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CHOLESTEROL AND HUMAN HEART

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Abstract

Cholesterol plays a vital role in human health. Researches have shown that high cholesterol is a major cause of human cardiovascular disease and stroke. Your blood cholesterol level has a lot to do with your chances of getting heart disease. The higher your blood cholesterol level, the greater your risk of developing heart disease or having a heart attack. Lately, there have been cases of some chronic diseases rising in Africa and the world at large. Some of these common chronic diseases are majorly caused by high cholesterol levels. In this article, the types of cholesterol, effects of high cholesterol on human heart, factors that can affect one's cholesterol levels and tips to lowering one's cholesterol levels were discussed. The aim of this article is to create awareness among readers worldwide regarding the impacts of cholesterol on their hearts and also correct some misconceptions about cholesterol. This article will help readers to select foods that can reduce cholesterol level and thus safeguard their hearts.

Keywords: Cholesterol, Human health, Heart, Products, Cells

Introduction

Cholesterol is a waxy, fat-like substance found in the walls of cells in all parts of the body, made by animal liver and also supplied in diet through animal products such as meats, poultry, fish and dairy products. Cholesterol is needed in the body to insulate nerves, produce certain hormones, bile acids, vitamin D and other substances. Cholesterol is part of a healthy body but can pose a serious health problem when in excess in the blood. In addition to the cholesterol the body makes, the type of food one eats can as well influence one's cholesterol levels. Foods rich in saturated fats(a type of fat found mostly in foods that come from animals) and trans-fats (found mostly in foods made with hydrogenated oils and fats such as stick margarine, crackers, and french fries) tend to increase Cholesterol level while those rich in unsaturated fats such as olive oil, nuts, seeds and avocado reduce cholesterol level. All foods of animal origin such as shrimps, eggs and red meat

contain cholesterol. Generally, foods rich in saturated fats such as grilled-cheese sandwich, margarine, potato with butter and chicken pot pie, etc. should also be limited.

As we eat, cholesterol from food is absorbed by our digestive tract. It then makes its way into our liver and can circulate through our body in the bloodstream. These fats cause your liver to make more cholesterol than it otherwise would. For some people, this added production means they go from a normal cholesterol level to one that' s unhealthy. Some tropical oils such as palm oil, palm kernel oil and coconut oil can also trigger your liver to make more cholesterol. These oils are often found in baked goods. Coronary heart disease (CHD) is the major cause of death in most developed countries. These diseases are mostly common in older adults and are caused by increase in Low Density Lipoprotein (LDL) which is as a result of the presence of saturated fatty acids that are deposited in the arteries, hardening and narrowing the arteries in a condition called Artherosclerosis. This can result to cardiovascular diseases and when it occurs in the brain, it can lead to stroke. Total blood cholesterol is the most common measurement of blood cholesterol. Cholesterol is measured in milligrams per deciliter of blood (mg/dl). Other risk factors such as age, gender, diabetes, family history, lifestyle, physical inactivity, obesity and race can affect an individual's cholesterol level.

Biosynthesis of Cholesterol

The process of cholesterol synthesis has five major steps:

1. Two molecules of Acetyl-CoA are converted to 3-hydroxy-3-methylglutaryl-CoA (HMG-CoA)

2. HMG-CoA is converted to mevalonate

3. Mevalonate is converted to the isoprene based molecule, isopentenyl pyrophosphate (IPP), with the concomitant loss of CO2

