VEGAN FOR A HEALTHY HEART

TO TREAT HEART DISEASE, YOU HAVE TO START ON YOUR PLATE

By Veronika Prošek Charvátová MSc
Viva! Health

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ABOUT VIVA! HEALTH

Viva! Health is the health and nutrition slice of Viva! – the vegan charity at the forefront of campaigning for a vegan world. It is the number one source for information on vegan health and nutrition for health professionals and the public. We are on-hand to support people on their journey into veganism.

We take the latest scientific studies and make them accessible to all, producing reports, guides and factsheets. We challenge and correct misinformation about diet, health and nutrition. In our groundbreaking reports and health campaigns – from dairy to zoonotic diseases – we provide all the evidence on why a vegan diet protects against all the major diseases and can help keep you happy and healthy.

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DIET DEFINITIONS

Meat-eater (omnivore) – people who eat meat, fish, dairy, eggs and all other animal products.

Pescatarian – people who don't eat meat but consume fish, seafood and other animal products, such as dairy, eggs and honey.

Flexitarian/reducetarian – people who eat everything but are consciously limiting the amount of animal products they eat.

Vegetarian – people who don't eat meat, fish or seafood and products obtained from dead animals, such as gelatine and lard, but consume animal products from live animals, such as dairy, eggs and honey.

Plant-based – people whose diet is entirely or almost entirely based on plant foods but they may not be strict about avoiding animal products at all times and in products other than food (eg wool and leather).

Vegan – people who only eat plant-based foods and avoid all animal products, including those made by or from insects, such as honey, shellac and carmine, as well as wool and leather.

Vegans also don't support any exploitative use of animals, such as product testing and experiments, entertainment or sports.

WHAT IS HEART DISEASE?

The term heart disease is often used instead of cardiovascular disease (CVD) and describes a chronic disease of the heart and blood vessels. Closely related is cerebrovascular disease – a term which means the problem is in the vessels in the brain, greatly increasing the risk of stroke.

When the condition mostly affects the heart by not allowing enough blood into the arteries that nourish the heart muscle (coronary arteries), it's called ischaemic or coronary heart disease.

Any form of the disease usually starts as atherosclerosis – thickening and hardening of artery walls. Arteries are the blood vessels that carry blood from the heart to the body. Atherosclerosis is characterised by the build-up of cholesterol, fats, white blood cells and other substances on and in the inner surface of the artery walls. These build-ups are called plaques – atherosclerotic plaques – and can cause arteries to narrow, limiting and eventually even blocking blood flow. A plaque can also burst, leading to a blood clot forming around the rupture that may block blood supply to a body part or organ.

The first sign of heart disease risk is usually high blood pressure. The heart has to pump the same volume of blood as usual through narrower arteries to keep the body working but because the blood flows through a smaller space, it increases the pressure on the artery walls.

Around eight million people are living with a heart or circulatory disease in the UK (British Heart Foundation, 2025). These diseases cause a quarter of all deaths in the UK – that's on average 480 deaths each day or one every three minutes. And they are the leading cause of death worldwide.

It is estimated that more than half of the UK population – that's every other person – will develop a heart or circulatory condition in their lifetime (British Heart Foundation, 2025a).

ATHEROSCLEROSIS IS A PROCESS

High cholesterol levels in the blood are a major contributor to atherosclerosis but it is also an inflammatory disease. It's essential to understand the process in order to follow how atherosclerosis is linked to lifestyle and diet.

The formation of atherosclerotic plaques starts with small cholesterol particles sticking to the inner lining of an artery, infiltrating its surface, where some of them accumulate and some are taken inside the lining cells (Rafieian-Kopaei *et al.*, 2014; Bäck *et al.*, 2019). All these cholesterol particles oxidise because they're exposed to free radicals. Free radicals are by-products of normal cell metabolism, but they are also produced as a result of lifestyle choices, such as smoking, excessive alcohol use, consumption of processed foods, as well as environmental pollution.

