

A submaximal test is a relatively easy method of assessing ones aerobic capacity. There are three widely used tests to measure a persons VO2 max uptake, or aerobic capacity. These tests are:

- *Bike Test
- *Treadmill Test
- *3-Minute Step Test

The easiest of the three tests is the 3-minute step test. This is the test we will discuss fully. The other two tests are included in the software. They are discussed in the book "The Y's Way to Physical Fitness", Golding, Meyers, & Sinning, 1989, 3rd edition. When doing the treadmill test follow the instructions in the software and use the continuous testing mode to record heart rate.

The Y's Way to Physical Fitness describes the 3-minute step test as follows:

"Many YMCAs that are involved in corporate health enhancement programs or with other large groups have a need for mass testing of participants. Because of equipment needs, the bicycle is unsuited for this task. The 3-minute step test can be used very successfully in mass-testing situations. This is an excellent cardiorespiratory test not only for mass-testing but also as a self-test or as an addition to a test battery. Minimal equipment is required, and participants can learn to administer it to themselves by counting the carotid or radial pulse; however, when done as part of the test battery, it should be done as described here".

Equipment

1. A 12 inch high, sturdy bench
2. One metronome set at 96 bpm (Four clicks of the metronome equal one step-up, up, down, down at 24 steps per minute).
3. One transmitter.
4. One receiver.
5. One 3.5 inch disk.

Procedure

" Face the bench and, in time with the metronome, step one foot up on the bench (first beat), step up with the second foot (second beat), step down with the first foot

(third beat), and step down with the other foot (fourth beat). The sequence is alternating feet. It does not matter which foot leads or if the lead foot changes during the test. Do not allow the participant to practice, as it will affect the heart rate."

Y' Way to Physical Fitness

"Explain to the participant both the test and the importance of sitting down quickly at the end of 3 minutes and remaining still for 1 minute so that the heart rate can be recorded. Position the participant facing the bench and allow him or her to pick up the beat of the metronome by marking time in place. When the participant starts stepping, start the timer. Check the rhythm and correct if necessary. Inform the participant of the time as it passes by saying "One minute, two minutes," and so on.

When 20 seconds remain, remind the participant that he or she is to sit down quickly at the end of stepping and wait for the tester to record the heart rate. On the last step it is helpful to say "Last step-up, up, down, and sit." It might be helpful to turn the metronome off during the last 15 seconds stepping and count the cadence for the participant until the last step.

When the participant sit down start counting for one full minute. Begin the count on a beat, counting that count as "zero." The recovery rate count must be started within 5 seconds or the heart rate will be significantly different. The 1-minute count reflects the heart's rate at the end of stepping as well as the rate of recovery.

The total 1-minute postexercise heart rate is the score for the test and can be recorded and compared to the norms of the population or to previous test result if appropriate. Score the total 1-minute post-exercise heart rate in beats per minute."

The software provided will automatically record heart rate and time. It will beep when 20 seconds remains in the test and it will also beep when the test ends. After the test ends it will record the 1-minute postexercise heart rate recovery. The software will then compare the test results to the Y's norms and give a rating. A metronome has been provided to sound off the 96 beats per minute stepping time.

The following has been quoted from the "Y's Way to Physical Fitness.

" It is desirable for participants in their first year of fitness training to repeat testing once after about 10 to 12 weeks and then again at the end of six to twelve months. This will show participants their personal responses to training and will possibly act as a motivator for continued participation. After the first year of exercise in the fitness program, most individual need not be tested more than once a year.

The measurement resulting from the bicycle test or the step test reflect the cardiorespiratory response of the individual and should be used to show changes in endurance during the exercise training program. If an individual scores in either the fair or poor categories of the step test, he or she should start out more slowly in the exercise program than should those scoring average or above. These individuals may not have the cardiorespiratory capacity to perform moderate to strenuous work and may start out with a walking program for several weeks before beginning the exercise class. In any case, signs of overexertion should be watched for during the first few weeks of the program. Individuals who score in the average, good, or excellent categories should be able to start out in the regular beginner's program and can handle an exercise program commensurate with their fitness rating.

There is a linear relationship between heart rate (HR) and work (W); however, this linearity exists only at certain heart rates. At low heart rates, many external stimuli can affect the heart rate (e.g., talking, laughter, and nervousness). However, once the heart starts pumping harder as the muscles demand more blood, external stimuli no longer affect the heart rate, and linearity occurs at about 110 bpm. The relationship between heart rate and work increases in a linear fashion until it plateaus, signalling the maximum heart rate. A 70-year old man will plateau at about 150, and, as 70-year-olds will usually be the oldest individuals tested, almost everyone will be linear between 110 and 150 bpm.

Linearity begins at approximately 110 bpm. The plateauing due to reaching maximum heart rate is a function of age; however, at a heart rate of 150 bpm, almost everyone tested will still be linear. Therefore, linearity is said to be between 110 and 150 bpm."

Steady-State Heart Rate

" The moment a participant starts to work, the heart rate immediately increases. At the end of a minute of work, the heart rate is still increasing. It takes about three minutes of work before the heart rate stabilizes. This plateauing is called the steady-state heart rate.

