

13

Body Composition

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Lesson 13.1

Body Composition Facts

Lesson Objectives

After reading this lesson, you should be able to

1. define *body composition*, *overweight*, and *obesity*;
2. describe some factors that influence body composition;
3. define *anorexia nervosa*, *bulimia*, and *anorexia athletica*;
4. explain how body composition and body fat level are related to good health; and
5. describe several laboratory and nonlaboratory tests for measuring body composition.



Lesson Vocabulary

anorexia athletica, anorexia nervosa, basal metabolism, body composition, body fat level, bulimia, essential body fat, lean body tissue, metabolic syndrome, obesity, overweight, skinfold, underweight

Body composition is a part of health-related physical fitness. It refers to all the tissues that make up your body. In this lesson, you'll learn about the types of tissue that make up your body and about key terms related to body composition. You'll also learn how to assess your current body composition and determine whether it is optimal for good health.

Body Composition Definitions

Your body is made up of two major types of tissue. In a healthy person, the great majority of the body consists of **lean body tissue**, including muscle, bone, skin, and body organs such as the heart, liver, kidneys, and lungs. All of the types of physical activity included in the Physical Activity Pyramid build lean body tissue, but muscle fitness exercises are especially good because they both build muscle and enhance bone development.

The other major type of body tissue is fat. Your **body fat level** refers to the percentage of your body that is fat tissue. A fit person has the right amount of body fat—neither too much nor too little.

About half of your body fat is located deep within your body. The remaining fat is located between your skin and your muscles. People who do regular physical activity typically have a larger percentage of lean body weight (especially from muscle and bone) and less body fat than people who do not do such activity. It's good if fat accounts for a relatively low

percentage of your total body weight. However, for good health, you do need some body fat. Determining your body fatness requires special equipment and expertise. Later, you'll learn how to measure the fat between your skin and muscles to estimate your total body fatness.

The terms **underweight** and **overweight** are commonly used to describe a body weight that is outside the healthy weight range—either below the range or above it. These terms have limitations because weight, or the combination of weight and height, does not always accurately reflect the amount of fat and lean tissue in the body. You'll learn more about underweight and overweight later in this chapter. The term **obesity** refers to the condition of being especially overweight or high in body fat.

FIT FACT

More than two-thirds of all American adults are considered overweight or obese. Fewer children and teens are considered overweight or obese, and the percentage varies by age, sex, and ethnic group. Obesity is high among Hispanic, African American, and Native American youth. For all ethnic groups combined, about 18 percent of youth and teens are considered obese. This is more than three times the rate of 30 years ago.

Factors Influencing Body Fatness

Many factors influence a person's level of body fat. Some are described in the following sections.

Heredity

You inherit your body type from your parents. Some people are born with a tendency to be lean, or muscular, or heavy. Inherited tendencies make it easier for some people and harder for others to keep their body fat level in the good fitness zone. You can't control your heredity, but you can be aware of tendencies in your family.

Metabolism

Your **basal metabolism** is the amount of energy (calories) your body uses just to keep you living. Your basal metabolism does not include the calories you burn while working, enjoying recreation, studying, or even sitting and watching television. Some people have a higher basal metabolism than others. This means that their bodies, at complete rest, burn more calories than the bodies of people with a lower metabolism. People with more muscle mass have a higher metabolism than people with less muscle mass. People with a higher metabolism can consume more calories than others can without increasing their level of body fat.

Your metabolism is affected by your heredity, age, and maturation. Most young people have a high metabolism because their bodies are growing and building muscle. As you grow older and lose muscle mass, your metabolism typically slows, which means that most people need to reduce the number of calories in their diet in order to avoid gaining fat.

Maturation

As you grow older and your hormone levels begin to change, your level of body fat also changes. During the teen years, female hormones cause girls to develop more body fat than boys. Because of male hormones, teenage boys have greater muscle development than girls.

Body Fat Levels Early in Life

Children who are too fat develop extra fat cells that make it more difficult to control their fat level later in life. Therefore, keeping your body fat level within the good fitness zone during your childhood and teen years will help you keep it in check throughout life.

Diet

The amount of energy contained in foods is measured in calories. Teens typically need more calories than adults. A typical teen male needs to consume about 2,500 to 3,000 calories a day to maintain an ideal level of body fat. A typical teenage female needs about 2,000 to 2,500 calories a day. Most males need more calories than most females because they are larger and have more muscle mass.



