Bioimpedance and Fat-Measuring Scale

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Seminar in Physiology and Instrumentation

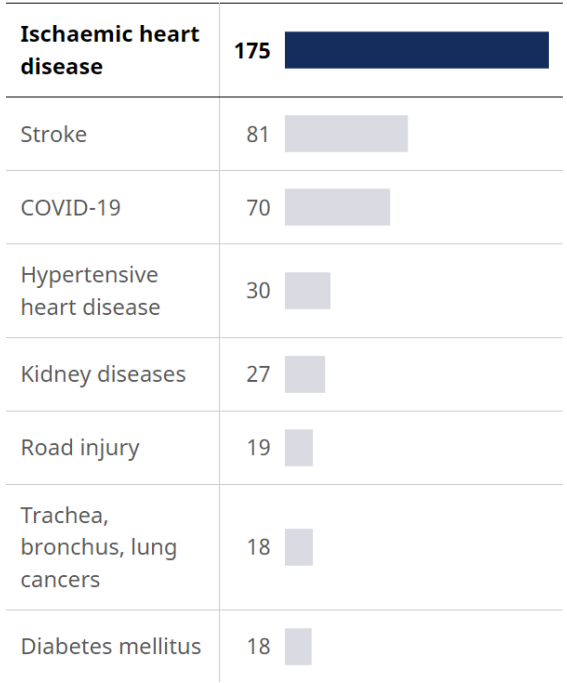
Introduction

- The importance of fat measurement
- Why Bioimpedance Fat measurement
- Electrical Properties of Body Tissues
- How is Bioimpedance Analysis Performed
- Medical Significance
- Medical Uses
- Product commercialization
- Future Perspectives
- Conclusion

The importance of fat measurement

Top causes of death

Deaths per 100 000 population. Morocco, 2021



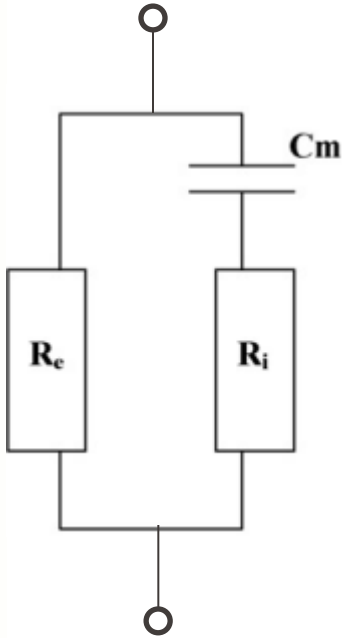
- Cardiovascular diseases remain in developing country one of the most prominent causes of death
- Hence the need to develop fat measurement techniques

Leading causes of death in Morrocco in 2021, WHO

Why Bioimpendance Fat Measuring?

- Limitation of body weight alone and commonly used tool tend to be misleading.
- Current techniques are either too expensive are too complex to set up.
- Non-invasive and user friendly at all levels, from personal to clinical!

Electrical Properties of Body Tissues



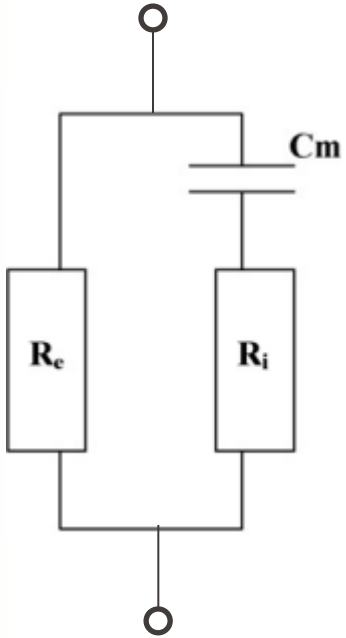
Impedance:

- **Resistance (R)**: Pure opposition to current flow.
- **Reactance (Xc)**: Opposition caused by cell membranes acting as capacitors.

Conductivity Differences:

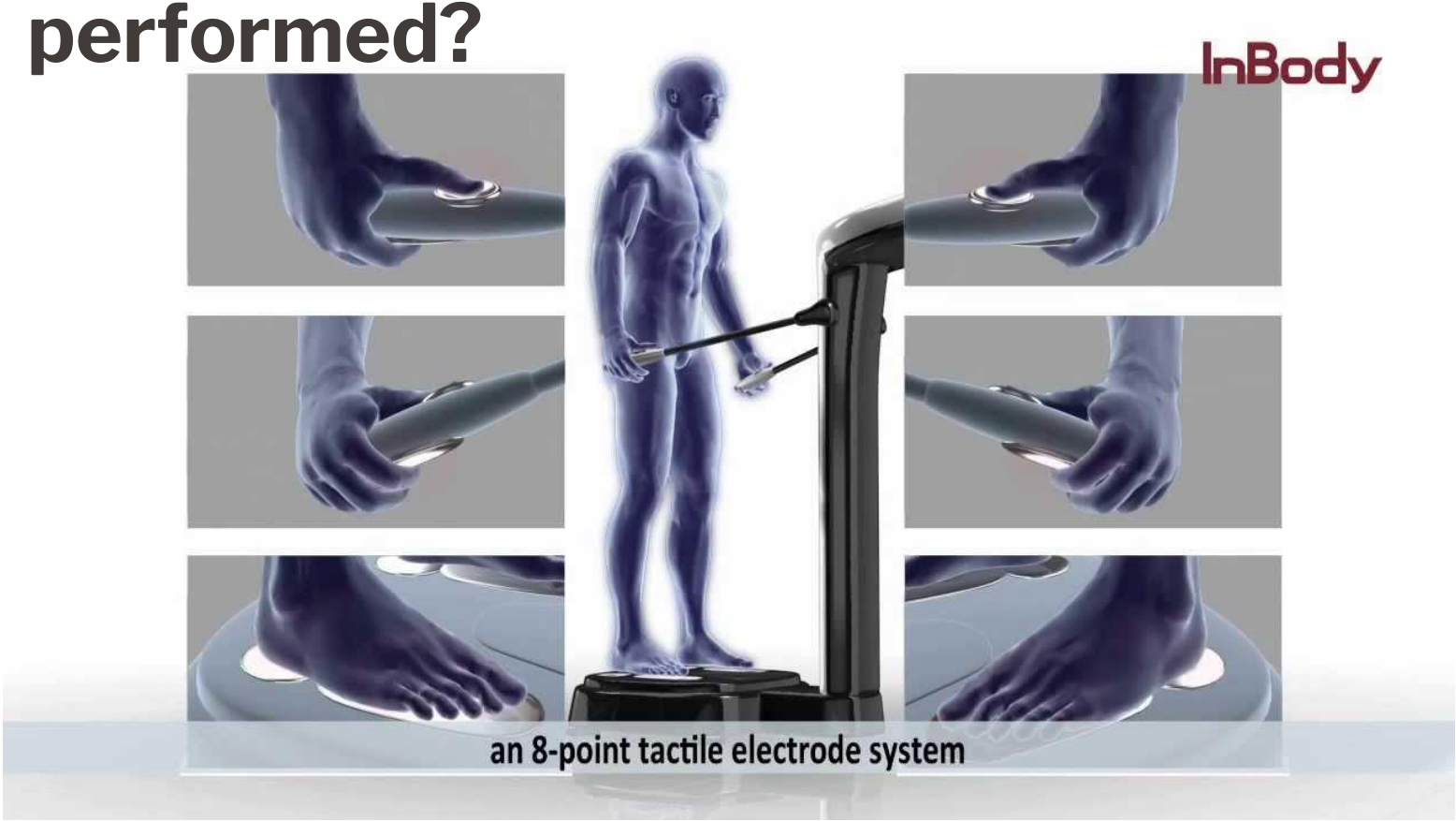
- **Water and Electrolytes**: Muscle and body fluids are good conductors due to their high water and electrolyte content.
- **Fat and Bone**: Poor conductors because they contain less water.

Body Composition Components



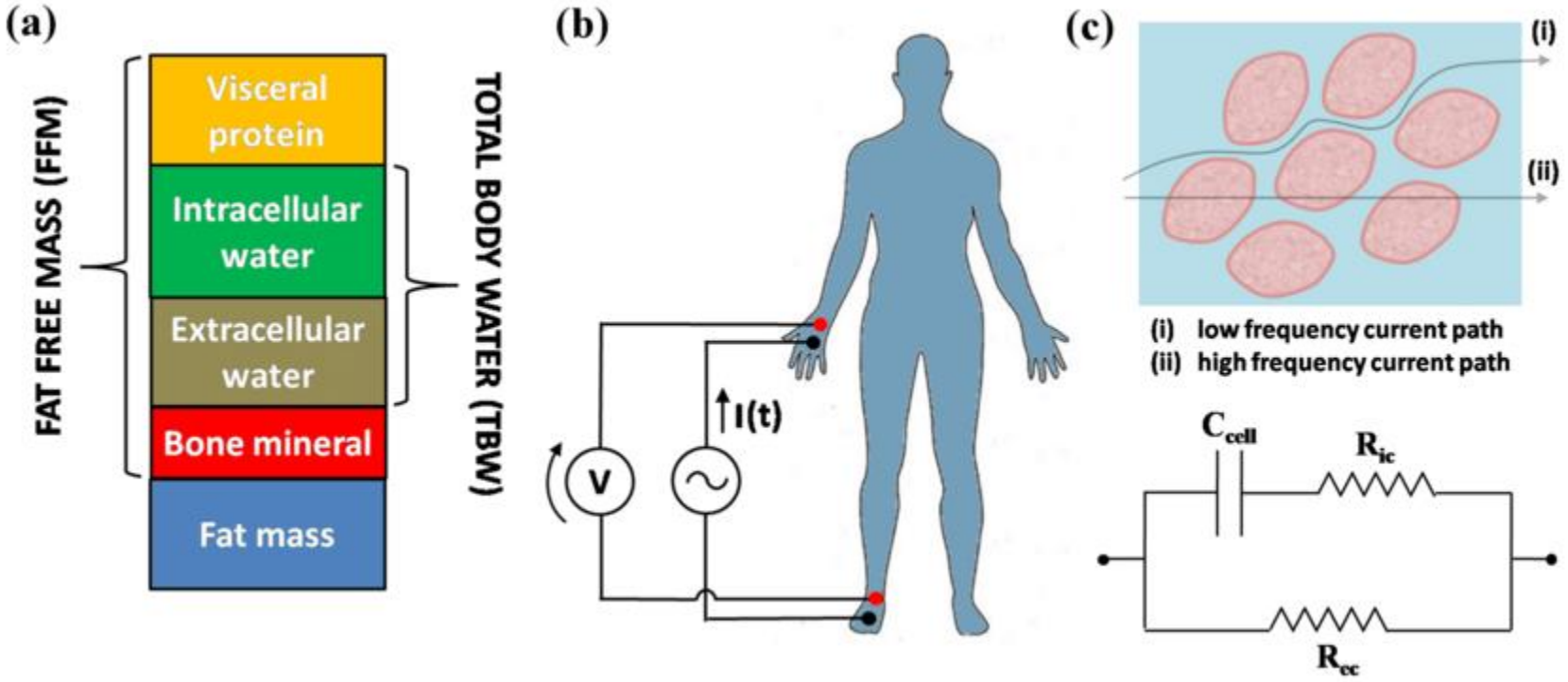
- **Fat-Free Mass (FFM)**: Includes muscle, water, bone, and connective tissue. This is a good conductor because it's rich in water and electrolytes.
- **Fat Mass (FM)**: Adipose tissue has low conductivity, leading to higher impedance.
- **Total Body Water (TBW)**: Accounts for most of the body's electrical conductivity. Approximately 50–70% of body weight is water, distributed as:
  - **Intracellular Water (ICW)**: Inside cells.
  - **Extracellular Water (ECW)**: Outside cells, including blood plasma and interstitial fluid.

