Aerobic Performance

What is it?

Aerobic performance, or cardiorespiratory fitness, is one's ability to perform dynamic exercise at moderate-high intensities, utilizing large muscle groups, for prolonged periods. The ability to perform such exercise depends on the functional ability of the cardio (heart), respiratory (lungs), vascular (blood) and musculoskeletal systems.

Why is it important?

Aerobic capacity (VO2max), the 'signature' measure in exercise physiology for the past half-century, is widely recognized as both a measure of aerobic fitness and a representation of the functional limitations of the cardiovascular system. Recent evidence suggests that aerobic capacity expressed in METs (where 1 MET is 3.5 ml/kg/min of oxygen uptake) is "a more powerful predictor of mortality among men than other established risk factors for cardiovascular disease" and that each one MET increase in VO2max confers a 12% improvement in survival. There is abundant evidence indicating that physical activity and fitness levels are associated with reduced risks of premature mortality and many chronic diseases, including coronary heart disease, stroke, hypertension, type II diabetes, and some cancers (colon and breast).

How is it assessed?

Depending on your selection of packages, your assessment will include some or all of the following parameters:

1. **Aerobic Capacity:** Maximum oxygen uptake, or VO2max (measured in L/min), is a parameter of aerobic performance that identifies functional capacity (physical work) of the integrated pulmonary, cardiovascular, and skeletal muscle systems. In a physiological context, VO2max refers to the maximal rate at which oxygen can be transported to and used by peripheral muscle during maximal metabolic stress (exercise). VO2max is therefore considered the 'gold standard' criterion measure and the single best index of physical work capacity and cardiorespiratory fitness. A distinction should be made between estimated VO2max measures and the directly measured VO2max which you will do with UC Fit. There exist a plethora of exercise tests that attempt to predict VO2max using assumptions about a positive linear relationship between heart rate and O2 uptake. These tests provide an estimation of maximal aerobic capacity based on heart rate response to one or more submaximal work rates and the time or distance to test completion. All predictions inherently contain error, referred to as the Standard Error of the Estimate (SEE) and the vast majority of these tests are associated with large errors (e.g., walking/running tests have SEEs of 8-10% while tests that use heart rate at submaximal work rates have SEEs of 10-20%). By contrast, direct measurement of VO2max (assessed with a metabolic measurement system and ECG during exercise performed to volitional fatigue on a calibrated cycle or treadmill ergometer) is precise, accurate, and reproducible.

2. **Metabolic (lactate) Threshold:** The metabolic threshold represents the intensity of exercise that can be sustained for long periods of time and coincides with the work intensity above which lactate begins to accumulate in exercising tissue, with levels increasing exponentially to the limits of exertion. This accumulation of lactate begins to occur when the energy required by physical activity exceeds the energy able to be produced by aerobic metabolism. Once lactate begins to accumulate, there is limited ability to produce greater amounts of energy and exhaustion follows shortly. The metabolic threshold is now widely viewed as the best and most sensitive determinant of cardiorespiratory performance. This suggests that the metabolic threshold is critical in determining ideal heart rate training zones for fitness enthusiasts as well as optimal race pace for endurance athletes. The onset of metabolic acidosis (i.e., metabolic threshold) during exercise, traditionally determined by serial measurements of blood lactate, can be determined noninvasively through use of a constellation of gas exchange variables including the nonlinear increase in carbon dioxide output relative to the increase in VO2 assessed during an incremental exercise test. An increase in ventilation is also observed since hyperventilation helps to eliminate the excess carbon dioxide produced in response to a sustained rise in blood lactate. The metabolic threshold from respiratory gas measurements is often expressed as a percentage of VO2max with higher percentages seen in fitter individuals. This means that, as fitness improves, individuals are able to exercise at intensities closer to their maximum capacity before blood lactose begins to accumulate, thus they are able to maintain these higher intensities without reaching exhaustion.
3. **Cardiovascular Responses:** The chronotropic index is defined as the slope of the heart rate versus oxygen uptake relationship during incremental work. It is accurately measured with any heart rate using an electrocardiograph (more accurate than a heart rate monitor) and a system for the measurement of oxygen uptake. When heart rate is actually measured via an ECG or heart rate monitor, most individuals exhibit a plateau at maximum heart rate similar to the plateau seen at VO2max. Every individual has a theoretical maximum heart rate, which declines with increasing age. Whereas most often maximum heart rate is estimated based on age-prediction equations that are scrupulously inaccurate (i.e., the standard deviation is estimated to be 10 beats/min), a direct measurement will confer more precision in establishing heart rate training zones to set training loads for cardiovascular regimens.
4. **Metabolic Efficiency:** Metabolic efficiency describes the relationship between fat and carbohydrate oxidation across a variety of exercise intensities. Many individuals are extremely inefficient at using their almost unlimited fat stores as energy during exercise and rely heavily on the body's limited carbohydrate stores. By observing the respiratory exchange ratio (RER) that is determined breath-by-breath during the VO2 max test, a strategic plan can be developed for utilizing more fat early on during exercise while conserving precious carbohydrate stores for later in the exercise bout.

What to expect during the assessment:

1. Electrodes (sticky patches) will be placed on your chest to monitor the electrical activity of your heart (ECG) and you will be fitted with a face mask that measures your breathing and concentrations of expired gases.
2. The testing window is usually between 8-12 minutes, plus a 3 min warm-up and cool down.
3. The test starts with you walking on a treadmill or riding a stationary bike; as the test progresses, the workload will gradually increase (i.e., faster speed and/or steeper incline every minute) until you can no longer maintain it and the test will cease.
4. **You may choose to stop the test at any time, although for meaningful results, you should continue exercising for as long as possible to achieve a "true" VO2max.**

Participant preparation:

Test validity and data accuracy are greatly improved by adhering to the following guidelines prior to your assessment. Your test(s) will be given on the assumption that you have followed these recommendations:

1. Refrain from ingesting heavy meals, alcohol, or caffeine or using tobacco products within 5 hours of testing
2. A light, healthy snack of protein and carbohydrate combination prior to testing is encouraged in those that experience hypoglycemia. Everyone is encouraged to eat something light and well-balanced in the 12 hours preceding the 5 hour pretest fast.
3. You should be well rested for the test: avoid significant exertion or exercise 24 hours prior to testing and get a good night's sleep
4. Drink ample fluids over the 24-hour period preceding the assessment to ensure normal hydration
5. Clothing should permit freedom of movement, be appropriate for high intensity exercise and include walking or running shoes; Women should avoid restrictive undergarments