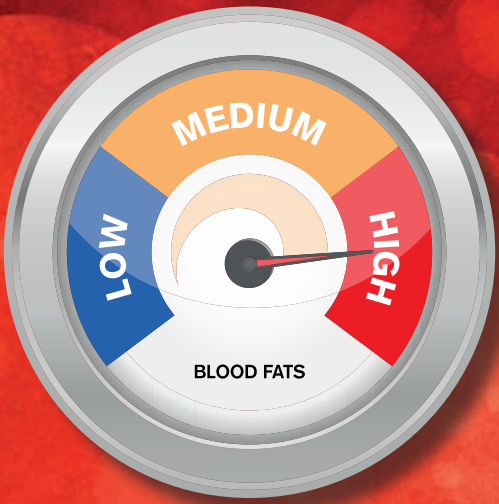
HEART UK
THE CHOLESTEROL CHARITY



Blood Fats Explained

HEART UK – The Cholesterol Charity

providing expert support, education and influence

Fats in the blood

Fats that circulate in the blood are called **lipids**. **Cholesterol** and **triglycerides** are both lipids. They have essential roles in the body. In excess they are harmful.

Cholesterol is needed to build cell walls and to make hormones and vitamin D. Some of our cholesterol comes from the food we eat; but most is made in the liver. When broken down cholesterol is used to make **bile acids** which help us to digest our food.

Triglycerides are fats which are found in our food. When we eat, any fat in our food is absorbed by our gut (intestine). It is then moved around the body, in our blood, as triglycerides. The liver also makes triglycerides. They provide the energy that is needed by our muscles and organs and help keep us warm.

What are lipoproteins?

Cholesterol and triglycerides cannot circulate loosely in the blood, so they travel in "round parcels" called **lipoproteins**. Lipoproteins contain a special mix of fats and proteins which allow them to flow freely in the blood.

The are four main lipoproteins (sometimes called apolipoproteins). They vary in size, content and how tightly they are packed (density).

Chylomicrons are the largest. They carry triglycerides from the intestine to the tissues where they are needed as a source of energy. The number of **chylomicrons** in the blood increases after a meal and then slowly decreases.

Very low density lipoproteins (VLDL) transport mainly triglycerides made by the liver to where they are either used to fuel our muscles or stored for later use.

Low density lipoproteins (LDL) carry most of the cholesterol in our body from the liver to the cells that need it. The cholesterol that is carried on LDLs is called **LDL-cholesterol** or **bad cholesterol**.

High density lipoprotein (HDL) plays a vital role in taking excess cholesterol, away from cells and artery walls, back to the liver for disposal and recycling. Having healthy HDL levels means less cholesterol will build up in the artery wall. The cholesterol that is carried on HDLs is called **HDL-cholesterol** or **good cholesterol**.

We also refer to **intermediate density lipoprotein (IDL)** in this booklet. These are cholesterol and triglyceride rich particles.

Unlike chylomicrons the levels of **VLDL**, **LDL**, **HDL**, **IDL** and cholesterol change very little after a meal. The levels of these lipoproteins usually reflect longer term diet and lifestyle habits.

Apolipoprotein B is the key protein for chylomicrons, VLDL and LDL.

Apolipoprotein A is the key protein for HDL.

Lipoprotein (a) or Lp(a) is a large "sticky" lipoprotein particle made in the liver. The amount of **Lp(a)** in our blood is largely decided by our genetic makeup. Doctors are interested in Lp(a) because high levels increase the risk of heart and circulatory disease.

Words in **red** are featured in our glossary on page 14.

At risk of cardiovascular disease?

Cardiovascular disease (CVD) is the medical name for circulatory diseases such as **coronary heart disease (CHD)**, stroke, mini stroke (transient ischaemic attack or TIA), **angina** and **peripheral vascular disease (PVD)**. You are more likely to develop **CVD** the more risk factors you have.

There are two types of risk factors:

Fixed risk factors – these include your age, family history and being a man. You cannot do anything to change these risk factors.