Physical Activity

Your body burns calories for energy. Therefore, the more vigorous activity you do (the more energy your body uses), the more calories you need. An inactive person uses less energy each day than an active person and thus needs to consume fewer calories. As a result, teens who participate in sports need to consume more calories than less active teens.



Body Fatness, Health, and Wellness

Having too much fat can be unhealthy. Scientists report that people who are high in body fat have a higher risk of heart disease, high blood pressure, diabetes, cancer, and other diseases. Until recently, type 2 diabetes was considered to be an adult disease, but it has become more common among youth primarily because of increases in body fat levels among youth. High levels of body fat are also associated with a condition called **metabolic syndrome**. This syndrome occurs when a person has a high level of body fat, large waist girth, and other health risks, such as high blood pressure, high blood fat, and high blood sugar.

In addition, health costs for obese people total thousands of dollars a year more than for people with healthy levels of body fat, and being high in body fat reduces a person's chances of successful surgery. A person with too much body fat also tires more quickly and easily than a lean person and therefore might be less efficient in both work and



Regular exercise expends calories.

recreation. Many experts believe that the reason so many adults have too much body fat is that they try to achieve an unrealistic weight or fat level. For example, many people try to be as lean as a movie star or an athlete shown in a commercial. When they cannot attain or maintain such an exceptionally low level of body fat, they give up and gain body fat. Instead, experts recommend setting less extreme goals that are achievable, which helps people maintain a healthy level of body fat throughout life.



We have to make sure that our kids still feel good about themselves no matter what their weight, no matter how they feel. We need to make sure that our kids know that we love them no matter who they are, what they look like.



—Michelle Obama,
First Lady of the United States

Too Little Body Fat



Having too little body fat is also a health risk. Eating disorders such as **anorexia nervosa**, **anorexia athletica**, and **bulimia** have many negative health consequences and can even be fatal. It is extremely important to identify the symptoms of an eating disorder as early as possible. An excessive desire to lose fat or maintain a very low fat level can lead to serious health problems.

The minimum amount of body fat required for healthy body functioning is called **essential body fat**. Having too little body fat can cause abnormal functioning of various organs. In fact, exceptionally low body fat can result in serious health problems, particularly among teenagers. Females with especially low body fat experience health problems related to their reproductive system and risk losing bone density. The following list summarizes several reasons your body needs some fat.

The Importance of Body Fat

- Fat is an insulator; it helps your body adapt to heat and cold.

- Fat acts as a shock absorber; it can help protect your organs and bones from injury.
- Fat helps your body use vitamins effectively.
- Fat is stored energy that is available when your body needs it.
- In reasonable amounts, fat helps you look your best, thus increasing your feelings of well-being.

Anorexia Nervosa

Anorexia nervosa is a serious eating disorder. A person who has this disorder severely restricts the amount of food that he or she eats in an attempt to be exceptionally low in body fat. In addition, many people with anorexia do extensive physical activity, thus further lowering their body fat to extremely dangerous levels.

Anorexia is most common among teenage girls, but it is becoming increasingly common among teenage boys. People with this disorder are usually very hard workers and high achievers. They have a distorted view of their body and see themselves as being too fat even when they are extremely thin. Persons with this disorder often fear maturity and the weight gain associated with adulthood. They often try to hide their condition by wearing baggy clothing, pretending to eat, and exercising in private. Anorexia is a life-threatening condition, and people who have it need immediate professional help.



People with eating disorders may be obsessed with their body weight even if they're already thin.

Anorexia Athletica

Anorexia athletica has many symptoms similar to those of anorexia nervosa. It is most common among athletes involved in sports—such as gymnastics, wrestling, and cheerleading—in which low body weight is desirable. This disorder can lead to anorexia nervosa. It is thought to be related to the pressure to maintain low weight and an excessive preoccupation with dieting and exercising for weight loss.

Bulimia

Bulimia is an eating disorder in which a person engages in binge eating—eating a very large amount of food in a short time. Bingeing is followed by purging, perhaps by vomiting or by the use of laxatives to rid the body of food and prevent its digestion. Bulimia can result in severe digestive problems and other health problems such as tooth loss and gum disease.

