

Resistance Training and Aging

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Introduction: Resistance Training and Aging

Aging is accompanied by a progressive decline of skeletal muscle mass and strength which is known as sarcopenia. On average, it is estimated that 5-13% of elderly people aged 60-70 years are affected by sarcopenia. The numbers increase to 11-50% for those aged 80 or above. Possible effects of sarcopenia include decreased muscle strength, problems with mobility, frailty, osteoporosis, falls, fractures, decreased activity levels, diabetes and loss of physical function and independence. This may impact their function, activities of daily living and quality of life. Sarcopenia and osteopenia are linked and commonly associated with aging. Aerobic exercise provides a partial solution to sarcopenia and resistance exercise strengthens muscle mass and function. Combinations of these exercise types provide muscular fiber hypertrophy, increased strength, extended independent living and reduced fall risk. The purpose of this paper is to provide current perspectives and treatment that resistance training had on aging.

As we age, the loss of skeletal muscle mass is accompanied with a decline in muscle strength and performance. This is known as sarcopenia which can cause a disability, frailty, comorbidities, hospital admissions and deaths.^[1] Sarcopenia a multifactorial condition that may occur because of protein metabolism, motor units, hormones and lifestyle are all factors that contribute to the occurrence of sarcopenia.^[1] Age related sarcopenia may progress by a variety of factors including changes in hormones, inactivity, poor nutrition, chronic illness and loss of function in the peripheral and central nervous systems.^[1] Muscle mass decreases by 1-2% in an annual rate once an individual is at the age of 50.^[1] This means that muscle strength may decrease by 12-15% every 10 years after an adult is older than 50.^[1]

The motor unit is very important to translate all input from the synapse into force production and movement.^[2] As we age, there is a decrease in the structure of motor units that change in their morphology and size which leads to skeletal muscle function deficits.^[2] There are a multitude of structural changes that occur within the muscle fibers that accompany the process. The three that are known include decreased satellite cells and fiber numbers, reduced fiber size and declines in expression of MHC IIa.^[2] Beginning with decreased satellite cell and fiber numbers, older adults have a higher rate of fiber denervation related to motor unit remodeling and experience greater amounts of oxidative stress and apoptosis.^[2] This can decrease satellite cell regeneration of muscle fibers and this can result in muscle fiber loss. The second thing that may occur is reduced fiber size. Muscle fibers are

usually smaller in older adults compared to younger people especially in the lower extremities.^[2] This can cause problems for functional activities that require strength for balance and postural control due to muscle atrophy in type II muscle fibers in older adults when compared with younger adults.^[2]

There are many reasons for the reductions in fiber size with aging, such as fewer satellite cells in type II muscle fibers and lower protein synthesis. Lower protein synthesis reduces the speed of skeletal muscle growth and repair. The last thing that can occur is a decreased expression of MHC IIa. In general, MHC IIa isoforms play a key role in the muscle strength and power.^[2] There is a smaller proportional area expressed in older adults' muscles compared to younger people. These smaller amounts occur in conjunction with reports of a shift to an increase in MHC IIX isoform expressions in older adults.^[2] This age-related change results in a slower myosin actin cross bridge kinetics and reduces the power for functional task performance.^[2]

There is some evidence that suggests during the early phase of sarcopenia, muscle protein synthesis increases.^[1] In the mature stage of the sarcopenia process, the synthesis rate of myofibrillar proteins is reduced.^[1] The loss of alpha motor units from the spinal cord is the most crucial contributor to sarcopenia. When motor neuron loss occurs, the increased size of the remaining motor units and the loss of muscle fibers have been identified as contributing factors of sarcopenia.^[1]

Resistance Training Benefits for Older Adults

There is treatment and prevention possible for the health and well-being of older adults that may help with the progression of sarcopenia. After considering all of the factors, muscle disuse is preventable and can be reversible. Resistance exercise training has been shown as an effective way to counteract muscle weakness and physical frailty and age related intramuscular adipose infiltration.^[3] Resistance training also increases muscle fiber area, improves muscle quality, bone density, metabolic health and insulin sensitivity, management of chronic health conditions, quality of life, psychological well-being, extended independent living and reduced risk for falls and fractures in older adults.^[3] Resistance exercise may improve metabolic capacity of skeletal muscle by improving glucose homeostasis, preventing intramuscular lipid accumulation, increases oxidative and glycolytic enzyme capacity, enhancing amino acid uptake, protein synthesis, and shifting the anabolic/catabolic milieu toward anabolism through release.^[3]

