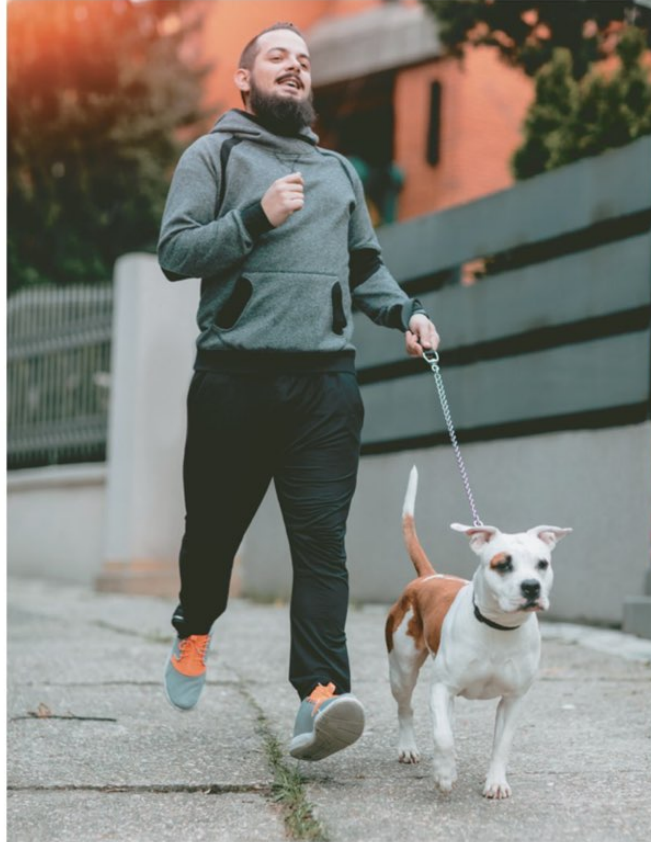


Chapter 10

Achieving and Maintaining a Healthful Body Weight



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Test Yourself

Interactive

3 questions

1. People who are moderately overweight and physically active should be considered healthy.
 - ☐ True
 - ☐ False



Learning Outcomes

After studying this chapter you should be able to:

- 10.1 Explain what is meant by a healthful body weight.
- 10.2 Distinguish five categories of body weight and three methods you can use to evaluate your body weight.
- 10.3 Discuss the concept of energy balance and the limitations of the energy balance equation.
- 10.4 Identify several biological, cultural, economic, and social influences on body weight.
- 10.5 Develop a diet, exercise, and behavioral plan for healthful weight loss.
- 10.6 Identify four key strategies for gaining weight safely and effectively.



Tristan has been a mathematics whiz since grade school, winning scholarships, awards, and internships and maintaining high honors in his classes throughout his academic career. Yet his peers are far less likely to acknowledge his talents and achievements than to fault him for his weight. Tristan admits he's "heavy," but he limits his consumption of junk food and alcohol, walks the 2 miles to and from campus each day, and joins his brother in the weight room at the local gym on Saturdays. Sometimes the negative comments about his weight bother him, especially when he compares himself with the athletes on campus. That's when he knows it's time to visit his grandfather. A "big man" all his life, he takes no medications, enjoys the vegetables he grows in his garden, and still coaches a community soccer team—at age 85!



Are you happy with your weight, shape, body composition, and fitness level? If not, what needs to change—your diet, your level of physical activity, or maybe just your attitude? How much of your body size and shape is due to genetics, and what factors can you control? And if you decide that you do need to lose weight, what's the best way to do it? In this chapter, we explore these questions and provide some answers.

What is a healthful body weight?

LO 1 Explain what is meant by a healthful body weight.

Throughout history, our standards of physical attraction, especially regarding body shape and weight, have changed. In the 1600s, the full-figured females and muscular males of Flemish Baroque painter Peter Paul Rubens were considered ideal. Fast-forward to the 1960s, when skinny stars such as Twiggy and Mick Jagger were the rage. These ideals shifted again in the 1980s, when physically fit bodies were in style for both women and men, and again in the 1990s, when the emaciated look of “heroin chic” was touted as beautiful for women, whereas the ideal man had broad shoulders and “six-pack abs.” There are also cultural differences in body shape and weight standards; in many cultures, being larger is associated with possessing greater wealth, health, fertility, and sexual desirability. These examples illustrate that standards for body shape and weight are influenced by social and cultural norms, fashion, and personal preferences, but they are not necessarily consistent with a body weight that is healthful.



What constitutes a healthful body weight varies for each individual. British singer Adele is comfortable with her body weight.

As you begin to think about achieving and maintaining a healthful weight, it's important to make sure you understand what that actually means. We can define a *healthful weight* as all of the following:

- A weight that is appropriate for your age and physical development
- A weight that you can achieve and sustain without severely curtailing your food intake or constantly dieting
- A weight that is compatible with normal blood pressure, lipid levels, and glucose tolerance
- A weight that is based on your genetic background and family history of body shape and weight
- A weight that is supported by good eating habits and regular physical activity
- A weight that is acceptable to you

As you can see, a healthful weight is one at which you don't have to be extremely thin or overly muscular. In addition, there is no *one* body type that can be defined as *healthful*. Thus, achieving a healthful body weight should not be dictated by the latest fad or current societal expectations of what is acceptable.

Recap

Standards of ideal body weight have changed over the course of human history, and vary from one culture to another. A healthful body weight is appropriate for your age, physical development, genetics, and family history; achievable without constant dieting; compatible with normal blood pressure, lipids, and glucose; supported by good eating and regular physical activity habits; and acceptable to you.

How can you evaluate your body weight?

LO 2 Distinguish five categories of body weight and three methods you can use to evaluate your body weight.

Various methods are available to help you determine whether you are currently maintaining a healthful body weight. Let's review a few of these methods.

Determine Your Body Mass Index

Body mass index (BMI) [🔗], or *Quetelet's index*, is a commonly used index representing the ratio of a person's body weight to the square of his or her height. A person's BMI can be calculated using the following equation:

$$\text{BMI (kg/m}^2\text{)} = \text{weight (kg)} / \text{height (m)}^2$$

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For those less familiar with the metric system, there is an equation to calculate BMI using weight in pounds and height in inches:

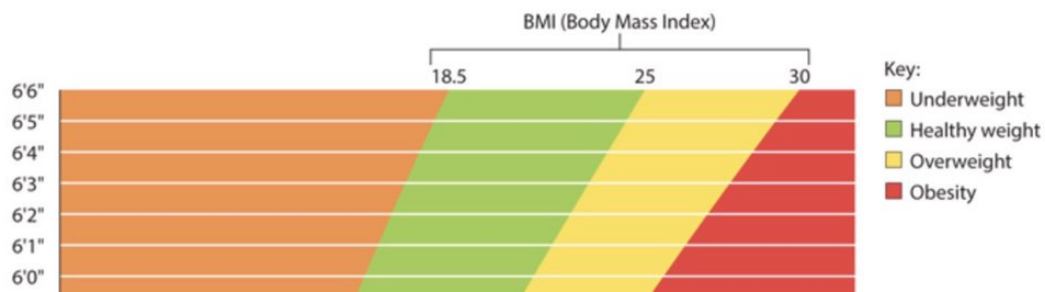
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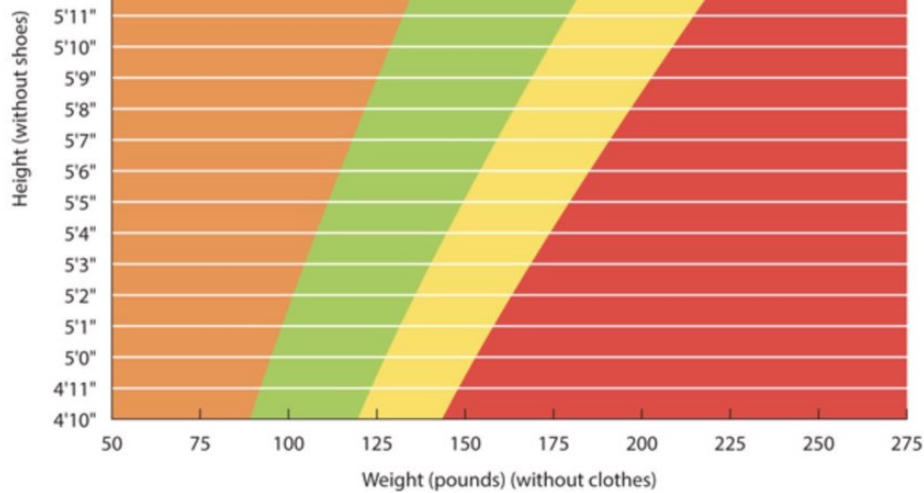
$$\text{BMI (kg/m}^2\text{)} = [\text{weight (lb)} / \text{height (inches)}^2] \times 703$$

A less exact but practical method is to use the graph in **Figure 10.1** [🔗], which shows approximate BMIs for a person's height and weight and whether a given BMI is in a healthful range.

Figure 10.1

Estimate your body mass index (BMI) using this graph. To determine your BMI, find the value for your height on the left and follow this line to the right until it intersects with the value for your weight on the bottom axis. The area on the graph where these two lines intersect is your BMI.





You can also calculate your BMI more precisely on the Internet using the BMI calculator from the U.S. Centers for Disease Control. Just enter “CDC BMI calculator” into your Internet browser and click on Adult BMI Calculator. Enter your data and the program will calculate your BMI.

Why Is BMI Important?

BMI provides an important clue to a person’s overall health because it is associated with one of five weight categories, each of which involves a certain level of health risk:

- **Underweight** is defined as having a BMI less than 18.5 kg/m^2 . This weight is below an acceptably defined standard for a given height. A person who is underweight has too little body fat to maintain health and therefore has an increased risk for many health problems.
- **Normal weight** ranges from 18.5 to 24.9 kg/m^2 . This weight is associated with the lowest disease risk.
- **Overweight** is a BMI between 25 and 29.9 kg/m^2 . It is defined as having a moderate amount of excess body fat, resulting in a person having a weight that is greater than some accepted standard for a given height but is not considered obese.
- **Obesity** is a BMI value between 30 and 39.9 kg/m^2 . Clinicians define obesity as having an excess of body fat that adversely affects health, resulting in a person having a weight that is substantially greater than some accepted standard for a given height. Research studies show that a person’s risk for type 2 diabetes, cardiovascular disease, and many other diseases increases significantly when BMI is above a value of 30 .

- **Morbid obesity**  (or extreme obesity) is defined as a BMI greater than or equal to 40 kg/m²; in this case, the person's body weight exceeds 100% of normal, putting him or her at very high risk for serious health consequences.

Until recently, data from national surveys have indicated that having a BMI value within the healthful range means that your risk of dying prematurely is within the expected average. Thus, if your BMI value fell outside this range, either higher or lower, your risk of dying prematurely was considered greater than the average risk. However, a 2013 analysis of 97 previously published studies found that people who are overweight (BMI of 25 to 29.9 kg/m².) but not obese have a 6% *lower* risk of dying prematurely than those with a normal BMI.¹

These findings created a firestorm of controversy among health professionals and prompted numerous scientists to question the study.² Most notably, Dr. Walter Willett of the Harvard School of Public Health called the findings “rubbish” and warned that they would confuse health care providers and discourage overweight and obese people from losing weight. In contrast, an editorial published in the journal *Nature* questioned the motives and views of these critics, emphasizing that the topic is highly complex, and concluding that “a bit of extra weight” does appear to be protective for people who are middle-aged or older or who are already sick.³ This controversy has drawn international attention to *how* research findings are reported in the media, leading to questions such as: Is it acceptable to reject major research findings when they don't agree? Do we risk misleading the public when we oversimplify our public health messages and fail to report the complexities of an issue such as obesity? Until future research findings clarify the relationship between body weight and risk for chronic disease and premature death, this topic will continue to be controversial.