Risk factors you can change:

- Unhealthy cholesterol (and triglyceride) levels in the blood
- Smoking
- High blood pressure
- Type 2 diabetes
- A large waistline

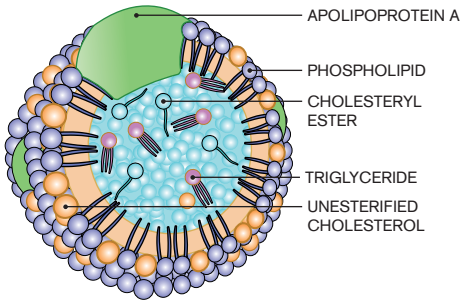
There is a lot you and your doctor can do to lower your risk from these.

Stopping smoking can make a big difference to both your short and long term health. People who smoke are more likely to have a stroke, heart attack or breathing problems when compared to someone with the same risk factors who does not smoke. On average smokers die 15 years earlier than non-smokers. Toxins in cigarette smoke put a bigger strain on the heart - making it beat faster, increasing the risk of blood clots and damaging the inside of your blood vessels (arteries). Smoking also lowers your protective HDL-cholesterol. You can cut your risk of CHD in half, in just one year, by stopping smoking.

Blood pressure is a measure of the resistance to the flow of blood around your body. It is measured in millimetres of mercury (mmHg). Your doctor or nurse will measure both your systolic (upper figure) and diastolic (lower figure) blood pressure. About a third of adults have **high blood pressure**. If untreated it increases the risk of heart attack and stroke. High blood pressure is usually diagnosed when a number of readings are made above 140/90mmHg.

Type 2 diabetes can affect your heart health. This is because it can affect the quantity and quality of fats (cholesterol and triglycerides) in your blood. Usually people with **type 2 diabetes** have increased triglyceride levels (due to an increase in VLDLs), low levels of HDL and smaller sized LDL particles. This pattern increases the risk of developing heart disease.

A large waistline is a sign that you are storing fat inside and around your vital organs. Doctors know this fat can increase your risk of diabetes and heart problems. We talk more about this on page 5.



The HDL lipoprotein

Cholesterol and triglycerides have essential roles in the body.
Lipoproteins - like LDL and HDL - carry cholesterol and triglycerides around in the blood

Having a healthy diet, not smoking, being active and keeping your waistline in check are good for everyone and can help you keep healthy.

How your heart works

The heart

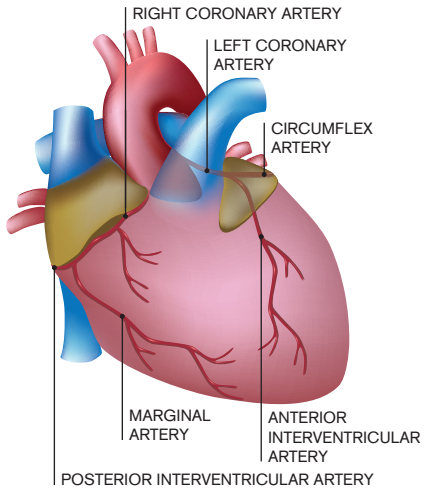
The heart, blood vessels and blood make up our circulatory system. The heart is a muscle which never stops beating, it pumps blood around the body. The left side pumps oxygen and nutrient rich blood to the brain, muscles, organs, and every cell in the body. The right side of the heart is slightly smaller and returns blood to the lungs to be topped up with oxygen.

The heart has its own blood supply which comes from the coronary arteries. These divide many times to provide oxygen and nutrients to every part of the heart muscle to help keep it healthy and pumping normally.

Heart disease

Problems occur when any one of these arteries become narrowed due to the slow build-up of fatty material (called **plaque** or **atheroma**). This process - called **atherosclerosis** - causes **coronary heart disease (CHD)**. Sometimes an artery can become so narrow it cannot deliver enough blood. This results in warning symptoms such as chest pain – we call this **stable angina**.

