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SHORT REPORT

Prevalence of sarcopenia in community-dwelling older adults using the definition of the European Working Group on Sarcopenia in Older People 2: findings from the Korean Frailty and Aging Cohort Study

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Abstract

Background: in October 2018, the European Working Group on Sarcopenia in Older People 2 (EWGSOP2) updated their original definition of sarcopenia to reflect the scientific and clinical evidence that has accumulated over the last decade.
Objective: to determine the prevalence of sarcopenia in a large group of community-dwelling older adults using the EWGSOP2 definition and algorithm.
Design: a cross-sectional study.
Setting: the nationwide Korean Frailty and Aging Cohort Study (KFACS).
Subjects: a total of 2,099 ambulatory community-dwelling older adults, aged 70–84 years (mean age, 75.9 ± 4.0 years; 49.8% women) who were enrolled in the KFACS.
Methods: physical function was assessed by handgrip strength, usual gait speed, the five-times-sit-to-stand test, the timed up-and-go test, and the Short Physical Performance Battery. Appendicular skeletal muscle mass (ASM) was measured by dual-energy X-ray absorptiometry.
Results: according to the criteria of the EWGSOP2, the sarcopenia indicators of combined low muscle strength and low muscle quantity were present in 4.6–14.5% of men and 6.7–14.4% of women. The severe sarcopenia indicators of combined low muscle strength, low muscle quantity and low physical performance were present in 0.3–2.2% of men and 0.2–6.2% of women. Using the clinical algorithm with SARC-F as a screening tool, the prevalence of probable sarcopenia (2.2%), confirmed sarcopenia (1.4%) and severe sarcopenia (0.8%) was low.
Conclusions: the prevalence of sarcopenia among community-dwelling older individuals varied depending on which components of the revised EWGSOP2 definition were used, such as the tools used to measure muscle strength and the ASM indicators for low muscle mass.

Keywords

Sarcopenia, muscle strength, physical function, European Working Group on Sarcopenia in Older People 2 (EWGSOP2), community-dwelling older individuals, older people

Key points

- In October 2018, the European Working Group on Sarcopenia in Older People 2 (EWGSOP2) updated the clinical algorithm for identifying, diagnosing, and determining the severity of sarcopenia.
- Low muscle strength according to the grip strength and chair stand tests showed a significant difference between the sexes.
- Prevalence of sarcopenia and severe sarcopenia varied depending on which components of the revised EWGSOP2 definition were used.

Introduction

Sarcopenia is a common condition among older individuals and is associated with adverse health outcomes [1]. A practical clinical definition and consensus diagnostic criteria for age-related sarcopenia were developed by the European Working Group on Sarcopenia in Older People (EWGSOP) based on the combination of appendicular skeletal muscle mass (ASM), muscle strength and physical performance [2]. Likewise, the International Working Group on Sarcopenia (IWGS) [3], Asia Working Group for Sarcopenia (AWGS) [4] and Foundation for the National Institutes of Health (FNIH) Sarcopenia Project [5] proposed defining sarcopenia as the loss of both ASM and muscle function. A systematic review reported that the estimated prevalence of sarcopenia varies from 9.9 to 40.4% depending on the definition used [6]. These differences in prevalence also exist across populations when using the same definition. The SARC-F was recently proposed as a simple and easy-to-use screening tool for sarcopenia [7]. The SARC-F has low-to-moderate sensitivity and high specificity based on the various definitions of sarcopenia used to screen for the condition among community-dwelling older adults [8, 9].

In October 2018, the EWGSOP2 updated the original definition of sarcopenia to reflect the scientific and clinical evidence that has accumulated over the last decade [10]. This updated definition of sarcopenia incorporates the following: low muscle strength as the first key determinant of diagnosis, new cut-off levels for the variables used to identify and characterise sarcopenia and advice on using the SARC-F questionnaire or clinical suspicion to assess sarcopenia-associated symptoms to identify individuals at risk of sarcopenia. Furthermore, the EWGSOP2 has proposed a clinical algorithm for identifying, diagnosing, and determining the severity of sarcopenia cases. Therefore, the aim of this study was to describe the prevalence of sarcopenia in a large group of community-dwelling older adults enrolled in the nationwide Korean Frailty and Aging Cohort Study (KFACS) using the EWGSOP2 definition and algorithm. A second objective was to compare the prevalence of sarcopenia between the EWGSOP2 and different sarcopenia definitions (EWGSOP1, AWGS, IWGS, and FNIH Sarcopenia Project).