Knowing how to calculate our BMI is important because we can't always predict our category of body weight based on our appearance. For example, Theo always worries about being too thin, and he wonders if he is underweight. Theo calculates his BMI (see the calculations in the **You Do the Math**  box on this page) and is surprised to find that it is 22 kg/m² and falls within the normal range.

You Do the Math

Calculating Your Body Mass Index

Calculate your personal BMI value based on your height and weight. Let's use Theo's values as an example:

You Do the Math

Calculating Your Body Mass Index

Calculate your personal BMI value based on your height and weight. Let's use Theo's values as an example:

$$\text{BMI} = \text{weight (kg)} / \text{height (m)}^2$$

1. Theo's weight is 200 pounds. To convert his weight to kilograms, divide his weight in pounds by 2.2 pounds per kilogram:

$$200 \text{ lb} / 2.2 \text{ lb per kg} = 90.91 \text{ kg}$$

2. Theo's height is 6 feet 8 inches, or 80 inches. To convert his height to meters, multiply his height in inches by 0.0254 meters/inch:

$$80 \text{ in.} \times 0.0254 \text{ m/in.} = 2.03 \text{ m}$$

3. Find the square of his height in meters:

$$2.03 \text{ m} \times 2.03 \text{ m} = 4.13 \text{ m}^2$$

4. Then, divide his weight in kilograms by his height in square meters to get his BMI value:

$$90.91 \text{ kg} / 4.13 \text{ m}^2 = 22.01 \text{ kg/m}^2$$

Is Theo underweight according to this BMI value? No. As you can see in [Figure 10.1](#), this value shows that he is maintaining a normal, healthful weight.

Limitations of BMI

Although calculating your BMI can be very helpful in estimating your health risk, the method has a number of limitations. BMI cannot tell us how much of a person's body mass is composed of fat, nor can it give us an indication of where on the body excess fat is stored. As we'll discuss shortly, upper-body fat stores increase the risk for chronic disease more than fat stores in the lower body. A person's age affects his or her BMI; BMI does not give a fair indication of overweight or obesity in people over the age of 65 years, as the BMI standards are based on data from younger people,

nor can it give us an indication of where on the body excess fat is stored. As we'll discuss shortly, upper-body fat stores increase the risk for chronic disease more than fat stores in the lower body. A person's age affects his or her BMI; BMI does not give a fair indication of overweight or obesity in people over the age of 65 years, as the BMI standards are based on data from younger people, and BMI does not accurately reflect the differential rates of bone and muscle loss in older people. BMI also cannot reflect differences in bone and muscle growth in children. BMI is also more strongly associated with height in young people; thus, taller children are more likely to be identified as overweight or obese, even though they may not have higher levels of body fat.



BMI is not an accurate indicator of overweight for certain populations, including heavily muscled people.

BMI also does not take into account physical and metabolic differences between people of different ethnic backgrounds. At the same BMI, people from different ethnic backgrounds will have different levels of body fat. For instance, African American and Polynesian people have less body fat than Caucasians at the same BMI value, while Indonesian, Thai, and Ethiopian people have more body fat than Caucasians at the same BMI value. There is also evidence that, even at the same BMI level, Asian, Hispanic, and people of African or Caribbean heritage have a higher risk for diabetes than Caucasians.^{4,5}

Finally, BMI is limited when used with pregnant and lactating women, and with people who have a disproportionately higher muscle mass for a given height, such as certain types of athletes. For example, one of Theo’s friends, Randy, is a 23-year-old weight lifter who is 5 feet 7 inches and weighs 210 pounds. According to our BMI calculations, Randy’s BMI is 32.9, placing him in the obese category. Is Randy really obese? In cases such as his, an assessment of body composition is necessary.

Measure Your Body Composition

There are many methods available to assess your **body composition**, or the amount of **body fat mass** (*adipose tissue*) and **lean body mass** (*lean tissue*) you have. **Figure 10.2** lists and describes some of the more common methods. It is important to remember that measuring body composition provides only an *estimate* of your body fat and lean body mass; it cannot determine your exact level of these tissues. Because the range of error of these methods can be from 3% to more than 20%, body composition results should not be used as the only indicator of health status.

Figure 10.2

Overview of various body composition assessment methods.

Method		Limitations
Underwater weighing: Considered the most accurate method. Estimates body fat within a 2–3% margin of error. This means that if your underwater weighing test shows you have 20% body fat, this value could be no lower than 17% and no higher than 23%. Used primarily for research purposes.		• Subject must be comfortable in water. • Requires trained technician and specialized equipment. • May not work well with extremely obese people. • Must abstain from food for at least 8 hours and from exercise for at least 12 hours prior to testing.
Skinfolds: Involves “pinching” a person’s fold of skin (with its underlying layer of fat) at various locations of the body. The fold is measured using a specially designed caliper. When performed by a skilled technician, it can estimate body fat with an error of 3–4%. This means that if your skinfold test shows you have 20% body fat, your actual value could be as low as 16% or as high as 24%.		• Less accurate unless technician is well trained. • Proper prediction equation must be used to improve accuracy. • Person being measured may not want to be touched or to expose their skin. • Cannot be used to measure obese people, as their skinfolds are too large for the caliper.
Bioelectrical impedance analysis (BIA): Involves sending a very low level of electrical current through a person’s body. As water is a good conductor of electricity and lean body mass is made up of mostly water, the rate at which the electricity is conducted gives an indication of a person’s lean body mass and body fat. This method can be done while lying down, with electrodes attached to the feet, hands, and the BIA machine. Hand-held		• Less accurate. • Body fluid levels must be normal. • Proper prediction equation must be used to improve accuracy. • Should not eat for 4 hours and should not exercise for 12 hours prior to the test. • No alcohol should be consumed within 48 hours of the test. • Females should not be measured if they are retaining water due to menstrual

feet, hands, and the bicep machine. Hand-held and standing models (which look like bathroom scales) are now available. Under the best of circumstances, BIA can estimate body fat with an error of 3–4%.

are retaining water due to menstrual cycle changes.

Dual-energy x-ray absorptiometry (DXA): The technology is based on using very-low-level x-rays to differentiate among bone tissue, soft (or lean) tissue, and fat (or adipose) tissue. It involves lying for about 30 minutes on a specialized bed fully clothed, with all metal objects removed. The margin of error for predicting body fat ranges from 2% to 4%.



- Expensive; requires trained technician with specialized equipment.
- Cannot be used to measure extremely tall, short, or obese people, as they do not fit properly within the scanning area.

Bod Pod: A machine that uses air displacement to measure body composition. This machine is a large, egg-shaped chamber made from fiberglass. The person being measured sits inside, wearing a swimsuit. The door is closed and the machine measures how much air is displaced. This value is used to calculate body composition. It appears promising as an easier and equally accurate alternative to underwater weighing in many populations, but it may overestimate body fat in some African American men.



- Expensive.
- Less accurate in some populations.

Let's return to Randy, whose BMI of 32.9 kg/m^2 places him in the obese category. Is he obese?

Randy trains with weights 4 days per week, rides the exercise bike for about 30 minutes per session three times per week, and does not take drugs, smoke cigarettes, or drink alcohol.

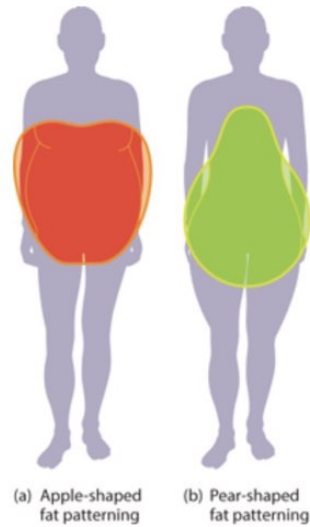
Through his local gym, Randy contacted a trained technician who assesses body composition. The results of his skinfold measurements show that his body fat is 9%. This value is within the healthful range for men. Randy is an example of a person whose BMI appears very high but who is not actually obese.

Assess Your Fat Distribution Patterns

To evaluate the health of your current body weight, it is also helpful to consider the way fat is distributed throughout your body. This is because your fat distribution pattern is known to affect your risk for various diseases. **Figure 10.3** shows two types of fat patterning. *Apple-shaped fat patterning*, or upper-body obesity, is known to significantly increase a person's risk for many chronic diseases, such as type 2 diabetes and cardiovascular disease. Apple-shaped patterning causes problems with the metabolism of fat and carbohydrate, leading to unhealthful changes in blood cholesterol, insulin, glucose, and blood pressure. In contrast, *pear-shaped fat patterning*, or lower-body obesity, does not seem to significantly increase your risk for chronic diseases.

Figure 10.3

Fat distribution patterns. (a) An apple-shaped fat distribution pattern increases an individual's risk for many chronic diseases. (b) A pear-shaped fat distribution pattern does not seem to be associated with an increased risk for chronic disease.



You can use the following three-step method to determine your type of fat patterning:

1. Ask a friend to measure the circumference of your natural waist, that is, the narrowest part of your torso as observed from the front (Figure 10.4a).

Figure 10.4

Determining your type of fat patterning. (a) Measure the circumference of your natural waist. (b) Measure the circumference of your hips at the maximal width of the buttocks as observed from the side. Dividing the waist value by the hip value gives you your waist-to-hip ratio.



(a)



2. Then, have that friend measure your hip circumference at the maximal width of the buttocks as observed from the side (Figure 10.4b).
3. Then, divide the waist value by the hip value. This measurement is called your *waist-to-hip ratio*. For example, if your natural waist is 30 inches and your hips are 40 inches, then your waist-to-hip ratio is 30 divided by 40, which equals 0.75.

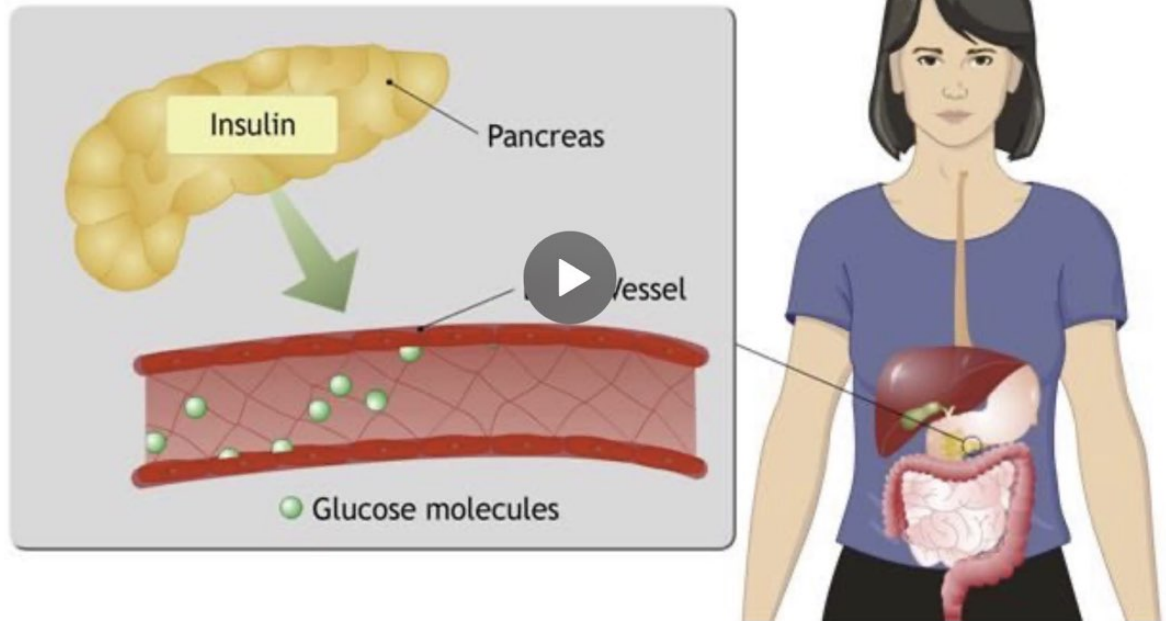
Once you figure out your ratio, how do you interpret it? An increased risk for chronic disease is associated with the following waist-to-hip ratios:

- In men, a ratio higher than 0.90
- In women, a ratio higher than 0.80

These ratios suggest an apple-shaped fat distribution pattern. In addition, waist circumference alone can indicate your risk for chronic disease. For males, your risk of chronic disease is increased if your waist circumference is above 40 inches (102 cm). For females, your risk is increased at measurements above 35 inches (88 cm).

