

How to Evaluate Aerobic & Anaerobic Systems

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Dr. Philip Maffetone, chairman of the Athletic Advisory Board of the International College of Applied Kinesiology, has done extensive research to develop the material discussed in this article. I highly recommend his book on the subject, *Everyone Is an Athlete*.

The Difference Between Aerobic and Anaerobic Exercise

Most types of exercise can be aerobic or anaerobic depending on the body's need to convert energy. In aerobic exercise fats are used as the energy source. If sugar or glucose are used as the energy source, then the activity becomes anaerobic.

Some activities, such as weight lifting, are always anaerobic. Racquetball, tennis, basketball and similar sports are usually anaerobic.

The level of heart rate determines whether or not you are using your aerobic or anaerobic system. Doing an activity such as running, biking or swimming at a lower heart rate makes it aerobic, while doing the same activity at a higher heart rate makes it anaerobic.

There is not a clear cut line between aerobic and anaerobic states. Biochemically both aspects exist at all times. However, the predominance of one over the other is what we are considering when we examine the two.

The Aerobic System

Improving one's overall health, weight, fat metabolism, enhancing athletic performance or dealing with any health problems all relate to the aerobic system. This system is influenced by the structural, chemical and mental sides of the triangle of health.

The aerobic system is made up of the aerobic muscle fibers and parts of the nervous, endocrine and circulatory systems. It allows much of the body's metabolism to take place, especially fat metabolism.

The system runs on fuel that includes dietary fats, their chemical end products, and key nutrients. When these combine together properly they produce a chemical balance which is necessary for good hormonal function and all related metabolic processes.

When the aerobic system is working properly, the body is utilizing more fats for energy and the blood sugar is stable. This stability means moods will also be stable due to the brain's reliance on blood sugar as a primary fuel.

Muscle Types

There are three types of skeletal muscle in the body: aerobic (slow twitch or red fibers), anaerobic (fast twitch or white fibers), and mixed. All muscles have a combination of these with the aerobic fibers being most numerous.

Aerobic Muscles

For the aerobic system to function well and to experience health and fitness, the aerobic muscles must be used. Proper exercise will increase energy and endurance.

The aerobic muscles utilize fatty acids as their dominant source of energy. This biochemical process occurs in the cell's mitochondria. The aerobic muscles are slower in action than the anaerobic muscles, but they can maintain activity for longer periods and thus contribute to endurance. The red color of these fibers is due to the higher myoglobin content which relates to iron. These muscles use sodium as an electrolyte.

Anaerobic Muscles

The anaerobic muscle fibers use glucose as an energy source. They are much fewer in number than the aerobic fibers and are fast acting, utilized in sprint events. These fibers have much less blood and lymph supply than aerobic fibers and are only able to maintain this activity for a short period of time. Pantothenic acid is a key nutrient for anaerobic muscle use as is potassium.

Aerobic

Myoglobin (red)

Iron

Slow moving

Endurance

Fatty Acid

Sodium

Anaerobic

No myoglobin (white)

Pantothenic acid

Fast moving (speed)

Short lasting

Glucose

Potassium

Balancing Aerobic and Anaerobic Activity

A balanced exercise program stimulates all three types of fibers. Between 80 and 90% of exercise and activity should be of the aerobic and mixed fiber type.

Hormonal Factors

The entire hormonal system helps to support the aerobic system. The adrenal glands produce aldosterone, which allows the kidneys to regulate sodium, an important nutrient for the adrenals, aerobic fibers, and water balance. The glucocorticoids produced by the adrenals help to regulate blood sugar and reduce inflammation. Adrenalin and estrogen also help the aerobic system.

As a regulator of metabolism in almost every cell of the body, the thyroid plays an important role in the aerobic system. If a person has even a subclinical hypothyroid state, he or she will have almost no desire for exercise. Therefore, thyroid function must be improved before encouraging an exercise program.

The Relationship of Stress to the Aerobic System

When under any type of stress the adrenal glands produce higher levels of epinephrine (adrenaline) and lower levels of norepinephrine. Prolonged or frequent periods of this state can cause health problems. Anaerobic activity will also produce this chemical state, whereas aerobic exercise will produce the opposite chemical state (normal epinephrine levels and a higher norepinephrine level), which enhances health.

States of Imbalance

There are four conditions of imbalance with regard to aerobic and anaerobic exercise. The first two are most common: aerobic deficiency and anaerobic excess. Aerobic excess and anaerobic deficiency are rarely seen.

The Aerobic Deficiency Syndrome

This syndrome is what Dr. Maffetone calls any factor that decreases the functioning of the aerobic muscle fibers.