When cholesterol is oxidised, it means its structure is changed and this sends a signal for white blood cells to gather in the area to clean things up. However, once white blood cells arrive and start working, they also release inflammatory substances that send a signal for other types of white blood cells to gather and release adhesive substances that hold everything in place – forming a lesion (Rafieian-Kopaei *et al.*, 2014). This part of the process is the inflammatory response that keeps white blood cells active in the area.
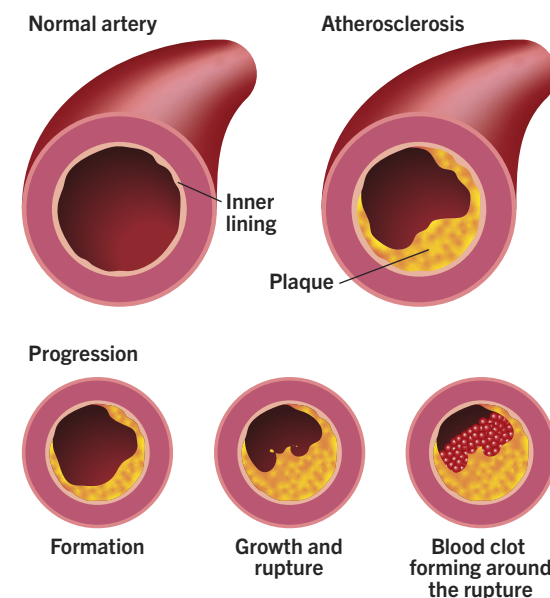
Some white blood cells take in some of the oxidised cholesterol and remove it from the lesion but if blood levels of cholesterol are high, new cholesterol particles will stick to the lesion and make it grow further. Other white blood cells may take the oxidised cholesterol in but stay and become embedded in the lesion – these so-called foam cells form what's called fatty streaks. As the lesion grows, some of these now cholesterol-filled white blood cells die and their contents remain embedded in the lesion, making matters worse and increasing local inflammation (Bäck *et al.*, 2019). Additionally, calcium from the blood may attach to the lesion and when more of it accumulates over time, this can cause hardening of the plaque and the entire artery.

The other part of the process happens inside the artery wall. As the lining is damaged, some smooth muscle cells from the artery wall migrate into the lining along with collagen fibres and white blood cells and form a bulge that reduces the artery diameter (Rafieian-Kopaei *et al.*, 2014). This is also called fibrous cap/plaque and is prone to rupture over time, which is dangerous because it exposes the accumulated fats, cellular waste and collagen (Korakas *et al.*, 2018). When that happens, platelets start to gather in place and form a small clot around the area. This scenario is treacherous because the clot may tear away along with a part of the plaque and completely block an artery, causing a heart attack, stroke or thrombosis (explained below).

Atherosclerosis takes many years to develop; it is a slow process but once symptoms become noticeable, it's usually quite advanced.

ATHEROSCLEROSIS

Normal artery

Atherosclerosis

Inner lining

Plaque

Progression

Formation

Growth and rupture

Blood clot forming around the rupture

An antioxidant-rich diet together with reducing blood cholesterol levels through diet can not only prevent atherosclerosis but also help remedy the problem – plaques can be gradually reduced (Rafieian-Kopaei *et al.*, 2014). Antioxidants decrease cholesterol oxidation in the arteries and can also reduce the inflammatory responses that make lesions grow. At the same time, omega-3 fats also decrease inflammation in arteries (Bäck *et al.*, 2019). In an eight-week study comparing the effects of a healthy vegan diet with those of the American Heart Association-recommended diet, the inflammatory marker (C-reactive protein), was 32 per cent lower in the vegan participants – and this was after just two months of following the diet (Shah *et al.*, 2018). The role of diet is explained in greater detail in following chapters.

HEART FAILURE

Heart failure, despite its name, doesn't mean the heart stops working – it means that the heart is unable to pump blood around the body properly. It has become too weak or stiff, usually as a result of heart muscle damage – for example, after a heart attack. The heart simply doesn't work as well as it should and tends to get gradually worse over time.

Developing this condition is a slippery slope because people with heart failure are two to three times as likely to have a stroke as healthy people (British Heart Foundation, 2025a). It's estimated that over one million people in the UK are living with heart failure.

HEART ATTACK

If the blood supply to the heart is blocked, it causes a heart attack – the heart suddenly fails. A heart attack can be fatal, but it doesn't have to be.

