# Assessments

Structured exercises and physical activities are known to reduce an individual’s risk for mortality and morbidity, while also providing many physiological, emotional, and cognitive benefits. While light-to-moderate intensities of exercise, such as walking or jogging, are generally considered safe for much of the population, higher-intensity activities in certain individuals may hold inherent risk of harm. For example, high-intensity interval training (HIIT) is a popular exercise format, but because of the more intense nature of the type of exercise, it might not be suitable at the outset for individuals who are deconditioned or those who have health concerns like high blood pressure or cardiovascular disease. Therefore, all new exercisers should be appropriately screened using some form of a health risk assessment (HRA) prior to initiating an exercise program to evaluate the benefits versus the risks of starting a program. An HRA is conducted to evaluate the safety of an individual participating in exercise. It differs from a fitness assessment, which measures physical parameters of fitness like aerobic capacity or body composition. Furthermore, fitness assessments can include both subjective and objective measures. Subjective measures reflect what the individual feels, experiences, or reports (e.g., low energy, back discomfort, headaches), whereas objective measures are quantified through the collection of data (blood pressure, heart rate, body fat percentage, etc.). Although both can be viewed as important, the collection of objective data is necessary to determine risk while quantifying any baseline or starting measures.

Although the general purposes of conducting physiological assessments are to collect baseline data to help fitness professionals develop personalized exercise programs, they serve many other important roles:

* Identifying individuals who are at increased risk for any cardiovascular, pulmonary, or metabolic diseases, or their signs or symptoms, and should first undergo more thorough medical evaluations
* Identifying individuals with medical contraindications who should be excluded from exercise until conditions have been corrected or are under control
* Identifying those individuals with medical contraindications who should participate in medically supervised programs
* Reducing the need for unwarranted medical evaluations prior to partaking in an exercise program for apparently healthy adults
* Providing appropriate recommendations regarding initiation or continuation of exercise or physical activity
* Educating individuals about their current physical condition
* Enabling effective program evaluation (i.e., tracking progress) using baseline and follow-up data
* Using the information to motivate individuals through realistic goal setting.

## Preparticipation screening

As indicated previously, it is necessary to always screen an individual with an HRA prior to starting any exercise regimen that involves exertion. This screening should take place prior to participation in any strenuous fitness assessments or exercise.

**The Health Risk Assessment**

Questionnaires are used to collect information regarding existing risk factors for participation in exercise and physical activity to determine the need for medical clearance beforehand. This is a vital, first step in the preparticipation screening process, but this screening procedure should always be valid, simple, and cost and time efficient, and it should also be appropriate for the target population. Remember, new exercisers may be apprehensive, both about starting exercise and the use of a long, overly detailed and time-consuming HRA, which might increase their anxieties associated with moving forward.

**Physical Activity Readiness Questionnaire (PAR-Q+)**

The Physical Activity Readiness Questionnaire (PAR-Q+) was developed in 2011, and updated in 2019, as an attempt to simplify the preparticipation screening and remove some of the unnecessary barriers for individuals seeking to adopt active behaviours, such as excessive and unnecessary doctor referrals. It is a questionnaire given to prospective clients to gain insight into their current health and wellness.

The PAR-Q+ and preparticipation process reflects these health indicators:

* An individual’s current level of physical activity
* Presence of signs or symptoms and/or known cardiovascular, pulmonary (respiratory), renal (kidney), or metabolic disease (e.g., diabetes)
* Desired exercise intensity (light, moderate, vigorous).

CRITICAL

Fitness professionals should continue to consult with medical professionals for any questions pertaining to disease or signs and symptoms found in their client’s PAR-Q+.

The criteria also provide general recommendations for medical clearance rather than a specific need for medical exams. This allows for greater discretion to the Certified Personal Trainer in the decision-making process, because exercise testing is not a uniformly recommended screening process for all individuals initiating an exercise program.

Part one of the questionnaire consists of seven questions. If the client answers no to all seven questions, then the survey is considered complete. However, if the client answers yes to any of the initial seven questions, they must complete part two of the survey.

CRITICAL

The PAR-Q+ has always been recognized as a minimal yet safe pre-exercise screening measure for low-to-moderate, but not vigorous, exercise training. While the seven questions are simple to administer, its simplicity was also problematic as it offered little opportunity for interpretation of the questions asked. Unfortunately, this resulted in far too many individuals not being cleared for participation and being referred unnecessarily to their doctors for medical clearance. For example, an individual diagnosed with any pulmonary diseases (e.g., asthma) was automatically referred to their medical provider for clearance before initiating an exercise or physical activity program. In reality, these diseases do not appear to increase the risks of fatal or nonfatal cardiovascular complications during or immediately following exercise.

STRETCH YOUR KNOWLEDGE

The current PAR-Q+ includes additional follow-up questions to better guide participation recommendations that were not part of the original PAR-Q for individuals who indicated yes on one or more questions. These questions aim to reduce false-positive screenings, reduce barriers to exercise initiation, and help customize pre-exercise recommendations based on relevant medical history and symptomology. This second section or follow-up inquiry consists of 10 questions, divided into multiple parts, focused on identifying signs and symptoms of any significant cardiovascular, pulmonary, or metabolic condition. Remember that signs or symptoms must be interpreted by a qualified professional within the clinical context in which they appear; Certified Personal Trainers are not qualified to make any such diagnosis. For example, if an individual complains of some occasional chest pain and tightness, the fitness professional should not make any diagnosis, assumptions, or deductions. To respect scope of practice, the fitness professional should encourage the individual to consult with their own medical provider.

**Health History Questionnaire (HHQ)**

A thorough pre-exercise health history questionnaire (HHQ) collects relevant information on the individual’s past and present health and serves to complement the PAR-Q+ in expanding one’s understanding of the participant’s health. This questionnaire is not normally standardized to the fitness industry, but rather customized to respective facilities or organizations. In fact, a health history may be accompanied by a verbal discussion and perhaps additional questionnaires designed to gather further information regarding exercise history, eating behaviours, and general lifestyle.

An HHQ typically contains the following information about a client, which is considered private and confidential:

* Age
* Gender
* Height
* Weight
* Physician’s name and contact information
* Emergency contact information.

Any information collected about an individual during the assessment process cannot be shared without written consent from that individual; further, the information must be securely stored away from other co-workers and the public.

The questions asked within an HHQ can vary significantly, but they generally collect information about a client’s lifestyle habits, including exercise, diet, sleep, stress, occupation, and recreational pursuits. In addition, the questionnaire will include questions about medical history, including past injuries, past surgeries, chronic diseases, and medication.

**Lifestyle habits**

Understanding a client’s lifestyle is an important step before designing an exercise program. This information provides context for how a client eats, works, sleeps, and spends leisure activity. From this information, fitness professionals will be better equipped to design individualized exercise programs for their clients.

Exercise habits

Collecting exercise and physical activity information will provide an indication of a client’s fitness level. Within this area, the fitness professional should gather information on whether or not the individual is currently active and participating in any regular exercise or physical activity. If so, it’s important to know details regarding the activity: length of time (i.e., history), the nature or type, frequency, duration, and intensity.

Fitness professionals should inquire about their client’s preferred exercise activities, such as running, weight lifting, group exercise, and others. These questions will provide opportunities to learn more about an individual’s preferences and desires, which can become relevant during exercise programming. In addition, it is important to inquire about a client’s general thoughts and impressions regarding fitness testing and evaluations.

Discussions inquiring about a client’s willingness to participate in exercise programs can prove useful when developing exercise regimens. For example, a fitness professional can ask a client to rank the importance of a list of outcomes using a scale of 0 to 10, with 0 being unimportant and 10 being very important. The list of outcomes can include many items like losing weight, improving overall health, increasing muscle mass, or enhancing sports performance.

Dietary habits

While the topic of nutrition cannot be understated, considering the depth and breadth of nutritional information that can be collected, the initially gathered information should be more generalized and qualitative in nature.

For example, general eating behaviours can be collected rather than calculations of portion sizes and tracked calories. Some examples to consider include answers to the following questions:

* On a scale of 0 to 10, do you consider your overall diet to be healthy? (0 for unhealthy and 10 for very healthy).
* Are you currently following any kind of diet? If so, what diet and for what reason(s)?
* How would you rank your daily salt intake: low, medium, or high?
* How would you rank your daily sugar intake: low, medium, or high?
* How would you rank your daily fat intake: low, medium, or high?
* On a scale of 0 to 10, how effectively are you able to control your temptations for junk food (0 for easily and 10 for very difficult)?
* How many alcoholic drinks do you consume per week?
* Do you consume caffeinated beverages such as coffee, tea, soda, and/or energy drinks? How many per week?

Gathering this information helps the fitness professional, without preexisting judgment or presumptions, gain further insight into the client’s dietary habits. Over time, the client’s eating habits can be reevaluated to determine if any improvements (or setbacks) have been made. In addition, gathering this information assists the fitness professional to ascertain if the client should be referred to a registered dietitian or medical professional due to an unexpected concern.

Sleep

Sleep quality and quantity is another area of interest. Fitness professionals should inquire about their clients’ sleeping habits, including the number of hours slept each night, the quality of sleep, and even the difficulties associated with falling asleep. Sleep is necessary, and when done right, it replenishes energy stores depleted from exercise and physical activity. Conversely, chronic sleep deprivation has many health consequences, such as elevated risk for chronic disease and negative impact on cognition and mood, to name a few. It is important to recognize that it is out of scope for fitness professionals to perform detailed sleep evaluations or recommend clinical treatment to improve sleep quality. However, gaining basic insight into a client’s sleeping habits provides a coaching opportunity on the importance of getting a good night’s sleep.

Stress

Stress is becoming a more prominent aspect of life and can cause serious health effects, including raising the risk of chronic disease. Fitness professionals should inquire about their clients’ stress levels, such as using a scaling system of 0 to 10 to rate their average stress level. Conversations about stress are also relevant. Fitness professionals should investigate whether or not the individual is cognitively aware of their sources of stress, the frequency with which the individual is exposed to specific stressors, the magnitude of each stressor, and whether or not the person has identified or implemented any methods to manage these stressors.

Similar to sleep, it is beyond a fitness professional’s scope of practice to provide counselling services and mental health treatment for stress management. However, gaining a basic overview of the client’s stress levels provides a coaching opportunity. Fitness professionals can share with their client how exercise and physical activity can improve mood and disposition and reduce stress when integrated into a daily routine.

Occupation

Occupational demands and work history also provide valuable insight into potential conditions and concerns. Fitness professionals should inquire about these aspects of their client’s work:

* The nature of the client’s occupation
* Whether the job requires extended periods of time standing, sitting, or performing repetitive movements (with explanations)
* The workspace environment (e.g., office layout) and typical attire (e.g., shoes with elevated heels).

If clients are sitting for long periods throughout the day, their hips are also flexed for prolonged periods, which in turn can potentially lead to overactive hip flexors and low-back pain. Moreover, if clients are sitting for prolonged periods, especially in front of a computer, there is a tendency for the shoulders and head to experience fatigue under the constant effect of gravity, which can lead to postural imbalances, including rounding of the shoulders and a forward head. In addition, prolonged periods of sitting are indicative of low energy expenditure throughout the day and potentially poor cardiorespiratory conditioning.

Wearing shoes with high heels puts the ankle complex in a plantarflexed position for extended periods, which can lead to tightness in the calf muscles and Achilles tendons, causing postural imbalance, such as decreased dorsiflexion and overpronation at the foot and ankle complex, resulting in flattening of the arch of the foot. This may lead to pain in the feet, knees, hips, or low-back.

Recreation and hobbies

In the context of a fitness assessment, recreation refers to a client’s physical activities outside of the work environment, also referred to as leisure time. By discovering the recreational activities that a client performs, a Certified Personal Trainer can better design an exercise program to fit the needs of their clients. For example, many clients like to dance, golf, ski, play tennis, or perform a variety of other sporting activities in their spare time. Proper exercise training must be incorporated to ensure that clients are conditioned in a manner that optimizes their physical ability, without predisposing them to injury.

Hobbies refer to activities that a client might enjoy on a regular basis but are not necessarily athletic in nature. Examples can include gardening, car repair, fishing, singing, or playing music. Many common types of hobbies do not involve vigorous physical activity, yet still need to be considered to create a properly planned exercise training program.

