REVIEW

Prevalence of sarcopenia according to EWGSOP1 and EWGSOP2 in older adults and their associations with unfavorable health outcomes: a systematic review

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Abstract

Background The European Working Group on Sarcopenia in Older People (EWGSOP) recently updated the definition and diagnostic criteria to assess sarcopenia, which can result in important changes in sarcopenia prevalence in older adults.

Aim To compare the prevalence of sarcopenia through the diagnostic criteria and definition proposed by the first (EWGSOP1) and recent (EWGSOP2) European consensus in older adults. We also aimed to evaluate which sarcopenia consensus is better associated with unfavorable health outcomes.

Methods The review followed PRISMA guidelines. Embase, Medline (PubMed), Scopus and Web of Science were searched from 2018 to February 2021. The systematic review protocol was registered at PROSPERO (CRD42020213303). The search, selection, and evaluation processes were done in a duplicate and independent manner.

Results Of the 298 potentially eligible articles, 9 were included in this review. The prevalence of sarcopenia was 17.7% by EWGSOP1 and 11% by EWGSOP2. Evaluating all the studies, the sarcopenia prevalence ranged from 6.2 to 35.3% for the EWGSOP1, and from 3.2 to 26.3% for the EWGSOP2. Five studies have evaluated the association between the prevalence of sarcopenia (EWGSOP1 versus EWGSOP2) and unfavorable health outcomes, in which three studies showed that EWGSOP1 was better associated with increased risk of hospitalization and/or mortality.

Conclusion In comparison with EWGSOP1, the prevalence of sarcopenia in older adults decreased when diagnosed according to EWGSOP2. Based on limited evidence, EWGSOP2 seems to be worse for predicting unfavorable outcomes compared with EWGSOP1.

Keywords Muscle strength · Skeletal muscle · Muscle mass · Physical performance · Older people · Elderly

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Introduction

Irwin Rosenberg proposed the term sarcopenia in 1989 that was characterized by a reduction in muscle mass with advancing age [1]. In 2010, the first consensus on sarcopenia was established by the European Working Group on Sarcopenia (EWGSOP1), in which sarcopenia was defined as a syndrome related to progressive and generalized loss of muscle mass and strength [2]. According to EWGSOP1, muscle mass is the most important component to diagnose sarcopenia. However, in 2018, a new sarcopenia consensus (EWGSOP2) was published [3], in which muscle strength is considered more important than the amount of muscle mass. In addition, muscle quality has been introduced as an alternative component for muscle mass evaluation. Physical performance became a criteria for assessing the severity

of sarcopenia [3] and is no longer used as a component to diagnose it, as was suggested by EWGSOP1 [2]. In general, all these changes proposed by EWGSOP2 can affect the prevalence of sarcopenia when compared with EWGSOP1.

The definition and methods of diagnosis of sarcopenia are still distinct among the populations and may generate incoherence when measuring the prevalence rates and associated risks [4]. The prevalence of sarcopenia may depend on the criteria used for the definition and diagnosis and the characteristics of the population, being more prevalent in older adults [5]. Recent studies have shown that the prevalence of sarcopenia can be changed when diagnosed by EWGSOP2 instead of by EWGSOP1 [6–8]. However, it is unknown whether the change in sarcopenia prevalence can affect its prediction for unfavorable health outcomes. To date, there is no study that systematically reviewed the impact on sarcopenia prevalence when it is diagnosed by EWGSOP2 in older adults. Thus, this systematic review aimed to compare the prevalence of sarcopenia through the diagnostic criteria and definition proposed by EWGSOP1 and EWGSOP2 in older adults. We also aimed to evaluate which sarcopenia consensus is better associated with unfavorable health outcomes.

Materials and methods

The protocol of the present review is registered at PROSPERO (CRD42020213303). The systematic review was carried out following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses) guidelines. The review protocol was established in advance. All authors agreed with the method before proceeding with the review.

