

Cholesterol: The Good, the Bad, and the Healthy Diet

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It's in the news on a near-weekly basis. Research studies address various aspects of it. National organizations and expert panels issue recommendations on it. Many people are probably asking about it at an increasing rate. "It" is cholesterol.

How much do you know about the complexities of cholesterol? What you need to know is vital to your lifelong health: According to the American Heart Association (AHA), an estimated 70 million Americans suffer from one or more forms of cardiovascular disease (CVD). These diseases claimed 927,448 lives in the U.S. in 2002 - more than the total lives claimed by cancer, accidents, and HIV combined. And in case you view CVD as a condition exclusive to the elderly population, take note that more than 150,000 of those killed by CVD in 2002 were **under** the age of 65.

The major type of cardiovascular disease, coronary heart disease, is caused by arteriosclerosis -the thickening or hardening of the coronary arteries. Here's where cholesterol enters the picture. Findings from the massive Framingham Heart Study, which began in 1948 under the direction of the National Heart Institute (now known as the National Heart, Lung, and Blood Institute), show that blood cholesterol is a risk factor for coronary heart disease, and that the higher the cholesterol level, the greater the CHD risk.

The Basics

Cholesterol is a soft, wax-like lipid that occurs naturally in the bloodstream and in cell walls and membranes. It is a normal and important part of a healthy body, because of the essential role it plays in cell membrane, hormone, and vitamin D production, and the digestive process.

The liver produces approximately 1,000 mg of cholesterol daily from other fats, which is all the cholesterol the body needs. In other words, you don't need to consume cholesterol from dietary sources to stay healthy. (Infants are the exception: During the growth process, their bodies make new cell membranes so rapidly that they require a certain amount of dietary cholesterol.)

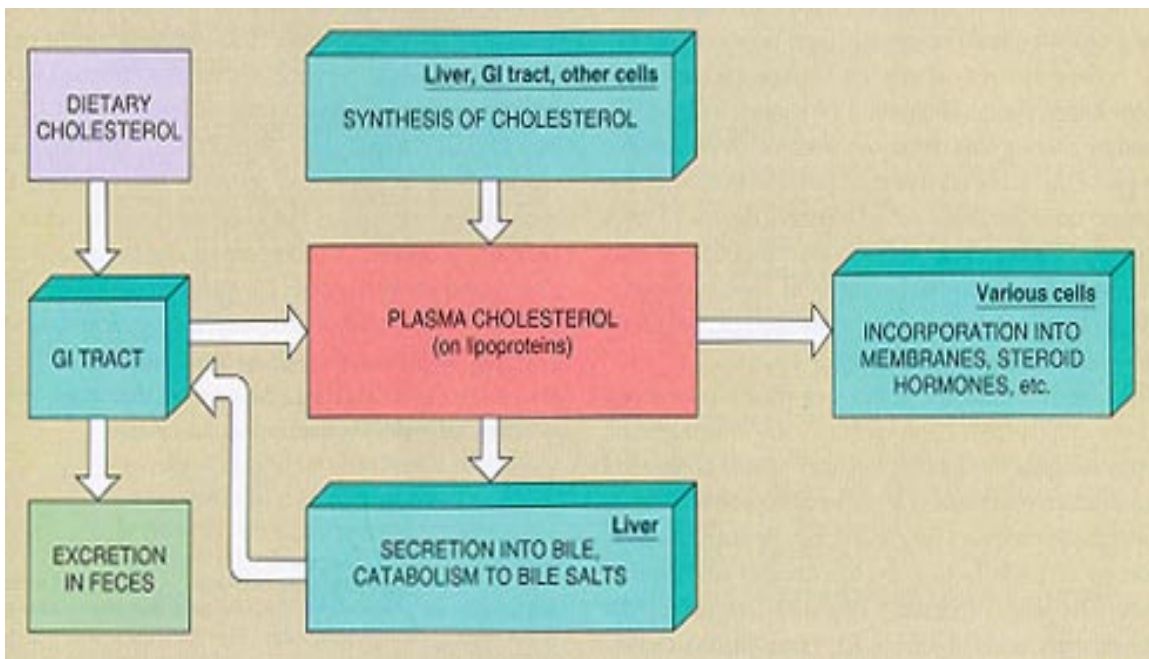
Because the body doesn't need dietary cholesterol, particularly not cholesterol with "no place to go," it means that consumption of cholesterol-laden foods can cause plaque formation/buildup and resulting in cardiovascular problems.

LDL Cholesterol (mg/dL)	
Below 100	Optimal
100 to 129	Near-optimal
130 to 159	Borderline high
160 to 189	High
190 or higher	Very high
HDL Cholesterol (mg/dL)	
40 or lower	Low
60 or higher	High
Total Cholesterol (mg/dL)	
Below 200	Desirable
200 to 239	Borderline high
240 or higher	High
Triglycerides (mg/dL)	
150 or lower	Optimal

Source: What Is Cholesterol?
 IntelliHealth – diseases and conditions
 section. www.intelhealth.com.