FIT FACT

Studies show that the number of teens who think they are overweight is four to five times the number who really are. At the same time, interviews with teens who actually are overweight show that 44 percent either have been or currently are teased about their body weight. Getting teased for being overweight—or just feeling like one is overweight—can result in low physical self-perceptions. Teens can help other teens improve their self-perceptions by being supportive rather than critical.

Laboratory Measurements for Assessing Body Composition

The most accurate methods for measuring body composition require special equipment and trained people. They are typically done in a laboratory. Three of the best methods are DXA, underwater weighing, and the Bod Pod (figure 13.1). All three are useful in determining how much of the body weight is fat and how much is lean tissue.



SCIENCE IN ACTION: Media Misrepresentation

Over the years, both exercise psychologists and nutrition scientists have conducted research about physical self-perceptions. They have found that people of all ages are self-conscious about the way they look. In fact, most people are far more critical of their own body than other people are. One reason is that we often compare ourselves with movie stars and other celebrities. Experts point out that the pictures we see of these people have been designed specifically to make them look as glamorous as possible and are touched up to enhance appearance. For example, computer programs can be used to make a female movie star's waist smaller and a male star's muscles larger. Some magazines have promised to limit changes in photos, but there are no regulations, and each magazine can do as it pleases.

Websites also use fake or altered pictures. Advertisements frequently show supposed before-and-after pictures to promote a product. The “before” photos often are taken with bad lighting and in unflattering conditions. The “after” photos are taken with better lighting and are sometimes altered. Video games also present unrealistic images of the human body. For example, body proportions for some male and female video game figures are literally impossible for real-life people.

Many experts believe that the misrepresentation of the human body in the media results in an obsession with leanness. Statistics indicate that many teens, especially girls, set unrealistic standards in judging their body composition. Many feel that they have more fat than they really do, and they try to lose weight unnecessarily.



Magazines and websites often alter photos of models and celebrities to make their bodies look unrealistically thin.

Because we are all a bit self-conscious, it is easy to overreact when others make comments about the way we look. For this reason, experts point out the importance of not making critical comments about others. It is also important to keep personal information, such as self-assessment results, confidential. You'll learn more about self-perceptions in the Taking Charge feature in the next lesson of this chapter.

Student Activity

Explore a variety of media sources to find examples of misrepresentation of the human body.



Dual-Energy X-Ray Absorptiometry

Dual-energy X-ray absorptiometry (DXA) is now considered the best method of assessing body composition (figure 13.1a) because it can accurately detect body fat, bone, muscle, and other body tissues. First, a high-tech X-ray machine takes a three-dimensional picture of the entire body. Then a computer analyzes the picture to determine the

amounts of different kinds of tissue, including fat, bone, and muscle.

Underwater Weighing

Until recently, underwater weighing was considered the best way to assess body fat level, and it is still a very good laboratory method. With this technique, you are weighed on land, then immersed in a tank of water and weighed again (figure 13.1b).

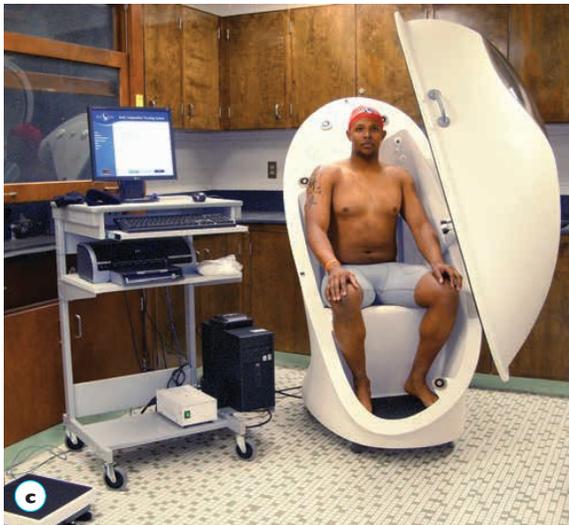


FIGURE 13.1 Laboratory methods for assessing body composition: (a) DXA; (b) underwater weighing; (c) Bod Pod.

Measurements of your lung capacity are also taken because the amount of air in your lungs influences your weight in water. A formula is then applied to determine your body fat level based on your land weight, your underwater weight, and your lung capacity.

