

A Weighty Subject

The ergonomics of resistance training

By Tamara Mitchell

Edited by Sally Longyear



Resistance training will improve your overall health by increasing your coordination, muscle tone, bone density, and resistance to muscle, tendon, and ligament tears during everyday activities. It should be considered an important component of your fitness program.¹ It is one form of cross-training which can help you to use different muscles or use the same muscles in a different kind of movement, or both, which helps to make sure that your body is trained for a variety of activities.² Even if you don't participate in a sport or a fitness program, resistance training is a good thing to do.

Goals

One or more of the following may be reasons for you to do weight training, but each of these goals involves specific types of training. A trainer can help you design a program that is time efficient, effective, and safe, whether it's to tone up, to train for a specific sport, or to work without discomfort.

Resistance training will build the **strength** of muscles needed for anaerobic activities such as sprinting as well as activities of daily living. It will also build muscle **endurance** that improves your muscles' ability to perform with resistance over a long period of time. This is important for aerobic, long-duration activities and weight management.³ For most sports and general conditioning, some combination of the two is desired, but the specific strength and endurance exercises and ratio will vary according to your goal.

In all cases, when you first start to train with weights or when you are trying a new lift, it is necessary to focus on practicing and perfecting your technique, concentrating on the muscles you are exercising, and increasing the number of repetitions (reps) or sets of reps that you perform.^{1,4} You should lift a weight no greater than 1/4 to 1/3 of your body weight for upper body exercises and a weight no greater than 1/2 to 2/3 of your body weight for lower body exercises.¹

- **Toning and overall fitness.** If you want to tone muscle or lose weight, you will want to focus on muscle endurance, using high repetitions with a small amount of weight. Lifting heavy weights will not reduce your body size as quickly.¹ For optimal gains in muscle endurance, do three to five sets of 10 to 50 reps. Do not increase the amount of weight, but increase the number of repetitions you perform.
- **Improve bone mass density (BMD).** Recent research has led to the recommendation that a program utilizing free weights increases BMD successfully in post-menopausal women.⁶ 1.5 million osteoporosis-related fractures of the hip, spine, and wrist occur each year, with 4 out of 10 women and 1 out of 10 men developing osteoporosis after age 65. The use of free weights, greater than 75% of 1RM, of 6-10 reps and 3 sets every other day has been shown to significantly increase hip and spinal BMD. (1RM is the maximum amount of weight that can be lifted one time. 75% of this weight is the minimum to be used in this recommended program). A sedentary control group during the same year showed a decrease in BMD. The program utilized in the study consisted of knee and hip extension, lateral pull-down, back extension, and abdominal flexion exercises at 80% of 1RM.
- **Counteract the effects of aging.** Working to improve strength, especially lower body and leg strength, after 65 may help to decrease injury and improve quality of life.^{7,8} About 40% of people over 65 fall at least once per year as a result of lower body muscle weakness. A majority of older people die of hip fracture and immobility

caused by muscle weaknesses and osteoporosis. Resistance training programs throughout life can help prevent these problems and improve the quality of life in later years.

- **Sports training.** Functional weight training, discussed in more detail below, is an excellent way to improve your ability to perform a sport consistently. It builds strength and endurance of specific body parts in an integrated way. In addition, for people who regularly run, cycle, or jump rope for exercise, weight training to develop arms, shoulders, stomach and back muscles which are generally neglected in such forms of exercise is recommended.¹ Use of resistance training has been shown to decrease the injury rate of athletes, reduce the time lost from sports and aid in faster rehabilitation.⁵ This is true for “industrial” athletes who sit at a desk or computer all day, performing the hardest endurance activity ever – sitting.

Medical and Orthopedic Considerations

If you are going to participate in a weight/resistance training program, please consult with a professional who can help you design a program using proper technique. Individuals who can help you include physical therapists, athletic trainers, and certified fitness and exercise specialists who have been specifically trained in weight-training technique. Your medical history determines which type of stress your body can take without harm.¹

Discuss previous injuries, current pain and repetitive strain injury (RSI) problems with the professional who is helping you with your program. Certain types of resistance training should not be done at all by people with RSI. If you have wrist, hand, or elbow problems, for example, you should not participate in training that exerts force on these body parts such as push-ups and dips. Over-the-head shoulder presses should not be done if shoulder pain is present. “Working through” the pain to strengthen a body part while it is injured will cause further damage that may be irreparable. Resistance training can be a tool in rehabilitation once damaged tissues have healed, but it’s advisable to get a green light from your health practitioner prior to starting a rehabilitation program.

