Issue Brief

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Growing Older, Staying Strong

Preventing Sarcopenia Through Strength Training

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Preface

Sarcopenia is a significant yet overlooked problem in the older population. Analogous to the loss of bone mass commonly known as osteoporosis, sarcopenia is the loss of muscle mass, which results in the loss of strength. Like osteoporosis, sarcopenia can have devastating consequences for an older individual, who can experience difficulty bathing, dressing, or other daily activities. Sarcopenia puts older persons at risk of sustaining a fall or simply being unable to care for themselves. Ultimately, this may require nursing home care.

Clearly, it is in the interest of both older persons and of society as a whole that older persons maintain muscle mass and strength as they age. This issue brief highlights the problem of sarcopenia and offers recommendations for older people to enable them to avoid muscle wasting. While this issue brief focuses on the role of the individual, it is clear that the federal government, which is the primary financer of health care for older people, has an interest in reducing the prevalence of sarcopenia as well. Additional research into issues such as the biological underpinnings of sarcopenia and effective interventions to reduce or reverse the condition is critical as we prepare for a growing number of older people who will be living longer. Given the current sedentary nature of the population, the need to address sarcopenia is becoming an increasingly important public policy issue.

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Preventing Sarcopenia Through Strength Training

By Michael J. Hewitt, Ph.D.

Introduction

Sarcopenia is a fairly new term for a very old phenomenon, the loss of lean body mass and strength with aging. Lean body mass, or simply lean mass, is the weight of all tissue present in the body excluding the fat. Comprised primarily of bone, muscle, water, and organ, lean mass is highly predictive of strength, mobility, and metabolic rate in individuals. Irwin Rosenberg, M.D., of the Jean Mayer Human Nutrition Research Center on Aging at Tufts University, coined the term sarcopenia (literally *flesh loss*) only as recently as 1988. By giving a name to this common but inadequately studied phenomenon, he hoped to influence the scientific community and the National Institutes of Health (NIH) to recognize the functional significance of a decline in lean mass and to encourage research leading to a better understanding of the causes and prevention of sarcopenia. In his campaign to bring sarcopenia to the forefront of clinical attention, Dr. Rosenberg emphasized his belief that "there may be no single feature of age-related decline that could more dramatically affect ambulation, mobility, caloric intake, and overall nutrient intake and status, independence, breathing, etc." than sarcopenia (Rosenberg, 1989).

*Sarco*penia is the lean mass analog to *osteo*penia, the loss of bone mineral content or density, also associated with aging. Osteopenia, if not treated, may result in osteoporosis, in which bone mass is reduced to the point that the bone becomes fragile and prone to fracture. Because bone tissue is a constituent of lean mass, sarcopenia and osteopenia are closely linked, are often simultaneously present, and respond to some similar methods for prevention and treatment. However, while the prevention and treatment of osteopenia and osteoporosis have been the focus of numerous scientific studies, the prevention of sarcopenia has not. This is especially unfortunate because the functional significance of muscle wasting may be even greater than that of osteopenic bone loss.

Prevalence and Impact of Sarcopenia

At its most basic, loss of lean mass in the quadriceps and gluteal muscles of the lower body makes rising from a chair difficult. Young people usually need about half of their strength, but for many older adults this basic activity requires more than 100 percent of their strength reserves, forcing them to sit only in armchairs. When a person cannot effectively rise from the bathtub or toilet, independence is diminished and often jeopardized. Other associated functional impairments include a suppressed metabolic rate, slow gait, stair-climbing limitations, compromised balance and increased risk of falls.

Based on data collected during the 1997 New Mexico Aging Process Study and the 1998 New Mexico Elder Health Survey, sarcopenia was present in about 13 percent of men and 8 percent of women under 70. By age 75, prevalence was about 17.5 percent for both sexes. Sarcopenia may affect more than 50 percent of the oldest old. However, as suggested

by John Morley, M.D., a researcher in aging at the St. Louis University School of Medicine, and his colleagues in New Mexico and Boston, "the magnitude of the public health problem posed by sarcopenia is not well established" (Morley et al. 2001).

The mechanism responsible for muscle loss is not fully understood. Nonetheless, there is a substantial body of knowledge related to strength training in older adults that has demonstrated significant, if not remarkable, increases in strength and the muscle cross-sectional area following very short-term exercise programs.