It's usually caused by a blockage in one of the coronary arteries – arteries that supply blood to the heart muscle. The coronary arteries wrap around the outside of the heart and small branches penetrate the heart muscle to supply oxygen and nutrients to it while taking away waste products. When these arteries get narrower because of plaques, it may cause angina – chest pain, tightness and uncomfortable pressure. If one of these arteries becomes blocked, the heart muscle cannot carry on working and stops, resulting in a heart attack.

If the heart stops for long enough, a heart attack will be fatal but with fast help, the person may survive.

They may then have to have an emergency operation where stents (tiny wire-mesh tubes) are placed in the coronary artery to keep it open and to prevent future blockages. Another option is a coronary artery bypass, where blood vessels are re-routed around the affected area to keep it supplied with blood. However, while these procedures keep the person alive, they don't address the cause of heart disease or atherosclerosis and more problems will likely follow.

In the UK there are around 100,000 hospital admissions each year due to heart attacks – one every five minutes (British Heart Foundation, 2025).

STROKE

Stroke is a sudden and life-threatening event in which an artery supplying the brain is blocked (ischaemic stroke) or a blood vessel in the brain bursts (haemorrhagic stroke). Ischaemic stroke is much more common than haemorrhagic. Both result in a part of the brain suddenly losing some or all of its blood supply which leads to a rapid loss of brain function and requires immediate medical care.

Stroke symptoms may include losing the ability to move and feel, usually on one side of the body, loss of speech, vision, inability to understand or react and dizziness. How much damage a stroke causes depends on how long brain cells remain without blood supply, the size of the affected area and the extent of the blood vessel blockage or damage. Some people recover fully, some partially, whilst for others a stroke can be fatal. There are also mini strokes, where the damage isn't so extensive and they may cause only mild symptoms. However, they are dangerous too because if the person doesn't seek medical attention, their health may further deteriorate.

In the UK, there are around 100,000 strokes each year and data suggest that the average age for someone having a stroke is decreasing, with over a third of strokes in adults aged between 40 and 69 (NICE, 2019). Strokes cause around 34,000 deaths in the UK each year and are the biggest cause of severe disability (British Heart Foundation, 2025).

THROMBOSIS

If a blood clot blocks the blood supply to a body part or organ, it's called thrombosis and symptoms may include pain and swelling in one leg, chest pain or numbness on one side of the body. Complications of thrombosis can be life-threatening, such as a stroke or heart attack.

