = 0.87–0.93) and was almost perfect according to AWGS2019 (prevalence with HGS: 23.5% and with CST: 26.3%; $\kappa = 0.91$, 95% CI = 0.88–0.94). A total of 12.1 and 11.9% of the patients diagnosed with confirmed sarcopenia using CST were not diagnosed using HGS for EWSGOP2 and AWGS2019, respectively. The difference in confirmed sarcopenia prevalence for EWGSOP2 and AWGS2019 stratified per ethnicity is shown in Supplementary Appendix 2. Agreement between severe sarcopenia prevalence using HGS or CST was almost perfect for EWGSOP2 ($\kappa = 0.91$, 95% CI = 0.88–0.94). Low muscle mass without low HGS occurred in 3.1% of the patients for EWGSOP2 and AWGS2019, while low muscle mass without abnormal CST occurred in 1.0 and 0.3% of the patients for EWGSOP2 and AWGS2019, respectively (Figure 3). Overall, 19.8 and 23.2% of the patients had low HGS, abnormal CST and low muscle mass for EWGSOP2 and AWGS2019, respectively (Figure 3).

Table 2 shows the association between HGS and CST and adverse outcomes. There was no effect modification for sex. After adjustments, low HGS was associated with higher odds for 3-month institutionalisation (EWGSOP2: OR = 1.59, 95% CI = 1.12–2.24; AWGS2019: OR = 1.53, 95% CI = 1.06–2.21), 3-month mortality (EWGSOP2: OR = 2.12, 95% CI = 1.12–4.04; AWGS2019: OR = 2.51, 95% CI = 1.18–5.35) and 1-year mortality (EWGSOP2: OR = 1.67, 95% CI = 1.14–2.44; AWGS2019: OR = 1.62, 95% CI = 1.08–2.44) compared to normal HGS. HGS and CST were not associated with 3-month readmission. No association was found between abnormal CST and institutionalisation or mortality.

Discussion

In a large inception cohort of geriatric rehabilitation inpatients, there was no agreement between the prevalence of probable sarcopenia using HGS or CST for both EWGSOP2 and AWGS2019 definitions. Strong to perfect agreement was found between confirmed as well as severe sarcopenia prevalence using either HGS or CST. Low HGS was associated with higher odds for 3-month institutionalisation and 3-month and 1-year mortality; no associations were observed between CST and adverse outcomes.

Agreement between sarcopenia prevalence using either HGS or CST

Probable sarcopenia prevalence was higher using CST compared to HGS resulting in no agreement between definitions. This implies that the interchangeability of both measures as a first step to diagnose sarcopenia in geriatric rehabilitation inpatients suggested by EWGSOP2 and AWGS2019 is not adequate in this population. Studies in community-dwelling older adults found inconsistent results: higher probable sarcopenia prevalence using CST than using HGS [10, 34], higher prevalence using HGS than using CST [11] and no difference in prevalence [35]. In community-dwelling older adults, HGS was reported not to be a proxy measure of lower extremity strength [36]. The higher probable sarcopenia prevalence in this cohort using CST compared to HGS is explained by the inability of three-fourth of the patients to perform the CST, while HGS assessment in a seated or supine position was feasible for most patients. The CST is a measure of overall physical performance rather than only muscle strength and is influenced by multiple factors including trunk stability, balance and pain [37–39], which are hampered in geriatric rehabilitation patients who experience mobility and function loss after a period of acute disease. In clinical rehabilitation practice, CST assessment at admission may therefore not be representative of the patients' muscle strength.

As the diagnosis of confirmed sarcopenia mostly relies on low muscle mass when using CST as first step in geriatric rehabilitation inpatients, the agreement in confirmed and severe sarcopenia using either HGS or CST was strong to perfect for both definitions. In clinical practice, the need to

Table 1. Patient characteristics at admission to geriatric rehabilitation and adverse outcomes at 3-month and 1-year post discharge (n = 1,250)