There are many positive physiological adaptations when resistance exercise training is completed in older adults. Beginning with muscular power, skeletal muscle power is the production of force or torque of a muscular contraction and the velocity. Skeletal muscle power declines at a greater rate and is linked to functional limitations when compared to muscular strength in older adults.^[3] Resistance training has shown marked improvements in skeletal muscle power that ranges from 14-

97%, reporting that lower training volumes are associated with greater improvements in muscle power.^[3]

Rate of force development is the rate of force and torque that is measured in explosive or rapid strength during an isometric maximal voluntary contraction. Rate of force development has been reported to decrease and is more important to function and fall risk in older adults.^[3] Upper and lower body rapid strength shows a significant increase after resistance training in older adults.^[3]

Hypertrophy has been shown in several reviews when resistance training is being completed. There is improvement in strength, structure and function in older men and women. Resistance training can increase muscle size and change the structural characteristics of muscle and tendons, this occurs by increasing stiffness and function.^[3] Resistance training can improve the neuromuscular structures and functions that are known to occur with age.^[3] The aging of the neuromuscular system cannot be stopped; it is possible to slow down the rate of decline across the neuromuscular systems.

Endocrine adaptations may occur as a response to resistance training. Different literature reviews provide evidence that resistance training has an impact on various hormone and molecular signaling pathways during aging.^[3] The endocrine system is important in signaling various hormones in response to resistance exercise. The changes in circulating concentration of hormones and acute exercise response to resistance exercise training are variables in older men or women.^[3] Further research is needed to determine local mechanisms that are operate and reflect the anabolic and catabolic effects in older adults.^[3]

There are also many functional benefits of resistance exercise training for older adults. A well-designed resistance training program can improve mobility, physical function, performance of activities of daily living and preserve the independence of older adults.^[3] Research has demonstrated that physical activity and exercise is related to delaying disability, preserve quality of life, restore independent functioning and prolong independent living in older adults.^[3] Higher levels of exercise were the most effective at improving functional activities of daily living.^[3] Resistance training can also help with age related changes such as functional mobility which include improvements in gait speed, static and dynamic balance and fall risk reduction.^[3]

A correctly designed resistance training program can increase an older adult's resistance to injuries and catastrophic events including falls.^[3] Falls are a common danger in the older adult population in the United States. About 30% of older adults experience at least one fall annually and 50% of adults older than 80 years of age experience a fall each year.^[3] Several studies have found the importance of resistance exercise and an exercise regimen to reduce vulnerability to falls, especially those that result in injury.^[3] Exercise programs that challenge balance with the combination of

exercises are the most beneficial. Some of these activities may include standing with both feet close together and or on one leg, minimal support by hands and controlled movements of the center of the body. [3] These are all great implementations that demonstrate the effects in fall prevention.

Exercise Prescription

In the elderly population, weak tendons can contribute to functional limitations, injuries and disabilities. [4] Although resistance training can help with this age-related decline. An integrated health education and elastic band resistance training program for a period of 18 weeks significantly improved the SPPB score which measures balance, gait speed and lower limb strength. It also improved isokinetic leg extension, flexion strength and leg muscle quality in community dwelling elderly women. [5] This elastic band resistance training program consisted of two 60-minute training sessions each week for 18 weeks. [5] Eight weeks of this exercise program were supervised training sessions and ten weeks were self-directed training sessions. [5] Participants chose a resistance band that they were able to complete 10-20 repetitions with correct posture and started the training program. [5] Every 4 weeks, the intensity of the sessions was increased after an exercise ability test by supervisors. [5] During the supervised training period, each session included 5 minutes of a warmup, 50 minutes of progressive elastic band resistance training and a 5-minute cool down. [5] The warmup and cool down focuses on flexibility and the elastic band resistance training focused on increasing muscle strength through four upper body exercises and four lower body exercises. [5] The upper body exercises are bicep curls, triceps extensions, lateral and front raises and the lower body exercises are ankle raises, squats, leg press and leg abduction. [5] Each participant completed 2-3 sets of 10-20 repetitions of each exercise per session. [5] This study shows us that resistance training is effective in improving many aspects in elderly women. This study can help us when prescribing exercise plans for elderly individuals that are beginners and women, since this was not completed with men, we may not know if the outcomes are the same.