When these fatty deposits become very large or extended they may burst. Just like when you graze your knee, a blood clot and then scarring forms over the damaged area. Over time this damage may partly or completely block the artery. When this happens it is called **acute coronary syndrome** (ACS), **unstable angina** or **heart attack**. A heart attack is sometimes referred to as a **myocardial infarction** or **MI**.



The heart and the coronary arteries

What is atherosclerosis?

(ather-o-scler-o-sis)

Atheroslcerosis is a very slow process, happening over many years. It can start very early in life and results in the build up of fatty material in the linings of your blood vessels.

These fatty deposits start when the blood vessel lining becomes damaged. This makes it easier for cholesterol (carried on lipoproteins like LDL) to stick on and build up more rapidly. HDL lipoproteins can remove cholesterol from these deposits.

Reducing your LDL cholesterol, increasing your HDL cholesterol and reducing other risk factors can help slow down the process of atherosclerosis.

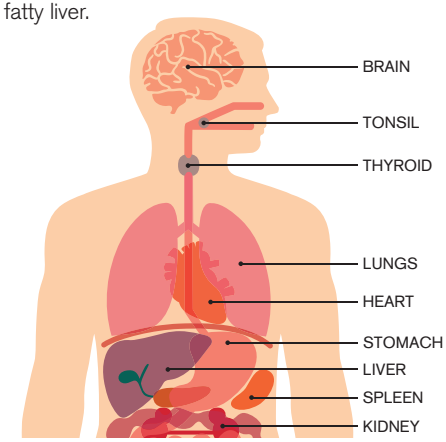
Why your liver is important

The liver plays a central role in controlling the amount of fat in your blood.

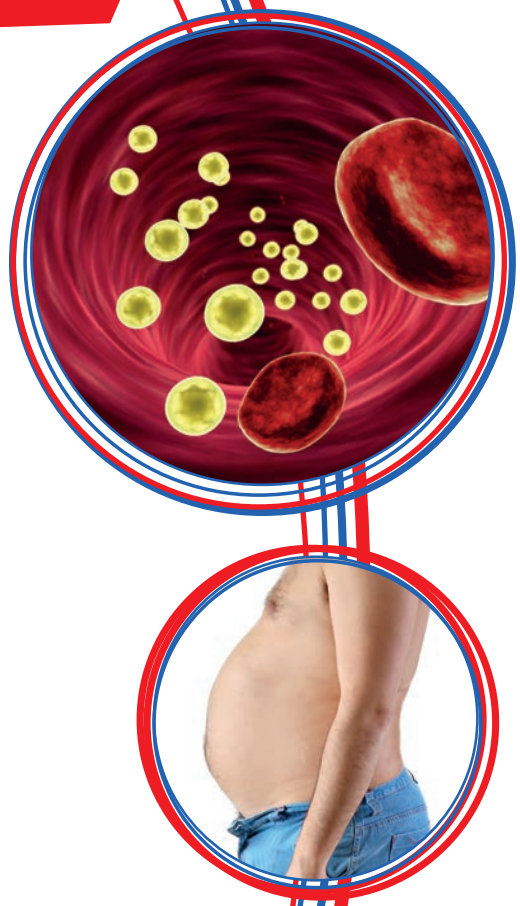
Liver cells have special “hooks” on them that can remove LDL cholesterol from the blood. These are called LDL receptors.

Most of our cholesterol is made in the liver. The liver is also the major site for changing excess sugars, proteins and alcohol into fatty acids and triglycerides, which are then either used for energy or stored for later.

Any fat that builds up in the liver, can damage it. **Fatty liver** can be caused by drinking too much alcohol or by eating too much. It is common in people who carry too much fat around their waistline. If you have too much fat in your liver it won’t work as well as it should - a sign could be too much cholesterol, triglycerides or sugar in your blood. Most people won’t know they have a fatty liver.



