Physiologic Changes of the Musculoskeletal System with Aging: A Brief Review

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KEYWORDS

• Older adults • Skeletal muscle • Weakness • Sarcopenia

KEY POINTS

- The number and percentage of people in older age groups is increasing significantly in most countries of the world resulting in important socioeconomic and health challenges.
- Many components of the musculoskeletal system, including skeletal muscle, tendons, ligaments, bone, and articular cartilage, show significant losses of structural and functional properties.
- Age-associated changes in musculoskeletal tissues compromised an individual's capacity to perform many activities of daily living as well as more demanding tasks.
- Many of the age-associated changes seen in the musculoskeletal system can be partially modified with an active lifestyle and appropriate exercise training.

INTRODUCTION

The World Health Organization has recognized the aging of the population in many countries around the world as one of the most significant challenges of the twenty-first century.[1] In several countries in Asia and Europe, the average life expectancy has already exceeded 80 years, particularly among women. In fact, the fastest growing age group in the United States is the oldest-old (>85 years) group. It has been estimated that by the year 2025, the number of people older than 60 years in the planet will exceed 1 billion and 2 billion by the year 2050.[1,2] Although there are significant differences between countries associated with sociopolitical conditions and the level of income, the increase in life expectancy and in the number of people in this age group has been documented in low-, middle-, and high-income countries.[3]

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It should not come as a surprise that these changes in the age-group composition of the population have significant social, economic, political, and health implications.[4] Thus, understanding age-related changes in human physiology and their consequences is of significant interest and relevance and has been identified as a research priority by the US National Institutes of Health.[5]

The main challenge associated with advanced adult age is the relationship between significant alterations in many physiologic functions, the development of multiple impairments, the decline in overall functional capacity, the associated morbidity and mortality, and the resulting loss of independence that most older adults fear more than death. For example, because maximal physiologic capacities are greatly diminished with age, the ability to perform physical tasks at the same absolute level of energy expenditure or muscular force becomes limited. In other words, activities such as rising from a chair or crossing a city street intersection that usually represent submaximal demands can become, in old age, maximal or impossible efforts (**Fig. 1**). It should also be noted that physical or architectural obstacles may contribute to this problem by making the environment less friendly.

Some of the most important contributors to the functional loss leading to impairment and disability are the multiple changes in structure and function of the musculoskeletal system. Left unchecked, life-threatening complications, such as falls and bone fractures associated with muscle weakness, can occur. In fact, mortality after a fall resulting in a fracture is higher in those with a lower level of muscle strength before the fall. The biological changes resulting from aging contribute to a decline in skeletal muscle strength and mass, alterations in muscle contractile properties, impaired motor performance, a reduction in bone mass and strength, a decrease in flexibility and joint range of motion, and the loss of the capacity of soft tissues to sustain and recover from injury. It is interesting that the qualitative nature of these changes is very similar to those experienced during the inactivity that follows injury or hospitalization underlining the contribution of a sedentary life, inactivity, and immobilization to the age-associated loss of function and independence.

MUSCLE STRENGTH

Skeletal muscle strength is one of the fundamental physiologic capacities that contribute to functional capacity. Muscle strength alone is a strong predictor of severe mobility limitation, slow gait speed, increased fall risk, risk of hospitalization, and high mortality rate. For example, older adults with poor muscle strength have a 2.6-fold

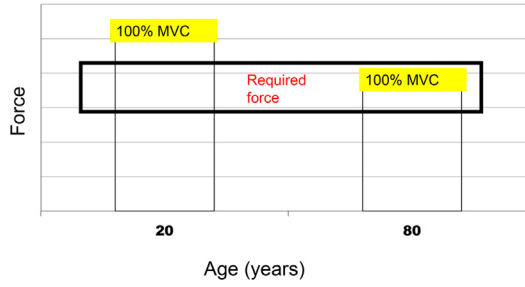

Fig. 1. Force required to rise from a chair relative to the strength of a person. At 20 years of age, the maximal voluntary contraction (MVC) is much higher than the force required to perform a simple task, such as rising from a chair. Because of the reduction in muscle strength with aging, the same task may represent a maximal effort in an 80-year-old person.