RESISTANCE EXERCISE PRESERVES PHYSICAL FUNCTION OF OLDER ADULTS—IMPLICATIONS FOR STRENGTH AND CONDITIONING PROFESSIONALS

VICTOR TRINGALI, MS, CSCS,*D

INTRODUCTION

By the year 2050, the United States will experience considerable growth in its older population (6). The baby boomers, who began turning 65 in 2011, are largely responsible for what has been described as the "graying of America" (2,6). This considerable demographic shift in American society has been accompanied by a coinciding change in attitudes towards physical activity across the lifespan. The idea that physical activity should be practiced regardless of age or gender has been coupled with the promotion of personal fitness in older adults (2). Biological changes due to aging may reduce an individual's physical capabilities. Consequently, these physical limitations may have negative effects on movement, fitness, and engagement in various forms of physical activity, along with a heightened risk of injury or medical complications. The purpose of this article is to describe the utility of resistance exercise for the preservation and improvement of physical function among active older adults. Additionally, programming considerations will be provided based on existing literature.

BIOLOGICAL AGING

Aging is a complex process characterized by structural and physiological changes in various systems of the body, which result in a progressive deterioration of fundamental fitness qualities. Ordinarily, age-related reductions in physical function begin between the ages of 40 – 50 years and are largely attributed to decreases in aerobic and musculoskeletal capacity. Between the ages of 30 – 65 years, muscular strength and endurance deteriorates by 25% and aerobic capacity declines by 40% (3).

Age-related loss of muscle strength is a particularly important physiological change as it has been associated with impairments in gait speed, balance, muscle coordination, and delayed time to completion for a variety of functional performance tasks (3,7). As a result, older adults display reduced work output and the inability to perform or sustain the necessary exertion when performing physically demanding activity. Therefore, when exposed to higher intensity efforts, older individuals become increasingly vulnerable to injury due to overexertion and fatigue (3). Consequently, injuries are more likely to occur among older adults when they are performing physical activities (1). Insufficient muscular strength has been linked to increased exposure to injuries and musculoskeletal disorders, which have been shown to increase substantially with age (3).

Despite the fact that older individuals experience a decline in physical capacity as they age, many continue to work in physically demanding roles and participate in recreational physical activity. These older adults are at particular need for health promotion strategies that assist in preserving their physical capabilities. Interventions that maintain muscular strength may play a vital role in conserving physical abilities to match the demands of activity, thereby, reducing risk of injury among the active and aging adult.

RESISTANCE EXERCISE IMPROVES STRENGTH AND FUNCTIONAL PERFORMANCE

Resistance training can be of great value, not only for athletes, but also for anyone interested in optimizing health and longevity. Numerous research studies have shown that properly designed resistance training programs can improve muscle mass and

function, and numerous markers of fitness among older adults (7,8,9). In turn, resistance training may be a viable intervention to improve performance and mitigate the decline in muscle strength among older adults. In a randomized controlled trial conducted in 2014, older subjects performed an undulatory total body resistance training program three times per week for 16 weeks. Individuals in the resistance training group showed a mean increase in strength of 54.15% in the lower limbs and 30.95% in the upper limbs (8). Whereas, a non-training control group showed no significant change in either upper or lower limb strength (8). Similarly, a 2015 study to determine the effects of training among previously untrained older men found that a 20-week moderate-intensity resistance training program performed twice weekly resulted in significant improvements in maximum isometric leg extension force and maximum leg press strength versus no changes in a comparison non-training group (10). These findings were further supported by a 2014 study which reported a 23% increase in knee extensor strength among older adult subjects who performed six weeks of twice weekly moderate-intensity resistance training workouts. Those in the resistance training group also displayed significant increases in muscle mass and function, and improved performance on numerous tests of functional strength (7). These associations reinforce the belief that resistance training can be a useful strategy to combat the physical decline associated with aging, and consequently, improve performance on a variety of physically demanding activities.