How is Bioimpedance Analysis performed?



- Example of commercial device, InBody Technology

How is Bioimpedance Analysis performed?



- Bioelectrical Impedance Analysis (BIA) principle of work, Grossi, Riccò

Medical significance

- Bioimpedance gives out information on the fat and fluid distribution in the body.

- Fluid parameters can be markers of conditions and diseases.

Acute coronary syndrome illustration,
Cardiovascular Business, 2022

Leg lymphedema illustration,
mayoclinic.org

Medical Uses: management of fluid balance in patients with chronic kidney disease undergoing hemodialysis

How BIA is Used in Hemodialysis:

1. **Assessment of Dry Weight:**
   - Dry weight is the optimal body weight achieved after removing all excess fluid during dialysis without causing dehydration or hypotension.
   - BIA helps estimate the patient's **total body water** and differentiate between:
     - By analyzing the ECW/ICW ratio, clinicians can assess whether a patient is overhydrated (fluid overload) or dehydrated
2. **Monitoring fluid overload**
3. **Guiding Personalized Dialysis**

Medical Uses: management of fluid balance in patients with chronic kidney disease undergoing hemodialysis

Advantages of BIA in This Context:

- **Non-invasive and Quick**: Provides real-time data without requiring invasive procedures.
- **Early Detection**: Identifies fluid imbalances before they cause clinical symptoms.
- **Improved Outcomes**: Better fluid management reduces hospitalization rates and improves cardiovascular health.

Medical Uses: Lymphedema

- **Fluid Assessment:**
  - BIA can measure the fluid distribution between limbs (e.g., comparing an affected arm to the unaffected one).
  - Increased extracellular water in one limb relative to the other indicates fluid retention.

- **Subclinical Lymphedema**:
  - BIA detects lymphedema even before visible swelling occurs, allowing for early intervention.

Medical Uses: Lymphedema

- **Non-Invasive**: Provides a painless alternative to imaging techniques like MRI or lymphoscintigraphy.
- **Quick and Easy**: Can be performed in a few minutes in outpatient settings.
- **Sensitive to Early Changes**: Allows for detection before physical symptoms become severe.

Product commercialization

Silvergear Body Fat Scale, Bathroom scales, White

98.00 CHF

digitec.ch

Livraison gratuite

Tunturi - Tunturi sc30 intelligente waage mit app

39.90 CHF

Decathlon.ch

★★★★½ (10)

Livraison gratuite

Hammer Fitness, Personenwaage, Body Screen TX...

158.00 CHF

galaxus.ch

★★★★½ (16)

Livraison gratuite

Tanita DC 360 P body fat scale

2 749.00 CHF

sharkfitness.ch

Livraison gratuite

Healthkeep 11.4"&288mm-Brown, Bathroom...

54.90 CHF

digitec.ch

★★★★½ (25)

Livraison gratuite

Ta... bo...

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Future perspectives

- More diagnosis using Bioimpedance Analysis
- Improved Accuracy and Precision
- Wearable and Continuous monitoring
- Integration with AI and Big Data
- Integration with Haptics (Kinect, Wii Fit).

Q&A

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