**Medical history**

Obtaining a client’s medical history is vitally important because it provides fitness professionals with information about known or suspected chronic diseases, such as coronary heart disease, high blood pressure, or diabetes. In addition, fitness professionals should inquire if their client smokes or uses tobacco products. Furthermore, a medical history provides information about the client’s past and current health status, as well as any past or recent injuries, surgeries, or other chronic health conditions. Gathering this information helps determine if a client is ready for a new exercise routine or if a medical referral is necessary.

Past injuries

All past or recent injuries should be recorded and discussed in enough detail to make decisions about whether exercise is recommended, or if a medical referral is necessary. Previous history of musculoskeletal injury is also a strong predictor of future injury during physical activity.

The effect of injuries on the functioning of the human body is well documented, especially with regard to the following injuries:

* Ankle sprains. These have been shown to decrease muscle activation of the gluteus medius and gluteus maximus muscles. In turn, this can lead to poor control of the lower extremities during many functional activities, which can eventually lead to injury
* Knee injuries involving ligaments. A knee injury can cause a decrease in activation to muscles that stabilize the patella (kneecap) and lead to further injury. Noncontact knee injuries are often the result of ankle or hip dysfunction because the knee is caught between the ankle and the hip. If the ankle or hip joint begins to function improperly, this results in altered movement and force distribution of the knee. Over time, this can lead to further injury
* Low-back injuries. These injuries can cause decreased activation to stabilizing muscles of the core, resulting in poor stabilization of the spine. This can further lead to dysfunction and pain
* Shoulder injuries. These injuries cause altered muscle activation of the rotator cuff muscles, which can lead to instability of the shoulder joint during functional activities
* Other injuries. Additional injuries can include (but are not limited to) repetitive hamstring strains, groin strains, patellar tendonitis (jumper’s knee), plantar fasciitis (pain in the heel and bottom of the foot), shin splints, biceps tendonitis (shoulder pain), and headaches.

Past surgeries

Surgical procedures create trauma for the body. These procedures may produce effects similar to injuries on the functioning of the human body and the safety and efficacy of exercise. Fitness professionals frequently interact with clients who have experienced some of the following more common surgical procedures:

* Foot and ankle surgery
* Knee surgery
* Back surgery
* Shoulder surgery
* Caesarean section for birth (cutting through the abdominal wall to deliver a baby)
* Appendectomy (cutting through the abdominal wall to remove the appendix).

Chronic disease

The risk of chronic disease increases dramatically in those individuals who are physically inactive. Chronic diseases can include the following:

* Cardiovascular disease, coronary heart disease, coronary artery disease, or congestive heart failure
* Hypertension (high blood pressure)
* High cholesterol or other blood lipid disorders
* Stroke or peripheral artery disease
* Lung or breathing problems
* Obesity
* Diabetes mellitus
* Cancer.

Medications

Many clients seeking fitness and exercise training advice from fitness professionals will currently be under the care of a physician or another medical professional, and they may be taking one or more prescribed medications. It is not the role of the Certified Personal Trainer to administer, prescribe, or educate clients on the usage and effects of any form of legally prescribed medication by a licensed physician or other healthcare provider. Certified Personal Trainers should always consult with their client’s physician or medical professionals regarding the client’s health information and which medications they may be currently taking, if any.

**Conducting health and fitness assessments**

Once the HRA is completed, and if the individual does not require medical clearance to initiate exercise, the fitness professional should then start to consider the need and the propriety of conducting various fitness assessments. Although fitness assessments provide lots of valuable information to the Certified Personal Trainer, clients may not feel comfortable undergoing specific assessments, especially if they believe they might not be able to complete the assessment. It’s possible that they might feel embarrassed by their results. For example, if Mary is deconditioned, the notion of completing a 1.5-mile run test might be both intimidating and uncomfortable. The decision on what and when to assess is never straightforward—it requires careful consideration on the part of the fitness professional.

Assessment considerations

A fitness professional should always be able to provide good rationale for any fitness assessments that they elect to conduct on a client. This rationale often manifests itself out of the following events, which should always be considered on a case-by-case basis.

Assessment sequencing

Some assessments should be conducted prior to performing specific exercises because of the way physical exertion impacts these measurements. For example, resting heart rate (RHR), blood pressure, and skinfold body fat are acutely affected by physical exertion, which may skew results. On the other hand, flexibility is frequently assessed following a light cardio warm-up because at this time the body displays greater tissue extensibility.

Fitness assessments that do not require physical exertion, such as the measurement of RHR, blood pressure, or body composition, should always be conducted prior to more vigorous fitness assessments that measure aerobic fitness, strength, or power output.

GETTING TECHNICAL

Physical activity raises a person’s heart rate and blood pressure. Consequently, measurements for RHR and blood pressure should be taken while the client is at rest.

Skinfold body fat testing should also be conducted while the client is in a rested state. Thermoregulation during exercise creates peripheral vasodilation at or around the skin to help remove heat, but this can increase a skinfold body fat measurement score.

Assessment: safety and legal implications

To maximize safety and minimize legal implications, all personnel involved in exercise testing and supervision must have a current certification for cardiopulmonary resuscitation (CPR) and automated external defibrillator (AED). Within a fitness facility, the responsibilities of Certified Personal Trainers responding to emergencies should be clearly defined and documented.

CRITICAL

An established written emergency plan should be clearly posted, including emergency medical services' telephone numbers. Regularly scheduled emergency medical services response rehearsals are advised to help improve response rates and times.

**Exercise test termination criteria**

During the administration of an assessment involving physical exertion (e.g., cardiorespiratory test), the fitness professional should always be aware of signs and symptoms that merit immediate termination of the test and a possible referral to a medical professional.

**Pre-assessment instructions**

Prior to conducting any assessment, measures should be taken to ensure individual safety and comfort. In advance, the fitness professional should provide precise and clearly defined instructions regarding preparation for testing. Clients should wear comfortable, athletic clothing and ingest plenty of fluids over the 24-hour period preceding the test to optimize hydration levels. Clients should also avoid heavy food, tobacco, alcohol, and caffeine at least 3 hours prior to testing, avoid exercise or strenuous activity the day before or the day of the test, and get adequate amounts of sleep the night before the test.

TRAINING TIP

Explaining and Demonstrating Assessments

Adopt a philosophy of briefly explaining the purpose of the test, the protocol, and expectations. However, keep your explanations short and simple and use appropriate easy-to-understand language. Because many individuals are visual learners, include demonstrations whenever possible (the explanation and demonstration can occur simultaneously). When appropriate, allow for some practice trials to facilitate learning and mastery of the physical tasks required.

## Fitness assessment protocols

Fitness assessments are an integral part of the services offered by fitness professionals to their clients. The ability to assess baseline measurements will facilitate the design and development of exercise programs while also providing a means to evaluate progress. Every fitness professional should possess the knowledge, skills, and abilities to select, administer, and interpret a variety of different physiological parameters aligned with their client’s health, fitness, or performance goals.

**Heart rate**

Heart rate (HR) is a valid indicator of work intensity or stress, both at rest and during exercise. Monitoring changes in resting HR helps to identify cardiovascular adaptations (becoming more aerobically fit) or regressions (deconditioning). Resting heart rate (RHR) lowers with improved fitness levels because the heart and lungs become more conditioned. When this occurs, the heart becomes stronger and can pump out more blood with each beat. This causes more oxygen and nutrients to be transported throughout the body. Conversely, when a person’s fitness level decreases, or they become ill, the RHR may elevate. These are important effects to understand because they provide the fitness professional with valuable physiological feedback on the training status of their client. However, it is also important to recognize that gender differences do exist in RHR, with men averaging approximately 5 to 10 fewer beats per minute than women. These differences can be explained in part to the smaller sizes of the heart chambers and lower volumes of circulating blood in women, which require an elevated HR response. This means that RHR measurements for men and women should not be compared against each other to assess fitness levels. Rather, fitness professionals should gauge how an individual’s own RHR changes with training.

Measuring heart rate manually

HR can be measured at many points around the body where an artery’s pulsation is transmitted to the body’s surface, often occurring when a blood vessel is compressed against an underlying structure, such as a bone or joint. The RHR is most accurately measured just before an individual gets out of bed in the morning.

There are many anatomical locations that can be used to measure a client’s RHR. However, for accuracy, safety, and ease of administration, we recommend that fitness professionals measure a client’s radial pulse.

Blood pressure

Blood pressure (BP) is defined as the outward pressure exerted by blood on the arterial walls. Blood pressure is not consistent within each heart beat—the pressure fluctuates between a peak and a low pressure in the bloodstream during each beat. This explains why two numbers are measured. Both are important to score because collectively, they provide insight into the average pressure within the bloodstream.

Systolic blood pressure (SBP), sometimes referred to as the top number, reflects the greatest pressure during the cardiac cycle. The SBP equals the force of blood pushing against the arterial walls when the heart is contracting and is measured in millimetres of mercury (mm Hg).

Diastolic blood pressure (DBP), sometimes referred to as the bottom number, reflects the lowest pressure during the cardiac cycle. The DBP equals the remaining force generated by the blood in the arteries while the heart is relaxed (not contracting) and is also measured in millimetres of mercury.

STRETCH YOUR KNOWLEDGE

NASM recommends fitness professionals measure RHR at the radial pulse versus the carotid pulse (which is located at the neck just to the side of the larynx), because the vagus nerve lies adjacent to the carotid artery. Applying too much pressure to the vagus nerve can inadvertently slow a client’s heart rate response.

Blood pressure is measured within the arterial system while using the brachial artery as the standard site of measurement, given its ease of access and the ability to hold the arm level with the position of the heart, which increases the accuracy of measurement.

GETTING TECHNICAL

In 2017, the American College of Cardiology and American Heart Association revised the classification scores for blood pressure and the risk they pose to overall cardiovascular health. New research illustrates the usefulness of DBP scores in predicting independent mortality risks in younger adults, while SBP is more important in predicting independent mortality risks in adults older than 50 years.

Blood pressure scores are important because higher scores indicate greater risks for developing cardiovascular disease, which can become life-threatening. Because both SBP and DBP represent pressure within the bloodstream, guidelines have been created that assess this degree of risk.

Measuring blood pressure

Blood pressure is traditionally measured using an aneroid sphygmomanometer, which consists of an inflatable cuff, a pressure dial, a bulb with a valve, and a stethoscope; however, digital blood pressure monitors are becoming more popular.

| **Classification** | **Systolic BP** | **Diastolic BP** | **Recommendation** |
| --- | --- | --- | --- |
| Normal | <120 mm Hg | <80 mm Hg | Maintain |
| Elevated | 120–129 mm Hg | <80 mm Hg | Lifestyle changes |
| Stage 1 hypertension | 130–139 mm Hg | 80–89 mm Hg | Lifestyle changes + medical monitoring |
| Stage 2 hypertension | ≥140 mm Hg | ≥90 mm Hg | Lifestyle changes + medical monitoring + medications |
| Hypertensive crisis | >180 mm Hg | >120 mm Hg | Seek immediate medical attention |

Measuring BP takes proper guidance and practice. It is recommended that all individuals, including fitness professionals, attend a live training class to learn how to properly assess BP. The following paragraphs are generalized steps for assessing BP using an aneroid sphygmomanometer (for informational purposes only).

To record BP, instruct the client to assume a comfortable seated position and place the appropriate size cuff on the client’s arm just above the elbow. Next, either rest the arm on a supported chair, or support the arm using your own arm, and place the stethoscope over the brachial artery, using a minimal amount of pressure. Continue by rapidly inflating the cuff to 20 to 30 mm Hg above the point at which the pulse can no longer be felt at the wrist. Next, release the pressure at a rate of about 2 mm Hg per second, listening for a pulse. To determine the SBP, listen for the first observation of the pulse. Diastolic pressure is determined when the pulse fades away. For greater reliability, repeat the procedure on the opposite arm.

CRITICAL

Abnormal Readings

If abnormal readings are made during a blood pressure assessment, repeat the measurement on the opposite arm. A significant discrepancy in the readings between the arms could represent a circulatory problem, and the individual should be referred to their physician for a medical evaluation.

### Anthropometry and body composition measurements

Anthropometry is the field of study of the measurement of living humans for purposes of understanding physical variation in size, weight, and proportion. Many different anthropometric measures exist, including body fat assessments, body mass index (BMI), and circumference measurements. Although many clients have goals of weight loss, what is really implied is a loss of fat mass while retaining or perhaps gaining lean muscle mass. While scale weight can measure and monitor weight loss, it is unable to determine the relative ratios of fat and muscle mass potentially being lost.

