Understanding
Cholesterol

Dr Mike Laker

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IMPORTANT
This book is intended not as a substitute for personal medical advice but as a supplement to that advice for the patient who wishes to understand more about his or her condition.

Before taking any form of treatment
YOU SHOULD ALWAYS CONSULT YOUR MEDICAL PRACTITIONER.

In particular (without limit) you should note that advances in medical science occur rapidly and some information about drugs and treatment contained in this booklet may very soon be out of date.

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Introduction

What is cholesterol and why does it matter?

Cholesterol is a type of fat (lipid) that is found in your blood and every cell of your body. It is important because high levels of cholesterol in your blood increase your risk of developing coronary heart disease (CHD) – one of the most common causes of death and disability in Europe, North America and Australia.

How common is coronary heart disease?

In the UK, about 26 per cent of deaths in men and 19 per cent of deaths in women under the age of 75 years are now caused by CHD, with another 13 to 14 per cent resulting from other related conditions affecting the heart and blood vessels.

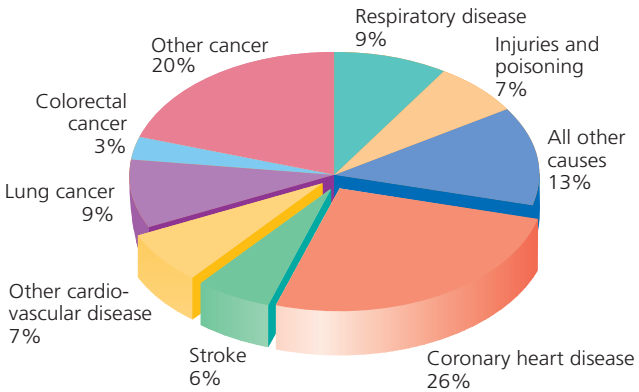
What is the pattern of coronary heart disease?

High rates of CHD occur particularly in the developed world, where lifestyle and dietary factors play important contributory roles. Within Europe, the incidence of CHD is higher in northern than in Mediterranean countries, and this difference is thought to be the result of dietary factors.

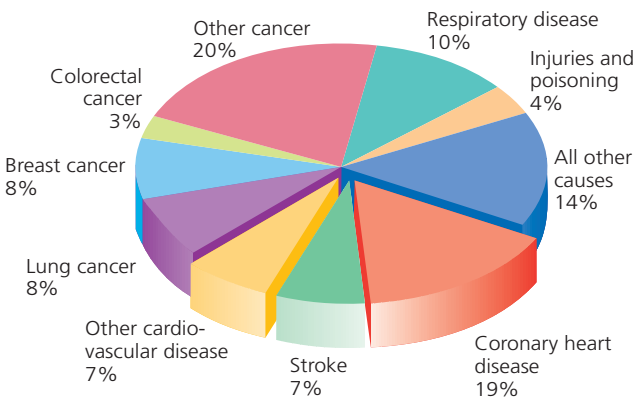
The causes of death for men and women aged under 75 years in the UK

Coronary heart disease (CHD) is a major cause of death in the UK among men and women. High levels of cholesterol in your blood increase your risk of developing CHD.

UK men



UK women



The incidence of coronary heart disease (CHD) in Europe

Within Europe there are major differences in the incidence of CHD between countries and even within one country. In southern Europe, CHD is generally less common than in northern Europe.

The incidence of CHD rose after the Second World War, but is now falling in the UK and North America. However, rates are now rising in developing countries, such as Singapore, Malaysia and eastern Europe.