Methods

Study population

KFACS is a nationwide multicenter longitudinal cohort study for which the baseline survey was conducted in 2016–17 [11]. Sex- and age-stratified community residents aged 70–84 years, drawn from urban and rural regions nationwide, were eligible for participation in the study. The recruitment of the study population is summarised in the Supplementary Methods. A total of 3,014 subjects participated in the baseline survey, 2,403 of whom underwent dual-energy X-ray absorptiometry (DEXA) in eight university hospital centres. In total, 611 subjects were excluded based on the results of the assessment of body composition by bioelectrical impedance analysis (BIA) at two community health centres because of the systematic bias of the appendicular lean mass between the BIA and DEXA measurements [12–14]. The final analysis included 2,099 subjects, after excluding 272 subjects who had artificial joints, pins, plates, metal suture materials or other types of metal objects in appendicular body regions (identified on DEXA images), and 32 subjects who had missing data for SARC-F and grip strength assessments, dementia, severe cognitive impairment, Parkinson's disease, or other neurological disorders. The KFACS protocol was approved by the institutional review board of the Clinical Research Ethics Committee of the Kyung Hee University Medical Center, and all subjects provided written informed consent (IRB number: 2015-12-103).

Definitions of sarcopenia

The EWGSOP2 defined sarcopenia as low muscle strength and low muscle quantity, with or without low physical performance. These measurements are described in the Supplementary measurements. We defined sarcopenia according to five sets of international diagnostic criteria (Supplementary Table 1): those of the EWGSOP1 [2], EWGSOP2 [10], AWGS [4], IWGS [3] and FNIH Sarcopenia Project [5]. The Korean version of the SARC-F questionnaire consists of five questions [9]. A SARC-F score ≥ 4 is considered to indicate sarcopenia [7].

Data analysis

The data analysis procedures are described in the Supplementary data analysis.

Results

The prevalence of sarcopenia, rates of combined low muscle strength and low physical performance, and the ASM indicators for low muscle quantity according to the revised EWGSOP2 consensus, are summarised in Table 1. The sarcopenia indicators of combined low muscle strength and low muscle quantity were present in 4.6–14.5% of men and 6.7–14.4% of women. The severe sarcopenia indicators of combined low muscle strength, low muscle quantity and low physical performance were present in 0.3–2.2% of men and 0.2–6.2% of women. The prevalence of sarcopenia was increased to 14.4% using the ASM and 18.4% using ASM/height^2 (men: 13.9% using the ASM and 17.0% using the ASM/height^2; women: 15.0% using the ASM and 19.8% using the ASM/height^2) if an additional one of the two measures of muscle strength (grip strength and chair stand test) was applied. For all the KFACS participants, the prevalence of low muscle strength using the handgrip strength and chair stand test was 19.3% and 9.6%, respectively, in men and 11.9% and 20.0%, respectively, in women (Supplementary Figure 1A). For the participants who underwent DEXA, the prevalence of low muscle strength using the handgrip strength and chair stand test was 18.0% and 9.6%, respectively, in men and 10.1% and 19.4%, respectively, in women (Supplementary Figure 1B). The characteristics of participants who were excluded from the analyses are listed in Supplementary Tables 3 and 4. The prevalence of low muscle strength as measured by the handgrip test was higher in excluded participants residing in rural and suburban regions who underwent BIA to measure body composition (24.0% of men and 19.5% of women, $P < 0.05$) than in those included in the analysis (17.2% of men and 10.1% of women). Low muscle strength (handgrip) was significantly more prevalent in men with metal implants in appendicular body regions (33.3%, $P < 0.05$) excluded from the study than in the men included in the analysis. In contrast, we found no significant differences in muscle strength between women with and without metal implants in appendicular body regions. Moreover, men with metal implants were more likely to perform poorly on the chair stand test than those who underwent BIA to measure body composition and those who were included in the analysis ($P < 0.05$). In contrast, chair stand test performance did not differ significantly among women with metal implants, those who underwent BIA, and those included in the analysis.