Strength Training Outcomes in Older Adults

Some of the classic strength-training studies with older adult subjects include a 12-week progressive resistance training program in 60- to 72-year-old men (Frontera et al. 1990) and an eight-week program in institutionalized 87- to 96-year-old men and women (Fiatarone et al. 1990). Both studies observed similar responses: The researchers noted an average strength increase of 174 percent and a 10 percent increase in muscle area in just eight to twelve weeks. Heel-toe walking speed, an indicator of balance, improved by almost 50 percent in the older group. Subsequent work by Fiatarone in a larger sample of older adults (37 men and 63 women, mean age 87 years) demonstrated a 113 percent increase in muscular strength and nearly a 12 percent increase in gait velocity in the exercise groups over the ten-week training program. In the same sample, stair-climbing power improved about 28 percent in the exercisers compared to less than 4 percent in the controls.

Controlled-trial longitudinal studies demonstrating that resistance training can prevent sarcopenia have yet to be completed, but there is early evidence that this will be the case. Regardless of age, it is in everyone's best interest to add strength training now to weekly routines for flexibility and cardiovascular health.

Principles of Strength Training

There are nearly as many programs to improve strength as there are health and fitness professionals. While this may make selecting the ideal strength program confusing, it is important to realize that there are many safe and effective ways to increase strength and muscle function. There are, however, some basic tenets common to most strength training programs: the concepts of *overload, balance,* and *sequence*.

Overload

Adaptations in skeletal muscle occur when the tissue is challenged. Whether enhanced strength occurs by increasing the size of individual muscle fibers (hypertrophy), increasing the number of fibers (hyperplasia), or by improving the nerve signals to the tissue, optimal improvements require overloading the muscles. In strength training, a *set* is a number of *repetitions* of the lifting motion. Two sets of eight repetitions means a weight (load) is lifted eight times, followed by a brief rest, then lifted another eight times. The load may be applied via strength machines at a health club or fitness center, hand-held barbells or dumbbells, elastic resistance bands or tubes, or even body weight, as in push-ups and pull-ups. The best method is usually dictated by what is available or most convenient.

A common strength program is built on three sets of 8 to 12 repetitions. Because the load must be sufficient to challenge the muscles, literally to *overload* them, the individual is encouraged to lift to fatigue without sacrificing lifting form. Fatigue does not mean complete exhaustion, pain, or injury, but rather that the individual has reached the end of her ability to do another repetition well. Thus, two sets of 8 to 12 means reaching fatigue two times within 8 to 12 repetitions. If a person cannot perform eight repetitions, the load is too heavy. If she can perform 13, more weight is required. Muscles challenged to fatigue may require 48 hours or more to respond to exercise; after 72 hours of inactivity, benefits begin to decline. Unlike cardiorespiratory activity, which can be performed every day, strength training should be performed two or three nonconsecutive days each week.

The American College of Sports Medicine (ACSM) recommends a minimum of one set of 8 to 12 repetitions, performed two to three nonconsecutive days each week to improve both strength and muscle endurance. A second or third set will bring about additional strength gains, and four sets will elicit maximal benefit. People over 50 to 60 years of age who are beginning a strength-training program and frail individuals may find slightly lighter weights and 10 to 15 repetitions more appropriate.

Balance

There are numerous strength exercises to challenge each muscle group. For example, the pectoralis muscles of the chest may be exercised by bench presses, chest flies, push-ups, incline or decline presses, and several other lifts. Selecting just one of these options is sufficient to improve chest strength, although athletes and serious body builders will typically do several different lifts for each muscle group. It is important to know that human skeletal muscles (those that move the skeleton, as opposed to those involved in swallowing, breathing, and pumping blood) are always arranged in pairs. This is because muscles can only pull as they contract. One muscle of the pair pulls to bend the joint (flexion), and its antagonist pulls to straighten the joint (extension). Without going into the complexity of human muscular anatomy, one can design a balanced program by pairing every *pulling* lift with an opposite *pushing* action. The biceps curl, for example, should be paired with a triceps extension, or an abdominal curl paired with a back extension. The human body has hundreds of skeletal muscles, but few of us have the time or inclination to perform hundreds of strength exercises. A single-joint lift such as the biceps curl is an exercise that flexes or extends one joint and works one or a few muscles. A multijoint lift flexes or extends two or more joints and can efficiently work multiple muscle groups at the same time. The squat, for example, extends the legs at the knee *and* the hip and works the quadriceps, hamstrings, and gluteal muscles simultaneously.

Although the ACSM recommends that an ideal program include eight to ten exercises involving the major muscle groups of the hips, legs, chest, back, shoulders, arms, and abdomen, just a few multijoint lifts can make up a compact and effective strength program. One such program is the *Key 3*®, which includes wall squats, chest presses, and the single-arm row, and challenges approximately 80 to 85 percent of the body's muscle mass in just three lifts using hand-held dumbbells (see Figures 1-3). Once mastered, two sets of the *Key 3*® can be completed in about ten minutes.

