Post-print Commentary on the "ESPEN/EASO Consensus on the Definition and Diagnostic Criteria of Sarcopenic Obesity"

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Abstract

In recent years, an international expert panel composed of experts from the European Society for Clinical Nutrition and Metabolism (ESPEN) and the European Association for the Study of Obesity (EASO) conducted a systematic evaluation of sarcopenic obesity. In February 2022, ESPEN and EASO jointly released the 'Consensus on the Definition and Diagnostic Criteria for Sarcopenic Obesity', which elaborated in detail on the definition and diagnosis of sarcopenic obesity, aiming to establish a consensus on its definition and diagnosis, to provide a reference basis for researchers and clinicians, to advance the development of prevention and treatment strategies for sarcopenic obesity, and to provide implementation standards suitable for clinical practice. This article primarily provides an interpretation of the content of this consensus to provide a reference for the diagnosis of sarcopenic obesity in our country.

Full Text

Preamble

Title: Interpretation of the "ESPEN/EASO Consensus Statement on the Definition and Diagnostic Criteria for Sarcopenic Obesity"

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Abstract: In recent years, an international expert panel convened by the European Society for Clinical Nutrition and Metabolism (ESPEN) and the European

Association for the Study of Obesity (EASO) conducted a systematic evaluation of sarcopenic obesity. In February 2022, ESPEN and EASO jointly released the "Consensus Statement on the Definition and Diagnostic Criteria for Sarcopenic Obesity," which provides a detailed exposition of the definition and diagnosis of sarcopenic obesity. The consensus aims to establish agreement on the definition and diagnostic criteria for sarcopenic obesity, offering a reference framework for researchers and clinicians to advance the prevention and treatment of this condition and to provide implementation standards suitable for clinical practice. This article primarily interprets the content of this consensus to provide reference for diagnosing sarcopenic obesity in China.

Keywords: sarcopenic obesity; obesity; sarcopenia; skeletal muscle mass; body composition; fat; muscle

Sarcopenic obesity (SO) is a chronic disease combining excessive obesity and sarcopenia, where sarcopenia is a musculoskeletal disorder characterized by declines in muscle mass, muscle strength, and muscle function [1-5]. The pathogenic factors of SO are complex, including aging, improper lifestyle (sedentary behavior, poor diet, lack of exercise), inflammation, and comorbidities of acute and chronic diseases. This dual burden of muscle loss and fat accumulation leads to complications such as frailty, disability, falls, fractures, metabolic diseases, and cancer, resulting in increasing mortality [3,5-6]. With population aging and rising obesity rates, the incidence of SO continues to increase (approximately 5%-10%), making it a major global public health concern [3]. Due to the current lack of unified definition and diagnostic criteria for SO, its treatment and prevention are hindered. Therefore, ESPEN and EASO (hereinafter referred to as "the Panel") initiated a consensus-building effort to address: (1) the definition of SO; (2) diagnostic processes including screening, diagnosis, and staging methods; and (3) proposed methods and associated cutoff values. The Panel advocates for applying these proposed definitions and diagnostic criteria in clinical practice.

1. Concept and Clinical Significance of SO

SO is a clinical and functional condition characterized by the coexistence of sarcopenia and obesity, featuring both high fat mass (FM) and low skeletal muscle mass (SMM) and function. SO is not caused by a single factor but results from multiple etiologies, conferring higher risks of metabolic disease and functional impairment than either obesity or sarcopenia alone [1-5]. Aging, sedentary lifestyle, insulin resistance (IR), inflammation, oxidative stress, excessive intake of high-calorie foods, and molecular mechanisms (leptin, adiponectin, myostatin, IL-6) all predispose to SO. Aging is particularly significant: with advancing age, body composition changes manifest as declining muscle mass and strength combined with increasing fat mass. Muscle mass and strength decline markedly after age 60, while fat mass peaks between ages 60-75 [1-2]. Aging leads to visceral fat accumulation that infiltrates various organs, causing acute and/or chronic diseases. Fat infiltration into muscle weakens muscle strength and leg

function, altering physical function and increasing risks of mobility impairment, falls, and fractures [5,7].