The possible consequences of high cholesterol

Coronary heart disease

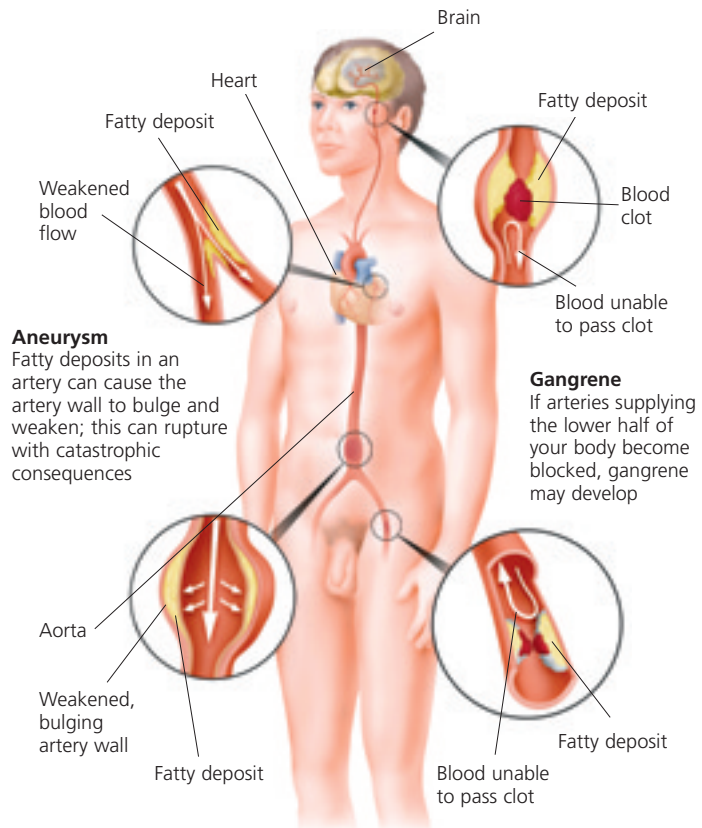
Every cell in the body needs oxygen and nutrition to

The possible clinical consequences of atherosclerosis

Diagram of the body showing the sites affected and the possible clinical consequences of atherosclerosis.

Coronary heart disease
In CHD the coronary arteries that supply the heart muscle with nutrients become narrowed and the heart muscle becomes starved of the blood that it needs

Stroke
When a blood vessel supplying vital nutrients to the brain becomes blocked the brain cells that it supplies will die



survive, and these essentials are transported around the body in the bloodstream. The blood carries high concentrations of oxygen and 'food' to the cell in the arteries, and carries the waste products of the cell's activity away from the cell in the veins. At the centre of the bloodstream is the heart, which acts as the pump and is responsible for the efficient flow of blood to and from the cells.

Too much cholesterol can lead to narrowing and blockage of arteries. CHD usually results from abnormalities that narrow the arteries supplying blood to your heart – the coronary arteries – hence the name 'coronary heart disease'. Narrowing of these arteries may restrict or completely block the supply of blood to your heart muscle, either of which can cause heart disease.

Stroke and peripheral vascular disease

This blocking of arteries can also occur in other parts of your circulation. If the blood supply to your brain is affected, a type of stroke may occur, whereas if arteries supplying the lower half of your body become blocked gangrene (blackening and death of skin and muscle) may develop (peripheral vascular disease).

Aortic aneurysm

These blockages can also weaken the main artery in your body, the aorta, causing a widening or dilatation (called an aneurysm) of its wall, which can rupture with catastrophic consequences.

Cardiovascular disease

The term 'cardiovascular disease' (CVD) includes CHD, stroke and peripheral vascular disease, together with their complications.

Atherosclerosis

The process leading to the blockage or weakening of arteries is termed 'atherosclerosis' (sometimes called arteriosclerosis). In the early stages, fatty streaks containing cholesterol develop in arterial walls and these can be found from the late teens onwards.

Fatty streaks are not normal but, in themselves, they don't cause problems and are reversible. However, fatty streaks can develop further and provoke an irreversible reaction in arterial walls. This leads to the laying down of fibrous tissue, rather like a scar, around the cholesterol deposits. These changes don't occur in everyone but they are more common with increasing age.

These changes affect relatively small areas within arteries, and are often raised above the inner surface of arteries, when they are known as plaques. Fibrous plaques are more difficult to reverse than fatty streaks. Plaques can lead to arterial narrowing, so that less blood, and possibly insufficient oxygen, reach certain parts of the body.

Other complications can also occur such as rupturing of a fibrous plaque, leading to a clot forming within the artery (thrombosis). Your artery may become completely blocked when this occurs and, if there is no other blood supply to that area of the body, at least some tissue will die (infarct), causing a heart attack (myocardial infarction), stroke or gangrene.