Watch ABC News Video: Fast-Paced TV May Lead to More Snacking





Recap

Body mass index, body composition, and the waist-to-hip ratio and waist circumference are tools that can help you evaluate the health of your current body weight. Body mass index represents the ratio of a person's body weight to the square of his or her height. A BMI in the normal weight category ranges from 18.5 to 24.9 kg/m². Body composition measurements help you estimate your fat-to-lean tissue mass. A waist-to-hip ratio higher than 0.90 for males and 0.80 for females is associated with an apple-shaped fat distribution pattern, which increases your risk for several chronic diseases. None of these methods is completely accurate, but most may be used appropriately as general health indicators.

How does energy balance influence body weight?

LO 3 Discuss the concept of energy balance and the limitations of the energy balance equation.

Have you ever wondered why some people are thin and others are overweight, even though they seem to eat about the same diet? If so, you're not alone. For hundreds of years, researchers have puzzled over what makes us gain and lose weight. In this section, we explore some information and current theories that may shed light on this complex question.

Fluctuations in body weight are a result of changes in energy intake (the food and beverages consumed) and energy expenditure (the amount of energy expended at rest and during physical activity). This relationship between what we eat and what we do is defined by the energy balance equation:

Energy balance occurs when $\text{energy intake} = \text{energy expenditure}$

Although the concept of energy balance appears simple, it is a dynamic process.⁶ This means that, over time, factors that impact the energy intake side of the equation (including total energy consumed and the macronutrient composition of this energy) need to balance with the factors that impact the energy expenditure side of the equation. **Focus Figure 10.5** is a simplistic representation of how our weight changes when either side of this equation is altered. From this figure, you can see that, in order to lose body weight, we must expend more energy than we consume. In contrast, to gain weight, we must consume more energy than we expend. Unless we purposefully change one side of the equation, weight change is typically gradual and occurs over an extended period of time. Finding the proper balance between energy intake and expenditure allows someone to maintain a healthful body weight over time.

Focus Figure 10.5 Energy Balance

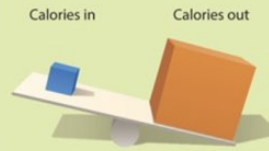


Energy balance is the relationship between the food we eat and the energy we expend each day. Finding the proper balance between energy intake and energy expenditure allows us to maintain a healthy body weight.

ENERGY DEFICIT

When you consume fewer Calories than you expend, your body will draw upon your stored energy to meet its needs. You will lose weight. When you are in a state of energy deficit the body can become more metabolically efficient, which can slow weight loss based on predicted changes.

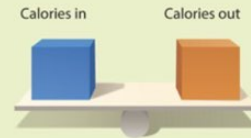
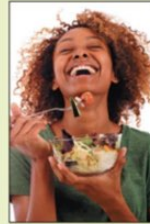
ENERGY INTAKE < ENERGY EXPENDITURE = WEIGHT LOSS



ENERGY BALANCE

When the Calories you consume meet your needs, you are in energy balance. Your weight will be stable.

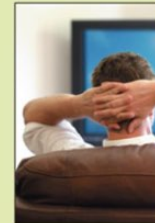
ENERGY INTAKE = ENERGY EXPENDITURE = WEIGHT MAINTENANCE



ENERGY EXCESS

When you take in more Calories than you need, the surplus Calories will be stored as fat. You will gain weight. However, when some people consume excess energy their body may attempt to increase energy expenditure through heat to slow weight gain. These people have a hard time gaining weight.

ENERGY INTAKE > ENERGY EXPENDITURE = WEIGHT GAIN



To determine how much energy you consumed in one meal or on one day, log on to ChooseMyPlate at www.choosemyplate.gov. Click on the tab for SuperTracker, then get started!

Energy Intake Is the Kilocalories We Consume Each Day

Energy intake is equal to the amount of energy in the foods and beverages we consume each day.

Daily energy intake is expressed as *kilocalories per day* (*kcal/day*, or *kcal/d*). Energy intake can be

estimated manually by using food composition tables or computerized dietary analysis programs. Remember (from [Chapter 1](#)) that the energy value of carbohydrate and protein is 4 kcal/g and the energy value of fat is 9 kcal/g. The energy value of alcohol is 7 kcal/g. By multiplying the energy value (in kcal/g) by the amount of the nutrient (in g), you can calculate how much energy is in a particular food. For instance, 1 cup of quick oatmeal has an energy value of 142 kcal, because it contains 6 g of protein, 25 g of carbohydrate, and 2 g of fat.

Over a period of time, when someone's total daily energy intake exceeds the amount of energy that person expends, then weight gain results. Without exercise, this gain will likely be mostly fat. How many Calories are in a pound of fat?

- First, it is important to remember that there are 454 g in 1 pound and that the energy value of fat is 9 kcal/g.
- Second, you need to know that adipose tissue contains 87% fat (the remainder is water).
- Finally, to calculate the amount of kcal that will result in a gain of 1 pound (454 g), you need to multiply the amount of weight, 454 g, by the proportion of fat in adipose tissue (87%, or 0.87) and then multiply this value by the energy value of fat (9 kcal/g):

$$454 \text{ g} \times 0.87 = 395 \text{ g of fat}$$

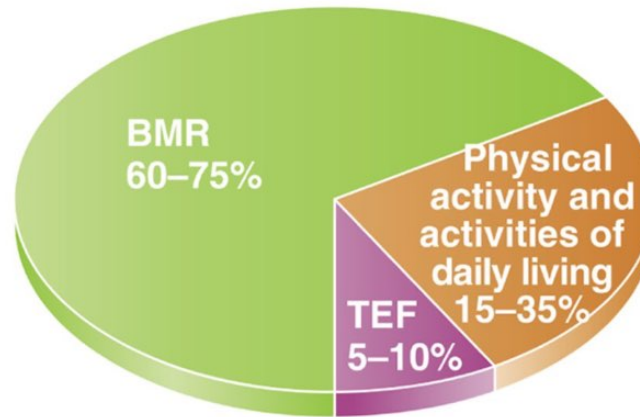
$$395 \text{ g} \times 9 \text{ kcal/g} = 3,555 \text{ kcal (which, for simplicity, is rounded to 3,500 kcal)}$$

Energy Expenditure Includes More Than Just Physical Activity

Energy expenditure (also known as *energy output*) is the energy the body expends to maintain its basic functions and to perform all levels of movement and activity. Total 24-hour energy expenditure is calculated by estimating the energy used during rest and as a result of physical activity. There are three components of energy expenditure: basal metabolic rate (BMR), thermic effect of food (TEF), and energy cost of physical activity and activities of daily living ([Figure 10.6](#)).

Figure 10.6

The components of energy expenditure are basal metabolic rate (BMR), the thermic effect of food (TEF), and the energy cost of physical activity and activities of daily living. BMR accounts for 60% to 75% of our total energy output, whereas TEF and physical activity together account for 25% to 40%.



Components of energy expenditure

Basal Metabolic Rate

Basal metabolic rate (BMR) is the energy expended just to maintain the body's *basal*, or *resting*, functions. These functions include respiration, circulation, body temperature, synthesis of new cells and tissues, secretion of hormones, and nervous system activity. The majority of our energy output each day (about 60% to 75%) is a result of our BMR. This means that 60% to 75% of our energy output goes to fuel the basic activities of staying alive, aside from any physical activity.

BMR varies widely among people. The primary determinant is the amount of lean body mass we have. People with a higher lean body mass have a higher BMR, as lean body mass is more metabolically active than body fat. Thus, it takes more energy to support this active tissue. One common assumption is that obese people have a depressed BMR. This is usually not the case. Most studies of obese people show that the amount of energy they expend for every kilogram of lean body mass is similar to that of a nonobese person. Moreover, people who weigh more also have more lean body mass and consequently have a *higher* BMR.

BMR decreases with age, approximately 3% to 5% per decade after age 30. This age-related decrease results partly from hormonal changes, but much of this change is due to the loss of lean body mass resulting from physical inactivity. Thus, a large proportion of this decrease may be prevented with regular physical activity. Of the many other factors that can affect a person's BMR, some of the most common are listed in [Table 10.1](#).

Table 10.1 Factors Affecting Basal Metabolic Rate (BMR)

Factors That Increase BMR	Factors That Decrease BMR
Higher lean body mass	Lower lean body mass
Greater height (more surface area)	Lower height
Younger age	Older age
Elevated levels of thyroid hormone	Depressed levels of thyroid hormone
Stress, fever, illness	Starvation, fasting or very-low-Calorie diets
Male gender	Female gender due to decreased lean tissue
Pregnancy and lactation	
Certain drugs, such as stimulants, caffeine, and tobacco	

How can you estimate the amount of energy you expend for your BMR? One of the simplest methods is to multiply your body weight in kilograms by 1.0 kcal per kilogram of body weight per hour for men or by 0.9 kcal per kilogram of body weight per hour for women. A little later in this chapter, you will have an opportunity to calculate your BMR and determine your total daily energy needs.

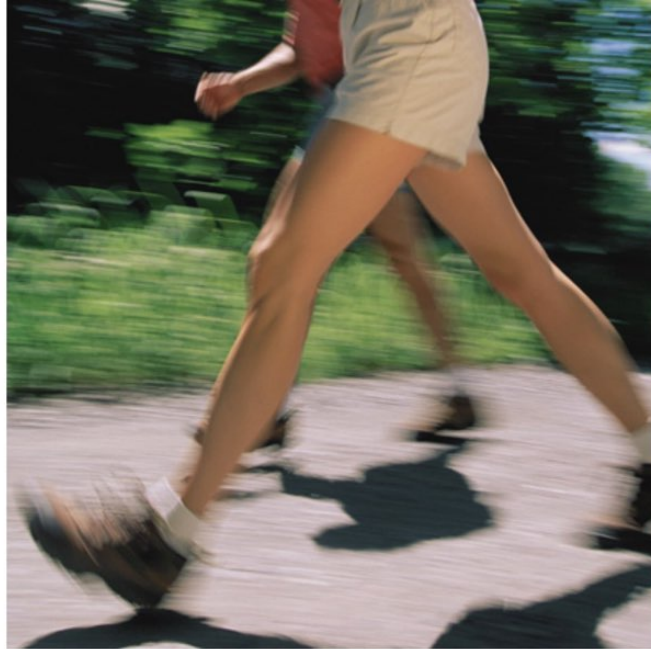
The Thermic Effect of Food

The **thermic effect of food (TEF)** is the energy we expend to digest, absorb, transport, metabolize, and store the nutrients we need. The TEF is equal to about 5% to 10% of the energy content of a meal, a relatively small amount. Thus, if a meal contains 500 kcal, the thermic effect of that meal is about 25 to 50 kcal, depending on how processed the foods contained in the meal happen to be. These values apply to eating what is referred to as a mixed diet, or a diet containing carbohydrate, fat, and protein. Individually, the processing of each nutrient takes a different amount of energy. Whereas fat requires very little energy to digest, transport, and store in our cells, protein and carbohydrate require relatively more energy to process. Finally, the more processed a food is prior to consumption, the less energy it takes to digest this food. For example, it requires more energy to digest an orange than it does to digest orange juice.