Functional weight training

Current research shows that using natural, continuous, and integrated movements incorporating the use of gravity along with your own body weight or free weights is the best approach to building strength.^{5, 9, 10} This type of strength training is called “functional training”.

Functional training has been shown to:

- Increase bone density, thereby reducing the risk of injury due to osteoporosis.
- Improve coordination through development of proprioceptive feedback mechanisms (see below).
- Develop systems of muscles rather than individual muscles, thereby reducing the risk of tears in ligaments and tendons.
- Increase the strength and power to perform throughout a range of motion for a specific sport or activity.
- Increase resting metabolic rate by increasing lean body mass so more calories will be burned during inactivity.
- Improve use of oxygen throughout the body.
- Improve appearance through overall muscle tone.

Weight Machines – Not the only choice

Use of weight machines alone are no longer considered the best way to build a strong body. Some people claim machines are useful in an integrated, functional plan, but since your body is completely supported, you do not develop balance and coordination due to the lack of proprioceptive feedback. Proprioception is the neuromuscular feedback system that gives you a sense of your body’s position, movement, and force.^{10, 12} In addition, use of weight machines as the only mode of resistance training has been shown to be less effective in improving bone density and in preventing general muscle atrophy resulting from aging.⁵ Finally, weight machines are large, expensive, and not portable!¹ If you learn resistance exercises that utilize gravity, you’ll be able to work out anywhere...unless you go to the moon!

Injury prevention

The repetitive nature of weight training and the often heavy loads involved provide fertile ground for chronic and overuse injuries.^{13, 14} Injuries while weight training generally occur due to:^{13, 15, 16}

- insufficient warm-up
- overstrain
- poor technique and concentration

- quick body-weight change
- insufficiently healed injury
- insufficient recovery (time off between workouts/overtraining)
- poor nutrition/substance abuse

Many people lift weights the way a friend showed them, or often they have had no training at all.¹⁵ After years of lifting weights incorrectly with increasing loads, repetitive strain injuries develop. This problem is magnified by the macho, competitive attitude which generally pervades gyms and weight rooms that encourages people to lift too much weight, too intensely, and for too long.¹⁴

Common overuse injuries resulting from incorrect weight lifting technique are:¹³

- *Tendon and ligament injuries* including:
 - 1) Rotator cuff injury from exercises such as upright row and military press, and the "pec deck" machines.
 - 2) Anterior shoulder instability (feelings of looseness of the shoulder or numbness of the arm) from behind-the-neck latissimus dorsi pull-downs, shoulder hyperextension during bench press and behind-the-neck military presses.
- *Skeletal disorders* of the clavical (collar bone), stress fractures of the lumbar spine, osteoarthritis, and stress fractures in the lower and upper extremities due to improper technique and heavy loading.
- *Nerve injuries* (called *Neuropathies*) such as thoracic outlet syndrome (TOC), suprascapular neuropathy, musculocutaneous neuropathy, and notaliga paresthetica. These develop over weeks or months of repetitive trauma or compression. TOC is a fairly common diagnosis among computer users due to slumping and poor posture. Weight lifting can actually increase this problem if the scalene or pectoralis muscles are overdeveloped causing impingement on the nerves and blood vessels at the thoracic outlet.

