BODY COMPOSITION LAB

Name________________________Lab____

Introduction:

Body composition evaluation is an important part of the overall fitness evaluation. It is well established that excess body fat is harmful to an individual’s health. Body composition refers to the relative percentages of body weight comprised of fat and fat-free body tissue. Assessment techniques vary from simple field measurements to elaborate laboratory techniques that require expensive equipment and specially trained technicians.

Common methods for body composition assessment include hydrostatic weighing, skinfold measurements, and bioelectrical impedance. For many years hydrostatic weighing was thought to be the definitive method of body composition determination. With emerging technologies, such as the BodPod, hydrostatic weighing is being replaced as the definitive method or gold standard. This change in technology has allowed a better capability of identifying specific tissues of the body. Hydrostatic weighing is however still the best and most accessible method for most individuals. Hydrostatic weighing is quite time consuming and involves a substantial amount of potential subject error.

Hydrostatic weighing is based on Archimedes’ principle, which states that when a body is immersed in water, it will be buoyed by a counterforce equal to the weight of the water displaced. Since bone and muscle weigh more in water, an individual with more lean tissue for the same total body weight will weigh more in water. This individual will also have a higher body density and a lower percent fat reading. An individual with more fat tissue for the same total body weight will weigh less in water, thus equaling a lower body density and a higher percent fat reading. Hydrostatic weighing requires an accurate assessment of lung residual volume in order to calculate body density. Small errors in residual volume can result in substantial errors in body fat estimation.

Skinfold techniques correlate well with body composition determination from hydrostatic weighing. The principle behind this technique is that the amount of subcutaneous fat is proportional to the total amount of body fat. Various equations have been developed to predict body density from skinfold measurement. Many of these equations are for more specific populations, based upon ethnicity, race, and age. Some more generalized equations do exist, the most popular being the Jackson & Pollock and Jackson, Pollock, and & Ward equations.

Bioelectrical Impedance Analysis (BIA) relies upon the principle that the flow of electricity is facilitated through hydrated fat-free tissue and extracellular water compared to fat tissue. This occurs because of the greater electrolyte and water content of lean tissue. Impedance to the electrical flow is directly related to the level of body fat. This technique is affected by a number of factors including the hydration status of the
individual, because of the effects of dehydration or overdehydration has on electrolyte status. BIA is constantly coming into question for its accuracy during assessment protocols.

Body Mass Index (BMI) is not an estimate of percent body fat, but an indicator of fat an individual is carrying based upon weight to height. Typically an individual who weighs a lot for their height will have a high percentage of body fat. However, this assumption does not hold true for all individuals. An example would be an individual who is 5’10” and weighs 230 lbs., but is very muscular with a low percentage of body fat. The BMI most often calculated by using the Quetelet index, which is as follows:

\[ \text{REMEMBER:} \text{pounds(lbs)} \div 2.2 = \text{kg} \]

\[
\begin{align*}
\text{Weight (kg)} \\
\text{Height (m²)} \\
\text{inches x 0.0254 = m} \\
\text{inches x 2.54 = cm}
\end{align*}
\]

**Purpose:**

The purpose of this lab is to become familiar with the different forms of assessing body composition by practicing these methods on fellow students. Also to get the student acquainted with using skinfold calipers, utilizing body fat percent equations, and proper use of a nomogram.

**Equipment/Personnel:**

Skinfold calipers, Omron BIA analyzer, Tanita BIA analyzer, weight scale, height scale, and all students participating.

**Definitions:**

1. **Archimedes’ Principle**- The principle that a partially or fully submerged object will experience an upward buoyant force equal to the weight or the volume of fluid displaced by the object.

2. **Basal Metabolic Rate (BMR)**- The level of energy required to sustain the body’s vital functions in the waking state.

3. **Resting Metabolic Rate (RMR)**- The energy expended while an individual is resting quietly in a supine position.

4. **Body Composition**- The partitioning of body mass into fat-free mass (weight or percentage) and fat mass (weight or percentage).
5. **Densitometry**- The measurement of mass per unit volume.

6. **Fat-Free Weight**- The weight of the body tissue excluding extractable fat.

7. **Hydrostatic Weighing**- Criterion measure for determining body composition through the calculation of body density.

8. **Skinfolds**- The double thickness of skin plus the adipose tissue between the parallel layers of skin.

**Procedures:**

Students should break up into pairs or groups of three and practice using the different methods for assessing body composition. Practice should be implemented with skinfold calipers, bioelectrical impedance analysis, waist-to-hip ratio, and body mass index procedures.

**TODAY’S TEST:**

Subject____________________________   Age_____ Ht_____ in → _____ cm → _____m

Wt_____ lbs → _____ kg

**Waist-to-Hip Ratio**

Waist _____ inches Hips _____ inches Ratio ______

**Body Mass Index**

Height _____     Weight _____     BMI ______

**Bioelectrical Impedance Analysis (BIA)**

% FAT _____ using Omron (hands)     _____ using Tanita (feet)
### Skinfolds

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<tr>
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<th>Trial 1</th>
<th>Trial 2</th>
<th>Trial 3</th>
<th>Average</th>
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SUM _______mm

% FAT ______ using three site equation ______ using nomogram

### Questions/Speculations:

1. How close is the estimate for skin fold caliper percent body fat compared to BIA? If they are different what factors would cause the discrepancy?
2. Calculate the four site skinfold technique and see how closely it comes to the other estimates.

3. Why is it necessary to use % fat, BMI and waist to hip ratio on the same client?

4. Use these equations to estimate pounds of body fat (assuming you did not already know) for your calculations in today’s test.

   \[
   \text{% fat} \times \frac{\text{Total BW}}{\text{Fat weight (decimal)}}
   \]

   \[
   \text{Total BW} - \text{Fat weight} = \text{Lean BW}
   \]

   Once you have established an estimated body fat percentage you can choose a target body fat percentage as a goal. Simply take the lean body weight by \((1.00 - X)\), where \(X\) is your chosen percentage of body fat. Example, if \(\text{LBW} = 128\), and the chosen percentage is 13% expressed as .13, the equation would look similar to this:

   \[\frac{128 \text{ LBW}}{1.00 - .13} = 147 \text{ lbs as target weight}\]

   If this client weighs 160 lbs, and you have assessed him at 20% fat, then the person needs to reduce from 160 lbs down to 147 lbs in order to go from 20% body fat to 13% body fat, overall it is a 13 lb weight loss.

Revised 11/27/01