The Energy Cost of Physical Activity

The **energy cost of physical activity** represents about 15% to 35% of our total energy output each day. This is the energy we expend in any movement or work above basal levels.





Brisk walking expends energy.

Non-exercise activity thermogenesis (NEAT) ^① is a term used to refer to the energy we expend to do all activities above BMR and TMF, but excluding volitional sporting activities. It includes *spontaneous physical activity*, which in turn includes subconscious activities such as fidgeting and shifting in one's seat. The amount of energy expended through NEAT can vary by as much as 2,000 kcal per day between two individuals of similar size.⁷ Because many people are not highly physically active, it has been proposed that NEAT makes a major contribution to overweight and obesity.⁷

The energy cost of physical activity also includes the energy we expend participating in higher-intensity activities such as running, skiing, and bicycling. One of the most obvious ways to increase how much energy we expend as a result of physical activity is to do more activities for a longer period of time. For example, the energy cost of physical activity in a highly trained athlete may represent 50% of their total energy expenditure, compared to lower values for those who are not as active.

Table 10.2 ^② lists the energy costs for certain activities. As you can see, activities such as running, swimming, and cross-country skiing, which involve moving our larger muscle groups (or more parts of the body) require more energy. The amount of energy we expend during activities is also affected by our body size, the intensity of the activity, and how long we perform the activity. This is why the values in **Table 10.2** ^② are expressed as kcal of energy per kilogram of body weight per minute.

Table 10.2 Energy Costs of Various Physical Activities

Activity	Intensity	Energy Cost (kcal/kg body weight/min)
Sitting, studying (including reading or writing)	Light	0.022
Cooking or food preparation (sitting or standing)	Light	0.033
Walking (e.g., to neighbor's house)	Light	0.042
Stretching—Hatha yoga	Moderate	0.042
Cleaning (dusting, straightening up, vacuuming, changing linen, carrying out trash)	Moderate	0.058
Weight lifting (free weights, Nautilus, or universal type)	Light or moderate	0.050
Bicycling, 10 mph	Leisure (work or pleasure)	0.067
Walking, 4 mph (brisk pace)	Moderate	0.083
Aerobics	Low impact	0.083
Weight lifting (free weights, Nautilus, or universal type)	Vigorous	0.100
Bicycling, 12 to 13.9 mph	Moderate	0.133
Running, 5 mph (12 minutes per mile)	Moderate	0.138
Running, 6 mph (10 minutes per mile)	Moderate	0.163
Running, 8.6 mph (7 minutes per mile)	Vigorous	0.205

Source: Data from the Compendium of Physical Activities Tracking Guide. Healthy Lifestyles Research Center, College of Nursing and Health Innovation, Arizona State University.

Using the energy value for running at 6 miles per hour (a 10-minute-per-mile running pace) for 30 minutes, let’s calculate how much energy Theo would expend doing this activity:

- Theo’s body weight (in kg) = 200 lb/2.2 lb/kg = 90.91 kg
- Energy cost of running at 6 mph = 0.163 kcal/kg body weight/min
- At Theo’s weight, the energy cost of running per minute = 0.163 kcal/kg body weight/min × 90.91 kg = 14.82 kcal/min
- If Theo runs at this pace for 30 minutes, his total energy output = 14.82 kcal/min × 30 min = 445 kcal

Given everything we’ve discussed so far, you’re probably asking yourself, “How many kcal do I need each day to maintain my current weight?” This question is not easy to answer, as our energy needs fluctuate from day to day according to our activity level, environmental conditions, and other factors, such as the amount and type of food we eat and our intake of caffeine, which temporarily increases our BMR. However, you can get a general estimate of how much energy your body needs to maintain your present weight. The **You Do the Math** box explains how to estimate your total daily energy needs.

You Do the Math

Calculating BMR and Total Daily Energy Needs

One potential way to estimate how much energy you need each day is to record your total food and beverage intake for a defined period of time, such as 3 or 7 days. You can then use a food composition table or computer dietary assessment program to estimate the amount of energy you eat each day. Assuming that your body weight is stable over this period of time, your average daily energy intake should represent how much energy you need to maintain your present weight.

Unfortunately, many studies of energy intake in humans have shown that dietary records estimating energy needs are not very accurate. Most studies show that humans underestimate the amount of energy they eat by 10% to 30%. Overweight people tend to underestimate by an even higher margin, at the same time overestimating the amount of activity they do. This means that someone who really eats about 2,000 kcal/day may record eating only 1,400 to 1,800 kcal/day. So one reason many people are confused about their ability to lose weight is that they are eating more than they realize.

A simpler and more accurate way to estimate your total daily energy needs is to calculate your BMR, then add the amount of energy you expend as a result of your activity level. Refer to the following example to learn how to do this. As the energy cost for the thermic effect of food is very small, you don't need to include it in your calculations.

1. *Calculate your BMR.* If you are a man, you will need to multiply your body weight in kilograms by 1 kcal per kilogram of body weight per hour. Assuming you weigh 175 pounds, your body weight in kilograms would be $175 \text{ lb} / 2.2 \text{ lb/kg} = 79.5 \text{ kg}$. Next, multiply your weight in kilograms by 1 kcal per kilogram body weight per hour:

$$1 \text{ kcal/kg body weight/hour} \times 79.5 \text{ kg} = 79.5 \text{ kcal/hour}$$

Calculate your BMR for the total day (or 24 hours):

$$79.5 \text{ kcal/hour} \times 24 \text{ hours/day} = 1,909 \text{ kcal/day}$$

If you are a woman, multiply your body weight in kg by 0.9 kcal/kg body weight/hour.

2. *Estimate your activity level by selecting the description that most closely fits your general lifestyle.* The energy cost of activities is expressed as a percentage of your BMR. Refer to the values in the following table when estimating your own energy output.
3. *Multiply your BMR by the decimal equivalent of the lower and higher percentage values for your*

3. *Multiply your BMR by the decimal equivalent of the lower and higher percentage values for your activity level.* Let's use the man referred to in step 1. He is a college student who lives on campus. He walks to classes located throughout campus, carries his book bag, and spends most of his time reading and writing. He does not exercise on a regular basis. His lifestyle would be defined as lightly active, meaning he expends 50% to 70% of his BMR each day in activities. You want to calculate how much energy he expends at both ends of this activity level. How many kcal does this equal?

$$1,909 \text{ kcal/day} \times 0.50 = 955 \text{ kcal/day}$$

$$1,909 \text{ kcal/day} \times 0.70 = 1,336 \text{ kcal/day}$$

These calculations show that this man expends about 955 to 1,336 kcal/day doing daily activities.

4. *Calculate total daily energy output by adding together BMR and the energy needed to perform daily activities.* In this man's case, his total daily energy output is

$$1,909 \text{ kcal/day} + 955 \text{ kcal/day} = 2,864 \text{ kcal/day}$$

or

$$1,909 \text{ kcal/day} + 1,336 \text{ kcal/day} = 3,245 \text{ kcal/day}$$

Assuming this man is maintaining his present weight, he requires between 2,864 and 3,245 kcal/day to stay in energy balance.

	Men	Women
Sedentary/Inactive Involves mostly sitting, driving, or very low levels of activity	25–40%	25–35%
Lightly Active Involves a lot of sitting; may also involve some walking, moving around, and light lifting	50–70%	40–60%
Moderately Active Involves work plus intentional exercise, such as an hour of walking or walking 4 to 5 days per week; may have a job requiring some physical labor	65–80%	50–70%
Heavily Active Involves a great deal of physical labor, such as roofing, carpentry work, and/or regular heavy lifting and digging	90–120%	80–100%

work, and/or regular heavy lifting and digging

Exceptionally Active

Involves a lot of physical activities for work and intentional exercise; also applies to athletes who train for many hours each day, such as triathletes and marathon runners or other competitive athletes performing heavy, regular training

130–145%

110–130%

Research Suggests Limitations of the Energy Balance Equation

As researchers have learned more about the factors that regulate body weight, the accuracy and usefulness of the classic energy balance equation illustrated in **Focus Figure 10.5** has been called into question. Many researchers point out that the equation in its current form is static and can only be applied when one is weight stable— meaning it does not account for many factors that can alter energy intake and expenditure when one side of the equation is changed, nor does it help explain why people gain and lose weight differently.

For example, if you were to consume an additional 100 kcal (the energy content of 8 fl oz of a cola beverage) each day above the energy you expended for 10 years, you would consume an extra intake of 365,000 kcal! Based on the static energy balance equation, and assuming that no other changes occur in energy expenditure, you should gain 104 pounds. However, the static energy balance calculation does not take into account the increase in energy expenditure that would occur, including increased BMR and increased cost of moving a larger body, as weight increased. Thus, after a short period of positive energy balance, your body weight would increase, resulting in an increase in energy expenditure that would eventually balance the increased energy intake. You would then achieve energy balance and become weight stable at a higher body weight. Thus, the extra 100 kcal/day would actually result in a more realistic weight gain of a few pounds. To maintain this larger body size you would need to continue to eat these additional kcal.



Predict a realistic time course for weight loss or weight gain using the Body Weight Planner at www.niddk.nih.gov/health-information/health-topics/weight-control/body-weight-planner/Pages/bwp.aspx.

The inadequacy of the classic energy balance equation to explain individual differences in weight loss or weight gain has prompted experts to propose a dynamic equation of energy balance that takes into account the rates of energy intake and expenditure and their effect on rate of change of energy stores (including fat and lean tissues) in the body, not simply on body weight overall.⁶

Watch ABC News Video: Experiment Shows Portion Control is the Key to Healthy Eating



Recap

The energy balance equation states that energy balance occurs when energy intake equals energy expenditure. Over time, consuming more energy than you expend causes weight gain, while consuming less energy than you expend causes weight loss. The three components of energy expenditure are basal metabolic rate, which is the energy expended to maintain basic physiologic functions; the thermic effect of food, which is the energy expended to process food; and the energy cost of physical activity,

What factors influence body weight?

LO 4 Identify several biological, cultural, economic, and social influences on body weight.

A variety of types of research studies over many decades suggest that the greatest influence on body weight is our genetic inheritance. However, many nongenetic factors also contribute.

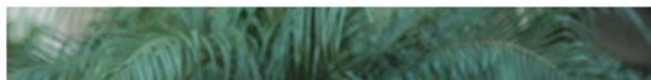
Genes May Influence Body Weight in Different Ways

Our genetic inheritance influences our height, weight, body shape, and metabolic rate. Research indicates that approximately 46% of children with overweight or obese parents are also overweight or obese, whereas only 14% of children with normal-weight parents are overweight or obese.⁸ Does this mean that we are destined to be overweight or obese if our parents are? Not necessarily. It is estimated that 50% to 70% of our BMI can be accounted for by genetic influences.⁹ This means that 30% to 50% of our BMI is accounted for by nongenetic, environmental factors and lifestyle choices, such as exposure to cheap, high-energy food and low levels of physical activity.

