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Resistance Training: Health Benefits and Recommendations

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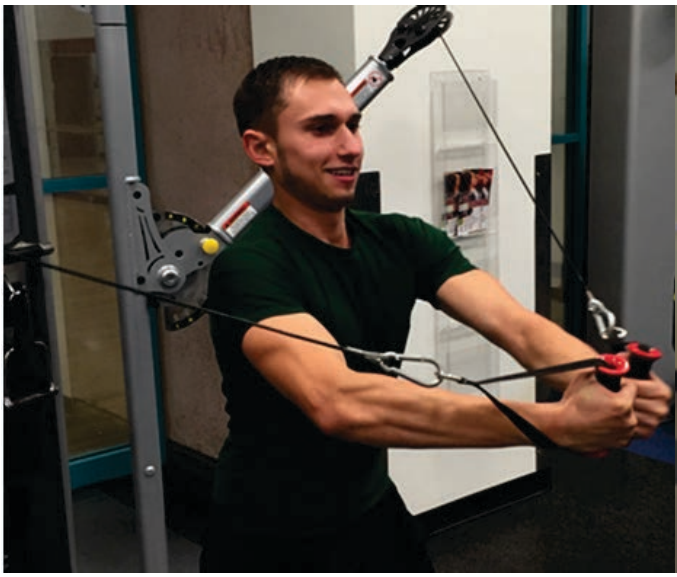


Resistance training, also known as strength training / exercise, has been growing in popularity in recent years. Resistance training is a form of physical activity that has been traditionally perceived as a component of training programs limited to athletic individuals and competitive weightlifters seeking to improve performance. However, this conception is no longer true. Extensive research reveals that not only is resistance training an effective method for improving muscular strength, endurance, and power, but it is also effective for improving the health status of most individuals – not only competitive athletes [1]. Also, it is a vital part of a balanced physical activity routine that includes aerobic and flexibility activities [2]. This article provides information about the health benefits and recommendations for the enhancement of strength, muscular fitness, and improvement of one's ability to perform tasks and reducing the risk of injury using resistance training.

What is Resistance Training?

Resistance training is any physical activity that causes the muscles to work against an additional force or weight (this concept is called resistance). There are essentially two different types of resistance training exercises:

1. Isotonic exercise – these exercises involve any movement of your muscle groups (legs, arms, stomach, back, etc.) against some type of resistance (examples: lifting barbells, dumbbells, exercise using resistance bands, or body weight exercises including pushups and sit-ups).
2. Isometric exercise – these exercises do not involve movement of the joint itself, but instead the muscle group is held still in place against the resistance (examples: plank holds, wall sits, holding grocery bags, etc.)

Both forms of resistance training can be used to firm and strengthen muscle. As the muscle strengthens, the amount of resistance can also increase, encouraging further muscle building and strength. Any muscle group can benefit from resistance training.

Health Benefits of Resistance Training

Resistance training can be effective in the development of muscular strength, muscular endurance, and muscular mass, in a broad range of people, including women and older adults. As older adults age, they lose muscle mass and quality (less strength for the same muscle mass), a condition known as sarcopenia. Resistance training can help slow down the loss of muscle mass

by continually rebuilding muscles. Resistance training also enhances muscle strength, which protects joints and improves stability and balance, reducing the risk of falls.

Resistance training can be a great tool to help older people prevent fractures that occur due to falls. Regular resistance training will increase muscle and bone strength, as well as bone density, leading to strong bones and more protection against fall fractures. Resistance training programs designed for older adults, such as *Stay Strong Stay Healthy (University of Missouri, Extension)* also support a better quality of life by promoting independence and contributing to the maintenance of functional abilities [3].

Research demonstrates that resistance training may decrease the risk of heart disease by lowering body fat, decreasing blood pressure, and improving cholesterol level [1]. The American Heart Association recommends resistance training as a component of a comprehensive exercise program (not a replacement for aerobic exercise in a program) designed to help meet the health and fitness goals for people with and without heart disease [4].

Resistance Training Guidelines

Current exercise guidelines recommend the inclusion of resistance training for healthy persons of all ages. *Physical Activity Guidelines for Americans* recommends all adults participate in moderate or high intensity resistance training two or more days a week. Children and adolescents are recommended to resistance train at least three days a week [2]. In 2011, the American College of Sports Medicine (ACSM) published research-based guidelines for resistance training using machine-based exercises and free weights (examples: dumbbells and barbells) [5]. The guidelines are summarized here and in Table 1.

Frequency:

For general health and fitness programs, the ACSM recommends doing a resistance training program 2-3 non-consecutive days per week that works on each major muscle group.

Intensity:

There are three recommended levels of intensity for strength improvement: 1) experienced individuals can work at a resistance load at hard to very difficult, 2) novice-to-intermediate individuals should exercise at a moderate to hard intensity, and 3) older or frail individuals initiating a resistance training program may begin a resistance load at a very light to light intensity. It is important that those in the early stages of resistance training perform the exercises at a light to moderate intensity level. This will allow time for the muscles to adapt and for learning good techniques and form, thereby improving balance and reducing muscle soreness and risk of injury.