The most common causes are:

- under use of aerobic muscles
- over use of anaerobic muscles

Other causes include:

- fatty acid deficiency
- dietary fat imbalance
- iron, copper, and/or other specific nutritional imbalance related to the aerobic system

Symptoms of the aerobic deficiency syndrome may include:

- fatigue
- low blood sugar
- depression and anxiety
- fat metabolism problems
- pre-menstrual syndrome
- circulation problems
- recurrent exercise injuries

People who have an aerobic deficiency syndrome also commonly have the following:

- hormonal imbalance
- deficiency in factors related to essential fatty acid metabolism
- improper iron metabolism
- poor exercise habits

Blood Lactate Levels:

Aerobic muscles convert fats into energy. Anaerobic muscles convert glucose into energy with lactates as a by-product. Lactate is a waste product that becomes a toxin if the

body can't get rid of it and it builds to excess. This is another reason why it is important to have a balance between aerobic and anaerobic activity.

General muscle soreness following exercise is usually caused by high blood lactate levels. This can also produce recurrent injuries, panic attacks, PMS, an abnormal increased heart rate, muscle cramping, shortness of breath and an inability to exercise at an aerobic level.

The Anaerobic Excess Syndrome

This is the second most common problem. This occurs with people who are anaerobic most, if not all, of the time in their workouts, generally avoiding warm ups or warm downs.

These people have frequent injuries and may experience exhaustion, cravings for sweets, and difficulty waking up in the morning. Further testing may reveal adrenal insufficiency, blood sugar imbalances, high cholesterol, triglyceride, and LDL levels with a low level of HDL and liver dysfunction.

Aerobic Excess

An aerobic excess is seen in a person who follows a strict aerobic exercise program for over six months to a year without ever incorporating anaerobic work. The symptoms are similar to an aerobic deficiency.

Anaerobic Deficiency

This can also occur when too much aerobic work is done for several months without anaerobic exercise. To balance the body chemistry, do anaerobic activities such as lifting weights or working out with a higher heart rate (i.e. running, biking, aerobic dance, etc.).

Testing for Aerobic and Anaerobic Excess and Deficiency

Aerobic exercise further balances the body in a person who is basically healthy and fit. I personally noticed that I had much fewer muscles that tested weak after I began aerobic training than I had had previous to training.

Dr. Maffetone has developed some simple tests to determine imbalances in the aerobic and anaerobic systems.

The Aerobic Challenge

If the necessary ingredients are present for the aerobic system to work correctly, aerobic exercise should provide immediate benefits for any person.

The following screening procedure can be used to assess the aerobic system:

1. Do a postural analysis to find possible muscle imbalances.
2. Find one or more inhibited (weak) muscles.
3. Find one or more normal (strong) muscles.
4. Have the person stimulate aerobic muscle activity by slowly raising and lowering the lower limbs eight times while in a supine position.
5. Immediately re-test the indicator muscles.
6. If the aerobic system is working properly, most if not all of the original inhibited muscles will test strong, and the strong muscles will not change. As with any neurological challenge, the improvement in muscle function will generally last only a few seconds.

Aerobic Deficiency

If the inhibited muscles did not strengthen after the aerobic challenge, this indicates a deficiency in the aerobic system. Aerobic exercise will not benefit the person until the structural, chemical and/or mental imbalances are corrected.

Once these imbalances are found and corrected, the aerobic challenge will then strengthen any previously inhibited indicator muscles. Note that the muscles that originally were inhibited may now test strong due to correcting the imbalances. Common problems can be small intestine malabsorption (quadriceps), improper liver function (pectoralis major sternal) and missing nutrients (carnitine, B6, iron and niacin).

Aerobic Excess

If the aerobic challenge produces no improvement in the previously inhibited muscles, yet the previously strong muscles test weak, there is an aerobic excess. This is a rare occurrence that is seen in people who are following a regular aerobic exercise program for eight months or longer and have not introduced any anaerobic work into their routine.

The correction for this is to simply include some anaerobic activity for a period of time. This could be 30 minutes twice a week of one or more of the following: moderately fast running, light weights with high repetitions, racquetball, or other hard, higher heart rate activities. It is important to warm up and warm down aerobically. This program should be continued for a minimum of about six weeks to a maximum of about 12 weeks.

The Anaerobic Challenge

In a similar manner we can screen the anaerobic system to assess its condition. Anaerobic muscular activity is generally more rapid and powerful. Upper body muscles tend to be more anaerobic in nature and therefore provide the best anaerobic challenge.