Exactly how do genetic factors influence body weight? We discuss here some hypotheses attempting to explain this link.

The FTO Gene

The existing evidence on genetics and obesity indicates that there is no one single “obesity gene.” Instead, 97 genes currently are thought to be associated with an increased risk for obesity.¹⁰ Nevertheless, one gene that has received a great deal of attention is the fat mass and obesity (FTO)–associated gene. This gene is relatively common: Approximately 44% to 65% of people are estimated to have at least one copy. The gene is associated with higher levels of hunger and increased intake of foods high in fat and refined starches, and increased depressive symptoms.¹¹ Thus, it’s not surprising that people who carry the gene weigh more, on average, than people who do not.





Genetic factors do influence body weight. Identical twins, for example, tend to maintain a similar weight throughout life.

The Thrifty Gene Hypothesis

The **thrifty gene hypothesis** suggests that some people possess a gene (or genes) that causes them to be energetically thrifty. This means that at rest and even during active times these individuals expend less energy than people who do not possess this gene. The proposed purpose of this gene is to protect a person from starving to death during times of extreme food shortages. This hypothesis has been applied to some Native American tribes, as these societies were exposed to centuries of feast and famine. Those with a thrifty metabolism survived when little food was available, and this trait was passed on to future generations. Although an actual thrifty gene (or genes) has not yet been identified, researchers continue to study this explanation as a potential cause of obesity.

If this hypothesis is true, think about how people who possess this thrifty gene might respond to today's environment. Low levels of physical activity, inexpensive food sources that are high in fat and energy, and excessively large serving sizes are the norm. People with a thrifty metabolism would experience a great amount of weight gain, and their body would be more resistant to weight loss.

The Set-Point Hypothesis

The **set-point hypothesis** ¹⁰ suggests that our body is designed to maintain our weight within a narrow range, or at a “set point.” When we dramatically reduce energy intake (such as with fasting or strict diets), the body responds with physiologic changes that cause BMR to drop. This results in a significant slowing of our energy output. In addition, being physically active while fasting or starving is difficult, because a person just doesn’t have the energy for it. These two mechanisms of energy conservation may contribute to some of the rebound weight gain many dieters experience after they quit dieting.

Conversely, overeating in some people may cause an increase in BMR, thought to be due to an increased TEF and increase in spontaneous physical activity. This in turn increases energy output and prevents weight gain. These changes may help to explain the limitations of the classic energy balance equation, mentioned earlier, in predicting how much weight people will gain from eating excess food.

A recent study examined people who participated in a televised weight loss competition *The Biggest Loser* and reported findings supportive of the set-point theory.¹² The average body weight of the participants before they started the competition was just over 327 pounds, and they lost an average of 128 pounds over 30 weeks. As would be expected from this large weight loss, their BMR decreased by 610 kcal/day. When these individuals were followed up 6 years later, all but one had regained some of the weight they had lost—on average, 90 pounds. Despite this increase in body weight, their BMR was now decreased by 704 kcal/day. Moreover, those who were most successful at long-term weight loss were also more likely to experience an ongoing slowing of their BMR. The authors of this study concluded that these individuals were experiencing a persistent metabolic adaptation that worked against their attempts to lose weight and favored maintaining their weight at their original set point.

The Protein Leverage Hypothesis

The **protein leverage hypothesis** ¹¹ suggests that humans have evolved to have a fixed daily dietary protein target that must be reached to optimize physiologic functioning, and that we overeat because modern diets contain more foods that are proportionally higher in carbohydrates and fats and lower in protein.¹³ That is, we eat more of these foods because our body is trying to meet our genetically programmed protein target.



According to the protein-leverage hypothesis, we may be less likely to overeat when our meals provide ample protein.

For example, if you eat two slices of white toast with 1 tablespoon of grape jelly, you would consume approximately 12 grams of protein and 200 kcal. Compare this to 3 ounces of roasted chicken breast, which has about 27 grams of protein and 142 kcal. You would have to eat more than double the amount of toast and jelly to consume the same amount of protein as in the chicken breast, which would lead to you consuming 450 kcal. A review of 38 experimental studies found that the lower the percentage of protein in the diet, the higher the total energy intake in normal, overweight, and obese adults, providing evidence to support the protein leverage hypothesis.¹⁴

The Drifty Gene Hypothesis

The drifty gene hypothesis suggests an explanation for the observation that, in the current food environment, some people become obese, but others do not. It proposes that the effect is due to random mutation and drift in the genes that control the upper limit of body fatness.¹³ This hypothesis states that most mutations in the genes that predispose us to obesity are neutral and have been drifting over evolutionary time. People without these mutations have genetic mechanisms that control the upper limit of body weight and resist obesity, whereas people with “drifty genes” lack this control and therefore are prone to obesity in our current climate of ample, high-energy food and reduced physical activity.

Metabolic Factors Influence Weight Loss and Gain

Six metabolic factors are thought to be predictive of a person's risk for weight gain and resistance to weight loss. These factors are:

- *Relatively low metabolic rate.* At any given size, people vary in their relative BMR—it can be high, normal, or low. People who have a relatively low BMR are more at risk for weight gain and more resistant to weight loss.
- *Low level of spontaneous physical activity.* People who exhibit less spontaneous physical activity are at increased risk for weight gain.
- *Low sympathetic nervous system activity.* The sympathetic nervous system plays an important role in regulating all components of energy expenditure, and people with lower rates of sympathetic nervous system activity are more prone to obesity and more resistant to weight loss.
- *Low rate of the use of fat for energy.* Some people use relatively more carbohydrate for energy, which means that less fat will be used for energy. Thus, relatively more fat will be stored in adipose tissue, so these people are more prone to weight gain. People who use relatively more fat for energy are more resistant to weight gain and are more successful at maintaining weight loss.
- *An abnormally low level of thyroid hormone, or an elevated level of the hormone cortisol, both of which play roles in metabolism, can lead to weight gain and obesity.* A physician can check a patient's blood for levels of these hormones.
- *Certain prescription medications, including steroids used for asthma and other disorders, seizure medications, and some antidepressants, can slow basal metabolic rate or stimulate appetite, leading to weight gain.*¹⁵

Physiologic Factors Influence Body Weight

Numerous physiologic factors, including hypothalamic regulation of hunger and satiety, specific hormones, and others, contribute to the complexities of weight regulation.

Hypothalamic Cells

After a meal, cells in the hypothalamic *satiety center* are triggered, and the desire to eat is reduced. Some people may have an insufficient satiety mechanism, which prevents them from feeling full after a meal, allowing them to overeat. Of course, people with a sufficient satiety mechanism can and do override these signals and overeat even when they are not hungry.

Energy-Regulating Hormones

Leptin ¹⁵ is a protein hormone produced by adipose cells. First discovered in mice, leptin acts to reduce food intake and to cause a decrease in body weight and body fat. Obese people tend to have very high amounts of leptin in their body but are insensitive to its effects. Researchers are currently studying the role of leptin in starvation and overeating.

Ghrelin ¹⁶, a protein hormone synthesized in the stomach, stimulates appetite and increases the amount of food one eats. Ghrelin levels appear to increase after weight loss, and researchers speculate that this factor could help explain why people who have lost weight have difficulty keeping it off.¹⁶

Peptide YY (PYY) ¹⁷ is a protein hormone produced in the gastrointestinal tract. It is released after a meal in amounts proportional to the energy content of the meal. In contrast with ghrelin, PYY decreases appetite and inhibits food intake. Interestingly, obese individuals have lower levels of PYY when they are fasting and show less of an increase in PYY after a meal, compared with nonobese individuals, which suggests that PYY may be important in the manifestation and maintenance of obesity.¹⁷

Other Physiologic Factors

The following other physiologic factors are known to increase satiety (or decrease food intake):

- The hormones serotonin and cholecystokinin (CCK); serotonin is made from the amino acid tryptophan, and CCK is produced by the intestinal cells and stimulates the gallbladder to secrete bile
- An increase in blood glucose levels, such as that normally seen after the consumption of a meal
- Stomach expansion
- Nutrient absorption from the small intestine

The following other physiologic factors can decrease satiety (or increase food intake):

- Beta-endorphins, which are hormones that enhance a sense of pleasure while eating, increasing food intake
- Neuropeptide Y, an amino-acid-containing compound produced in the hypothalamus; neuropeptide Y stimulates appetite

- Decreased blood glucose levels, such as the decrease that occurs after an overnight fast

Sociocultural Factors Affect Food Choices and Body Weight

Sociocultural factors can influence food choices, eating patterns, and engagement in physical activity, and thereby contribute to obesity.

Sociocultural Factors and Overeating

Learned food preferences, religious practices, and cultural customs influence the timing, size, and content of meals and snacks. Pressure from family and friends to eat the way they do can encourage people to overeat. For example, the pressure to overeat on special occasions is high, as family members or friends offer an array of favorite foods and may follow a large meal with a rich dessert.

Americans also have numerous opportunities to overeat because of easy access throughout the day to high-energy convenience and fast foods. Vending machines selling junk foods are everywhere, and city streets and shopping malls are filled with fast-food restaurants where inexpensive, high-energy meals are the norm. Fast-food franchises are offering meal items in ever-larger sizes: Hardee's $1\frac{1}{2}$ lb Frisco Thickburger® El Diablo packs 1,060 kcal—which is about 50% of the energy intake recommended for an average adult for an entire day! As both parents now work outside the home in most American families, more people are embracing this “fast-food culture,” eating high-energy meals from restaurants and grocery stores rather than lower-kcal, home-cooked meals.



Portion sizes have grown over the last few decades. To find out how much, take the Portion Distortion quiz from the National Institutes of Health at www.nhlbi.nih.gov/health/educational/wecan/eat-right/portion-distortion.htm.

In addition to producing ever-larger fast-food meals, the food industry has been manufacturing foods with ever-lower nutrient density. Foods that used to be considered healthful, such as peanut butter, breads and rolls, canned soups, or yogurt, are now made with added sugars, typically high-fructose corn syrup. Over time, the empty Calories from these added sugars contribute to weight gain.

Sociocultural Factors and Inactivity

Coinciding with these influences on food intake are sociocultural factors that promote inactivity. These include the shift from manual labor to more sedentary jobs and increased access to labor-saving devices in all areas of our lives. For instance, many people don't expend energy preparing food anymore, choosing foods that are ready-to-serve or require a few minutes to cook in a microwave oven. Even seemingly minor changes—such as texting someone in your dorm instead of walking down the hall to chat or walking through an automated door instead of pushing a door open—add up to a lower expenditure of energy by the end of the day.

Research with sedentary ethnic minority women indicates that other common barriers to increasing physical activity include lack of time due to placing family responsibilities first, lack of confidence to be physically active, no physically active role models to emulate, acceptance of larger body size, exercise being considered culturally unacceptable, and fear for personal safety.^{18,19} In short, cultural factors influence both food consumption and levels of physical activity and can contribute to weight gain.

Economic status is known to be related to health status, particularly in developed countries, such as the United States: people of lower economic status have higher rates of obesity and related chronic diseases than people of higher incomes.²⁰ Income influences not only eating patterns, but also activity levels, stress levels, and aspects of the environment thought to influence body weight. For example, lower-income populations are more likely to live in areas with higher levels of traffic, and higher levels of pollution from vehicular exhaust have been found to be associated with a higher BMI in children 5 to 11 years of age.²¹ Researchers speculate that various factors could contribute to this association, including:

- Reduced levels of physical activity and active travel due to pollution and perceived safety risks;
- Increased stress levels due to higher noise and vibration levels and feeling less safe, which disrupt sleep and increase energy intake; and
- Potential direct effects of pollution itself on hormone regulation and insulin resistance, which could affect appetite and basal metabolic rate.