Features of coronary heart disease

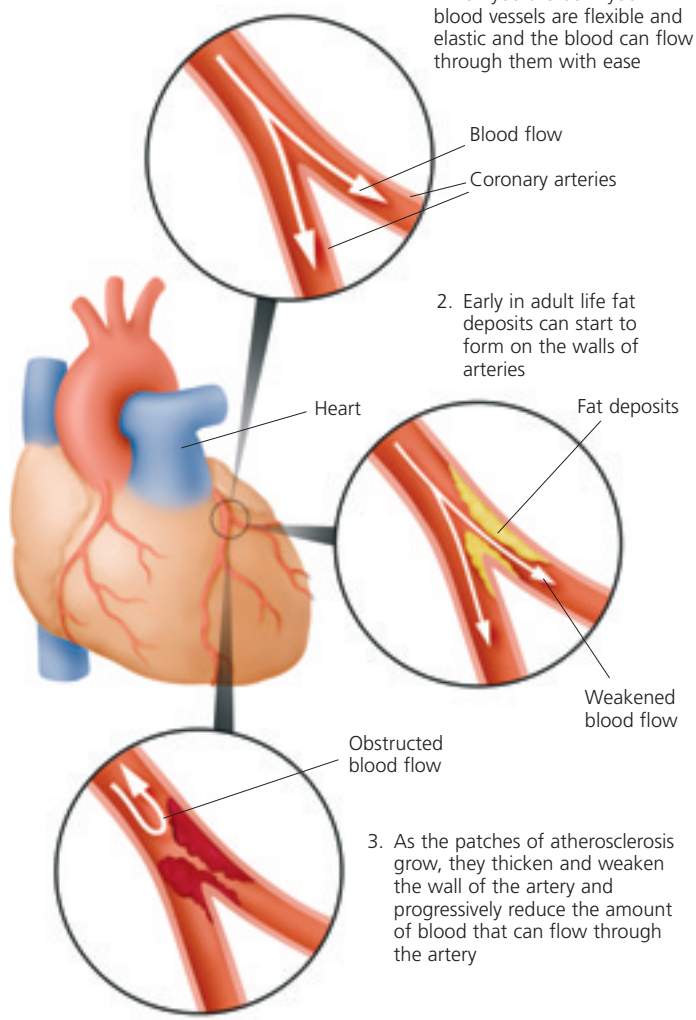
The features of CHD are caused by changes in arteries supplying blood to the heart and include the following.

Angina

Chest pain comes on with exertion and improves with

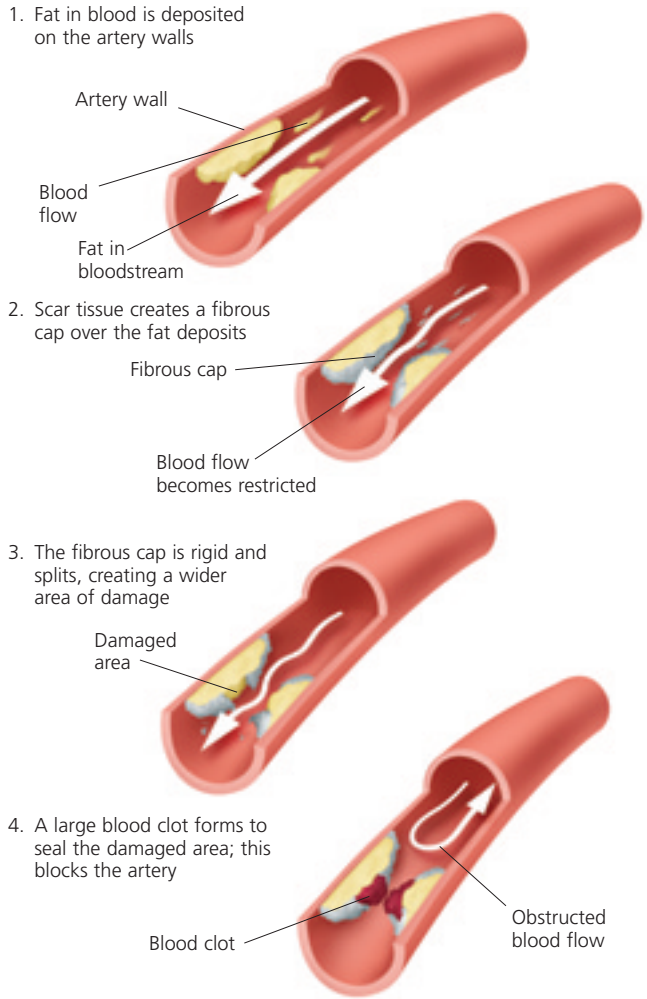
The process of atherosclerosis

Atherosclerosis, atheroma and hardening of the arteries are all the same thing – the process leading to the blockage or weakening of arteries.



