Some purposes of fitness testing include:
- To assess current fitness levels relative to age & sex;
- To aid in the development of an exercise program;
- To identify areas of health and injury risks with possible referral to the appropriate health professional;
- To establish goals & provide motivation; and/or
- To evaluate progress.
Introduction

A comprehensive assessment measure the following four (4) components:
1. Cardiorespiratory efficiency (at rest and during exercise)
2. Muscular strength & endurance
3. Muscle and joint flexibility
4. Body composition
Required vs. Optional Evaluation Components

- An exercise history and attitude questionnaire is a prerequisite assessment that should be used as a minimum evaluation tool for any client who, for whatever reason, is not being comprehensively tested.

- The American College of Sports Medicine (ACSM) recommended that men over 45 and women over 55 with two (2) or more cardiovascular risk factors have a physician-supervised maximal graded exercise test before taking part in any vigorous exercise (i.e., > 60% of capacity). Refer to the PAR-Q.
Required vs. Optional Evaluation Components

- All clients should read and sign an informed consent before being tested.

- Informed consent is a voluntary acknowledgement of the purpose, procedures, and specific risks of an activity in which one intends to engage.
Cardiorespiratory Testing & Evaluation

- Cardiorespiratory testing can give you valuable information to aid in both the development and maintenance of your client’s program.

- Regular resting heart rate and blood pressure checks provide some basic cardiovascular health status and program progress information.
Cardiorespiratory Testing & Evaluation

- Resting heart rate may be measured indirectly by placing the fingertips on a pulse site (palpation) or directly by listening through a stethoscope (auscultation).

- Stroke volume is the amount of blood pumped by the left ventricle in one heart beat.
Cardiorespiratory Testing & Evaluation

- Blood pressure reflects the force of the heartbeat and the resistance of the arteries to the pumping action of the heart.

- Systolic blood pressure represents the pressure created by the heart as it pumps blood (via ventricular contraction) to the body.

- Diastolic blood pressure represents the pressure that remains in the arteries, during the filling phase of the cardiac cycle, when the heart relaxes.
Cardiorespiratory Testing & Evaluation

• Cardiorespiratory fitness is directly assessed by measurement of $O_2$ uptake during a maximal graded exercise test, or indirectly by estimating maximal $O_2$ uptake ($VO_2$ max).

• During submaximal fitness tests, it is important to record perceived exertions.
## Ratings of Perceived Exertion

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<th>RPE</th>
<th>Category Ratio Scale</th>
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</table>
Cardiorespiratory Testing & Evaluation

• Target Heart Rate (THR) - the number of heartbeats per minute that indicate appropriate exercise intensity levels for an individual; also called training heart rate.

• The Karvonen Formula is the mathematical formula that uses maximum heart rate reserve minus resting heart rate to determine target heart rate.
Karvonen Formula

Below is an example of the Karvonen formula for a 23-year-old person with a resting heart rate of 65bpm:

220-23 (age) = 197
197-65 (RHR) = 132
132 * 65% (low end of heart rate) OR 85% (high end) = 85.8 or 112.2
85.8 + 65 (RHR) = 150
112.2 + 65 (RHR) = 177

The target heart rate zone for this person would be 150-177.
Maximal O$_2$ Uptake = Maximal O$_2$ Consumption (VO$_2$ max)

- Maximal O$_2$ uptake measurements are taken from weight-bearing activities such as walking, jogging, & stepping and are expressed in milliliters (mL) of O$_2$ per kilogram (kg) of bodyweight per minute.

  $\text{mL O}_2 / \text{kgbw/ min}$

- Absolute O$_2$ uptake can be converted to relative O$_2$ uptake by using the following formula:

  \[
  \text{Relative O}_2 \text{ uptake} = \text{O}_2 \text{ uptake (L/min) \times 1,000} / \text{bodyweight (kg)}
  \]
Cardiorespiratory Testing & Evaluation

- The calculation of relative $O_2$ uptake allows for comparison to others of different body weights.