The purpose behind body composition measurements is to quantify body compositional changes (e.g., losses of fat mass) from which an individual can be classified as healthy or unhealthy. Currently, there is no universally accepted, standard percentage of body fat for all ages and genders. In general, men’s body fat percentages are lower than those for women. These studies demonstrate that healthy body fat typically ranges from about 10% to 20% for men and about 20% to 30% for women, although these ranges can vary significantly based on the individual’s age, gender, and ethnicity.

**Body Mass Index**

BMI is a rough assessment based on the concept that a person’s weight should be proportional to his or her height. An elevated BMI is linked to increased risk of disease, especially if associated with a large waist circumference (Aune et al., 2016). Although this assessment is not designed to assess body fat, BMI is a quick and easy method for determining whether a person’s weight is appropriate for that person’s height.

BMI can be determined using several methods, including mathematical formulas available in both metric and imperial units and various online calculators. There are two formulas to calculate BMI. It is calculated by either dividing a person’s weight in kilograms by the square of their height in meters, or dividing their body weight in pounds by the square of their height in inches, and multiplying by 703.

* Metric formula: BMI = weight (kg) ÷ [height (m)]2
* Imperial formula: BMI = 703 × weight (lb) ÷ [height (in.)]2

TRY THIS

Calculate Mary’s BMI score using either formula if she currently weighs 160 lb (72.57 kg) and stands 5 ft 7 in. or 67 in. (1.70 m).

Answer: BMI = 25.1

The lowest risk for disease lies within a BMI range of 22 to 24.9. Scientific evidence indicates that the risk for disease increases with a BMI of 25 or greater. Even though research has shown the risk for premature death and illness does increase with a high BMI score, individuals who are underweight are also at risk.

Because of its simplicity and measurement consistency, BMI is the most widely used measure to determine overweight and obesity levels. BMI is a useful tool to screen the general population, but its one weakness is that it fails to differentiate fat mass from lean body mass. Using BMI, athletes or bodybuilders with a large amount of muscle mass can mistakenly fall within the moderate- to high-risk categories.

| **BMI** | **Disease Risk** | **Classification** |
| --- | --- | --- |
| <18.5 | Increased | Underweight |
| 18.5–24.9 | Low | Healthy weight |
| 25.0–29.9 | Increased | Overweight |
| 30.0–34.9 | High | Obese |
| 35.0–39.9 | Very high | Obesity II |
| ≥40.0 | Extremely high | Obesity III |

**Circumference measures**

A circumference is a measure of the girth of body segments (e.g., arm, thigh, waist, and hip), which serves to identify body shape and changes, and acts as an important indicator of health risks for diseases such as heart disease and diabetes.

* Individuals described as android or apple-shaped are characterized as having more fat within the abdominal region of the body (i.e., more visceral fat), which is associated with elevated health risks.
* Individuals described as gynoid or pear-shaped are characterized as having more fat within the hips and thighs, which may be associated with a lower health risk when compared to an android.

Waist circumference

The most commonly measured circumference measure is the waist circumference; as a stand alone, it can be used to assess health.

Men with a waist circumference greater than or equal to 100 cm (~40 in.) are at higher risk for developing health issues, such as cardiovascular disease or diabetes, while women with a waist circumference greater than or equal to 88 cm (~35 in.) are at higher risk for developing health issues like diabetes and cardiovascular disease. It is important for fitness professionals to monitor each client’s waist circumference to identify health risks and track weight loss efforts. However, some clients may feel apprehensive and do not wish to have their waist measured. In these instances, fitness professionals are advised to teach their clients how to measure their own waistlines and report their findings back to the professional.

| **Risk Category** | **Women** | **Men** |
| --- | --- | --- |
| Very low | <70 cm (< 27.5 in.) | <80 cm (<31.5 in.) |
| Low | 70–89 cm (27.5–35.0 in.) | 80–99 cm (31.5–38.9 in.) |
| High | 90–109 cm (35.4–42.9 in.) | 100–120 cm (39.3–47.2 in.) |
| Very high | ≥110 cm (≥43.3 in.) | >120 cm (>47.2 in.) |

Waist-to-hip ratio

The waist-to-hip ratio (WHR) is another commonly used set of circumference measurements used to assess health risk by defining the shape of the body (i.e., android, gynoid). The hip circumference measures the widest circumference around the hips or buttocks region, above the gluteal fold, where the buttocks join the back of the thigh. With both measurements, a ratio can be determined using the formula provided.

WHR = Waist Measurement ÷ Hip Measurement

A high WHR has significant health implications because individuals who are more apple-shaped and carry more fat in the abdominal region are at greater risk for developing cardiovascular and metabolic diseases, such as diabetes.

| **Health Risk** | **Men** | **Women** |
| --- | --- | --- |
| Low | 0.95 or lower | 0.80 or lower |
| Moderate | 0.96–1.0 | 0.81–0.85 |
| High | 1.0 or higher | 0.86 or higher |

Additional circumference measures

Circumference measurements can be measured at almost any body segment, although standardized sites exist as described in Table 11-5. Some of these measurements can also be used to quantify body composition (i.e., percentage of body fat), even with significantly overweight clients, but they unfortunately correlate poorly with true body composition measurements. They are better used to assess girth changes in the body over time, rather than body fat percentage, and offer the convenience of being inexpensive and easy to administer.

Many clients might be keen to have their body composition measured, but accurate assessments of body composition are not always easy to obtain. Measuring circumference can become a good alternative, because measurements taken at various locations can provide valuable feedback to clients on their bodily transformation while they work toward achieving their fitness goals.

**Skinfold measurements**

Skinfold measurements continue to remain a popular method for determining body composition, although significant skill is required in locating the skinfold sites and accurately measuring fat folds using callipers. This takes practice, and it is recommended that fitness professionals learn from a trained professional before using these techniques. Table 11-6 provides descriptions of the different locations used by various skinfold measurement protocols.

Calliper skills and techniques

Skinfolds (SKF) are indirect measurements of the thickness of subcutaneous adipose tissue (fat beneath the skin). The assumption is that the amount of fat present in the subcutaneous region of the body is proportional to overall body fatness, and most of the time, this is the case. Proper assessments of body composition using skinfolds include these recommendations:

* Train with an individual skilled in SKF assessment and frequently compare your results against theirs.
* Take a minimum of two measurements at each site; each site must be within 1 to 2 mm to take an average.
* Completely open the jaw of the caliper before removing from the site.
* Be meticulous when locating anatomic landmarks.
* Do not measure SKFs immediately after exercise.
* Instruct clients ahead of time regarding test protocol.
* Avoid performing SKFs on obese clients.

Jackson and Pollock seven-site protocol

The Jackson and Pollock 7-Site protocol, like all SKF methods, mandates skill and proficiency on the part of the fitness professional in measuring the skinfold sites. To perform this assessment, the sum of the averages of the acceptable measurements from each site are totalled and used to calculate body density. The same seven sites are used for both men and women. Once the sum of the SKFs has been recorded, various online resources (e.g., tables, calculators) can be used for estimating body fat percentage.

| **Gender** | **Sites** |
| --- | --- |
| Men | Chest, mid-axillary, subscapular, triceps, abdomen, suprailiac, thigh |
| Women | Chest, mid-axillary, subscapular, triceps, abdomen, suprailiac, thigh |

Jackson and Pollock three-site protocol

An alternative to the seven-site protocol is the Jackson and Pollock 3-Site protocol. The three-site method can be used for determining body composition in healthy populations. The chest, abdomen, and thigh locations are used for men, whereas the triceps, suprailiac, and thigh locations are used for women. This protocol holds good validity and offers convenience as it only requires measurements to be taken at three locations. Like the seven-site measurement, various online resources can be used for estimating body fat percentage once the three SKFs have been calculated.

| **Gender** | **Sites** |
| --- | --- |
| Men | Chest, abdomen, thigh |
| Women | Triceps, suprailiac, thigh |

Four-site Durnin-Womersley protocol

The Four-Site Durnin–Womersley protocol is an alternative to the Jackson and Pollock formulas previously described. This formula uses a simple four-site upper body measurement process. The four sites include the biceps, triceps, subscapular, and suprailiac. The same four sites are used for both men and women.

| **Gender** | **Sites** |
| --- | --- |
| Men | Biceps, triceps, subscapular, and suprailiac |
| Women | Biceps, triceps, subscapular, and suprailiac |

After the four sites have been measured, add the totals of the four sites and then find the appropriate sex and age categories for the body composition on the Durnin–Womersley body fat percentage calculation. For example, a 40-year-old female client with the sum of the SKFs of 40 has a percent body fat of 28.14%, which can be rounded down to 28%.

Skinfold assessment considerations and concerns

The different skinfold assessment protocols as described can provide many options when assessing a client’s body fat percentage. While providing the fitness professional with options, it can also prove to be confusing about which protocol to use. Some simple guidelines can simplify the decision-making process.

* Although the seven-site method is considered the most accurate because it collects SKFs at more locations across the body, this protocol is certainly more invasive to the client. As such, it may be best used for clinical or athletic populations.
* While the Jackson and Pollock three-site protocol is perhaps not as accurate as the seven-site protocol, it is still considered valid. An advantage is that the three-site protocol is less invasive to conduct.
* The Durnin–Womersley formula is best used for individuals between the ages of 17 and 49 years of age and may not be as applicable for older adults. A potential advantage is that it only requires measurements for the upper body; it does not require an individual to wear shorts for a thigh measurement.

TRAINING TIP

Assessing body fat using skinfold callipers can be a sensitive situation. Additionally, the accuracy of the SKFs for obese individuals decreases; thus, it would be more appropriate not to use this method for assessing body fat. Instead, use bioelectrical impedance, circumference measurements, scale weight, or even the fit of clothing to evaluate one’s weight loss and body fat reduction progress.

**Bioelectrical Impedance Analysis**

Unlike a skinfold assessment, bioelectrical impedance analysis (BIA) is a very easy body fat assessment to administer that does not require additional hands-on training or tables to reference. In this technique, sensors are applied to the skin, and a weak electrical current is run through the body to estimate body fat and lean body mass. Because muscle cells can contain as much as 70% to 75% water in comparison to fat cells that contain only about 10% to 15% water, a leaner individual will experience less resistance and reactance to the electrical flow versus an individual with more body fat. In other words, fat is a less efficient conductor than lean body tissue; the faster the conduction, the leaner the individual. Body weight scales with sensors, as well as handheld devices, are available to conduct this procedure.

Given the advances in technology in assessing body composition through BIA, and the concerns over SKF measurement (e.g., invasive nature, time investment, reliability of fitness professionals), BIA is becoming more commonly conducted in fitness settings. However, BIA does have its own limitations that can compromise the accuracy of the measurements taken. These include any event where the body either retains or loses water. Examples include fluctuating hydration levels, dehydration, extreme temperatures, heavy sweat rates, the use of diuretics, and even the presence of urine in the bladder volume. Furthermore, the quality of the BIA device is also an important consideration because lower-quality devices are more likely to produce inaccurate results versus higher-quality multi-extremity devices that measure at both extremities (i.e., hands and feet).

**Hydrostatic Underwater Weighing**

Underwater weighing, often referred to as hydrostatic weighing, has been the most common technique used in exercise physiology labs to determine body composition. This method is founded on the principle that bone, muscle, and connective tissues are denser and heavier in comparison to fat tissue, which is less dense, lighter, and floats. In essence, a person’s weight on land is compared to their underwater weight to determine fat percentage.

The science behind this process is Archimedes’ principle. Archimedes’ principle is a physical law of buoyancy. Because bone and muscle are denser than water, a person with a larger percentage of lean body mass will weigh more in the water and ultimately have a lower body fat percentage versus someone with less lean body mass. A person with more body fat will make the body lighter in water and will have a higher percentage of body fat. This technique is very accurate, but for obvious reasons, it is not practical outside of a laboratory setting.

### Cardiorespiratory assessments

Cardiorespiratory fitness also commonly referred to as cardio fitness or aerobic fitness, is often assessed to evaluate a client’s capacity for performing work. Knowledge of this capacity is important because it serves as a significant predictor of overall health, of one’s capacity to perform physical work, and even of longevity.