According to the algorithm using the SARC-F questionnaire as a screening tool proposed by the EWGSOP2, 2.2% ($n = 47$), 1.4% ($n = 30$) and 0.8% ($n = 16$) of the study population were classified into the probable sarcopenia, confirmed sarcopenia and severe sarcopenia groups, respectively (Supplementary Figure 2). The prevalence of sarcopenia and severe sarcopenia among participants who were SARC-F–positive and –negative is shown in Supplementary Figure 3. The sensitivity and specificity of the SARC-F questionnaire (≥ 4 points) for sarcopenia screening based on the various definitions of the EWGSOP2 of sarcopenia (15.4–29.5% and 92.2–94.2%, respectively) and severe sarcopenia (42.2–100% and 93.0–94.5%, respectively) are listed in Supplementary Table 5. Based on the EWGSOP1, EWGSOP2, IWGS, AWGS and FNIH Sarcopenia Project, the prevalence of sarcopenia ranged from 8.4% to 25.5% in men and from 4.7% to 16.2% in women (Figure 1).

Discussion

To our knowledge, this is the first study to evaluate the prevalence of sarcopenia among a large population of community-dwelling older adults using the diagnostic algorithm proposed by the EWGSOP2. In our study population, the prevalence of sarcopenia and severe sarcopenia varied depending on which components of the revised EWGSOP2 definition were used. More importantly, low muscle strength according to the results of grip strength and chair stand tests showed a significant difference between the sexes. Compared with low muscle quantity calculated using the height-adjusted ASM (47.9% of men and 62.2% of women), the prevalence of sarcopenia was higher when the absolute ASM (63.2% of men and 80.1% of women) was applied. This is concerning and may be due to differences in body size and anthropometric characteristics between Western and Asian populations. In this study, the prevalence of severe sarcopenia was lower using the timed up-and-go (TUG) test to assess physical performance, then when using gait speed and SPPB findings according to the revised EWGSOP2 definition.

The EWGSOP2 recommended the use of grip strength and chair stand measures to identify low muscle strength [10]. Low muscle strength is used for trigger assessment of causes and initiate intervention based on possible sarcopenia in clinical practice. In this study, the muscle strength values indicative of probable sarcopenia, according to the cutoffs set by the EWGSOP2, were significantly different between the sexes. For example, more women were classified as probable sarcopenic using the chair stand test, and more men were probably classified as sarcopenia applying the grip strength test. Moreover, the chair stand test was more likely to reveal low muscle strength in men with metal implants, who were excluded from the study, than in those included in the study. Only 73 participants (3.5%) had low muscle strength in both the handgrip strength and chair stand tests. In our study, women had a higher prevalence of osteoarthritis than men. Indeed, previous studies have reported that women are more likely than men to suffer from osteoarthritis [15–17]. Patsika *et al.* [18] reported that patients with knee osteoarthritis had poorer performance in chair stand tests due to less efficient use of knee extensor

Table 1. Prevalence of sarcopenia according to the method of measuring muscle strength and physical performance, and appendicular skeletal muscle mass indicators for muscle quantity (absolute ASM and height-adjusted ASM) established by the EWGSOP2.

