Objectives

- Define body composition and understand its relationship to assessment of recommended body weight.
- Explain the difference between essential fat and storage fat.
- Describe various techniques used to assess body composition.
- Be able to assess body composition using skinfold thickness and girth measurements.
- Understand the importance of body mass index (BMI) and waist circumference in the assessment of risk for disease.
- Be able to determine recommended weight according to recommended percent body fat values and BMI.
- Learn how to measure body composition.
- Assess your risks for potential disease.

Introduction

- Body composition
  - Percent body fat
    - Proportion of the fat on the body compared to overall weight.
  - Lean body mass
    - Nonfat component
- Recommended body weight
  - A fat distribution pattern that is not associated with higher risk for illness.
  - Best determined based on the percent of body fat and lean tissue
Introduction

- **Overweight**
  Excess amount of weight against a given standard, such as height or recommended percent body fat

- **Obesity**
  Excessive accumulation of body fat, usually at least 30% above recommended body weight
  - Some individuals are heavy because of a large amount of muscle.
  - Some individuals are light but have a substantial amount of body fat.

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Essential and Storage Fat

- Total fat is determined by:
  - **Essential fat**
    - Needed for normal physiologic function.
    - Found in muscles, nerve cells, bone marrow, intestines, heart, liver, and lungs.
    - Constitutes about 3% of body weight in men and about 12% of body weight in women
  - **Storage fat**
    - Stored in Adipose tissue under skin and around organs
      - An insulator to retain heat.
      - An energy substrate for metabolism.
      - Padding against physical trauma to the body.

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Typical Body Composition of an Adult Man and Woman

- Similar amounts of storage fat in men and women:
  - Men tend to store fat around the waist ("android").
  - Women tend to store fat around the hips and thighs ("gynoid").
Techniques to Assess Body Composition

- Dual Energy X-ray Absorptiometry (DEXA)
  - Uses very low-dose beams of X-ray energy
  - Research and medical facilities
  - SEE ± 1.8 percent

- Hydrostatic weighing
  - Most other tests compare to this one
  - A person’s "regular" weight is compared with a weight taken underwater
  - Drawbacks?
  - SEE ± 0.5 percent

- Air displacement
  - Bod Pod
  - Computerized pressure sensors determine the amount of air displaced by the person inside the chamber.
  - Not population specific
  - SEE ± 2.2 percent
Techniques to Assess Body Composition

- Skinfold thickness
  - Relation of subcutaneous fat and total body fat
  - SEE ± 3.5 percent
  - Should be taken by the same technician and at the same time of day

- Girth measurements
  - Administered using a measuring tape to assess the circumference of various body parts.
    - Women—the upper arm, hip, and wrist
    - Men—the waist and wrist
  - May not be valid for athletic individuals or for people who can be classified visually as thin or obese.
  - SEE ± 4 percent

Body Fat Assessment According to Girth Measurements

For Women:
1. Measure the upper arm, hip, and wrist.
2. Use the following equations to calculate body fat percentage:
   - Upper arm: \( B = 0.49 \times A - 4.12 \)
   - Hip: \( B = 0.46 \times H - 3.96 \)
   - Wrist: \( B = 0.49 \times W - 4.97 \)

For Men:
1. Measure the waist and wrist.
2. Use the following equations to calculate body fat percentage:
   - Waist: \( B = 0.46 \times W - 3.96 \)
   - Wrist: \( B = 0.49 \times W - 4.97 \)

Example:
- Upper arm = 6 in
- Hip = 38 in
- Wrist = 6 in
- Waist = 36 in

Body Fat Percentage = \( B \)
Techniques to Assess Body Composition

- Bioelectrical impedance
  - Based on the principle that fat tissue is a less efficient conductor than lean tissue of electrical current.
  - Accuracy is questionable
    - 10 percentage points
    - Hydration and body temp can affect the results

Body Composition Classifications According to Percent Body Fat

<table>
<thead>
<tr>
<th>Age</th>
<th>Underweight</th>
<th>Excellent</th>
<th>Good</th>
<th>Moderate</th>
<th>Overweight</th>
<th>Obese</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>11-18</td>
<td>13.1-17.0</td>
<td>17.1-22.8</td>
<td>22.1-27.0</td>
<td>27.1-32.0</td>
<td>&gt;32.1</td>
</tr>
<tr>
<td></td>
<td>&lt;19</td>
<td>13.1-18.0</td>
<td>18.1-23.0</td>
<td>23.1-28.0</td>
<td>28.1-33.0</td>
<td>&gt;33.1</td>
</tr>
<tr>
<td></td>
<td>20-29</td>
<td>15.3-20.0</td>
<td>20.1-25.0</td>
<td>25.1-30.0</td>
<td>30.1-35.0</td>
<td>&gt;35.1</td>
</tr>
<tr>
<td></td>
<td>30-39</td>
<td>17.5-22.0</td>
<td>22.1-27.0</td>
<td>27.1-32.0</td>
<td>32.1-37.0</td>
<td>&gt;37.1</td>
</tr>
<tr>
<td></td>
<td>40-49</td>
<td>19.7-24.0</td>
<td>24.1-29.0</td>
<td>29.1-34.0</td>
<td>34.1-39.0</td>
<td>&gt;39.1</td>
</tr>
<tr>
<td></td>
<td>≥50</td>
<td>21.9-26.0</td>
<td>26.1-31.0</td>
<td>31.1-36.0</td>
<td>36.1-41.0</td>
<td>&gt;41.1</td>
</tr>
</tbody>
</table>