Cardiorespiratory assessments can use multiple formats, such as treadmill, step machine, or bicycle, and range from simple to very complex, all depending on the client’s abilities or the fitness goals that they plan to achieve.

Cardiorespiratory assessments help the fitness professional identify starting exercise intensities that are safe and effective for clients, as well as appropriate modes of cardiorespiratory exercise.

**VO2max**

mitochondria

* A higher VO2max score reflects greater oxygen utilization and a greater capacity for physical work.
* VO2max usually peaks at around ages 25 years to the early 30s, but it is highly trainable, implying that an active person in their 40s could have a higher VO2max than during their sedentary 20s.
* VO2max decreases by approximately 5% per decade in fit individuals (an average of 0.5% per year) and around 10% per decade in unfit individuals (an average of 1.0% per year).

Conducting a VO2max assessment provides the fitness professional with an indication of the client’s overall aerobic fitness. However, it is perhaps a better marker of health, mortality, and morbidity. VO2max may be the single most effective predictor of heart function because VO2 scores reflect overall heart health. Individuals with higher VO2max scores generally have healthier hearts, have a greater capacity to perform work, and may have lower risks of developing heart disease. However, it is not always practical to measure because of equipment requirements, time involved, and the willingness of clients to perform at maximal physical capacity. Therefore, submaximal tests are often the preferred method for determining cardiorespiratory functional capacity and fitness.

**Ratings of Perceived Exertion**

A subjective rating of perceived exertion (RPE) is a technique used to express or validate how hard a client feels that they are working during exercise. When using the RPE method, a person is subjectively rating the perceived difficulty of exercise. It is based on overall physical sensations experienced by a person during physical activity, which would include increased heart rate, increased respiration rate, increased sweating, and muscle fatigue. The client’s subjective rating should be reported based on the overall feelings of how hard they are working, including an overall sense of fatigue rather than isolated areas of the body (i.e., tired legs during treadmill testing). Although the RPE scale is a subjective measure, if clients report their exertion ratings accurately, RPE does provide a good estimate of the actual heart rate during physical activity. There are two versions of RPE: the original 6 to 20 scale, and the newer 1 to 10 scale.

| **Original Scale** | |
| --- | --- |
| 6 |  |
| 7 | Very, very light |
| 8 |  |
| 9 | Very light |
| 10 |  |
| 11 | Fairly light |
| 12 |  |
| 13 | Somewhat hard |
| 14 |  |
| 15 | Hard |
| 16 |  |
| 17 | Very hard |
| 18 |  |
| 19 | Very, very hard |
| 20 |  |

| **Rating** | **Perceived Exertion Level** |
| --- | --- |
| 0 | No exertion, at rest |
| 1 | Very light |
| 2-3 | Light |
| 4-5 | Moderate, somewhat hard |
| 6-7 | High, vigorous |
| 8-9 | Very hard |
| 10 | Maximum effort, highest possible |

**YMCA 3-minute step test**

The YMCA 3-minute step test is a cardiorespiratory assessment that assesses the aerobic fitness of deconditioned clients by having them complete 3 minutes of continuous stepping on and off a 12-in. (30-cm) box. With this assessment, cardiorespiratory fitness is evaluated from the recovery heart rate (RHR) rather than from an estimate of VO2max. The YMCA 3-minute step test is considered suitable for low-risk, apparently healthy, nonathletic adults.

YMCA 3-Minute Step Test Instructions

* Briefly discuss the protocol, answer all questions satisfactorily, and allow adequate warm-up, stretching, and recovery prior to conducting the test.
* Ensure that proper athletic footwear is worn for the test.
* Terminate the test if the individual experiences any symptoms of light-headedness, dizziness, chest pain, or excessive shortness of breath.
* The client will perform 96 steps per minute. Fitness professionals can demonstrate proper step cadence by setting a metronome to 96 “clicks” per minute and allow practice trials. If the fitness professional does not have access to a metronome, they can state out loud, “up, up, down, down” to help keep the correct cadence.
* Begin the 3-minute test and maintain cadence throughout the test.
* After completing the test, the individual sits while the fitness professional quickly palpates the radial pulse (within 5 seconds) and measures the number of heartbeats over the ensuing 60 seconds.
  + Count starts at zero.
  + The individual should lightly paddle feet to maintain circulation.
  + Allow for a proper cool-down following data collection.

Test Interpretation: Once the 60-second HR count is collected, the individual’s fitness level can be categorized.

The YMCA 3-minute step test is very basic and does not impose much of a cardiovascular challenge for aerobically fit adults. It is primarily intended as a protocol for deconditioned individuals or older adults who do not have any balance, joint issues, or concerns associated with stepping to measure how quickly their heart rate returns to normal after exercise.

| **Ratings for Men (age)** | **18–25** | **26–35** | **36–45** | **46–55** | **56–65** | **≥65** |
| --- | --- | --- | --- | --- | --- | --- |
| Excellent | 50–76 | 51–76 | 49–76 | 56–82 | 60–77 | 59–81 |
| Good | 79–84 | 79–85 | 80–88 | 87–93 | 86–94 | 87–92 |
| Above average | 88–93 | 88–94 | 92–88 | 95–101 | 97–100 | 94–102 |
| Average | 95–100 | 96–102 | 100–105 | 103–111 | 103–109 | 104–110 |
| Below average | 102–107 | 104–110 | 108–113 | 113–119 | 111–117 | 114–118 |
| Poor | 111–119 | 114–121 | 116–124 | 121–126 | 119–128 | 121–126 |
| Very poor | 124–157 | 126–161 | 130–163 | 131–159 | 131–154 | 130–151 |
| Ratings for Women (age) | 18-25 | 26–35 | 36–45 | 46–55 | 56–65 | ≥65 |
| Excellent | 52–81 | 58–80 | 51–84 | 63–91 | 60–92 | 70–92 |
| Good | 85–93 | 85–92 | 89–96 | 95–101 | 97–103 | 96–101 |
| Above average | 96–102 | 95–101 | 100–104 | 104–110 | 106–111 | 104–111 |
| Average | 104–110 | 104–110 | 107–112 | 113–118 | 113–118 | 116–121 |
| Below average | 113–120 | 113–119 | 115–120 | 120–124 | 119–127 | 123–126 |
| Poor | 122–131 | 122–129 | 124–132 | 126–132 | 129–135 | 128–133 |
| Very poor | 135–169 | 134–171 | 137–169 | 137–171 | 141–174 | 135–155 |

**The Rockport Walk Test**

For new exercisers who may not be very fit, a walking test is considered an appropriate cardiorespiratory assessment, providing an appropriate challenge while requiring little skill development or learning to complete the test. The Rockport walk test is a 1-mile walking test that predicts maximal oxygen consumption (VO2max) from either a timed performance or heart rate response. Fitness professionals should keep in mind that for fit individuals, this test will most likely underpredict their VO2max because it was not designed for fit individuals. While the test was originally developed for outdoor use on a track, it can also be used indoors using a treadmill. Rockport Walk Test Instructions

* Briefly discuss the protocol, answer all questions satisfactorily, and allow adequate warm-up, stretching, and recovery prior to conducting the test.
* Ensure that proper athletic footwear is worn for the test.
* Terminate the test if the individual experiences any symptoms of light-headedness, dizziness, chest pain, or excessive shortness of breath.
* The goal of the test is to complete the 1-mile (1.6-km) distance as quickly as possible. Pacing may be necessary, but no running or jogging is permitted. Instead, the client will walk as quickly as possible.

Test Interpretation:

1. Use the next table to determine results of the test.

Normative Values for the Rockport Walk Test

| **Rating** | **Males (Age 30–69 years)** | **Females (Age 30–69 years)** |
| --- | --- | --- |
| **Time (minutes:seconds)** | **Time (minutes:seconds)** |
| Excellent | <10:12 | <11:40 |
| Good | 10:13–11:42 | 11:41–13:08 |
| Above average | 11:43–13:13 | 13:09–14:36 |
| Average | 13:14–14:44 | 14:37–16:04 |
| Fair | 14:45–16:23 | 16:05–17:31 |
| Poor | >16:24 | >17:32 |
| Percentile | | |
| 90% | 11:08 | 11:45 |
| 75% | 11:42 | 12:49 |
| 50% | 12:38 | 13:15 |
| 25% | 13:38 | 14:12 |
| 10% | 14:37 | 15:03 |

**The 1.5-Mile Run Test**

For more fit population groups, the 1.5-mile (2.4 km) run test is a cardiorespiratory assessment that can be used to measure a client’s aerobic endurance. The 1.5-mile run test estimates aerobic fitness levels by either scoring the individual’s timed performance or their heart rate response, which is used to estimate VO2max. This test, much like the Rockport walk test, was originally developed as a field test (i.e., conducted on a track), but it can be administered indoors on a treadmill. 1.5-Mile Run Test Instructions

* Briefly discuss the protocol, answer all questions satisfactorily, and allow for adequate warm-up, stretching, and recovery prior to conducting the test.
* Ensure that proper athletic footwear is worn for the test.
* Terminate the test if the individual experiences any symptoms of light-headedness, dizziness, chest pain, or excessive shortness of breath.
* The goal of the test is to complete the 1.5-mile distance as quickly as possible. Pacing may be necessary.

Test Interpretation: Use the next tables to determine the results of the test.

Normative Values for the 1.5 Mile Run (Men)

| **Rating** | **Time to Complete 1.5 Mile Run Rating** | | | | |
| --- | --- | --- | --- | --- | --- |
| **20–29 years** | **30–39 years** | **40–49 years** | **50–59 years** | **60–69 years** |
| Superior | 8:22–9:10 | 8:49–9:31 | 9:02–9:47 | 9:31–10:27 | 10:09–11:20 |
| Excellent | 9:34–10:08 | 9:52–10:38 | 10:09–11:09 | 11:09–12:08 | 12:10–13:25 |
| Good | 10:49–11:27 | 11:09–11:49 | 11:52–12:25 | 12:53–13:53 | 14:33–15:20 |
| Fair | 11:58–12:29 | 12:25–12:53 | 13:05–13:50 | 14:33–15:14 | 16:19–17:19 |
| Poor | 13:08–13:58 | 13:48–14:33 | 14:33–15:32 | 16:16–17:30 | 18:39–20:13 |
| Very Poor | 15:14–20:55 | 15:56–20:55 | 17:04–22:22 | 19:24–27:08 | 23:27–31:59 |

Normative Values for the 1.5 Mile Run (Women)

| **Rating** | **Time to Complete 1.5 Mile Run Rating** | | | | |
| --- | --- | --- | --- | --- | --- |
| **20–29 years** | **30–39 years** | **40–49 years** | **50–59 years** | **60–69 years** |
| Superior | 9:23–10:20 | 9:52–11:08 | 10:09–11:35 | 11:34–13:16 | 12:25–14:28 |
| Excellent | 10:59–11:56 | 11:43–12:53 | 12:25–13:38 | 13:58–15:14 | 15:32–16:46 |
| Good | 12:51–13:25 | 13:41–14:33 | 14:33–15:17 | 16:26–17:19 | 18:05–18:52 |
| Fair | 14:15–15:05 | 15:14–15:56 | 16:13–17:11 | 18:05–19:10 | 20:08–20:55 |
| Poor | 15:56–17:11 | 16:46–18:18 | 18:26–19:43 | 20:17–21:57 | 22:34–23:55 |
| Very Poor | 18:39–25:17 | 20:13–25:10 | 21:52–27:55 | 23:55–30:34 | 26:32–33:05 |

GETTING TECHNICAL

Another popular cardiorespiratory assessment is the 1-mile (1.6-km) run test. Although this test is practically feasible, its ability to evaluate cardiorespiratory fitness across the general population is limited because its validation (i.e., research studies) was focused primarily on youth and college-aged individuals. The 1.5-mile run test provides a more valid evaluation of aerobic fitness across a larger population group and is therefore considered a more appropriate test to use with clients. However, because the duration of this assessment is longer than the 1-mile run test, there is certainly more of a demand for experience and pacing throughout this assessment.

GETTING TECHNICAL

Perhaps the biggest limitation of the assessments discussed is that they only provide generalized estimates of aerobic fitness rather than a personalized score unique to the individual. Therefore, research and newer ideas have evolved to assess cardiorespiratory fitness and efficiency based on a person’s unique metabolism.

