

## Understanding sarcopenia : causes, mechanisms and consequences

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The concept of sarcopenia is encountered with increasing frequency in practice and research, not only in geriatric medicine – where it was born - but also in a range of other specialties. Sarcopenia is common and has huge personal and societal costs, but it remains uncoded in the ICD-10, and no treatment guidelines are yet available.

Sarcopenia has been defined recently by the EWGSOP as a geriatric syndrome characterised by progressive and generalised loss of skeletal muscle mass and strength, with a risk of adverse outcomes such as physical disability, poor quality of life and death. It may best be viewed as an organ failure (*muscle insufficiency*) and is usually chronic, but can develop acutely (for example, during hospital admission). It is linked, through physical frailty, to the development of physical disability.

The pathophysiology of sarcopenia is complex, involving muscle and associated neural and hormonal regulation. With normal ageing, the quality of muscle fibres slowly deteriorates and peak power, shortening speed and elasticity decline slowly. The weakness of the muscle fibres can be explained by the interaction of several age-related changes, including loss of anabolic stimuli and age-associated subclinical inflammation.

The EWGSOP divides sarcopenia into categories and proposes the terms primary and secondary sarcopenia. Sarcopenia can be considered *primary* (or age related) when no other cause is evident apart from advanced age, while sarcopenia can be considered secondary when one or more other causes are evident (reduced physical activity, impaired nutrition or different conditions, when it may be linked with cachexia). In many older people, the aetiology of sarcopenia is multifactorial, so it may not be possible to characterise each individual as having exclusively primary or *secondary* sarcopenia.

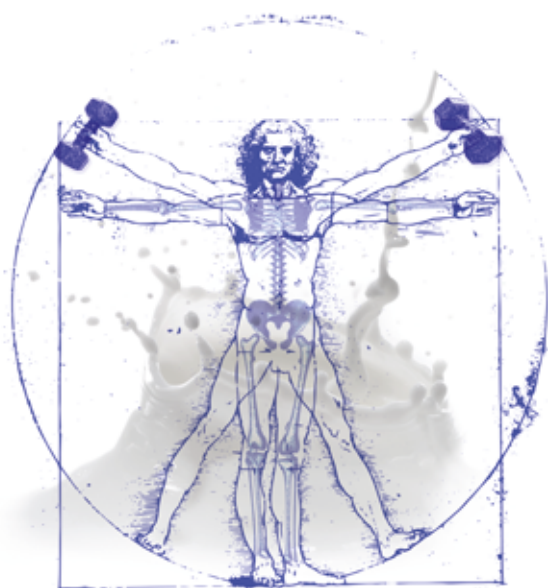
Sarcopenia increases the risk of physical disability, morbidity, nursing home admissions and death, so it should be considered a major public health issue. Interventions to prevent or treat sarcopenia are currently being explored in clinical trials.

*Conflicts of interest: grants/research support or consultancy fees from Abbott Nutrition, Novartis, Nutricia, Regeneron.*

## Dairy protein and muscle mass maintenance : preventing sarcopenia

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Skeletal muscle represents the most abundant tissue type in the human body, accounting for up to 40-50% of body weight in young healthy adults. Given its primary role in generating the forces that are required for human movement, skeletal muscle represents a major determinant of functional performance. Additionally, muscle tissue plays a major role in overall metabolism. Obviously, maintenance of skeletal muscle mass and function throughout life, and especially with aging, is essential to prevent sarcopenia, thereby limiting functional impairments, preserving metabolic health, and supporting healthy aging.

It has been well established that physical activity and food intake (primarily protein intake) represent the two main anabolic stimuli, affecting the intricate balance between muscle protein synthesis and breakdown. Indeed, protein intake stimulates net muscle protein deposition. Likewise, physical activity (muscle contraction) strongly stimulates muscle protein synthesis and improves the balance between synthesis and breakdown. Moreover, physical activity and protein intake work synergistically, thereby optimizing net muscle protein balance.

Recent work has reported a diminished response to protein intake and physical activity in elderly versus young individuals, a phenomenon termed 'anabolic resistance'. Therefore, research in this area has focused on the manipulation of these two factors to maximize postprandial muscle protein synthesis rates, in order to better maintain and/or even improve muscle mass, health and function with aging. In this lecture, an overview will be given on both acute and long-term studies addressing the role of nutrition in stimulating muscle protein synthesis, and improving muscle mass and function in the elderly population. Specifically, the amount of protein needed, the source of protein ingested, the timing of protein ingestion throughout the day, and the benefits of physical activity will be discussed, with due attention for the role of high-quality dairy protein in this context.

*Conflict of interest: none applicable.*

## Osteosarcopenia: cross-talking between muscle and bone

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### Objective

Based on the advance of knowledge in biology and medicine, a shift toward a new holistic paradigm and integrative perspective, after decades of reductionist research, will help to understand the complex issue of musculoskeletal health. The present lecture will address the current understanding of the bone-muscle system to define new levers to simultaneously prevent/treat sarcopenia and osteoporosis and to provide effective recommendations.

### Material and methods

Literature review.

### Results

Loss of bone and muscle with advancing age represents a huge threat to dependency in the elderly. Both tissues share many similarities and are essential for locomotion and individual autonomy. This is why, in the past decades, the idea of a bone-muscle unit has emerged. Indeed, simultaneous bone and muscle dysfunction has been reported in various situations such as ageing, immobilization, or secondary to diseases (obesity, diabetes, paralysis...). On the opposite many regulation factors, including nutrition, vitamin D, hormones (GH/IGF1 axis, sex steroids) are beneficial. Mechanical loading is also a key mechanism linking both tissues with a central promoting role of physical activity. Moreover, at the cellular and molecular levels, bone cells and myoblasts share common targets and signaling pathways and the close anatomical location of both cell types suggests a possibility of paracrine communication. The skeletal muscle secretome accounts various molecules that affect bone, including insulin-like growth factor-1 (IGF-1), IGF2, basic fibroblast growth factor (FGF-2), interleukin-6 (IL-6), IL7, IL-15, myostatin, follistatin, osteoglycin (OGN), FAM5C, Tmem119, leukemia inhibitory factor (LIF), irisin and osteoactivin. Besides, few osteokines have been identified as well. Prostaglandin E2 (PGE2), and Wnt3a, which are secreted by osteocytes, osteocalcin (OCN) and IGF-1, which are produced by osteoblasts and sclerostin which is secreted by both cell types, might impact skeletal muscle cells. Connexin 43 has also been shown to impair skeletal muscle development.

### Conclusion

The understanding of the musculoskeletal system will enable to identify concomitant therapies, or how each condition may benefit from treatment of the other.