The Panel proposes that SO can be classified as primary or secondary, though no specific evidence defines differences in their diagnostic criteria. Primary SO is age-related and common in older adults, while secondary SO is age-unrelated and associated with physical inactivity, malnutrition, or chronic diseases (advanced organ failure, malignancy, chronic inflammatory diseases) [8]. This classification aids understanding of SO etiology and pathogenesis and informs different therapeutic approaches. Population aging and obesity have become major global public health issues [9]. Statistics show worldwide SO prevalence is approximately 11%, and with worsening population aging, SO prevalence continues to rise, posing serious societal health challenges [4-5,10]. Therefore, in-depth understanding of SO is crucial for early screening, diagnosis, and treatment strategies, representing an important task for Chinese general practitioners and researchers. Particularly in China, a large country with severe population aging, attention to and research on SO represents an inevitable future trend.

2. Diagnostic Process for SO

SO diagnosis involves screening, diagnosis, and staging for both sarcopenia and obesity, as shown in Figure 1 [Figure 1: see original paper].

Figure 1: Diagnostic algorithm for SO. BMI: body mass index; WC: waist circumference; SARC-F: Strength, Assistance with walking, Rise from a chair, Climb stairs, and Falls; HGS: hand grip strength; ALM/W: appendicular lean mass adjusted for weight; ASMM: absolute skeletal muscle mass; BIA: bioelectrical impedance analysis; DXA: dual-energy X-ray absorptiometry; FM: fat mass; SMM/W: total skeletal muscle mass adjusted for weight.

2.1 Screening

SO screening should identify both high BMI or waist circumference (based on ethnic-specific cutoffs) and surrogate markers for sarcopenia (such as clinical syndromes, risk factors, or validated questionnaires like SARC-F) [9]. The Panel considers specific cutoff values for particular contexts (Table 1) and recommends that future research should identify optimal cutoffs for clinical practice and research. China currently lacks scientific awareness and attention to SO, and early symptoms are often inconspicuous, making screening, education, and prevention particularly important among older adults. This is especially crucial for primary care institutions lacking equipment, where early identification and screening should be prioritized.

The Panel addresses screening capacity, tools, settings, and target populations. Screening should be performed by different healthcare professionals (HCPs) for all at-risk individuals who can afford it, using tools applicable in various clinical settings (hospitals, outpatient clinics, nursing homes) to maximize case detection sensitivity. BMI and waist circumference can screen for obesity. While

BMI has limitations in analyzing fat distribution and body composition and decreases with age, its widespread clinical use justifies its application in the screening phase. Waist circumference is also a useful SO screening indicator for evaluating abdominal obesity and associated cardiometabolic risks [1,19-20]. When using these indicators, diseases affecting fluid retention and body weight, such as heart failure, renal failure, and cancer, should be considered to avoid screening errors.

The Panel also advocates questionnaire-based screening, such as SARC-F [9]. SARC-F is a sarcopenia screening tool comprising five components: Strength, Assistance with walking, Rise from a chair, Climb stairs, and Falls. It can be used for older adults in screening phases, though not validated for younger populations. Despite low sensitivity, its high specificity and clinical convenience encourage its use as a simple screening tool. Calf circumference positively correlates with muscle mass, and the Panel considers it a promising indicator that could enhance SARC-F sensitivity [9].

Age is closely related to SO. With advancing age, muscle metabolic rate changes, and muscle mass and strength decline [4,8,21]. The Panel considers obese and overweight adults over 70 years at risk for SO and recommends regular screening. Different cutoffs exist for skeletal muscle mass across age groups. The Panel supports using lists of risk factors causing clinical symptoms, including age, as shown in Table 2 .

Table 2: Clinical symptoms or risk factors in the SO screening phase.

2.2 Diagnosis

Following positive screening results, further diagnostic evaluation for SO is required. Diagnostic strategies vary by healthcare setting. Primary care institutions should refer patients to higher-level hospitals for definitive diagnosis after screening. Facilities with appropriate equipment can perform rapid community-based diagnosis. Large general or specialized hospitals should follow the "screening-diagnosis" pathway (Figure 1) with etiological assessment. Diagnosis proceeds in two sequential steps: assessment of skeletal muscle function parameters followed by body composition [2-6,8,21].