Variable	Overall (n = 2,099)	Men (n = 1,053)	Women (n = 1,046)	P-value
Age, years	75.9 ± 4.0	76.4 ± 3.9	75.4 ± 3.9	0.000
Height, m^2	158.4 ± 8.5	164.9 ± 5.6	151.9 ± 5.3	0.000
Weight, kg	60.9 ± 9.4	65.2 ± 9.0	56.6 ± 7.7	0.000
BMI, kg/m^2	24.2 ± 2.9	23.9 ± 2.9	24.5 ± 2.8	0.000
Number of comorbidities	1.6 ± 1.3	1.4 ± 1.2	1.9 ± 1.3	0.000
ADL disability, %	32 (1.5)	15 (1.4)	17 (1.5)	0.422
IADL disability, %	236 (11.2)	132 (12.5)	104 (10.0)	0.037
Osteoarthritis, %	416 (19.8)	112 (10.6)	304 (29.1)	0.000
Appendicular skeletal muscle mass (ASM), kg	16.3 ± 3.7	19.2 ± 2.7	13.4 ± 1.8	0.000
ASM/$height^2$	6.43 ± 0.99	7.04 ± 0.86	5.82 ± 0.71	0.000
ASM/BMI	0.680 ± 0.156	0.806 ± 0.106	0.553 ± 0.075	0.000
Handgrip strength, kg	26.8 ± 7.4	32.4 ± 5.8	21.2 ± 3.9	0.000
Five times sit to stand test, s	11.2 ± 3.7	10.6 ± 3.2	11.9 ± 4.1	0.000
4-m usual gait speed, m/s	1.13 ± 0.26	1.17 ± 0.27	1.09 ± 0.24	0.000
Timed up-and-go test (TUG), s	10.3 ± 2.5	10.0 ± 2.3	10.5 ± 2.7	0.000
Short Physical Performance Battery (SPPB), score	10.9 ± 1.5	11.1 ± 1.3	10.7 ± 1.6	0.000
EWGSOP2				
Low muscle strength, %				
Handgrip strength (<27 kg in men and <16 kg in women)	287 (13.7)	181 (17.2)	106 (10.1)	0.000
Chair stand test (>15 s in men and women)[a]	286 (13.6)	95 (9.0)	191 (18.3)	0.000
Grip strength and/or chair stand test	493 (23.5)	241 (22.9)	252 (24.1)	0.537
Low muscle quantity, %				
ASM (<20 kg in men and <15 kg in women)	71.7 (71.7)	666 (63.2)	838 (80.1)	0.000
ASM/$height^2$ (<7.0 kg/m^2 in men and <6.0 kg/m^2 in women)	1158 (55.2)	504 (47.9)	654 (62.2)	0.000
Low physical performance, %				
Gait speed (≤ 0.8 m/s in men and women)	147 (7.0)	56 (5.3)	91 (8.7)	0.002
SPPB score (≤ 8 points in men and women)	140 (6.7)	45 (4.3)	95 (9.1)	0.000
TUG test (≥ 20 s in men and women)	18 (0.9)	6 (0.6)	12 (1.1)	0.115
Gait speed, SPPB, and/or TUG	207 (9.9%)	74 (7.0)	133 (12.7)	0.000
SARC-F (≥ 4 points)	152 (7.2)	30 (2.8)	122 (11.7)	0.000
Sarcopenia, %				
Grip strength + ASM	245 (11.7)	153 (14.5)	92 (8.8)	0.000
Grip strength + ASM/$height^2$	195 (9.3)	125 (11.9)	70 (6.7)	0.000
Chair stand test + ASM	207 (9.9)	56 (5.3)	151 (14.4)	0.000
Chair stand test + ASM/$height^2$	165 (7.9)	48 (4.6)	117 (11.2)	0.000
Grip strength and/or chair stand test + ASM	303 (14.4)	146 (13.9)	157 (15.0)	0.457
Grip strength and/or chair stand test + ASM/$height^2$	386 (18.4)	179 (17.0)	207 (19.8)	0.102
Severe sarcopenia, %				
Grip strength + ASM + gait speed	45 (2.1)	23 (2.2)	22 (2.1)	0.509
Grip strength + ASM/$height^2$ + gait speed	37 (1.8)	20 (1.9)	17 (1.6)	0.378
Chair stand test + ASM + gait speed	59 (2.8)	16 (1.5)	43 (4.1)	0.000
Chair stand test + ASM/$height^2$ + gait speed	47 (2.2)	16 (1.5)	31 (3.0)	0.018
Grip strength + ASM + SPPB	47 (2.2)	21 (2.0)	26 (2.5)	0.270
Grip strength + ASM/$height^2$ + SPPB	38 (1.8)	19 (1.8)	19 (1.8)	0.557
Chair stand + ASM + SPPB	86 (4.1)	21 (2.0)	65 (6.2)	0.000
Chair stand + ASM/$height^2$ + SPPB	68 (3.2)	20 (1.9)	48 (4.6)	0.000
Grip strength + ASM + TUG	9 (0.4)	4 (0.4)	5 (0.5)	0.496
Grip strength + ASM/$height^2$ + TUG	6 (0.3)	4 (0.4)	2 (0.2)	0.347
Chair stand + ASM + TUG	13 (0.6)	3 (0.3)	10 (1.0)	0.044
Chair stand + ASM/$height^2$ + TUG	8 (0.4)	3 (0.3)	5 (0.4)	0.359
Grip strength and/or chair stand test + ASM + gait speed, SPPB, and/or TUG	108 (5.1)	34 (3.2)	74 (7.1)	0.000
Grip strength and/or chair stand test + ASM/$height^2$ + gait speed, SPPB, and/or TUG	81 (3.9)	29 (2.8)	52 (5.0)	0.006

Values are means ± SD, n (%). ADL, activities of daily living; ASM, appendicular skeletal muscle mass; BMI, body mass index; IADL, instrumental activities of daily living; SARC-F, simple 5-item questionnaire for sarcopenia screening; SD, standard deviation; SPPB, short physical performance battery; TUG, timed up-and-go test. P-values are based on the Chi-square, Fisher's exact, and independent t-tests. Comorbidities were defined as a self-reported physician's diagnosis of hypertension, myocardial infarction, dyslipidemia, diabetes mellitus, congestive heart failure, angina pectoris, peripheral vascular disease, cerebrovascular disease, osteoarthritis, rheumarthritis, osteoporosis, asthma or chronic obstructive pulmonary disease. [a]Included 15 participants who were unable to complete the chair stand test.

