

In Depth 5.5

Cardiovascular Disease



Learning Outcomes



Learning Outcomes

After studying this In Depth, you should be able to:

- 5.1 Describe cardiovascular disease, including the major types and contributing mechanisms
- 5.2 Explain the role of modifiable factors and blood lipids in the development of cardiovascular disease
- 5.3 Identify several lifestyle choices that can reduce your risk for cardiovascular disease



Pizza can be a nutritious food—if it's made with a whole-grain crust, loaded with vegetables, and only lightly sprinkled with low-fat cheese. But the pizza that most Americans enjoy, a refined-flour crust, topped with pepperoni or sausage and high-fat cheese, provides 25–35% of an average adult's recommended daily intake of saturated fat—in a single slice. Why does this matter?

As you learned (in **Chapter 5**), many researchers have linked diets high in saturated fat with an increased risk for diseases of the heart and blood vessels. These diseases together account for more than 29% of all deaths of Americans.¹ The deaths can result from a sudden cardiac arrest, heart attack, or stroke, or occur after many years of chronic, progressive heart failure.

What role does a diet high in saturated fats play in these diseases? Are genetics also to blame? What about obesity, smoking, or failure to engage in recommended levels of physical activity? We'll explore the factors behind cardiovascular disease **In Depth** here, and identify steps you can take to reduce your risk.



What is cardiovascular disease?

LO 1 Describe cardiovascular disease, including the major types and contributing mechanisms.

Cardiovascular disease (CVD) ⓘ is a general term used to refer to any abnormal condition involving dysfunction of the heart (*cardio-* means “heart”) and blood vessels (*vasculature*). Among the many forms of this disease, the two with the highest mortality rates are the following:

- Coronary heart disease (CHD), also known as coronary artery disease (CAD), occurs when blood vessels supplying the heart (the coronary arteries) become blocked or constricted. Such blockage reduces the flow of blood—and the oxygen and nutrients it carries—to the heart muscle. This can result in chest pain, called *angina pectoris*. It can lead to a heart attack (also called a myocardial infarction, or MI), which is a loss of blood to, and death of, a region of heart muscle. It can also lead to sudden cardiac arrest, in which the heart suddenly stops beating. CHD causes about 600,000 deaths annually.¹



Knowing the warning signs of a heart attack could save your life.

Download the wallet card from the National Institutes of Health at www.nhlbi.nih.gov. From the home page, type “heart attack wallet card” in the search bar to find it.

- Stroke, also known as *cerebrovascular disease*, is caused by a blockage of one of the blood vessels supplying the brain (the cerebral arteries). When this occurs, the region of the brain that depends on that artery for oxygen and nutrients cannot function. As a result, the movement, speech, or other body functions controlled by that part of the brain suddenly stop. Stroke causes about 129,000 deaths annually.¹



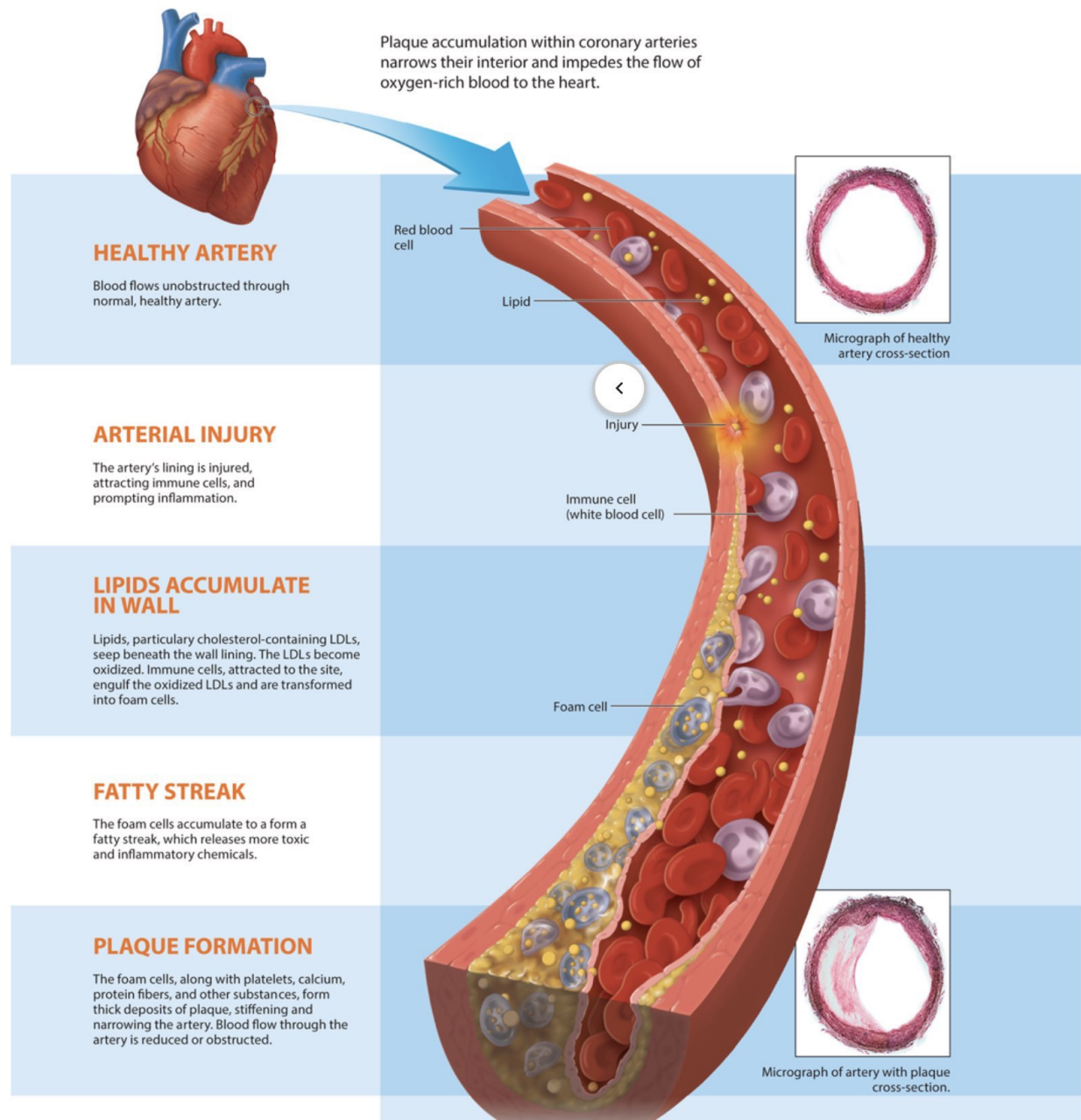
To view a brief animation of a stroke, visit MedlinePlus at www.nlm.nih.gov/medlineplus. From the home page, select “Videos and Tools,” then “Health Videos,” then click on “Stroke” in the index.

