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## **Is sarcopenia the best determinant of frailty?**

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## **Introduction**

The concept of frailty is being actively revised in recent times. The experts present at the workshop where this paper is presented have deeply discussed the complexity of frailty as a construct, and the problems involved in its definition and operationalization in clinical research and practice. Current thinking is that frailty cannot be limited to a physical paradigm, but also psychological, cognitive and social factors contribute to frailty and need to be taken into account in its definition.

Research on physical frailty is, however, far more advanced than research on other aspects of frailty. Physical frailty is strongly linked to muscle mass and function. In 1988, Irwin H. Rosenberg stated that “over the decades of life, there is probably no decline in structure and function more dramatic than the decline in lean body mass or muscle mass”. This decline, he proposed, has an impact on ambulation, mobility, energy intake, overall nutrient intake and status, independence and breathing. He suggested giving it a name (sarcopenia), but many would argue that the whole picture depicted here is not far from the current phenotypic definition of frailty.

The definition of sarcopenia has also been evolving since it was named. Definitions of sarcopenia and physical frailty have many common points, but sarcopenia is physiologically closer to an organ function (muscle) than frailty and may be easier to apply in clinical practice. We thus propose that sarcopenia can be widely used as a determinant of physical frailty.

## **The evolving concept of geriatric syndromes**

In developing and validating the concepts of frailty and sarcopenia, both need to be distinguished from normal age-related changes and from other age-related diseases and conditions. In fact, recent literature shows that both sarcopenia and frailty are best understood when considered as geriatric syndromes.

The term “geriatric syndrome” has been commonly used in the Geriatric literature for decades to define complex clinical conditions that are common in older persons and do not fit into discrete disease categories such delirium, dementia or gait disorders. The concept of geriatric syndromes is well understood by any professional working in Geriatric Medicine, and most geriatric textbooks include a series of chapters on their diagnosis and management. However, it is surprising how sparse the literature is in conceptualizing what geriatric syndromes are.

Geriatric syndromes correspond to observable characteristics at the physical, morphologic and biochemical levels of an individual as determined by the genotype and the environment (1). They capture clinical conditions in older persons that do not fit into disease categories, but are highly prevalent in old age, multifactorial, associated with multiple co-morbidities and poor outcomes such increased disabilities and decreased quality of life. The conceptual understanding of a geriatric problem as a geriatric syndrome has been shown to be feasible and useful.

Geriatric syndromes have been defined as health conditions common in older persons that result from the accumulated effect of multiple predisposing factors and that may be precipitated by an acute insult. Geriatric syndromes are relevant because they are usually the presenting manifestation of multiple underlying diseases and conditions; they cause morbidity by themselves; and are treatable when a multidimensional approach is used. Screening for geriatric syndromes seems to be more effective than using medical diagnosis in identifying frail older subjects at risk for mortality and nursing home utilization.

### **A syndromic approach to sarcopenia and frailty**

Several recent papers have shown that frailty can be understood as a geriatric syndrome (2,3). Frailty can be identified or defined using different clinical features, being the presenting manifestation of multiple underlying diseases and complex conditions. The risk of frailty increases with the accumulated effects of multiple conditions and predisposing factors, and subjects identified as frail have been shown to have impaired outcomes (function, morbidity, mortality, costs). However, research on the underlying biologic basis for frailty by studying basic homeostatic pathways and mechanisms has not yet yielded many relevant results, and these pathways seem to be extremely intricate, as shown by the growing number and complexity of the “cycles of frailty” published in recent years.

We have also proposed recently that sarcopenia is best understood as a geriatric syndrome (4). This syndromic view has been included in the European definition (“sarcopenia is a *syndrome* characterized by progressive and generalized loss of skeletal muscle mass and strength with a risk of adverse outcomes such as physical disability, poor quality of life and death”). Nowadays, discussions are mostly focused on a better understanding of the physiopathology, the early recognition of risk factors, an integrative approach on clinical presentations, complications and prevention treatment or reversibility of the loss of skeletal muscle mass and function.