Bod Pod

A third type of laboratory assessment of body composition uses a machine called the Bod Pod. In this method, the person being tested sits in an egg-shaped chamber or pod (figure 13.1c). The person's body, of course, takes up space in the pod, thus causing air to be moved from the pod. Information gained from changes in the pod's air

is then plugged into a special formula to determine the person's body fatness.

Nonlaboratory Measures

Because laboratory measures require special equipment and special training, they are rarely used in schools. For school and home use, nonlaboratory measures are available. Several practical methods of assessment are described here. However, not all of these measures accurately predict the amount of fat and lean body tissue; for this reason, they are typically referred to as body measurements. Body measurements are easier to use than laboratory measures and can be performed at school and often

at home. Because you will probably encounter all of these measures at some time in your life, you should try each one of them.

Skinfold Measurements

Your body fat level can also be determined by measuring **skinfold** thickness (the amount of fat under your skin). Skinfold thickness is measured by means of a special instrument called a caliper (see figure 13.2). Skinfold measurements can be used to provide an estimate of the total amount of fat in the body. As noted earlier, a high level of body fat is associated with a variety of health problems, including diabetes, heart disease, and other chronic diseases. You'll learn to do skinfold measurements in this chapter's Self-Assessment feature.

Height–Weight and BMI

Height and weight are commonly used in two ways. One method uses height–weight tables that show “normal” weight ranges for people according to age, height, and sex. These tables indicate what the average person of a given sex weighs at a given height. However, because nearly two-thirds of adults in the United States are overweight or obese, many people who are classified as “normal” or “average” are still overweight or obese. For this reason, height–weight tables are considered less useful than some other methods presented in this chapter. You'll get a chance to use height–weight charts in the self-assessment that follows this lesson.

Height and weight are also used to calculate a person's body mass index (BMI). This index is considered to be a better measure than height and weight alone, but it still does not give as accurate an assessment of body fatness as DXA, underwater weighing, Bod Pod analysis, or skinfold measurement. Both the BMI and the height–weight charts can provide inaccurate measurements for people who have a lot of muscle (athletes, for example) because muscle weighs a lot more than fat. As a result, a very muscular person could be high in weight but not too fat. Similarly, a person who appears normal according to height–weight and BMI charts could actually have an unhealthy level of body fat. This is why skinfolds and laboratory techniques are often considered to be better measures.

In spite of the BMI index's limitations, however, high BMI has been associated with a variety

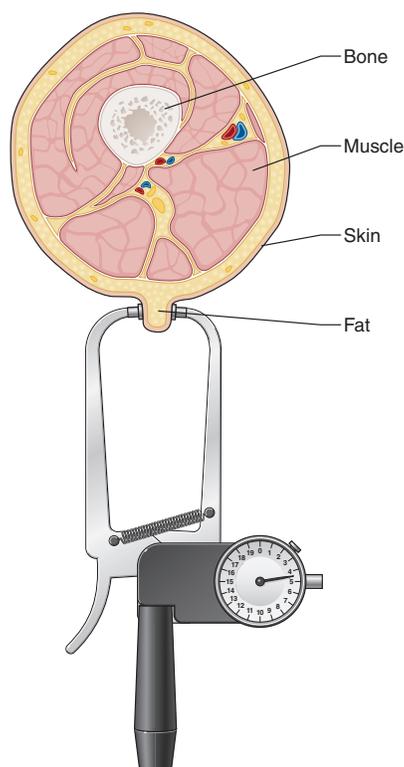


FIGURE 13.2 A caliper measures skinfolds.

of health problems among both teens and adults. In addition, BMI is often used because it's easy to measure, especially in large groups.

Body Measurements: Waist-to-Hip Ratio

The waist-to-hip ratio is used not to determine body fatness but to assess health risk. Scientists now know that people who carry more weight in the middle of the body have a higher risk of disease than people who carry more weight in the lower body (legs and hips). People who carry too much weight in their midsection are said to have an apple body type, whereas people who carry more weight in their hips are said to have a pear body type. In general, women are more likely to be the pear type, and men are more likely to be the apple type.

