

## Chapter 10: Achieving and Maintaining a Healthful Body Weight

### 10.1 What Is a Healthful Body Weight?

- A healthful weight
  - Is appropriate for your age
  - Is maintained without constant dieting
  - Is compatible with normal blood pressure, lipid levels, and glucose tolerance
  - Is based on family history of body shape and weight
  - Promotes good eating habits and allows for regular physical activity
  - Is acceptable to you

### 10.2 Evaluating Body Weight

- A person's actual weight is not the only factor to consider
- Determining if a person's body weight is healthful should include
  - Determining the body mass index (BMI)
  - Measuring body composition
  - Assessing the pattern of fat distribution
- Body mass index (BMI)
  - Expresses the ratio of a person's weight to the square of his or her height
  - $BMI = \text{weight (kg)} / \text{height (m)}^2$
  - BMI values below 18.5 or above 30 have increased risks of health problems
  - BMI results are distorted in people with high muscle mass (athletes and lactating women)

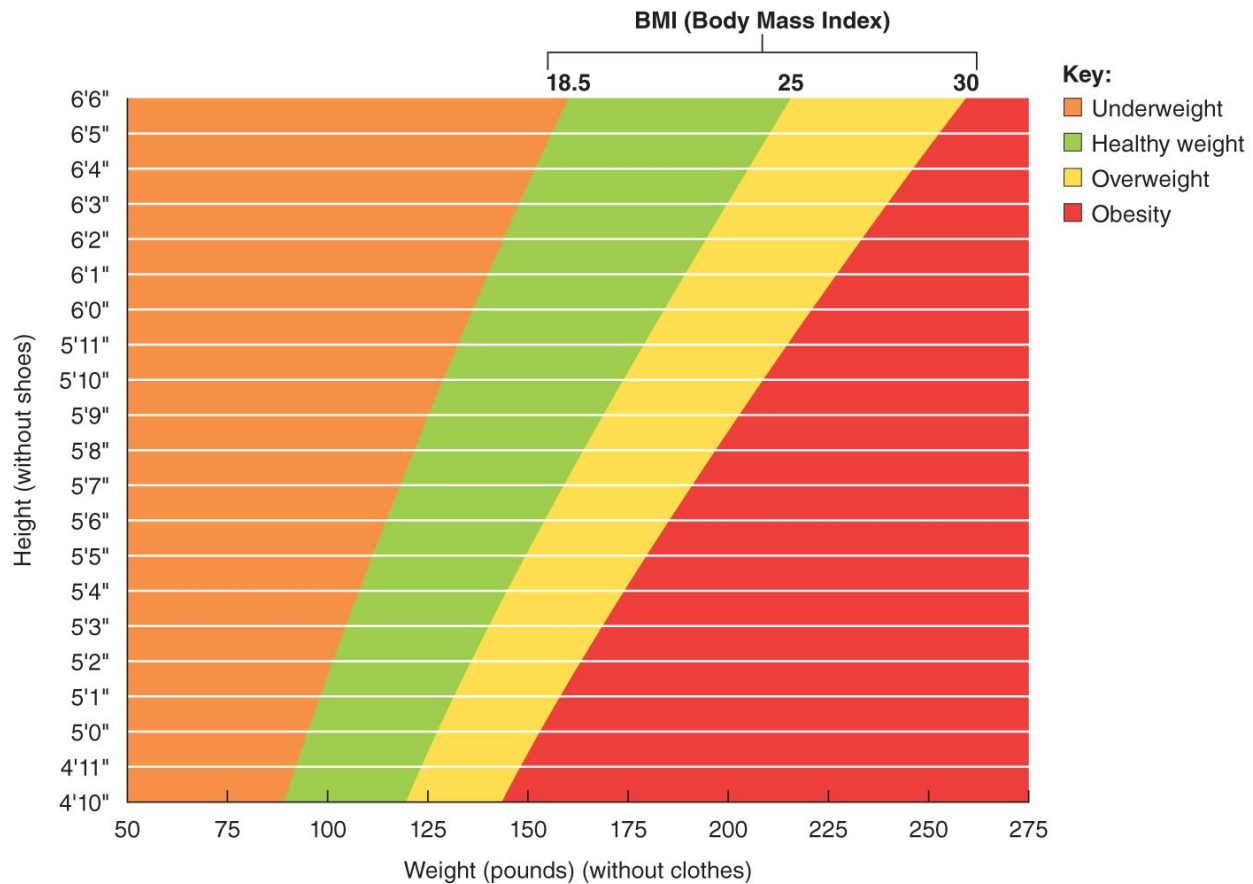


Figure 10.1: Estimating BMI

- **Underweight** – having too little body fat to maintain health
- **Overweight** – having a moderate amount of excess body fat
- Normal weight: appropriate weight for height. Associated with the lowest disease risk
- **Obesity** – having an excess of body fat that adversely affects health
- **Morbid obesity** – body weight exceeding 100% of normal, creating a very high risk of serious health complications

### 10.3 Evaluating Body Weight

- Body composition
  - Measurement of body fat and lean body mass
  - Can be measured by
    - \* Underwater weighing
    - \* Skinfold measurements

- \* Bioelectrical impedance analysis (BIA)
- \* Dual-energy x-ray absorptiometry (DXA)
- \* Bod Pod

Method		Limitations
<b>Underwater weighing:</b> 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.		<ul style="list-style-type: none"> <li>• Subject must be comfortable in water.</li> <li>• Requires trained technician and specialized equipment.</li> <li>• May not work well with extremely obese people.</li> <li>• Must abstain from food for at least 8 hours and from exercise for at least 12 hours prior to testing.</li> </ul>