Major organs in the body



Heart facts

- **Your coronary arteries supply your heart muscle with oxygen and nutrients**
- **A heart attack happens when one of these arteries become blocked**

- **Your liver controls the amount and type of fat in your blood**
- **Fatty liver happens when your body stores fat inside your liver**

Lipid clinics

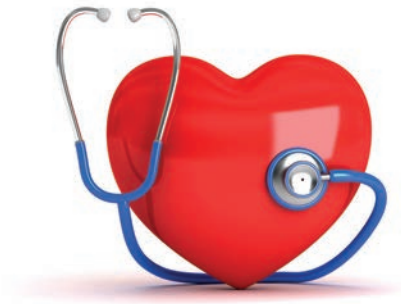
Lipid clinics provide specialist help and advice to those who have raised blood lipids such as cholesterol and triglycerides and who may have, or be at high risk of developing, CVD.

You may be referred to a lipid clinic if:

- Your GP thinks you may have a blood fat condition that is passed down through families
- You have too much cholesterol or triglyceride in your blood
- You are having problems when taking a statin or another cholesterol lowering medicine
- If you need a specialist test

Doctors working in lipid clinics have a variety of names such as **lipidologist**, **chemical pathologist** or **clinical biochemist**, or they may be a **cardiologist**, **diabetologist** or **endocrinologist**. Their job is to find people with blood fat conditions and to decide on the right treatments.

Lipid specialists may work with **dietitians** and **lipid nurses**, and alongside your **GP**, to help give you the support you need to manage your condition.



Checking your blood fat levels

Your doctor can check the amount of cholesterol and triglycerides in your blood. They are measured in millimoles per litre (mmol/L). Sometimes, but not always, you will be asked to fast overnight before a test. Lipid clinics can also carry out other more specialised tests to help diagnose and manage your condition.

What is a healthy level of cholesterol?

Healthy adults should aim for a:

- Total cholesterol below 5mmol/L
- Non-HDL cholesterol below 4mmol/L
- HDL cholesterol above 1mmol/L (man) or above 1.2mmol/L in a woman

What is a healthy level of triglycerides?

Healthy adults should aim for a:

- Fasting triglyceride below 1.7mmol/L
- Non-fasting triglyceride below 2.3mmmol/L

If you have existing heart disease, or are at high risk of getting it, your doctor may advise you to aim for lower levels of cholesterol and triglycerides.

It is best to discuss this with your doctor when they review your treatment. Any target levels your doctor suggests will depend on your diagnosis, your age and any other risk factors you have. Talk to your doctor about the levels you should aim for.

Unhealthy patterns of cholesterol and triglycerides in the blood are often referred to as **dyslipidaemia.**

Lipid clinics

Lipid clinics see people who are referred for specialist help and advice by their GP. Lipid clinic doctors and nurses are experts in treating blood fat conditions.

How blood fats cause heart disease

Having enough cholesterol and triglycerides is vital for health. But sometimes we have too much cholesterol, triglycerides, and the lipoproteins that carry them, in our blood. High cholesterol and/or triglycerides can run in families. What you eat and drink, your weight, how active you are and if you smoke can also have an effect.

Your doctor will be concerned if, in your blood:

- You have too much cholesterol or apolipoprotein B
- You have too little HDL-cholesterol
- Your triglyceride levels are high
- You have high levels of Lp(a)

If in addition:

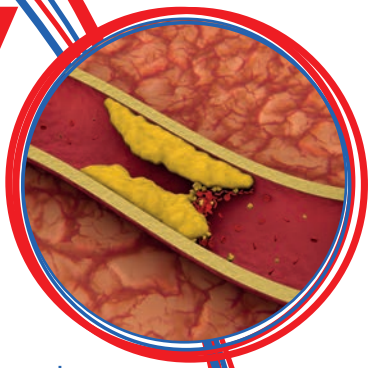
- You have other risk factors (see page 3)

Too much cholesterol

On page 2 we talked about how cholesterol travels around the blood inside lipoproteins called LDL, HDL, VLDL, IDL and chylomicrons. Up to now most doctors have referred to LDL cholesterol as “bad” cholesterol. But experts now say it is not that simple. They now believe it is the sum of all the cholesterol that is carried on LDL, VLDL, IDL and chylomicrons that is damaging. We usually refer to this as non-HDL cholesterol.