2.2.1 Skeletal Muscle Function Parameters Assessment of skeletal muscle function parameters is the first diagnostic step. The Panel supports evaluating skeletal muscle strength, including hand grip strength (HGS), knee extensor strength testing (SCPT), and chair stand tests (5-time sit-to-stand test; 30-second chair stand test). Cutoffs for these parameters should be validated for sex, ethnicity, and age (Table 3).

Muscle Strength: The first diagnostic step assesses muscle strength. HGS is commonly measured using handheld dynameters, which are widely applied due to low cost and ease of operation. Knee extensor strength also correlates closely with muscle strength. Reference values for chair stand tests and SCPT

are generated based on population differences in age, ethnicity, and sex; currently, the cutoff closest to the target population should be referenced (Table 3). The Panel supports using maximum strength between two limbs to define HGS and knee strength and encourages further definition of optimal standards, particularly for obese patients [10].

Physical Function: Physical function tests include gait speed, walk tests, rise tests, and the Short Physical Performance Battery (SPPB). Although gait speed is safe and easy to measure, the Panel does not recommend it as a mandatory primary assessment tool in SO diagnostic protocols because potential clinical confounders (knee osteoarthritis) may affect results [10,22]. SPPB, comprising standing balance, gait speed, and chair stand tests, is also widely used clinically. Each skeletal muscle strength assessment method has advantages and limitations. The Panel does not endorse a single optimal measurement system and recommends using different cutoffs for different races, sexes, and ages (Table 3).

Table 3: Cutoff values for skeletal muscle function. HGS: hand grip strength; CART: classification and regression tree; ROC: receiver operating characteristic; AUC: area under the curve; SD: standard deviation; RG: reference group; CPF: composite physical function.

2.2.2 Body Composition Body composition assessment requires increasingly sophisticated tools that are more difficult to obtain than those for muscle function evaluation. Assessment must analyze body composition to derive SMM and FM. The Panel supports FM standardization but acknowledges limitations (increased body water), requiring further research on whether different FM adjustments (e.g., by height) are applicable in SO diagnosis for obese individuals. Even without absolute muscle mass reduction, relative muscle mass reduction at high FM may have clinical and functional consequences; therefore, sarcopenia diagnosis requires assessing relative skeletal muscle mass adjusted for body weight. The Panel advocates further research on the validity of each specific indicator, particularly standardization by height.

The Panel supports using DXA or BIA as preferred methods, with CT as the alternative gold standard when available [21,33]. Appendicular lean mass (ALM) is an important indicator for evaluating muscle mass, with DXA recommended. Since muscle quantity relates to body size, ALM requires standardization by different body sizes. When using DXA, ALM/W is the most appropriate parameter; when using BIA, ALM/W or SMM/W are suitable parameters [1,8]. When BMI $>$ 34 kg/m^2, BIA may overestimate fat-free mass and underestimate FM; therefore, the Panel considers using ALM/height^2 or ALM/height^2 as parameters to define sarcopenia in SO. Due to differences in age, ethnicity, sex, and health status, cutoffs for defining low muscle mass vary, as detailed in Table 4 [3,6,34].

DXA cannot accurately distinguish muscle mass in trunk organs and thus excludes trunk muscles. DXA has relatively high cost, limited portability, and

reduced accuracy due to tissue thickness variability, muscle tissue hydration, lack of skeletal muscle quantification, and inclusion of non-muscle components [35]. However, DXA has lower radiation than CT and MRI. BIA indirectly measures body fat and fat-free content, lacking direct body composition measurement, which reduces accuracy in obese patients [1,3,35]. BIA is economical, radiation-free, relatively simple to operate, suitable for mobility-impaired populations and large-scale measurements, and more portable than DXA [3,5,22].

CT and MRI are considered gold standards for assessing muscle mass, representing precise imaging systems. CT offers precision and high resolution, commonly used to measure selected muscle regions; the Panel recommends measurement at the third lumbar vertebra (L3) level as it correlates strongly with whole-body muscle mass. However, high cost and setting limitations restrict clinical application [22]. MRI shows great promise for quantifying soft tissue muscle mass, but few studies have used MRI for whole-body composition quantification, and time consumption limits clinical application. MRI estimates muscle mass based on muscle quality rather than tissue composition [36]. Overall, CT and MRI measurements are accurate but costly with low clinical utilization rates.