4. IPP is converted to squalene

5. Squalene is converted to cholesterol.

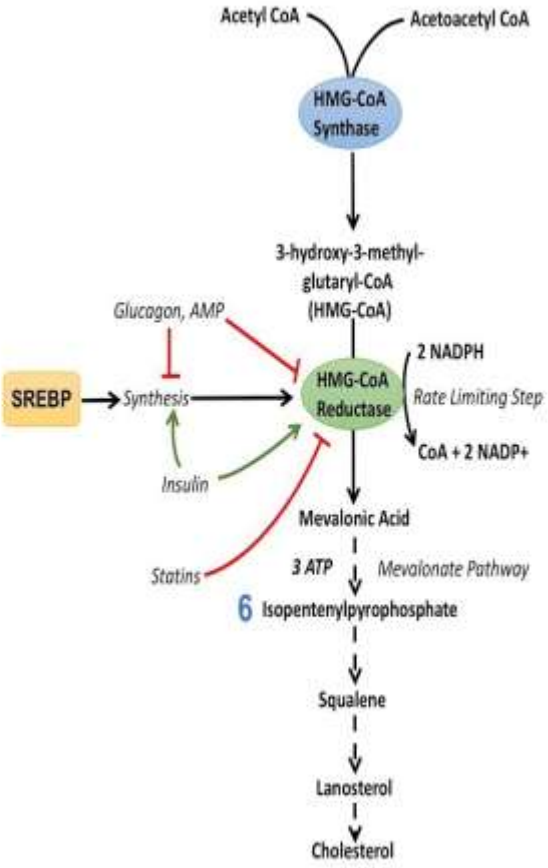

Fig. 1. Cholesterol Biosynthetic Pathway

Physical and chemical nature of cholesterol

Cholesterol is an amphipathic sterol present in higher animals. It's a waxy lipid and distributed in body tissues. Cholesterol can be toxic in the form of polar lipid (Liu J.P., 2009). Its molecular formula is C27H46O and weight is 386.65354. The melting point of cholesterol is 140 degrees centigrade and its specific gravity ranges from 1.06 to 1.07. Cholesterol is

minimally soluble in water but insoluble in blood.

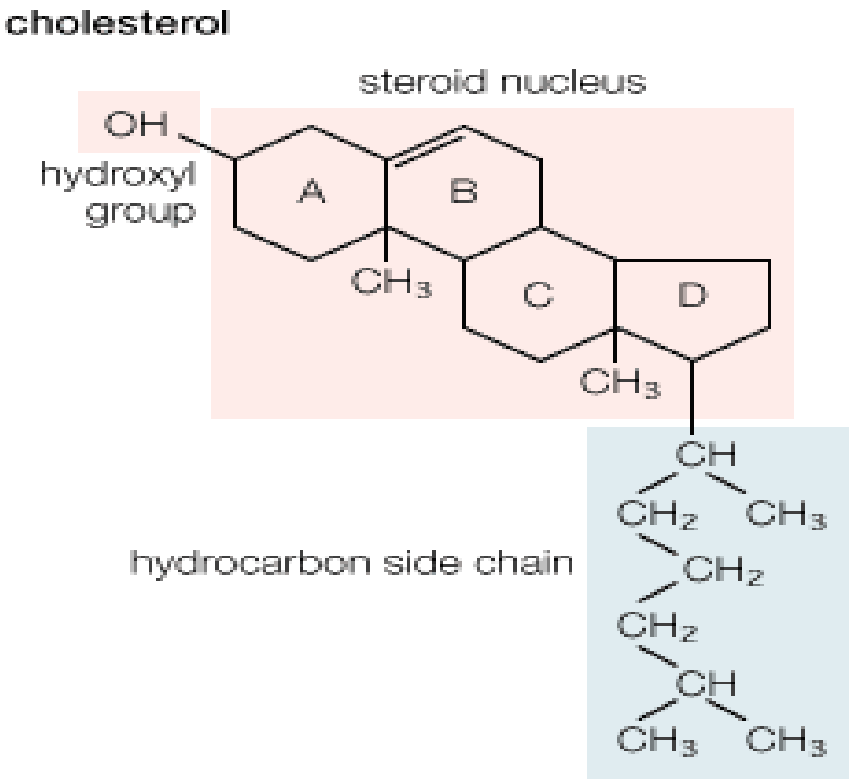

Fig. 2. Chemical Structure of Cholesterol

Types of Cholesterol

Cholesterol is circulated in the bloodstream but cannot move by itself. As with oil and water, cholesterol (which is fatty) and blood (which is watery) do not mix. So cholesterol is transported in packages called lipoproteins, which have fat (lipid) inside and protein outside. The lipids need to be attached to the proteins so they can move through the blood. There are two kinds of lipoproteins that carry cholesterol in the blood.

■ Low density lipoprotein (LDL) also known as “bad” cholesterol because it carries cholesterol to tissues, including arteries but in excess, it can start to build up in the walls of our arteries, causing them to narrow. Over time these fatty deposits (plaques) can start to restrict blood flow to the heart muscle, brain, arms, legs and vital organs. For this reason

LDL is often called " bad cholesterol" . LDLs have little protein and high levels of cholesterol. LDL is the main source of artery clogging plaque. Most of the cholesterol in the blood is the LDL form. The higher the level of LDL cholesterol in the blood, the greater your risk for heart disease.

■ High density lipoprotein (HDL) also referred to as the "good" cholesterol because it tends to carry cholesterol away from the arteries to the liver where it can be broken down and removed from the body. HDL has a lot of protein and very little cholesterol. HDL actually works to clear cholesterol from the blood. A low level of HDL cholesterol (less than 40 mg/dL) also increase the risk of heart disease.