(For more information on the association between poverty and obesity, see the [In Depth](#) essay following [Chapter 13](#).)

Certainly, social factors are contributing to decreased physical activity among children. There was a time when children played outdoors regularly and physical education was offered daily in

school. Today, many children cannot play outdoors due to safety concerns and lack of recreational facilities, and few schools have the resources to regularly offer physical education to children.



Behaviors learned as a child can affect adult weight and physical activity patterns.

Another social factor promoting inactivity in both children and adults is the increasing dominance of technology in our choices of entertainment. Instead of participating in sports or gathering for a dance at the community hall, we go to the movies or stay at home, watching television, surfing the Internet, and playing with video games, smartphones, and other hand-held devices. By reducing energy expenditure, these behaviors contribute to weight gain. For instance, television watching in adults has been shown to be associated with weight gain over a 4-year period.²²

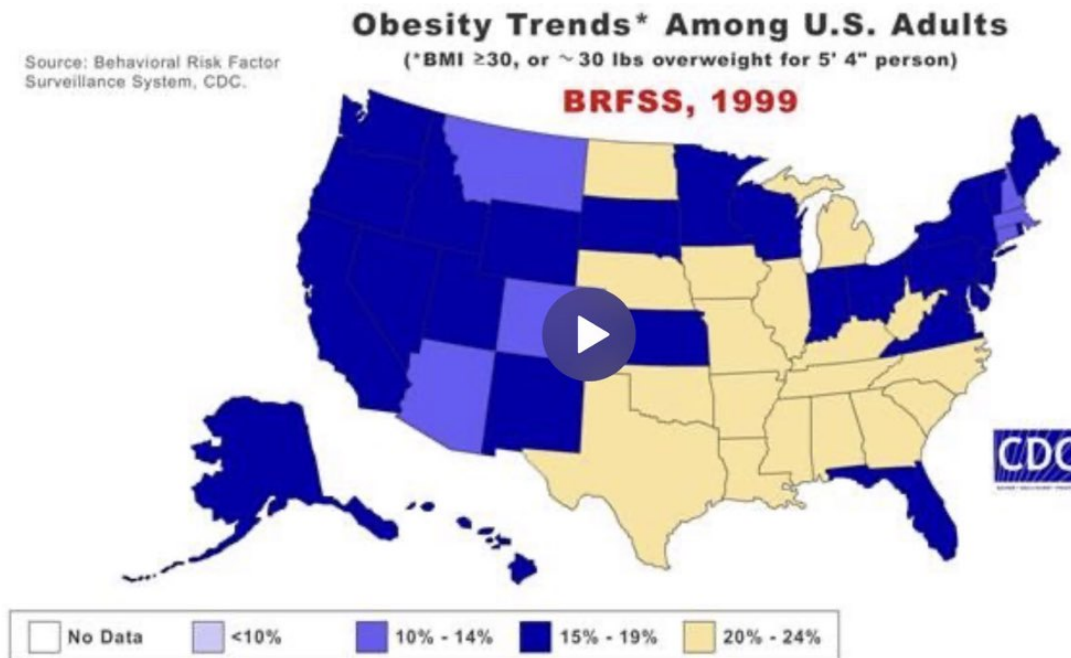
Social Pressures, Overweight, and Underweight

On the other hand, social pressures to maintain a lean body are great enough to encourage many people to undereat or to avoid foods that are perceived as “bad.” Our society ridicules and often ostracizes overweight people, many of whom face discrimination in housing, employment, and other areas of their lives. A recent study found that children who are obese are up to 2.7 times more likely to experience bullying than children of normal weight.²³ Moreover, media images of waiflike fashion models and men in tight jeans with muscular chests and abdomens encourage

many people—especially adolescents and young adults—to severely restrict their food intake and exercise obsessively to achieve an unrealistic and unattainable weight goal. (See the [In Depth](#) essay following [Chapter 11](#) for information on the consequences of these behaviors.)

It should be clear that how a person gains, loses, and maintains body weight is a complex matter. Most people who are overweight have tried several diet programs but have been unsuccessful in maintaining their weight loss. A significant number of these people have consequently given up all weight-loss attempts. Some even suffer from severe depression related to their body weight. Should we condemn these people as failures and continue to pressure them to lose weight? Should people who are overweight but otherwise healthy (e.g., low blood pressure, cholesterol, triglycerides, and glucose levels) be advised to lose weight? As we continue to search for ways to help people achieve and maintain a healthful body weight, our society must take measures to reduce the social pressures facing people who are overweight or obese.

Watch Animation: Increase in Obesity Rates in the United States



Recap

Many factors affect our ability to gain and lose weight. Our genetic background influences our height, weight, body shape, and metabolic rate. The FTO gene variant appears to prompt overeating and weight gain. The thrifty gene hypothesis suggests that some people possess a gene or set of genes that makes their body metabolically thrifty. The set-point hypothesis suggests that our body is designed to maintain weight within a narrow range, also called a set point. The protein-leverage hypothesis suggests that our modern diet, which provides a higher ratio of carbohydrate and fat and a lower ratio of protein, prompts us to overeat. The drift gene hypothesis suggests that the variation in a people's tendency to maintain a normal weight or to gain weight is due to random mutation and drift in the genes that control the upper limit of body fatness. Metabolic factors, such as low relative resting metabolic rate, low spontaneous physical activity, and low sympathetic nervous system activity, increase the risk for weight gain. Physiologic factors, such as various energy-regulating hormones, impact body weight by their effects on hunger, satiety, appetite, and energy expenditure. Sociocultural factors can significantly influence the amounts and types of food we eat and our engagement in physical activity. These include, for example, the ready availability of large portions of high-energy foods and the dominance of technology in our leisure time. Social pressures on those who are overweight can drive people to use harmful methods to achieve an unrealistic body weight.

How can you lose weight safely and keep it off?

LO 5 Develop a diet, exercise, and behavioral plan for healthful weight loss.

Achieving and maintaining a healthful body weight involve three primary strategies:

- Reasonable reductions in energy intake
- Incorporation of regular and appropriate physical activity
- Application of behavior modification techniques

In this section, we first discuss popular diet plans, which may or may not incorporate these strategies. We then explain how to design a personalized weight-loss plan that includes all three of them.

Nutri-case

HANNAH



“I wonder what it would be like to be able to look in the mirror and not feel fat. Like my friend Kristi—she’s been skinny since we were kids. I’m just the opposite: I’ve felt bad about my weight ever since I can remember. One of my worst memories is from the

YMCA swim camp the summer I was 10 years old. Of course, we had to wear a swimsuit, and the other kids picked on me so bad I'll never forget it. One of the boys called me 'fatso,' and the girls were even meaner, especially when I was changing in the locker room. That was the last year I was in the swim camp, and I've never owned a swimsuit since."

Think back to your own childhood. Were you ever teased for some aspect of yourself that you felt unable to change? How might organizations that work with children, such as schools, YMCAs, scout troops, and church-based groups, increase their leaders' awareness of social stigmatization of overweight children and reduce incidents of teasing, bullying, and other insensitivity?

Avoid Fad Diets

If you'd like to lose weight and feel more comfortable following an established plan, many are available. How can you know whether or not it is based on sound dietary principles, and whether its promise of long-term weight loss will prove true for *you*? Look to the three strategies just identified: Does the plan promote gradual reductions in energy intake? Does it advocate increased physical activity? Does it include strategies for modifying your eating and activity-related behaviors? Reputable diet plans incorporate all of these strategies. Unfortunately, many dieters are drawn to fad diets, which do not.

Fad diets are simply what their name implies—fads that do not result in long-term, healthful weight changes. To be precise, fad diets are programs that enjoy short-term popularity and are sold based on a marketing gimmick that appeals to the public's desires and fears. The goal of the person or company designing and marketing a fad diet is to make money.

How can you tell if the program you are interested in qualifies as a fad diet? Here are some pointers to help you:

- The promoters of the diet claim that the program is new, improved, or based on some new discovery; however, no scientific data are available to support these claims.
- The program is touted for its ability to promote rapid weight loss or body fat loss, usually more than 2 pounds per week, and may include the claim that weight loss can be achieved with little or no physical exercise.
- Common recommendations for these diets include avoiding certain foods, eating only a

special combination of certain foods, and including foods in the diet that are said to “burn fat” and “speed up metabolism.”

- The diet may include a rigid menu that must be followed daily or may limit participants to eating a few select foods each day. Variety and balance are discouraged.
- The diet includes special foods and supplements, many of which are expensive and/or difficult to find or can be purchased only from the diet promoter, but are described as critical to the success of the diet. The promoters may also claim that these products can cure or prevent a variety of illnesses or stop the aging process.

In a world where many of us feel we have to meet a certain physical standard to be attractive and “good enough,” fad diets flourish, with millions of people trying one each year.²⁴ Unfortunately, the only people who usually benefit from them are their marketers, who can become very wealthy promoting programs that are highly ineffectual.

Many Diets Focus on Macronutrient Composition

The three main types of weight-loss diets that have been most seriously and comprehensively researched all encourage increased consumption of certain macronutrients and restrict the consumption of others. Provided here is a brief review of these diets and their general effects on weight loss and health parameters.

Diets High in Carbohydrate and Moderate in Fat and Protein

The DASH diet, the USDA Food Guide, Weight Watchers, and Jenny Craig are nutritionally balanced diets that typically contain 55% to 60% of total energy intake as carbohydrate, 20% to 30% as fat, and 15% to 20% as protein. Typical energy deficits are between 500 and 1,000 kcal/day. Although a substantial amount of high-quality scientific evidence indicates that these diets may be effective in decreasing body weight and improving blood lipids and blood pressure, at least initially, other studies have found that these diets do not result in significant long-term weight loss or reduce the risk for cardiovascular disease.^{25,26,27,28} Is it possible that diets high in carbohydrate and moderate in fat and protein are not as effective as we’d come to believe? Refer to the [Nutrition Debate](#) essay to learn more about this controversy.

Nutrition Debate

High-Carbohydrate, Moderate-Fat Diets—Have They Been Oversold?



Research findings supporting a high-carbohydrate, moderate-fat diet have been mixed.

For the past 30 years, dietary fat has been demonized as a cause of obesity, cardiovascular disease, type 2 diabetes, and many types of cancer; thus, national dietary guidelines have encouraged consumption of a moderate-fat, high-carbohydrate diet. Then, in 2006, results from the Women's Health Initiative (WHI) Dietary Modification Trial indicated that, although the more than 48,000 postmenopausal women who participated in the trial lost a modest amount of weight (on average 4.8 pounds), they experienced no significant health benefits. There was no reduction in risk for cardiovascular disease, breast cancer, or colorectal cancer.^{36–39}

Moreover, a number of other studies since 2006 have found no significant advantage of high-carbohydrate, moderate-fat diets in promoting weight loss as compared to other types of diets. For example, the Diabetes Excess Weight Loss (DEWL) trial compared weight loss in 419 adults with type 2 diabetes who consumed either a moderate-fat, high-protein diet or a moderate-fat, high-carbohydrate diet.⁴⁰ Weight loss over 12 months averaged 4.4 to 6.6 pounds for both diet groups, with a similar number of participants sustaining their weight loss for an additional 12 months. Similarly, in the POUNDS LOST trial, participants consumed one of four diets that differed in levels of fat, protein, and carbohydrate.⁴¹ Weight loss was similar for all groups at 6 months (an average of 13.9 pounds), and maintenance of net weight loss after 2 years was also similar (8.4 pounds).