LDL, HDL and Triglycerides

First, a little background: Dietary fat is absorbed by the intestine and transported to the liver. The liver then converts fat into cholesterol and releases it into the bloodstream. Because cholesterol isn't water-soluble, cholesterol and triglycerides (a blood lipid) combine with proteins to form lipoproteins, which then transport cholesterol through the watery blood system.



Ex. 1 Cholesterol Metabolism

Low-density lipoprotein (LDL) and high-density lipoprotein (HDL) are the two main types of lipoproteins; they differ markedly from one another in their ratio of cholesterol and triglycerides to protein, and thus, in their effect on blood levels of cholesterol.

LDL cholesterol: LDLs carry a great deal of cholesterol, because they help transport it from the liver to the rest of the body. Too much LDL cholesterol circulating in the blood can cause buildup on the inner walls of the arteries that feed the heart and brain. Over time, LDL cholesterol can contribute to the formation of plaque - a thick, hard deposit that clogs arteries, resulting in atherosclerosis. As arteries narrow, the oxygen supply to the heart is gradually compromised, and the risk for a heart attack grows. (Preventing the oxidation of LDL may be the most powerful means of preventing cellular injury leading to atherosclerosis)

HDL cholesterol: HDLs carry relatively little cholesterol - they actually circulate in the bloodstream, helping remove excess cholesterol from blood and tissues. Specifically, evidence suggests that HDLs tend to carry cholesterol away from the arteries and back to the liver, where it is then eliminated from the body; and that HDLs also remove excess cholesterol from plaque in the arteries, resulting in a slower potential buildup of plaque.

Causes of Low HDL Cholesterol:

- Elevated triglycerides
- Overweight and obesity
- Physical inactivity
- Type 2 diabetes
- Cigarette smoking
- High carbohydrate intakes (>60% energy)
- Certain drugs (beta-blockers, anabolic steroids, progestational agents)

Triglycerides transport and store fat in the body. It's clear that high triglyceride levels aren't good for the body, and can be particularly problematic when combined with excess levels of LDL cholesterol. People with high triglycerides often have high total cholesterol, high LDL cholesterol, and low HDL cholesterol. And some lipoproteins are rich in triglycerides that also contain cholesterol.

The National Cholesterol Education Program, developed by the National Heart, Lung and Blood Institute of the National Institutes of Health, has set the "safe" total cholesterol level at 200 mg/dL. A score of 200 or higher signifies increased risk for developing heart disease; over 240 puts the patient in the high-risk category.

An LDL cholesterol level of less than 130 mg/dL is acceptable for most people; less than 100 mg/dL is ideal. The desirable level of LDL cholesterol depends on whether an individual has risk factors for coronary artery disease, or a pre-existing health condition caused by atherosclerosis or diabetes.

The AHA and the American Diabetes Association currently recommend HDL levels of at least 40 mg/dL for men and at least 50 mg/dL for women. A blood level of 60 mg/dL or above is ideal.

The HDL:LDL ratio is crucial - perhaps more so than the total cholesterol score (should be 1:2, or less, which is optimal). For example, a patient with a total cholesterol score of less than 200 mg/dL could still be at risk for developing cholesterol-related atherosclerosis - if his or her LDL level constitutes a large percentage of that score. By comparison, a patient whose total cholesterol is higher than 200 mg/dL may actually be at less risk, if his or her HDL score is high. The ideal ratio of total cholesterol to HDL cholesterol is 3:1.

FYI

$$\text{VLDL (precursor to LDL)} = \frac{\text{triglycerides}}{5}$$

$$\text{Calculated LDL} = \text{total cholesterol} - \text{HDL} - \text{VLDL}$$

Calculated LDL is most commonly requested on blood tests. It is only valid if triglycerides are less than 400. I suggest also ordering a direct LDL until triglyceride levels are established.

Getting More Specific with Cholesterol

Apolipoprotein B (apoB) is a cholesterol particle that is believed to promote heart disease by affecting how cholesterol is transported into the arteries and the tissues. ApoB is found in low density lipoprotein (LDL) and other potentially harmful cholesterol, such as very low density lipoproteins (VLDL). Conversely, apolipoprotein A (apoA-1) is found in HDL cholesterol and provides a protective effect against heart disease.

A large study known as the AMORIS (Apolipoprotein-related Mortality Risk) measured the levels of apoA-1 and apoB, as well as other lipids, in more than 175,000 men and women in Sweden. Researchers found that people at greatest risk of dying from a heart attack tended to have the highest ratios of apoB to apoA-1. In this study, these newer markers were more predictive of a heart attack than were the typical total, HDL, and LDL cholesterol and triglycerides. Men with the highest apoB/apoA-1 ratio had almost four times the risk of a fatal heart attack, compared to those with the lowest ratios; and in women the relative risk was threefold. ApoB appears to be an important marker for people with normal to low LDL cholesterol, as well as for those with diabetes and insulin resistance.