Characteristics	*n*	Total
Age, years	1,250	83.1 [77.5–88.3]
Female, *n* (%)	1,250	707 (56.6)
Primary reason for acute admission, *n* (%)	1,250	
Musculoskeletal		586 (46.9)
Neurological		207 (16.6)
Cardiac		90 (7.2)
Respiratory		84 (6.7)
Infection		75 (6.0)
Gastrointestinal		65 (5.2)
Other		143 (11.4)
Ethnicity, *n* (%)	1,217	
Caucasian		1,059 (87.0)
Asian		68 (5.6)
Other		90 (7.4)
Length of stay in geriatric rehabilitation, days	1,250	19.7 [13.0–30.0]
CIRS, score	1,249	12 [9–15]
CCI, score	1,250	2 [1–4]
CFS, score	1,151	6 [5–7]
Cognitive impairment, *n* (%)[a]	1,250	805 (64.4)
BMI, kg/m^2	1,250	26.1 [22.7–30.4]
At risk of malnutrition (MST ≥ 2), n (%)	1,243	504 (40.5)
Katz-ADL, score	1,235	2 [1–3]
Lawton-IADL, score	1,235	1 [0–2]
Muscle and physical performance measures		
HGS, kg, mean ± SD	1,158	16.9 ± 7.8
Female	661	13.4 ± 5.8
Male	497	21.6 ± 7.8
Unable, *n* (%)	1,250	92 (7.4)
CST, s	290	20.5 [16.1–27.6]
Unable, *n* (%)	1,250	960 (76.8)
SPPB, score	1,242	1 [0–4]
Gait speed, m/s	788	0.43 [0.30–0.59]
Unable, *n* (%)	1,250	462 (37.0)
ALMI, kg/m^2, mean ± SD	1,248	7.27 ± 1.56
Female	706	6.84 ± 1.49
Male	542	7.82 ± 1.47
Adverse outcomes		
3-month readmission, *n* (%)	1,250	274 (21.9)
3-month institutionalisation, *n* (%)	1,052	249 (24.2)
3-month mortality, *n* (%)	1,210	82 (6.6)
1-year mortality, *n* (%)	1,210	227 (18.2)

Data presented as median (IQR) unless otherwise indicated. [a]Presence of dementia or abnormal sMMSE score <24 points or MoCA <26 points or RUDAS <23 point.

measure muscle mass in almost all geriatric rehabilitation patients when using CST compared to 7 patients out of 10 when using HGS may affect the feasibility of diagnosis implementation. As low muscle mass appears to rarely occur without low HGS in this population, it is advised to first assess HGS and then muscle mass as described in the EWSGOP2 and AWGS2019 algorithms [1, 8]. In community-dwelling older adults, confirmed sarcopenia prevalence was found to be significantly higher when using HGS compared to CST [11, 35, 40] except for one study showing a higher prevalence when using CST [10]. These conflicting findings highlight the need to assess the adequacy of diagnostic criteria with respect to the target population.

Association between HGS and CST and adverse outcomes

HGS is known to be a good predictor of mortality in various populations, including healthy individuals [41, 42], older adults [43] and older hospitalised patients [44]. Similarly, HGS has shown to be associated with institutionalisation in older patients [45, 46]. Although poorly studied, CST was associated with long-term mortality in older adults [47]. In healthy older females, both HGS and CST were predictors for all-cause mortality, with comparable ORs for both measures [48]. The present study confirmed the association between low HGS and higher odds for institutionalisation and mortality. CST, on the other hand, was not associated

Table 2. Association between HGS and CST, according to the EWSGOP2 and AWGS2019 cut-offs, and adverse outcomes in geriatric rehabilitation inpatients

