

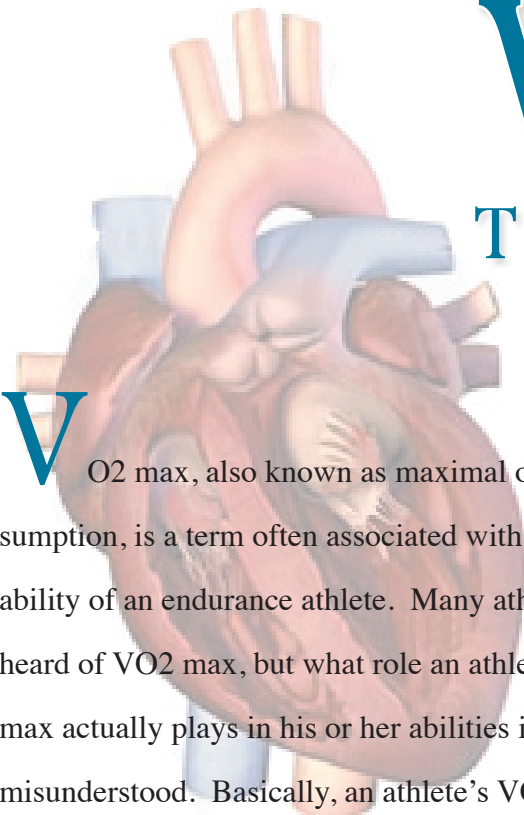


This article is an excerpt from  
*The Optimal Athlete's Endurance Sports*.  
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# VO<sub>2</sub> Max: The Ultimate Predictor?

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**V**O<sub>2</sub> max, also known as maximal oxygen consumption, is a term often associated with the physical ability of an endurance athlete. Many athletes have heard of VO<sub>2</sub> max, but what role an athlete's VO<sub>2</sub> max actually plays in his or her abilities is sometimes misunderstood. Basically, an athlete's VO<sub>2</sub> max is a measurement used to determine his or her capacity to consume oxygen, or how efficient the cardiovascular system can metabolize oxygen. What does oxygen have to do with performance, other than the obvious? Well, the more oxygen consumed, or the greater the VO<sub>2</sub> max, the greater the potential extended work rate.

## So what exactly is VO<sub>2</sub> max and how is it measured?

A VO<sub>2</sub> max is the highest rate at which oxygen can be consumed, distributed throughout the body, and utilized by the skeletal muscles. VO<sub>2</sub> max is often expressed by the number of milliliters of oxygen consumed by the athlete's body, divided by the athlete's body weight (in kilograms) per minute. Say an athlete has a VO<sub>2</sub> max of 65. This means that each minute, he or she can maximally consume and distribute 65 milliliters of oxygen, per kilogram of his or her bodyweight (65ml/kg/m).

A VO<sub>2</sub> max test is conducted as follows: an athlete's exercise intensity is progressively increased until he or she is unable to consume enough oxygen to meet

the demands of the exercise. This will, in turn, result in fatigue. Typically, the athlete can perform the VO<sub>2</sub> max test using a number of different exercise modalities including running, cycling, rowing, cross country skiing, etc. However, the criteria needed to obtain an accurate reading the athlete must a) perform an exercise he or she is used to performing and b) choose an exercise that employs a large amount of muscle mass (ie. an exercise utilizing the large lower limb muscles). Regardless of the exercise modality, the testing protocol remains the same. As an athlete's exercise intensity is increased, a "metabolic cart" tracks and records the athlete's VO<sub>2</sub>. This will continue until the athlete is unable to consume any more oxygen. At this point, the athlete's oxygen consumption will level off or "plateau". This plateau in oxygen consumption will be considered the athlete's VO<sub>2</sub> max.

## But why is oxygen so important?

As you may already know, oxygen is used to help produce a molecule known as ATP (Adenosine Triphosphate). ATP is a form of energy used by the muscle to produce movement. ATP is produced in the presence of oxygen through a biochemical process known as oxidative phosphorylation, which takes place in structures within the muscle cells known as the mitochondria. It should be noted that the body can also produce ATP without the presence of an adequate amount of oxygen; however, for activities lasting longer than a couple of minutes, oxidative phosphorylation is the body's only way to produce enough ATP to meet such a demand.

**“Keep in mind that a decrease in bodyweight can result in an increase in VO<sub>2</sub> Max”**

## Can I improve my VO2 max?

Over the years, researchers have found that a properly designed endurance-training program can significantly increase an athlete's VO2 max. The extent to which an athlete can improve his or her VO2 max is highly dependent upon their training status, as well as, their genetic predisposition. On average, a sedentary individual might expect to improve his or her VO2 max by 15-20%, while the trained individual might only accomplish a 3-5% increase through endurance training. Something else to keep in mind when evaluating VO2 max is that a decrease in bodyweight can result in an increase in VO2 max.

## How does my VO2 max compare?

VO2 max can vary considerably depending upon factors including gender, age, training state and genetic predisposition. The following table represents VO2 values for several different types of individuals.

Training Status	Untrained	Trained	Elite
VO2 Max (ml/kg/min)	26-42 (F) 36-52 (M)	40-60 (F) 50-70 (M)	55-70 (F) 60-85 (M)

Costill DL and Wilmore 1h. (1994). *Physiology of Sport and Exercise*. Champaign, IL: Human Kinetics.

## Is VO2 max the best predictor of athletic performance?

Contrary to popular belief, VO2 max may not be considered the best indicator of endurance based athletic performance. The reason for this is that after an athlete reaches his or her VO2 max, he or she will fatigue shortly thereafter. Because an athlete cannot sustain this rate of intensity over a long period of time, a VO2 max will not provide the best representation of athletic potential. So, while it is important to know your VO2 max, it is even more beneficial for you to know your LTVO2.

LTVO2 (Volume of Oxygen taken in at Lactate Threshold) is the rate at which your body can produce the ATP necessary for energy demands of the body. Well what differentiates one's LTVO2 from their VO2 max?

LTVO2 is closely related to one's LT (Lactate Threshold) and represents the point at which the body

fails to consume enough oxygen to continue the synthesis of ATP through oxidative phosphorylation. As discussed earlier, the body is not very efficient at producing ATP without oxygen; therefore, it makes more sense to measure one's "usable" VO2 rather than his or her VO2 max. For example, 2 distance swimmers have an identical VO2 max of 65ml/kg/min, but one swimmer has a LTVO2 of 55ml/kg/min and the other swimmer has a LTVO2 of 60ml/kg/min. If we look at the two swimmer's LTVO2 as a primary athletic predictor, the swimmer with the LTVO2 of 60ml/kg/min should be able to sustain a much greater exercise intensity and thus be more likely to perform better (assuming that both swimmers had identical stroke economy).

## To sum it all up

VO2 max has been a very popular concept associated with the prediction of athletic endurance performance, but ultimately it cannot be used as a sole predictor when determining athletic potential. Other factors, including lactate threshold, movement economy, physiological state, race tactics, etc., are heavily involved with athletic performance. Therefore, maximal oxygen consumption must only be considered a piece of the puzzle when it comes to predicting athletic potential.

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## REFERENCES

1. Costill DL and Wilmore 1h. (1994). *Physiology of Sport and Exercise*. Champaign, IL: Human Kinetics.