Effects of high cholesterol on human heart.

If you have a high cholesterol level, it simply means that you have too much LDL cholesterol in your blood. High cholesterol in serum is a leading risk factor for human cardiovascular disease such as coronary heart disease and stroke - America's number one killer (Tabas, 2002). If there is too much cholesterol in the blood, some can be trapped in the walls of your arteries. Over time, this builds up and is called plaque. The plaque can narrow vessels and make them thicker, less flexible and harder, a condition called Atherosclerosis or " hardening of the arteries" , resulting to slowing down and sometimes blocking blood flow to the heart. This process can happen to blood vessels anywhere in the body, including those of the heart, which are called the coronary arteries. When Atherosclerosis affects the coronary arteries, the condition is referred to as coronary heart disease or coronary artery disease. It is the leading type of heart disease. The blood carries oxygen to the heart and if enough blood and oxygen cannot reach your heart, as a result of the coronary arteries being partly

blocked by plaque, it can lead to angina (chest pain).

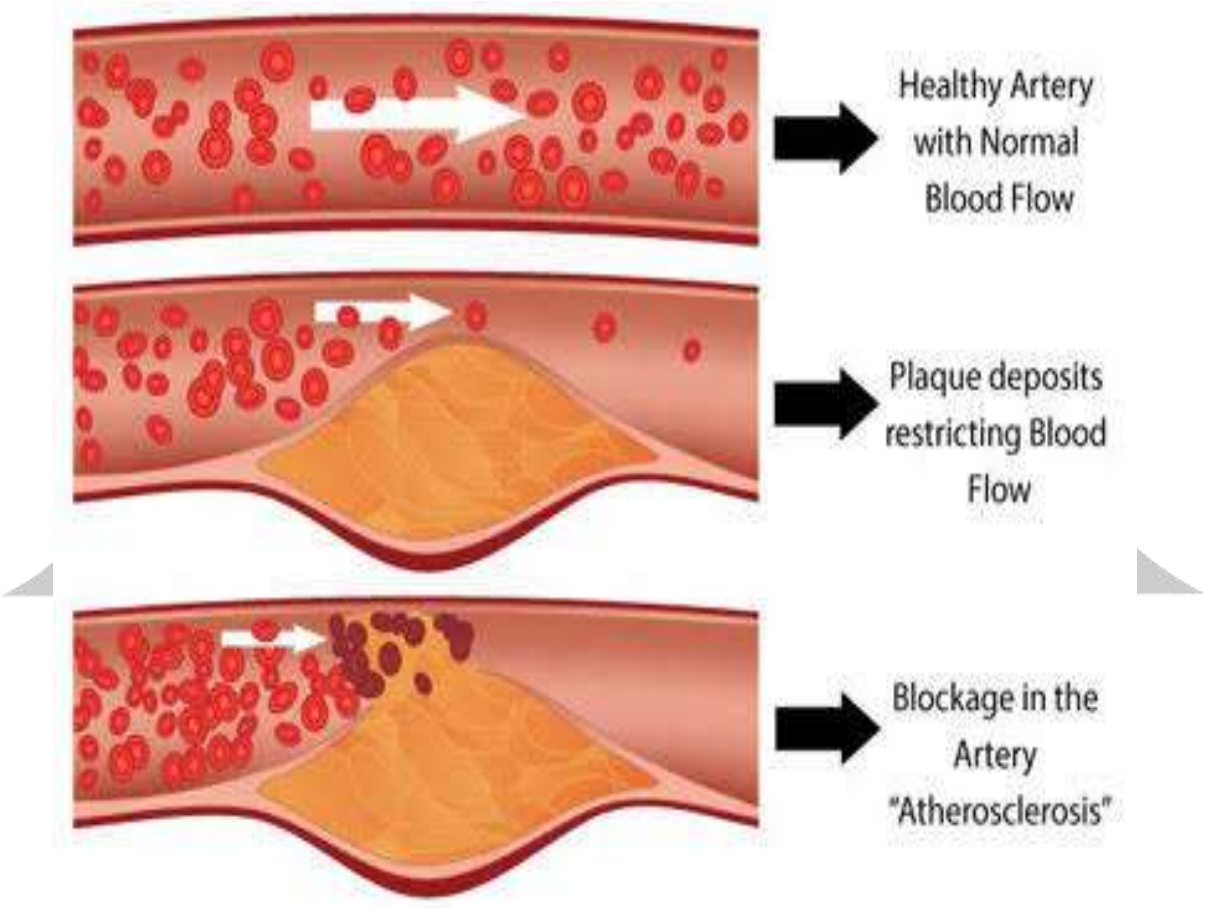

Fig. 3. Cholesterol plaques cause arteries to narrow

Some cholesterol-rich plaques are unstable, that is, they have a thin covering and can burst, releasing cholesterol and fat into the bloodstream. The release can cause a blood clot to form over the plaque, blocking blood flow through the artery resulting to a heart attack.