The waist-to-hip ratio is a simple method for assessing the risk associated with body type. As you'll see when you do the self-assessment for this chapter,



FITNESS TECHNOLOGY: Bioelectrical Impedance Analysis

Computers and other machines have been developed to test body fat levels. For example, bioelectrical impedance analysis (BIA) requires a special machine and expertise in using the machine, but in recent years BIA machines have become more common in schools because of lower prices and improved ease of use. Used properly, they can provide reliable and accurate estimates of body fatness. One limitation is that different machines can give different results, so it is important to use the same machine and to be sure that the machine is properly calibrated (tested for accuracy). In addition, testing should be done under similar conditions each time you are tested—for example, at the same time of day

and not at times when you might be dehydrated. Some health and fitness clubs and doctors' offices now have BIA machines. Results of a BIA test can help determine the accuracy of measurements made using other techniques described in this chapter.

Using Technology

If possible, arrange to have a BIA test done. Compare your BIA results with the results of other self-assessments performed in this chapter. If a BIA test is not available, do some research about BIA testing and report your findings.

this ratio is determined by using a tape to measure your waist circumference and your hip circumference. It is desirable to have a waist circumference smaller than your hip circumference.

Body Measurements: Waist Girth (Circumference)

Waist girth (also called waist circumference) can be used by itself as an indicator of health risk. Evidence indicates that people with a very large waist are at risk for health problems. As people grow older, their waist size often increases, thus exposing them to greater health risk. Thus waist girth is a useful health risk indicator that you can use throughout your life.

What Is My Ideal Body Weight?

Even after learning about the various forms of assessment, many people wonder what their ideal body weight is. Experts agree that there is no such thing as one ideal body weight for all people; that is, there is no single table or test that provides a best number for everyone. The best advice is to set a long-term goal of achieving a body fat level in the good fitness zone. Once you have achieved a body fat level that you are comfortable with and that puts you in the good fitness zone, weigh yourself and maintain

that weight (this is sometimes referred to as target weight). It's a desirable lifetime goal to maintain this weight and a fat level in the good fitness zone.

If you're in the marginal or low fitness zone, develop a plan that will gradually move you to the next zone. Trying to achieve the good fitness zone when you're too far from it is unrealistic. Instead, people in the low fitness zone should try to move to the marginal zone. Those in the marginal zone should try to move to the good fitness zone. If you're already in the good fitness zone, a reasonable goal for you is simply to stay there.

Some athletes and people in careers that require high levels of fitness may be in the very lean zone, and some people can be very lean because of hereditary factors. While it is possible to be fit and healthy and be in the very lean zone, exceptional leanness is not necessarily a sign of good health and may not be a realistic goal for all people. As noted earlier in this chapter, your body needs a certain amount of body fat (essential body fat), and having too little can cause health problems. Too little body fat can also indicate an eating disorder. If you already have too little fat, increase your weight by gaining body fat. People with eating disorders often try to reduce body fat even when they already have too little for good health. It is important for all people to eat well, especially people who want to be athletes or perform jobs that require high levels of fitness.

As part of a lifelong self-assessment plan, you may choose to monitor your hip-to-waist ratio and your waist girth, especially if you find it difficult to get a good assessment of your body fat level. These measurements are good indicators of health risk. You may also choose to track your BMI over time because physicians often use this measure. High scores are associated with health risks, but because BMI does not estimate body fat levels or lean body mass, it may misclassify some people as overweight or obese when they are not. Similarly BMI may classify a person as “normal” in weight when the person has a higher than healthy level of body fat. The same is true for height–weight charts.

Assessment Confidentiality

Self-assessments are done to gain information that will help the person build an accurate personal profile and plan for healthy active living. The results of self-assessments are personal information. In many assessments, you’ll work with a partner, and you and your partner must agree to keep test results private. Information may be submitted to an instructor or a parent or guardian but always with the expectation that the information is private. Assessment-related information should not be shared with others without permission from the person being tested.



Body fat helps buoyancy in water, so people with disabilities can do exercises in water that they can't do on land.

Lesson Review

1. What do the terms *body composition*, *overweight*, and *obesity* mean?
2. What are some factors that influence body composition?
3. What do the terms *anorexia nervosa*, *bulimia*, and *anorexia athletica* mean?
4. How are body composition and body fat level related to good health?
5. What are some laboratory and nonlaboratory tests for measuring body composition?