To understand CVD, we need to look at two conditions, atherosclerosis and hypertension, which underlie CHD and stroke.

Atherosclerosis Is Narrowing of Arteries

Atherosclerosis ⓘ is a disease in which arterial walls accumulate deposits of lipids and scar tissue that build up to such a degree that they impair blood flow. It's a complex process that begins with injury to the cells that line the insides of all arteries (Focus Figure 1 ⓘ). Factors that commonly promote such injury are the forceful pounding of blood under high pressure and blood-vessel damage from irritants, such as the nicotine in tobacco, the excessive blood glucose in people with poorly controlled diabetes, or even the immune response associated with chronic infection.

Focus Figure 1 Atherosclerosis



Whatever the cause, the injury leads to vessel inflammation, which is increasingly being recognized as an important marker of CVD.² Inflamed lining cells release chemicals that cause certain blood lipids to accumulate at the site. These lipids are mainly low-density lipoproteins, or LDLs, described shortly. LDLs invade beneath the lining of the artery wall and become oxidized. As they do, they attract the attention of immune cells that move to the site, squeeze between the lining cells, and ingest the lipids beneath, becoming foam cells. Accumulated foam cells form *fatty streaks* that are the first visible sign of atherosclerosis.

Over time, foam cells, along with proteins, calcium, platelets (cell fragments found in blood), and other substances, form thick, grainy deposits called *plaque*. The term *atherosclerosis* reflects the presence of these deposits: *athere* is a Greek word meaning “a thick porridge.” As plaques form, they narrow the interior of the blood vessel (see [Figure 1](#)). This slowly diminishes the blood supply to any tissues “downstream.” As a result, these tissues wither, and gradually lose their ability to function. The person may experience angina, shortness of breath, and fatigue.

Alternatively, the blockage may occur suddenly; this happens when an enlarging plaque ruptures and the blood vessel tears. *Platelets*, substances in blood that promote clotting, stick to the damaged area. This quickly obstructs the artery, causing the death of the tissue it supplies. As a result, the person experiences a heart attack or stroke.



Arteries damaged by atherosclerosis become not only narrow, but also stiff; that is, they lose their ability to stretch and spring back with each heartbeat. This characteristic is often referred to as “hardening of the arteries.” As you can imagine, atherosclerosis strains the heart, forcing it to exert increased pressure to eject each burst of blood into narrowed, stiffened vessels. Physicians refer to this increased pressure as *systolic hypertension*, as we explain next.

Hypertension Increases the Risk for Heart Attack and Stroke

Hypertension (HTN) is one of the major chronic diseases in the United States. It affects over 29% of all adults in the United States and more than 64% of people over the age of 65.³ Although HTN itself is often without symptoms, it is a warning sign that a person’s risk for a heart attack or stroke is increased. It can also damage the kidneys, reduce brain function, and impair physical mobility. In addition, chronically elevated blood pressure is one of the criteria for metabolic syndrome (see [Chapter 4](#)), which dramatically increases the risk of CVD and diabetes.