Data sources and search strategy

The search was undertaken on February 2021 on Embase, Medline/PubMed, Scopus and Web of Science. Detailed search strategy was performed using descriptors related to "sarcopenia", "older adult", "older adults", "aged", "older people", "seniors", "prevalence", "epidemiology", "diagnostic", "diagnosis", "case-finding", "community-dwelling", "European Working Group on Sarcopenia in Older People", "EWGSOP", "revised consensus" and "European consensus" (Supplementary Table 1). The search was not restricted by language. There were additional searches in relevant journals to identify newly published qualifying papers. First, the titles and abstracts were read independently and simultaneously by two investigators (LVF and AEGP), who selected the studies according to the inclusion criteria. After reading the full text of the selected articles, the exclusion criteria were applied. The search, selection, and evaluation processes were done in a duplicate and independent manner.

Selection criteria

Search results from each database were exported into Mendeley Software. Duplicates were removed and the remaining results were screened based on the following inclusion criteria: (1) cross-sectional or cohort studies; (2) studies recruiting free-living older adults aged 60 years or over; (3) studies published between 2018 and 2021; (4) studies that reported the sarcopenia prevalence in both consensuses (EWGSOP1 and EWGSOP2). Exclusion criteria were: (1) participants living in hospitals, nursing homes or long-term care facilities; (2) studies that assessed the prevalence of sarcopenia in individuals who have diseases.

Data extraction

Two authors (LVF and AEGP) worked independently and in parallel to assess the full text of included studies. The full texts were read by the two authors (LVF and AEGP). Data extracted from each eligible study using a software included: the first author name, publication year, study design, country of origin, sample size, characteristics of participants, such as age and sex; methods used to diagnose sarcopenia, and sarcopenia prevalence according to both consensuses (EWGSO1 and EWGSOP2). Disagreements in data extraction between the reviewers were resolved through discussion for agreement/consensus.

Quality assessment

The quality of each study was independently evaluated by two investigators (LVF and AEGP) using the Appraisal tool for cross-sectional studies (AXIS) [9] and Newcastle–Ottawa Scale (NOS) [10] for risk of bias of cohort studies.

The Appraisal tool for Cross-Sectional Studies (AXIS) was used to assess the quality of selected full-text articles regarding the comparison of sarcopenia prevalence (cross-sectional data; $n = 9$). AXIS consists of 20 questions, and each question has three responses (yes, no or do not know) [9]. A numerical scale to reflect quality is not included in the final tool [9]. The final bias risks were developed from the discussion and consensus between the two investigators (LVF and AEGP), and a third investigator (when necessary) for conflict resolution.

The NOS assessment tool was used to evaluate the quality of the studies ($n = 5$) that have evaluated the associations between sarcopenia prevalence and unfavorable health outcomes (cohort data). NOS uses eight multiple-choice items covering three domains: selection (4 items), comparability (1 item), and outcome (3 items). A maximum of one point can be awarded for each item in the

"selection" and "outcome" domains and a maximum of two points for the "comparability" domain. NOS ranges from 0 (low quality) to 9 points (high quality). Score final ≥ 8 was classified as high quality [11], 5–7 points as moderate quality, and 4 or less points indicated low quality.

Results

Study selection

Of the 298 potentially eligible articles, 132 were selected after removing duplicates. After screening the titles and abstracts, 121 studies were excluded. Eleven studies were elected for full-text review. Among them, two studies were excluded. Therefore, nine studies were selected for this systematic review to compare the sarcopenia prevalence according to the consensuses (Fig. 1). Five of these studies have evaluated the association between the prevalence of sarcopenia and unfavorable health outcomes.

Study characteristics

The characteristics of the nine included studies are summarized in Table 1. The studies involved 7430 older adults of both sexes from eight countries. Eight studies included women and men [6–8, 12–16], while one study included only men [17]. One study did not show the number of participants according to the sex [8]. It was evaluated 3282 women and 2773 men, removing the study that did not inform the number of individuals for each sex [8]. The minimum age was 60 years [6, 13–15]. Most studies (six) did not show the maximum age of the participants [6, 7, 13–16] and did not present the age range with the highest number of participants (seven studies) [7, 8, 13–17]. In three studies, the maximum age was 89 years [17], 93 years [12] and 101 years [8]. In two studies, the age range with the highest number of individuals was 60–69 years (55.3% of population) [6] and 65–74 years (55.7% of population) [12]. The included studies were dated from 2019 to 2020 and all evaluated free-living older adults. Sarcopenia was diagnosed according to EWGSOP1