**The Talk Test**

The talk test (or continuous talk method) is an informal cardiorespiratory assessment used to gauge the intensity of the activity based on the client’s own unique metabolic markers and ability to hold a conversation. Gauging the client’s ability or inability to talk continuously during aerobic exercise has existed as a nonspecific guide for exercise intensity for many years. However, over the past 20 years, researchers have investigated this concept further and determined that intensity that disrupts talking and breathing is connected to specific metabolic events happening within the body’s energy systems.

**The ventilatory threshold (vt1) test**

The ventilatory threshold 1 (VT1) test is an incremental test performed on any device (e.g., treadmill, bicycle) that gradually progresses in intensity level and relies on the interpretation of the way a person talks to determine a specific event at which the body’s metabolism undergoes a significant change.

A key point for this protocol is to remember that it is an aerobic test that aims to estimate the intensity of the body’s usage of a balance of fuels (i.e., 50% fat, 50% carbohydrates). Because it is an aerobic test, steady-state (SS) heart rate must be attained before any assessment of talking is collected.

VT1 Test Considerations

* Determine the preferred exercise modality (e.g., treadmill, bicycle).
* Determine the preference for increasing workloads (e.g., speed, grade, wattage). A range of 0.5 to 1 mph increases or 1% to 2% inclines are used for treadmills; 15- to 25-watt increases are used for cycling, and 10- to 15-watt increases are used for arm ergometers.
* Determine the duration of each stage. Stages usually last between 1 and 3 minutes to ensure that SS heart rate is attained. Larger increases in intensity require longer durations to attain SS heart rate and are not recommended. Remember, SS heart rate implies a visible levelling of the client’s heart rate at each stage, rather than continuing to climb upwards.
* Conduct the continuous talk test once a steady state heart rate is attained. The continuous talk test involves speaking continuously for about 20 seconds, although the talking challenge can usually be observed within 10 seconds. The continuous talk test must be continuous and recited from memory, for example, the phonetic alphabet: “A is for apple, B is for boy, C is for cat.” Another option is to have the client share information regarding their typical morning routine, detailing the steps involved in getting ready for work or school. Just remember that the dialogue they provide needs to be continuous, as explained previously.

VT1 Test Instructions

* Briefly discuss the protocol, answer all questions, and allow adequate warm-up, stretching, and recovery before starting the test.
* Begin the test at an intensity considered light to easy and gradually progress through incremental stages, performing the continuous talk test toward the end of each stage, once an SS heart rate is attained.
* Repeat the continuous talk test until the talk test becomes challenging, but not difficult, for the client. This is a sign that the client has reached VT1. At this moment, record the client’s heart rate and speed, grade, or wattage, depending on which type of equipment is being used.
* Evaluate the challenge of continuous talking:
  + Observe the ability to speak continuously at a conversational pace (e.g., smooth, streamlined, and continuous versus choppy, interrupted, and disjointed).
  + Ask the individual to rate the challenge (e.g., an easy, small challenge, an uncomfortable/challenging task, or a difficult, nearly impossible task); VT1 is marked as uncomfortable or challenging.
  + Listen to the client’s breathing sounds; VT1 occurs when breathing becomes clearly audible with fairly visible signs of rib cage elevation.
  + Consider continuing one stage beyond the suspected VT1 stage to validate the assessment.

Ideally, this protocol should be repeated within 2 to 3 days for purposes of reliability; use the average physiological response to notate the client’s VT1.

Example VT1 test

1-minute stages were selected because of the small work increments (i.e., 0.5 mph per stage), which is usually ample time to attain a SS heart rate response. At minute 9 (6.5 mph), the continuous talk test becomes challenging, which corresponds to a heart rate of 142 beats per minute (bpm) and an RPE (10-point scale) of 6.5. At 6.0 mph, breathing and continuous talking remain somewhat easy, whereas at 7.0 mph, they become difficult. As mentioned previously in the protocol instructions, the continuous talk test should ideally be conducted on two separate occasions for reliability purposes, with the average score being recorded as VT1.

Example of a VT1 Test With 1-Minute Incremental Increases

| **Time** | **Speed** | **Talk Test** | **HR** | **RPE 1–10** |
| --- | --- | --- | --- | --- |
| Warm-up (minutes 1–4) | 4.0 mph |  |  |  |
| Minute 5 | 4.5 mph | Easy | 117 | 3.5 |
| Minute 6 | 5.0 mph | Easy | 125 | 4 |
| Minute 7 | 5.5 mph | Somewhat easy | 133 | 5 |
| Minute 8 | 6.0 mph | Somewhat easy | 138 | 6 |
| Minute 9 | 6.5 mph | Challenging | 142 | 6.5 |
| Minute 10 | 7.0 mph | Difficult | 147 | 7 |
| Cool down (minute 11–14) | 4.0 mph |  |  |  |

Proficiency in identifying VT1 depends largely on the fitness professional’s ability to accurately determine when continuous talking becomes challenging. This may take time, practice, and repetition, but once proficiency is established, this skill set will allow the fitness professional to identify an individualized and unique metabolic event where the body shifts from fat as its primary fuel to an equal mix of fat and carbohydrate fuel sources. This intensity will serve as an important intensity marker when designing cardiorespiratory exercise programs.

**VT2 talk test**

For individuals who have more performance-centric goals, their capacity to sustain high-intensity work becomes important as a predictor of success. The ventilatory threshold 2 (VT2) talk test measures the level at which the body can work at its highest sustainable steady-state intensity for more than a few minutes. At this level, the body relies heavily on the anaerobic energy systems that begin to overwhelm the blood’s lactic acid buffering capacity.

In fact, VT2 corresponds with an individual’s inability to speak during exercise. In other words, at this level of intensity, the individual cannot verbally respond to a question or responds “no” to the question, Can you speak competently?

This measurement (VT2) is a critical measurement of athletic performance, because the intensity immediately below this level represents the exercise pace that an endurance athlete can sustain throughout their race or training to attain their best performance.

VT2 Test Considerations

* VT2 testing is only recommended for individuals with performance goals given the purpose, nature, and intensity required for measuring this physiological marker.
* While several standardized field tests exist (e.g., 60-minute ride, 30- or 60-minute runs), they demand a lot of time and are tedious to administer.
* A modified test, such as a 20-minute run or ride test protocol, provides a viable alternative, which is easier to conduct than the standardized 30- or 60-minute protocols.
* The test requires the subject to maintain their highest-sustainable pace for 20 minutes and the fitness professional to record the client’s heart rate and marker of performance (e.g., RPE, speed, wattage) over the last 5 minutes.

VT2 Test Instructions

* Briefly discuss the protocol, answer all questions, and allow adequate warm-up, stretching, and recovery prior to conducting the test.
* To start, increase the intensity to a predetermined pace. Some careful programming is required to determine this pace, but allow for some minor adjustments as needed during the first few minutes of the bout. Remember that the client will need to hold this pace for 20 minutes; it should be the most intense pace they can safely handle.
* Record the individual’s heart rate and marker of performance (e.g., speed, wattage, RPE) during the last 5 minutes of the bout.
* Use the average heart rates collected over the last 5 minutes, then correct that number by 95% to estimate the client’s VT2. This 5% correction is needed because a 20-minute pace is usually more intense than when a client is performing a 30- to 60-minute test.

**Example VT2 test**

As an example, Amy starts her test at 8.5 mph, then adjusts it to 8.8 mph within the first 3 minutes and sustains this pace for the remainder of the run. Her heart rate responses are as follows:

* Minute 16: HR = 176 bpm
* Minute 17: HR = 178 bpm
* Minute 18: HR = 177 bpm
* Minute 19: HR = 179 bpm
* Minute 20: HR = 179 bpm

Amy’s average HR = 177.8 bpm × 0.95 = 168.9 bpm, or 169 when rounded up.

## Postural, Movement, and Performance Assessments

Posture, movement, and performance assessments are an integral part of the intake process for all clients and will assist the fitness professional in developing customized fitness programs to enhance a client’s well-being. Static posture is the positioning of the musculoskeletal system while the body is standing still, whereas a person’s dynamic posture represents what happens to that alignment when the body is in motion. Functional movement is the means by which individuals can perform activities ranging from activities of daily living to occupational tasks to sports and recreational enjoyment. It is important that fitness professionals are proficient at recognizing optimal movement based on a foundation of anatomy and kinesiology. Further, understanding optimal postural alignment and movement strategies allows fitness professionals to identify movement impairments by conducting movement assessments, which can indicate possible muscle imbalances or mobility limitations. In addition, performance assessments can be used to assess a client’s power, strength, and muscular endurance, which are necessary for athletic endeavours.

**Importance of posture**

Optimal posture allows for an individual’s body to be aligned in a manner that decreases stress on bodily tissues and joints, whether in seated, standing, or lying positions. However, due to a lack of postural awareness as well as work environments that require excessive sitting, many individuals suffer from poor posture. This can negatively affect the length-tension of muscles and increase stress on the body throughout the day. As a result, it is important for the fitness professional to have confidence in evaluating static standing posture, which will also serve as the foundation for movement assessments.

When the Certified Personal Trainer works with a client for the first time, it is a good idea to first gain an understanding of their client’s static posture. Many of the postural deviations that are detected in a static postural assessment will also occur during various movement assessments. For example, if the client presents with a flattened arch of the foot, also known as pes planus, in static posture, they will typically also display altered foot and ankle mechanics during various movement assessments. When impairments are identified across multiple assessments, this is a good indication that exercise programming should address these issues.

**Muscle imbalances**

Muscle imbalances are alterations in the lengths of muscles surrounding a joint in which some are overactive (forcing compensation to occur) and others may be underactive (allowing for the compensation to occur). In other words, muscle imbalance is a condition in which there is a lack of balance between muscles surrounding a joint. Muscle imbalance can be caused by a variety of mechanisms, including (but not limited to) repetitive movement, sedentary lifestyle, and trauma.

GETTING TECHNICAL

The terms *overactive* and *underactive* are used in this text to refer to the activity level of a muscle relative to another muscle or muscle group, not necessarily to its own normal functional capacity. When a muscle is overactive, it is in a state of elevated neural activity (compared to its antagonist muscle), which causes the muscle to be held in a chronic state of contraction. When a muscle is underactive, it is in a state of inhibited neural drive (compared to its antagonist muscle). This can cause the muscle’s functional antagonist to pull it into a chronically elongated state.

**Static postural assessment**

A static postural assessment allows the fitness professional to look for any deviations from optimal alignment of the body in a standing posture. Over time, these deviations can cause muscle imbalances or compromise joint mobility. A static postural assessment requires strong visual observation skills that are developed with time and practice, and it requires a systematic approach. Commonly, static postural assessments begin at the feet and travel upwards toward the head. The static postural assessment includes anterior, lateral, and posterior views to observe all the potential deviations from optimal posture. Leveraging the kinetic chain checkpoints enables the fitness professional to systematically view the body during stance and motion. Although each region of the body will be assessed individually, the fitness professional should think of the body as an interconnected system, where one joint or region has an impact on the others. For example, overactive hip flexors from prolonged sitting may cause an anterior pelvic tilt, which then causes lumbar (low-back) extension.

The static postural assessment administered by a fitness professional is a simplified version of a thorough evaluation that would be performed by a healthcare professional, such as a physical therapist or physician. In general, the fitness professional should look for neutral alignment, symmetry, balanced muscle tone, and common postural deviations.

The kinetic chain checkpoints refer to major joint regions of the body, including the following:

1. Feet and ankles
2. Knees
3. Lumbo-pelvic-hip complex (LPHC)
4. Shoulders
5. Head and neck

Anterior View

1. Feet/ankles: Straight and parallel; not flattened or externally rotated
2. Knees: In line with toes; not in knee valgus (knock-kneed) or knee varus (bowlegged)
3. LPHC: Level pelvis; not rotated or hiked on one side
4. Shoulders: Level; not elevated or rounded
5. Head: Neutral position; not forward, tilted or rotated

Note: An imaginary line should begin between the feet, extending upward between the lower extremities, through the midline of the pelvis, and bisecting the trunk and skull.

