

strength training for runners requires just one set of an exercise for each major muscle group, which does not take much time and does not produce much lasting fatigue, nor will it result in large muscle gains. You may also choose to strength train only one or two days per week, which should make muscle fatigue issues even less likely.

Program Design for Runners

The strength training protocol followed by the Notre Dame athletes described earlier is a comprehensive conditioning program that addresses all of the major muscle groups. This program does not attempt to imitate specific running movements or emphasize specific running muscles, but rather focuses on exercises that will increase strength in the muscle groups relied on in running. The program establishes training frequencies that reduce the possibility of overtraining, muscle imbalances, and injury.

Some people believe that runners should complete numerous sets and many repetitions with light resistance to enhance their endurance capacity. However, this is not the purpose of strength training. Remember that running is best for improving cardiorespiratory endurance and that strength training is best for increasing musculoskeletal strength.

Muscle strength is best developed by training with heavy loads and 1 to 6 repetitions, the type of loads that are used by competitive weightlifters who typically possess a high percentage of fast-twitch muscle fibers. Heavy loads are not recommended for distance runners. Instead distance runners, who usually possess a higher percentage of slow-twitch muscle fibers, will benefit more using lighter loads (60 to 70 percent of maximum resistance) that permit 12 to 16 repetitions per set. Whenever you can complete 16 repetitions using proper form in two successive workouts, increase the exercise load by 1 to 5 pounds (.45 to 2.3 kilograms). One set of each exercise is sufficient for strength development.

Perform repetitions in a slow and controlled manner. Exercising in a controlled manner maximizes muscle tension and minimizes momentum, resulting in a better training effect and reducing the likelihood of injury. Each repetition should take 4 to 6 seconds, 1.5 to 2 seconds for each lifting movement and 2.5 to 4 seconds for each lowering movement. We suggest that you train two or three times a week on nonconsecutive days. Also, it is essential to breathe on every repetition, because holding your breath can lead to undesirable increases in blood pressure and can restrict blood flow. The recommended breathing pattern is to exhale during each lifting movement and to inhale during each lowering movement.

Strength Exercises for Runners

Runners can develop muscle strength by performing a variety of exercises using free weights or machines. The following sections recommend strength training exercises for the major muscle groups, and these are listed in table 8.1 on page 210.

Leg Muscles

Although the barbell squat is the traditional leg exercise, many runners find that placing the barbell on the shoulders is uncomfortable. The dumbbell squat provides



Figure 8.1 Weighted toe raises.

an option; however, some people may find it difficult to balance well enough to perform the exercise properly or may lack the strength to hold heavy dumbbells.

If you decide not to do barbell or dumbbell squats, you can strengthen your hamstrings, quadriceps, and gluteals by doing the leg press on a machine that offers a full movement range and back support. It may be advisable to precede the leg press exercises with leg extension exercises, which target the quadriceps and with leg curl exercises, which target the hamstrings. By prefatiguing these muscle groups, you will use less resistance in the more challenging leg press exercise to achieve the same conditioning effect. One set of each exercise is sufficient, but you may perform an additional set if you desire.

Runners should conclude their strength training workouts with a set of weighted toe raises, as shown in figure 8.1, to strengthen the shin muscles (anterior tibialis) and maintain muscular balance in the lower-leg musculature (gastrocnemius, soleus, plantaris).

Upper-Body Muscles

Popular exercises for developing the upper body are bench press for the chest muscles, bent-over row for the mid- and upper-back muscles, and overhead press for the shoulder muscles. If you lack experience in performing these upper-body exercises with a barbell, dumbbell training is a good alternative. Regardless of which type of equipment you use, how you use it is very important. For instance, performing a standing bent-over row exercise, with the body from the hips to the shoulders parallel with the floor, increases stress on the low back 10 times the weight of the dumbbells or barbell. However, by using one dumbbell, and placing your other hand on a bench for back support, you can greatly reduce the stress on the lower back, thus making the exercise safer and more effective for the upper back.

If you have access to machines, do the chest crossover for the chest muscles, the pullover for the mid- and upper-back muscles, and the lateral raise for the shoulder

muscles. These machines effectively isolate the target muscle groups. If you prefer exercises that involve more arm work, the chest press, seated row, and shoulder press machines are excellent choices.

Arm Muscles

The basic exercise for the biceps muscles is the arm curl performed with barbells, dumbbells, or machines. Training the triceps involves some form of arm extension, either with free weights or machines.

A good means for working the biceps and upper-back muscles together is the chin-up with body weight or on a weight-assisted chin-up machine. A good means for working the triceps and chest muscles together is the bar dip with body weight or on a weight-assisted bar dip machine.

Midsection Muscles

Machines provide a safe method for progressively strengthening and conditioning the muscles of the midsection. Key exercises for accomplishing this outcome can be performed on the abdominal and low back machines. These exercises also develop an injury-resistant midsection. The rotary torso machine strengthens the oblique muscles surrounding the midsection.