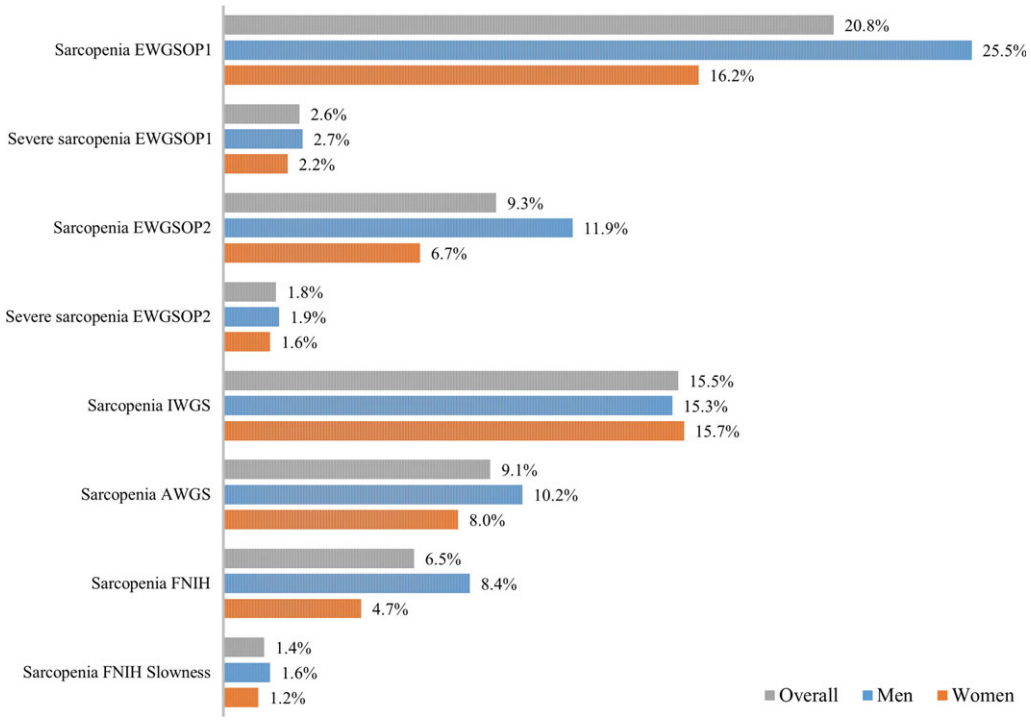

Figure 1. Prevalence (%) of sarcopenia according to diagnostic criteria. Sarcopenia was defined as low muscle strength (handgrip strength), low muscle mass (appendicular skeletal muscle mass [ASM] [kg]/height^2) and/or low physical performance (gait speed). The prevalence of sarcopenia as defined by the EWGSOP1, EWGSOP2, and FNIH criteria was significantly different between men and women ($P < 0.001$), with the exceptions of the prevalence of severe sarcopenia as defined by the EWGSOP1, EWGSOP2, AWGS and IWGS criteria, and the prevalence of sarcopenia as defined by slow gait speed in the FNIH Sarcopenia Project ($P > 0.5$). AWGS, Asian Working Group for Sarcopenia; BMI, body mass index; EWGSOP, European Working Group on Sarcopenia in Older People; FNIH, Foundation for the National Institutes of Health; IWGS, International Working Group on Sarcopenia.

