

Chapter 6 – part 2 :

Densitometry

Densitometry

- Assessing the body composition by measuring the density of the entire body.
- Obtained through several techniques:
 - Hydrostatic (underwater weighing).
 - Air displacement plethysmograph.
 - DXA

Hydrostatic (underwater weighing)



Hydrostatic (underwater weighing)

- **Archimedes' principle:**

'The volume of an object submerged in water equals the volume of water the object displaces'

- **Based on the 2 compartments model:**

- Assumes a constant fat mass density 0.9 g/cm^3
- And density of fat free mass of 1.10 g/cm^3

• If mass and body volume are known \rightarrow we can calculate the density \rightarrow
from the density we can get the percent of body fat

See figure 6.36 P189

Weaknesses of underwater weighing:

1. Not practical for testing large numbers of people.
2. Needs subject cooperation and training.
3. Requires some special equipment, experience, and financial investment.
4. **It's accuracy can be affected by many factors:** it's depending on the fat-free mass, consumption of food and carbonated beverages shortly before underwater weighing, fluid loss during intensive training, etc.
5. Not appropriate for children

Air Displacement Plethysmography

- **Alternative for underwater weighing**
- **Body volume (and consequently, body density and percent body fat) can be measured**
- **Principle:**
 - When subject enters a chamber of known volume, the subject's body volume equal to the reduction in chamber volume.
 - Pressure differences within the front chamber when its empty and when the subject is present are used to calculate the subject's body volume



Strength

1. Requires less cooperation.
2. Residual lung volume measurements are not needed.
3. Has a high accuracy level

Limitations :

Same as underwater weighing (assumptions about fat free tissue density)

Bioelectrical Impedance

- It based on **conducting properties**.
- **Difference in electrolyte content between fat and fat free mass tissues**
 - Electrolytes such as sodium , chloride and potassium are found in fat-free mass while they are very low in adipose tissue
 - **The body's fat free mass has a greater electrical conductivity than fat mass**

Bioelectrical Impedance

- Low-level current is passed through the body and the impedance to the current is measured using an analyzer.
- Resistance is greater with high body fat and lower with greater total body water(TBW).
- The resistance measured by the instrument.





- Segmental multi-frequency BIA



Bioelectrical Impedance.

Advantages :

- Quick.
- Easy and comfortable.

Disadvantages :

1. Assumes that subjects are normally hydrated.
 - Dehydration can be caused due to: excessive perspiration, heavy exercise, alcohol use
 - **If body dehydrated → overestimation of body fat**
2. The instrument's cost (\$2,000-\$3,000).

Dual-Energy X-Ray Absorptiometry

- It was developed for assessing bone mineral density for the diagnosis of **osteoporosis**.
- Now it's used for the determination of fat mass and fat-free mass.
- During testing a subject lies on a table and the body is slowly scanned. Computer software then reconstructs an **image of the underlying tissue to determine total fat and lean mass**.



Strengths of DXA:

1. Requiring low cooperation.
2. Relatively quick
3. Having a low radiation dose

Limitations of DXA

1. Measurements maybe affected by the thickness of the body part being scanned.
2. Marked differences in the hydration of lean tissue between patients and healthy adults may affect the accuracy of measures.