<b>Skinfolds:</b> 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%.		<ul style="list-style-type: none"> <li>• Less accurate unless technician is well trained.</li> <li>• Proper prediction equation must be used to improve accuracy.</li> <li>• Person being measured may not want to be touched or to expose their skin.</li> <li>• Cannot be used to measure obese people, as their skinfolds are too large for the caliper.</li> </ul>
<b>Bioelectrical impedance analysis (BIA):</b> 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 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%.		<ul style="list-style-type: none"> <li>• Less accurate.</li> <li>• Body fluid levels must be normal.</li> <li>• Proper prediction equation must be used to improve accuracy.</li> <li>• Should not eat for 4 hours and should not exercise for 12 hours prior to the test.</li> <li>• No alcohol should be consumed within 48 hours of the test.</li> <li>• Females should not be measured if they are retaining water due to menstrual cycle changes.</li> </ul>
<b>Dual-energy x-ray absorptiometry (DXA):</b> 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%.		<ul style="list-style-type: none"> <li>• Expensive; requires trained technician with specialized equipment.</li> <li>• Cannot be used to measure extremely tall, short, or obese people, as they do not fit properly within the scanning area.</li> </ul>
<b>Bod Pod:</b> 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.		<ul style="list-style-type: none"> <li>• Expensive.</li> <li>• Less accurate in some populations.</li> </ul>

Figure 10.2: Body Composition Assessment Methods

- Fat distribution pattern
  - Measured by waist-to-hip ratio and waist circumference
    - \* Disease risk is associated with a waist-to-hip ratio of higher than 0.90 in men, and 0.80 in women
  - **Apple-shaped fat patterning** – upper body
    - \* Increased risk of chronic diseases (type 2 diabetes, heart disease, hypertension)
  - **Pear-shaped fat patterning** – lower body
    - \* No significant increased risk of chronic diseases



**(a)**

Figure 10.3: Determining Fat Patterns

## 10.4 Gaining or Losing Weight

- Whether a person gains or loses weight depends on
  - Energy intake versus energy expenditure
  - Genetic factors
  - Composition of the diet
  - Metabolic factors
  - Physiologic factors
  - Cultural and economic factors
  - Social factors

## 10.5 Energy Balance

- Occurs when energy intake = energy expenditure
- Energy intake = kcal from food
- Energy expenditure
  - Energy expended at rest (basal metabolic rate)
  - Physical activity
  - Thermic effect of food





© 2015 Pearson Education, Inc.