Thrombosis is a type of embolism, which is a general term for something blocking the blood supply – it can be a blood clot, a fat particle, a bubble of air or another gas or foreign material. Embolisms can be fatal as they can cause heart attack, stroke or lung collapse (pulmonary embolism).
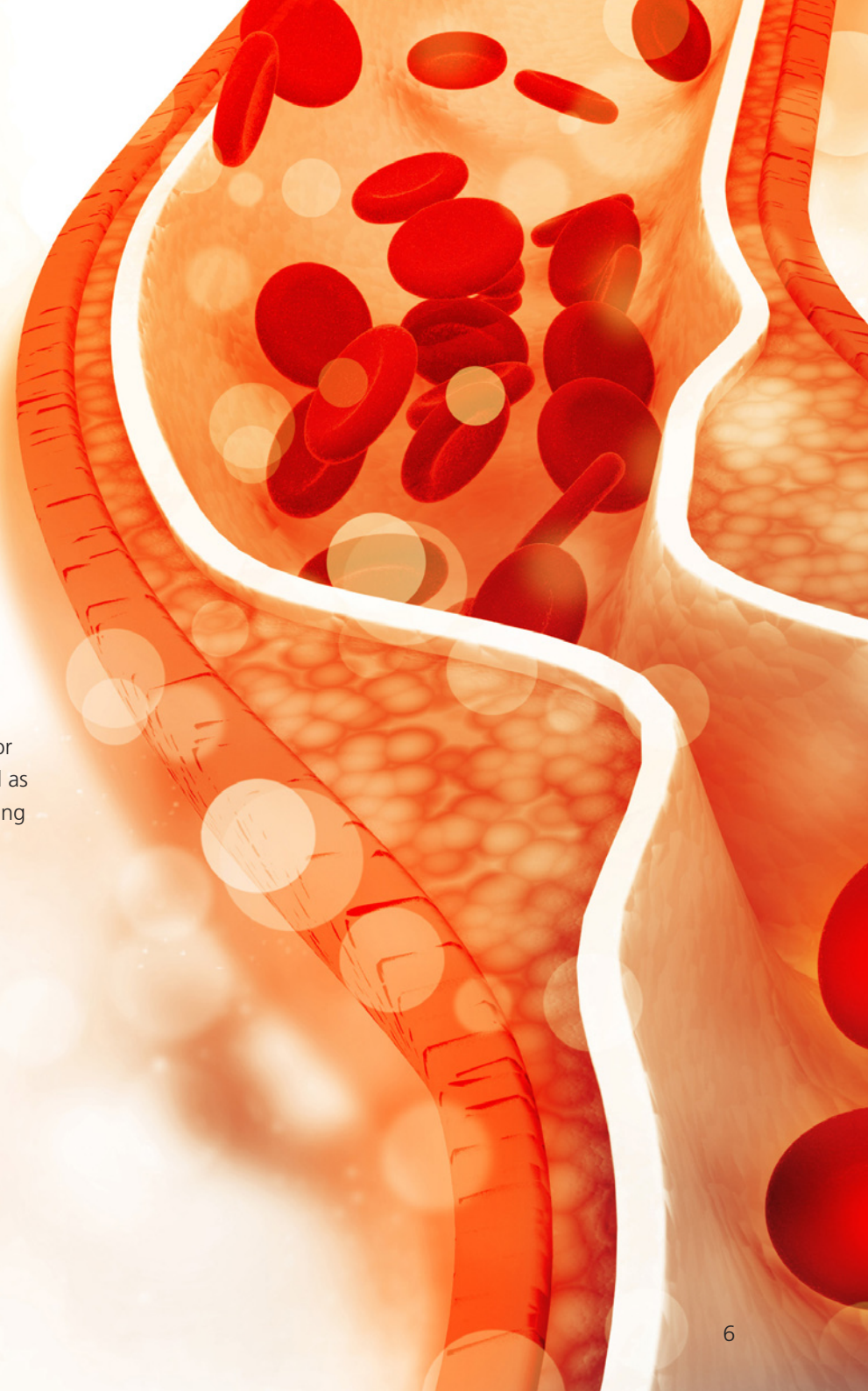
HOW DOES HEART DISEASE DEVELOP?

Some people have genes that make them more susceptible to heart disease, but lifestyle is what matters most. So, while risk factors such as family history, ethnic background and age are beyond your control, most of the risk factors listed below are heavily influenced by diet and lifestyle.

For example, diets rich in meat increase the risk of high cholesterol, blood pressure and diabetes significantly, whereas diets rich in fruit, vegetables, pulses, wholegrains, nuts and seeds lower the risk. More often than not, it's not about the genes that run in the family but about the diet and lifestyle that children inherit from their parents.

The main risk factors for heart disease include:

- **high blood pressure** – a risk factor but also often the first symptom, tightly linked to diet and lifestyle. For example, red and processed meat is linked to high blood pressure, whereas fruit and vegetables lower it
- **high cholesterol levels** – the more cholesterol is in the blood, the more building material is available for plaque formation; the amount of cholesterol in the blood usually depends on the diet. For example, meat raises the risk; fruit and vegetables lower it

- **smoking** – the harmful substances resulting from tobacco smoking can damage blood vessels and increase plaque formation
- **physical inactivity** – the less we move about, the less exercise our circulatory system gets. For blood vessels to stay healthy, it's important that they get stimulated by different levels of activity
- **being overweight or obese** – this factor has a lot to do with diet and physical inactivity. Again, diets packed with meat, high-fat dairy products and processed foods increase the risk and healthy plant-based diets lower it
- **diabetes** – having high blood sugar levels can directly damage blood vessels and it also increases cholesterol levels. There is a strong link between meat – especially red and processed meat – and diabetes. Switching to plant-based sources of protein, such as pulses and nuts, lowers the risk
- **alcohol consumption** – excessive alcohol intake can increase your cholesterol levels and blood pressure, and contribute to weight gain