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When we define hypertension as blood pressure above the normal range, what exactly do we mean? Blood pressure is measured in two phases, systolic and diastolic.

- *Systolic blood pressure* represents the pressure exerted in our arteries at the moment that the heart contracts, sending blood into our blood vessels.
- *Diastolic blood pressure* represents the pressure in our arteries between contractions, when the heart is relaxed.

Blood pressure measurements are recorded in millimeters  of mercury (mmHg).

- *Normal blood pressure* includes a systolic blood pressure *less than* 120 mmHg, and a diastolic blood pressure *less than* 80 mmHg.
- *Prehypertension* is defined as a systolic blood pressure of 120–139 mmHg, or a diastolic blood pressure of 80–89 mmHg. About one of every three adults in the United States has prehypertension.³
- *Hypertension or high blood pressure* is defined as a systolic blood pressure of 140 mmHg or higher or a diastolic blood pressure of 90 mmHg or higher.



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What causes HTN? For about 45–55% of people, the condition is hereditary. This type is referred to as *primary* or *essential hypertension*. For the other 45% of people with HTN, a variety of factors may contribute. In addition to underlying atherosclerosis, as just explained, anything that increases the volume or viscosity (thickness) of blood forces the heart to beat harder, increasing the pressure of the ejected blood against the vessel walls. Because salt draws water, high blood sodium can increase the volume of blood and, thus, blood pressure. Other factors implicated in HTN include age, race or ethnicity, family history of HTN, genetic factors, sleep apnea (a sleep disorder that affects breathing), psychosocial stressors, tobacco use, obesity, low levels of physical activity, excessive alcohol intake, and dietary factors, including sensitivity to salt and low potassium intake.^{3, 4}

What factors influence the risk for cardiovascular disease?

LO 2 Explain the role of modifiable factors and blood lipids in the development of cardiovascular disease.

Coronary heart disease is the leading cause of death in the United States, while stroke is the fourth leading cause of death.¹ Overall, about 92.2 million Americans of all ages suffer from CVD or the after effects of stroke.⁴ So, who's at risk?

Many CVD Risk Factors Are Within Your Control

Over the last two decades, researchers have identified a number of factors that contribute to an increased risk for CVD. Some of these risk factors are nonmodifiable, meaning they are beyond your control. These include age—the older you are, the higher your risk. Until about age 60, men have a higher risk for CVD than women. After that, the risk is about equal. At any age, you have an increased risk for CVD if a parent suffered a heart attack, especially at a young age.

Other risk factors are modifiable—meaning they are at least partly within your control. Following is a brief description of each of these modifiable risk factors. Notice that many of them have a dietary component.^{4,5,6}

- **Overweight and Obesity** Being obese is associated with CVD and higher rates of death from CVD than being overweight or normal weight. The risk is due primarily to a greater occurrence of high blood pressure, inflammation, abnormal blood lipids (discussed in more detail shortly), and type 2 diabetes in people who are overweight or obese, with the prevalence highest in the obese. (See [Chapter 10](#) for information on body weight.)





Obesity is associated with higher rates of death from cardiovascular disease.