Figure 10.4: Energy Balance

- Basal metabolic rate (BMR)
  - Energy expended to maintain basal, or resting, functions of the body
  - 60–75% of total energy expenditure
  - More lean tissue increases your BMR



- BMR decreases with age, 3–5% per decade after age 30

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	

- Thermic effect of food (TEF)
  - Energy expended to digest, absorb, transport, metabolize, and store food
  - 5–10% of total expenditure
  - Lowest for fat and highest for protein
- Physical activity
  - 15–35% of daily energy expenditure
  - Factors that influence energy expended
    - \* The more muscle groups used, the greater the energy expenditure
    - \* Intensity
    - \* Duration
    - \* Body size

Table 10.2: Energy Costs of Physical Activities

Activity	Intensity	Energy Cost (kcal/kg body weight/min)
Sitting, studying (including reading or writing)	Light	0.022
Cooking or food production (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

## 10.6 Genetic Factors

- Different ideas have been suggested to explain the impact of genetics on body fat
  - FTO gene
  - Thrifty gene theory
  - Set-point theory

### 10.6.1 FTO gene

- Fat mass and obesity-associated gene
- 44–65% of people have at least one copy
- Stimulates excessive food intake
- Physical activity can attenuate the gene's influence

### **10.6.2 Thrifty gene theory**

- Proposes that a gene (or genes) causes people to be energetically thrifty
- Proposes that people with this gene expend less energy than other people and therefore gain weight
- A “thrifty gene” has not been identified

### **10.6.3 Set-point theory**

- Proposes that each person’s weight stays within a small range (set point)
- The body compensates for changes in energy balance and keeps a person’s weight at his or her set point
- Can change with time, as diet and activity levels vary over a long period of time

### **10.6.4 Protein leverage hypothesis**

- Humans have evolved to have a fixed daily dietary protein target that must be reached to optimize physiologic functioning
- Diets high in carbohydrates and fats and low in protein may cause people to overeat

### **10.6.5 Drifty gene hypothesis**

- Suggests that in the new food environment some people become obese while others do not
- This effect may be due to random mutations and drift in genes that control upper body fatness
- These genes are originally thought to be neutral but over time and evolved to predispose us to obesity

### **10.6.6 Metabolic Factors**

- Relatively low metabolic rate
- Low level of spontaneous physical activity
- Low sympathetic nervous system activity
- Low fat oxidation
- Low levels of thyroid hormones
- Certain prescription medications

### **10.6.7 Physiologic Factors**

- Hunger and satiety
- Specific proteins and hormones
  - Leptin
  - Ghrelin
  - Peptide YY, or PYY
  - Brown adipose tissue
  - Serotonin and cholecystokinin (CCK)
  - Blood glucose levels
  - Stomach expansion
  - Nutrient absorption from the small intestine
  - Beta-endorphins
  - Neuropeptide Y
  - Decreased blood glucose levels

### **10.6.8 Leptin**

- Leptin is a hormone produced by fat cells that causes reduced food intake, reduced weight, and decreased body fat in mice
- The role of leptin in human obesity is being studied

### **10.6.9 Ghrelin**

- Protein synthesized in the stomach
- Stimulates appetite by acting on the hypothalamus

### **10.6.10 Peptide YY, or PYY**

- Produced in the GI tract
- Decreases appetite
- Obese people have lower levels when fasting

### **10.6.11 Cultural and Economic Factors**

- Food choices
  - The composition of a person's diet should remain balanced
- Levels of physical activity
  - Minor changes can add up
- Economic status
  - Food choices and eating behaviors are affected
- Cultural customs
- Changes in work and leisure activity levels
- Larger body size acceptance/cultural norms
- Lack of access to healthcare and health information
- Lack of access to affordable, healthful foods
- Lack of access to positive role models
- Personal safety issues
- Transportation issues

## **10.7 Sociocultural Factors**

- Social factors influencing our diet and activity levels include
  - Expectations of family and friends
  - Holiday foods, fast foods, and serving sizes
  - Television and other amusements that do not involve physical activity
  - Work responsibilities that do not involve physical activity
  - Media images and social pressures to achieve unrealistic weight goals

## **10.8 Achieve and Maintain Healthful Weight**

- Healthful weight change requires
- Gradual and reasonable changes in energy intake
- Regular and appropriate physical exercise
- Application of behavior modification techniques

## 10.9 Diets focusing on Macronutrient Composition

- Diets high in carbohydrates and moderate fat and protein
  - DASH diet, USDA Food Guide, Weight Watchers, and Jenny Craig
- Diets low in carbohydrate and high in fat and protein
  - Atkins, Sugar Busters!, and the Paleo diet