The D3-creatine dilution method is a biochemical approach that directly assesses whole-body muscle mass noninvasively with simple operation, unaffected by body composition. However, it requires validation across various clinical settings and cannot be widely applied in clinical practice. It assesses only whole-body, not regional, muscle mass, lacking precision, standardization, and extensive data [37-38].

In summary, the Panel considers DXA and BIA the best available options for measuring skeletal muscle mass and applying SO diagnosis. Current sarcopenia cannot be evaluated with a single diagnostic indicator; at least three indicators are needed to avoid increasing SO prevalence [2]. Furthermore, age-, sex-, and ethnicity-specific cutoffs are required for different devices (Table 4).

Table 4: FM: fat mass; SMM: skeletal muscle mass; W: weight; RG: reference group; ROC: receiver operating characteristic; SD: standard deviation; DXA: dual-energy X-ray absorptiometry; BIA: bioelectrical impedance analysis.

2.2.3 Anthropometry SO diagnosis requires assessment not only of muscle mass, strength, and physical performance but also of FM. Anthropometric measurements (BMI for general obesity and waist circumference for abdominal obesity) are commonly used in clinical practice and research, making BMI, body fat percentage (BF%), DXA, and waist circumference primary indicators for evaluating obesity.

Over the past 30 years, obesity prevalence has increased significantly, with China facing an increasingly severe obesity epidemic. Body composition changes with age. BMI is a simple and reasonable method for diagnosing obesity but is an imperfect indicator of fat accumulation or abnormality, providing only rough body composition assessment without accurately determining fat distribution,

fluid content, or important weight components, thus having limitations for routine use in obesity. According to WHO guidelines, BMI $\geq$ 30 kg/m^2 defines obesity, though different populations require different BF% cutoffs. BF% is a more precise obesity indicator than BMI; WHO recommends using BF% to measure obesity, as lower muscle mass yields higher BF% at the same fat mass [61]. Waist circumference, another measure of fat distribution, values above population-specific quartiles indicate obesity [34]. Waist or hip circumference provides simple fat distribution assessment and correlates more strongly with body fat distribution than BMI. Additionally, BIA, DXA, CT, or MRI can assess obesity but have clinical limitations due to complex implementation. The Panel explicitly states that anthropometric measures are less sensitive than body composition assessment methods.

Currently, SO lacks specific diagnostic criteria. Commonly used epidemiological diagnostic criteria include several major guidelines and expert consensus statements (Table 5). In China, early identification and intervention for SO are recommended to reduce chronic disease incidence and progression, thereby improving quality of life in older adults.

Table 5: Comparison of SO diagnostic criteria. EWGSOP: European Working Group on Sarcopenia in Older People; IWGS: International Working Group on Sarcopenia; FNIHSP: Foundation for the National Institutes of Health Sarcopenia Project; AWG: Asian Working Group for Sarcopenia.

2.4 Staging

The Panel stages SO into two phases based on presence and severity of complications. Stage I has no complications, only risk factors such as age >70 years, certain chronic disease diagnoses, osteoarthritis, or cancer. Stage II involves at least one complication, such as metabolic disease, disability from high FM or low muscle mass, or cardiovascular or respiratory diseases. In China, staging patients according to clinical severity and poor prognosis facilitates early, aggressive treatment and follow-up.

3. Intervention and Treatment for SO

Active intervention and treatment for confirmed SO patients improve quality of life. Main measures include: (1) **Lifestyle intervention:** The cornerstone of SO prevention and treatment includes dietary control and exercise training. Dietary strategies involve calorie restriction and protein and micronutrient supplementation to alter body composition and improve quality of life. However, energy restriction requires caution to avoid loss of muscle mass, strength, and bone density. Combining energy restriction with aerobic and resistance exercise can mitigate these effects and improve physical function. Adequate protein intake is important for treating SO [4]. Diet combined with exercise is the optimal strategy for improving metabolic status and preserving muscle mass and strength. Exercise training includes resistance training, aerobic training, and