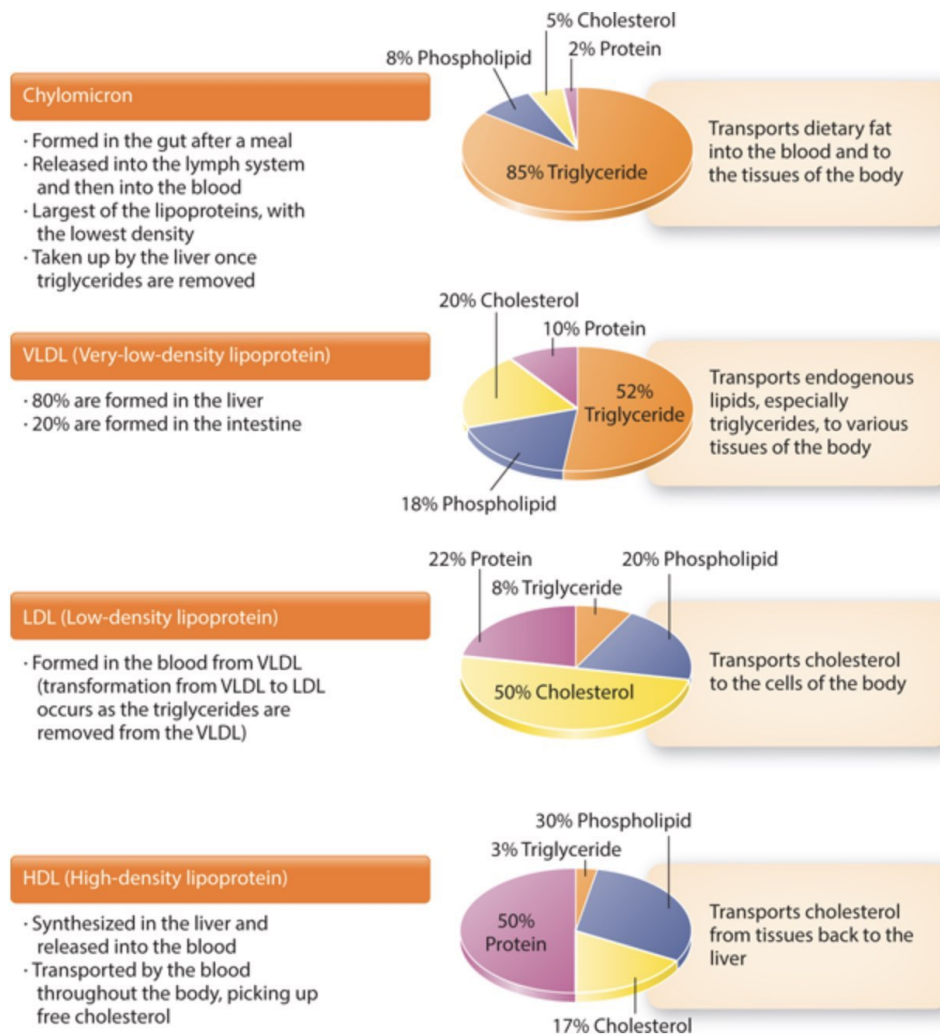
- **Inactivity** A sedentary lifestyle increases the risk of CVD. Conversely, numerous research studies have shown that regular physical activity can protect against several risk factors associated with the disease. Physical activity can also significantly reduce the risk for type 2 diabetes, a major CVD risk factor in itself.⁵ According to the 2008 U.S. Physical Activity Guidelines,⁶ physical activity can reduce your risk for heart disease by 20–30%, stroke by 25–30%, and type 2 diabetes by 25–35%.
- **Smoking** There is strong evidence that smoking increases your risk for blood-vessel injury and atherosclerosis. Research indicates that smokers die 13–14 years earlier than nonsmokers, with one-third of deaths from CHD attributable to smoking or second-hand smoke.⁴ Smokers also have two to four times increased risk of stroke than nonsmokers, depending on age and gender.⁴ People who stop smoking at 25–34 years of age gain 10 years of life compared to those who continue to smoke.⁴
- **Type 2 Diabetes Mellitus** For many people with type 2 diabetes, the condition is directly related to being overweight or obese, which is also associated with abnormal blood lipids and high blood pressure. The risk for CVD is three times higher in women with diabetes and two times higher in men with diabetes compared to individuals without diabetes.
- **Inflammation** We noted earlier that inflammation plays a role in atherosclerosis. C-reactive protein (CRP) is a nonspecific marker of inflammation somewhere in the body. Its level can be measured with a simple blood test. Risk for CVD appears to be higher in individuals who have an elevated CRP level in addition to other risk factors, such as abnormal blood lipids.^{7, 8} Obesity, a diet low in omega-3 fatty acids, and a high intake of saturated fats promote inflammation. Thus, reducing these factors can lower your risk for CVD.
- **Abnormal Blood Lipids** As we explain next, abnormal levels of cholesterol and triglycerides in the blood are associated with an increased risk for CVD. A diet high in added sugars and saturated and *trans* fat, and low in soluble fiber, overweight and obesity, and low levels of physical activity are all associated with abnormal blood lipids. Conversely, omega-3 fatty acids reduce blood triglycerides, and increase levels of lipids that protect the health of blood vessels.^{9, 10}

Blood Lipids Play a Significant Role in Cardiovascular Disease

Recall that lipids are transported in the blood by lipoproteins made up of a lipid center and a protein outer coat. The names of lipoproteins reflect their proportion of lipid, which is less dense, to protein, which is very dense. For example, very-low-density lipoproteins (VLDLs) are only 10% protein, whereas high-density lipoproteins (HDLs) are 50% protein (Figure 2).