Guidelines for avoiding injury are:^{14,15}

- Have a goal for your weight training and for your overall fitness program.
- Breathe. Don't hold your breath. Blood pressure can increase to dangerous levels during weightlifting if you hold your breath. Exhale during the lift....or simply remember to breathe freely while you lift.
- Seek balance. Work all your major muscles - abdominals, legs, chest, back, shoulders and arms. Strengthen the opposing muscles in a balanced way: for example, the front of the shoulder as well as the back of the shoulder.
- Lift an appropriate amount of weight. See the discussion on endurance vs. strength training above.
- Don't rush. Don't jerk the weight up. Lift and lower the weight in a slow and controlled fashion.
- Don't grip the weights too tightly and use equipment with large grips and padding when possible. Gripping too tightly is a common cause of repetitive strain injuries. It also means that you are not focusing the intensity of the training on the muscle group intended.
- Rest. Give your body a day to recover between workouts of the same muscle group.
- Warm up and stretch to avoid muscle, tendon, and ligament tears.
- Be consistent. Three workouts a week will build muscles and just two will maintain the strength you've gained.
- Wear shoes to protect your feet, keep you from slipping, and maintain balance.
- Store weights properly and keep them away from children. Lift weights off the rack by keeping your spine stable and lifting with your whole body. Many injuries occur when people lift weights off the rack improperly!!
- Stay hydrated. Make sure you drink plenty of water before, during, and after training.

This article and all of our articles are intended for your information and education. We are not experts in the diagnosis and treatment of specific medical or mental problems. When dealing with a severe problem, please consult with a healthcare or mental health professional and research the alternatives available for your particular diagnosis prior to embarking on a treatment plan. You are ultimately responsible for your own health and treatment!

REFERENCES:

1. ***Hold It! You're Exercising Wrong***, by Edward J. Jackowski, © 1995, Fireside Books, New York, NY.
2. "Cross-Training? What's It All About?" by Denise Howard, © 1999 World Fitness
<http://www.worlffitness.org/denise1.html>
3. "Weight Training", © 2002 St. John's Hospital, <http://www.st-johns.org/programs/bonejoint/athletihints/weight.htm>
4. "Safety Precautions and Basic Gym Safety", by Chad Tackett,
<http://www.personalhealthzone.com/gymsafety.html>
5. "Weightlifting Injuries", by Steven M. Horowitz, D.C., © 1999 You Can Be Fit, Inc., Notes from presentations to the North Carolina Chiropractic Association 1st Annual Sports Symposium, July, 1999 and the Maryland Chiropractic Association, March, 2000. <http://www.sports-doc.com/weight.html>
6. "Resistance Training and Bone Health", by T. LaFontaine, *Strength and Conditioning Journal* 21(1) 11-12, © 1997. In Horowitz, above.
7. "Aging: It's Effects on Strength, Power, Flexibility and Bone Density", by K. Adams, *Strength and Conditioning Journal* 21(2): 65-77, © 1999. In Horowitz, above.
8. "Lower Extremity Rehab for the Elderly", by Kim D. Christensen, D.C., C.C.S.P, D.A.C.R.B.,
http://www.ccptr.org/KDC/new_page_6.htm
9. "Growing Old is not for Sissies", by Etta Clark, 20/20 Tape. In Horowitz, above.
10. ***Functional Training***, by RoseMarie Gionta Alfieri, © 2001, Hatherleigh Press/Getfitnow.com Books, Long Island City, N.Y.
11. "Boost Your Metabolism -- and Your Spirits -- This Holiday Season", by Tami Donnelly, R.D., C.D., 2003 Medical College of Wisconsin, <http://healthlink.mcw.edu/article/943038351.htm>
12. "What is Proprioception?", by Hazel Fish, © 2001 Imperial Society of Teachers of Dancing (ISTD),
<http://www.istd.org/features/health/proprioception.html>
13. "Weight Training Injuries: Part 2: Diagnosing and Managing Chronic Conditions", by Ronald K. Reeves, MD, Edward R. Laskowski, MD, and Jay Smith, MD. © *The Physician and Sportsmedicine*, 26(3), March 1998,
<http://www.physsportsmed.com/issues/1998/03mar/laskow2.htm>
14. "Avoiding Injuries", 2002, http://www.discoverfitness.com/avoiding_injuries/html
15. "Weight training: Avoid injury with proper muscle-building techniques", <http://www.mayclinic.com>, Fitness and Sports Medicine Center. March 6, 2002. ©1998-2003.
16. "Weightlifting Injuries", by Mauro De Pasquale, MD, © 1997-2002 CoachSOS.com,
<http://www.coachsos.com/weightinjuries.html>