- A heavy person may have a somewhat high absolute maximal $O_2$ uptake (L/ min) when compared to a lighter person, but when expressed in relative terms (mL/ kg/ min), the lighter person may show a higher level of cardiovascular fitness.
## Absolute vs. Relative O₂ Uptake

<table>
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<th>Weight</th>
<th>Subject A</th>
<th>Subject B</th>
</tr>
</thead>
<tbody>
<tr>
<td>231# (105kg)</td>
<td>3.8L/ min</td>
<td>3.2L/ min</td>
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<tr>
<td>132# (60kg)</td>
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</table>

### Absolute VO₂ Max

<table>
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<tr>
<th>Weight</th>
<th>Subject A</th>
<th>Subject B</th>
</tr>
</thead>
<tbody>
<tr>
<td>231# (105kg)</td>
<td>3.8 x 1,000/105 = 36.1mL/kg/min</td>
<td>3.2 x 1,000/60 = 53.3mL/kg/min</td>
</tr>
<tr>
<td>132# (60kg)</td>
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</tbody>
</table>
Cardiorespiratory Testing & Evaluation

- The YMCA adapted a submaximal bicycle ergometer test, to evaluate physical working capacity, in order to estimate maximal $O_2$ uptake.

- The YMCA uses the bicycle ergometer instead of the treadmill because it is less expensive, requires little space, is easily transported, and makes it easier to take a heart rate.

- And, because its external work is known (treadmill workload must be calculated from rate & grade), it requires little training or practice.
Cardiorespiratory Testing & Evaluation

• The Ross Submaximal Treadmill Test is an easy-to-use alternative to bicycle ergometer testing.

• The treadmill speed is held constant at a comfortable walk of 3.4mph, and the elevation is increased every three (3) minutes.

• The change is 4% per stage for men and 3% per stage for women.
Cardiorespiratory Testing & Evaluation

- The YMCA Submaximal Step Test is a three-minute step test where the aerobic stimulus is controlled by stepping to a standardized cadence.

- This type of test is easier to administer than the bicycle ergometer test. It requires less equipment, costs less, and can be used in mass testing situations.

- A disadvantage of this test is that it does not result in an estimation of maximal O₂ consumption.
Cardiorespiratory Testing & Evaluation

- The McArdle Step test is an alternative step test which may be more useful for fit clients.

- Though this test results in an estimation of maximal O₂ uptake, the standard of error of estimation of +/-16% is still comparable to other submaximal tests.
Cardiorespiratory Testing & Evaluation

- The Rockport Fitness Walking Test is routinely used to assess the cardiovascular fitness of those with a low-to-moderate aerobic fitness level.

- The test involves a timed one-mile walk on a smooth and level surface.
Cardiorespiratory Testing & Evaluation

- The BYU (Brigham Young University) Jog Test is similar to the Rockport test except it replaces walking with jogging.

- It is a good test for more fit clients.

- The test requires a one-mile jog at a steady pace, and exercise heart rate is measured immediately after the run.
Body Composition Testing & Evaluation

- Body composition refers to the quality or makeup of total body mass, which can be divided into fat-free mass and fat mass.

- Fat-free mass is composed of bone, muscle, and organs.

- Fat is composed of adipose tissue.

- Body composition assessment determines the relative percentages of fat-free and fat mass.
Body Composition Testing & Evaluation

• Hydrostatic weighing, also known as underwater weighing, is considered to be the “gold standard” of body composition assessment.

• Bioelectrical impedance is a popular method for determining body composition by measuring the body’s resistance to electrical flow.
Body Composition Testing & Evaluation

- More useful estimates of body composition can be obtained by adjusting weight for height or stature and calculating a height-normalized index.

- The most commonly used index is the body mass index (BMI), which is calculated as follows:

  \[ \text{BMI} = \frac{\text{Weight (kg)}}{\text{Height}^2 (m)} \]

  - Convert pounds to kilograms by dividing by 2.2.
  - Convert inches to meters by multiplying by 2.54 then dividing by 100.

