BIOMECHANICS LABROTORY

Measuring body composition using Hydrodensitometry

A. Object:

To illustrate how to measure human body composition using Hydrodensitometry.

B. Introduction:

Body composition, or fat versus fat-free (lean) mass, reflects the results of a person's physical activity and nutritional practices. Only by accurately assessing body composition will one know exactly what makes up their weight, enabling sensible decisions regarding nutrition and exercise programs to be made. Assessment body composition is the single best way for a person to get the "whole picture" of what's really going on in their body. Monitoring body weight alone can be very misleading, because a scale can't tell the difference between a pound of fat and a pound of muscle.

A body composition analysis would reveal these important shifts in body composition that a scale cannot and even though a certain amount of body fat is needed to ensure good health, excess body fat has been found to dramatically increase risk of diseases such as cancer, diabetes, heart disease and so on. Examine the relationship of relative leanness and fatness to performance in sport, find out what guidelines best determine an athlete's goal weight, food & nutritionboard, energy expenditure, will discussed in terms of human body composition calculated by body density in different methods.

C. Hydrodensitometry (hydrostatic weighting):

The oldest and perhaps most accurate being underwater weighting. A valid, reliable, and widely-used laboratory method for assessing total body density. Behke first used the technique, showing that excess body weight in American football players was not the result of excess fat but of enlarged muscle mass.

Hydrostatic weighting Principles involved:

- Fat is less dense than water.
- FFM is more dense than water.

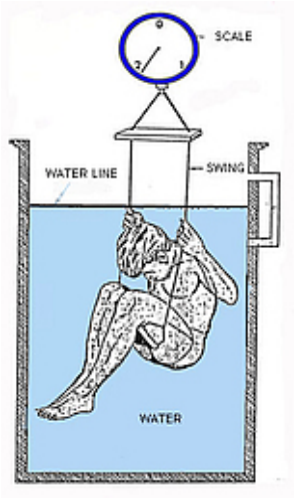

Fig.1: Hydrodensitometry technology

Fig.2 Under water weighing test.

D. Method:

Based on Archimedes' principle that a body immersed in a fluid is acted on by a buoyancy force, which is evidenced by a "lose" of weight equal to that weight of the displaced fluid. Weight of water displaced divided by density of water equals body volume.

E. Apparatus components:

1. Packer: Glass one, its size 101 liter. Used as container filled with water, the toy will immersed in to it to calculate it's weighting.
2. Belt: plastic belt used to carry the toy during the procedure. It's stabilized by the concave end of helical steelyard for weighting the toy in air and in water.
3. Toy: plastic toy stuffed by ballast (cobble stone) for weighting 990g. The toy enclosed completely by taping its limps and head with the abdomen area by silicone sealant to prevent water entering the toy so will not affect the desired weight.
4. Helical balance: It can weigh 2kg (kilogram) 20N (Newton) used for weighing the toy in air and in water. It's semicircular end used for stabilizing it with the stand top end, second component is the spring, its elasticity constant k (333 N/m, $F=k*x$ where x is the displacement), attached to plastic cylinder with circular ends (superior one attached to the spring and inferior one attached to the concave end of the steelyard), its length represent x and will define the weight reading of the toy they are covered by transparent plastic contain the reading graduations with 2 percent error. It's concave end used to carry the toy.
5. The stand: used to suspend the helical balance.

F. The procedure:

Fig.3 Hidrodensitometry Experiment.

1. Wrap the toy by the belt and closes it tightly.
2. Stabilize the helical balance at the stand to catch in the free end of the belt.
3. Record the result which will represent the weight in air (W_a).
4. Fill the packer with water put the toy inside it.
5. Record the result which will represent weight in water (W_w).
6. Apply the formulas:

$$Wa - Ww$$

$$Db = Wa/(Wa - Ww)$$

Where:

Db: Body density (g/mL)
Wa: Body mass out of water.
Ww: Body mass underwater
Dw: Density of water (g/mL)

7. Use the following formulas to calculate fat percent:
   - Siri Percent Fat Equation:
     - %fat = (495 ÷ Body Density) – 450
   - Brozek Percent Fat Equation:
     - %fat = (457 ÷ Body Density) – 414
   - Schutte Percent Fat Equation (for African American males):
     - %fat = (437.4 ÷ Body Density) – 392.8
   - Wagner Percent Fat Equation (for African American males)
     - %fat = (486 ÷ Body Density) – 439
   - Ortiz Percent Fat Equation (for African American females)
     - %fat = (485 ÷ Body Density) – 439

G. Discussion

1. What are the other techniques that are used for the assessment of body composition?
2. What's the difference between Hydro density and other techniques?