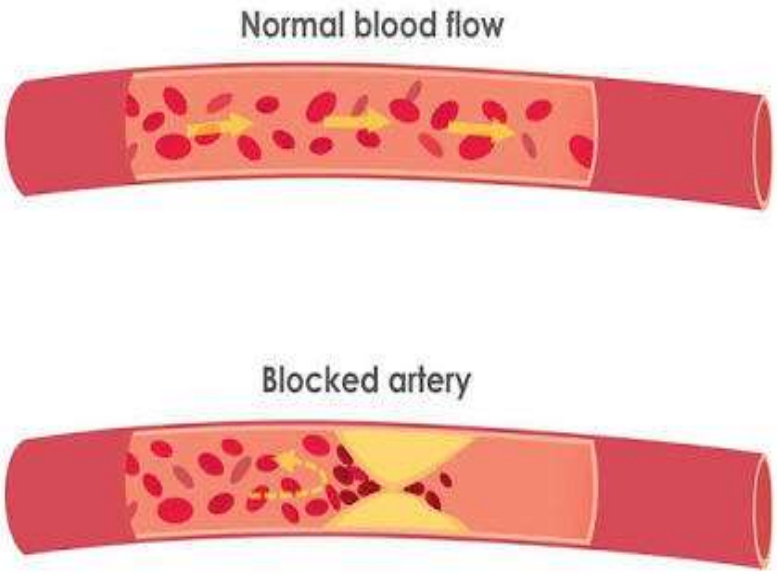

Fig. 4. Difference between a normal artery and a blocked artery.

Factors that affect cholesterol levels

Things that can affect your LDL level include:

Diet. High intake of foods containing Saturated fats and Trans-fats tends to increase LDL level.

- Saturated fats found primarily in animals is the primary cause of high blood cholesterol. Examples: to beef, lamb, pork, lard, poultry and dairy products.

- Trans-fats mostly found in foods made with hydrogenated fats and oil tend to increase LDL and lower HDL. Examples are butter, deep fried foods, baked foods such as pies, pastries, cakes and biscuits.

Physical Activity: Not being physically active is a risk factor for heart disease. A lack of physical activity can lead to weight gain, which can raise your LDL level.

Lifestyle: Cigarette smoking and alcohol consumption lower your HDL cholesterol. Since HDL helps to remove LDL from your arteries, if you have less HDL, that can contribute to you having a higher LDL level.

Age and Gender: As women and men get older, their cholesterol levels rise. Before age 50, women have lower total cholesterol levels than men of the same age but after age 50, the opposite happens. That' s because with menopause, women's LDL levels often rise.

Heredity: Your genes partly determine how much cholesterol your body makes and how fast it is removed from your body. High cholesterol can run in families. For example, familial hypercholesterolemia (FH) is an inherited form of high blood cholesterol. However, very few persons are stuck with a high cholesterol just by heredity. Furthermore, even if high cholesterol does not run in your family, other factors can as well lead to that.

Other medical conditions: Diseases such as chronic kidney disease, diabetes, obesity and HIV/AIDS can cause a higher LDL level.

Race: Certain races may have an increased risk of high blood cholesterol. For example, African Americans typically have higher HDL and LDL cholesterol levels than whites.

Knowing your cholesterol level

High blood cholesterol does not have significant symptoms, so many people can have high cholesterol and not realize it. It is important to find out what your cholesterol numbers are because lowering cholesterol levels that are too high lessens the risk for developing heart disease and reduces the chance of a heart attack. Cholesterol lowering is important for everyone– younger, middle age, and older adults. It is important for all adults age 20 and above to check their cholesterol levels at least once every 5 years.