Fig. 1 PRISMA flow diagram
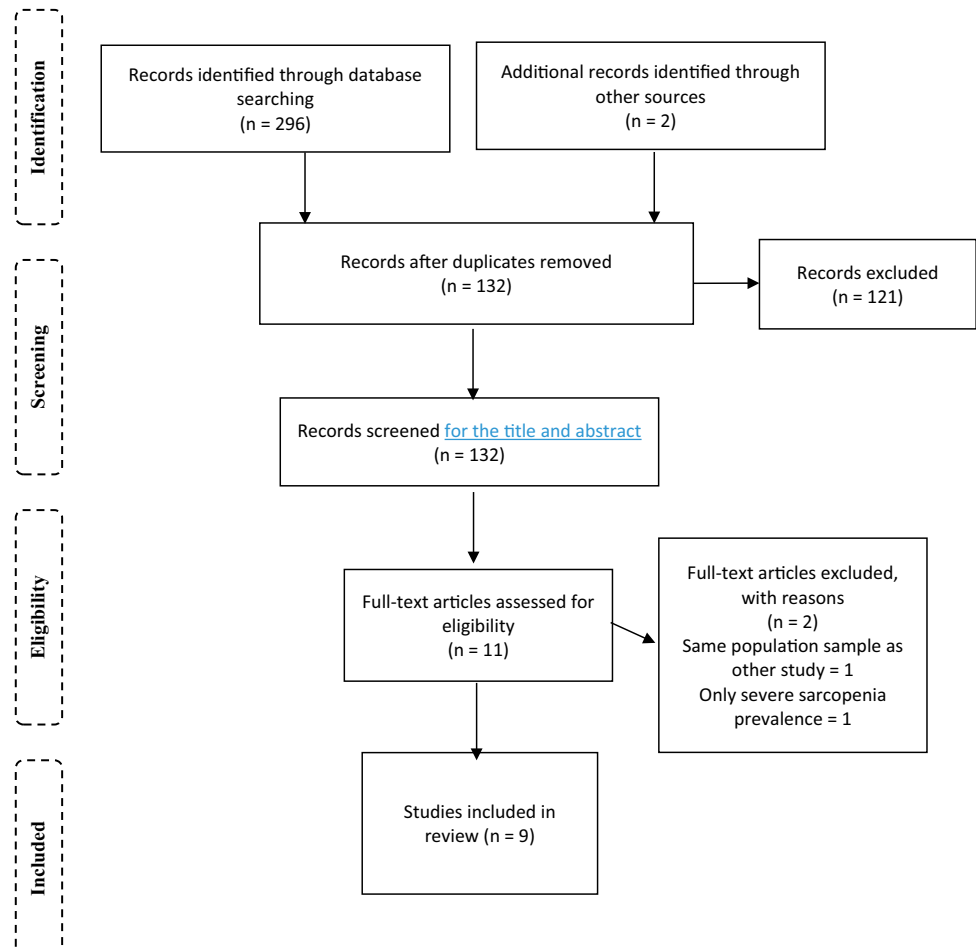
Table 1 Summary of study characteristics

