

Cholesterol

WHAT IS CHOLESTEROL?

Cholesterol is a waxy, fatlike substance that occurs naturally in every body cell and is needed by the body to function normally. It is found throughout the body, including the brain, nerves, muscle, hormones, vitamin D, and the bile acids that help to digest and absorb fat. With the help of sunlight, cholesterol in skin can change to vitamin D, which is essential for building strong bones.

Only a small amount of cholesterol is needed in the blood to meet all the body's needs. Too much cholesterol in the bloodstream can lead to atherosclerosis, a type of "hardening of the arteries." Atherosclerosis is a condition in which cholesterol and fat are deposited in artery walls, causing them to become narrow and reducing blood flow. Narrowing of the coronary arteries by atherosclerosis can produce signs and symptoms of heart disease, including angina and heart attack. Sometimes there are no symptoms until an artery is about 75% blocked.

WHERE IS CHOLESTEROL FOUND?

There are two types of cholesterol: blood (serum) and dietary cholesterol. Blood (serum) cholesterol circulates in the bloodstream. While every cell can make cholesterol, the liver produces most of it. When the body makes too much, this increases the risk for heart disease, including heart attack and stroke.

The body of an adult can make all the cholesterol it needs, but most people also get it from foods. Unlike adults, children under age two do not produce enough cholesterol; therefore, their food must supply part of it.

Plants do not produce cholesterol, even if they contain fat. Dietary cholesterol only comes from foods of animal origin. Common sources are eggs, meats, poultry, fish, dairy products and animal fats, such as butter or lard.

GOOD AND BAD CHOLESTEROL

Blood cholesterol cannot mix with blood, so it needs a vehicle to transport it around the bloodstream. Therefore, cholesterol uses three lipoproteins as vehicles: high density lipoproteins (HDL), low density lipoproteins (LDL) and very low density lipoproteins (VLDL). These three measures make up total blood cholesterol level. Table 1 shows what LDL and HDL do in the body and their effects on risk of heart disease.

	LDL	HDL
Full Name:	Low Density Lipoprotein.	High Density Lipoprotein.
What it does:	Takes cholesterol from the liver to the rest of the body, depositing some on artery walls and vessels.	Primarily takes cholesterol from body tissue back to liver for removal from the body.
Effect on risk of heart disease:	Excess amounts increase risk.	High amounts reduce risk.
Nickname:	"Bad" cholesterol.	"Good" cholesterol.

TRIGLYCERIDES

Triglycerides are the main form of fat in food, whether it is saturated, monounsaturated, or polyunsaturated. The body produces them when excess calories are eaten from any foods (protein, carbohydrate or fat). Most of the fat in the body is stored as triglycerides. Triglycerides trigger the liver to make more cholesterol, causing the levels of LDL and total cholesterol to rise. The desired level for triglycerides is < 250 mg/dL. High triglyceride levels alone may not be associated with heart disease. Triglyceride levels are affected by alcohol, medication, hormones, diet, recent exercise, menstrual cycle, and time of day.

BLOOD CHOLESTEROL LEVELS

The National Cholesterol Education Program (NCEP) recommends that everyone age 20 and older obtain a “fasting lipoprotein profile” every five years, more often for older adults and people at risk for heart disease. A child is considered at risk if a parent has a total cholesterol level of 240 mg/dL or higher or suffered a heart attack before age fifty-five, and if there is a family history of heart disease. A “fasting lipoprotein profile” is a blood test done after a nine to twelve-hour fast without food, liquids or pills. It reveals information about the total cholesterol, LDL cholesterol, HDL cholesterol, and triglyceride levels in the blood.

Total cholesterol is made up of HDL cholesterol (good) and LDL cholesterol (bad). Problems develop when the total cholesterol or LDL cholesterol gets too high and HDL is too low.

There should be more HDL cholesterol than LDL cholesterol. HDL carries the artery clogging cholesterol out of the body, while LDL carries the cholesterol around the body, depositing it where it can cause serious problems.

Results of the “fasting lipoprotein profile” can help determine the overall risk for heart disease. Other risk factors include: age, gender, family history, high-fat

eating, inactivity, cigarette smoking, excessive alcohol intake, hypertension, diabetes, obesity and low HDL. Before menopause, women usually have lower cholesterol levels than men. However, women’s LDL cholesterol often rises after menopause.

