

Running and Breathing: A Lesson in Oxygen Intake and VO2 Max

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When first starting out, many runners struggle with running and breathing. Many have probably heard the term VO2Max. And many know that having a high one is good, but most aren't quite sure what it really represents. The term broken down actually stands for V (volume per time), O2 (oxygen), Max (maximum).

Sometimes VO2 max is referred to as maximal oxygen consumption, maximal oxygen uptake, peak oxygen uptake or aerobic capacity. Never mind all that fancy and technical lingo. It basically stands for the maximum amount of oxygen your body can take in and actually utilize at max exertion.

Made even simpler, if you increase your O2 uptake, you'll run faster, bike faster, and/or swim faster. Your performance in any aerobic endurance activity would improve with an increased or high VO2Max.

Simply breathing faster or heavier won't increase your VO2Max. We've all seen runners huffing and puffing who look like they're about to hyperventilate (and if we're being honest, we can all probably include ourselves in that group at one point or another).

Breathing for New Runners

New runners often experience rapid heavy breathing. As a new runner's heart rate increases, his/her body automatically knows it needs more oxygen, so the most natural thing to do is to breathe faster. The reason this isn't helpful is because the breaths are usually shallow and even though the runner is breathing rapidly, he's not getting the oxygen deep into the lungs where it's taken by the blood stream to the muscle to make energy. A new runner needs to concentrate on a deep inhale and a big exhale to clear the lungs of CO2. Focusing on belly breathing (seeing the abdomen expand with each inhale rather than then chest) will help new runners get more oxygen deep into the lungs.

Tidal Volume

The amount of air inhaled and exhaled with each breath is your tidal volume. It increases from .4 to 1L at rest to as much as 3L during aerobic exercise. An aerobically unfit person's tidal volume is going to be less than that of an aerobically fit person. Also, a person who's aerobically unfit isn't going to have a very complex network of capillaries (the smallest blood vessels woven throughout the muscle fibers) at the muscle level. A person who has a higher tidal volume and a more complex system of capillaries at the muscle level is going to be able to get more oxygen into the lungs which will diffuse into the pulmonary blood and make its way down to the capillary level to the many mitochondria in the muscle. Mitochondria are found inside the cells, and they're the power producers. The mitochondria is where cellular respiration occurs, which produces fuel for the cell's activities.

The good news is that you can increase your tidal volume, expand your capillary network, and increase the number of mitochondria you have. By doing consistent aerobic exercise (running, cycling, swimming, etc.), you'll increase all of the above. The more you run, your body will actually increase and build that important network of capillaries in the muscles and when that happens, you'll actually increase the number and size of the mitochondria in the tissue. When that happens your body will be more efficient at extracting oxygen from the blood and getting it to

the muscle where it's needed for energy production. For experienced runners, more intense workouts such as intervals, hill repeats, fartleks, and/or tempo runs will help up their VO2Max.

New runners will see the dramatic increases as they work to improve their VO2Max. Once you reach a certain level, the athlete will plateau and it will be harder to make increases, but continued VO2Max training will help more experienced runners maintain their VO2Max level for longer periods of time. This will help them become even more efficient runners and help keep fatigue at bay for longer. Genetics does play a role with VO2Max. So, if you can't seem to get past a certain level no matter what you try, you can blame mom and dad. Also, as you age, your VO2max will naturally begin to decrease a little each year.

So, how do you find your VO2Max? If you're a runner you can do the following run test. Do a 5-10-minute warm-up walk or easy jog. Then run 1.5 miles at or near what you consider max exertion. On a 1-10 perceived exertion scale you should be running at about a 9. Record your time. Then plug your body weight in kilograms, your run time in minutes and your gender number (1=male, 0=female) into the equation below. The result will be your VO2Max. *(Note: Before doing the test, or beginning any new exercise, first consult with your doctor.)*

VO2Max Equation

$$88.02 - .1656 (\text{body weight in kg}) - 2.76 (1.5 \text{ mile time in minutes}) + 3.716 (\text{gender})$$

The charts below show the Average to Excellent VO2Max ranges for men and women.

MEN

| | 18-25 yrs old | 26-35 yrs old | 36-45 yrs old | 46-55 yrs old | 56-65 yrs old | 66+ yrs old |
|------------------|---------------|---------------|---------------|---------------|---------------|-------------|
| Excellent | >60 | >56 | >51 | >45 | >41 | >37 |
| Good | 52-60 | 49-56 | 43-51 | 39-45 | 36-41 | 33-37 |
| Above Avg | 47-51 | 43-48 | 39-42 | 35-38 | 32-35 | 29-32 |
| Average | 42-46 | 40-42 | 35-38 | 32-35 | 30-31 | 26-28 |

WOMEN

| | 18-25 yrs old | 26-35 yrs old | 36-45 yrs old | 46-55 yrs old | 56-65 yrs old | 66+ yrs old |
|------------------|---------------|---------------|---------------|---------------|---------------|-------------|
| Excellent | >56 | >52 | >45 | >40 | >37 | >32 |
| Good | 47-56 | 45-52 | 38-45 | 34-40 | 32-37 | 28-32 |
| Above Avg | 42-46 | 39-44 | 34-37 | 31-33 | 28-31 | 25-27 |
| Average | 38-41 | 35-38 | 31-33 | 27-30 | 25-27 | 22-24 |

A long slow run is typically run at about 70 percent of your VO2Max. Tempo runs maybe closer to 80 to 85 percent of your VO2Max and intervals may reach the 85 to 90 percent level. Some treadmills have made it easy to gage this by using METs (metabolic equivalent scale). Once you know your VO2Max score, just divide that number by 3.5 and that will give you your VO2Max in METs. So if your VO2Max score is 40 then the METs equivalent would be around 11. On a treadmill that has METs, you would know that your max effort would be at the 11 METs setting. Your regular runs would be 70% of that so the METs setting would be 7.7. If you were doing intervals the setting may be closer to 9 or 9.5. Not all treadmills have a METs scale, but if yours does, it can be a useful tool when training.

If you're just beginning to run, but you're not quite up to running 1.5 miles, there are a couple of different types of VO2Max tests that can be done such as the 1-mile Rockport Walk Test, and a 3-minute step test. Check with a personal trainer, a local gym or YMCA to see if they provide fitness testing that includes a VO2Max test. Having a complete fitness assessment done by a personal trainer before beginning a running program will be very helping in providing baseline data on your current fitness level. A fitness assessment should include data on vitals (blood pressure/resting heart rate), body composition measures, muscular strength, muscular endurance, muscular flexibility and balance, as well as your VO2Max level.

So, if you're new to running, hang in there, it will get easier. Just stick with it. And if you're a seasoned runner, try mixing up your workouts with some speedwork or hillwork to up or help maintain that VO2Max.