First author, year	Country	Population characteristics	Methodology to assess sarcopenia parameters	Sarcopenia prevalence
Bachettini et al., 2020[6]	Brazil	1291 participants (483 men and 808 women)	*Muscle strength* handgrip Strength (HGS) by dynamometer *Muscle mass* calf circumference *Physical performance* 4-m usual gait speed test Sarcopenia was defined using EWGSOP1 and EWGSOP2; the cutoff points used for EWGSOP1 and EWGSOP2 were those recommended by European consensus. The cutoff points for muscle strength by EWGSOP2 were, validated for the study population	EWGSOP1: 8.8% EWGSOP2: 3.4%
Costanzo et al., 2020 [7]	Italy	535 participants (248 men and 287 women) 77 ± 5.5 years	*Muscle strength* handgrip strength (HGS) by dynamometer and five times chair stand test (CST) *Muscle mass* bioelectrical impedance (BIA) EWGSOP1 and EWGSOP2: the co-occurrence of low muscle strength and low muscle mass confirms the diagnosis of sarcopenia. Cutoff points for handgrip strength and muscle mass were defined using EWGSOP1 and EWGSOP2 EWGSOP1 muscle strength: HGS EWGSOP2 muscle strength: HGS and/or CST	EWGSOP1: 6.2% EWGSOP2: 3.2%
Jang et al., 2020 [8]	Korea	1408 participants 65 – 101 years	*Muscle strength* handgrip strength (HGS) by dynamometer *Muscle mass* bioelectrical impedance (BIA) *Physical performance* 4-m usual walking speed test Sarcopenia was defined using EWGSOP1 and EWGSOP2; EWGSOP1 (with EWGSOP2 cutoff); EWGSOP2 (with EWGSOP2 cutoff)	EWGSOP1: 35.30% EWGSOP2: 26.28%
Krzyminska-Sie-maszko et al., 2020 [12]	Poland	115 participants (34 men and 81 women) 74.2 ± 6.7 years	*Muscle strength* handgrip strength (HGS) by dynamometer and chair stand test (CST) *Muscle mass* bioelectrical impedance (BIA) *Physical performance* 4-m usual walking speed test Sarcopenia was defined using EWGSOP1 and EWGSOP2, the cutoff points for HGS and physical performance were that proposed by the consensuses. Cutoff points for muscle mass Polish population < 7.4 kg/m^2 for men and < 5.6 kg/m^2 for women	EWGSOP1: 17.4%; men: 17.6%; women: 17.3% EWGSOP2: 13,9%; men: 14.7%; women: 13.6%
Locquet et al., 2020 [16]	Belgium	501 participants 73.5 ± 6.2 years	*Muscle strength* handgrip strength (HGS) by dynamometer *Muscle mass* dual X-ray absorptiometry (DXA) *Physical performance* short physical performance battery test (SPPB) Sarcopenia was defined using EWGSOP1 and EWGSOP2; as well as the cutoff points	EWGSOP1: 13.6% EWGSOP2: 7.4%
Yang et al., 2019 [14]	China	483 participants (184 men and 299 women) 66.8 ± 4.4 years	*Muscle strength* handgrip strength (HGS) by dynamometer *Muscle mass* bioelectrical impedance (BIA) *Physical performance* 4-m usual gait speed test Sarcopenia was defined using EWGSOP1 and EWGSOP2; as well as the cutoff points	EWGSOP1: 15.7% men: 22.3%; women 11.7% EWGSOP2: 4.6% men: 6.5%; women: 3.3%

Table 1 (continued)

First author, year	Country	Population characteristics	Methodology to assess sarcopenia parameters	Sarcopenia prevalence
Shafiee et al., 2020 [13]	Iran	2426 participants (1166 men and 1260 women) 69.34 ± 6.40 years	*Muscle strength* handgrip strength (HGS) by dynamometer *Appendicular skeletal muscle mass* dual X-ray absorptiometry (DXA) *Physical performance* walking speed over 4.57 m Sarcopenia was defined using EWGSOP1 and EWGSOP2; EWGSOP1 (Iranian cutoff); EWGSOP2 (EWGSOP2 cutoff) Reference data of the Iranian population: the cutoff points for low SMI were 7.0 kg/m^2 for men and 5.4 kg/m^2 for women The low muscle strength was < 26 kg for men and < 18 kg for women	EWGSOP1: 16.53%; men: 19.7%; women: 13.6% EWGSOP2: 8.9%; men: 12.7%; women: 5.42%
Sobestiansky et al., 2019 [17]	Sweden	287 men 86.6 ± 1 years	*Muscle strength* handgrip strength (HGS) by dynamometer and five times chair stand test (CST) *Appendicular skeletal muscle mass* dual X-ray absorptiometry (DXA) *Physical performance* 6 m gait speed test Sarcopenia was defined using EWGSOP1 and EWGSOP2; as well as the cutoff points *EWGSOP1 muscle strength* HGS *EWGSOP2 muscle strength* HGS and/or CST	EWGSOP1: 21% EWGSOP2: 20%
Tang et al., 2020 [15]	China	384 participants (160 men and 224 women) 71.5 ± 5.8 years	*Muscle strength* handgrip strength (HGS) by dynamometer *Muscle mass* bioelectrical impedance (BIA) *Physical performance* 4-m usual gait speed test Sarcopenia was defined using EWGSOP1 and EWGSOP2; as well as the cutoff points	EWGSOP1: 11.7% EWGSOP2: 9.9%