How does thrombosis occur?

Thrombosis (formation of blood clots) may be triggered by damage to the lining of a blood vessel. The resulting blood clot may then obstruct the flow of blood through the vessel.



rest. Angina is caused by partial blockage of an artery so that insufficient oxygen-rich blood reaches the heart muscle when its requirements increase.

Myocardial infarction

Severe chest pain occurs when part of the heart muscle dies. This usually results from total blockage of an artery so that no blood reaches the affected tissues.

Arrhythmia

Abnormal heart rhythm can occur as a result of damage to the heart and may be detectable as palpitations.

Heart failure

This is a weakening of the pumping action of the heart, and can lead to a build-up of fluid in the body with symptoms such as breathlessness and swollen ankles.

Risk factors for coronary heart disease

Risk factors are characteristics associated with increased incidence of a disease. You can reduce the likelihood of suffering from CHD by reducing your exposure to 'modifiable' risk factors (for example, stop smoking, lose excess weight). There are some, such as age and gender, that cannot be changed (non-modifiable).

Non-modifiable risk factors (can't be changed)

Risk factors that you can't change include:

- pre-existing factors
- CHD
- age

Risk factors for coronary heart disease

Non-modifiable risk factors (can't be changed)	Modifiable risk factors (can be changed)
• Existing CHD • Age • Family history of CHD • Being male • Ethnic factors	• High blood cholesterol levels • Cigarette smoking • Hypertension • Diabetes mellitus • Obesity • Poor diet • Lack of exercise • Abnormal blood clotting

- family history of CHD
- male gender.

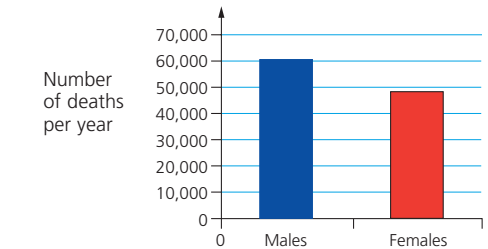
The risk of having a heart attack is much higher in people who already have CHD than in those without CHD, with the risk increasing nearly three times in those with angina and six times after a previous heart attack.

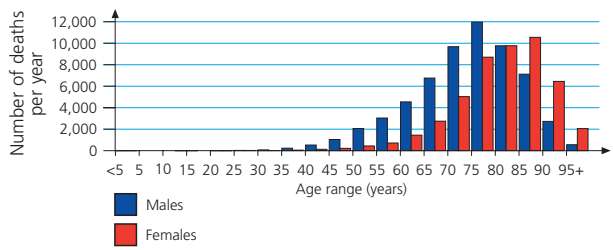
Heart attacks are more common in older than in young people and also when there is a family history of heart disease. Men are at risk of developing heart disease earlier in life than women. We cannot change our parents, biological sex or previous history, and we are not able to stop the march of time.

CHD is more common in people from the Indian subcontinent living in the UK than in white British people. This ethnic factor is not fully understood, but seems to be partly the result of an increased tendency

The incidence of CHD in men and women

Men are at a greater absolute risk of developing CHD than women. Men are also at risk of developing CHD earlier in life than women.



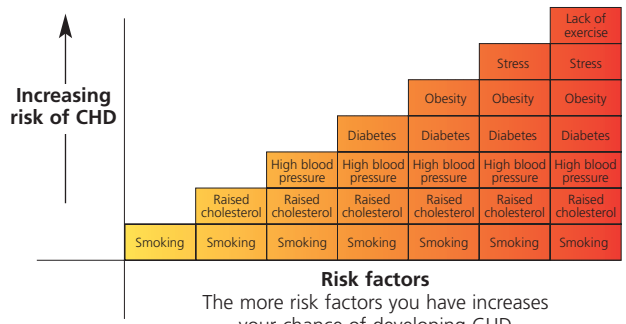


Diagrams showing the approximate incidence of heart attack in men and women absolutely and at varying ages.

to develop diabetes. CHD incidence is low in those of Chinese origin.