		EWSGOP2					AWGS2019				
			Crude		Adjusted[a]			Crude		Adjusted[a]	
		n	OR (95% CI)	*P*	OR (95% CI)	*P*	*n*	OR (95% CI)	*P*	OR (95% CI)	*P*
3-month readmission											
HGS	Normal	364	1		1		297	1		1	
	Low	886	1.09 (0.81–1.47)	0.569	1.11 (0.81–1.51)	0.517	953	1.21 (0.87–1.67)	0.254	1.23 (0.88–1.71)	0.230
CST	Normal	56	1		1		20	1		1	
	Abnormal	1,194	0.93 (0.49–1.75)	0.811	0.95 (0.50–1.82)	0.884	1,230	1.60 (0.47–5.51)	0.455	1.76 (0.50–6.20)	0.377
3-month institutionalisation											
HGS	Normal	314	1		1		259	1		1	
	Low	738	**1.78 (1.27–2.50)**	**<0.001**	**1.59 (1.12–2.24)**	**0.009**	793	**1.70 (1.19–2.45)**	**0.004**	**1.53 (1.06–2.21)**	**0.024**
CST	Normal	49	1		1		16	1		1	
	Abnormal	1,003	1.22 (0.60–2.48)	0.583	1.12 (0.54–2.32)	0.755	1,036	0.93 (0.30–2.91)	0.900	0.76 (0.24–2.45)	0.644
3-month mortality											
HGS	Normal	353	1		1		290	1		1	
	Low	857	**2.53 (1.35–4.72)**	**0.004**	**2.12 (1.12–4.04)**	**0.022**	920	**3.08 (1.47–6.47)**	**0.003**	**2.51 (1.18–5.35)**	**0.017**
CST	Normal	56	1		1		20	1		1	
	Abnormal	1,154	0.94 (0.33–2.67)	0.911	0.69 (0.24–2.05)	0.509	1,190	0.40 (0.12–1.40)	0.154	**0.26 (0.07–0.97)**	**0.045**
1-year mortality											
HGS	Normal	353	1		1		290	1		1	
	Low	857	**1.97 (1.38–2.82)**	**<0.001**	**1.67 (1.14–2.44)**	**0.008**	920	**1.92 (1.30–2.83)**	**<0.001**	**1.62 (1.08–2.44)**	**0.021**
CST	Normal	56	1		1		20	1		1	
	Abnormal	1,154	1.65 (0.74–3.69)	0.224	1.40 (0.60–3.26)	0.438	1,190	0.92 (0.31–2.79)	0.886	0.66 (0.21–2.15)	0.494

Bold values indicate statistical significance $P < 0.05$. [a] Adjusted for age, sex, CCI score and cognitive impairment.

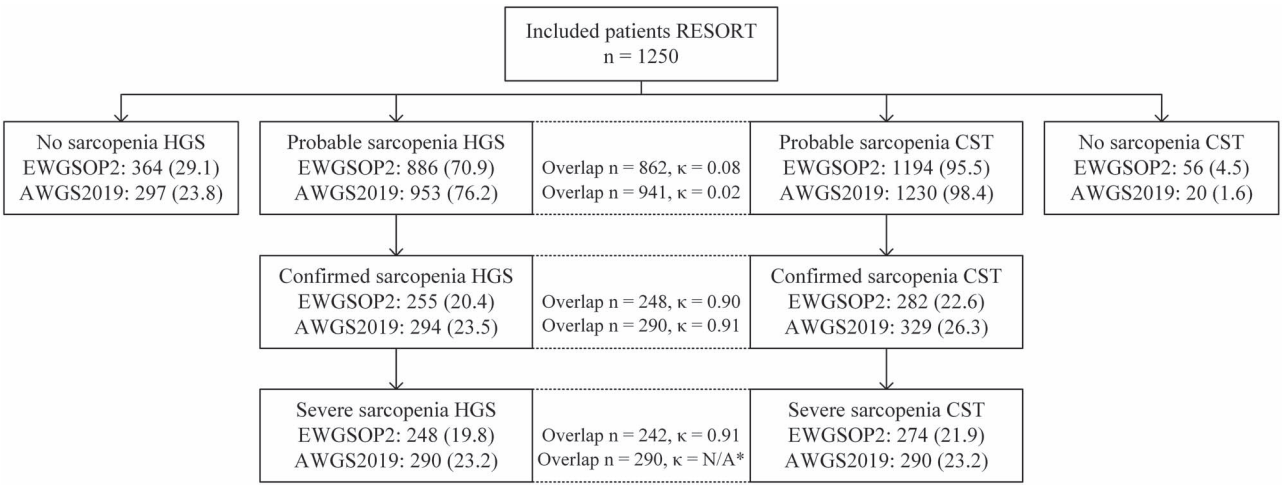

Figure 2. Agreement between sarcopenia stages prevalence using either HGS or CST according to EWGSOP2 and AWGS2019, which was assessed with Cohen's kappa (n = 1,250). Data presented as n (%). κ = Cohen's kappa coefficient. Figure adapted from Johansson et al. [10]. *Agreement analysis was not performed as the diagnosis of severe sarcopenia for AWGS2019 relies on both HGS and CST.