EWGSOP1 European Working Group on Sarcopenia in Older People, 2010; *EWGSOP2* European Working Group on Sarcopenia in Older People, 2018; *HGS* handgrip strength, *CST* chair stand test, *BIA* bioelectrical impedance, *DXA* dual X-ray absorptiometry

[2] and EWGSOP2 [3]. Nine studies [6–8, 12–17] compared the sarcopenia prevalence between the consensuses, in which five [6–8, 16, 17] also associated the sarcopenia prevalence with unfavorable health outcomes.

Quality assessment

According to the Appraisal Tool for Cross-Sectional Studies (AXIS) [9], the objectives were clear in all studies and designed appropriately for their stated objectives [6–8, 12–17]. Two studies did not [14, 18] justify the sample size. Eight studies did not evaluate non-responders or missing data, while only one study described this information [17]. One study [16] did not discuss limitations. All studies mentioned funding sources or conflicts of interest and report on ethical approvals or participant consent. The AXIS questions are reported in Supplementary Table 2.

According to the Newclastle–Ottawa Scale (NOS) [10], all studies (*n* = 5) presented high quality (score final ≥ 8) [6–8, 16, 17]. The NOS scores are presented in Supplementary Table 3.

Muscle mass assessment methods

Three studies used the dual energy X-ray absorptiometry (DXA) [13, 16, 17] to assess appendicular skeletal muscle mass; five studies used the bioelectrical impedance analysis (BIA) [7, 8, 12, 14, 15] to assess muscle mass; and one study used the calf circumference [6]. In seven studies [8, 12–17], the appendicular skeletal muscle mass was used to define muscle mass for the EWGSOP1 [2] and EWGSOP2 [3]. Appendicular skeletal muscle mass index (ASMMI) was calculated using the sum of skeletal muscle/lean mass of both arms and legs (appendicular skeletal muscle mass; kg) divided by height squared (ASMM) [19]. In one study [7], the skeletal muscle mass index (SMMI)

was obtained from total muscle mass (SMM) divided by height squared, calculated through Janssen et al. equation [20] for the EWGSOP1 [2], whereas the Sergi et al. equation [21] was used to estimate the appendicular muscle mass according to the EWGSOP2's [3] recommendations. The cutoff for low ASMMI for the EWGSOP1 ranged from <7 kg/m^2 to ≤ 7.4 kg/m^2 for men, and from <5.4 kg/m^2 to <6 kg/m^2 for women. The cutoff for low SMMI for the EWGSOP1 was <8.87 kg/m^2 for men and <6.42 kg/m^2 for women. The cutoff for low ASMMI for the EWGSOP2 ranged from <5.5 kg/m^2 to <6 kg/m^2 for women, and <7 kg/m^2 to ≤ 7.4 kg/m^2 for men. In one study [6], the calf circumference was measured in the region of the greatest circumference (two in each leg, alternately); and the cutoff was ≤ 34 cm for men and ≤ 33 for women.

Muscle strength assessment methods

Six studies [6, 8, 13–16] evaluated the muscle strength through handgrip strength (HGS) using a dynamometer, according to EWGSOP1 and EWGSOP2. Three studies [7, 12, 17] measured the strength through the HGS for EWGSOP1 [2], and using the HGS and/or the chair stand test (CST) according to the EWGSOP2's [3]. In eight studies [6–8, 13–17], the maximum HGS value was recorded. In one study [12], the mean value of all measurements of HGS was used as the final score. The measurement of the CST was used in all studies that performed this test [7, 12, 17]. The cutoff for low HGS ranged from <26 to <32 kg for men, and from <16 to <21 kg for women. The cutoff for inadequate CST was >15 s in all studies [7, 12, 17].

