Exercise and the Older Adult

By the year 2030, the number of individuals 65 years and over will reach 70 million in the United States alone. Those 85 and older will then be the fastest-growing segment of our population. We must determine the extent and mechanisms by which exercise and physical activity can improve health, functional capacity, quality of life, and independence in this population.

Current evidence clearly indicates that participation in a regular exercise program is an effective way to reduce and/or prevent a number of the functional declines associated with aging. Older adults have the ability to adapt and respond to both endurance and strength training.

Aerobic/endurance training can help to maintain and improve various aspects of heart and lung function and cardiac output, and such exercise can enhance endurance. Strength/resistance training will help offset the loss in muscle mass and strength typically associated with aging, thereby improving functional capacity. Also important, reduction in risk factors associated with disease (heart disease, diabetes, osteoporosis, and so on) will improve health status and contribute to an increase in lifespan. Together, these training adaptations will greatly improve the functional capacity of older men and women, therefore improving their quality of life and extend independent living.

Cardiovascular system

Effects of Aging: Maximal oxygen consumption (VO2 max) is the most frequently used indicator of overall cardiovascular function and maximum capacity. Consistent findings indicate that VO2max decreases approximately five to 15 percent per decade beginning at 25-30 years of age. This decline in VO2max can be attributed to age-related reductions in both maximal cardiac output and maximal arteriovenous oxygen (a-v O2) difference. Maximal heart rate decreases about six to ten beats per minute per decade, and is responsible for much of the age-associated decrease in maximal cardiac output. However, a reduction in stroke volume during maximal exercise in older adults also contributes to the decline in cardiac output. In addition, left ventricular contractility appears to be reduced in older adults during maximal exercise compared to young adults. Decreases in vascular capacity and local blood flow regulation, along with a decline in muscle oxidative capacity, contribute to the overall reduction in maximal a-v O2 difference observed with age. Coupled with poor oxygen delivery mechanisms, mitochondrial alterations also lead to a reduction in maximal capacity to utilize oxygen at the level of active skeletal muscle.

For a submaximal exercise bout, cardiac output is lower in older adults, while a-v O2 difference tends to be somewhat higher in a compensatory response to maintain VO2 . A reduction in stroke volume appears to be the major factor responsible for the lower cardiac output observed during submaximal exercise. Blood pressures are also higher at both the same absolute and relative work rates in older versus younger adults. Associated with the blood pressure response, total peripheral resistance is generally higher in older versus young adults for a given exercise intensity.

Effects of Aerobic Exercise Training: Over the past ten years, we have learned that older persons can adapt to a program of regular aerobic training as well as their younger counterparts. Older adults can achieve the same 10 to 30 percent increase in VO2max in response to endurance exercise training as young adults. The magnitude of these adaptations in VO2max in older adults is a function of training intensity; low intensity training elicits only marginal changes. The increase in VO2max in older adults is a result of improvements in both maximal cardiac output and a-v O2 difference. In addition, improvements in submaximal endurance capacity and the greater ability to tolerate higher levels of physical activity are important training adaptations.

For improvements in cardiovascular fitness, the American College of Sports Medicine recommends an exercise intensity of 55/65 to 90 percent of maximum heart rate (or 40/50 to 80 percent of heart rate reserve). ACSM further recommends accumulating 20-60 minutes at that level three to five days a week. The lower ranges are for unfit or even frail individuals who are about to begin an exercise program.

Muscle strength and endurance

Effects of Aging: Loss of muscle mass (sarcopenia) with age in humans is well documented. A primary factor in sarcopenia is disuse of skeletal muscle, resulting in atrophy. A reduction in muscle strength is directly associated with loss of muscle mass. Inactivity may also play a role, contributing to other factors affecting aging muscle mass, including:

- Neuromuscular realignment (changes in motor units and innervation of fibers)
- Reduction in growth factors
- Changes in muscle protein turnover