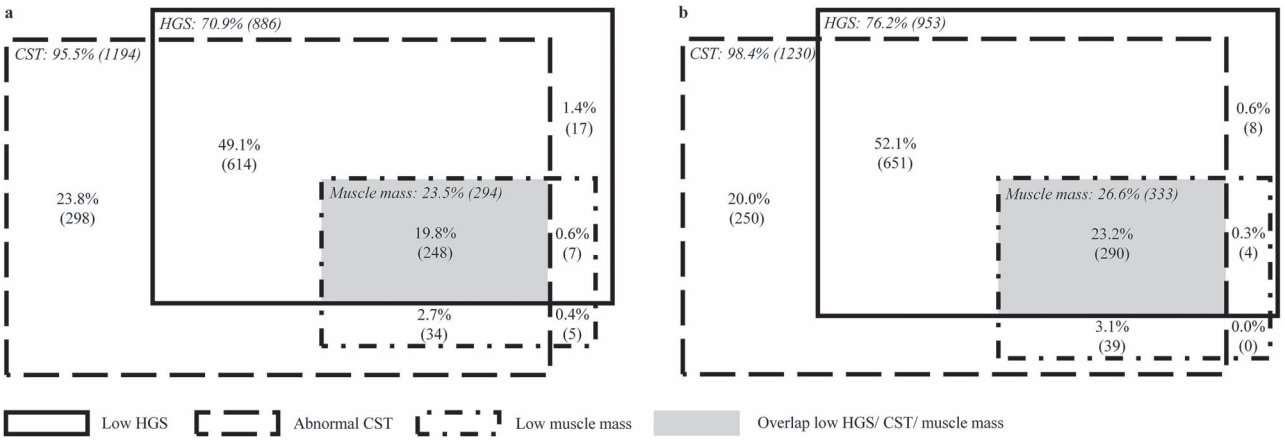

Figure 3. Number of patients with low HGS and/or abnormal CST and/or low muscle mass according to EWGSOP2 (n = 1,223 out of 1,250 participants) (a) and AWGS2019 (n = 1,242 out of 1,250 participants) (b).

with institutionalisation and mortality as very few patients scored above the EWSGOP2 and AWGS2019 cut-off points, leading to an important floor effect of the test in this population. CST performance at admission is therefore not useful as predictor of adverse outcomes in geriatric rehabilitation inpatients. Contrary to our expectations, neither HGS nor CST were associated with readmission. A meta-analysis in hospitalised older patients showed a higher risk of readmission in patients with sarcopenia, who were assessed with HGS and muscle mass [49]. Moreover, CST was associated with 26-week readmission in older patients [50]. Whereas, in hip fracture patients, HGS at admission to hospital was not associated with 1-year readmission [45]. The discrepancy between populations highlights the need for specific cut-off points in certain populations, such as hospitalised and geriatric rehabilitation patients, based on their predictive value for adverse outcomes.

Strengths and limitations

To the best of our knowledge, this is the first study investigating the impact of using either HGS or CST on sarcopenia prevalence using both EWGSOP2 and AWGS2019 in a large cohort of geriatric rehabilitation inpatients. Moreover, all measurements were conducted by a multidisciplinary team as part of a CGA with validated and standardised assessments appropriate to older patients. A limitation of this study is the assessment of muscle mass using BIA, which can be influenced by the hydration status of the patient [27] and could not be performed in patients with amputations or pacemakers and other electronic implants. Furthermore, this

was a single-site study, which could limit generalisability to other hospitals.

Conclusion

HGS and CST are not interchangeable as initial diagnostic measures of sarcopenia in geriatric rehabilitation given the low agreement in probable sarcopenia prevalence using either HGS or CST. CST is not predictive of adverse outcomes in this population while HGS is. As low muscle mass rarely occurs with normal HGS, it is advised to first assess HGS and subsequently muscle mass to diagnose sarcopenia in geriatric rehabilitation inpatients. Further research is needed to find adequate alternative(s) to the CST to measure lower extremity strength in this population.

Supplementary Data: Supplementary data mentioned in the text are available to subscribers in *Age and Ageing* online.

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