  Ex., 185# 6’2” Client

  \[ 84\text{kg/ (1.88m)}^2 = 23.8 \text{ (BMI)} \]
Anthropometric assessments of body composition are perhaps the easiest and least expensive methods for assessing body composition. These assessments include circumference and skinfold measures, which are readily used in the field. Anthropometric measures also can be used to estimate body fat and its distribution (i.e., central vs. peripheral, or upper vs. lower body).
Body Composition Testing & Evaluation

- Waist-to-Hip Circumference Ratio (WHR) - A measure for determining health risk due to the site of fat storage; taken by dividing the abdominal girth (waist measurement) by the hip measurement to form a ratio.
Body Composition Testing & Evaluation

• Of the many equations for estimating body composition, two developed by Jackson and Pollock (1985) have the smallest margin of error for the general population.

• These equations are based on the sum of measurements taken at three (3) sites:
  - Men - chest, thigh, & abdomen
  - Women - triceps, thigh, & suprailium
Body Composition Testing & Evaluation

- The two (2) primary sources of error in measuring girth are inconsistent tape placement during repeated measures and variations in the tension placed on the tap during the measurement.
Flexibility Testing & Evaluation

- Flexibility is defined as the range of motion of a given joint.

- It is often associated only with muscular flexibility, the extent to which range of motion is limited by muscles and tendons surrounding the joint.
Flexibility Testing & Evaluation

- The trunk-extension test evaluates the amount of backward bend (extension) available to the lumbar spine.

- To evaluate trunk-extension, have the client lie face down with the hands in position for a push-up. The client then pushed the upper body up while letting the lower back relax as much as possible and attempting to keep the hip bones in contact with the floor. Note the location along the spine where the bending is taking place, then evaluate trunk-extension using established criteria.
Flexibility Testing & Evaluation

- Hip flexion tests evaluate range of motion in the hips & hamstring tightness.

- To assess hip flexion, have the client lie flat on his or her back. Hold the left leg down with your right hand to stabilize the pelvis, and use your left hand to passively raise the right leg to an angle of 80-85 degrees. Normal range of motion will allow for this amount of hip flexion.
Flexibility Testing & Evaluation

- The test of shoulder flexibility measures the multi-rotational components of the shoulder joints.

- Test the left shoulder of a client by having him/her sit or stand with their right arm straight up, letting the elbow bend so the hand comes to rest, palm down, between the shoulder blades. The client should reach back with the left arm so the palm is up. Have the client attempt to touch hands. Evaluate shoulder flexibility using established criteria, and repeat the procedure for the opposite shoulder.
Muscular Strength/Endurance Testing & Evaluation

- Two (2) components of muscular fitness testing are muscular strength and muscular endurance.
  - Muscular strength is the greatest amount of force that muscles can produce in a single maximal effort.
  - Muscular endurance refers to the muscle’s ability to exert a submaximal force either repeatedly or statically over time.
Muscular Strength/Endurance Testing & Evaluation

- Any strength test that involves movement will either underestimate or overestimate maximum force output. This is because internal muscle friction decreases effective force output during concentric exercises, and increases effective force output during eccentric contractions. Faster movement speeds produce even more muscle friction.

- Consequently, isometric (static) strength testing is the most accurate means for assessing actual muscle strength because it entails muscle contraction without movement.
Muscular Strength/Endurance Testing & Evaluation

• Isokinetic strength testing measures effective muscle force output at every point in the movement range using a computer.
Muscular Strength/Endurance Testing & Evaluation

• The most popular form of strength testing is dynamic (isotonic) assessments using free weights or weight-stack machines.

• Examples include the one-repetition maximum (1RM) bench press, squat, overhead press, and dead-lift.
Muscular Strength/Endurance Testing & Evaluation

• The assessment of muscular strength can be independent of muscular endurance; however, the assessment of muscular endurance can also measure muscular strength to a degree.

• There are two (2) muscle-endurance tests that are reliable, easy to administer, and relative to body weight:
  1. Push-up test
  2. Half sit-up test

• The bench-press test is another option, but it only measures muscular endurance - not any facet of muscular strength and is not relative to body weight.
Follow-Up

- The frequency of follow-up testing will depend on the quality and quantity of exercise training and on the design of the testing and training packages offered by you or the fitness center.

- The first follow-up tests are usually administered 4-12 weeks following the onset of training.

- The most important goal of follow-up testing is to evaluate the program’s effectiveness over time.