The consequences of sarcopenia can be extensive; individuals are more susceptible to falls and fractures, impaired in ability to regulate body temperature, slower in metabolism, possibly deficient in glucose regulation and may suffer an overall loss in the ability to perform everyday tasks. Muscle atrophy appears to result from a gradual loss of both muscle fiber size and number. A gradual loss in muscle cross-sectional area is consistently found with advancing age; by age 50, about ten percent of muscle area is gone. After 50 years of age, the rate of accelerates significantly. Muscle strength declines by approximately 15 percent per decade in the sixties and seventies and by about 30 percent thereafter. Although intrinsic muscle function is reduced with advancing age, age-related decrease in muscle mass is responsible for almost all loss of strength in the older adult. The number of functional motor units also declines with advancing age, which requires surviving motor units to innervate a greater number of muscle fibers.

Effects of Resistance Training: Given an adequate training stimulus, older adults can make significant gains in strength. A two- to threefold increase in strength can be accomplished in three to four months in fibers recruited during training in older adults. With more prolonged resistance training, even a modest increase in muscle size is possible. Because sarcopenia and muscle weakness are so prevalent in the aging population, it is important to devise strategies for preserving or increasing muscle mass in the older adult. With increasing muscle strength come increased levels of spontaneous activity in both healthy, independent older adults and very old and frail men and women. Strength training, in addition to its possible effects on insulin action, bone density, energy metabolism, and functional status, is also an important way to increase levels of physical activity in the older adult.

Health Benefits

Most risk factors associated with disease increase with age, so the benefits of regular exercise are significant from a health perspective. Health benefits associated with cardiovascular disease risk factors include favorable changes in lipid profile, blood pressure, and body composition. Older adults can improve their plasma lipoprotein lipid profiles with exercise training similar to those observed in younger adults and may include modest increases in plasma HDL levels and reductions in LDL and plasma triglyceride levels. This results in more favorable HDL/LDL and light cholesterol: HDL ratios. Aerobic training reduces resting blood pressure in hypertensive young persons, and this training effect is evident in older hypertensive adults as well. Changes in body composition are associated with aerobic exercise training in older populations. A modest yet significant reduction in total percent body fat is generally observed with exercise training in older adults, which can occur despite a maintained body weight. It is important to note that in older men, a decrease in intra-abdominal fat accounts for the greatest relative loss of fat mass. This finding is significant in that intra-abdominal fat increases the most with advancing age and is associated with cardiovascular disease, particularly in men. In addition to reducing heart disease risk, regular exercise results in an increase in insulin sensitivity in older adults.

As insulin resistance increases with age, the positive effects of regular aerobic exercise in older individuals on improving insulin sensitivity and increasing glucose transporters in muscle are of clinical importance for the treatment and prevention of adult-onset diabetes.

Finally, because decreased bone density is more common among older adults, evidence suggests that participation in regular exercise improves bone health and thus reduces the risk for developing osteoporosis. Further, this can reduce the incidence of breaks and fractures associated with falls.

Summary: Aging is a multi-faceted process in which a variety of factors interact (genetics, lifestyle, disease) and frequently is associated with reduced functional capacity and chronic illness. In addition, physical inactivity and maintenance of a sedentary lifestyle represent a significant health risk to aging individuals. Older adults can safely participate in regular exercise programs (aerobic and strength). Regular physical activity has been shown to elicit a number of favorable adaptations that contribute to healthy aging. Further, the trainability of older individuals is evident from their ability to adapt and respond to both endurance and strength training. Endurance training can help to maintain and improve various aspects of cardiovascular function as measured by VO2 max, cardiac output and a VO2 difference as well as enhance submaximal performance. It is important to note that reductions in risk factors associated with disease states (heart disease, diabetes, etc.) will improve health status and contribute to an increase in lifespan. Strength training will help offset the loss in muscle mass and strength typically associated with normal aging.

Additional benefits include improved bone health and thus reductions in risk for osteoporosis; improved postural stability, reducing the risk of falling; and increased flexibility and range of motion. Together, these benefits associated with regular exercise and physical activity will contribute to a healthier, more independent lifestyle, greatly improving functional capacity and quality of life for the fastest-growing segment of our population.

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