Physical performance assessment methods

In five studies [6, 8, 12, 14, 15], the usual walking speed was evaluated by the 4-m walk test (m/s). One study [13] assessed the functional capacity using the 5.57-m walk test, while other [17] through 6-m walk test. The participants walked as their usual gait speed (during daily activities) twice and the time required for each attempt was recorded; the best performance (that is, the fastest) was chosen. The cutoff of >0.8 m/s was used for both sexes in all studies. One study [16] assessed the physical performance using the short physical performance battery test (SPPB) in which the cutoff was ≤ 8 points. Only one study [7] did not include physical performance for sarcopenia diagnosis according to the EWGSOP1.

Sarcopenia prevalence estimates

Out of participants in all studies ($n = 7430$), the sarcopenia prevalence was 17.68% ($n = 1314$) for the EWGSOP1

and 11% ($n = 818$) for the EWGSOP2. In all studies, the sarcopenia prevalence ranged from 6.2% [7] to 35.3% [8] for EWGSOP1, and from 3.2% [7] to 26.3% [8] for EWGSOP2. Three studies [12–14] evaluated the prevalence separated by sex; however, one study [17] assessed only men. The prevalence of sarcopenia in women ranged from 11.7% [14] to 17.3% [12] for EWGSOP1, and from 3.3% [14] to 13.6% [12] for EWGSOP2. The prevalence of sarcopenia in men ranged from 17.6% [12] to 22.3% [14] for EWGSOP1, and from 6.5% [14] to 20% [17] for EWGSOP2. The prevalence of severe sarcopenia was evaluated in three studies [6, 13, 17], ranging from 2.5% [17] to 14.8% [13] for EWGSOP1 and 1.8% [17] to 14.6% for EWGSOP2.

Unfavorable health outcomes

Five studies [6–8, 16, 17] have evaluated the association between the prevalence of sarcopenia (EWGSOP1 and EWGSOP2) and unfavorable health outcomes (Table 2). One study [6] observed that only severe sarcopenia defined by both consensuses was associated with increased risk of mortality, in which EWGSOP2 presented a greater risk of mortality (HR 4.1, 95% CI 1.88–9.0) when compared with EWGSOP1 (HR 3.6, 95% CI 2.9–4.3). One study [7] showed that people with low muscle strength, independent of the adopted algorithm (EWGSOP1 or EWGSOP2), were associated with higher mortality risk when compared to robust individuals. Jang et al. [8] showed that sarcopenia by EWGSOP1 was associated with increased risk of mortality and institutionalization due to functional impairment, but no significant associations were found for EWGSOP2. Locquet et al. [16] observed that EWGSOP1 was associated with increased risk of mortality, but no significant associations were observed for EWGSOP2. Sobestiansky et al. [17] observed that EWGSOP1 was associated with increased risk of all-cause of mortality and the number of hospitalizations, but these associations were not significant with EWGSOP2. However, in this study [17], probable sarcopenia (EWGSOP2) was associated with increased risk of all-cause mortality.

Discussion

The results of this systematic review showed that the prevalence of sarcopenia diagnosed according to EWGSOP2 decreased by ~7% when compared to EWGSOP1. We observed that 496 individuals considered as sarcopenic by the EWGSOP1 did not present sarcopenia according to the EWGSOP2. In all studies included in the present review, a reduction in sarcopenia prevalence was observed when EWGSOP2 was used, which shows that the recent

consensus seems to diagnose sarcopenia in a lower number of older adults. However, the sarcopenia prevalence decreased only by 1% when diagnosed according to EWGSOP2 in one study [17], which does not seem to be a relevant reduction. Based on limited evidence [8, 16, 17], we also observed that EWGSOP1 seems to better predict unfavorable health outcomes, such as increased risk of institutionalization, hospitalization and mortality in older adults when compared with EWGSOP2, although this is not a consensus [6]. This result can be possibly explained because EWGSOP1 diagnoses a greater number of individuals with sarcopenia that may have poorer health status than EWGSOP2.