muscles. In this study, the rate of low muscle strength according to the chair stand test showed no significant difference between the sexes among the participants with metal implants in appendicular body regions (Supplementary Table S4). Therefore, older persons with musculoskeletal complaints, osteoarthritis and a history of fractures may score lower on chair stand tests. The revised EWGSOP2 definition specifies low muscle strength as the primary symptom of sarcopenia; muscle strength is currently the most reliable measure of muscle function given the technological limitations of assessing muscle mass [10]. In our study, 611 (20.2%) of 3,014 participants were excluded on the basis of the results of the body composition assessment by BIA in two community health centres in suburban or rural areas where they resided. Although the ages of the included and excluded patients were similar, the prevalence of low muscle strength as measured by the handgrip test was significantly higher in the excluded group. Gao *et al.* [19] reported that rural older adults had significantly lower handgrip strength than those residing in urban areas; moreover, the authors found that rural residence was an independent risk factor for sarcopenia. Therefore, in clinical settings that have limited access to techniques to assess muscle mass (e.g. DXA and regional body composition tools that recognise artificial joints, metal sutures, and metal objects), it is necessary to use simple, valid methods to detect low muscle mass and quality as indicators of sarcopenia.

We found no significant differences between sexes using the EWGSOP1 (32.9% of men and 36.1% of women) and FNIH (12.5% of men and 10.1% of women) handgrip strength cutoffs (Supplementary Table S2). In addition, when the AWGS definition was applied, the prevalence of low handgrip strength was 12.5% in men and 19.4% in women ($P < 0.001$). Therefore, sex differences in handgrip strength may be related to the sex-specific cut-offs used. Also, there was a significant univariate correlation between gait speed and TUG test performance ($r = 0.59$, $P < 0.001$). However, the revised EWGSOP2 definition using the TUG to assess low physical performance yielded the lowest prevalence. The EWGSOP2 proposed a cutoff of ≥ 20 s based on the data of community-dwelling and institutionalised older persons [20]. In addition, they suggested 12 s as a clinical cutoff for normal TUG test performance in community-dwelling older persons. Therefore, 12 s may be a useful cutoff point for normal mobility in community-dwelling individuals. In this study, the prevalence of low muscle mass was higher in men than in women for all five cut-off criteria. In general, body composition differs between the sexes; males have more lean mass and females have more fat mass [21].

We found that the prevalence of sarcopenia according to the clinical algorithm using the SARC-F as a screening tool proposed by the EWGSOP2 was 1.4%, and that of severe sarcopenia was 0.8%. A previous study demonstrated a high specificity for the SARC-F screening tool, making it useful for efficiently ruling out sarcopenia in clinical settings [8]. However, the SARC-F has a low-to-moderate sensitivity for sarcopenia screening in community-dwelling older adults, outpatients, and the long-term care population when used in conjunction with the various sarcopenia definitions [8, 9, 22–25]. The prevalence of sarcopenia was low in our cohort of ambulatory community-dwelling older adults assessed by the case-finding algorithm using the SARC-F as a screening tool. As it may be difficult to operationalise clinical suspicion to assess sarcopenia-associated symptoms, the case-finding algorithm may not be easily implemented in community research settings. As the SARC-F screening tool will primarily detect severe cases, the EWGSOP2 recommended that the SARC-F be used to introduce the assessment and treatment of sarcopenia into clinical practice [10].

We demonstrated that the prevalence of sarcopenia varied depending on which of the EWGSOP2 [10], EWGSOP1 [2], AWGS [4], IWGS [3] and FNIH Sarcopenia Project [5] criteria were used. The prevalence of sarcopenia was lower using the EWGSOP2 compared with the EWGSOP1 criteria [6, 26]. The prevalence of severe sarcopenia defined by the EWGSOP1 (2.6%), EWGSOP2 (1.8%), and slow gait speed definition of the FNIH Sarcopenia Project (1.4%) showed no significant difference between the sexes. The EWGSOP2 guidelines suggested that individuals at risk of sarcopenia can be identified using the SARC-F questionnaire or based on clinical suspicion of sarcopenia-associated symptoms. The EWGSOP2 also recommended further testing for sarcopenia among individuals with risk of sarcopenia. The strengths and limitations of our study are described in the Supplementary data.

In conclusion, the prevalence of sarcopenia among community-dwelling older individuals varied depending on which components of the revised EWGSOP2 definition were used; (e.g. the tools used to measure muscle strength and the ASM indicators for low muscle quantity. The prevalence of probable sarcopenia according to the results of grip strength and chair stand tests showed a significant difference between the sexes. Furthermore, the revised EWGSOP2 definition using the TUG to assess physical performance yielded the lowest prevalence of severe sarcopenia. Further research is necessary to explore the optimal cutoff levels and composite measures of the EWGSOP2 algorithm given the impact on adverse health outcomes and taking into account differences in ethnicity, lifestyle, and culture.

Supplementary data are available from the *Age and Ageing* website.

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