Sequence

There is a safe and optimally effective sequence for strength training. The large muscles should be exercised first, followed by the smaller muscles, and the postural muscles should always be exercised last. The postural muscles of the lower back and abdomen allow one to support and stabilize the trunk. If they have been challenged to fatigue, the risk of back injury when other lifts are attempted is increased. The small muscles of the arms and shoulders are often partially involved in the exercises for the larger muscles of the chest and upper back. A bench press, for instance, primarily works the pectoralis muscles of the chest but also involves a triceps extension. If the triceps muscles have

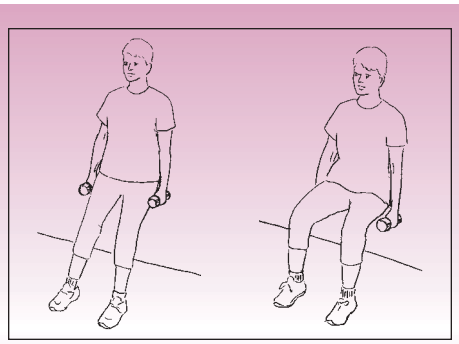

Figure 1: Wall Squats
Stand with back against smooth wall, feet shoulder-width apart and about 1½ foot lengths from wall. Maintain slight bend in knees and hang arms freely at sides. Slowly slide down wall until knees approach but do not exceed 90 degrees. Press upward until legs are nearly straight. Repeat.

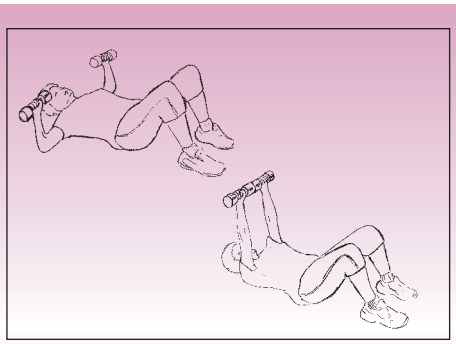

Figure 2: Chest Presses
Lie bent-knee on back with arms perpendicular to trunk. Hold hand weights directly over elbows. Slowly press hands toward ceiling bringing weights together in a triangular motion. Lower slowly and repeat.

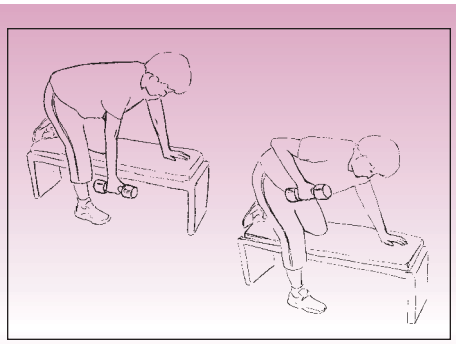

Figure 3: Single Arm Row
Place one hand and one knee on bench or edge of chair with other foot on floor. Keep back flat and parallel to floor. Let a hand weight hang directly below shoulder. Slowly raise weight to just under shoulder, keeping elbow close to side. Lower slowly and repeat. Reverse position to work opposite side of body.

already been fatigued by a triceps-specific lift, they may lack the endurance to allow the larger and stronger muscles of the chest to be challenged. If the chest is worked first, the large muscles are effectively challenged and the smaller triceps muscles will have been partially fatigued. A subsequent triceps exercise can finish the job.

Consulting with an exercise professional is always a good idea and can result in a compact and effective strength-training program. It would be unfortunate, however, if individuals did not exercise their muscles because such a consultation was not possible. Strength training is neither difficult nor dangerous; it is simply an efficient form of manual labor. As long as one does not hold his or her breath, which can elevate the blood pressure, or attempt to lift very heavy weights too soon, the important health benefits far outweigh the small potential for injury.

Recommendations

The prevention of sarcopenia is as important as is the prevention of osteoporosis to long-term health, function, and independence. In addition to a regular program of cardiorespiratory exercise such as walking, bicycling, swimming, dancing, or numerous other options, and a brief stretching program, every adult should consistently perform some type of strength training at least two times every week. Whether through a sophisticated machine and free-weight program under the guidance of a personal fitness trainer, or a simple and compact *Key 3*® program using hand-held weights in one's home, the muscles must be regularly exposed to a strength challenge. Two days per week is adequate, and a single set of 8 to 12 or 10 to 15 repetitions to fatigue is recommended. If time, energy, and interest permit, a third session each week and an additional set or two will increase the rate of adaptation and ultimately result in greater strength gains. Any strength program, however, is better than none, and any activity requiring more strength than one is doing now will reduce the likelihood and severity of sarcopenia.

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