LDL + VLDL + IDL + Chylomicrons = non HDL cholesterol = damaging cholesterol

All the lipoproteins that make up non HDL-cholesterol have the same characteristic protein - apolipoprotein B (apoB). So lipid experts will sometimes find it helpful to measure the amount of apoB in the blood.



High triglycerides and low HDL-cholesterol

People who have too much triglyceride in the blood often have too little HDL-cholesterol too. This can run in families but usually it happens in those who are obese, have type 2 diabetes, or who drink too much alcohol. High triglycerides and low HDL cholesterol can increase the risk of heart disease. Very high triglycerides may cause pancreatitis, a very painful and serious problem of the pancreas gland in the abdomen.

Inherited lipid conditions

Here we describe some of the main inherited blood fat conditions.

Familial Hypercholesterolaemia (FH), usually referred to as FH, results from inheriting an altered gene that causes very high blood cholesterol. "**Familial**" means that it runs in families. "**Hypercholesterolaemia**" means high blood cholesterol. The type of cholesterol that is increased in FH is LDL-cholesterol.

As many as 1 in 250 people may have FH. It increases the risk of early **CVD** if not found and treated. A pattern of early death from heart disease in close family members is a sign that FH might affect your family.

Total cholesterol levels in adults are normally above 7.5mmol/L and LDL-cholesterol above 5 mmol/L, with normal triglyceride levels. Some people will have physical signs of FH and these can help doctors to make a diagnosis. Tendon xanthoma and corneal arcus (before the age of 45) are definite signs of FH.

Almost all people with FH will have **heterozygous FH**, inheriting a single gene alteration from one parent. If you have this form of FH then each of your children have a 1 in 2 chance of inheriting FH.

Homozygous FH is rare (up to 1 in 250,000) and happens when a baby inherits a gene alteration from both parents, resulting in extremely high levels of cholesterol.

Some people with FH have too much Lp(a) in their blood and this should be checked. If yours is high, your doctor will want to discuss how best to manage this.

Familial Combined Hyperlipidaemia (FCH) is an inherited condition that affects about 1 in 100 people. It happens when the body makes too much VLDL and apolipoprotein B. People with FCH usually have higher than normal levels of cholesterol and triglycerides in their blood.

This condition is not as well understood as FH, but is also associated with early **CVD**. Raised cholesterol and triglyceride levels will not be present in childhood, and may not appear until people are in their twenties, thirties or even older. FCH is more likely to present early in those adults who are overweight or have an unhealthy diet and lifestyle. Checking apolipoprotein B levels can be useful when making a diagnosis.

Polygenic Hyperlipidaemia is the name given to conditions caused by inheriting a mixture of "common LDL-cholesterol" and/or "triglyceride" raising genes. On their own each of these genes would have little effect on blood fats but together they can cause big increases. The term "**polygenic**" means the influence of many genes. **Polygenic hypercholesterolaemia** is quite common and can be made worse, or better, by what you eat and drink and how active you are.

Familial Chylomicronaemia Syndrome (FCS) also known as **lipoprotein lipase deficiency (LPLD)** is a very rare genetic problem that affects about one person in a million people.

People with **FCS** have very high triglyceride levels. This is because they lack **lipase**, the enzyme that clears triglycerides from the blood after a meal.