## 10.10 Weight-Loss Strategies

- Guidelines for successful weight loss
- **Set realistic goals**
  - Specific
  - Reasonable
  - Measurable
    - \* Monitor progress regularly
- **Eat smaller portions of lower-fat foods**
  - Reduce consumption of high-fat and high-energy foods
  - Consume foods high in nutrient density
- **Participate in regular physical activity**
  - Critical for long-term maintenance of weight loss
- **Incorporate appropriate behavior modifications**
  - Mindful eating: refers to a nonjudgmental awareness of emotional and physical sensations one experiences while eating

## 10.11 Behavior Modification

- Mindful eating tips
  - Focus only on eating
  - Savor each bite
  - Recruit all of your senses
  - Pause and rest between bites
  - Try 10 minutes of silence

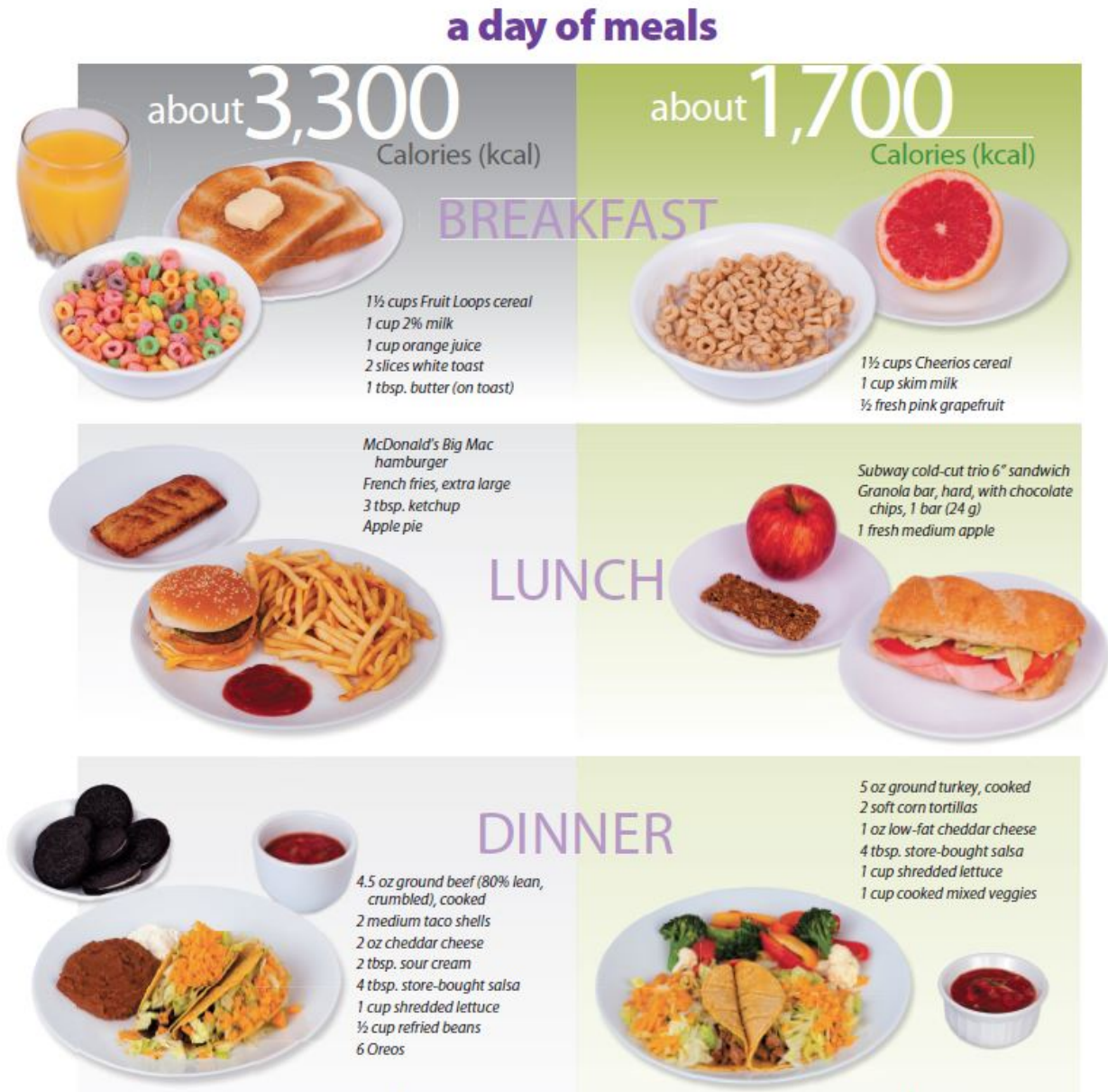


Figure 10.5: The Energy Density of Meals

## 10.12 Underweight

- BMI below  $18.5 \text{ kg/m}^2$
- Increases the risk of infections and illness
- Can be just as unhealthy as overweight
- Effective weight gain should include
  - Eating 500 to 1,000 extra kcal/day



- Eating frequently throughout the day
- Selecting healthful, energy-dense foods
- Avoiding tobacco products, which depress appetite and increase BMR
- Regular exercise with resistance training

## 10.13 Obesity

- BMI between 30 and 39.9 kg/m<sup>2</sup>
- Morbid obesity
  - Body weight exceeding 100% of normal
  - BMI greater than or equal to 40 kg/m<sup>2</sup>
- Chronic diseases and complications linked to obesity include
  - Hypertension
  - Dislipidemia
  - Type 2 diabetes
  - Heart disease
  - Stroke
  - Gallbladder disease
  - Osteoarthritis
  - Sleep apnea
- Chronic diseases and complications linked to obesity include
  - Certain cancers
  - Menstrual irregularities and infertility
  - Gestational diabetes, premature fetal deaths, neural tube defects, and complications during labor and delivery
  - Depression
  - Alzheimer's disease, dementia, and cognitive decline

