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Better Rowing Through Strength Training

Better Running Through Strength Training

Strength Training For Tennis

Conditioning for Rock Climbing or Hiking

Better Rowing Through Strength Training

Wayne L. Westcott, PH.D., CSCS

If you enjoy rowing, canoeing, or kayaking, then the information in this section should be most helpful for improving your rowing/paddling performance and reducing your risk of muscle overuse/imbalance injuries. The first objective is to strengthen the muscles used in these activities for more powerful rowing/paddling actions. To do this we will concentrate on those exercises that specifically address the rowing muscles. However, the second objective is to strengthen the muscles not used in these activities, especially the opposing muscle groups that must balance the prime mover muscles and maintain joint integrity throughout thousands of repetitive rowing movements. That is, you need a sound and sensible strength training program for comprehensive musculoskeletal conditioning. This will become more obvious when you realize how much musculature is actually involved in rowing/paddling activities.

Let's begin with a basic analysis of the rowing action as produced by the contributing muscle groups, and the recommended resistance exercises for strength conditioning. The first movement in sliding seat rowing is extension of the legs, starting with the muscles that straighten the knees. These are the quadriceps muscles of the front thighs, the largest and strongest muscles in the body. The second and almost simultaneous movement is extension of the hip joint, which is accomplished by the opposing hamstrings muscles of the rear thighs. The single best strength exercise for the quadriceps muscles is the leg extension, and the single best exercise for the hamstrings muscles is the leg curl (either seated or prone). The exercise that most effectively works both the quadriceps and hamstrings muscles at the same time is the leg press. As shown in Table 1, these three leg exercises should be performed first in the strength training program, as they are responsible for the initial power production of every rowing action.

The next phase of the rowing action is extension of the trunk, which is produced by contraction of the lower back muscles. Although the erector spinae muscles can become extremely strong, the lower back represents a most vulnerable area of the body for many people. You must therefore train these important muscles in a careful and progressive manner to reduce the risk of injury during the strengthening process. Without question, the best exercise for safely developing stronger lower back muscles is the low back machine. However, to ensure comprehensive midsection conditioning you should combine the low back exercise with the abdominal machine and the rotary torso machine. These three exercises address the erector spinae muscles of the rear midsection, the rectus abdominis muscles of the front midsection, and the oblique muscles (internal and external) on both sides of the midsection, respectively. All of these midsection muscles are involved in efficient force transfer from the lower body to the upper body, and should be included in each strength training session. Due to their stabilization function in essentially every strength exercise, I recommend placing the midsection exercises at the end of each workout (see Table 1).

The next aspect of the rowing sequence is the arm pulling action that actually moves the oars through the water to propel the boat forward. Although always challenging, the arm pull is much easier when it is appropriately timed to immediately follow the trunk extension movement. The prime mover muscles for the arm pull are the latissimus dorsi and teres major muscles of the upper back, the rear deltoid muscles of the shoulders, and the biceps muscles of the arms, with assistance from the large shoulder retractor muscles (upper trapezius, middle trapezius, and rhomboids). The super pullover machine is most productive for isolating the latissimus dorsi and teres major muscles, and should be followed by the compound row machine that addresses these muscles, the posterior deltoid muscles and the biceps muscles, as well as the upper trapezius, middle trapezius, and rhomboids. Additional biceps conditioning can be obtained by using the biceps machine. These exercises should be performed in the order presented in Table 1. To ensure muscle balance and joint integrity in the upper body you should also do exercises for the opposing muscle groups, namely the pectoralis major, anterior and middle deltoids and triceps. As shown in Table 1, the chest press, shoulder press and triceps extension exercises achieve this purpose and should be included in your strength training program where indicated.

All of the strength exercises should be performed 2 of 3 days per week, typically in a total body workout that can be completed in less than 30 minutes. One properly performed set of each exercise should be sufficient, with approximately one minute recovery time between successive exercises. Proper exercise performance is characterized by full movement range and slow movement speed on every repetition. I suggest taking about 6 seconds for each repetition, with 2 seconds for the more challenging lifting movement and 4 seconds for the otherwise less challenging lowering movement. Use enough resistance to fatigue the target muscles within the anaerobic energy system, generally during a range of 50 to 70 seconds. At 6 seconds per repetition, this corresponds to about 8 to 12 good repetitions per exercise set. Whenever you can complete 12 repetitions in proper form, you should increase the weightload by approximately 5 percent (or less). For most exercises, this requires adding 2 to 10 pounds, which will of course reduce the number of repetitions that you can perform, accordingly. Train with the higher resistance until you can again complete 12 repetitions, then add an appropriate amount of weight to your next workout. Keep careful records of all your training sessions for purposes of progression and motivation.