These studies are part of a growing body of evidence that the key to weight loss is decreasing *total* energy intake—not one particular macronutrient group—sufficiently below energy expenditure, and that the key to reducing chronic disease risks is changing the *types* of dietary fat and carbohydrate consumed, not the relative amounts. Many Americans reduce their intake of all types of dietary fat, including beneficial unsaturated fats, and replace that fat with low-fiber, highly refined carbohydrate foods—often made with added sugars. We now know that this substitution can contribute to weight gain and negative changes in blood lipids and blood glucose.⁴²

The detrimental health effects resulting from the over-consumption of processed foods, grains, and grain-fed animals is a key factor driving the popularity of the paleo (or paleolithic) diet, which encourages consumption of only those foods that can be hunted, fished, or gathered. This includes fresh lean meats and fish (ideally wild game and fish), eggs, fruits, some vegetables, nuts and seeds, and olive and coconut oils. All refined foods are prohibited, along with all grains, legumes, dairy, and processed vegetable oils such as canola.

To date, a limited number of research studies have been conducted on the long-term effects of the paleo diet. A recent systematic review found four studies examining the effect of paleo-type diets on the metabolic syndrome and weight loss as compared to control diets based on current dietary recommendations (in three studies) or the Mediterranean diet (in one study).⁴³ These studies included a small number of participants (17 to 70), and ranged in duration from 2 weeks to 2 years. The findings indicate that the paleo-type diet can promote greater weight loss (almost 6 pounds greater) than the control diets, with greater reductions in waist circumference,

triglycerides, and blood pressure. However, the Academy of Nutrition and Dietetics cautions that the paleo diet exceeds the DRIs for saturated fat and protein intake, and is deficient in carbohydrates; moreover, the exclusion of whole grains, legumes, and dairy could lead to deficiencies in micronutrients and dietary fiber.⁴⁴

So what is the most healthful approach to weight loss? Most reputable sources, including the Dietary Guidelines for Americans, recommend reducing total energy intake by 500 to 750 kcal per day, decreasing intake of added sugars and saturated and *trans* fats, increasing intake of foods high in unsaturated fats, and meeting or exceeding the physical activity guidelines for Americans.

Critical Thinking Questions

1. Do you think that higher-fat diets, such as the paleo diet, are better or worse alternatives to higher-carbohydrate, lower-fat diets? Why or why not?
2. Vegan diets are consistently associated with numerous health benefits. How might both a vegan diet and the paleo diet improve body weight, blood lipids, and other factors associated with the metabolic syndrome?
3. Go to ChooseMyPlate.gov and use the SuperTracker tool to create a one-day food plan for the following diets: (1) high in carbohydrate and moderate in fat and protein; (2) low in carbohydrate and high in fat and protein. Based on your research, which diet do you think would be easier for you to follow long term and provide enough energy and nutrients to maintain your lifestyle, your lean-body mass, and your long-term health?



Diets Low in Carbohydrate and High in Fat and Protein

Low-carbohydrate, high-fat and protein diets generally contain about 55% to 65% of total energy intake as fat and most of the remaining balance of daily energy intake as protein. Examples include Dr. Atkins' Diet Revolution, Sugar Busters!, and the paleo diet. Instead of advising participants to restrict energy intake, they advise restricting carbohydrate intake, proposing that carbohydrates are addictive and cause overeating, insulin surges leading to excessive fat storage, and an overall metabolic imbalance that leads to obesity. The goal is to reduce carbohydrates enough to cause ketosis, which will decrease blood glucose and insulin levels and can reduce appetite.

Countless people claim to have lost substantial weight on these types of diets. The current limited evidence that has examined their effectiveness suggests that individuals following them, in both free-living and experimental conditions, do lose weight and improve their metabolic risk factors (such as blood lipid levels) for a period of at least 6 months.²⁹ However, the long-term health benefits of this type of a diet are unknown at this time.

If You Design Your Own Diet Plan, Include the Three Strategies

As we noted earlier, a healthful and effective weight-loss plan involves implementing a modest reduction in energy intake, incorporating physical activity into each day, and practicing changes in behavior that can assist you in reducing your energy intake and increasing your energy expenditure. If you'd like to lose weight, the following guidelines can help you design your own personalized diet plan that incorporates these strategies.

Set Realistic Goals

The first key to safe and effective weight loss is setting realistic, achievable goals related to how much weight to lose and how quickly to lose it. A fair expectation for weight loss is gradual: experts recommend a pace of about 0.5 to 2 pounds per week. Unless you are under a physician's supervision your weight-loss plan shouldn't provide less than 1,200 kcal/day, which would be less than the energy needed to cover most individuals' BMR. Your weight-loss goals should also take into consideration any health-related concerns you have. After checking with your physician, you may decide initially to set a goal of simply maintaining your current weight and preventing additional weight gain. After your weight has remained stable for several weeks, you might then write down realistic goals for weight loss.

Goals that are more likely to be realistic and achievable share the following characteristics:

- *They are specific.* Telling yourself “I will eat less this week” is not helpful because the goal is not specific. An example of a specific goal is “I will eat only half of my restaurant entrée tonight and take the rest home and eat it tomorrow for lunch.”
- *They are reasonable.* If you are not presently physically active, it would be unreasonable to set a goal of exercising for 30 minutes every day. A more reasonable goal would be to exercise for 15 minutes per day, 3 days per week. Once you’ve achieved that goal, you can increase the frequency, intensity, and time of exercise according to the improvements in fitness that you have experienced.
- *They are measurable.* Effective goals are ones you can measure. An example is “I will lose at least 1 pound by May 1.”

Recording and monitoring your goals will help you better determine whether you are achieving them or whether you need to revise them based on accomplishments or challenges that arise.

Eat Smaller Portions of Nutrient-Dense Foods

The portion sizes of foods and beverages offered and sold in restaurants and grocery stores in the United States have expanded considerably over the past 40 years. Studies associate these larger portion sizes with a corresponding increase in the average energy consumption of American children and adults.^{30,31} Thus, reducing the portion size of the foods and beverages you consume may be a highly effective weight-loss strategy. Refer to the **Quick Tips** box to learn more about how to control your portion sizes.

Quick Tips

Controlling Portion Sizes

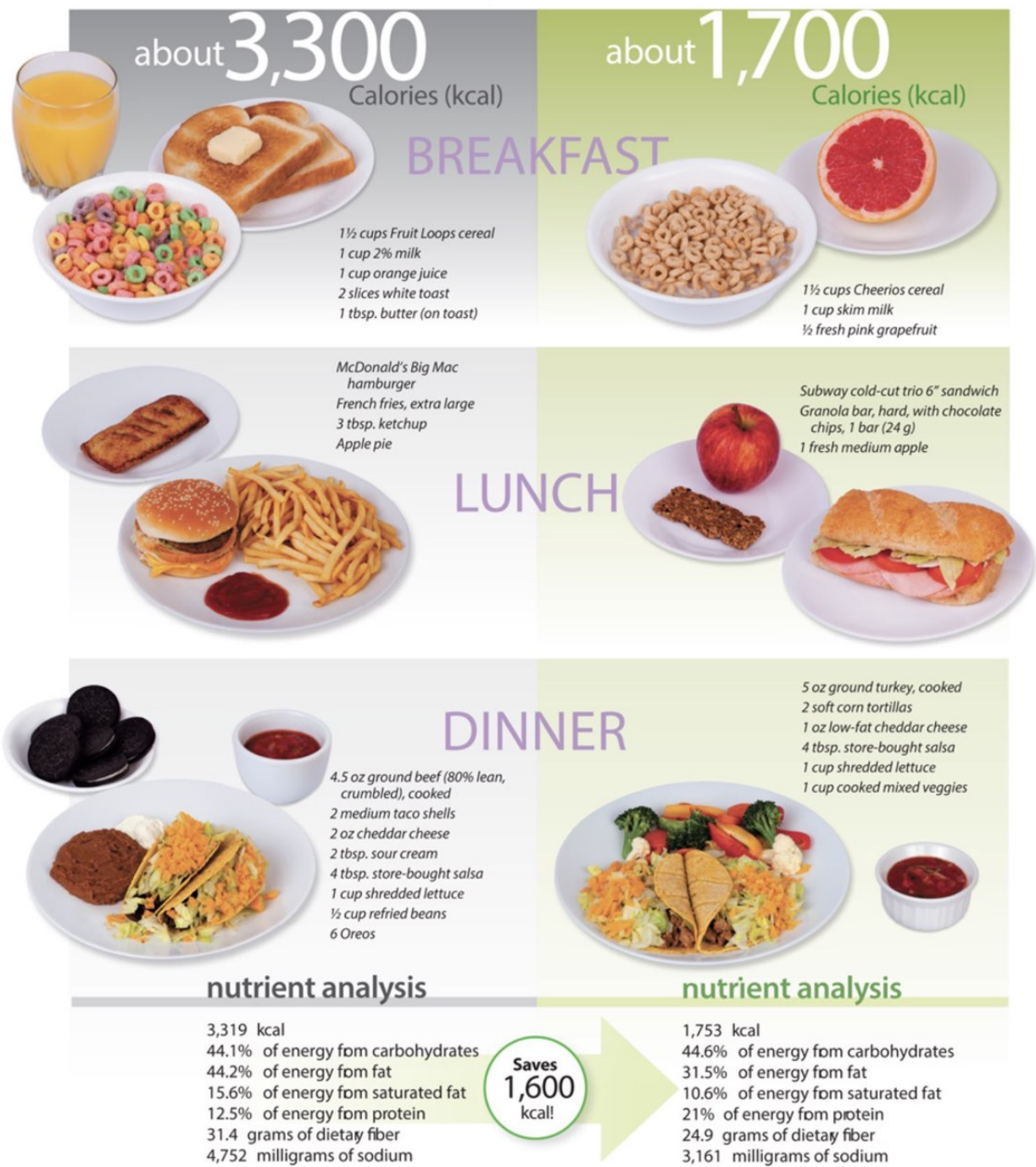
- ✓ To help increase your understanding of the portion sizes of packaged foods, measure out the amount of food that is identified as 1 serving on the Nutrition Facts panel, and eat it from a plate or bowl instead of straight out of the box or bag.
- ✓ Try using smaller dishes, bowls, and glasses. This will make your portion appear larger, and you’ll be eating or drinking less.

- ✓ When cooking at home, put a serving of the entrée on your plate; then freeze any leftovers in single-serving containers. This way, you won't be tempted to eat the whole batch before the food goes bad, and you'll have ready-made servings for future meals.
- ✓ To fill up, take second helpings of plain vegetables. That way, dessert may not seem so tempting!
- ✓ When buying snacks, go for single-serving, prepackaged items. If you buy larger bags or boxes, divide the snack into single-serving bags.
- ✓ When you have a treat, such as ice cream, measure out 1/2 cup, eat it slowly, and enjoy it!
- ✓ To test your understanding of what exactly constitutes a serving size, take the "Portion Distortion" interactive quiz from the National Institutes of Health. (See [Web Links](#) at the end of this chapter.)

In addition to controlling portion sizes, try to increase the number of times each day that you choose foods that are relatively low in energy density. This includes salads (with low-Calorie dressings), whole fruits and vegetables, whole grains, low-fat and nonfat dairy products, lean meats, and broth-based soups. Research indicates that eating a diet low in energy density improves weight loss and weight maintenance.³² Because low energy-dense foods are relatively high in water and fiber than more energy-dense foods, they have a greater volume and occupy more space in the stomach, helping a person to feel full. In addition, low energy-dense foods are just as satiating as those higher in energy density, but they are lower in energy for every gram of food consumed. Thus, the energy content of an energy-dense eating plan is lower but equally as satisfying.