- **family history** – if your male relatives developed heart disease before the age of 55 and/or your female relatives developed it before the age of 65, it is considered a family history of heart disease
- **ethnic background** – in the UK, people of South Asian and Black African or African Caribbean background have an increased risk of heart disease
- **age** – the older we get, the higher the risk
- **gender** – men generally tend to develop heart disease at a younger age than women

For atherosclerotic plaques to develop, building materials are needed and we either do or don't supply those through our diet. In the following sections, you'll find why high cholesterol, high blood pressure and excessive body weight are the main risk factors for heart disease and how they are all affected by diet.

TRIGLYCERIDES

Triglycerides are a type of fat found in the blood – tiny floating molecules of fat made up from a molecule of glycerol and three fatty acids. They are fats from the food you eat but your body also turns any extra calories, alcohol and sugar into triglycerides and they are then stored in fat cells throughout the body. If you regularly eat more calories than you burn, you may have a high level of triglycerides in your blood (hypertriglyceridemia) because your body is constantly transporting them between tissues.

High triglyceride levels usually accompany high cholesterol levels and so are always considered when assessing a person's health and heart disease risk. They also indicate potential lifestyle risk factors, such as poor diet with too much fat and sugar, smoking, high alcohol intake, obesity and physical inactivity.

In a blood test, normal triglyceride levels should be below 1.7 mmol/L when the person is fasting for eight to 12 hours before the test, or below 2.3 mmol/L when the person eats as usual beforehand.

CHOLESTEROL

Cholesterol is a waxy substance made by the liver and it's normally used to build cell membranes and produce hormones, vitamin D and bile. Therefore, some cholesterol is necessary for healthy functioning of the body, but the liver makes all we need. The problem starts when there's too much of it.

Cholesterol doesn't travel through the bloodstream on its own, it is carried with proteins and other fat molecules in special transport vehicles called lipoproteins. These are the main forms:

- **chylomicrons** – these are ultra-low-density lipoproteins that consist of triglycerides, phospholipids, cholesterol and proteins. They are formed in small intestine cells (enterocytes) and carry fats from the food we eat to other locations in the body. Once the fats – triglycerides – are delivered, chylomicron remnants are carried by the blood to the liver where they are processed
- **very-low-density lipoprotein (VLDL)** – these particles are made by the liver and they carry triglycerides to tissues throughout the body. When the tissue cells receive fatty acids from VLDLs, these turn into intermediate-density lipoproteins and some of them eventually into low-density lipoproteins

- **intermediate-density lipoprotein (IDL)** – these particles form when VLDLs give up their triglycerides. Some of them are then broken down by the liver, others are turned into low-density lipoproteins
- **low-density lipoprotein (LDL)** – these particles contain more pure cholesterol because all or most of the triglycerides they carried were removed. LDL is known as 'bad' cholesterol because it distributes cholesterol to various tissues and is strongly associated with the build-up of atherosclerotic plaques
- **high-density lipoprotein (HDL)** – these particles are called 'good' cholesterol because it is the form of cholesterol in which it's returned back to the liver for removal

Once cholesterol gets back to the liver, it's mostly turned into bile acids – a major component of bile – that help us digest fats in the small intestine. Some cholesterol also directly passes into the bile and with it, into the small intestine. Much of the bile acids and some cholesterol is then absorbed again in the small intestine and circulates back into the body, while the rest is excreted in our faeces.

High levels of cholesterol in the blood are a significant risk factor for developing heart and circulatory diseases. When total and LDL cholesterol levels are increased, there's plenty of building material for atherosclerotic plaques to develop and grow. On the other hand, it's good when HDL cholesterol levels are increased as that means cholesterol is being cleared away.