TABLE 1. STRENGTH TRAINING DIFFERENCES BETWEEN HEALTHY, SEDENTARY, AND MEDICALLY RESTRICTED ADULTS

CLIENT	STRENGTH TRAINING
Healthy Adult (No cardiovascular risk factors)	2 – 3 days/week 70 – 80% 1RM Full body 6 – 8 repetitions 3 – 4 sets
Sedentary Adult (1 – 2 cardiovascular risk factors)	2 – 3 days/week 60 – 70% 1RM Full body 8 – 12 repetitions 2 – 3 sets
Medically Restricted (Displays a major cardiovascular risk factor, such as stroke, diabetes, heart attack, or major surgery, within past six months)	2 – 3 days/week 50 – 60% 1RM Full body 12 – 15 repetitions 1 or more set(s)

TABLE 2. SAMPLE STRENGTH TRAINING PROGRAM FOR SEDENTARY ADULT

EXERCISE	NUMBER OF REPETITIONS	NUMBER OF SETS
Chair squat	8 – 12	2 – 3
Glute bridge	8 – 12	2 – 3
Wall push-up	8 – 12	2 – 3
Standing banded row	8 – 12	2 – 3
Standing banded hip abduction	8 – 12	2 – 3
Standing banded lat raise	8 – 12	2 – 3
Standing banded biceps curl	8 – 12	2 – 3

EXERCISE PROGRAMMING CONSIDERATIONS FOR OLDER ADULTS

The probability of developing disease increases throughout the lifespan, making older adults more likely to be affected by existing health conditions, such as arthritic dysfunctions, limited mobility, and cardiovascular and metabolic disease (5). As such, a comprehensive health assessment of an older adult may be especially critical as this provides the strength and conditioning professional a baseline of vital statistics. Strength and conditioning professionals should consider a review of health history that includes biometric data collection and biomechanical analysis in addition to gaining prior approval from the client's physician before prescribing an exercise program (11). When constructing an exercise protocol for older adults, it is also important to consider the various training-related variables which are represented herein.

EXERCISE SELECTION

Resistance exercise machines may be the preferred modality for older adults who are unfamiliar with resistance training. This is because machines generally require less skill to perform and the fixed path of movement may make them inherently safer for the user (11). Weight machines may also be more time-efficient, as the time required to reposition a pin in a weight stack or selecting a resistance from a dial is comparably less than the time needed to load and unload a barbell. In the event that weight machines are inaccessible, elastic resistance training devices may be used. Elastic resistance devices may be a more practical solution due to their portability while also allowing the user to self-regulate intensity and range of motion (5). As the individual progresses and improves their physical functional capacity, free weights can be incorporated.

The resistance training protocol should be well-rounded, with all major muscle groups (e.g., chest, back, arms, shoulders, legs, abdomen) incorporated into the program (11). One or two exercises per muscle group is adequate for the beginner and intermediate with an emphasis placed on performing multi-joint exercises (11). Multi-joint exercises are those in which more than one joint is involved in the movement (e.g., chest press, overhead press, rowing, leg press).

FREQUENCY

Training frequency refers to the number of times within a given timeframe (e.g., calendar week) that a resistance training program is completed. It has been recommended that older individuals train 2 – 4 days per week, utilizing a program structure that allows a minimum of 48 hr between training sessions (11). The training program may be arranged by incorporating exercises for all muscle groups during each training session (total body) two or three days per week. As the individual acquires more training experience and physical fitness, an alternative approach might be employed where selected muscle groups are exercised on one or two days a

week while the remaining muscles are trained on a separate one or two days (11).

SETS

It is recommended that the individual start with one set of each exercise as they become familiarized with the training program before progressing up to as many as three sets when it has been determined appropriate by a strength and conditioning professional (4). When multiple sets are employed, a sufficient interset rest interval should be taken. A 2 – 3-min rest period between sets has been advocated as sufficient enough to avoid excessive fatigue while allowing the remaining sets to be performed with appropriate form and greater intensity of effort (11).

INTENSITY AND REPETITIONS

Intensity refers to the amount of weight being lifted and is often expressed as a percentage of the maximum amount of weight that can be lifted for one repetition. For example, if an individual who has a maximum effort of 100 lb on an exercise performs a set with 70 lb, they would be training at an intensity of 70% of one-repetition maximum (1RM). The number of repetitions that one can perform is inversely related to the exercise intensity. For instance, an intensity of 60% generally equates to 16 – 20 repetitions, 70% is 12 – 13 repetitions, 80% is 8 – 9 repetitions, 90% is 4 – 5 repetitions, and 100% is one repetition. Previous recommendations have suggested that older adults may benefit from training at an intensity of 65 – 75% of 1RM, which would allow the individual to perform an adequate amount of weight to complete approximately 10 – 15 repetitions (4). This range is capable of eliciting increases in strength while simultaneously decreasing the risk of musculoskeletal injury that often coincides with higher intensities of resistance training (11).