Figure 2

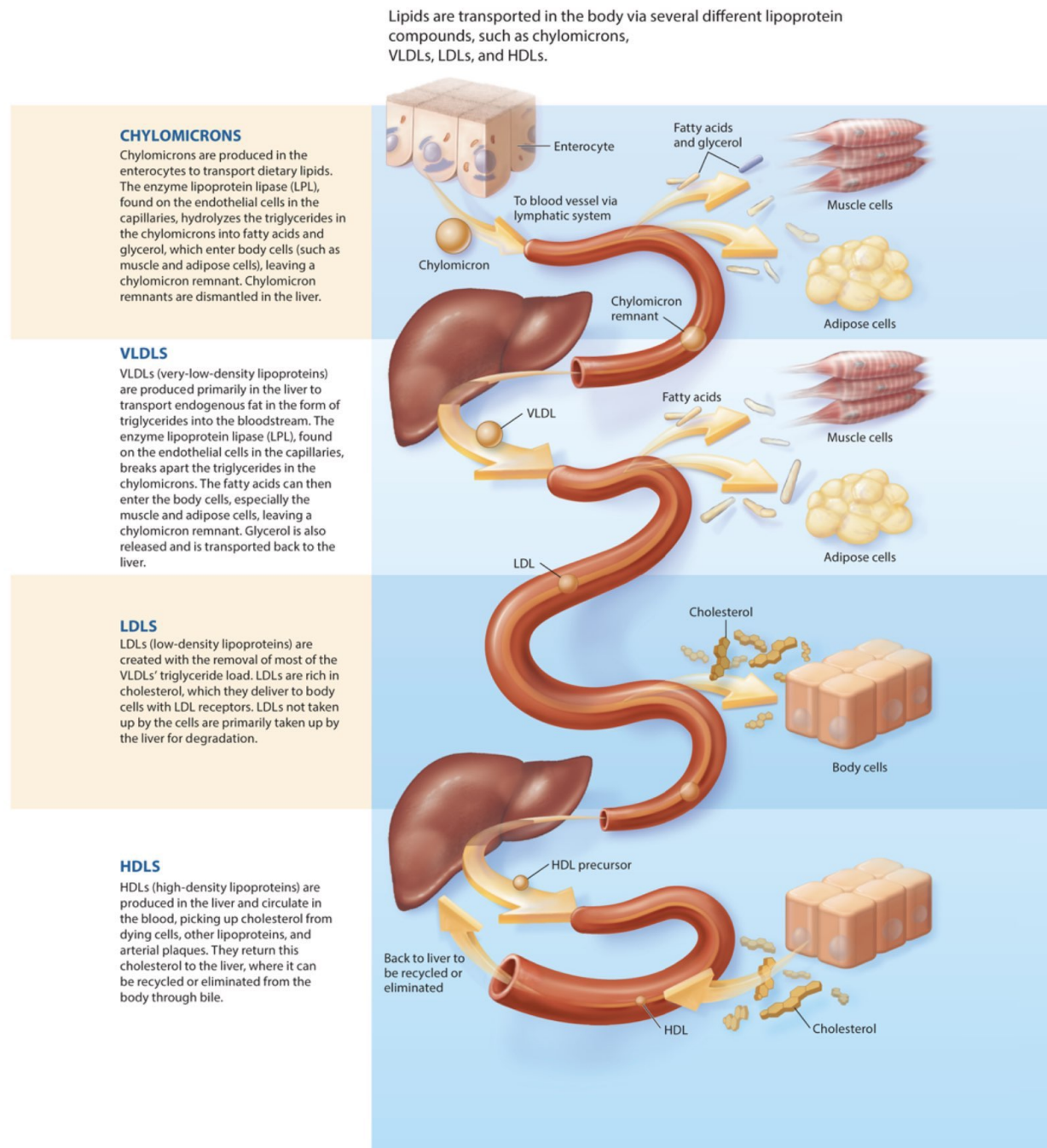
The chemical components of various lipoproteins. Notice that chylomicrons contain the highest proportion of triglycerides, making them the least dense, whereas high-density lipoproteins (HDLs) have the highest proportion of protein, making them the most dense.



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Focus Figure 3 Lipoprotein Transport and Distribution



Chylomicrons

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Recall (from [Chapter 5](#)) that chylomicrons are produced in the small intestine to transport dietary fat into the lymphatic vessels and from there into the bloodstream. At 85% triglyceride, chylomicrons have the lowest density. However, your blood contains chylomicrons only for a short time after you have consumed a meal.

Very-Low-Density Lipoproteins

More than half of the substance of very-low-density lipoproteins (VLDLs) is triglyceride. The liver is the primary source of VLDLs, but they are also produced in the intestines. VLDLs are primarily transport vehicles ferrying triglycerides from their source to the body's cells, including to adipose tissues for storage. The enzyme lipoprotein lipase (LPL) frees most of the triglyceride from the VLDL molecules, resulting in its uptake by the body's cells.

Diets high in fat, simple sugars, and extra Calories can increase the body's production of VLDLs, whereas diets high in omega-3 fatty acids can help reduce their production. In addition, exercise can reduce VLDLs because they're readily used for energy instead of remaining to circulate in the blood.

Low-Density Lipoproteins

The molecules resulting when VLDLs release their triglyceride load are higher in cholesterol, phospholipids, and protein and therefore somewhat more dense. These low-density lipoproteins (LDLs) circulate in the blood, delivering their cholesterol to cells.