This table is a general guide for ideal cholesterol levels for healthy adults. If you have heart disease or diabetes, your target levels may be lower – your doctor will be able to advise you.

	mmol/L	mg/dL
Total cholesterol	below 5.0	below 193
Non HDL cholesterol	below 4.0	below 155
LDL cholesterol	below 3.0	below 166
HDL cholesterol	above 1.0 for a man and above 1.2 for a woman	above 39 for a man and above 46 for a woman
Total cholesterol/ HDL ratio	6 or below	

In the UK, the average total cholesterol level is 5.7 mmol/L and it's estimated that around half of all adults in the UK are living with high cholesterol levels, greater than 5 mmol/L (British Heart Foundation, 2025a).

DIETARY CHOLESTEROL AND BLOOD CHOLESTEROL

Animals, just like us, make their own cholesterol and it's a basic component of their cell membranes. So, all animal products – meat, fish, shellfish, eggs and dairy – contain cholesterol. Plant foods do not contain any cholesterol whatsoever, so a vegan diet is cholesterol-free.

Dietary cholesterol can have a different effect in different people – in some, it doesn't affect blood cholesterol levels much but in others, it directly and significantly increases it (Kang and Zivkovic, 2022). This is because some people have certain genes that make them absorb cholesterol from food extremely well, too well in fact. The range of how much cholesterol we absorb from the gut is 20 to 80 per cent and that includes dietary cholesterol and bile cholesterol (Stellaard, 2022).

However, even in people who have low-cholesterol-absorbing genes, dietary cholesterol can still increase blood cholesterol levels if consumed together with high amounts of saturated fat (Kang and Zivkovic, 2022). Most animal products, such as meat, fish or high-fat dairy contain both, while others may be combined in a way that delivers both cholesterol and saturated fats in one meal – for example eggs with buttered toast or chicken fried in butter, lard or coconut oil.

In a typical Western diet, the average daily cholesterol intake is between 100 to 400 milligrams but some people consume as much as 800 milligrams (Stellaard, 2022).

Plant compounds that are similar in structure but not function to cholesterol – sterols and stanols – compete with cholesterol for absorption in the gut and so lower the amount of cholesterol absorbed (Stellaard, 2022). That's why there are so many products enriched with plant sterols (also called phytosterols) and marketed as 'cholesterol-lowering'. However, a diet based on plant foods achieves this reduction naturally.

A recent German study of different dietary groups – meat-eaters, flexitarians, vegetarians and vegans – found that while meat-eaters ate around 400 milligrams of cholesterol a day, vegans had a negligible intake and less than half the saturated fat intake compared to meat-eaters (Dawczynski *et al.*, 2022). In this study, blood tests showed that vegans had almost 25 per cent lower levels of total cholesterol and 27 per cent lower levels of LDL 'bad' cholesterol than meat-eaters.

Although the body makes its own cholesterol and regulates its overall levels, diet certainly plays an important role. In another study of people consuming omnivore, vegetarian or vegan diets, it was revealed that only vegans had markedly lower LDL cholesterol levels – on average, their levels were 13 per cent lower

compared to other diet groups (Lütjohann *et al.*, 2018).

A study looking into the effects of plant-based diets on blood lipids (cholesterol and triglycerides) found that people consuming vegetarian diets had lower levels of cholesterol and slightly lower levels of triglycerides in their blood (Yokoyama *et al.*, 2017). The total cholesterol levels were on average 0.8 mmol/L or 29.2 mg/dL lower in vegetarians compared with meat-eaters and the authors stated that vegans (included in the vegetarian group) had even lower levels.

These are all predictable results because people who eat meat, fish, dairy and eggs consume the most cholesterol and saturated fat in their diet. Vegetarians eat less but vegans don't consume any animal products and therefore take in no cholesterol whatsoever. Eggs are the richest dietary source of cholesterol, with just one egg containing an average 187 milligrams of cholesterol.

A comprehensive overview from the American Heart Association suggests that while dietary cholesterol doesn't always increase the risk of heart disease, high intakes do raise blood cholesterol levels (Carson *et al.*, 2020). They also highlight that cholesterol-rich foods often also contain saturated fats or are combined with them and this blurs the measurable effect of cholesterol alone. The Association recommends focusing on healthy dietary patterns rather than just on cholesterol and fats – they recommend a diet rich in fruits, vegetables, wholegrains, plant protein sources, nuts, seeds and vegetable oils.