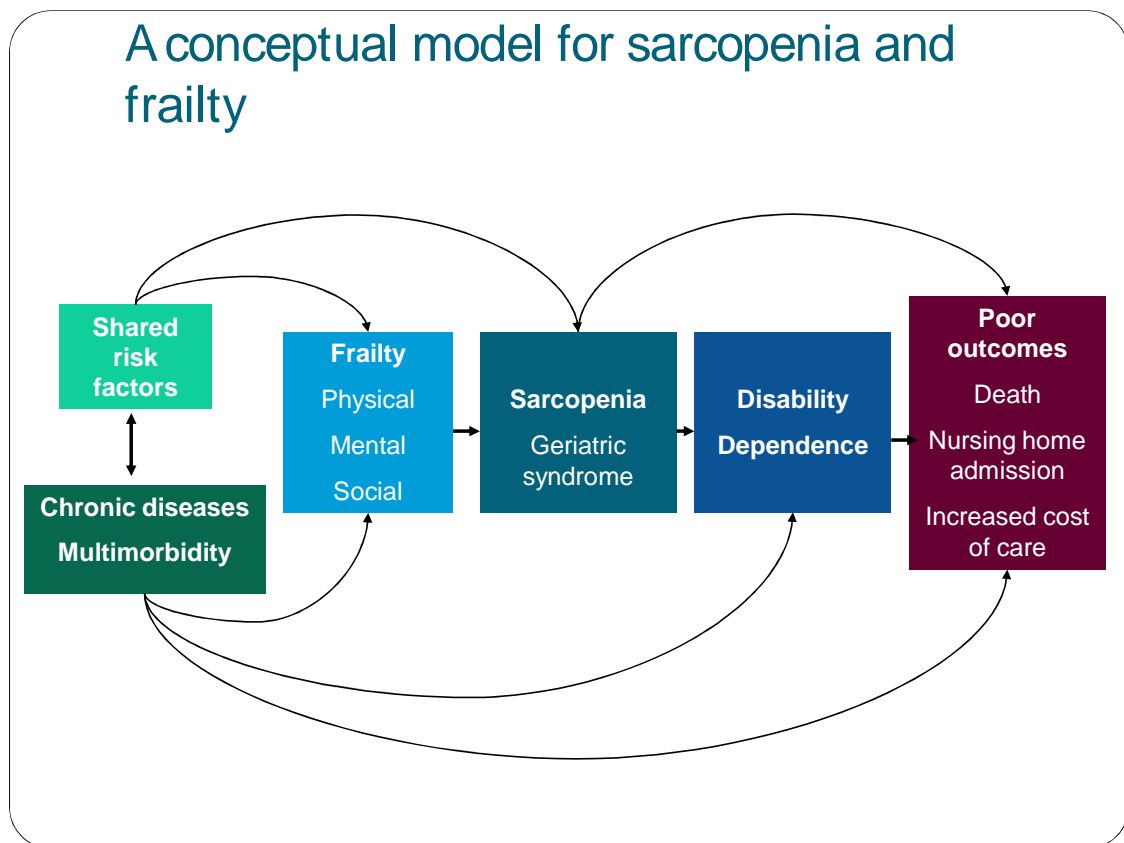
### **Sarcopenia as a determinant of physical frailty**

Older definitions of sarcopenia, based only on absolute or relative muscle mass, are losing relevance, as it is now clear that muscle mass and function do not run parallel. The concept of frailty developed in this arena, pointing out that functional aspects were more relevantly linked to relevant health outcomes than muscle mass. However, new definitions of sarcopenia are moving away from the “muscle mass only” concept to include muscle function and physical performance (5).

Physical frailty has close links to muscle function, and therefore to the new concept of sarcopenia. The consequences of sarcopenia are mainly impaired mobility, disability for basic activities of daily living, and increased mortality. Sarcopenia is also associated with impairments in other physiological functions including glucose regulation, hormone production, cellular communication and protein storage and turnover. In fact, many of the immediate outcomes of frailty are probably mediated by sarcopenia.

Sarcopenic subjects show increased vulnerability, which is a dynamic process of negative adaptation in the face of adversity or external stressors. Sarcopenia plays a crucial etiological role in the frailty process itself, being also a key player of its latent phase and explaining numerous phenomenologies of the frailty status. Although frailty is a more complex problem that includes physical, functional, mental and social aspects, sarcopenia can be considered as being the link between physical frailty and disability (figure 1). Being closer to the musculoskeletal system (the organ system with the function of mobility), we propose that sarcopenia, using recent definitions and considered as a geriatric syndrome, is a more useful construct than physical frailty for clinical diagnosis and intervention.

**Figure 1:** A conceptual model for sarcopenia and frailty



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