LDLs not removed from the bloodstream are left to circulate in the blood. The more LDL-cholesterol circulating in the blood, the greater the risk that some of it will adhere to the walls of the blood vessels, contributing to the development of atherosclerosis. Because high blood levels of LDL-cholesterol increase the risk for CVD, it is often labeled the "bad cholesterol." Diets lower in simple carbohydrate and saturated fats, along with regular physical activity, can reduce LDL-cholesterol.^{11, 12}

High-Density Lipoproteins

As their name indicates, high-density lipoproteins (HDLs) are small, dense lipoproteins with a very low cholesterol content and a high protein content. They are released from the liver and intestines to circulate in the blood. As they do, they pick up cholesterol from dying cells and

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As their name indicates, high-density lipoproteins (HDLs) are small, dense lipoproteins with a very low cholesterol content and a high protein content. They are released from the liver and intestines to circulate in the blood. As they do, they pick up cholesterol from dying cells and arterial plaques and transfer it to other lipoproteins, which return it to the liver. The liver takes up the cholesterol and uses it to synthesize bile, thereby removing it from the circulatory system. High blood levels of HDL-cholesterol are therefore associated with a low risk for CVD. That’s why HDL-cholesterol is often referred to as the “good cholesterol.” There is some evidence that diets high in omega-3 fatty acids and participation in regular physical exercise can modestly increase HDL-cholesterol levels.^{13, 14}

Total Serum Cholesterol

Normally, as the dietary level of cholesterol increases, the body decreases the amount of cholesterol it makes and the amount of cholesterol it absorbs, which keeps the body’s level of cholesterol constant. Unfortunately, this feedback mechanism does not work well in everyone. For some individuals, eating dietary cholesterol doesn’t decrease the amount of cholesterol produced in the body, and their total body cholesterol level—including the level in their blood—rises. These individuals benefit from reducing their intake of saturated and *trans* fats, because doing so also decreases the intake of dietary cholesterol.

For most Americans, the Dietary Guidelines suggest focusing on limiting saturated fat intake.¹⁵ By limiting intake of animal products or selecting low-fat versions, you can reduce your intake of both saturated fat and cholesterol. (See the suggestions for choosing healthful fats in [Chapter 5](#).)

You Can Estimate Your Risk for Cardiovascular Disease

Now that you know more about blood lipids, you’re probably wondering what your levels look like. If so, you can have them measured by your physician. See [Table 1](#) to compare your blood lipid levels to optimal levels. You also need to know your blood pressure. Especially if you have a family history of CVD, it’s important to have your blood pressure checked regularly.

Table 1 **Interpreting Blood Cholesterol Levels**

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Total Cholesterol Level	Category
Less than 200 mg/dL	Desirable
200–239 mg/dL	Borderline high
240 mg/dL and above	High

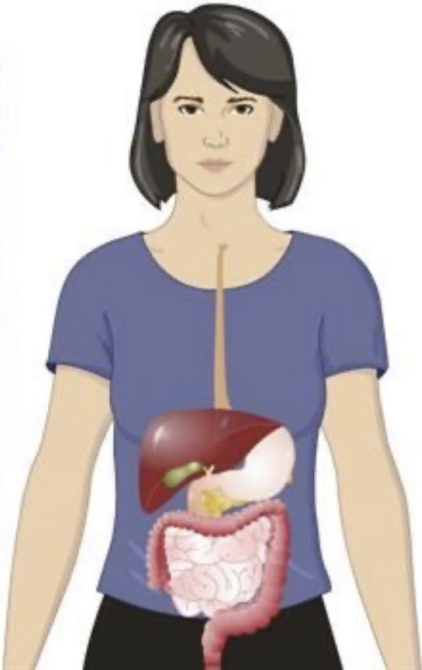
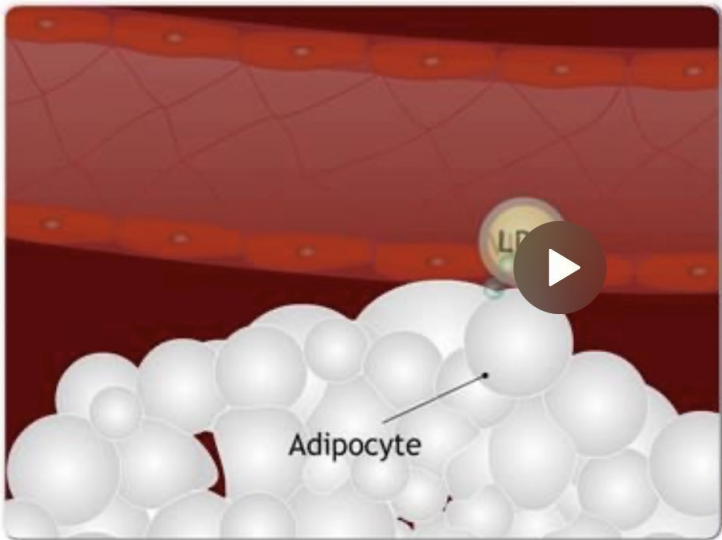
LDL (Bad) Cholesterol Level	LDL Cholesterol Category
Less than 100 mg/dL	Optimal
100–129 mg/dL	Near optimal/above optimal
130–159 mg/dL	Borderline high
160–189 mg/dL	High
190 mg/dL and above	Very High

HDL (Good) Cholesterol level	HDL Cholesterol Category
Less than 40 mg/dL	A major risk factor for heart disease
40–59 mg/dL	The higher, the better
60 mg/dL and higher	Considered protective against heart disease

Source: National Institutes of Health. 2012, Summer. Cholesterol levels: What you need to know. *NIH Medline Plus Magazine* 7(2):6–7. www.nlm.nih.gov/medlineplus

After you’ve found this information, visit the website of the National Heart, Lung, and Blood Institute (NHLBI) to assess your 10-year risk for having a heart attack. See the [Web Links](#) at the end of this chapter.