Table 1. Recommended strength exercises and training order for increased rowing/paddling power.

Exercise	Relevance	Muscle Group	Rowing
Leg extension		Quadriceps	Power production
Leg curl		Hamstrings	Power production
Leg press		Quadriceps, hamstrings, gluteals	Power production
Super pullover		Latissimus dorsi, teres major	Arm pull
Compound row		Latissimus dorsi, teres major, biceps, upper trapezius, middle trapezius, rhomboids	Arm pull
Biceps curl		Biceps	
Chest press		Pectoralis major, anterior deltoids, triceps	Joint integrity
Shoulder press		Anterior deltoids, middle deltoids, triceps	Joint integrity
Triceps extension		Triceps	Joint integrity
Low back		Erector spinae	Force transfer
Abdominal		Rectus abdominis	Force transfer
Rotary torso		Internal obliques, external obliques	Force transfer

Better Running Through Strength Training

Wayne L. Westcott, Ph. D.

Distance running is a great sport that is enjoyed at a variety of levels by millions of competitive and recreational athletes. Whether you prefer to jog a couple of miles through the neighborhood, or are training to complete a marathon, distance running is a highly effective and efficient means of aerobic conditioning. Unfortunately, distance running is considerably less beneficial for your musculoskeletal system. Injury rates among runners are extremely high. In fact, at the high school level, cross-country runners experience more injuries than athletes in any other sport, including football and gymnastics.

Why is a non-contact sport like running such a high-risk activity? Actually, running involves an incredible amount of contact, but it is with road surfaces rather than other athletes. Every running stride places about three times the weight of your body on your foot, ankle, knee and hip joints. These landing forces may also stress your lower back structures.

The repetitive pounding encountered mile after mile produces a degree of microtrauma to the shock-absorbing tissues. Under ideal conditions, these tissues recover completely within a 24-hour period. However, there are numerous factors that may interfere with normal recovery processes, eventually resulting in weakened and injury-prone tissues. These factors include longer running sessions, faster running paces, shorter recovery periods between workouts, more downhill running, more hard-surface running, more racing, more general fatigue, and undesirable changes in eating or sleeping patterns.

Of course, you may wisely take steps to reduce the amount of tissue trauma and decrease your risk of running-related injuries. Such precautions include making very gradual increases in training distances and speeds, taking sufficient recovery periods (particularly between hard training sessions), selecting user-friendly running courses (soft surfaces and level terrain), competing in fewer races, avoiding over-fatigue, and paying careful attention to proper nutrition and sleep.

However, one of the most effective means for minimizing tissue trauma is to develop stronger muscles, tendons, fascia, ligaments and bones. This is the primary reason that every runner should perform regular strength exercise. Consider the results of our four-year strength training project with the Notre Dame High School girls' cross-country and track teams.

Notre Dame High School Strength Training Program

For four consecutive years, 30 distance runners from Notre Dame High School participated in a basic and brief strength training program during the summer and winter months between their cross-country and track seasons. Every Monday, Wednesday, and Friday, they performed 30 minutes of strength exercise (12 Nautilus machines) that addressed all of their major muscle groups. Each of these years, the cross-country team won both the Massachusetts and New England championships in this sport. More important, during the four years that they did strength training, only one girl experienced an injury that resulted in a missed practice session or meet.

Strength Training Benefits

The Notre Dame runners realized that a sensible strength training program provides many benefits for runners. These include the following:

- Greater muscle strength
- Greater muscle endurance
- Greater joint flexibility
- Better body composition
- Reduced injury risk
- Improved self-confidence
- Improved running economy

While the first six strength training benefits should be self-explanatory, you may be intrigued by improved running economy. In a 1995 study at the University of New Hampshire, the women cross-country runners who did strength training experienced a significant improvement in their running economy. They required 4 percent less oxygen at sub-maximum running speeds (7:30, 7:00, and 6:30 minute mile paces), meaning that they could run more efficiently and race faster than before.

