Improving the Functional Ability of the Elderly With Resistance Training

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The aging of the world’s population has led to an increasing prevalence of “lifestyle” diseases such as type 2 diabetes, osteoporosis, heart attack, and stroke. The elderly of today may be more frail and less able to perform activities of daily living (ADL) than the elderly of previous generations. Physical inactivity is a strong contributor to the increased morbidity associated with these lifestyle diseases (1, 4, 8, 11). According to a recent position stand from the American College of Sports Medicine, elderly adults may decrease their frailty and improve their ability to perform a range of ADL by engaging in a strength and conditioning program (8). This article outlines the rationale for the prescription of resistance training for the elderly.

Physiology of Aging

The aging process is associated with a significant reduction in strength, muscular endurance, muscle mass, bone mineral density, aerobic power, and sensory acuity as well as an increase in body fat and reaction time (1, 5, 8, 11). These changes in the neuro-musculoskeletal system are largely responsible for the decreased functional performance (i.e., slower task performance or diminished accuracy) observed in elderly compared with young adults. This decrease can be readily observed in ADL such as walking, climbing stairs, rising from a chair, writing, buttoning a shirt, carrying a glass of water, or using hand-held tools (4, 11). In the more physically demanding ADL like sit-to-stand and stair climbing, the force or torque required to perform these movements may be close to, or even greater than, the maximum force (torque) that an elderly adult is able to produce (4). Thus, frail elderly adults will have a compromised ability to perform ADL like sit-to-stand and stair climbing.

In comparison with younger adults, the elderly suffer more trips and slips that may result in a fall (3, 4). Whereas a fall may be inconsequential to most younger adults, such an incident for an elderly adult with osteoporosis can result in a fracture, especially of the hip, thigh, vertebrae, or forearm. As a result of the fracture, the elderly adult is likely to be forced to endure several weeks or months of bed rest or reduced physical activity. During this period, the lack of weight-bearing exercise will result in further loss of bone mineral density, muscle mass, strength, and ability to perform ADL. For some frail elderly, this period of inactivity may even prove fatal (4, 11).

What mechanisms underlie the decline in neuromuscular, and hence functional, performance commonly seen with advanced age? Obviously one factor is muscle atrophy (5, 8). As it is well demonstrated that the cross-sectional area of muscle is proportional to the force (strength) produced (3), age-related reduction in muscle mass obviously contributes to decreases in strength. However, the reduction in strength tends to be greater than that of the muscular atrophy (3). Hence, changes at the level of the motor unit (MU) have been proposed to be partly responsible (3, 9). These MU changes include the selective death of fast twitch MU, a reduced ability to recruit the remaining fast twitch MU, and increased coactivation between agonist and
antagonistic muscle groups. Therefore resistance training appears to be a tool that can be used to improve muscular hypertrophy and strength in older adults.

■ Resistance-Training Adaptations

Resistance training has been demonstrated to elicit morphological and neural adaptations in both young and elderly adults (1, 4–9). The morphological adaptations associated with resistance training include enhanced muscular hypertrophy (via an increase in muscle fiber cross-sectional area) and specific tension (the intrinsic capability of muscle fibers to produce force). Chronic neural adaptations arising from resistance training may include an increased ability to recruit fast twitch MU, improved intra- and intermuscle coordination, as well as decreased MU firing rate variability and coactivation (3, 9). Ultimately, these morphological and neural adaptations appear to be responsible for the increased strength observed in elderly adults who have participated in resistance training programs (6–9).

To date, the majority of training studies performed on elderly adults have been concerned with determining the effect of training on muscle function (e.g., muscular strength or aerobic power). Although these measures are important, the pertinent question is whether increases in these measures of muscle function translate to an improvement in the elderly’s ability to perform ADL.

The limited number of studies that have investigated the relationship between changes in muscle function and performance of ADL have shown that an increase in muscular strength improves ADL proficiency (4, 7–10). For example, significant improvements in the elderly’s walking speed, sit-to-stand speed and postural stability have been reported as a result of both short- and long-term training (4, 7, 8). Therefore, older adults with compromised lower-body strength may improve mobility and stability and thus, independence and quality of life, by simply increasing lower-body strength. An increase in lower-body strength and postural stability may also reduce the incidence of falls in this population (4, 8).