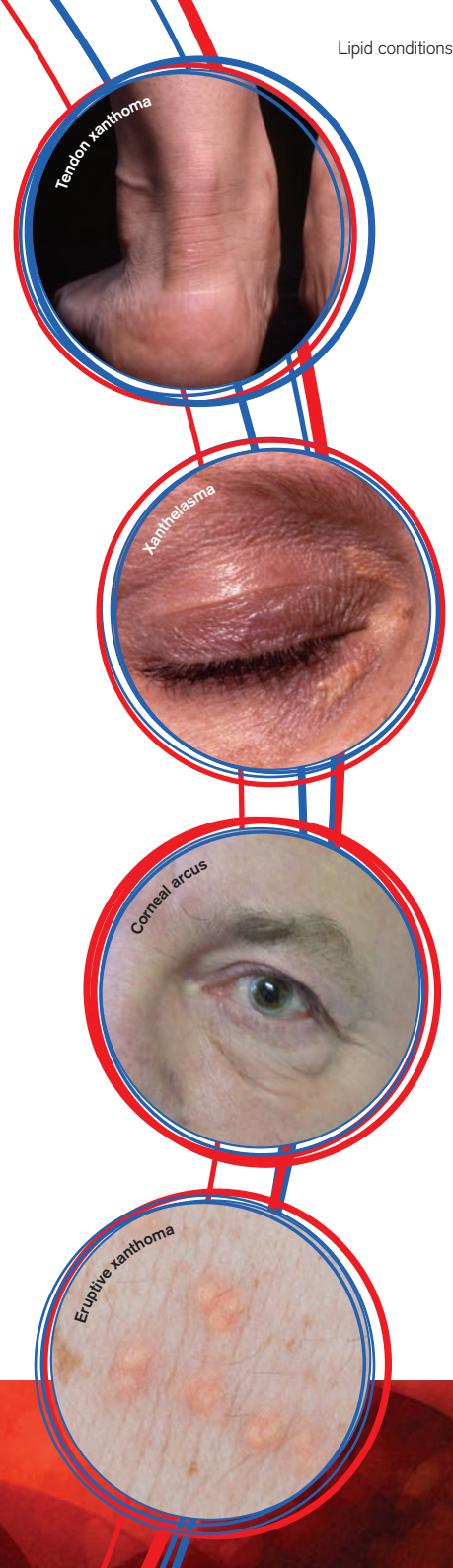
From the time they are born, people with FCS will have very high triglyceride levels - but these may not be spotted until they are much older. Signs include recurrent abdominal pain, fat-filled spots known as 'eruptive xanthoma', and attacks of acute pancreatitis. The main treatment is diet, which must be as low in fat as possible.

Type 3 Hyperlipidaemia is also known as **dysbetalipoproteinaemia** or **remnant particle hyperlipidaemia.**

This condition is thought to occur in 1 in 5000 people, with a 1 in 4 chance of inheriting it from a parent. Both **cholesterol** and **triglyceride** levels are high. Some people with Type 3 have physical signs such as yellow deposits (xanthoma) which appear in the creases of the hand (palmar creases) and at the elbows and knees (eruptive xanthoma).

The pattern of **lipoproteins** for Type 3 is very different to other inherited lipid conditions and is key to making a diagnosis. There are higher levels of VLDL and IDL particles, which appear in the blood after meals and which contain both **cholesterol** and **triglyceride**. LDL-cholesterol and apolipoprotein B levels are often low.

Unless treated, people with type 3 are at high risk of **CHD** and **peripheral vascular disease (PVD). PVD** is the name given to changes in the major arteries supplying the legs, arms and major organs. It can result in a poor supply of blood to the legs. One of the main symptoms of PVD is pain in the legs when walking.



Checking for lipid conditions

Lipid conditions are usually diagnosed by a combination of:

- **Measuring blood fats and other special tests**
- **Looking for telltale signs on the body**
- **Taking a family history**
- **In some cases, doing a genetic test**

Diet and lifestyle

Everyone can benefit from eating well and having a healthy lifestyle. And for people with raised cholesterol and triglycerides this is very important.

Being physically active

Being active is a great way to exercise your heart, boost your levels of HDL-cholesterol, manage your weight and reduce your waist circumference. It also helps you look and feel great. Adults should aim for at least 150 minutes a week. The exercise you choose should get you slightly out of breath. If you haven't exercised for some time check with your doctor first.

Eating well

A heart-healthy diet is rich in fruit and vegetables, whole grains, pulses, nuts, seeds, fish and vegetable proteins such as soya. Eating well is an important part of your treatment. It can help you to control blood cholesterol and triglyceride levels.

Simple fat swaps

Dietary fats fall into two main groups: **saturated** and **unsaturated**. Most **saturated fat** is solid at room temperature and found mainly in foods from animals, such as meat, dairy products, butter, ghee and lard. It is also found in hard margarines, coconut and palm oils and in processed foods such as pies, pastries, cakes and puddings.