Repetitions:

For most adults, the selected resistance/weight (intensity) should permit the completion of 8-12 repetitions for one to three sets*. For older and frail individuals, a greater number of repetitions (10-15) per set with very light intensity are recommended [4]. (*Set – a set consists of several repetitions performed one after another with no break between them.)

Resistance training programs are effective for improving bone health. For bone strengthening, two to three sets of resistance training exercises with the maximum amount of weight that can be lifted for six to eight repetitions is recommended [6, 7].

The ACSM recommends that resistance training should follow the principle of progressive overload [5]. This means that the

Table 1. Recommendations for Resistance Exercise Guidelines

Frequency (days/week)	Intensity	Repetitions	Type	Comments
2 to 3 days/week for each major muscle group	**For strength improvement:** For older or sedentary individuals, begin at a very light to light intensity; For novice-to-intermediate individuals, a moderate to hard intensity; For experienced individuals, hard to very hard intensity. **For endurance improvement:** A low level of resistance.	**For strength improvement:** For most adults, including middle age and older adults starting resistance training, 8-12 repetitions for 2-4 sets; For more frail adults, 10 to 15 repetitions for 1 set. For bone strengthening, 6-8 repetitions for 1-3 sets. **For endurance improvement:** For most adults, 15-20 repetitions for 1-2 sets.	Variety of exercise equipment (free weights, resistance machines, resistance bands, resistance tubes or body weight) can be used through the full range of motion of the joint, using proper breathing and lifting techniques.	**For strength improvement:** Rest up to 3 minutes to focus more on strength. The extra recovery time allows the muscle to work harder on the next set. **For endurance improvement:** Rest less than one minute between sets. For beginning resistance training, limit to a single set performed 2 days per week.

*Set – a set consists of several repetitions performed one after another with no break between them
References: [4], [5], [6}

weights being lifted are heavy enough to create muscular fatigue. When the amount of weight being used becomes easier, the weight can be increased. As individuals progress, the weight can continue to be increased (overload) to facilitate improvement in muscular strength and endurance.

Resistance Training Equipment

Many types of resistance training equipment can be used effectively to improve muscular fitness. Among these are free weights, resistance machines, and resistance bands. Even your own body weight can be used for resistance training. Each method of resistance training has advantages and disadvantages. Choosing one or a combination of these can help you reach your fitness goals.

Free weights:

Examples of free weights are barbells and dumbbells.

Advantages:

- Free weights can be used for many different exercises.
- Free weights allow you to train anywhere (at home or at a gym): the added convenience may increase the likelihood of performing resistance training exercises more regularly.
- You have freedom to move based on your unique anatomy, unlike the more confined movement of machines. It allows your body to move how it is naturally built to move.
- Free weights require more coordination and balance to use than machines: this helps strengthen the supporting muscles in addition to the main muscles being trained.
- If you have limited time to exercise or don't have access to a gym, free weights are a good choice.

Disadvantages:

- There is a risk of injury from dropping or improperly using barbells or dumbbells.
- Resistance training using free weights requires skills and knowledge to learn proper technique. It is a good idea to have a certified fitness trainer help you get started to prevent injury.

Resistance machines:

Many stationary resistance machines in gyms use selectable stacks of weights to change resistance.

Advantages:

- Resistance machines focus on one muscle group at a time, allowing a specific range of motion.
- Resistance machines don't require as much coordination and balance as free weights. They assist with control of movement, reducing the risk of injury.
- Resistance machines are relatively safe; as long as they are properly adjusted for the correct intensity of your training level without dramatic increases in weight/resistance or number of repetitions, and they are used at a moderate to slow controlled speed.

Disadvantages

- Cost – you must have a gym membership or access to a place with resistance machines.
- Each machine is typically limited to working just one muscle group, so several machines are needed to cover all of the muscle groups.
- When increasing weight, you must add a whole or half plate which may be too much for some individuals.
- If your body does not anatomically match the movement of the resistance machine due to height or body shape, you are more likely to injure a joint with repetitive use over time.

Resistance bands or tubes:

Resistance bands or tubes consist of elastic bands or tubes that can substitute for free weights or machines to help you build muscular strength, fitness, and bone density. They come with various levels of resistance from extra light to extra heavy.

Advantages:

- Resistance bands or tubes offer an inexpensive and portable way to get a full-body strength-training workout at home, in the office, or outdoors.
- Resistance bands or tubes can be used for many different exercises and are more versatile than free –weights [8].
- They are relatively safe and cost-effective.

Disadvantages:

- Over time, resistance bands or tubes may lose some of their elasticity.
- Resistance bands may contain latex. If you are sensitive or allergic to latex, check the package label to find out if the bands contain latex.