Table 2 shows how test results are classified for everyone, regardless of height and weight. Since this test is a per unit measurement rather than a measure of all the cholesterol in the body, each deciliter of blood should contain less than 200 milligrams of cholesterol.

Some doctors also believe that the ratio of total cholesterol to HDL (TC/HDL) is the most predictive measure of risk for heart disease. Women should strive for a ratio less than 4.0 and men should strive for less than 4.5.

HOW ARE FATS RELATED TO BLOOD CHOLESTEROL?

According to scientific evidence, blood cholesterol can be affected by the type and amount of dietary fat consumed. High cholesterol levels and high LDL levels are most often related to a diet high in saturated fats and a sedentary lifestyle. Dietary cholesterol can raise blood cholesterol but generally is not as important as saturated fat and total fat in the diet.

Table 2. Classifications of a Fasting Lipoprotein Profile

Total Cholesterol		HDL Cholesterol	
Desirable	< 200 mg/dL	Low	< 40 mg/dL
Borderline High	200 – 239 mg/dL	High ¹	> 60 mg/dL
High	> 240 mg/dL	¹ An HDL of 60 mg/dL and above is considered protective against heart disease.	
LDL Cholesterol		Triglycerides	
Optimal	< 100 mg/dL	Normal	< 150 mg/dL
Near Optimal/Above Optimal	100 – 129 mg/dL	Borderline High	150 – 199 mg/dL
Borderline High	130 – 159 mg/dL	High	200 – 499 mg/dL
High	160 – 189 mg/dL	Very High	> 500 mg/dL
Very High	> 190 mg/dL		

To lower blood cholesterol levels, eat less fat, especially saturated fats, and replace some saturated fats with polyunsaturated and monounsaturated fats (especially olive and canola oil). High total blood cholesterol levels and LDL cholesterol levels increase risk of heart disease while lower levels reduce risk. Higher levels of HDL cholesterol help lower the risk for heart disease.

Genetics can be an important factor as well. Some people have genetically high blood cholesterol levels, and despite their best efforts cannot lower their cholesterol into the safe range without the help of medication.

ARE ALL FATS THE SAME?

There is no single type of fat. Rather, the word “fat” is often used to refer to all of the fatty substances found both in food and in the body. Here are the types of fat.

Lipid: Scientific term referring to fat, cholesterol and other fat-like substances. A common quality among lipids is that they do not dissolve in water.

Lipoprotein: A protein-coated transporter that carries fat and/or cholesterol in the bloodstream.

Triglycerides: Scientific name for the main form of fat found in the diet and in the body. Most of the fat in the body is stored as triglycerides.

Saturated Fats: Usually solid or firm at room and refrigerator temperatures, saturated fats have all of the hydrogen atoms they can hold (saturated with hydrogen). They can raise blood cholesterol more than anything else in the diet. They trigger the liver to make more total and LDL cholesterol. Saturated fats primarily come from animal products, such as meat, butter, lard, cheese, whole milk, and cream. They are also found in tropical plant oils, such as coconut and palm, hydrogenated vegetable oil and cocoa butter (in chocolate.)

Monounsaturated Fats: Liquid at room temperature, monounsaturated fats are missing one pair of hydrogen atoms. They lower blood cholesterol and trigger more HDL cholesterol production. Monounsaturated fats primarily come from plants and include olive oil, canola oil and peanut oil.

Polyunsaturated Fats: Liquid at room temperature, polyunsaturated fats are missing two or more pairs of hydrogen atoms. They can lower total blood cholesterol and may lower HDL, as well as LDL. Many common vegetable oils, such as corn, soybean, safflower, sesame, cottonseed and sunflower oil, are high in polyunsaturated fats.

Hydrogenated Fats: Polyunsaturated fats and monounsaturated fats are sometimes processed to make them stable and solid at room temperature and to protect against rancidity. Examples are stick margarine and packaged crackers and cookies. Hydrogen atoms are added through a process called hydrogenation.

Trans Fatty Acids: A type of fat formed during the process of hydrogenation. Trans fatty acids act like saturated fats in the body and tend to raise blood cholesterol levels. They have been shown to increase LDL cholesterol and lower HDL cholesterol, which may increase the risk for heart disease.