We all need a little saturated fat, but too much increases blood cholesterol levels, so an important part of a heart-healthy diet is to limit saturated fat. Instead choose more unsaturated fats (nuts and seeds; vegetable, olive and nut oils; soft vegetable spreads, oily fish, avocado).

Certain foods can actually lower cholesterol if eaten regularly. These include:

- Foods rich in soluble fibre (oats, barley, beans, peas, lentils, vegetables, fruits)
- Nuts (choose unsalted varieties)
- Plant proteins such as soya and quorn
- Dairy foods fortified with plant sterols and stanols*

Certain foods can raise triglycerides and these should be either limited or avoided by people with raised triglycerides:

- Sugar, foods containing refined, added or "free sugars"
- Alcohol

See the HEART UK website for more information on how to lower cholesterol and triglycerides. Why not try HEART UK's **Ultimate Cholesterol Lowering Plan (UCLP©)**, our **Low Fat Eating Plan** or call us for a copy of our popular **Diet Guide**.

What about alcohol?

It is best to ask your doctor about drinking alcohol. If they advise it is ok then try to limit alcohol to no more than 14 units spread across the week with several alcohol free days in between. If you are pregnant you should not drink alcohol at all.

*Foods fortified with plant sterols and stanols are not suitable during pregnancy or when breastfeeding. Children with an inherited blood fat condition may benefit from these foods but check with your doctor or dietitian first.

Five important guidelines for a heart-friendly diet

1. Swap foods high in saturated fats for those rich in unsaturated fats
2. Eat more whole grains, nuts, pulses, vegetables and fruit every day
3. Choose meat free meals (fish, nuts, pulses, soya, quorn) more often
4. Limit food and drinks high in sugar or alcohol
5. Cook more meals from scratch, and limit takeaway and processed foods

Medical treatments

Most of the blood fat conditions we talk about in this booklet are treated with one or more of the following medicines.

Statins work by slowing down and reducing the amount of cholesterol our bodies make.

For most people statins are safe and well tolerated - but a few people may experience general muscle aches which should be reported to your doctor. Statins should not be used if you are planning to have a baby, are pregnant or breastfeeding.

Fibrates may be useful when triglycerides are raised. Used alone fibrates can raise LDL-cholesterol levels. For this reason they are usually given alongside a statin. You are most likely to be prescribed a fibrate if you have triglyceride levels above 10mmol/L. They are well tolerated but should not be used during pregnancy or by individuals with significant liver or kidney disease.

Resins (bile acid sequestrants) come as powder, granules or tablets. The powder and granules are taken by mixing with water, fizzy drinks, fruit juice or yoghurt. They work by preventing the re-absorption of **bile acids** in the intestine, which means that more cholesterol is used up in replacing them. Resins are safe for children and pregnant women because they are not absorbed into the body. Resins can cause wind and constipation which can be a problem for some people.

Ezetimibe: Ezetimibe blocks the absorption of cholesterol and bile acids in the intestines. It is often given to help people who are already taking a statin but who need a little extra help to reach their cholesterol targets. Ezetimibe may also be prescribed for those unable to tolerate statin therapy.

PCSK9 inhibitors are very good at lowering cholesterol but they are not yet widely available. They are given by injection once or twice a month and appear to be well tolerated. Talk to your lipid specialist about whether they may be suitable for you.

Omega 3 fish oils (1-4g daily) reduce plasma triglyceride levels in some lipid conditions. They work by reducing VLDL production in the liver. To get the equivalent of 1g of fish oil per day you would need to eat three good portions of oily fish per week. Fish oils are prescribed less often these days and are thought to be less effective than a fibrate.

Lipoprotein apheresis: Lipoprotein or LDL apheresis is not a drug, it is a treatment similar to kidney dialysis. A person is connected to a machine that removes LDL-cholesterol, Lp(a) and triglycerides from their blood. The 'cleaned' blood is then returned to them. The process takes about 3 hours and has to be repeated at weekly or fortnightly intervals. Only a few people will need this treatment - it is costly to do and so is only available in a few specialised centres. It may be considered when people still have a high cholesterol level despite taking all available or tolerated medicines and a healthy diet.