A study by Johannsmeyer and colleagues from 2016 studied the effects of creatine supplementation and drop-set resistance training in untrained aging adults. Although these aging adults were between the ages of 40-62, this study is still important for potential exercise prescription. The creatine supplementation group took 0.1 g/kg/day of creatine and 0.1 g/kg/day of maltodextrin. [6] The subjects completed 12 weeks of drop set resistance training 3 days a week that consisted of 2 sets of leg press, chest press, back squat and lat pull down exercises performed to muscle fatigue at 80% baseline 1 repetition maximum immediately followed by repetitions to muscle fatigue at 30% baseline 1 repetition maximum. [6] This study found that drop set resistance training increased muscle mass, strength and decreased muscle protein catabolism in males. [6] The creatine supplementation increased

the muscle mass by 2.8 kg and the placebo increased by 0.9 kg. ^[6] These results are important because the reduction in muscle mass and strength with aging decreases the ability to perform activities of daily living. ^[6] This kind of resistance training should only be prescribed to individuals that are at a moderate to advanced exercise level. A medical professional should be consulted if this kind of resistance training program is prescribed.

To attenuate the effects of sarcopenia, it has been recommended that older adults preform resistance training 2-3 days per week. ^[7] Clinicians should focus on what patients can do instead of what they cannot do. ^[7] Older adults should be encouraged to participate in progressive resistance training activities and should move along a continuum of exercise from immobility toward the recommended daily amount of activity. ^[7] As clinicians encourage patients to move along the spectrum toward prescribed levels, the patient will gain confidence in their mobility and increase intrinsic motivation towards more activity. ^[7] Supplements can also be used by clients including essential amino acids, creatinine, vitamin D, and omega-3 fatty acids. ^[8] Supplements must be individualized to each patient. Elderly patients with low levels of IGF-1 or testosterone may benefit from those specific supplements. ^[8]

To summarize, sarcopenia is common in aging adults and can cause a disability, frailty, comorbidities, falls, hospital admissions and deaths. Resistance training is a well-researched and effective treatment and preventative method that can be used for the health and well-being for older adults. ^[8] Resistance training may help with the progression of sarcopenia, increase muscle fiber hypertrophy, increased strength, extended independent living and reduced fall risk. ^[8] A correctly designed resistance training program can increase an older adult's resistance to injuries and catastrophic events including falls. The most common resistance training exercise recommendation is 2-3 times per week for 30 minutes per session. A medical professional should be consulted before exercise is prescribed. Exercise testing may be performed to assess the client to determine what resistance training should be performed.

Elements

1. Apply It:

- This article will provide evidence of the importance of incorporating resistance training into your exercise programming as a preventative measure for sarcopenia.
- This article will teach clinicians to focus on what patients can do instead of what they cannot do. Older adults should be encouraged to participate in progressive resistance training activities and

should move along a continuum of exercise from immobility toward the recommended daily amount of activity

2. Bridging the Gap:

Sarcopenia is common in aging adults and can cause a disability, frailty, comorbidities, hospital admissions and deaths. Resistance training is a well-researched and effective treatment and preventative method that can be used for the health and well-being for older adults. Resistance training may help with the progression of sarcopenia. A correctly designed resistance training program can increase an older adult's resistance to injuries and catastrophic events including falls.

3. Summary Statement:

Sarcopenia is common in aging adults and can cause a variety of disabilities. Resistance training is a well-researched and effective treatment and preventative method that can be used for the health and well-being for older adults.

4. Pulled Text:

Our quality of life is important to all of us especially as we age. It is important to want to be mobile and have the best quality of life as long as possible. Continue reading and I will explain preventative measures and treatments to help improve these factors.

Bio:

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