high-intensity interval training (HIT). Resistance training helps reduce weight and increase muscle mass and strength; aerobic training reduces abdominal and visceral fat mass, improves cardiorespiratory fitness, combats obesity, and reduces mortality. Combining resistance and aerobic training is more effective than either alone. HIT increases muscle mass while reducing weight. (2) **Pharmacological intervention:** Potential therapeutic agents include myostatin antibodies and hormonal therapy, which may improve muscle mass and composition and reduce fracture risk in SO. China currently lacks specific evidence-based medicine for SO in older adults, and treatment measures need improvement. Evidence-based prevention and treatment measures for Chinese older adults should be developed promptly [4-7].

4. Limitations and Strengths

The current statements and recommendations are based on expert consensus from an international research group. The Panel comprises representatives from diverse fields, forming an international multidisciplinary group; thus, these statements represent a broad summary of different perspectives, enhancing acceptance of the proposals. The Panel aims to provide standards suitable for clinical practice implementation, empowering non-professional HCPs during screening while engaging professionals in diagnosis and staging. Discussions were rigorous, addressing all potential issues.

A recognized limitation is that previous clinical studies lacked consistency in SO definitions and diagnostic criteria, which may affect consensus initiatives in this field. The current statements are expert-based rather than data-driven. A balance must be struck between practicality (time, availability, cost) and ideal protocols for maximal precision and sensitivity. Clinical and research settings require differentiation: research should employ more complex and precise methods, while clinical practice selects assessments based on equipment availability. Current diagnostics apply only to present clinical practice; the Panel plans to revise these proposals within 3-5 years as new data become available to confirm or provide stronger alternatives. Importantly, the Panel strongly encourages further research to address major uncertainties, including but not limited to:

(1) **Cutoff values:** Most parameters cited herein lack universal validation, providing only available data from different contexts (Tables 1, 3, and 4). The Panel believes cutoffs should be validated as predictors of specific adverse outcomes (comorbidities, disability, mortality, or other clinical outcomes).

(2) **Relative muscle mass and fat mass:** The Panel supports using relative muscle mass, particularly ALM standardized for body weight. The Panel recognizes FM' s importance, though implementation in existing research is difficult.

(3) **Skeletal muscle function parameters in secondary SO:** The Panel believes requiring altered skeletal muscle function parameters as manda-

tory diagnostic components may create potential boundary issues, particularly in younger patients with relatively low muscle mass but preserved muscle function. The Panel advocates research on the predictive value of skeletal muscle function parameters for diagnosing SO in younger subjects. The Panel also recognizes that in secondary SO or most studies on cancer, other chronic diseases, or hospitalized patients with secondary SO, function parameters are not primary outcomes. For example, in intensive care units, body composition may be more feasible and relevant than functional assessment. Further research is needed to determine the role of function parameters in clinical outcomes for SO patients in these contexts.

5. Implications for General Practice in China

As SO incidence increases, general practitioners should pay greater attention to SO screening and diagnosis, developing professional competence in SO screening, diagnosis, treatment, and follow-up. Based on current evidence and consensus, the above tools should be used to diagnose SO whenever possible. However, due to incomplete primary care infrastructure and inability to access these tools, simple screening tools (e.g., SARC-F) are encouraged for SO screening. Secondary prevention or treatment should be provided for suspected SO older adults and patients when feasible. General practitioners should possess essential qualities including first-contact care, coordinated services, continuity of care, and prevalence/incidence-based clinical decision-making. Clinical work should first implement general practice philosophy with a "patient-centered, treat the person before the disease" approach, comprehensively evaluating and caring for individual health.

In summary, this consensus provides agreement on SO definition and diagnostic criteria. The Panel advocates implementing the proposed SO definition and diagnostic criteria in clinical practice and interventional randomized controlled trials, offering guidance for early diagnosis and treatment of SO in China. However, as this consensus originates from Western countries, differences exist from Chinese SO characteristics and clinical practices. Chinese researchers and general practitioners should reference domestic SO consensus in addition to this international consensus to develop SO diagnosis and treatment guidelines tailored to China' s national conditions.

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