Statins and Ezetimibe can be prescribed by your GP but the other medicines are usually only prescribed by specialists. From time to time new medicines and treatments are developed for people with raised blood fats.

Guide to medical terms

Acute coronary syndrome (ACS): The term for any condition brought on by sudden reduced blood flow to the heart.

Angina: Usually severe pain in the chest, sometimes spreading to the shoulders, arms, and neck, caused by too little blood getting to the heart muscle.

Apolipoprotein - see lipoprotein.

Atheroma (plaque): Fatty deposits inside the artery wall.

Atherosclerosis: The process by which arteries become narrowed over many years.

Bile acids: Used in fat digestion, these are made from cholesterol.

Cholesterol: An essential building block, needed for growth and good health.

CHD – Coronary heart disease: When one or more of the coronary arteries become narrowed or blocked.

Chylomicrons, VLDL, LDL, HDL, IDL: Types of lipoproteins that carry fat around in the blood.

CVD – Cardiovascular disease: A collective term for circulatory diseases such as coronary heart disease (CHD), stroke, mini stroke and peripheral vascular disease (PVD).

Dyslipidaemia: A general term for an altered and unhealthy pattern of blood fats.

Familial: Used to describe conditions that run in families.

Fatty liver: Fat becomes stuck in the liver. It can stop the liver working properly.

Heterozygous: When someone has only one copy of a disease-causing altered gene - coming from either their mum or their dad.

HDL-cholesterol: Good cholesterol, it takes excess cholesterol back to the liver where is can be disposed of.

Homozygous: When someone has two copies of a disease-causing altered gene - one from each of their parents.

Hypercholesterolaemia: High blood cholesterol.

Hyperlipidaemia: High levels of cholesterol and triglycerides in the blood.

Hypertriglyceridaemia: High levels of triglycerides in the blood.

LDL-cholesterol: Most cholesterol in the blood is in this form. It is also referred to as bad cholesterol.

Lipids: The name for fats in the blood.

Lipoproteins (apolipoproteins): The fat and protein parcels that carry fats around the body.

Lp(a): A large "sticky" lipoprotein; high levels increase the risk of heart and circulatory disease.

MI – Myocardial Infarction: A heart attack.

PVD: Peripheral vascular disease – partial or complete blockage in the main arteries that supply the legs, arms and major organs.

Polygenic: The small effects of many genes.

Saturated fat: The type of fat that can increase your cholesterol, it is found mainly in animal foods.

Triglycerides: Another name for fat, it is found in foods and in the blood. Triglycerides are made from three fatty acids and one glycerol molecule joined together.

Unsaturated fat: The type of fat that does not increase your cholesterol level. Most of the fat we eat should be unsaturated.

HEART UK – The Cholesterol Charity

We hope this booklet has helped to explain what blood fats are, how they move around our bodies, why too much can be harmful and how healthy living and taking any medicines or treatments your doctor prescribes can help.

HEART UK is the only charity in the UK dedicated to providing expert support, guidance and education for people with blood fat conditions and their relatives.

Call/email our Cholesterol Helpline

0345 450 5988/ask@heartuk.org.uk

A free and confidential service offering information on cholesterol and an opportunity to talk things over with qualified nurses and dietitians.

Donate

Please help to fund our work. All our materials are free, but you can make a donation towards our work via our website.

Raise funds

There are many ways you can raise funds for HEART UK. Visit our website for more information.

National Cholesterol Month

October is National Cholesterol Month – a whole month devoted to raising awareness and funds for HEART UK.

Literature orders

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Advice and lots more information is available on our website. Check out our frequently asked questions, recipe ideas, what your cholesterol and triglyceride numbers mean and sign up to our free monthly e-newsletter for more facts and tips to help you and your family stay healthy.

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You can find out more on our website at www.heartuk.org.uk

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