Although you cannot change non-modifiable risk factors, your level of risk from CHD is reduced if your modifiable risk factors are improved. Thus, if you have already had a heart attack and have a raised cholesterol level, you will probably have fewer further heart attacks and live longer if you reduce your fat intake (see page 80).

Risk factors for coronary heart disease (CHD)



Risk factors
The more risk factors you have increases your chance of developing CHD

Modifiable risk factors (can be changed)

High blood cholesterol, high blood pressure and smoking

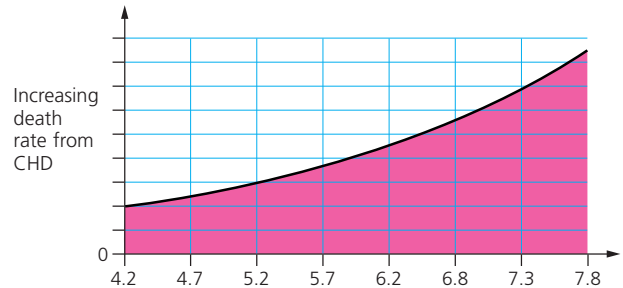
High blood cholesterol levels (hypercholesterolaemia), cigarette smoking and high blood pressure (hypertension) are all associated with an increased risk of heart disease.

If you have one of these factors, your risk of developing CHD is increased by two and a half to four times. If you have more than one risk factor, the risk multiplies. The risk for someone with hypertension who smokes cigarettes and has a high blood cholesterol level is about 30 times higher than for a non-smoker with normal blood pressure and a low cholesterol level.

This increased risk can be reduced significantly by lowering high blood pressure, reducing blood cholesterol and stopping smoking. Hypertension and smoking do not affect cholesterol levels but interact with cholesterol in damaging arteries.

Relationship between CHD risk and cholesterol

Graph showing the approximate relationship between risk of CHD/mortality and blood cholesterol levels.



Diabetes

People with both type 1 and type 2 diabetes mellitus have a higher incidence of arterial disease, and are more likely to suffer a heart attack or stroke than someone without diabetes. Careful treatment of diabetes will reduce this risk, although it is also important to address any other CHD risk factors that are present. For example, abnormal blood fat levels and hypertension are more common in people with diabetes than in the non-diabetic population (see page 45).

Weight

Obesity increases the risk of CHD, particularly if fat is deposited around the abdomen rather than the shoulders and thighs. Lifestyle factors such as a diet rich in fat and lack of exercise are also important.
A further risk factor is high blood levels of specific proteins that promote clotting – these can be detected through blood tests.

Do high blood cholesterol levels cause CHD?

The short answer is yes, for the following reasons:

- People develop CHD whereas it is not seen in other animals under natural conditions, and people have higher cholesterol levels than other animals. If cholesterol levels are artificially raised in laboratory animals they can develop atherosclerosis.
- There is an association between blood cholesterol levels and the risk of CHD. The graph on page 13 shows more cases of CHD in people whose blood cholesterol is greater than five millimoles of cholesterol per litre of blood (usually shortened to mmol/l; a millimole is a way of quantifying a very small amount of a substance).
- Some people are born with a genetic abnormality in the way that their body handles cholesterol. There are several such conditions, of which the most common is familial hypercholesterolaemia (familial means it runs in families). Patients with this condition often have blood cholesterol levels that are two or three times higher than normal. In general, they have a much greater risk of developing CHD than those without the condition (see page 43).
- Effective treatment of hypercholesterolaemia with drugs called statins reduces the incidence of CHD. This means that there are fewer heart attacks and a slower progression of the changes in the arteries. This improves life expectancy and reduces the need for an operation called a coronary artery bypass graft.

Taking all these factors together, there is little doubt that high blood cholesterol levels cause heart disease.

How do strokes occur?

The most common cause of a stroke is a thrombosis – when a blood vessel supplying the brain becomes blocked with a blood clot. The second most common cause of a stroke is a brain haemorrhage, of which there are two types; both involve a blood vessel bursting inside the head.