ApoB reference range: 55 – 125 mg/dL

ApoA-1 reference range: 125 – 215 mg/dL

ApoB/ApoA-1 ratio reference range: 0.30 – 0.90

Cutting Edge Cholesterol Marker

Lipoprotein can also now be broken down into two classes (both of which are LDL bad) - Apolipoprotein B and lipoprotein A. (Lipoprotein A is a hereditary marker CHD) The size and concentration of LDL particles are also health markers. Small LDL particle size and more volume of the particles contributes to increased CHD risk.

The Food Factor

The Coronary Primary Prevention Trial (1984) demonstrated that reducing total and LDL cholesterol levels significantly reduced the incidence of CHD; more recent investigations have affirmed this association. Dietary habits play a major role in determining your total blood cholesterol level, as well as the relative distribution of HDL and LDL cholesterol. Consumption of foods high in saturated fat and LDL cholesterol are a major reason for out-of-control cholesterol levels and rising heart attack rates in the United States.

All foods that contain fat have different distributions of saturated and unsaturated fats. **Saturated fat** is found primarily in foods that come from animals - red meat (particularly fatty cuts), poultry with the skin on, whole-milk dairy products (whole milk, butter, cheese, ice cream), and tropical oils (coconut, palm kernel, etc.). Consumption of saturated fat increases LDL and total cholesterol in the bloodstream.

On the other hand, **unsaturated fats** do just the opposite: They increase HDL cholesterol and reduce LDL cholesterol and triglycerides. Good sources of monounsaturated fat are canola, peanut and olive oil; olives; avocados; and most nuts. Polyunsaturated fat can be found in corn, soybean, safflower, and cottonseed oils, as well as in fish. And let's not forget omega-3 fatty acids, a type of polyunsaturated fat. Evidence suggests omega-3s, good sources of which are fatty fish, such as mackerel, salmon, sardines, or swordfish, may help prevent heart disease. That's one reason why the American Heart Association currently recommends that everyone eat at least two servings of fish on a weekly basis.

Trans fats are liquid vegetable oils that are transformed via hydrogenation into solids at room temperature. This chemical process transforms healthy vegetable oils into unhealthy fats that have been shown to raise LDL cholesterol.

In today's world of processed foods, more and more non-animal products contain hydrogenated fats/oils, a source of trans fats - which actually cause your body to make more cholesterol. Foods that contain trans fats include margarines, vegetable shortening, partially hydrogenated vegetable oil, countless fast foods (especially French fries), and most commercial baked goods (crackers, donuts, potato chips, etc.).

The good news, if there is any, regarding trans fats is that as of 2006, the Food and Drug Administration is requiring that food manufacturers list amounts of trans fats on the nutrition information labels of products.

DIETARY FATS			
Type of Fat	Main Source	State at Room Temperature	Effect on Cholesterol Levels
Monounsaturated	Olives; olive oil, canola oil, peanut oil; cashews, almonds, peanuts, and most other nuts; avocados	Liquid	Lowers LDL; raises HDL
Polyunsaturated	Corn, soybean, safflower, and cottonseed oils; fish	Liquid	Lowers LDL; raises HDL
Saturated	Whole milk, butter, cheese, and ice cream; red meat; chocolate; coconuts, coconut milk, and coconut oil	Solid	Raises both LDL and HDL
Trans	Most margarines; vegetable shortening; partially hydrogenated vegetable oil; deep-fried chips; many fast foods; most commercial baked goods	Solid or semi-solid	Raises LDL

Percentage of Specific Types of Fat in Common Oils and Fats*				
Oils	Saturated	Mono-unsaturated	Poly-unsaturated	Trans
Canola	7	58	29	0
Safflower	9	12	74	0
Sunflower	10	20	66	0
Corn	13	24	60	0
Olive	13	72	8	0
Soybean	16	44	37	0
Peanut	17	49	32	0
Palm	50	37	10	0
Coconut	87	6	2	0
Cooking Fats				
Shortening	22	29	29	18
Lard	39	44	11	1
Butter	60	26	5	5
Margarine/Spreads				
70% Soybean Oil, Stick	18	2	29	23
67% Corn & Soybean Oil Spread, Tub	16	27	44	11
48% Soybean Oil Spread, Tub	17	24	49	8
60% Sunflower, Soybean, and Canola Oil Spread, Tub	18	22	54	5
*Values expressed as percent of total fat; data are from analyses at Harvard School of Public Health Lipid Laboratory and U.S.D.A. publications.				