Omega-3 Fatty Acids: A type of fatty acid that is highly polyunsaturated. Omega-3 fatty acids are mainly found

in higher-fat, cold-water fish, such as salmon, albacore tuna, mackerel, whitefish and herring. While eating fish is encouraged, the use of fish oil supplements is not currently recommended by the American Heart Association. Additional omega-3 sources are nuts, soy, canola and flaxseed oils. Diets high in omega-3 fatty acids may help lower levels of LDL cholesterol and triglycerides and reduce risk of heart disease. They may protect from hardening of the arteries and help reduce blood clotting.

Omega-6 Fatty Acids: Polyunsaturated fatty acids found in vegetable oils. Soybean, corn and safflower oils are good sources. Omega-6s may reduce the risk of heart disease by lowering total and LDL cholesterol levels. However, they also may lower HDL levels.

RECOMMENDED CHOLESTEROL, CALORIE, AND FAT INTAKES

Frequently, recommendations for fat are given in percentage of calories from fat or fat calories. The average American gets about 34 percent of total calories from fat. Most medical experts think this is too much. The U.S. Dietary Guidelines advise a general reduction in fat (especially saturated fat) and cholesterol. Table 3 presents the dietary recommendations for fat and cholesterol intakes for both the general public and for people with high LDL cholesterol, heart disease and/or diabetes. These recommendations are for the total diet, not a single food or meal.

Table 3. Recommendations for Calories, Fat and Cholesterol Intakes*

Nutrient	People without Heart Disease or High LDL Cholesterol	People with Heart Disease, Diabetes, or High LDL Cholesterol
Total Calories	Balance energy intake and expenditure to maintain desirable body weight and prevent weight gain.	
Total Fat	Less than 30% of total calories	25 – 35% of total calories ¹
Saturated Fat	Less than 10% of total calories	Less than 7% of total calories
Polyunsaturated Fat	Up to 10% of total calories	
Monounsaturated Fat	10-15% of total calories	
Cholesterol	Less than 300 mg/day	Less than 200 mg/day
*By the American Heart Association and the National Cholesterol Education Program ¹ A higher fat intake is allowed, provided most of it is unsaturated fat, and may be needed to prevent low HDL levels from worsening		

Some people with high risk may find that diet therapy alone is inadequate. Most people, however, continue diet therapy at least six months before deciding whether to add drug treatment.

Optimal fat intake for children is unknown, according to the American Academy of Pediatrics. However, 30 percent of calories from fat seems sensible for adequate growth and development in children, especially after the age of two.

LOWERING BLOOD CHOLESTEROL

Diet impacts blood cholesterol levels both positively and negatively. Dietary cholesterol can elevate blood cholesterol levels, although it does not automatically become cholesterol in blood. The total amount of fat eaten, especially saturated fat, has a greater impact on blood cholesterol levels.

Here are some simple daily guidelines for lowering blood cholesterol:

- Watch caloric intake by eating a wide variety of foods low in saturated fat and cholesterol.
 - Eat at least five servings of fruits and vegetables. To meet this goal, enjoy one at breakfast, one fruit and one veggie at lunch and a salad plus one cooked veggie for dinner. Fruits are excellent snacks and desserts. Eat the whole fruit, skin included, rather than drinking fruit juice, which contains no fiber.
 - Eat six or more servings of cereals, breads, pasta and other whole-grain products.
 - Eat fish, poultry without skin and leaner cuts of meat instead of fatty ones.
 - Eat organ meats, egg yolks and whole eggs in moderation. Choose egg whites and egg substitutes, which contain no cholesterol and little or no fat.
 - Consume nonfat or 1% milk dairy products rather than whole-milk dairy products.
 - Eat more fiber-rich foods, particularly those containing soluble fiber. It appears to help bile acids, which are made up of cholesterol, pass through the system as waste while the body absorbs less cholesterol. Good sources of soluble fiber are oats, legumes, and many fruits and vegetables such as apples, pears, oranges, and carrots. When increasing fiber intake, remember to go slowly so that the system has time to adjust.
 - For breakfast choose fiber-rich foods like oatmeal, whole grain muffins and fruit. Read nutrition labels on cereal boxes and select those containing five grams or more of fiber per serving. Oat bran and rice bran are the most effective.
 - Eat legumes at least three times a week. Replace meats with dry beans and peas occasionally. Bean soup, cold bean salad, humus sandwiches, black bean dip, toasted soybeans, textured soy protein, soy milk, and tofu are excellent choices.
- Garlic, both raw and cooked, contains compounds that may help lower the liver's production of cholesterol. Other cholesterol fighting foods are raw onions, salmon, olive oil, almonds, walnuts and avocados. Although the latter five are high in fat, most of the fat is monounsaturated, which helps to improve cholesterol levels.
 - Choose food products that contain plant stanols or plant sterols. These are noted on product food labels and include cholesterol-lowering margarines.
 - Eat plenty of foods that contain beta-carotene, and vitamins C and E, the natural antioxidants. Foods rich in beta-carotene include: apricots, pumpkin, sweet potatoes, carrots, and cantaloupe. Foods rich in vitamin C include: red and green bell peppers, cantaloupe, papaya, oranges, grapefruits, broccoli, Brussels sprouts, and strawberries. Vitamin E-rich foods include: sunflower seeds, almonds, peanuts, hazelnuts, wheat gum, soybeans, wheat germ oil, and soybean oil.
 - Eat less fried foods, fatty and processed meats like hot dogs, sausage, bacon and lunch meats, and skip high fat desserts such as ice cream, pastries, pies, and cheesecake.
 - Add flavor to foods with herbs and spices rather than high-fat sauces. Minimize the use of fats and oils, such as vegetable oils, butter, margarine, lard, cream cheese and bacon. Broil, bake, boil, steam, stir-fry, grill or microwave foods rather than fry them.
 - Learn portion sizes. The amount of cholesterol and fat in food choices depends on how much is eaten as well as what is eaten.
 - Small amounts of wine or beer may be helpful in lowering cholesterol levels, according to studies. Those who choose to drink alcoholic beverages should do so sensibly and in moderation, defined as the consumption of up to one drink per day for women and up to two drinks per day for men.
 - Enjoy at least 30-60 minutes of vigorous activities on most (or all) days of the week. This raises HDLs, lowers LDLs, and helps total cholesterol and triglyceride levels remain normal.
 - Maintain a healthy weight and trim any extra pounds of body fat.

In Summary: Eat foods low in saturated fat and cholesterol, and eat lots of fruits, vegetables, whole grains and non-fat dairy products. Foods known to help lower blood cholesterol include soluble fiber, garlic, salmon, foods rich in vitamin C and E, and food products that contain plant stanols or plant sterols. Maintain a healthy weight and stay physically active.

SHOPPING TIPS

Buy Foods With Less Fat:

- Hamburger with deep color or labeled “lean” instead of hamburger with light pink color or labeled “regular”
- Least fatty grades of meat rather than heavily marbled beef
- Nonfat, 1% or 2% milk instead of whole milk
- Nonfat dry milk instead of nondairy coffee creamer
- Tuna packed in water, not in oil

Look For These Food Labeling Terms, Which Describe Products That Help Reduce Fat Intake:

- Low fat = 3 grams or less per serving
- Low saturated fat = 1 gram or less per serving
- Low cholesterol = Less than 20 mg cholesterol per serving
- Low calorie = 40 calories or less per serving. Synonyms for low include “little,” “few” and “low source of.”
- Lean = Less than 10 grams fat, less than 4 grams saturated fat, and less than 95 mg cholesterol per serving and per 100 grams.
- Extra lean = Less than 5 grams fat, less than 2 grams saturated fat, and less than 95 mg cholesterol per serving and per 100 grams.

Sources:

1. Anderson, J. and L. Young. *Cholesterol and Fats*, No. 9.319. (Updated 08/04). Colorado State University Cooperative Extension Service. <http://www.ext.colostate.edu/pubs/foodnut/09319.html>
2. Duyff, Roberta Larson. *American Dietetic Association Complete Food and Nutrition Guide, 2nd Edition*. 2002.
3. National Institutes of Health: Heart, Lung, and Blood Institute. *High Blood Cholesterol: What You Need to Know*, NIH Publication No. 01-3290. (05/01). <http://www.nhlbi.nih.gov/health/public/heart/chol/wyntk.htm>
4. American Heart Association. *Checklist for Lowering Your Cholesterol*. <http://www.americanheart.org/presenter.jhtml?identifier=514>

This information has been reviewed and adapted for use in South Carolina by J. G. Hunter, HGIC Information Specialist, and K. L. Cason, Professor, State EFNEP Coordinator, Clemson University.

This information is supplied with the understanding that no discrimination is intended and no endorsement by the Clemson University Cooperative Extension Service is implied. (New 09/05).