Meal Focus Figure 10.7 illustrates two sets of meals, one higher in energy density and one lower. You can see from this figure that simple changes to a meal, such as choosing leaner meats, skipping the cookies, and reducing portion sizes, can reduce energy intake without sacrificing taste, pleasure, or nutritional quality!

a day of meals



Participate in Regular Physical Activity

The *Dietary Guidelines for Americans* emphasize the role of physical activity in maintaining a healthful weight. Why? Of course, we expend extra energy during physical activity, but there's more to it than that, because exercise alone (without a reduction of energy intake) does not result

in dramatic weight loss. Instead, one of the most important reasons for being regularly active is that it helps us maintain or increase our lean body mass and our BMR. In contrast, energy restriction alone causes us to lose lean body mass. As you've learned, the more lean body mass we have, the more energy we expend over the long term.

Although very few weight-loss studies have documented long-term maintenance of weight loss, those that have find that only people who are regularly active are able to maintain most of their weight loss. The National Weight Control Registry is an ongoing project documenting the habits of people who have lost at least 30 pounds and kept their weight off for at least 1 year. Of the people studied thus far, the average weight loss was 66 pounds over 5.5 years.³³ Almost all of the people (98%) reported changing their dietary intake to lose weight, and 94% report increasing their physical activity, with walking being the most commonly reported form of activity. These successful "losers" reported doing an average of at least 1 hour of physical activity per day.

In addition to expending energy and maintaining lean body mass and BMR, regular physical activity improves our mood, results in a higher quality of sleep, increases self-esteem, and gives us a sense of accomplishment. All of these changes enhance our ability to engage in long-term healthful lifestyle behaviors.

What specific changes can you make to your level of physical activity? Although plenty of practical suggestions will be offered (in [Chapter 11](#)), the [Quick Tips](#) box provides some ideas that can help you to start identifying and overcoming your barriers to an active life.

Quick Tips

Overcoming Barriers to Physical Activity

✓ **I don't have enough time!** An active lifestyle doesn't have to consume all your free time. Try to do a minimum of 30 minutes of moderate activity most—preferably all—days of the week. If you can, do 45 minutes. But remember, you don't have to get in all of your daily activity in one go! Be active for a few minutes at a time throughout your day. Walk from your dorm or apartment to classes, if possible. Instead of meeting friends for lunch, meet them for a lunchtime walk, jog, or workout. Break up study sessions with 3 minutes of jumping jacks. Skip the elevator and take the stairs. When you're talking on the phone, pace instead of sitting still.

✓ **I can't manage the details!** Bust this excuse by keeping clean clothes, shoes, water, and equipment for physical activity in a convenient place. If time management is an obstacle, enroll in a scheduled fitness class, yoga class, sports activity, walking group, or running club. Put it on your schedule of academic classes and make it part of your weekly routine.

✓ **I just don't like to work out!** You don't have to! Try dancing, roller blading, walking, hiking, swimming, tennis, or any other activity you enjoy.

✓ **I can't stay motivated.** Friends can help. Use the "buddy" system by exercising with a friend and calling each other when you need encouragement to stay motivated. Or keep a journal or log of your daily physical activity. Write your week's goal at the top of the page (such as "Walk to and from campus each day, and at least 10 minutes on campus at lunch"). Then track your progress. If you achieve your goal for the week, reward yourself with a massage, a new song for your iPod, or some other nonfood treat.

Incorporate Appropriate Behavior Modifications into Daily Life

Successful weight loss and long-term maintenance of a healthful weight require people to modify their behaviors. Some of the behavior modifications related to food and physical activity were discussed in the previous sections. Here are a few more **Quick Tips** on modifying behavior that will assist you in losing weight and maintaining a healthful weight.

Quick Tips

Modifying Your Behaviors Related to Food

- ✓ Shop for food only when you're not hungry.
- ✓ Avoid buying problem foods—that is, foods that you may have difficulty eating in moderate amounts.
- ✓ Avoid purchasing empty-Calorie foods and beverages from vending machines and convenience stores.

- ✓ Avoid feelings of deprivation by eating small, regular meals throughout the day.
- ✓ Always use appropriate utensils.
- ✓ Eat mindfully, savoring the aromas, tastes, and textures of each food. Do not eat while studying, working, driving, watching television, and so forth.
- ✓ Eat slowly. Take at least 20 minutes to eat a full meal.
- ✓ Stop eating if you begin to feel full. Store food for the next meal.
- ✓ Keep a log of what you eat, when, and why. Try to identify social or emotional cues that cause you to overeat, such as getting a poor grade on an exam or feeling lonely. Then strategize about nonfood-related ways to cope, such as phoning a sympathetic friend.
- ✓ Save empty-Calorie snack foods (such as ice cream, doughnuts, and cakes) for occasional special treats.
- ✓ Whether at home or dining out, share food with others.
- ✓ Prepare healthful snacks to take along with you, so that you won't be tempted by foods from vending machines, fast-food restaurants, and so forth.
- ✓ Don't punish yourself for deviating from your plan (and you will—everyone does). Ask others to avoid responding to any slips you make.

Interest has been growing about the effects of applying mindfulness to our eating practices. *Mindfulness* refers to the nonjudgmental awareness of the present moment. **Mindful eating** ³⁴ refers to a nonjudgmental awareness of the emotional and physical sensations one experiences while eating or in a food-related environment. Several recently published pilot studies conducted with small numbers of participants have indicated that mindful eating may help to promote healthy eating practices when eating out; enhance weight loss and psychological well-being in people with obesity; and improve dietary intake and blood glucose control in adults with type 2 diabetes. ^{34,35}

Interested in exploring mindful eating practices? Here are some tips to help get you started:

- **Focus only on eating:** Turn off the television, put away your cell phone, tune out distractions,

Interested in exploring mindful eating practices? Here are some tips to help get you started:

- **Focus only on eating:** Turn off the television, put away your cell phone, tune out distractions, and focus on your food and the process of eating.
- **Savor each bite:** Take your time, slow down, and chew slowly.
- **Recruit all of your senses:** Focus your attention on the smell, taste, texture, and even the temperature of your food. Pay attention to any sensations of satisfaction or fullness.
- **Pause and rest between bites:** Take a few breaths, sit back, and relax between each mouthful of food.
- **Try 10 minutes of silence:** If eating with others, try to avoid conversations in order to enhance your ability to be more aware of your food and the experience of eating.

Incorporating mindful eating into your life doesn't have to be a chore. Try practicing mindful eating during one meal each week. With practice, you may be inspired to do it more often!

Watch ABC News Video: Low-Carb Diet Trumps Low Fat in Weight Loss Study



Recap

If you would like to lose weight and maintain that weight loss, a first step is to set a realistic, achievable goal. Experts recommend a pace of about 0.5 to 2 pounds of weight loss per week. You can achieve this by making gradual reductions in energy intake, such as by eating smaller portion sizes and choosing foods low in energy density and high in nutrient density. The precise macronutrient composition of the diet is thought to matter less than reduction in your energy intake. Avoid fad diets, programs that enjoy short-term popularity but do not incorporate sensible energy, activity, and behavioral strategies. A second step is to engage in regular physical activity, typically at least 30 minutes a day at least 5 days a week. This will not only burn energy but also help maintain or increase your lean body mass and BMR. Third and finally, apply appropriate behavior modification techniques, such as keeping a food log, avoiding shopping when you're hungry, and engaging in mindful eating.

What if you need to gain weight?

LO 6 Identify four key strategies for gaining weight safely and effectively.

As defined earlier in this chapter, underweight occurs when a person has too little body fat to maintain health. People with a BMI of less than 18.5 kg/m^2 are typically considered underweight. Being underweight can be just as unhealthful as being obese, because it increases the risk for infections and illness and impairs the body's ability to recover. Some people are healthy but underweight because of their genetics and/or because they are very physically active and consume adequate energy to maintain their underweight status, but not enough to gain weight. In others, underweight is due to heavy smoking; an underlying disease, such as cancer or HIV infection; or an eating disorder, such as *anorexia nervosa* (see the [In Depth](#) essay following [Chapter 11](#)).

For Safe and Effective Weight Gain, Choose Nutrient-Dense Foods

With so much emphasis in the United States on obesity and weight loss, some find it surprising that many people are trying to gain weight. People looking to gain weight include those who are underweight to the extent that it is compromising their health and many athletes who are attempting to increase strength and power for competition.



Eating frequent nutrient-dense snacks can help promote weight gain.

To gain weight, people must eat more energy than they expend. While overeating large amounts of foods high in saturated fats (such as bacon, sausage, and cheese) can cause weight gain, doing this without exercising is not considered healthful because most of the weight gained is fat, and high-fat diets increase our risks for cardiovascular and other diseases. However, diets that are relatively higher in mono- and polyunsaturated fats, such as a Mediterranean-style diet, can be a healthful approach to weight gain. Recommendations for weight gain include:

- Eat a diet that includes about 500 to 1,000 kcal/day more than is needed to maintain present body weight. Although we don't know exactly how much extra energy is needed to gain 1 pound, estimates range from 3,000 to 3,500 kcal. Thus, eating 500 to 1,000 kcal/day in excess should result in a gain of 1 to 2 pounds of weight each week.
- Eat frequently, including meals and numerous snacks throughout the day. Many underweight people do not take the time to eat often enough.
- Avoid the use of tobacco products, as they depress appetite and increase metabolic rate, and both of these effects oppose weight gain. Tobacco use also causes lung, mouth, esophageal and other cancers and is a factor in cardiovascular disease.
- Exercise regularly and incorporate weight lifting or some other form of resistance training into your exercise routine. This form of exercise is most effective in increasing muscle mass. Performing aerobic exercise (such as walking, running, bicycling, or swimming) at least 30 minutes for 3 days per week will help maintain a healthy cardiovascular system.

The key to gaining weight is to eat frequent meals throughout the day and to select healthful energy-dense foods. For instance, smoothies and milkshakes made with low-fat milk or yogurt are a great way to take in a lot of energy. Eating peanut butter with fruit or celery and including salad dressings on your salad are other ways to increase the energy density of foods. The biggest challenge to weight gain is setting aside time to eat; by packing a lot of foods to take with you throughout the day, you can enhance your opportunities to eat more.

Amino Acid and Protein Supplements Do Not Increase Muscle Mass

Many products marketed for weight gain are said to be *anabolic*, that is, to increase muscle mass. The most common of these include amino acid and protein supplements, often powders used to make protein “shakes.” However, current evidence indicates that these products are not necessary to increase muscle mass. Instead, adequate intake of energy, protein from high-quality food

to increase muscle mass. Instead, adequate intake of energy, protein from high-quality food sources, and resistance training promote healthy increases in muscle mass. Moreover, although they are legal to sell in the United States, all potentially anabolic substances are banned by the National Football League, the National Collegiate Athletic Association, and the International Olympic Committee. We do know that buying these substances can have a substantial slenderizing effect—on your wallet!



Protein powders or amino acid supplements will not enhance muscle growth or make you stronger.

Recap

Weight gain can be achieved by increasing your kcal intake by about 500 to 1,000 kcal/day more than is needed to maintain your present body weight. Focus on eating more nutrient-dense foods. Engage in regular resistance training to build and maintain muscle mass, and aerobic exercise to preserve your cardiovascular fitness. Avoid tobacco use, as it depresses appetite and increases metabolic rate, and is associated with an increased risk of cancer and many other diseases. Protein and amino acid supplements are not necessary to increase muscle mass, as adequate high-quality protein can be easily obtained in the diet. Anabolic substances are banned by major sports governing organizations.