Chapter 6: Body Composition

LEARNING OBJECTIVES

After reading this chapter, the student will be able to:
• Define fat-free mass and body fat, and describe their functions in the body.
• Explain how body composition affects overall health and wellness.
• Describe how body mass index, body composition, and body fat distribution are measured and assessed.
• Explain how to determine recommended body weight and body fat distribution.

KEY TERMS AND DEFINITIONS

essential fat Fats incorporated in various tissues of the body, critical for normal body functioning.
adipose tissue Connective tissue in which fat is stored.
subcutaneous fat Fat located under the skin.
visceral fat Fat located around major organs; also called intra-abdominal fat.
percent body fat The percentage of total body weight that is composed of fat.
overweight Body weight that falls above the recommended range for good health; sometimes defined as a body mass index between 25 and 29.9.
obesity Severely overweight, characterized by an excessive accumulation of body fat; may also be defined in terms of some measure of total body weight or a body mass index of 30 or more.
metabolic syndrome A cluster of symptoms present in many overweight and obese people, that greatly increases their risk of heart disease, diabetes, and other chronic illnesses; symptoms include insulin resistance, abnormal blood fats, abdominal fat deposition, type 2 diabetes, high blood pressure, and chronic inflammation.
chronic inflammation A response of blood vessels to harmful substances, such as germs, damaged cells, or irritants that can lead to heart disease, cancer, allergies, and muscle degeneration.
amenorrhea Absent or infrequent menstruation, sometimes related to low levels of body fat and excessive quantity of intensity of exercise.
female athlete triad A condition consisting of three interrelated disorders: abnormal eating patterns (and excessive exercising) followed by lack of menstrual periods (amenorrhea) and decreased bone density (premature osteoporosis).
body mass index (BMI) A measure of relative body weight correlating highly with more direct measures of body fat, calculated by dividing total body weight (in kilograms) by the square of body height (in meters).
caliper A pressure sensitive measuring instrument with two jaws that can be adjusted to determine thickness.

EXTENDED LECTURE OUTLINE

Introduction
Those with optimal body composition tend to be healthier, move more efficiently, and feel better about themselves.
I. What Is Body Composition and Why Is It Important?

A. Body composition is the body’s relative amount of fat and fat-free mass.

1. Fat-free mass is composed of all the body’s nonfat tissues: bone, water, muscle, connective tissue, organ tissues, and teeth.
2. Body fat includes essential and adipose tissues.
   a. Essential fat includes lipids in the nerves, brain, heart, lungs, liver, and mammary glands. These fat deposits are necessary for normal body functioning and make up about 3-5% of total body weight in men and 8-12% in women.
   b. Adipose (or storage) fat is found below the skin (subcutaneous fat) and around major organs (visceral fat). The amount of storage fat depends on gender, age, heredity, metabolism, diet, and activity level.

B. Overweight and Obesity

1. Height-weight tables were frequently used to determine percent body fat, but they can be highly inaccurate for some individuals.
   a. Because muscle tissue is denser and heavier than fat, it is possible for a fit person to be classified as overweight and for an unfit person to fall below recommended weights.
   b. These tables do not directly measure fat.
2. When looking at body composition, the most important consideration is the proportion of the body’s total weight that is fat – the percent body fat.
3. Overweight is usually defined as total body weight above the recommended range for good health (as determined by large-scale population surveys).
4. Obesity is defines as a more serious degree of overweight. The cutoff point for obesity may be set in terms of percent body fat or in terms of some measure of total body weight.

C. Prevalence of Overweight and Obesity Among Americans

1. Americans are getting fatter. The prevalence of obesity has increased from 13% in 1960 to 34% today. 67% of adult Americans are now overweight. About 33% of men and 35% of women are obese, according to the latest statistics. By 2015, 75% of adults will be overweight and 41% will be obese.
2. Possible explanations for this increase include more time spent in sedentary work and leisure activities, fewer short trips on foot and more by automobile, fewer daily gym classes for students, more meals eaten outside the home, greater consumption of fast food, increased portion sizes, and increased consumption of soft drinks and convenience foods. According to the USDA, average calorie intake among Americans increased more than 500 calories per day between 1970 and 2010. 40% of adult Americans are physically inactive according to the CDC.

D. Excess Body Fat and Wellness

As rates of overweight and obesity increase, so do the problems associated with them.

1. Metabolic Syndrome, Diabetes, and Premature Death
   a. Many overweight and obese people suffer from a group of symptoms known as metabolic syndrome.
b. Symptoms include a resistance to the effects of insulin, high blood pressure, high blood glucose levels, abnormal blood fat levels (high triglycerides and low HDLs, or “good” cholesterol), chronic inflammation, and fat deposits in the abdominal region. Over 50 million Americans have metabolic syndrome.

c. Diabetes mellitus is a disease that causes a disruption of normal metabolism. The pancreas normally secretes the hormone insulin which stimulates cells to accept glucose in order to produce energy. This process becomes disrupted, causing a buildup of blood sugar in the bloodstream, resulting in kidney failure, retinal damage, blindness, possible heart attack, stroke, and hypertension. Diabetes is currently the 7th leading cause of death in the U.S.

d. Obesity is associated with an increased risk of death from many forms of cancer. Other health problems associated with obesity include hypertension, impaired immune function, gallbladder and kidney disease, skin problems, sleep and breathing disorders, erectile dysfunction, pregnancy complications, back pain, arthritis and other bone and joint disorders.