Lateral View

1. Feet/ankles: Leg vertical at right angle to sole of foot
2. Knees: Neutral position; not flexed or hyperextended
3. LPHC: Pelvis and lumbar spine in neutral position; not anteriorly (lumbar extension) or posteriorly tilted (lumbar flexion)
4. Shoulders: Shoulders aligned with ears; not excessively rounded
5. Head: Neutral position; not “jutting” forward

Note: An imaginary line should run through the lateral malleolus (lateral ankle bone), middle of the femur (thigh bone), center of shoulder, and middle of the ear.

Posterior View

1. Foot/ankle: Heels are straight and parallel; Achilles tendon is vertical; calcaneus (heel bone) not excessively everted; weight is equally balanced between right and left sides
2. Knees: Neutral position, not in valgus or varus
3. LPHC: Pelvis is level; not rotated or hiked on one side
4. Shoulders/scapulae: Level; not elevated or protracted
5. Head: Neutral position; neither tilted nor rotated

Note: An imaginary line should begin between the feet, extending upward between the lower extremities, through the midline of the pelvis, and bisecting the trunk and skull. When examining exclusively the foot and ankle, an imaginary line should begin at the midline of the calcaneus (heel bone), extending upward along the Achilles tendon. The Achilles tendon should be vertical.

**Common distortion patterns**

How a client presents in static stance is, in a sense, a roadmap of how they have been using their body with time. Interestingly, the body tends to compensate in observable patterns, causing predictable alterations in muscle function. For example, presentation of a forward head (head juts forward) and protracted (rounded) shoulders in static posture will typically be related to dysfunction of the muscles that surround the shoulder and neck areas and predictable patterns of muscle imbalance.

Three distortion patterns

Basic compensatory patterns were studied and described by Janda (2002) in the early 1970s. It is not to say that other compensations do not occur; he simply suggested that there was a cascading effect of deviations in static posture that would, more likely than not, present themselves in a particular pattern.

The three postural distortion patterns to be assessed during a static postural assessment include the pes planus distortion syndrome (developed by NASM) and the lower and upper crossed syndromes described by Janda.

1. Pes planus distortion syndrome: Characterized by flat feet, knee valgus, and adducted and internally rotated hips
2. Lower crossed syndrome: Characterized by an anterior pelvic tilt and excessive lordosis (extension) of the lumbar spine
3. Upper crossed syndrome: Characterized by a forward head and protracted (rounded) shoulders Observing dynamic posture

Posture is often viewed as being static (without movement), but everyday posture is constantly changing to meet the demands placed on the body. Thus, once completing a static postural assessment, movement assessments (also known as dynamic postural assessments) should be performed.

The findings from the dynamic postural assessment should further reinforce the observations made during the static postural assessment. In addition, any issues not revealed during the static postural assessment may be observed during the dynamic postural observations and are often the quickest way to gain an overall impression of a client’s movement quality. Movement observations should relate to basic functions, such as squatting, balancing, pushing, and pulling. The observation process should search for any muscle imbalances or movement impairment patterns that may possibly lead to injury, both in and out of the fitness environment. With the limited time that most fitness professionals have for observation, incorporating a systematic assessment sequence is essential.

HELPFUL HINT

The faulty postures identified during a static postural assessment will likely appear during a movement assessment, but the same cannot be said in the opposite direction. When standing at rest, a client could have observably perfect posture; however, when tasked to perform a movement assessment, they may suddenly reveal movement impairments.

Like a static postural assessment, movement assessments require observation of the client’s five kinetic chain checkpoints. Although abnormal movement may be noticed at a specific joint, the cause of that impairment may be coming from a lack of mobility or stability from an adjacent region.

For example, a client may display knee valgus while squatting, but the cause of the movement impairment could be caused by hip or ankle dysfunction (or both). Each joint region has a specific biomechanical motion that it produces based on its own structure and function, as well as the joints above and below it. When that specific motion deviates from its normal path, it is considered a movement impairment and can be used to presume possible muscle imbalance or joint dysfunction.

It should be noted that the term *movement impairment* is simply being used to describe a client’s abnormal movement when it deviates from optimal postural alignment while in motion. The fitness professional should be careful how they explain these movement impairments to the client to avoid embarrassing or discouraging them. Instead, the focus should remain on helping the client move more safely and efficiently.

**Overhead Squat Assessment**

The overhead squat assessment (OHSA) is typically the first movement assessment that is used for most clients. An individual’s movement quality during this assessment often provides valuable information about what areas of the body need to be addressed through focused exercise programming. The findings from this assessment can also serve as the basis for all additional movement assessments.

The overhead squat is designed to assess dynamic posture, core stability, and neuromuscular control (i.e., coordination) of the whole body during a squatting motion. Research suggests that the presence of movement impairments during squatting motions is predictive of the risk of musculoskeletal injuries in individuals who practice physical exercise. Further, observational screening during the overhead squat is a valid method to identify movement impairments, such as knee valgus and limited ankle mobility.

Recognizing movement impairments during the OHSA helps the fitness professional identify their clients’ muscle imbalances. Using this information, the fitness professional can create an exercise program that aims to correct these muscle imbalances by stretching identified overactive muscles and strengthening identified underactive muscles.

OHSA Starting Position

1. The client stands on a flat, stable surface with the feet shoulder-width apart and pointing straight ahead.
2. The foot and ankle complex should be in a neutral position.
3. Ideally, the assessment should be performed with the shoes off to better view the client’s foot and ankle complex.
4. The client should raise their arms completely overhead with elbows fully extended.

OHSA Movement

1. The client should squat to a depth that brings the femur parallel to the ground (approximately chair height) and then return to the starting position. The squat depth can be reduced if the client has discomfort or is incapable of performing a squat to this depth.
2. The client will repeat the movement for approximately five repetitions, while the fitness professional views them from both the anterior and lateral vantage points.

Anterior View

* Feet: View the feet and knees from the front. The feet should remain pointed straight forward, as if the client is on snow skis. A common movement impairment is the feet externally rotating (turning out).
* Knees: The client’s knees should track straight forward and remain directly over the client’s second and third toes. A common movement impairment is knee valgus (knees caving inward).

Lateral View

* View the LPHC and shoulders from the lateral view. Three common movement impairments observed from the lateral view include an excessive forward lean of the torso, an excessive low-back arch, or arms falling forward.

Overactive muscles require stretching, whereas underactive muscles require additional strengthening to help correct the muscle imbalance.

| **View** | **Kinetic Chain Checkpoint** | **Movement Impairment** | **Result** |
| --- | --- | --- | --- |
| Anterior | Feet/Ankles | ❑ Turn out | ❑ Yes ❑ No |
| Knees | ❑ Valgus (knock knees) | ❑ Yes ❑ No |
| Lateral | LPHC | ❑ Forward lean of trunk | ❑ Yes ❑ No |
| LPHC | ❑ Low-back arches | ❑ Yes ❑ No |
| Shoulders | ❑ Arms fall forward | ❑ Yes ❑ No |

CRITICAL

The purpose of the OHSA is to observe a client’s movement patterns and identify movement impairments. These impairments indicate potential muscle imbalances. To correct each muscle imbalance, it is important to stretch the identified overactive muscles and strengthen the identified underactive muscles.

The overhead squat provides valuable information for the fitness professional to program mobility and strengthening exercises that are tailored to the client’s needs. This is the main reason the OHSA is recommended to screen a majority of clients during the first session and then periodically to monitor progress. Poor performance on this assessment can be discouraging for a new client, so fitness professionals should remember to keep a positive approach to explaining the benefits of addressing the various movement impairments a client may display. This assessment also provides the foundation for other assessments. The next lower-extremity assessment is the single-leg squat assessment, which is also a good test for balance.

**Single-Leg Squat Assessment**

The single-leg squat assessment evaluates dynamic posture, lower-extremity strength, balance, and overall coordination in a single-limb stance. This test should be used for clients who have performed well in the OHSA, or if the fitness professional is considering single-leg exercises in their programming (single-leg squats, pistol squats, step-ups, etc.). This test is an effective assessment of an individual’s ability to balance, which is an important functional consideration for activities of daily living and exercise programming. This assessment should be avoided by clients who are at risk for falls or loss of balance or who are recovering from a lower- body injury.

The single-leg squat assessment has been shown to have strong inter- and intrareader reliability, meaning it can be evaluated consistently over time and between multiple professionals. Further, like the OHSA, observational screening during the single-leg squat is an accurate method to identify movement impairments, such as knee valgus. The single-leg squat is observed from the anterior view.

### Single-Leg Squat Starting Position

1. The client stands on a flat, stable surface, hands on the hips, and eyes focused forward.
2. The client lifts one foot approximately 6 in. off the floor. The stance foot, ankle and knee, and the LPHC should be in a neutral position and pointed straight ahead.

### Single-Leg Squat Movement

1. The client squats as deep as possible (while maintaining balance) and returns to the starting position. The depth of the single-leg squat will be client dependent and will likely vary across populations.
2. The client performs up to five repetitions before switching sides.

Anterior View

* The client’s knee should track straight forward and remain directly over the client’s second and third toes. A common movement impairment is knee valgus

The single-leg squat assessment is much more challenging than the OHSA, but it provides valuable information for the fitness professional about the client’s ability to balance on one leg.

| **Joint** | **Movement Impairment** | **Right or Left** |
| --- | --- | --- |
| Knee | ❑ Valgus | ❑ Right ❑ Left ❑ Both |
| Note: Mark right, left, or both based on the stance limb tested. | | |

This assessment also requires much more strength than the overhead squat, which typically limits squat depth and stability. However, if the fitness professional plans to program single-leg exercises, it is a good idea to assess this pattern of movement first. As usual, fitness professionals should remember to only use this test if clients are stable enough to avoid falling or injuring themselves.

**Pushing assessment**

The pushing assessment is an assessment that challenges the upper extremities and trunk during a pushing movement. This type of assessment can be completed prior to a workout session or as an integrated part of the actual programming. The pushing assessment evaluates scapular and shoulder mechanics and stability of the LPHC, cervical spine, and head. The fitness professional should carefully evaluate all repetitions, because the client may demonstrate movement impairments as they become fatigued during the assessment.

Pushing assessment starting position

1. The client should stand in a narrow, split stance with the toes pointing forward and handles in each hand.
2. The fitness professional should choose a resistance that will challenge (but not exhaust) the client while executing 10 repetitions.

If the client is not able to perform a standing chest press in a narrow, split stance, use one of the following modifications:

* Option 1: The client stands in a wider split stance. This testing position still assesses the upper extremity and cervical spine and head, but it decreases the challenge to the LPHC and the client’s balance.
* Option 2: The client performs a pushing movement seated in a machine.

### Pushing Assessment Movement

1. The fitness professional should instruct the client to push the handles away from their body and return to the starting position.
2. The client should use a slow repetition tempo.
3. The client should perform five repetitions in a split stance, switch legs, and then perform five additional repetitions.

Lateral View

* View the LPHC, shoulders, cervical spine, and head from the side. The lumbar and cervical spine should remain neutral while the shoulders stay level. Common movement impairments that may be observed include low-back arches, shoulder elevation, and head jutting forward.

|  |  |  |
| --- | --- | --- |
| Kinetic Chain Checkpoint | Movement Impairment | Yes or No |
| LPHC | ❑ Low-back arches | ❑ Yes ❑ No |
| Shoulders | ❑ Shoulders elevate | ❑ Yes ❑ No |
| Head/Neck | ❑ Head juts forward | ❑ Yes ❑ No |

The pushing assessment can easily be integrated into a typical workout program, while providing useful information about the client’s shoulder mechanics and trunk stability during a pushing task. If the fitness professional plans to program pushing exercises, it is a good idea to assess this pattern of movement first.

**Pulling assessment**

The pulling assessment is an assessment that challenges the upper extremities and trunk during a pulling movement. This type of assessment can be completed prior to a workout session or as an integrated part of the actual programming. The pulling assessment evaluates upper-extremity strength, as well as stability of the LPHC, cervical spine, and head. Due to the narrow, split stance, this assessment also challenges the individual’s balance. The fitness professional should carefully evaluate all repetitions, because the client may demonstrate movement impairments as they become fatigued during the assessment.

Pulling assessment start

1. The client should stand in a narrow, split stance with toes pointing forward and handles in each hand.
2. The fitness professional should choose a resistance that will challenge (but not exhaust) the client while executing 10 repetitions.

If the client is not able to perform a standing row in a narrow, split stance, use one of the following modifications:

* Option 1: The client stands in a wider split stance to increase their base of support. This testing position still assesses the upper extremity and cervical spine and head, but it decreases the challenge to the LPHC and the client’s balance.
* Option 2: The client performs a pulling movement seated in a machine.