DIFFERENT TYPES OF FAT

Fats are divided into separate categories based on the structure of the fatty acids they contain. The chemical bonds within fatty acids are described as saturated or unsaturated and this also determines their activity in the body. Saturated means something has bonded as many times as possible and no more bonds can be made. This is a brief overview – more information on each is discussed in the following chapters.

Saturated fats – all bonds in their structure are saturated. Saturated fat is something we don't need in the diet as our bodies can make it. High intakes increase blood cholesterol levels. The main sources of saturated fat are animal products (meat, fish, shellfish, eggs, dairy products, butter, lard, pies, pastries, processed foods and high-fat spreads), coconut oil and palm fat. Saturated fats are usually solid at room temperature.

Monounsaturated fats – these have one unsaturated bond in their structure. They are not essential in the diet but not harmful as a part of a balanced diet. Monounsaturated fats are found in many plants and vegetable oils. Probably the most common one is oleic acid – an omega-9 fat – the main component of olive, macadamia, avocado and sunflower oils.

Polyunsaturated fats – these have at least two unsaturated bonds in their structure. Polyunsaturated fats are the essential omega-6 and omega-3 fats – we need them for good health. The main omega-6 fat is linoleic acid found in seeds, nuts, corn, pulses and soya oil. It can be converted into other important omega-6 fatty acids in the body. We usually have enough of omega-6 fats and need to increase the intake of omega-3s.

Omega-3 fats from plants come in the form of ALA (alpha-linolenic acid) which our bodies convert to EPA (eicosapentaenoic acid) and DHA (docosahexaenoic acid). Rich sources of ALA are ground flaxseeds, hempseeds, chia seeds, walnuts and rapeseed oil. Microalgae contain ready-made EPA and DHA – this is where fish obtain their omega-3s. Algae-derived omega-3 supplements are a much healthier choice than fish or fish oil supplements because they are not contaminated with dangerous pollutants and are sustainable.

Trans/hydrogenated fats – these fats have a different structure to all other fats and are dangerous to heart health because they raise blood cholesterol levels. Smaller amounts of trans-fats are naturally found in dairy products, lamb and beef fat. Larger amounts can be found in processed foods. These fats are made by the hydrogenation process, which converts liquid vegetable oils into solid fats. The final product is called hydrogenated vegetable oil/fat. Foods that contain hydrogenated fats should be avoided.

Note on margarine: margarine used to contain hydrogenated fats and that's why it gained a bad reputation. However, most manufacturers have since changed their ingredients and production methods, so margarine is a healthy butter alternative (always check the ingredients to be certain).

SATURATED FATS AND CHOLESTEROL

It's well-established that a diet high in saturated fat increases blood cholesterol levels – in particular, the dangerous LDL type (Kris-Etherton and Krauss, 2020). While the precise mechanisms of how this works are still being worked out, many studies show similar results – higher saturated fat intakes increase cholesterol levels and when they are replaced by unsaturated fats, cholesterol levels drop.

For example, a large study combining the results from the Nurses' Health Study and the Health Professionals Follow-Up Study (Li *et al.*, 2015) found that replacing just five per cent of energy from saturated fats with polyunsaturated fats, monounsaturated fats or carbohydrates from wholegrains was associated with a 25 per cent, 15 per cent and nine per cent lower risk of heart disease, respectively.

Cochrane reviews are internationally recognised as the highest standard in evidence-based healthcare – often referred to as the gold standard. A Cochrane review on the subject found that cutting down on saturated fat led on average to a 17 per cent lower risk of cardiovascular events, including heart disease, heart attacks and strokes (Hooper *et al.*, 2020). The review highlighted that this risk reduction resulted from replacing saturated fats with polyunsaturated fat or starchy foods (wholegrains). The lower the saturated fat intake, the lower the blood cholesterol and that, in turn, lowered the risk of cardiovascular events. Interestingly, according to the authors, people who are at low risk of cardiovascular events appear to benefit from reduced saturated fat intake as much as those at increased risk of heart disease or stroke, suggesting

that we all need to reduce saturated fat intake. There was no difference in effect between men and women.

