6.6: How to Measure Body Composition

Multiple methods exist to estimate body composition. Remember, body composition is the ratio of FM and FFM used to help determine health risks. Of the other methods already mentioned (waist, waist-to-hip ratio, and BMI), none provide estimates of body composition but do provide measurements of other weight-related health markers, such as abdominal fat. Experts have designed several methods to estimate body composition. While they are not flawless, they do provide a fairly accurate representation of body composition. The most common are:

- **Hydrostatic Weighing (Underwater Weighing)**
  At one time, hydrostatic weighing (also and maybe more accurately called hydrodensitometry) was considered the criterion for measuring body composition. Many other methods are founded on this model, in one form or another. This method attempts to measure the density of the body by applying Archimedes’ principle: density = mass/volume. The mass and volume components are measured by using dry weight and then weight while being submerged in a water tank. Since fat is less dense than muscle tissue, a person with more body fat will weigh less in the water than a similar person with more lean mass. Using the measurements, the density can be determined and converted into body fat percentage. With a small margin of error (around 1-2%) this method is very accurate. Unfortunately, the expense and practicality of building and maintaining a water tank limits access for most. Also, for those with a fear of water, this would obviously not be the preferred method.

- **Dual Energy X-Ray Absorptiometry (DEXA)**
  Replacing underwater weighing as the new “gold standard,” is DEXA. While underwater weighing accurately compartmentalizes FM and FFM, DEXA adds a third compartment by using low-radiation X-rays to distinguish bone mineral. This addition slightly increases the accuracy of DEXA by eliminating some of the guess work associated with individual differences, such as total body water and bone mineral density.

  Originally, DEXA scanners were designed to determine and help diagnose bone density diseases. As a result, they can be found in many physicians’ offices. However, a full body scan, which takes only a few minutes, is all that is needed to also determine body fat percentage. Major disadvantages to this method are its high cost and the need for a well-trained professional to operate the equipment and analyze the results.

- **Air Displacement (Plethysmography)**
A good alternative to more expensive methods, air displacement determines body density using the same principle as underwater weighing, by measuring mass and volume. Clearly, the main difference is that mass and volume are being determined by air displacement rather than water displacement. Using a commercial device (the Bod Pod is most commonly referenced), a person sits in a chamber that varies the air pressure allowing for body volume to be assessed. Air displacement provides a viable alternative for those with a fear of water.

Like many other methods, the expense, availability, and training of personnel Air Displacement requires limit accessibility. Additionally, its accuracy is slightly less than underwater weighing.

- **Bio-electrical Impedance Analysis (BIA)**
  BIA takes a slightly different approach to measuring FFM. The premise behind BIA is that FFM will be proportional to the electrical conductivity of the body. Fat-tissue contains little water, making it a poor conductor of electricity; whereas, lean tissue contains mostly water and electrolytes, making it an excellent conductor. BIA devices emit a low-level electrical current through the body and measure the amount of resistance the current encounters. Based on the level of impedance, a pre-programed equation is used to estimate body fat percentage.

  The most accurate BIA devices use electrodes on the feet and hands to administer the point-to-point electrical current. The margin of error for these devices falls in the range of 3–5%. Portable or handheld BIA devices that only measure lower or upper body conductivity have a higher margin of error (4–8%).

  Because BIA devices primarily measure hydration, circumstances that may influence hydration status at the time of measurement must be taken into account. Recent exercise, bladder content, hydration habits, and meal timing can cause wide measurement variations and influence accuracy. However, this method is generally inexpensive, often portable, and requires limited training to use, making it a very practical option.

- **Skinfold Analysis**
  Skinfold analysis is a widely used method of assessing body composition because of its simplicity, portability, and affordability. It is also fairly accurate when administered properly. Margins of error are about 4–7%, depending on the quality of the skinfold calipers and skill of the administrator/technician. The assumption of skinfold measurement is that the amount of subcutaneous fat is proportionate to overall body fat. As such, a technician pinches the skin at various sites and uses calipers to measure and record the diameter of the skin folds. These numbers can then be plugged into an equation to generate an estimate of body fat percentage.

  The proportionality of subcutaneous fat and overall body fat depends on age, gender, ethnicity, and activity rates. As such, technicians should use the skinfold technique specific to the equation that accounts for those variables to improve accuracy.