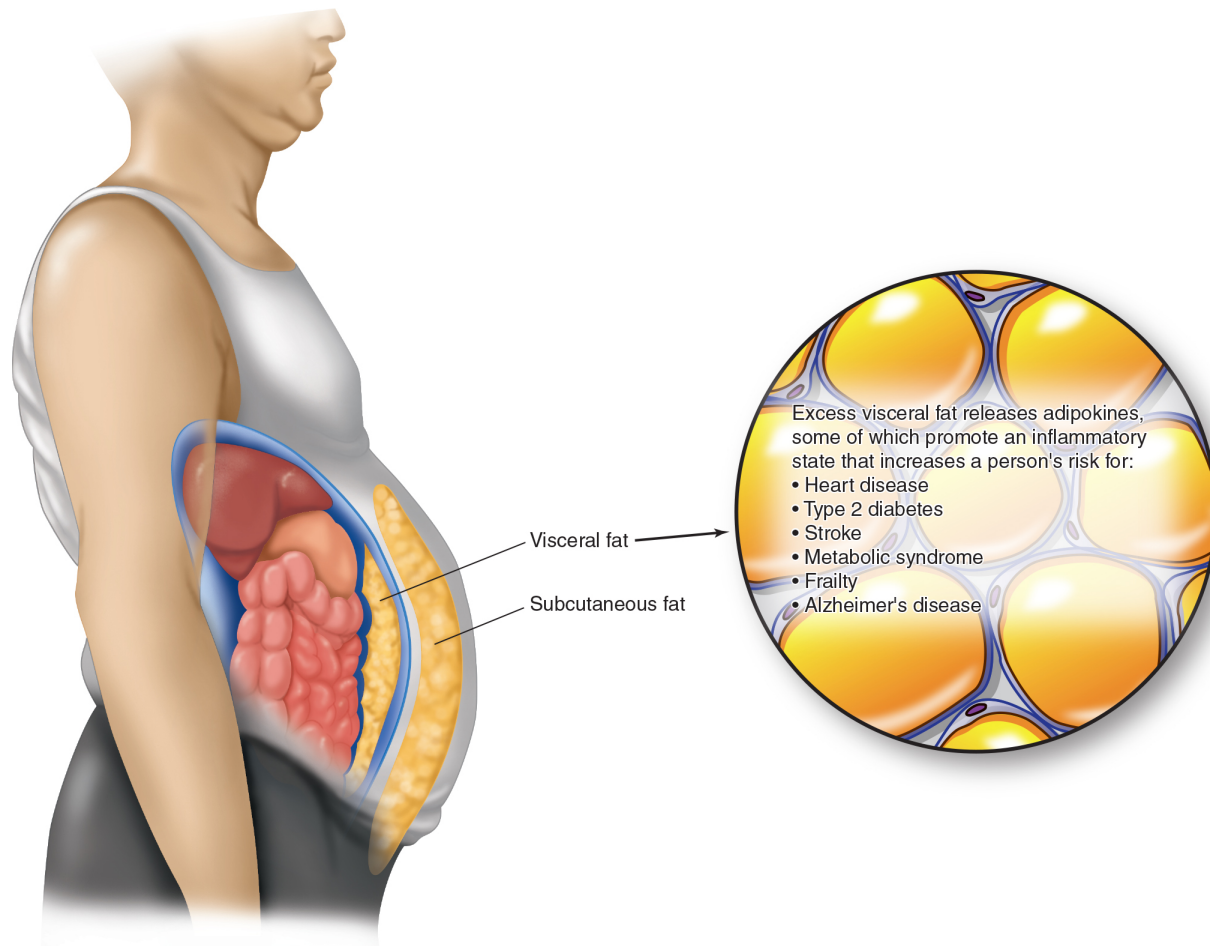


Figure 10.6: Abdominal Obesity

### 10.13.1 Metabolic Syndrome

- Abdominal obesity is one of the five risk factors of the metabolic syndrome
- People with metabolic syndrome are
  - Twice as likely to develop heart disease
  - Five times as likely to develop type 2 diabetes
- Factors that can influence the chance of developing obesity include
  - Biology (genetics, metabolic, environment)
  - Physical activity environment
  - Individual physical activity
  - Individual psychology
  - Societal influences
  - Food environment
  - Food consumption