Pulling assessment movement

* The client should pull the handle toward their body and return to the starting position.
* The client should use a slow repetition tempo.
* The client should perform five repetitions in a split stance, switch legs, then perform five additional repetitions.

Lateral View

* View the LPHC, shoulders, cervical spine, and head from the side. The lumbar and cervical spine should remain neutral while the shoulders stay level. Common movement impairments that may be observed include low-back arches, shoulder elevation, and head jutting forward.

The pulling assessment can easily be integrated into a typical workout program, while providing useful information about the client’s shoulder mechanics and trunk stability during a pulling task. If the fitness professional plans to program pulling exercises, it is a good idea to assess this pattern of movement first.

| **Kinetic Chain Checkpoint** | **Movement Impairment** | **Yes or No** |
| --- | --- | --- |
| LPHC | ❑ Low-back arches | ❑ Yes ❑ No |
| Shoulders | ❑ Shoulders elevate | ❑ Yes ❑ No |
| Head/Neck | ❑ Head juts forward | ❑ Yes ❑ No |

### Performance assessments

Performance assessments are typically used for clients looking to assess and improve athletic performance or specific fitness measures, because these assessments will measure overall strength, muscular endurance, power, and agility. However, the strength-based, performance assessments can also be used with clients who have experience with weight-lifting exercises and want to improve their strength in these movements.

To ensure these assessments are safe for clients, they should only be implemented after thorough static postural and movement assessments are completed. Further, it is important to determine if the client is ready for weighted and dynamic movements before initiating any of these assessments. Basic performance assessments include the following:

* Push-up test
* Bench press strength assessment
* Squat strength assessment
* Vertical jump
* Long (broad) jump
* Lower extremity functional test (LEFT)
* 40-yard dash
* Pro shuttle

**Push-up test**

The push-up test measures muscular endurance of the upper extremities during a pushing movement. The goal is to complete as many repetitions as possible, with good form, usually for a predetermined length of time. There are a variety of methods for performing this assessment, depending on the population being tested (e.g., older adults, youths, military). Below is information for a standard 60-second push-up test for apparently healthy adults. This test can be completed prior to a workout session or as an integrated part of the actual programming.

Push-up test position

1. The client should assume a push-up position with hands slightly outside of shoulder-width apart and elbows and knees fully extended and spine in a neutral position. If the client is not able to perform a standard push-up, the client can perform push-ups from a kneeling position.

Push-up test movement

1. The client lowers their body to achieve 90 degrees of elbow flexion before returning to the start position. They repeat this pattern for 60 seconds or until exhaustion.
2. All repetitions completed to the appropriate depth should be counted during the 60-second testing period.
3. The client should be reassessed at regular intervals (e.g., 4 to 6 weeks) to evaluate progress.

**Bench Press Strength assessment**

The bench press strength assessment is designed to assess maximal strength and estimate the one-rep maximum for the bench press exercise. This test is considered an advanced assessment for strength-specific goals and, as such, may not be suitable for all clients, especially those with limited experience with resistance training. Generally speaking, Certified Personal Trainers should not perform this assessment for clients with general fitness or weight-loss goals.

This assessment is most applicable for those seeking to assess their maximal strength capabilities. A proper warm-up is encouraged before beginning any maximal strength testing. Bench Press Strength Assessment Position

1. The client should lay on their back on a weight-lifting bench.
2. The low-back should be in a neutral position (avoid excessive arching).
3. Both feet should be firmly planted on the ground.
4. A comfortable weight should be used for the warm-up and initial repetitions of the testing.
5. The client will grasp the barbell with their hands slightly greater than shoulder-width apart.
6. Proper spotting by the Certified Personal Trainer is required during the testing.

Bench Press Strength assessment movement

1. The client, with assistance from the fitness professional, should unrack the weighted barbell, lower it to their chest, and press it back into full elbow extension. After completing three repetitions, the weight should then be re-racked.
2. The client should take a 2-minute rest.
3. Ten to twenty pounds (or 5% to 10% of initial load) should be added.
4. The client should repeat steps 1 through 3 until they are no longer comfortable adding weight or cannot complete a minimum of three repetitions.
5. The one-rep maximum estimation chart in Appendix A should be used to calculate one-repetition max.
6. The client should be reassessed at regularly scheduled intervals to measure progress.

**Squat Strength assessment**

The squat strength assessment is designed to estimate maximal strength and the one-rep maximum for the squat exercise. This test is considered an advanced assessment for strength-specific goals and, as such, may not be suitable for all clients. Certified Personal Trainers should not perform this assessment for clients with general fitness or weight-loss goals, or those with limited experience performing resistance training. This assessment is most applicable for those seeking to assess their maximal strength capabilities. A proper warm-up is encouraged before beginning any maximal strength testing.

Squat Strength assessment position

1. The client should stand with their feet approximately shoulder-width apart. The knees should be in line with the toes, and the low-back should be in a neutral position (avoid excessive arching). For safety reasons, it is important to avoid knee valgus during the duration of this assessment.
2. A comfortable weight should be used for the warm-up and initial repetitions of the testing. Clients should lower themselves under the racked barbell, placing it on their shoulders and grasping the barbell with their hands. Proper spotting by the Certified Personal Trainer is required during the testing.

Squat Strength Assessment Movement

1. The client should unrack the weighted barbell and step away from the squat rack. The client should then lower into a squatting position and return to the starting position. After completing three repetitions, the weight should then be re-racked.
2. The client should take a 2-minute rest.
3. Thirty to 40 pounds (or 10% to 20% of initial load) should be added.
4. The client should repeat steps 1 through 3 until they are no longer comfortable adding weight or cannot complete a minimum of three repetitions.
5. The one-rep maximum estimation chart in Appendix A should be used to calculate the client’s one-repetition max.
6. The client should be reassessed at regularly scheduled intervals to measure progress.

TRAINING TIP

The squat and bench press strength assessments are not recommended for most clients seeking weight loss or improvements in overall health. These assessments are typically reserved for clients seeking improvements in maximal strength, such as strength and power athletes (e.g., football linemen, powerlifters, Olympic weightlifters).

Moreover, these assessments are not required for determining appropriate training loads (weight) during resistance training exercise for the average weight-loss client. If the client has experience with resistance training, the fitness professional should ask about the weights they typically use and adjust accordingly. If the client does not have experience with resistance training, the fitness professional should use caution and select a relatively light weight that the client can safely handle while learning the movement patterns. After a few sessions, with some trial and error, appropriate training loads can be determined. An appropriate training load is a weight that can be performed for the desired number of repetitions with ideal form, with the last few repetitions a struggle to complete.

**Vertical Jump assessment**

The vertical jump assessment is designed to test maximal jump height and lower-extremity power. There are several variations of the test; however, the version discussed here requires the use of a Vertec vertical jump tester. This test is considered an advanced assessment for power and performance-specific goals and, as such, may not be suitable for all clients. Generally speaking, Certified Personal Trainers should not perform this assessment for clients with general fitness or weight-loss goals. This test is most appropriate for clients with athletic goals and seeking to assess lower-body power. A proper warm-up is encouraged before beginning any maximal performance testing.

Vertical Jump Assessment Position

1. The fitness professional should measure the standing reach of the client with one arm next to the Vertec.
2. The client should then stand in a ready position underneath the Vertec.

Vertical Jump Assessment Movement

1. The client should jump and touch the highest possible vane. No stepping, of any kind, is allowed prior to the jump.
2. The height difference between the standing reach and jumping height is calculated. Red vanes are spaced 6 inches apart, blue vanes 1 inch apart, and white vanes are spaced every 0.5 inches.
3. The client should take a 2-minute rest.
4. A second attempt should be provided. If the client increases their jump height on the second attempt, a third attempt is awarded.
5. The client should be reassessed at regularly scheduled intervals to measure progress.

**Long Jump assessment**

The long jump assessment, also known as the broad jump, is designed to test maximal jump distance and lower-extremity horizontal power. This test is considered an advanced assessment for power and performance-specific goals and, as such, may not be suitable for all clients. Generally speaking, Certified Personal Trainers should not perform this assessment for clients with general fitness or weight-loss goals. This test is most appropriate for clients with athletic goals and seeking to assess lower-body power. A proper warm-up is encouraged before beginning any maximal performance testing.

Long Jump Assessment Position

1. A tape measure should be extended along a nonslip surface, with a starting line marked with athletic tape.
2. The client should stand in a ready position behind the line.

Long Jump Assessment Movement

1. The client should jump forward as far as possible. It should be a 2-feet jump with a 2-feet landing. No stepping, of any kind, is allowed prior to or after the jump.
2. The jump distance should be measured from the starting line to the heels of the feet after landing.
3. The client should take a 2-minute rest.
4. A second attempt should be provided. If the client increases their jump distance on the second attempt, a third attempt is awarded.
5. The client should be reassessed at regularly scheduled intervals to measure progress.

**Lower extremity functional test**

The lower extremity functional test (LEFT) is designed to test lateral speed and agility. The LEFT is considered an advanced assessment for speed and performance-specific goals and, as such, may not be suitable for all clients. Generally speaking, Certified Personal Trainers should not perform this assessment for clients with general fitness or weight-loss goals. This test is most appropriate for clients with athletic goals and seeking to assess speed and agility. A proper warm-up is encouraged before beginning any maximal performance testing.

LEFT Position

1. Two cones are spaced 10 yards (9.1 meters) apart on a nonslip surface.
2. The client should stand in a ready position behind cone one.

LEFT Movement

1. The client should complete the following sequence as quickly as possible.
   * Forward sprint to cone two.
   * Backpedal to cone one.
   * Side shuffle to cone two.
   * Side shuffle to cone one.
   * Carioca to cone two.
   * Carioca to cone one.
   * Forward sprint to cone two.
2. The timer should start at the first movement and end when the client runs past the final cone.
3. The client should be reassessed at regularly scheduled intervals to measure progress.

**36-metre Dash assessment**

The 36-metre dash assessment is designed to test reaction capabilities, acceleration, and maximal sprinting speed. The 36-metre dash assessment is considered an advanced assessment for speed and performance-specific goals and, as such, may not be suitable for all clients. In the US it is called 40-yard dash assessment (40 yards are 36.6 metres).

Certified Personal Trainers should not perform this assessment for clients with general fitness or weight-loss goals. This test is most appropriate for clients with athletic goals seeking to assess straight-ahead sprinting speed. A proper warm-up is encouraged before beginning any maximal performance testing.

36-Metre Dash Assessment Position

1. Two cones are spaced 36 meters apart or use an American football field with clearly indicated yard lines.
2. The client should stand in a ready position behind cone one.

36-Metre Dash Assessment Movement

1. The client should sprint as quickly as possible to the 36-metre marker.
2. The timer should start at the first movement and end when the client hits the 36-metre mark.
3. The client should be reassessed at regularly scheduled intervals to measure progress.

**Pro Shuttle assessment**

The pro shuttle (5-10-5) assessment is designed to assess acceleration, deceleration, agility, and control. This test is considered an advanced assessment for speed and performance-specific goals and, as such, may not be suitable for all clients. Generally speaking, Certified Personal Trainers should not perform this assessment for clients with general fitness or weight-loss goals. This test is most appropriate for clients with athletic goals seeking to assess agility and sprinting speed. A proper warm-up is encouraged before beginning any maximal performance testing.

Pro Shuttle Assessment Position

1. Two cones are spaced 9 metres apart, with a third cone in the middle (4.5 metres from other cones).
2. The client should stand in a ready position next to the middle cone.
3. The timer should stand facing the middle cone.

Pro Shuttle Test Movement

1. The client should sprint as quickly as possible in the following pattern:
   * Cone one to cone two
   * Cone two to cone three
   * Cone three to cone one
2. The timer should start at the first movement and end when the client passes the middle cone at the end of the sprint pattern.
3. The client should be reassessed at regularly scheduled intervals to measure progress.

