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Editorial

Challenges in assessing muscle function within sarcopenia and intrinsic capacity frameworks

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Sarcopenia is defined by the progressive loss of muscle mass and function with aging [1]. Muscle strength, rather than muscle mass, drives the ability to perform everyday activities and is closely associated with mobility limitations, disability, and adverse health outcomes [2]. Nevertheless, despite widespread consensus on the importance of assessing muscle strength, the available tools for evaluation remain diverse and often inadequate to fully capture the complexity of neuromuscular decline in older adults.

The variability in sarcopenia prevalence (10%−22%) reflects the evolving definitions and inconsistent diagnostic standards [3]. Although the Global Leadership Initiative in Sarcopenia (GLIS) aims to harmonize these criteria [4], the revised European Working Group on Sarcopenia in Older People (EWGSOP2) definition [5] remains widely applied and recommends handgrip strength (HGS) or the chair stand test (CST) as interchangeable measures of muscle strength. HGS is promoted for its practicality. However, convenience should not be mistaken for comprehensiveness.

HGS is widely used, but it only captures a limited aspect of muscle function. It reflects the isometric strength of the forearm and explains only about 40% of the variance in lower-limb strength [6]. As a result, it may lead to misclassification in older persons with impaired mobility but preserved grip strength. Evidence consistently shows poor agreement between HGS and CST in identifying low muscle strength or sarcopenia [7–11]. This is not particularly surprising, given their biomechanical and physiological differences. Indeed, the HGS assesses localized, upper-limb isometric strength with relatively low ecological validity for everyday mobility tasks [12,13]. In contrast, the CST is a dynamic, multi-joint, task-oriented measure involving coordination, balance, and both isometric and dynamic strength components [8,12,13]. CST performance is also more responsive to interventions [14–16], likely because exercise programs primarily target the lower limbs [17].

Lower-limb decline occurs more rapidly and is more pronounced than upper-limb decline, with knee extensors being especially vulnerable [18]. Since lower-limb deterioration is strongly linked to frailty and disability [19], relying solely on HGS may miss clinically important deficits. Excess adiposity further complicates assessment: obesity disproportionately impairs lower-limb function, making HGS prone to underestimating relative weakness [11].

Recent frameworks emphasize muscle-specific strength (MSS; i.e., strength normalized to muscle size) to refine diagnostic criteria [4,20]. The Asian Working Group for Sarcopenia's 2025 update aligns with this perspective [21]. Evidence from the I-Lan Longitudinal Aging Study shows that MSS (i.e., handgrip strength normalized to arm muscle mass) better predicts functional decline and correlates with adverse metabolic and inflammatory biomarkers [22]. This suggests that traditional phenotypic measures may fail to capture early subclinical deterioration in neuromuscular capacity.

Beyond these conceptual differences, several practical issues also limit the clinical usefulness and widespread adoption of current strength assessments. The considerable heterogeneity of instruments (ranging from hydraulic to electronic dynamometers) leads to measurement variability and complicates the use of standardized cut-offs. Patient-related factors (such as motivation, pain, cognitive capacity, and comorbidities) further impact task performance, decreasing reproducibility. These elements may explain the relatively low clinical uptake despite strong evidence of their prognostic value. Both HGS and CST are also limited by floor and ceiling effects, which reduce sensitivity in the frailest individuals (who may be unable to perform CST) and in healthier populations (where HGS may not detect early decline). These limitations underline the need for new research directions (such as improved digital strength measurements, rate of force development, neuromuscular steadiness, cross-device calibration, and early biomarkers of neuromuscular decline) to enhance or supplement traditional tests.

Within the framework of intrinsic capacity (IC), the vitality domain aims to reflect underlying physiological reserve. However, its operationalization remains challenging from certain perspectives. HGS and knee extension strength (KES) have been proposed as indicators of neuromuscular function [23–25], but each has limitations. KES offers

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sensitivity but requires specialized equipment and non-natural movement patterns, affecting clinical feasibility [10]. HGS is practical but captures late-phenotypic expression rather than physiological reserve. This aspect has practical implications, especially when early neuromuscular decline is a key target for preventive strategies.

The emerging IC framework increasingly discusses the CST as a potentially ecologically relevant indicator of neuromuscular function [25]. However, while CST is mentioned among possible measures in working operational definitions of the vitality domain [23], it is primarily used within the WHO Integrated Care for Older People (ICOPE) approach [26] as a core tool for assessing locomotor capacity. Its interpretation as a vitality indicator should therefore be considered exploratory and complementary rather than established.

Without accessible biomarkers of early decline, relying solely on HGS risks delaying the detection of meaningful deterioration and may mask deficits in locomotor capacity. For clinicians, integrating simple functional tests (e.g., CST or the Timed Up and Go [TUG] test) can complement isolated strength assessments and provide a more complete picture of motor performance. Clinicians should therefore be encouraged to combine simple functional assessments with pragmatic strength tests, rather than relying on a single isolated measure.

Lower-limb function is essential to mobility and independence, yet the diversity of assessment tools continues to hinder consistent clinical integration [27,28]. Although sarcopenia received an ICD-10 code in 2016 [29], its multidimensional nature challenges traditional disease-based diagnostic models. A pragmatic approach balancing clinical feasibility with the depth required to guide targeted interventions is needed.

Functional tests, like CST and TUG, help connect muscle strength to real-world performance. They better capture the complex interactions of coordination, balance, strength, and power that support independence. As consensus frameworks develop, it's important to avoid overreliance on surrogate measures such as HGS. Improving IC assessments, especially in the locomotor domain, by adding more ecologically valid functional tests could increase their clinical relevance and promote earlier, more effective interventions.

HGS remains a practical tool, but it should not be used alone to represent complex concepts like sarcopenia, neuromuscular function, or vitality. An integrated approach combining practical strength tests, functional performance assessments, and new measures of muscle quality can provide a deeper understanding of physiological reserve and enable more personalized and timely interventions for older adults.

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