If you don't have access to machines, the twisting trunk curl is your best alternative for abdominal conditioning. The counterpart for the low back muscles is the body-weight trunk extension. Although both of these exercises are performed with body-weight resistance, they are reasonably effective for strengthening the midsection muscles, especially when you execute them in a controlled manner.

Neck Muscles

The head, which weighs approximately 15 pounds (6.8 kilograms), is held in position throughout each run by the neck muscles. For this reason, many runners experience fatigue in the neck and shoulder muscles. The neck extension and flexion machine, listed in table 8.2, will help runners strengthen these muscles. If you do not have access to this machine, the best approach is to exercise against manual resistance: Place your hands against your forehead and resist slow neck-flexion movements as you press your head forward, and place your hands against the back of your head and resist slow neck-extension movements as you press your head backward.

Table 8.1 presents the strength training exercises for an overall conditioning program for runners. Once you have mastered the basic exercise program, you may want to add some of the complementary exercises presented in table 8.2. To perform the barbell quarter squat listed in the complementary exercises, simply reduce the depth of the barbell or dumbbell squat listed in table 8.1 by performing just one-quarter of the range of motion.

Summary for Running

The main objectives of a strength training program for runners are to decrease injuries while increasing muscular strength and running performance. To obtain these results, the workout should be short, but strenuous. One set of 12 to 16

Table 8.1 Basic Strength Training Exercises for Runners

Targeted muscle groups	Machine exercises	Free weight exercises
Quadriceps, hamstrings, gluteals	Leg press	Barbell or dumbbell squat
Gastrocnemius, soleus	Heel raise	Barbell or dumbbell heel raise
Pectoralis major	Chest crossover	Barbell or dumbbell bench press
Latissimus dorsi	Pullover	Dumbbell one-arm row
Deltoids	Lateral raise	Dumbbell seated press
Biceps	Biceps curl	Barbell or dumbbell curl
Triceps	Triceps extension	Dumbbell lying triceps extension
Erector spinae	Low back extension	Body-weight trunk extension
Rectus abdominis	Abdominal flexion	Twisting trunk curl

Table 8.2 Complementary Strength Training Exercises for Runners

Targeted muscle groups	Machine exercises	Free weight exercises
Quadriceps	Leg extension	Dumbbell lunge
Hamstrings	Leg curl	Barbell quarter squat
Pectoralis major, triceps	Weight-assisted bar dip	Body-weight dip
Latissimus dorsi, biceps	Weight-assisted chin-up	Body-weight chin-up
Internal and external obliques	Rotary torso	Twisting trunk curl
Sternocleidomastoids and upper trapezius	Neck flexion and extension	Manual resistance neck flexion and extension
Anterior tibialis	—	Weighted toe raise

repetitions for each major muscle group will provide a safe, effective, and efficient exercise experience. Two or three training sessions per week are sufficient. Each workout should take no more than 30 minutes, depending on the number of exercises you perform. The key to productive strength training is proper exercise technique, which includes performing the exercises through the full movement range and in a controlled manner. Be sure to eat enough calories to fuel your combined physical activities, including a little more protein and lots of water. Finally, try to sleep at least eight hours nightly so that you enter every exercise session with energy and enthusiasm. After following these training recommendations for a couple of months, you could see your strength increase 40 to 60 percent and your running performance improve, too.

Exercise selection	Include at least one exercise for each major muscle group.
Training load	Use a training load that is 60 to 70 percent of maximum resistance.
Repetitions	Complete 12 to 16 controlled repetitions.
Progression	Increase the resistance by 5 percent when you can complete 16 repetitions during two successive sessions. After two months, consider adding several of the exercises listed in table 8.2.
Sets	Complete one set of each exercise.
Movement speed	Complete each movement at a moderate speed, taking 1.5 to 2 seconds to lift and 2.5 to 4 seconds to lower.
Movement range	Perform each exercise through a relatively full movement range. Avoid a locked-out position on pressing exercises.
Training frequency	Complete two or three exercise sessions per week.

Strength Training for Cyclists

The bicycle is an extremely energy-efficient machine, and cycling is an excellent exercise for enhancing cardiorespiratory endurance. Like running, cycling uses the leg muscles to generate power. Unlike running, cycling does not generate landing forces to the feet, legs, and back, which reduces the risk of impact injuries. Nonetheless, cycling, like any repetitive-movement activity, stresses some muscles more than others, which may lead to overuse injuries.

Let's examine the major muscles involved in cycling. The power stroke in cycling is produced primarily by knee extension from contraction of the quadriceps muscles, and hip extension from contraction of the hamstring muscles, with some assistance from the gluteal muscles of the buttocks. Lower-leg muscles also contribute.