The loss of muscle mass with age

Bong-Seok Oh *
Department of Sport & Leisure, Sunchon National University, Suncheon, Korea.

INTROTUCTION

Muscle mass and strength are associated with everyday activities that effect on quality of life and fall-related injuries in the elderly. Especially, the aging-related loss of muscle mass, strength and function are likely to be risk factors for falling, disability and morbidity among older individuals. The purpose of this review was to characterize associations between muscle mass and aging.

METHODS

In this study, various types of literature regarding muscle mass and human aging were reviewed. PMC and Pubmed's research articles that relate to muscle mass and aging in human beings will provide primary sources of literature to this review process.

RESULTS

After at least 60 years of age, there are dramatic changes in the human tissues including skeletal muscle fibers, which is related to the frailty syndromes with muscle aging. The loss of skeletal muscle mass with aging is associated with sarcopenia. Sarcopenia with human aging has a negative effect on not only healthy aging but also public heath care systems. Sarcopenia is also related to frailty, weight loss and impaired movements in older adults. Especially, the loss of lower limb's muscle mass in the elderly is likely to be connected to falling and falling-related reaction, which in turn is also tends to be result in serious secondary injuries of the physical and mental disabilities such as fracture and depression. Lower limbs including buttocks and thighs possess more than two-thirds of whole-body skeletal muscle mass. Therefore, the skeletal muscle in hips and thighs plays a vital role in preventing falling and supporting body weight and keeping up the body posture and temperature. Generally, after the age of 30 years, the loss percentage of skeletal muscle mass is about 0.5-1% per year, while, after the age of 60 years the percentage tends to be raised dramatically. Especially, the aging-related progressive loss of lower limb's skeletal muscle mass including buttocks and thighs muscle volume causes defects in health care, which in turn is likely related to the various health problems including falling, depression, weakness, impaired body movement and catabolic diseases. That is, the decrement in the skeletal muscle mass and function enhances susceptibility to whole-body frailty in the elderly. Sarcopenia during human aging is also associated with the deterioration of endocrine environments such as decrement in IGF-1 (insulin-like growth factor-1) and anabolic cytokines in muscle tissues, which can be also accompanied by the increase in inflammation, adipose tissue and fibrosis in the elderly. Although the loss of muscle mass tends to be related to muscle disuse and fasting, and although the exact mechanism of sarcopenia is yet unknown and unresolved question, studies have suggested that sarcopenia is associated with the combinations of the external and internal factors in muscle tissues. External factors for the reduction of muscle mass include the elements that have negative effect upon the muscle homeostasis. Main essential causes are the malfunctions of cellular organelle and protein mechanism that accompanies the accumulation of damaged proteins in cellular compartments, which consequently increase in functional defects and apoptosis at the cellular levels. Internal or morphological changes regarding muscle aging include the atrophy of muscle satellite cells, interstitial adipocytes accumulation, capillarization decrease, nuclear faults, and the deficiencies in neuromuscular junctions and innervations. These external and internal factors for muscle aging indicate that it is not easy for the elderly to avoiding the loss of skeletal muscle mass with aging. The age-related sarcopenia and loss of muscle strength are likely to be associated with both of the muscle quantity and quality reduction accompanied by the compositional and functional changes in sarcomeric proteins, which in turn also result in a reduction in the contractile activity of skeletal muscle. The dramatic muscle deterioration with aging is related to the dysfunctional interactions of satellite stem cells with muscle repair. These relations suggest that the extracellular factors can be important determinants of the regenerative capacity during muscle aging. Although aerobic or resistance exercise is a complementary intervention that reduces muscle aging, studies have indicated that the inhibition of myostatinactivin pathway accompanied by using anti-myostatin antibody is very likely to be one of useful interventions for decreasing the loss of muscle mass in the elderly. However, studies have also suggested that the decreasing rate of maximal muscle strength during human aging is three times greater than the decrement rate of muscle mass, and that the effect of muscle function and strength on the delay and prevention of elderly frailty is higher than muscle volume. The loss of muscle strength with aging is also related to the decline in mitochondrial function accompanied by the decrement in the mitochondrial enzymes, protein synthesis, respiratory capacity and insulin sensitivity. Skeletal muscle aging in mammals is involved in the complex role of mitochondrial dysfunction accompanied by oxidative stress and metabolic changes. This also indicates that proper exercise interventions can play fundamental roles in improving mitochondrial metabolism, intracellular accumulation of lipids and insulin resistance, which consequently can contribute to the safe and effective reduction of muscle mass loss in human beings.

CONCLUSIONS

After 60 years of age, the human soft tissues including skeletal muscle fibers are on course for dramatic changes in the quantity, quality and function. It is not easy to avoid the age-related changes in various soft tissues including skeletal muscle fibers. The loss of muscle mass with aging can has negative effects on not only daily life, physical and mental health but also public health care system. Especially, in the elderly, the reduction of lower extremity muscle mass and strength tends to relate to the serious secondary injuries and hospitalization. That is, the reduction of skeletal muscle mass with aging enhances the possibility for a whole-body frailty. Sarcopenia with aging is associated with various factors such as the malfunctions of cellular organelle and protein homeostasis, mitochondrial dysfunction. However, weight-bearing exercise interventions including resistance training enhance protein synthesis in muscle tissues and improve neuromuscular junctions or motor neurons, and delay the loss of muscle mass with aging. Therefore, most people should bear in mind that regular strength or resistance exercise training plays an important role in delaying muscle aging and in maintaining or improving the skeletal muscle mass and function.

* Email: loveobs@scnu.ac.kr