CONCLUSION

Aging is generally associated with a decline in physical function, which is attributed to a progressive loss of muscle strength. However, biological age is not a reason to avoid pursuing a physically active life. Older adults who desire to remain physically active at work, recreation, or sport can improve muscular strength, physical performance, and injury prevention if engaged in a properly designed resistance exercise program. Strength and conditioning professionals are encouraged to place a strong emphasis on appropriate screenings and important training-related variables when designing and prescribing resistance exercise for older adults. The programming considerations presented herein may serve as a useful reference for strength and conditioning professionals working closely with active older adults.

REFERENCES

1. Bande, R, and López-Mourelo, E. The impact of worker's age on the consequences of occupational accidents: Empirical evidence using Spanish data. *Journal of Labor Research* 36(2): 129, 2015.

2. Gard, M, Dionigi, R, Horton, S, Baker, J, Weir, P, and Dionigi, C. The normalization of sport for older people? *Annals of leisure research* 20(3): 253-272, 2017.

3. Kenny, GP, Groeller, H, McGinn, R, and Floris, AD. Age, human performance, and physical employment standards. *Applied Physiology, Nutrition, and Metabolism* 41(6): S92-S10, 2016.

4. Law, TD, Clark, LA, and Clark, BC. Resistance exercise to prevent and manage sarcopenia and dynapenia. *Annual Review of Gerontology and Geriatrics* 36(1): 205, 2016.

5. Martins, WR, Safons, MP, Bottaro, M, Blascyk, JC, Diniz, LR, Fonseca, RMC, et al. Effects of short term elastic resistance training on muscle mass and strength in untrained older adults: A randomized clinical trial. *BMC Geriatrics* 15: 99, 2015.

6. Ortman, JM, Velkoff, VA, and Hogan, H. An aging nation: The older population in the United States. United States Census Bureau, Economics and Statistics Administration, US Department of Commerce, 2014.

7. Pinto, RS, Correa, CS, Radaelli, R, Cadore, EL, Brown, LE, and Bottaro, M. Short-term strength training improves muscle quality and functional capacity of elderly women. *Age* 36(1): 365-372, 2014.

8. Santos, GM, Montrezol, FT, Pauli, LS, Sartori-Cintra, AR, Colantonio, E, and Gomes, RJ. Undulatory physical resistance training program increases maximal strength in elderly type 2 diabetics. *Einstein (São Paulo)* 12(4): 425-432, 2014.

9. Scanlon, TC, Fragala, MS, Stout, JR, Emerson, NS, Beyer, KS, Oliveria, LP, and Hoffman, JR. Muscle architecture and strength: Adaptations to short-term resistance training in older adults. *Muscle and Nerve* 49(4): 584-592, 2014.

10. Walker, S, Peltonen, H, and Häkkinen, K. Medium-intensity, high-volume "hypertrophic" resistance training did not induce improvements in rapid force production in healthy older men. Age 37(3): 41, 2015.

11. Willoughby DS. Current comments are official statements by the American College of Sports Medicine concerning topics of interest to the public at large. Indianapolis, IN: American College of Sports Medicine, 2015.

ABOUT THE AUTHOR

Victor Tringali is currently employed by the University of Virginia, where he is responsible for design and administration of wellness programming for more than 28,000 University of Virginia and University of Virginia Health System employees. Tringali previously served as the Executive Director of University Wellness at Drexel University, where he innovated a nationally-acclaimed wellness initiative aimed at improving the health and productivity among faculty and staff members. Tringali has received numerous awards and recognition for his achievements in many facets of health promotion and fitness, and has expertise and interest in improving health and fitness among aging and working populations. Tringali is currently working to complete a Doctorate in Health and Physical Activity degree at the University of Pittsburgh.

CONFLICT OF INTEREST STATEMENT

Conflicts of Interest and Source of Funding: The authors report no conflicts of interest and no source of funding.