Runner Concerns

With so many advantages, why do so few runners regularly perform strength exercise? Consider these four concerns that keep many runners from strength training:

- Increased bodyweight
- Decreased movement speed
- Less fluid running form
- Fatigued muscles

Let's take a closer look at each of these issues.

Increased Bodyweight

Very few people who perform strength exercise have the genetic potential to develop large muscles. This is especially true for distance runners, who typically have ectomorphic (thin) physiques. Strength training increases their muscle strength and endurance, but rarely results in significant weight gain.

Decreased Movement Speed

With respect to running speed, our studies and many others have shown that greater strength results in faster movement speeds. We need only look at sprinters and middle distance runners to realize that strength training has a positive impact on running speed, as essentially all of these athletes perform regular strength exercise.

Less Fluid Running Form

Running involves coordinated actions of the legs and the arms, and one cannot function without the other. Your right arm moves in mirror image with your left leg, and your left arm counterbalances your right leg in perfect opposition. That is why it is almost impossible to run fast and move your arms slow or to move your arms fast and run slow. By strengthening the upper body muscles, you more effectively share the running effort between your arms and legs, resulting in more fluid running form.

Fatigued Muscles

It is true that a strenuous strength training session can cause a considerable amount of muscle fatigue that could adversely affect the quality and quantity of your runs. That is why we recommend brief strength workouts that do not leave you feeling enervated or exhausted. Remember that you are strength training to enhance your running performance, not to become a competitive weightlifter. Our program of strength training requires just one set of exercise for each major muscle group, which does not take much time and does not produce much lasting fatigue. You may also choose to strength train only one or two days per week, which should make muscle fatigue even less likely.

Runners' Strength Training Program

The strength training protocol followed by the Notre Dame athletes, and all of our runners, is a comprehensive conditioning program that addresses all of the major muscle groups in the body. We do not attempt to imitate specific running movements or emphasize specific running muscles, because this typically results in an overtrained, imbalanced, and injury-prone musculoskeletal system.

For example, the calf (gastrocnemius and soleus) muscles are used extensively in running. Due to their involvement in every running stride, many people think that runners should strengthen their calf muscles. Indeed they should, but it is even more important to strengthen their weaker counterpart, the shin (anterior tibial) muscles. If you strengthen only the larger and stronger calf muscles they will eventually overpower the smaller and weaker shin muscles, which may lead to shin splints, stress fractures, achilles tendon problems, and other lower leg difficulties. With this in mind, our runners always conclude their strength workouts with a set of weighted toe raises to strengthen the shin muscles and maintain balance within the lower leg musculature.

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

Generally, muscle strength is best developed by training with moderate weightloads (about 75 percent of maximum) for 8 to 12 repetitions per set. However, distance runners typically possess a higher percentage of slow-twitch muscle fibers, and therefore attain better results by training with about 12 to 16 repetitions per set. You should add 1 to 5 pounds more resistance whenever you complete 16 repetitions in good form. One set of each exercise is sufficient for strength development.

There is no reason to train with fast movement speeds, because training fast will not make you faster and training slow will not make you slower. Exercising with controlled movement speeds maximizes muscle tension and minimizes momentum for a better training effect. We recommend six-second repetitions, taking two seconds for each lifting movement and four seconds for each lowering movement.

Research supports three non-consecutive strength training sessions per week for best results, but fewer workouts can produce significant strength gains. Our recent studies have shown two weekly workouts to be 70 to 85 percent as effective and one weekly workout to be 60 to 75 percent as effective as three-day-per-week strength training.

Summary of Strength Training Guidelines

- Exercise all of the major muscle groups
- Perform 12 to 16 repetitions per set
- Add one to five pounds whenever 16 repetitions can be completed
- Perform one set of each exercise
- Use controlled movement speeds (six seconds per rep)
- Train one, two or three non-consecutive days per week

Recommended Strength Exercises For Runners

You may develop muscle strength with a variety of exercises using free-weights or machines. The following section presents recommended strength exercises for the major muscle groups.

Leg Muscles

Although barbell squats are the traditional leg exercise, most runners may do better to avoid placing a heavy barbell across their shoulders. Dumbbell squats are an acceptable alternative, but it may be difficult to hold enough weight to appropriately stress the large leg muscles.

Our recommendation is leg presses on a well-designed machine that offers a full movement range and good back support. It may be advisable to precede leg presses with leg extensions that target the quadriceps and leg curls that target the hamstrings. One set of each exercise is sufficient, but you may perform an additional set if you desire.