The following screening procedure can be used to assess the anaerobic system:

1. Examine the posture for muscle imbalances.
2. Find two or more weak muscles.
3. Find two or more strong muscles.
4. Have the person simulate the anaerobic system by tightening both fists and rapidly flexing and extending the biceps and triceps alternately as fast as possible for eight seconds.
5. Immediately re-test both groups of indicator muscles.
6. This anaerobic challenge will produce no change in muscle strength in the person with a normal balance of aerobic and anaerobic function.

If you get different results, look below to determine the imbalance.

Anaerobic Excess

This is the most common occurrence in which the anaerobic challenge will weaken the strong indicator muscles while not effecting the previously tested weak ones.

The person who exhibits an anaerobic excess is usually one who has overdone anaerobic exercise without even realizing it. This is common in people who lift weights or who run with their heart rates too high.

It is beneficial for people in this category to build an aerobic base without any anaerobic workouts for a minimum of two to three months.

In this state there is an excess of lactic acid or lactate in the system. Nutritional factors which are commonly needed to balance this are: pantothenic acid, niacin, biotin, B-1, B-2 and B-6. Magnesium, molybdenum and phosphorus are commonly deficient minerals.

Anaerobic Deficiency

In this uncommon state, which is similar to aerobic excess, the previously weak indicator muscles test strong, with no change in the previously strong muscles. This person has usually done too much aerobic work over a long period of time, with no anaerobic work to balance it, and needs to do some anaerobic activity immediately. Lifting light weights, playing racquetball, running moderately hard, or doing some similar activity for 30 minutes two to three times per week for six to twelve weeks will be of benefit. These workouts should include a fifteen minute warm-up and a fifteen minute warm-down of aerobic activity.

Computing Your Heart Rate For Your Aerobic/Anaerobic Line

1. Subtract your age from 180
2. Modify this number by selecting the appropriate category:
 - a. If you have, or are recovering from a major illness or surgery, or if you are on medication...
subtract 10
 - b. If you are new to exercise, have been exercising but have been injured or

are going downhill in your training or competition, or if you get sick frequently or have allergies...

subtract 5

- c. If you have been exercising for up to two years without any major problems and have not been sick more than twice a year..

subtract 0

- d. If you have been exercising for more than two years without any problems and are making progress in competition without injury...

add 5

3. For example, if you are 30 years old and fit into category b:

$180 - 30 = 150$, then $150 - 5 = 145$ beats per minute is the maximum heart rate that the body can maintain to exercise in an aerobic state. Exercising above this heart rate becomes anaerobic.

Using a heart rate monitor is an excellent way to monitor your aerobic/anaerobic state. Set the monitor for a high pulse of the number calculated in the above table. Set the low pulse for 10 below the high. If you get outside this range, the monitor will give you a signal.

If you do not have a heart monitor, a simple formula is to divide the number in the above table by six and take your pulse for ten seconds. In the above example, the aerobic ceiling is $145 \div 6 = 24$ beats per ten seconds.

Another guide to being in an aerobic state is that, when you are aerobic, you can still carry on a conversation. If you are unable to talk without being out of breath, you are in an anaerobic state.

Building an Aerobic Base

To be most successful, every exercise program requires that the individual begin by building an aerobic base. This consists of

exercising for a period of time doing aerobic workouts only without anaerobic activity. This period may be from two to eight months, during which time an improved aerobic system is developed. Doing any anaerobic activity during this time may jeopardize the building of the aerobic base.

Building an Anaerobic Base

After an aerobic base is built, one, two or sometimes three anaerobic workouts per week can be done to build an anaerobic base.

This program can be continued for five to twelve weeks for optimal results. After this time, a return to the aerobic base is needed to continue progress. A general guide is to have three months of aerobic and three months of anaerobic in alternating cycles.

A person who has built a good aerobic base for the second time can do a short easy anaerobic workout two or three times a month during the aerobic period with little adverse affects on the aerobic base.

The anaerobic system may peak around age 18 or 20, whereas the aerobic system doesn't peak until you are 35 to 40 years old.

Conclusion

By evaluating and balancing the aerobic and anaerobic systems, you can be successful in developing an exercise program. If you build and keep a good aerobic base, you can enjoy the benefits for years to come. Not only will it make you a better athlete, it will also burn off excess fat, improve your immune system, give you more energy and keep you relatively injury-free. Therefore, to achieve optimal health and fitness, it is important to develop both the aerobic and anaerobic systems.

Reference

Maffetone, Philip, DC, *Everyone Is an Athlete*, David Barmore Pub, 1989