Several factors can explain the differences in sarcopenia prevalence comparing EWGSOP1 and EWGSOP2. The EWGSOP1 determines that muscle mass is the first sarcopenia component [2], whereas EWGSOP2 emphasizes that muscle strength is more relevant than the amount of muscle mass [3]. In addition to these changes, the cutoff points for muscle mass and HGS have been modified [3].

The recent consensus also proposes the use of specific cutoff points for muscle mass and strength for each population, if it already exists. Moreover, CST has been added as an alternative method to assess muscle strength. The EWGSOP2 proposes the evaluation of muscle quality in addition to the muscle quantity, besides the use of physical performance as a marker of severe sarcopenia [3]. However, none of the studies included in this review evaluated muscle quality as a method to diagnose sarcopenia. This can be possibly explained because muscle quality was only recently recommended by the EWGSOP2, requiring specific methods to evaluate this variable. Of the nine articles included in the present study, only three [6, 7, 17] evaluated the prevalence of pre-sarcopenia (EWGSOP1) and probable sarcopenia (EWGSOP2), which limits the conclusion of which parameter (low muscle mass or low muscle strength) directly contributed to the reduction of sarcopenia prevalence by EWGSOP2.

Muscle mass, strength and physical performance can be modified by demographic and anthropometric factors [8].

Table 2 Comparison of the prevalence by EWGSOP1 and EWGSOP2 and their associations with unfavorable health outcomes

First author, year	Participants, n	Prevalence sarcopenia EWGSOP1, n (%)	Prevalence sarcopenia EWGSOP2, n (%)	Unfavorable outcomes
Bachettini et al., 2020 [6]	1291	114 (8.8)	44 (3.4)	Severe sarcopenia according to EWGSOP1 and EWGSOP2 was associated with increased risk of mortality when compared with people without sarcopenia
Costanzo et al., 2020 [7]	535	33 (6.2)	17 (3.2)	Sarcopenia according to EWGSOP1 and EWGSOP2 showed low sensitivity and high specificity toward mortality
Jang et al., 2020 [8]	1408	497 (35.3)	370 (26.3)	EWGSOP1, but not EWGSOP2, was associated with increased risk of mortality or institutionalization
Krzyminska-Siemaszko et al., 2020 [18]	115	20 (17.4)	16 (13.9)	–
Locquet et al., 2019 [16]	501	68 (13.6)	37 (7.4)	EWGSOP1, but not EWGSOP2, was associated with an increased risk of mortality
Yang et al., 2019 [14]	483	76 (15.7)	22 (4.6)	–
Shafiee et al., 2020 [13]	2426	401 (16.53)	216 (8.9)	–
Sobestiansky et al., 2019 [17]	287	60 (21)	58 (20)	EWGSOP1, but not EWGSOP2, was associated with an increased risk of all-cause mortality and number of hospitalizations Probable sarcopenia according to EWGSOP2 was associated with an increased risk of all-cause mortality
Tang et al., 2020 [15]	384	45 (11.7)	38 (9.9)	–
Total, n	7430	1314 (17.68)	818 (11)	EWGSOP1 seems to predict more unfavorable outcomes when compared to EWGSOP2

EWGSOP1 European Working Group on Sarcopenia in Older People, 2010; *EWGSOP2* European Working Group on Sarcopenia in Older People, 2018

Each study included in the present review was conducted in a different country. In seven studies [6, 7, 12–16], the majority of the participants were women. One study [8] did not show the number of individuals according to sex; and one study [17] included only men. It is known that sarcopenia prevalence increases with advancing age [22, 23]; however, it was not possible to observe the predominant age-rage group with sarcopenia in this review, as they were not reported in seven studies. In one study [6], 55.3% of the participants who had sarcopenia were between 60 and 69 years old, and in another [12] 55.7% were between 65 and 74 years. Despite all these differences in the population characteristics, all studies showed a lower sarcopenia prevalence when diagnosed by EWGSOP2, which demonstrates that EWGSOP2 diagnoses a lower number of older adults with sarcopenia independent of the country, sex and age-range.