Watch Animation: Lipoproteins: VLDL, LDL, and HDL



How can you reduce your risk for cardiovascular disease?

LO 3 Identify several lifestyle choices that can reduce your risk for cardiovascular disease.

Many diet and exercise interventions aimed at reducing the risk for CVD center on reducing high levels of triglycerides and LDL-cholesterol while raising HDL-cholesterol. Approaches aimed specifically at reducing blood pressure include most of the same recommendations, along with strict monitoring of sodium intake.

Take Steps to Improve Your Blood Lipid Levels

The Centers for Disease Control and Prevention and the American Heart Association have made the following dietary and lifestyle recommendations to improve blood lipid levels and reduce the risk for CVD.^{4, 16}

- Keep fat intake to within 20–35% of total energy intake.¹⁷
- Decrease dietary saturated fat to less than 7–10% of total energy intake and keep *trans* fatty acids as low as possible.^{11, 15} (For dietary strategies, see the Quick Tips in [Chapter 5](#).)
- Increase your intake of the omega-3 fatty acid ALA from dark green, leafy vegetables, soybeans or soybean oil, walnuts or walnut oil, flaxseed meal or oil, or canola oil. Also, consume fish, especially oily fish, at least twice a week to increase your intake of the omega-3 fatty acids EPA and DHA.
- Consume the RDA for vitamin B₆, B₁₂, and folate, because these B vitamins help maintain low blood levels of the amino acid homocysteine. High homocysteine levels in the blood are associated with increased risk for CVD.





Consuming whole fruits and vegetables can reduce your risk for cardiovascular disease.

- Increase dietary intakes of whole grains, fruits, and legumes and other vegetables, so that total dietary fiber is 20–30 g per day. Include oat bran, beans, and fruits, as these foods contain a type of fiber that helps to reduce LDL-cholesterol specifically.¹⁸
- High blood glucose levels are associated with high blood triglycerides. To help maintain normal blood glucose, consume whole foods high in fiber (see the above bullet); select lean meats and low-fat dairy products; and limit your intake of foods high in added sugars and/or saturated fat.
- Eat meals throughout the day instead of eating most of your Calories in the evening before bed. This approach decreases the load of fat entering the body at any one time. Exercising after a meal also helps keep blood lipids and glucose within normal ranges.
- Consume no more than two alcoholic drinks per day for men and one drink per day for women. Because heavy alcohol consumption can worsen high blood pressure, it is suggested that people with HTN abstain from drinking alcohol entirely. (Alcohol consumption is discussed [In Depth](#) following [Chapter 7](#).)
- If you smoke, stop. As noted earlier, smoking significantly increases the risk for CVD.
- Exercise most days of the week for 30 to 60 minutes if possible. Exercise will increase HDL-cholesterol while lowering blood triglyceride levels. Exercise also helps you maintain a healthful body weight and a lower blood pressure and reduces your risk for type 2 diabetes.
- Maintain a healthful body weight. Obesity promotes inflammation; thus, keeping body weight within a healthful range helps keep inflammation low.¹⁹ In addition, blood pressure values have been shown to decrease 7–8% in people who have lost several pounds of body weight (~ 13 pounds).²⁰

Take Steps to Manage Your Blood Pressure

We noted earlier that HTN is a risk factor in the development of atherosclerosis, CHD, and stroke. Therefore, the lifestyle changes just identified are appropriate for anyone diagnosed with hypertension or prehypertension. In addition, recommendations for reducing blood pressure include limiting dietary sodium intake and following the DASH diet.

Limit Dietary Sodium

Many people with HTN are sensitive to sodium; that is, when they consume a high-sodium diet, their blood pressure increases. We know, however, that not everyone with HTN is sensitive to sodium, and it is impossible to know who is sensitive and who is not because there is no ready test for sodium sensitivity. Moreover, lowering sodium intake does not reduce blood pressure in all people with hypertension. Thus, there is significant debate over whether everyone—or even everyone with HTN—can benefit from eating a lower-sodium diet.

Despite this debate, the leading health organizations, including the American Heart Association and the NHLBI, continue to support a reduction in dietary sodium to less than 2,300 mg/day, as recommended in the *2015–2020 Dietary Guidelines for Americans*.¹⁵ Currently, the average sodium intake in the United States is about 3,300 mg/day.