BMI (Body Mass Index)

- Determine thinness and excessive fatness
  - Height and weight to estimate fat values
- Most widely used measure to determine obesity and overweight
  - Weight (lb.) x 705 ÷ Height (in.)²
- Disease risk
  - Lowest risk 22-25 range
Disease Risk According to Body Mass Index (BMI)

Table 4.7  Disease Risk According to Body Mass Index (BMI)

<table>
<thead>
<tr>
<th>BMI</th>
<th>Disease Risk</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;18.5</td>
<td>Increased</td>
<td>Underweight</td>
</tr>
<tr>
<td>18.5–21.99</td>
<td>Low</td>
<td>Acceptable</td>
</tr>
<tr>
<td>22.0–24.99</td>
<td>Very Low</td>
<td>Acceptable</td>
</tr>
<tr>
<td>25.0–29.99</td>
<td>Increased</td>
<td>Overweight</td>
</tr>
<tr>
<td>30.0–34.99</td>
<td>High</td>
<td>Obesity I</td>
</tr>
<tr>
<td>35.0–39.99</td>
<td>Very High</td>
<td>Obesity II</td>
</tr>
<tr>
<td>≥40.00</td>
<td>Extremely High</td>
<td>Obesity III</td>
</tr>
</tbody>
</table>

Mortality Risk Versus Body Mass Index (BMI)

- Compared with a BMI between 22-25:
  - Mortality rates for those with a BMI between 25 and 30 (overweight) are up to 25 percent higher.
  - Mortality rates for those with a BMI above 30 (obese) are 50 to 100 percent higher.
  - The risk for premature illness and death increases for individuals who are underweight.

- Weakness of BMI
  - cannot differentiate between muscle and fat therefore doesn’t work well with athletes

- Storage of fat affects disease risk
  - Android obesity
    - Apple shape
    - Fat around organs
    - Higher risk for Heart disease, Hypertension, Type 2 diabetes, and stroke
  - Gynoid obesity
    - Pear shape
  - Measured at the level of the umbilicus

Waist Circumference

Visceral Fat Compared to SBC or RTP Fat for Disease Risk
### Disease Risk from WC and BMI

#### Table 4.8 Disease Risk According to Waist Circumference

<table>
<thead>
<tr>
<th>Men</th>
<th>Women</th>
<th>Disease Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 35.5</td>
<td>&lt; 35.5</td>
<td>Low</td>
</tr>
<tr>
<td>35.5-40.0</td>
<td>35.5-40.0</td>
<td>Moderate</td>
</tr>
<tr>
<td>&gt;40.0</td>
<td>&gt;40.0</td>
<td>High</td>
</tr>
</tbody>
</table>

#### Table 4.9 Disease Risk According to Body Mass Index (BMI) and Waist Circumference (WC)

<table>
<thead>
<tr>
<th>Classification</th>
<th>BMI (kg/m²)</th>
<th>Men WC (100 cm)</th>
<th>Women WC (100 cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>18.5-24.9</td>
<td>Very low</td>
<td>Increased</td>
</tr>
<tr>
<td>Overweight</td>
<td>25.0-29.9</td>
<td>Increased</td>
<td>High</td>
</tr>
<tr>
<td>Obesity Class I</td>
<td>30.0-34.9</td>
<td>High</td>
<td>Very high</td>
</tr>
<tr>
<td>Obesity Class II</td>
<td>35.0-39.9</td>
<td>Very high</td>
<td>Extremely high</td>
</tr>
<tr>
<td>Obesity Class III</td>
<td>&gt;40.0</td>
<td>Extremely high</td>
<td>Extremely high</td>
</tr>
</tbody>
</table>

### Determining Recommended Body Weight

#### Example:

- **Sex:** Female  
- **Age:** 19 years  
- **FP:** 30% (.30)  
- **DFP:** 22% (.22)  
- **BW:** 160 lbs.

1. **FW** = BW x %F  
   - FW = 160 x .30 = 48 lbs.

2. **LBM** = BW - FW  
   - LBM = 160 - 48 = 112 lbs.

3. **RBW** = LBM ÷ (1.0 - DFP)  
   - RBW = 112 ÷ (1.0 - .22)  
   - RBW = 112 ÷ .78 = 144 lbs.

4. **Desired Weight Loss (DWL)**  
   - DWL = BW - RBW  
   - DWL = 160 - 144 = 16 lbs.
Importance of Regular Body Composition Assessment

- Fat gain after 25 yrs
  - 1 to 2 lbs weight gain per year
  - ½ lb lean tissue lost per year
- Body composition reassessment periodically because of the effects of negative caloric balance on lean body mass.