### 10.13.2 Obesity Responds to Diet and Exercise

- Diet and exercise are the first line of defense against obesity
- Dietary and physical activity changes should be made gradually
- Physical activity for at least 30 minutes per day 5 days per week, but up to 60 minutes per day may be more beneficial for some people
- Treatments for obesity may include
  - Low-energy diet and regular exercise
  - Counseling or psychotherapy
  - Prescription medications
  - Surgery
    - \* Sleeve gastrectomy
    - \* Gastric bypass
    - \* Gastric banding

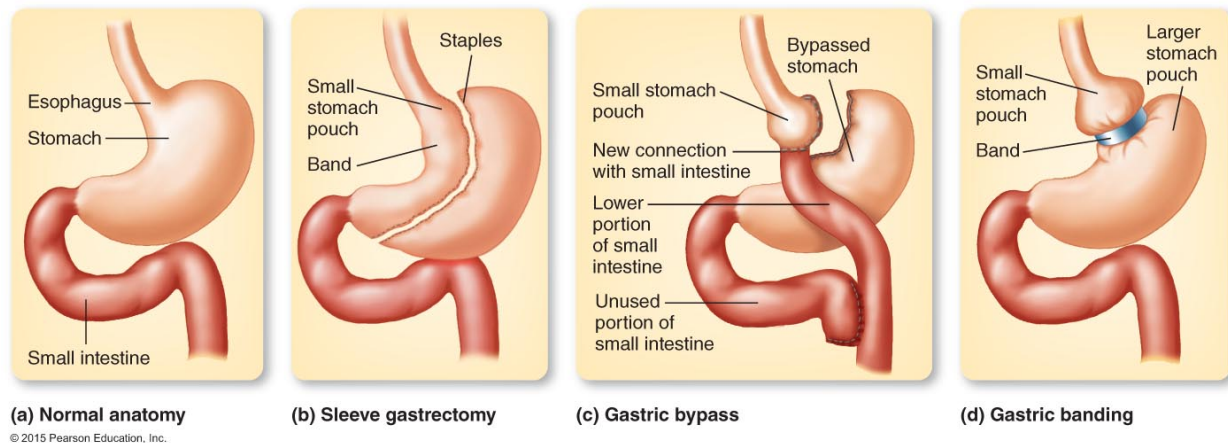


Figure 10.7: Weight-Loss Surgery