Five studies used BIA to evaluate muscle mass [7, 8, 12, 14, 15], while three studies used DXA [13, 16, 17], which limits the comparisons between the studies. One study [6] evaluated calf circumference (CC), which is not the most appropriate method to assess muscle mass, mainly in older adults with elevated body fat because it can similarly predict lean and fat mass [24]. Nevertheless, EWGSOP2 recommends the use of CC in clinical practice when other body composition methods are not available [3]. Collectively, it has been shown that independent of the method used to assess muscle mass, there is a smaller sarcopenia prevalence according to the EWGSOP2.

Muscle strength was evaluated by a manual dynamometer in all studies included in this review, but three studies [7, 12, 17] also assessed the strength through CST in EWGSOP2 [3]. Two studies [7, 12] did not show whether the prevalence of muscle strength inadequacy was higher when CST or HGS was used. However, one study [17] demonstrated that the prevalence of muscle strength inadequacy was higher when CST was used (91%) when compared to HGS ($< 30\,\text{kg} = 56\%$; $< 27\,\text{kg} = 38\%$). Thus, these results [17, 25] show that the use of CST seems to increase the prevalence of low strength, but this is not a consensus since Yee et al. observed that the prevalence of sarcopenia by EWGSOP2 was lower using CST when compared to HGS [26]. In addition, a weak correlation was observed between the CST and HGS, suggesting a low agreement between these strength tests [26]. More studies are needed evaluating the differences in sarcopenia prevalence when strength is measured by HGS or CST.

Physical performance was used as a diagnosis criteria for sarcopenia in EWGSOP1, whereas EWGSOP2 recommends the physical performance to assess the severity of sarcopenia. Of the nine articles included in this review, only one [7] did not evaluate the physical performance to diagnose sarcopenia according to the EWGSOP1. The studies that evaluated severe sarcopenia according to both consensuses [6, 13, 17] showed a low decrease in its prevalence when EWGSOP2 was used, as the reductions ranged from 0.7% [17] to 1.8% [6]. In these studies [6, 13, 17], severe sarcopenia for EWGSOP1 was defined as the presence of low muscle mass, low strength and low gait speed; for EWGSOP2 was defined as the presence of low muscle strength, low muscle mass and low gait speed. It is likely that severe sarcopenia prevalence was not affected due to physical performance (gait speed) per se, since its cutoff was not changed in EWGSOP2. However, Phu et al. [25] showed that the prevalence of severe sarcopenia was lower when TUG was used to evaluate physical performance when compared to the SPPB, which shows that the use of different tests to evaluate the functional capacity can affect the severe sarcopenia prevalence. More studies are needed to elucidate which is the best test to evaluate the functional capacity in older adults, as severe sarcopenia diagnosis is an important predictor of mortality [6]. The standardization of the components can facilitate the comparisons of sarcopenia prevalence between studies in the literature.

This systematic review has limitations. First, four studies did not demonstrate the prevalence of sarcopenia according to sex, and it is not possible to compare the sarcopenia prevalence for women and men separately. Second, most studies (seven) did not show the age group with the highest number of participants, and it was not possible to evaluate the sarcopenia prevalence according to each age-range. Third, the cutoff points used were heterogeneous, since the European consensus recommends the use of specific cutoff points for each population, when available. Therefore, more studies evaluating the prevalence of sarcopenia by both consensuses in older adults are necessary to contribute to the standardization of diagnostic criteria used in different countries, observing which consensus will be more appropriate to evaluate the sarcopenia and its consequences, such as increased risk of falls and mortality.

Conclusion

In comparison with EWGSOP1, the prevalence of sarcopenia in older adults decreased when diagnosed according to EWGSOP2. EWGSOP2 seems to be worse for predicting unfavorable outcomes such as risk of hospitalization and mortality when compared to EWGSOP1. However, this conclusion is based on limited evidence and more studies are needed evaluating which sarcopenia consensus better predicts adverse health outcomes and mortality in older adults.

Declarations

Conflict of interest The authors declare no conflict of interest.

Statement of human and animal rights This article does not contain any studies with human participants or animals performed by any of the authors.

Informed consent Not applicable.

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