2. Body Fat Distribution and Health

a. The distribution of body fat is also an important indicator of health. An apple-shaped distribution compared to the pear shape tends to increase risk of high blood pressure, diabetes, early onset heart disease, stroke, certain cancers, and mortality. The reason is not clear, however; it appears that abdominal fat is more easily mobilized and sent into the bloodstream increasing disease-related blood fat levels.

b. The risks from body fat distribution are usually assessed by measuring waist circumference. A total waist measurement of more than 40 inches for men and more than 35 inches for women is associated with a significantly increase risk of disease.

3. Performance of Physical Activities

Overfat people generally do not have the muscular strength, endurance, and flexibility that make normal activity easy.

4. Emotional Wellness and Self-Image

Being perceived as fat can be a source of ridicule, ostracism, and sometimes discrimination from others; it can contribute to psychological problems such as depression, anxiety, and low self-esteem.

5. Goals for body composition should be realistic, however; a person’s ability to change body composition through diet and exercise depends not only on a wellness program, but also on heredity.

II. Problems Associated with Very Low Levels of Body Fat

A. Too little body fat is viewed by health experts as a threat to health and well-being.

1. Too little for women is less than 8–12%.

2. Too little for men is less than 3–5%.

B. Extreme leanness is linked with reproductive, circulatory, immune system disorders and with premature death. Extremely lean people may experience muscle wasting and fatigue and are more likely to suffer from an eating disorder. For women, an extremely low percentage of body fat is associated with amenorrhea and loss of bone mass.

III. Assessing Body Mass Index, Body Composition, and Body Fat Distribution
One’s weight alone is not an accurate indicator of body composition.

A. Body Mass Index
   1. BMI is a measure of body composition that is useful for those without access to sophisticated equipment.
   2. This technique involves dividing body weight (kg) by height (m$^2$) and comparing this figure to an index.
   3. An alternative equation, based on pounds and inches is
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      \text{BMI} = \frac{\text{weight}}{\text{height} \times \text{height}} \times 703
      \]
   4. Optimal BMI depends on age and other health factors, however, according to most recognized organizations, a BMI between 18.5 and 24.9 is considered healthy.
   5. BMI provides useful general guidelines; however, excess fat in the abdomen is the greater concern. Other factors such as high blood pressure, diabetes, blood fats, and insulin resistance must be considered along with a BMI score.

B. Estimating Percent Body Fat
   These methods are more sophisticated and can be obtained via direct or indirect methods.
   1. Underwater Weighing
      a. An individual is submerged and weighed under water.
      b. The percentage of fat and fat-free weight are calculated from body density.
      c. Muscle has a higher density and fat a lower density than water.
   2. Skinfold Measurements
      a. This technique measures skinfolds with calipers at specific sites to estimate percentage of body fat.
      b. It is important to test the exact sites, to measure several different times, and to take measurements at approximately the same time of day, because the amount of water in the body changes during the day.
   3. The Bod Pod (Plethysmography)
      This method uses a small chamber to measure body composition through air displacement rather than water displacement.
   4. Bioelectrical Impedance Analysis (BIA)
      a. This method depends on the fact that fat is not a good conductor of electrical current.
      b. Fat and fat-free tissues have different resistances, so body composition can be estimated by amount of impedance measured when a small electrical charge is sent through the body.
      c. Bioelectrical Impedance Analysis has an error rate of ± 4-5%.
   5. Advanced Techniques: Dual-energy X-ray absorptiometry (DEXA) works by measuring the tissue absorption of high- and low-energy X-ray beams. Total body electrical conductivity (TOBEC) estimates lean body mass by passing a body through a magnetic field.
C. Assessing Body Fat Distribution

Increased risk of disease is associated with waist measurements over 40 inches (men) or 35 inches (women) and waist-to-hip ratios above 0.94 for young men and 0.82 for young women.

IV. Setting Body Composition Goals

A. If you determine you need to lose fat after taking body composition assessments, select a target BMI or percent body fat.

B. Be sure your goal is realistic and will ensure good health.

C. If you are significantly overfat or if you have known risk factors for disease, consult your physician to determine a body composition goal for your individual risk profile. Heredity limits your capacity to change your body composition, so keep this in mind when setting goals.

D. Periodically check your weight and your body composition which will change as your weight changes.

V. Making Changes in Body Composition

Regular physical activity, endurance exercise, strength training, and moderate energy intake are keys.

A. Track your progress by checking your body weight regularly.

B. Reassess your body fat by having regular checks during your program.

C. Focus on physical activity compared to making significant food cuts. Most people have better success focusing on this for long-term goal setting.