The Healthy Diet

Just as poor diet choices contribute to high cholesterol, dietary changes are one of the best ways to treat it. Start with consuming a diet that is high in fiber. This means increasing the amount of vegetables, fruits, nuts, seeds and whole grains in your diet.

Soluble fiber is the first choice (this type of fiber does not dissolve in water and binds cholesterol as it passes through the digestive tract). Example of soluble fiber is oat bran, pectin (in apple skin), flax seeds.

The reduction of harmful fats as described earlier is also important. In addition, consuming less sugar/sugar products, and refined carbohydrates can make a significant difference in cholesterol levels. (When a greater quantity of carbohydrates enter the body that can be used immediately for energy or stored in the form of glycogen, the excess is rapidly converted into triglycerides).

Recommended Foods

- 1) Soluble fibers: oats, brown rice, beans, fruits
Recommendation: Have some at every meal
- 2) Increase consumption of deeply colored fruits and vegetables (these are all high in antioxidants, which fight free radicals. Cholesterol molecules are highly vulnerable to free radicals)
Recommendation: try at least up to nine servings per day (raw or lightly cooked)
- 3) Consume some essential fatty acids (which have a heart-protecting effect) like coldwater fish, i.e. salmon or mackerel, several times a week
- 4) Flaxseeds are a good source of EFA's
Recommendation: sprinkle over salads use as a dressing
- 5) Olive oils increase HDL levels. Use on vegetables, sauces, or add a little to grill
- 6) Garlic and onions are good complements to most meals (lower LDL and raise HDL)
- 7) Add spices to meals i.e. cayenne, basil, rosemary, oregano (high in antioxidants)
- 8) Consume nuts, raw almonds, cashews, walnuts.
Recommendation: eat a handful 3 times a week (decrease cholesterol and triglyceride)

Foods to Avoid

- 1) Fats that are saturated. Hydrogenated, partially hydrogenated, margarine, vegetable shortening
- 2) Sugar and alcohol stimulate the liver to produce more cholesterol
- 3) Keep coffee consumption down to 1 cup per day. (Green tea is a better choice – it is rich in antioxidants). Excess coffee has been linked to high cholesterol. According to the Journal of the American College of Nutrition (Oct. 2005, p. 342-346), found daily consumption of green tea decreased serum LDL.

Nutritional Supplementation

1. Policosanol: 10 – 20 mg daily. Numerous studies show that policosanol reduces total and LDL cholesterol, lipoprotein (a) and increases the good HDL cholesterol
2. Niacin (inositol hexaniacinate): 1500 – 2500 mg daily. It is a non-flush form of niacin. It is known to reduce cholesterol levels and increase HDL
3. Red Yeast Rice extract (*monascus purpureus*): 1200 mg twice daily. This has been shown to reduce cholesterol levels and increase HDL. Must be taken with COQ10
4. Guggulipid: take up to 1500 mg per day. This herb helps to reduce cholesterol levels and increase HDL
5. Garlic: 1000 mg of garlic taken daily. It helps reduce cholesterol levels and increase HDL cholesterol levels
6. Fish Oil: 1 – 3 g. daily (EPA/DHA). Fish oils help to reduce inflammation in the arteries and lower cholesterol and triglyceride levels
7. Multivitamin/Multimineral complex: with proper antioxidant formula (Antioxidant prevent cholesterol oxidation)
8. Magnesium: 400 – 800 mg.
9. Exercise: helps raise HDL

Quote

“The desire to take medicine is perhaps the greatest feature which distinguishes man from animals”

Sir William Osler

FYI

The cholesterol-lowering drugs known as “statins” are among the most widely prescribed drugs used today. These “statin” drugs work by inhibiting the liver enzyme HMG CoA reductase, which acts to help the liver synthesize cholesterol. This same enzyme is also involved in the synthesis of CoQ10, a vital nutrient that’s required for proper heart function. A study in the Journal of Clinical Pharmacology found that the use of statin drugs reduced CoQ10 levels by an average of 40 percent after three months of use. Other studies have also found CoQ10 depletion effects. In one study, 100mg per day of supplemental CoQ10 reversed this effect. Additionally Milk Thistle seed extract (Silybum Marinum) approximately 200 mg per day will counter-act any increase in liver enzymes attributed to statin use.

Comparison Effects of Magnesium and Statins

- Statin medications inhibit the same rate-controlling enzyme of the cholesterol biosynthesis pathway that requires adequate Mg for normal deactivation, regulation and control
- Statin drugs lower LDL-C levels more sharply than do Mg supplements, but Mg more reliably acts to improve all aspects of dyslipidemia including raising HDL-C and lowering triglycerides, and has the same pleiotropic effects as statins without their adverse effects.

Quote

“A mind once stretched by a new idea, never returns to its original dimensions”

Oliver Wendell Holmes

Resources

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