# Chapter 6 – part 2 : Densitometry

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### 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)



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### 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/cm3

•And density of fat free mass of 1.10 g/cm3

•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

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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 STUDENTS-HUB.com

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

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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)

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## 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.

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• Segmental multi-frequency BIA



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## 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  $\rightarrow$  overestimation of body fat
- 2. The instrument's cost (\$2,000-\$3,000).

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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.



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### Strengths of DXA:

Requiring low cooperation.
 Relatively quick
 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.