Upper Body Muscles

The typical exercises for the upper body are bench presses for the chest muscles, bent rows for the mid-upper back muscles, and overhead presses for the shoulder muscles. These are acceptable exercises, but are much safer when performed with dumbbells rather than barbells. For example, because there is no back support in a barbell bent row, the stress to the low-back area is 10 times the weight of the barbell. By using one dumbbell, and placing your other hand on a bench for back support, this exercise can be performed more safely and effectively.

If you have access to machines, we recommend chest crosses for the chest muscles, pullovers for the mid and upper back muscles, and lateral raises for the shoulder muscles. These machines require rotary movements that better isolate the target muscle groups. If you prefer linear movements that involve more muscle groups, well-designed chest press, seated row, and shoulder press machines provide combined training for the upper body and arm muscles.

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 chin-ups with bodyweight or on a weight-assisted chin/dip machine. A good means for working the triceps and chest muscles together is bar dips with bodyweight or on a weight-assisted chin/dip machine.

Midsection Muscles

Machines provide the best means for safely and progressively conditioning the muscles of the midsection. In our opinion, the abdominal machine and low-back machine are key exercises for developing a strong and injury resistant midsection. We also recommend the rotary torso machine for strengthening the oblique muscles surrounding the midsection. If appropriate machines are not available, the basic trunk curl may be the best alternative for abdominal conditioning. The recommended counterpart for the low-back muscles is a front-lying (face down) back extension. Although both of these exercises are performed with bodyweight resistance they are reasonably effective for strengthening the midsection muscles.

Neck Muscles

The neck muscles maintain head position throughout each run. As the head weighs up to 15 pounds, this is an important function. In fact, the first place where many runners fatigue and tighten up is the neck/shoulder area. We therefore recommend the 4-way neck machine to strengthen these muscles. If you do not have access to this machine, perhaps the best approach is manual resistance. That is, place your hands in front of your forehead to resist slow neck flexion movements, and place your hands behind your head to resist slow neck extension movements.

Table 1 presents the recommended strength training exercises for an overall conditioning program that should be beneficial for runners.

Table 1. Recommended Strength Training Program: Basic Exercises

Major Muscle Groups	Machine Exercises	Free-Weight Exercises
Quadriceps	Leg Extension Machine	Dumbbell Half-Squat
Hamstrings	Leg Curl Machine	Dumbbell Half-Squat
Chest	Chest Cross Machine	Dumbbell Bench Press
Upper Back	Pullover Machine	Dumbbell Bent Row
Shoulders	Lateral Raise Machine	Dumbbell Overhead Press
Biceps	Biceps Machine	Dumbbell Biceps Curl
Triceps Extension	Triceps Machine	Dumbbell Triceps
Low Back	Low Back Machine	Back Extension (Bodyweight)
Abdominals	Abdominal Machine	Trunk Curls (Bodyweight)

Once you have mastered the basic exercise program, you may want to add some of the exercises presented in Table 2.

Table 2. Recommended Strength Training Program: Additional Exercises

Muscle Groups	Machine Exercises	Free Weight Exercises
Quadriceps & Hamstrings	Leg Press Machine	Dumbbell Lunge
Chest & Triceps	Weight-Assisted Chin/Dip Machine	Bar Dip
Upper Back & Biceps	Weight-Assisted Chin/Dip Machine	Chin Up
Internal & External Obliques	Rotary Torso Machine	Trunk Curls w/Twists
Neck Flexors & Extensors	4-Way Neck Machine	Manual Resistance Neck Flexion & Extension
Calves	Calf Machine	Dumbbell Heel Raises
Shins	_____	Weight Plate Toe Raises

Summary

The main objectives of a strength training program for runners is to decrease injury risk and increase performance potential. For best results the program should be high in exercise intensity and low in training time. One good set of 12-16 repetitions for each major muscle group is recommended for a safe, effective and efficient exercise experience. One or two training sessions per week are sufficient, although three weekly workouts produces greater strength gains. Each workout should take no more than 20-30 minutes depending upon the number of exercises performed. The key to productive strength training is proper exercise technique, which includes full movement range and controlled movement speeds. When you make every repetition count, a basic and brief training program should increase your strength significantly (40-60 percent) over a two month training period.