Resistance training can also enhance fine motor control in elderly adults (9, 10). Patten and Kamen (9) reported significant improvements in the force control and strength of the dorsiflexors for elderly adults who performed dorsiflexion force modulation tasks for 3 sessions per week over a period of 2 weeks. This enhanced control and strength of the dorsiflexors may translate to greater toe clearance during the swing phase of gait, thus enabling elderly adults to reduce their incidence of trips and to increase their ability to climb stairs and maneuver around or over obstacles (9). Similarly, Ranganathan et al. (10) reported that older adults who performed resisted coordination training with their fingers, 6 times per week for 8 weeks, significantly improved hand steadiness and finger-pinching force control. These improvements in hand steadiness and force control are indicative of enhanced upper-limb dexterity (10), which may allow the older adult to improve their ability in ADL such as sewing, woodwork, writing, and carrying a tray of drinks.

In contrast, some studies have reported no significant improvement in the ability to perform a number of ADL even though significant increases in strength were observed. This lack of association between changes in strength and proficiency in ADL may be a result of several factors. These may include the age and functional status of the elderly adults before the training intervention and the reliability or validity of the ADL tests. Perhaps, and even more importantly, the training program used also influences the results obtained. Thus, factors such as the contraction-type (isoinertial, isokinetic, or isometric), form of resistance (free weights, machines, or elastic bands), biomechanical specificity of the exercises to the ADL, frequency, sets, and repetitions, may all contribute to the varying results reported. Therefore, the reader must consider these factors when determining the effectiveness of resistance training for improving ADL in older adults.

Regular resistance training also may have considerable benefit on the psychological well-being of elderly adults. These psychological adaptations may include enhanced morale and self-efficacy as well as reduced depression (4, 8). Therefore, irrespective of morphological or neural adaptations, an improvement in psychological health resulting from resistance training may contribute to an improved ability to perform ADL (4, 8).

■ Exercise Guidelines

Although recent research indicates that resistance training has many benefits for the older adult, is resistance training safe for this population? According to Fatarone Singh (4), no serious medical complications, e.g., heart attack or hypertension, have occurred in the numerous resistance-training studies involving frail elderly adults, where medical screening, supervision, and instruction were provided. Similarly, it appears that 1 repetition
maximum testing also could be safely conducted on elderly adults if proper medical precautions such as proper medical screening and sufficient supervision are available (2). Consequently, resistance training appears well tolerated by healthy older adults when assisted by qualified strength and conditioning personnel.

Each elderly adult should be screened by a medical practitioner for any cardiovascular or musculoskeletal conditions that may be aggravated by resistance training. Based on the medical practitioner’s report, the strength and conditioning coach can design an appropriate training program to suit the client’s needs, while not aggravating existing injuries or medical conditions.

The training program should involve exercises for all major muscle groups of the body, with an emphasis on multi-joint, free-weight exercises, as improvements in these exercises may have greater transfer to performance of ADL (1). Thus, squats, deadlifts, lunges, presses, and rows should be regarded as the core lifts in the training program (1). However, it would be prudent for the elderly adult to demonstrate proficiency of simpler, biomechanically similar exercises (e.g., Smith machine squats, lunges, and presses) before attempting free-weight versions. All resistance-training exercises should be performed in a smooth, controlled manner through the range of motion that the elderly adult feels comfortable performing. Although maintaining proper technique is crucial, the elderly lifter should also strive to increase the weights that they use in the core lifts.

**Conclusions**

In summary, aging is characterized by changes within the neuromusculoskeletal system that reduce muscle function and the ability to perform ADL. However, resistance training can partly counteract the effects of aging and restore muscle function. Recent studies demonstrate that resistance training can improve performance in ADL that require gross- or fine-motor control of the lower- or upper-body musculature. Thus, resistance-training programs that include free-weight, multi-joint exercises for the upper- and lower-body should be prescribed for elderly adults, especially those who are identified as having difficulty in performing many ADL.

As professionals, we need to inform other health care professionals and members of the public of the benefits that resistance training has for the older individual. We also have a duty to assist the elderly adult in reaping the full benefits of resistance training. ▲

**References**


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