

# Cardio Endurance Training

How to build cardiovascular fitness for long distance, endurance exercise...

Endurance is a term widely used in sport and can mean many different things to many different people. In sports it refers to an athlete's ability to sustain prolonged exercise for minutes, hours, or even days. Endurance requires the circulatory and respiratory systems to supply energy to the working muscles in order to support sustained physical activity.

When most people talk about endurance they are referring to aerobic endurance, which is often equated with cardiovascular fitness. Aerobic means "with oxygen" and during aerobic exercise the body uses oxygen to help supply the energy needed for exercise.

The objective of endurance training is to develop the energy production systems to meet the demands of activity for as long as they are required.

## Energy Pathways - How Foods Fuel Exercise

The body converts food to fuel via several different energy pathways. In the simplest terms, the body can convert nutrients to energy with or without the presence of oxygen. These two energy systems are called:

- Aerobic metabolism (with oxygen)
- Anaerobic metabolism (without oxygen)

These pathways can be further divided. The three energy systems most commonly mentioned in

exercises include:

- ATP-CP Anaerobic Energy Pathway which supplies short bursts of energy lasting up to 10 seconds.
- Anaerobic Metabolism Glycolysis which supplies energy for short, high-intensity bursts of activity lasting several minutes.
- Aerobic Metabolism which supplies most of the energy needed for long duration, less intense exercise and requires plenty of oxygen. The waste products, carbon dioxide and water, are removed in sweat and exhalation.



## Aerobic Metabolism and Endurance

Most often it's a combination of energy systems that supply the fuel needed for exercise, with the intensity and duration of the exercise determining which method gets used

when. However, aerobic metabolism fuels most of the energy needed for long duration or endurance exercises.

Athletes continually strive to push their capacity to exercise harder and longer and increase their endurance. The factors that limit sustained high intensity efforts include fatigue and exhaustion. Sport training has been shown to modify and postpone the point at which this fatigue occurs.

## VO<sub>2</sub> Max and Aerobic Endurance

VO<sub>2</sub> max or maximal oxygen uptake is one factor that can determine an athlete's capacity to perform sustained exercise and is linked to aerobic endurance. VO<sub>2</sub> max refers to the maximum amount of oxygen that an individual can utilize during maximal or exhaustive exercise. It is measured as milliliters of oxygen used in one minute per kilogram of body weight. It is generally considered the best indicator of cardio respiratory endurance and aerobic fitness. Elite endurance athletes typically have a high VO<sub>2</sub> max. And some studies indicate that it is largely due to genetics, although training has been shown to increase VO<sub>2</sub> max up to 20 percent. A major goal of most endurance training programs is to increase this number.

## Muscle Fiber Type and Endurance

High level endurance athletes often have a higher proportion of slow twitch (Type I) muscle fibers. These slow twitch fibers are more efficient at using oxygen (and aerobic metabolism) to generate more fuel (ATP) for continuous, extended muscle contractions over a long time. They fire more slowly than fast

twitch fibers and can go for a long time before they fatigue. Therefore, slow twitch fibers are great at helping athletes run marathons and bicycle for hours.

## Adaptations to Endurance Training

With endurance training, the body becomes better able to produce ATP through aerobic metabolism. The cardio respiratory system and aerobic energy systems become more efficient at delivering oxygen to the working muscles and converting carbohydrate and fat to energy.

## Endurance Training Programs

There are many different ways to train for improved aerobic endurance. The duration, frequency and intensity of each type of training varies and the training focuses on slightly different energy systems and skills and results in different physical adaptations. Some of the most well known endurance training programs include:

- Long Slow Distance Training. This type of training is the most common type of endurance training and the foundation for marathon runners, long distance cyclists and other sports that demand long, sustained steady energy outputs. It is also the easiest form of endurance training for new or novice exercisers.
- Pace/Tempo Training consists of training at a steady, but fairly high intensity just slightly higher than “race pace” for a shorter duration, usually 20-30 minutes at a steady pace.
- Interval Training consists of short, repeated, but intense physical efforts (3-5 minutes followed by short rest periods).
- Circuit Training consists of a series of specific exercises performed for a short durations and rotated through in quick in succession with little or no rest in between. Traditional circuit training routines build both strength and endurance

and can be varied in a multitude of ways to meet any athlete’s training goals.

- Fartlek Training combines some or all of the other training methods during a long, moderate training session. During the workout the athletes adds short bursts of higher intensity work with no set plan; it’s up to how the athletes feels.

## How to Measure Cardiovascular Endurance

Cardiovascular endurance testing measures is used along with other fitness tests to measure how efficiently the heart and lungs work together to supply oxygen and energy to the body during physical activity. The most common methods of determining endurance include:

- 12 Minute Run Test
- VO2 Max Testing
- The Bruce Treadmill Test Protocol
- Exercise Stress Testing
- Rockport Fitness Walking Test Calculator

Source

Wilmore, J.H. and Costill, D.L. *Physiology of Sport and Exercise: 3rd Edition. 2005. Human Kinetics Publishing.*