The recommended cholesterol test is called a " lipoprotein profile." It measures

the levels of total cholesterol (which

CHOLESTEROL AND LIPOPROTEIN PROFILE CLASSIFICATION

CHOLESTEROL READING	CLASSIFICATION
Total Cholesterol (mg/dl)	
<200	Desirable
200-239	Borderline high risk
≥240	High risk
LDL Cholesterol (mg/dl)	
<100	Optimal
100-129	Near optimal
130-159	Borderline high risk
160-189	High risk
≥190	Very high risk
HDL Cholesterol (mg/dl)	
≥60	Optimal
<40	Low
Triglycerides (mg/dl)	
<150	Normal
150-199	Borderline high risk
200-499	High risk
≥500	Very high risk

includes the cholesterol in all lipoproteins), LDL, HDL, and triglycerides (blood fats). The lipoprotein profile is done after a 9- to 12-hour fast without food, liquids or pills. A small sample of blood is taken from your finger or arm. Cholesterol levels are measured as milligrams of cholesterol per deciliter of blood or mg/dL.

Fig. 5. Cholesterol and lipoprotein profile classification

Tips to lowering your cholesterol levels

1. Diet : Consume more unsaturated fats and fibre. Unsaturated fats lower total cholesterol and LDL cholesterol. There are

two types of unsaturated fats: mono- and poly-unsaturated fats. Examples of foods high in monounsaturated fats include; peanuts, walnuts, almonds, avocados, canola and olive oils. Examples of foods high in poly-unsaturated fats include; salmon, soybean, safflower and sunflower oils.

Foods that are high in dietary fibre, particularly soluble fibre, can reduce the amount of LDL cholesterol in your blood. Include fibre-containing foods in your diet by choosing vegetables, fruits, wholegrains, legumes and cereals every day.

2. Regular physical activity: Regular exercise can help lower LDL (bad) cholesterol and raise HDL (good) cholesterol levels. It also helps you lose weight. You should try to be physically active for at least 30 minutes a day.

3. Lifestyle changes: We all know that cigarettes and alcohol are not good for the heart. What you may not know is that they tend to lower HDL, which in turn raises LDL. Giving up on alcohol and smoking will definitely boost one's HDL level.

4. Medication: If the 3 tips above, did not produce the desired result, your doctor may use medications such as statins (HMG CoA reductase inhibitors) to reduce LDL and boost HDL cholesterol. Medication treatment controls but does not "cure" high blood cholesterol. Therefore, you must continue taking your medicine to keep your cholesterol level in the recommended range.

The five major types of cholesterol-lowering medicines are:

- Statins
- Bile Acid Sequestrants
- Nicotinic Acid
- Fibrates
- Ezetimibe

Common Misconceptions about Cholesterol

*** If the Nutrition Facts label shows no cholesterol, a food is " heart-healthy" :**

A food' s Nutrition Facts label can be helpful for choosing heart-healthy foods, if you know what to look for. Many foods

marketed as " low-cholesterol" have high levels of saturated or trans fats, both of which raise blood cholesterol. Even foods billed as " low-fat" may have a surprisingly high fat content.

Look for how much saturated fat, trans fat and total calories are in a serving. (Even check the serving size itself, which may be smaller than you expect.) Ingredients are listed in descending order of use, so choose products where fats and oils appear near the end of the ingredients list.

*** Thin people don't have high cholesterol:**

Overweight people are more likely to have high cholesterol but thin people can be affected as well. A person with any body type can have high cholesterol. People who don't easily gain weight are often less aware of how much saturated and trans fat they eat. Nobody can " eat anything they want" and stay heart-healthy. Have your cholesterol checked regularly regardless of your weight, physical activity and diet.

*** Only men need to worry about cholesterol:**

Both men and women tend to see higher triglyceride and cholesterol levels as they get older. Premenopausal women may have some protection from high LDL (bad) levels of cholesterol, compared to men. That is because the female hormone estrogen is highest during the childbearing years and it tends to raise HDL (good) cholesterol levels. This may help explain why premenopausal women are usually protected from developing heart disease.

On the other hand, postmenopausal women may find that, despite a heart-healthy diet and regular physical activity, their cholesterol still rises. For this reason, women nearing menopause should have their cholesterol levels checked and talk with their doctor about their risk factors and treatment options.

*** Using margarine instead of butter will help lower cholesterol:**

It's true butter has a high amount of saturated fat and some trans fat. That raises LDL (bad) cholesterol and contributes to

atherosclerosis but many hard margarines have a high amount of trans fat as well as saturated fat. That’ s still bad.

The healthiest choice is a liquid margarine, or a soft margarine in a tub. These are made with vegetable oils. They have less partially hydrogenated fat and saturated fat than solid spreads like hard stick margarine and butter. Look for margarines that say 0g trans fat on the Nutrition Facts label. Switching from butter to soft margarine is a good step.

References

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