Although steady-state heart rate usually occurs within 3 minutes, it may take longer. If the difference between the second-minute heart rate and the third-minute heart rate is more than 5 bpm, the heart rate is still significantly increasing, and a fourth minute should be added. If the difference is 5 or less bpm, the heart rate has stabilized."

Maximum Heart Rate

" As an individual works harder, the heart rate increases in a linear fashion. The higher the workload, the higher the heart rate. At some point, even though the amount of work increases, the heart rate does not increase. At this point the heart has reached its fastest rate or maximum heart rate. Everyone has a point at which the heart rate will go no higher, although this point differs in individuals due to various reasons. The main reason is age. As one ages, the ability to drive the heart to high rates decreases. This decrease in maximum heart rate is partly due to a decrease in physical fitness, and in the general population this decrease is very evident. However, in fit individuals who continue aerobic activity into later life this decrease is not so rapid.

It has been shown that maximum heart rate decreases with age in a linear fashion. The mathematical formula for calculating your maximal heart rate is to take the number 220 and subtract your age from that number. An individual who was 40 years old would have a maximum heart rate of 180 bpm ($220-40=180$). This prediction is only representative of the average for a population of 40-year old individuals and does not take into account individual variations."

Maximum Oxygen Uptake (VO₂max)

" The maximum oxygen uptake is an excellent test of cardiorespiratory efficiency and is often mentioned in both scientific and popular literature. The measurement of maximum oxygen uptake is a laboratory technique that involves both the collection and the analysis of expired air during exercise; however, it is known that both heart rate

and oxygen uptake increase. This relationship allows the prediction of a maximum oxygen uptake from the maximum heart rate.

The bicycle test shows the relationship of heart rate to work and thereby can predict the workload that an individual would be capable of handling at maximum heart rate. It can also be used to predict an individual's maximum oxygen uptake.

The amount of oxygen needed for any task is a function of size (i.e., weight), so oxygen uptakes between individuals can be compared only if weight is equalized between individuals, including males and females. This is accomplished by dividing oxygen uptake by body weight. (Note: For ease of calculation, convert oxygen liters per minute to milliliters per minute by multiplying by 1,000 or by moving the decimal point three places to the right; divide by body weight in kilograms [divide pounds by 2.2 to get kilograms] and this will give results in milliliters per kilogram [milliliters divided by kilograms = mL/kg]. Because oxygen uptake is always given per minute, this expression becomes mL/kg/min, or mL X kg⁻¹ X min⁻¹."

Predicted Maximum Physical Working Capacity (PWC)

" The predicted maximum PWC shows the workload at which the heart rate is expected to reach its maximum value. Assuming the test is done correctly, the greatest source of error is the possibility that the maximum heart rate has a wide range of values at any age. If the estimate is too high, maximum PWC will be overestimated; if it is too low, it will be underestimated. Accuracy can be improved if the true maximum heart rate is known. This is sometimes available if the participant has, for some reason, recently taken a stress ECG test. However, regardless of the possible errors, the norm tables are based on 220 minus age. If the norm tables are used do not use the actual maximal heart rate even if it is known.

The greatest value in using the maximum PWC come from comparing results before and after a participant enters an exercise program."

Predicted Maximum Oxygen Uptake

" The predicted maximum oxygen uptake is an extension of the PWC test. It is useful because there is so much interest in maximum oxygen uptake in current scientific and popular literature. As with the maximum PWC, improvement is

expected with conditioning, and the results can be compared to available norms.

Assuming that the test is done correctly, the predicted maximum oxygen uptake is subject to the same source of errors as is the predicted maximum PWC, that is, the accuracy of the age-estimated maximum heart rate. There is also a second source of error. The oxygen uptake is calculated from the estimated maximum work rate. The assumption is that everyone expends the same amount of energy and uses the same amount of oxygen at a given work rate (energy expenditure is computed from the volume of oxygen used). The test will underestimate the true maximum for an individual who is very inefficient (expending a disproportionately large amount of energy to perform a given task) and will overestimate the true maximum oxygen uptake for an individual who is very efficient. Participants who are unfamiliar with bicycle exercise will tend to be less efficient than will those who bicycle regularly."

INSTRUCTIONS

1. Place strap just below the sternum on the bare skin of the chest.
2. Make sure the red button is on the left.
(Transmitter should be in center of chest).
3. Once strap is on, flip the entire strap over to wet two designated areas.
Now flip the strap back onto bare chest as shown.
4. Make sure receiver is plugged into COM1 serial port of your computer.
5. Velcro the receiver to the transmitter and you are ready to be tested.
6. To be sure not to trip on the receiver wire, hold wire in one hand away from feet while stepping up and down.
7. Put the diskette in drive A:.
8. At the A:> type HR
9. The 3-minute step test.
10. Enter necessary information, the wait for the heart rate on the screen to start beating.
11. Set the metronome to 96 bpm and turn on.
12. Once the heart rate has reach a relatively steady beat start the test by hitting the enter key.
13. The computer will beep when there is 20 seconds remaining. (Do not sit down until the 20 seconds has expired.)
14. After the test has ended remain seated for one minute, then hit enter for test result.