Resistance Band Exercise – Upper body, lateral raise. Photo courtesy of the University of Arizona, UA Life & Work Connections

Body Weight (plank holds, push-ups, squats, stomach curls, wall sit, etc.):

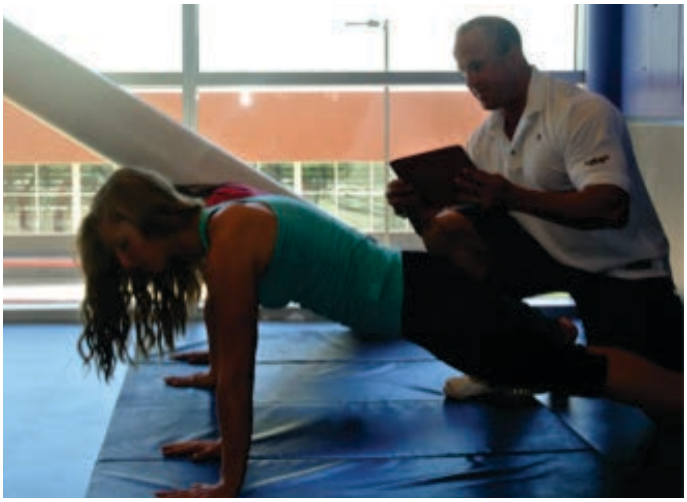
You can use your own body weight for resistance training.

Advantages:

- You can do most exercises that strengthen your body using its own weight anywhere and anytime.
- You don't need any equipment - only a small amount of space.
- It is suitable for almost anyone with minimal risk of injury.
- Many of these exercises can be found in books, videos, apps, and websites [9].

Disadvantages:

- Resistance is always equal to own body weight.



Safety – Important Precautions

Prior to beginning any exercise program, including the resistance training described in this article, you should check with your medical doctor first to make sure it is safe to start. Resistance training is not suitable for everyone. To reduce the risk of injury, it is important to learn proper techniques. Before you begin any type of resistance training exercise program, get advice from a certified fitness expert that has experience working with people in your age group. You should stop participating in any physical activity, including resistance training, that causes abnormal pain or discomfort, and immediately obtain medical consultation.

Overtraining

You may be excited to start the challenge of resistance training, but you should avoid a dramatic increase in exercise volume (frequency, intensity, and repetitions) to reduce the risk of overtraining. The ACSM recommends that a 2-3% increase in intensity is appropriate when the individual can comfortably perform the current workload for one to two sets for two consecutive training sessions.

Remember to start slowly, use proper form, avoid weights that are too heavy for your strength level, and follow the principle of progressive overload: use weights/resistance heavy enough to create muscular fatigue, and then when that gets easy, increase the weight/resistance slowly. Lift at that new weight until the same number of repetitions can be achieved. When you first add new weight/resistance, you will lift with fewer repetitions because it is heavier and harder, but as you gain muscle strength, you can perform more repetitions. The principle of progressive overload prevents injury while creating better outcomes for your training.

References

1. Cornelissen VA, Fagard RH, Coeckelberghs E, Vanhees L. (2011) Impact of resistance training on blood pressure and other cardiovascular risk factors: a meta-analysis of randomized, controlled trials. *Hypertension*. 58(5):950-958.
2. The U.S. Department of Health and Human Services. 2008 Physical Activity Guidelines for Americans. http://www.health.gov/paguidelines
3. Ball S, et al (2013) Outcomes of Stay Strong, Stay Healthy in community settings. *Journal of Aging and Health*; 25(8):1388-1397.
4. Williams MA, et al (2007) Resistance exercise in individuals with and without cardiovascular disease: 2007 update: a scientific statement from the American Heart Association Council on Clinical Cardiology and Council on Nutrition, Physical Activity, and Metabolism. *Circulation*. 2007 Jul 31;116(5):572-584.
5. Garber CE et al (2011) American College of Sports Medicine position stand. Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: guidance for prescribing exercise. *Medicine & Science in Sports and Exercise.* 43(7):1334-1359.

6. Going S, et al (2003) Effects of exercise on bone mineral density in calcium-replete postmenopausal women with and without hormone replacement therapy. *Osteoporosis International*. 14(8):637-643.

7. Zhao R, Zhao M, Xu Z. (2015) The effects of differing resistance training modes on the preservation of bone mineral density in postmenopausal women: a meta-analysis. *Osteoporosis International*. [Epub ahead of print].

8. Traywick, L, Henson T, Pickle S. (2010) Increasing Physical Activity as We Age: Strength Training With Stretch Tubes. FSFCS36. University of Arkansas Division of Agriculture Cooperative Extension Service. https://www.uaex.edu/publications/PDF/FSFCS36.pdf

9. Rice, LL. (2007) Focused on a 5K: Strong Strides with Resistance Training. HSW-LR937. University of Kentucky, College of Agriculture Cooperative Extension Service. http://www2.ca.uky.edu/hes/fcs/factshts/HSW-LR937.pdf

Abstract

Research suggests that combining resistance exercise training (also known as strength training) with an aerobic physical activity program has healthy effects on the body and on well-being. This article provides information on the health benefits of resistance training, resistance training equipment, resistance exercise guidelines, and safety issues related to resistance training.

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