Follow the DASH Diet

The impact of diet on reducing the risk for cardiovascular disease—including hypertension—was clearly demonstrated in a study from the National Institutes of Health (NIH) called Dietary Approaches to Stop Hypertension (DASH). The **DASH diet** is an eating plan that is high in several minerals that have been shown to help reduce hypertension, including calcium, magnesium, and potassium. At the same time, it is moderately low in sodium (2,300 mg/day on a 2000 kcal/d diet), low in saturated fat, and high in fiber, and it includes 10 servings of fruits and vegetables each day. **Figure 4** shows the DASH eating plan for a 2,000-kcal diet.

Figure 4

The DASH diet plan.

Note: This example is based on 2,000-kcal/day. Your number of servings in a food group may differ from the number listed, depending on your own energy needs.

The DASH Diet Plan



Food Group	Daily Servings	Serving Size
Grains and grain products	7–8	1 slice bread 1 cup ready-to-eat cereal* ½ cup cooked rice, pasta, or cereal
Vegetables	4–5	1 cup raw leafy vegetables ½ cup cooked vegetable 6 fl. oz vegetable juice
Fruits	4–5	1 medium fruit ¼ cup dried fruit ½ cup fresh, frozen, or canned fruit 6 fl. oz fruit juice
Low-fat or fat-free dairy foods	2–3	8 fl. oz milk 1 cup yogurt 1½ oz cheese
Lean meats, poultry, and fish	2 or less	3 oz cooked lean meats, skinless poultry, or fish
Nuts, seeds, and dry beans	4–5 per week	¼ cup or 1½ oz nuts 1 tbsp. or ½ oz seeds ½ cup cooked dry beans
Fats and oils [†]	2–3	1 tsp. soft margarine 1 tbsp. low-fat mayonnaise 2 tbsp. light salad dressing 1 tsp. vegetable oil
Sweets	5 per week	1 tbsp. sugar 1 tbsp. jelly or jam ½ oz jelly beans 8 fl. oz lemonade

*Serving sizes vary between ½ and 1¼ cups. Check the product's nutrition label.

[†]Fat content changes serving counts for fats and oils: for example, 1 tablespoon of regular salad dressing equals 1 serving; 1 tablespoon of a low-fat dressing equals ½ serving; 1 tablespoon of a fat-free dressing equals 0 servings.

The results of the original NIH study showed that eating the DASH diet can dramatically improve blood lipids and lower blood pressure. These changes occurred within the first 2 weeks of eating the DASH diet and were maintained throughout the duration of the study. Researchers estimated that if all Americans followed the DASH diet, it could reduce the risk of heart disease by 25%.

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A subsequent study of the DASH diet found that blood pressure decreases even more as sodium intake is reduced below 3,000 mg per day. In the study, participants ate a DASH diet that provided 3,300 mg, 2,300 mg, or 1,500 mg of sodium each day.²¹ After 1 month on this diet, all the participants experienced a significant decrease in their blood pressure; however, those who ate the lowest-sodium version of the DASH diet experienced the largest decrease. Even more recent research shows that if you combine the DASH diet with physical activity and weight loss (of approximately 20 pounds), not only blood pressure, but blood lipids and other markers of CVD improve.²²



For DASH diet recipes, visit the Mayo Clinic at www.mayo.org. From the home page, type "DASH diet" in the search bar, then click on "DASH Diet Recipes" and get cooking!

Nutri-case

GUSTAVO





“Sometimes I wonder where doctors get their funny ideas. Yesterday I had my yearly checkup and my doctor says, ‘You’re doing great! Your weight is fine, your blood sugar’s good. The only thing that concerns me is that your blood pressure is a little high, so I want you to watch your diet. Cut back on the red meats and eat fish instead. When you do eat red meat, trim off the fat. Cook with olive oil instead of lard. And go easy on the salt.’ I know he means well, but my wife’s finally able to move around again after breaking her hip. How am I supposed to tell her she has to learn a whole new way to cook?”

Do you think that Gustavo’s objection to his doctor’s advice is valid? Why or why not? Identify at least two alternatives or resources that might help Gustavo and his wife.

Prescription Medications Can Improve Blood Lipids and Blood Pressure

For some individuals, lifestyle changes are not completely effective in normalizing blood lipids and blood pressure. When this is the case, a variety of medications can be prescribed. Some inhibit the body’s production of cholesterol. These types of drugs, typically called *statins*, block an enzyme in the cholesterol synthesis pathway, which can help to lower blood levels of LDL-cholesterol and VLDL-cholesterol.² Other medications prevent the reabsorption of bile in the gastrointestinal (GI) tract. Because bile is made from cholesterol, blocking its reabsorption and promoting its excretion in feces reduces the total cholesterol pool, which means the liver must draw on body cholesterol stores to make new bile acids. Diuretics may also be prescribed to flush excess water and sodium from the body, reducing blood volume and thus blood pressure. Other hypertension medications work to relax the blood vessel walls, allowing more room for blood flow. People taking such medications should also continue to practice the lifestyle changes listed earlier in this section because these changes will continue to benefit their long-term health.