### Implementing Fitness Assessments

After implementing a thorough health screening, administering postural, movement, and performance assessments provide an opportunity for fitness professionals to establish a baseline for their client’s functional status. Since Certified Personal Trainers will work with a wide range of clients, it is helpful to evaluate static and dynamic posture prior to designing and implementing a fitness program to help provide insight to the physical capabilities and limitations of the client. These assessments will provide a baseline level of function as well as postural and movement impairments that need to be corrected throughout the programming. This information will also help inform the selection of exercises and intensity at which an individual can perform. Lastly, performing these assessments before implementing an exercise program will provide a baseline from which to evaluate progress in static posture, movement quality, and dynamic performance. The following list describes the benefits of conducting and implementing fitness assessments:

1. Assessing a client’s static posture allows for a quick understanding of how they position their body during the day.
2. Movement and performance assessments demonstrate a baseline of the client’s functional status in a wide range of tasks.
3. Movement assessments are helpful to identify and correct movement impairments and potential muscle imbalances.
4. Strength-based assessments allow the fitness professional to accurately assess a client’s maximal strength capabilities.
5. Performance assessments allow for careful tracking of athletic performance (e.g., power, speed, agility, muscular endurance).

**Sequencing assessments**

Certified Personal Trainers can use static postural and overhead squat assessments as recruiting tools for prospective clients. By offering these assessments, often complimentary, clients are more likely to engage with the fitness professional and begin to build trust in their expertise. The fitness professional can encourage the client by telling them good things about their posture and movement, while also pointing out any impairments that they can help correct with a focused exercise program.

For example, if a client agreed to participate in a complimentary OHSA, the fitness professional may be able to identify a common pattern of excessive knee valgus during the squat. The fitness professional could then tell the client how they were impressed with their squat depth but how important it is to maintain good alignment during the squat for long-term knee health. This would then be a natural time to show some simple modifications to their technique and explain how a focused exercise plan, with proper supervision, could help the client to squat more safely and effectively.

Onboarding and sequencing assessments

All movement assessments should begin with a standing, static postural assessment. Any postural distortions can affect the length-tension of muscles and increase stress on the body throughout a person’s day. As a result, it is important for the fitness professional to have confidence in evaluating static standing posture, which will also serve as the foundation for movement and performance assessments.

Following a static postural assessment, the fitness professional should implement an OHSA to evaluate dynamic posture, core stability, and neuromuscular control. This assessment will begin to expose various movement impairments that can be addressed with an individualized fitness program. Further, a single-leg squat assessment can then be used to test single-leg balance and challenge the client with a more demanding movement.

If the fitness professional has time, they can then implement upper-extremity pushing and pulling assessments to gain more information about how the client uses their upper body while stabilizing their trunk. These tests can be administered prior to a workout session or as an integrated part of the actual programming.

As a group, static postural and movement assessments provide a good overview about how the client positions and moves their body during everyday tasks. Any postural distortions or movement impairments can then be addressed with a focused exercise program, by stretching the identified overactive muscles and strengthening the identified underactive muscles.

If the client complains of pain during any of the movement assessments, further evaluation by a medical professional is recommended.

It is not recommended to work with a client who is currently experiencing pain without proper clearance and direction by their physician.

Lastly, when working with an athletic population, it may be appropriate to implement various performance assessments. This is not common when working with the general population, but it may be necessary to help a client with athletic goals. These assessments can be selected based on the movement demands of the client’s sport. For example, a vertical jump test is commonly used with basketball athletes, whereas the pro shuttle is used with soccer athletes. These assessments help inform the exercise program design and can be used to track progress over time.

Sequencing all assessments

It is important for all assessments to be sequenced in a specific order to help guarantee accurate results. For example, the fitness professional should always begin the assessments process with a preparticipation health screening (PAR-Q+, health history questionnaire), physiological (resting heart rate and blood pressure), and body composition (BMI, circumference, body fat percentage) assessments prior to performing assessments that require physical exertion. Physical exertion can skew the results of these assessments.

Once these assessments have been completed, the next step is to perform static postural and movement assessments. Lastly, cardio (aerobic/VT1 and anaerobic/VT2) tests and performance assessments can be administered. The fitness professional should choose to perform cardio and performance assessments on separate days to ensure the client’s energy levels are fresh to maximize accuracy of these assessments.

However, performance assessments that cause little fatigue (e.g., vertical jump test, horizontal jump test) can be administered prior to cardio tests if sufficient rest periods are provided. If an exercise program is properly designed by the Certified Personal Trainer, the client should experience improvement in each assessment over time.

**Opportunity for rapport building**

Many clients come into the gym or training centre intimidated by all the equipment and lacking knowledge about how to properly create exercise programs. They may also be fearful that they will become injured or push too hard during an exercise session. In these cases, postural, movement, and performance assessments are excellent tools for building trust and rapport with current and potential clients. These assessments, when implemented with confidence and compassion, can display a high level of expertise by the fitness professional and help a Certified Personal Trainer stand out among the competition. They also open the door for the fitness professional to discuss potential movement impairments and opportunities for improvements in posture and movement. Further, they help the fitness professional to carefully design an exercise program that is uniquely individualized for each and every client. With regular practice, these assessments will provide a roadmap for the development and execution of quality fitness programs.

**Reassessment**

Postural, movement, and performance assessments provide an important baseline from which to measure progress. Fitness professionals should carefully document the findings from these assessments to be referred to at a later time. Depending on the environment and client’s training schedule, it is recommended to reassess the client every month, or quarterly, to measure the progress they have gained from staying consistent with their fitness plan. The following are a few positive reasons to reassess clients on a regular basis:

1. It provides positive encouragement to clients and serves as a helpful reminder for them to continue working hard toward the goals they have set.
2. It helps clients realize how the exercise programming provided by their Certified Personal Trainer is making a difference in their fitness level, which helps foster adherence to the exercise program.
3. It provides an opportunity for fitness professionals to refine or progress exercises as their clients’ abilities improve.

**Considerations and modifications**

Due to the wide range of clients a fitness professional will work with, it is important to recognize and implement assessment modifications for certain populations with movement restrictions or safety concerns. The fitness professional should always use caution when implementing movement and performance assessments and only progress them once the client demonstrates the ability to perform advanced movements.

For example, if during the OHSA the client seems very unstable or lacking enough strength to smoothly lower and raise from the squat, it would not be a good idea to progress them to a single-leg squat. The fitness professional may instead choose to implement the pulling and pushing assessments. However, rather than requiring a narrow, split stance during the pulling and pushing assessments, it might be better to use a seated chest press or rowing machine to limit the balance challenge of the task. They key is to make sure that clients are comfortable and safe during the assessments, especially if they have any conditions that may limit full participation in the various assessments.

**Overweight and obese clients**

Prior to working with overweight and obese populations, a thorough preparticipation health screening must be completed. Also, note that overweight and obese clients show a large spectrum of abilities, from highly functional and strong to significantly limited in their movement quality and confidence. Fitness professionals should not make assumptions about anyone’s ability, but rather use the results from a systematic postural and movement assessment to help inform their approach. Standing postural assessments may be more challenging due to the amount of body mass that covers bony landmarks, but this will still be the first step in the assessment process. Next, an OHSA should be used to evaluate whole body movement and stability. If the overweight or obese client appears unstable or at risk of falling, a modified overhead squat with reduced range of motion can be used instead. If the overweight or obese client performs confidently and is stable in the overhead squat, a single-leg squat may be helpful to evaluate balance, but it is not necessary and depends on the fitness professional’s evaluation.

Performance assessments are also not necessary for many overweight or obese clients, as these clients are typically seeking to improve body composition and health measures, not athletic performance. Assessment considerations for overweight and obese clients include the following:

1. Ensure a thorough preparticipation health screening is completed.
2. Avoid making assumptions about the overweight or obese client’s ability, and instead, allow results from posture and movement screening to help determine their functional status.
3. Consider limiting movements that require an overweight or obese client to get on and off the ground.

Assessment modification options for overweight and obese clients include the following:

1. Consider modifying the overhead squat with a reduced squat depth.
2. Skip the single-leg squat for overweight and obese clients, unless they show adequate strength and stability during the OHSA.
3. Perform pushing and pulling assessments in a standing position or with the use of machines for improved stability and comfort.

**Youth clients**

With increased use of technology and long hours seated in classroom environments, even youth clients will present with postural distortions. As a result, static postural assessments are recommended and should be performed before movement assessments. Overhead squat, single-leg squat, pushing, and pulling assessments should also be used to determine the client’s functional status and movement quality. In many cases, movement impairments for youth are the result of limited strength and poor motor control.

Youth clients can benefit from performance assessments, especially if the child plays sports. The most important things to consider, however, are the youth’s maturity level and goals. Is the youth seeking weight loss or improved athletic performance? This information will determine the most appropriate assessments to conduct. Note that one-repetition maximum tests (bench press and squat) would not be appropriate for most youth clients. Instead, select muscular endurance and cardiovascular assessments, unless measuring absolute strength is vitally important for the child’s goals and the child has the maturity level and exercise experience to handle such assessments.

Assessment considerations for youth include the following:

1. The OHSA should be used to begin learning about the youth client’s functional abilities and to determine if they are ready for the single-leg squat assessment.
2. Assumptions about the youth client’s ability should be avoided, and instead, results from postural and movement screenings should be used to help determine their functional status.
3. Youth clients should typically not be challenged with maximum strength testing due to their developmental stage of life and lack of maturity needed for such assessments.
4. Many movement impairments will be the result of a lack of strength or motor control in the youth populations.

Assessment modification options for youth include the following:

1. Implementation of muscular endurance assessments should be considered instead of maximum strength testing.
2. Performance assessments, such as the push-up test, LEFT, and pro shuttle assessment, may be a fun way to keep youth clients engaged, while also testing their muscular endurance, power, and agility.

**Older adult clients**

Preparticipation health screening should be conducted for older adult clients prior to any other assessments. Once it is determined that the individual can safely proceed, the goal of the assessment process is to determine the older adult’s functional status. Some of the typical movement assessments may need to be modified for this population. After a static postural assessment, a modified OHSA (limited range of motion) may need to be administered. In many cases, a single-leg squat test is not safe for this population, unless the client displays remarkably good strength and stability during the OHSA. Upper-extremity pushing and pulling assessments should typically be performed in a standing position with light resistance from a cable pulley or seated in a machine. Performance assessments are typically not appropriate for older adult clients unless they are an athlete and have specific athletic goals. Assessment considerations for older adults include the following:

1. A thorough preparticipation health screening should be completed prior to further testing.
2. Assumptions about the older adult’s ability should be avoided, and instead, results from postural and movement screenings should be used to help determine their functional status.
3. Movements that require senior clients to get on and off the ground may need to be limited depending on the client’s functional status.
4. The assessment process should be started conservatively and then progress to more challenging movements based on the client’s goals and abilities.

Assessment modification options for older adults include the following:

1. The overhead squat may need to be modified with a reduced squat depth.
2. The single-leg squat for older adult clients should be skipped, unless they show exceptional strength and stability during the OHSA.
3. Pushing and pulling assessments should be performed in a standing position or with the use of machines for improved stability and comfort.

**Prenatal clients**

The types of assessments performed for prenatal clients depend on their goals and stage of pregnancy. The most important assessment for a prenatal client is a preparticipation health screening. Medical clearance, prior to exercise, by the client’s physician is also recommended. It is presumably safe to perform most assessments with prenatal clients in their first trimester. However, precautions must be made for clients in their second and third trimesters. Performance assessments are likely not necessary for prenatal clients, unless the client is an athlete with medical clearance to continue vigorous exercise. In all cases, prone and supine positions should be avoided for prenatal clients in their second and third trimesters; instead, opt for seated or standing assessments. Assessment considerations for prenatal clients include the following:

1. Thorough preparticipation health screening and medical clearance should be obtained prior to further testing.
2. Assumptions about a prenatal client’s ability should be avoided, and instead, results from postural and movement screenings should be used to help determine her functional status.
3. The prenatal client’s concerns about movements or activities should be noted, and she should not be forced into any assessments that she is not comfortable with.
4. Movements that require a prenatal client to get on and off the ground should be limited.
5. The assessment process should start conservatively and then progress to more challenging movements based on the prenatal client’s goals and abilities.
6. Prone and supine positions should be avoided for prenatal clients in their second and third trimesters.

Assessment modification options for prenatal clients include the following:

1. The overhead squat may need to be modified with a reduced squat depth, especially for clients in their second or third trimesters.
2. Skipping the single-leg squat assessment is recommended for prenatal clients.
3. Pushing and pulling assessments should be performed in a standing position or with the use of machines for improved stability and comfort.