When the UK Scientific Advisory Committee on Nutrition (SACN) reviewed all available evidence in 2019, they came to the conclusion that reducing saturated fat intake reduces the risk of heart and circulatory disease and lowers cholesterol levels. They suggest that "reducing population average saturated fat intakes from current levels of intake to no more than about 10 per cent of [total] dietary energy would result in health benefits to the population".

A comprehensive study was undertaken by the American Heart Association, examining the effect of saturated fats on heart health. They published their results as *Dietary Fats and Cardiovascular Disease: A Presidential Advisory from the American Heart Association* in which they state that replacing saturated fats in the diet with polyunsaturated achieves a significant reduction in cardiovascular events (Sacks *et al.*, 2017). This dietary change can reduce the risk of heart disease and related events by about 30 per cent, which is a reduction similar to that achieved by cholesterol-lowering drugs, statins.

A systematic review and analysis published by the

World Health Organisation evaluated 84 randomised controlled trials that studied the effects of dietary fats on LDL cholesterol, triglycerides and HDL cholesterol (Mensink, 2016). The author calculated the effect of replacing just one per cent of daily calorie intake from saturated fats by one per cent of calories from polyunsaturated fat, monounsaturated fat or carbohydrates. The results showed that polyunsaturated fat lowered LDL cholesterol by 2.1 mg/dL, monounsaturated fat by 1.6 mg/dL, and carbohydrates by 1.3 mg/dL. In mmol/L, these substitutions resulted in a reduction from 0.05, 0.04 and 0.03 respectively – small but significant. Imagine the effect of replacing more than just one per cent!

While many studies show that replacing saturated fats with unsaturated achieves the best results in terms of cholesterol and cardiovascular risk reduction, the results for replacing them with carbohydrates vary depending on the type of carbohydrates (Clifton and Keogh, 2017). Carbohydrates from wholefoods, such as wholegrains, reduce the risk of heart disease and related events, while carbohydrates from sugary foods, refined-flour products or potato chips may even increase the risk.

HOW ABOUT TROPICAL OILS – COCONUT AND PALM?

While most plant oils are low in saturated fats, palm and coconut oils are exceptions – they are very rich sources. Coconut oil is made up of more than 80 per cent saturated fat, while the figure for palm oil is 50 per cent (similar to butter) and for palm kernel oil, 80 per cent. Palm oil is made from the palm fruit while palm kernel oil comes from the seeds and both can be used in foods or food preparation, such as frying.

Despite many misleading claims, these so-called tropical oils raise LDL cholesterol levels and the risk of heart disease (Sun *et al.*, 2015; Sacks *et al.*, 2017; Neelakantan *et al.*, 2020). Some studies show that coconut oil doesn't raise cholesterol levels as much as animal fats but because it raises LDL cholesterol nevertheless, it cannot be recommended as a healthy oil (Eyres *et al.*, 2016; Santos *et al.*, 2019).

When it comes to palm oil, it raises both LDL and HDL cholesterol, which is why some argue that its health effects may not be as detrimental as with saturated fats of animal origin (Unhapipatpong *et al.*, 2021) but major health institutions, such as the American Heart Association disagree and warn against its consumption (Sacks *et al.*, 2017).

TRANS FATS, CHOLESTEROL AND ATHEROSCLEROSIS

Trans fats are naturally found in small amounts in the meat and milk of ruminant animals (eg cattle, sheep and goats) and can also be produced when liquid vegetable oils are hydrogenated to make them solid or semi-solid at room temperature. These industrial trans fats are frequently used in processed foods or for frying and are usually listed as hydrogenated fats, partially hydrogenated fats (or fatty acids) or trans fats.

Trans fats raise cholesterol levels even more than saturated fats and are considered a risk factor for heart disease. The reason for their detrimental effect is thought to be that they slow down the natural breakdown of LDL cholesterol and increase the breakdown of HDL cholesterol – this leads to increased total and LDL cholesterol levels and low HDL levels, which is a dangerous scenario for blood vessel health as it facilitates the build-up of atherosclerotic plaques (Sacks *et al.*, 2017; Oteng and Kersten, 2020). On top of that, trans fat consumption also increases inflammation in blood vessels – stimulating the release of more inflammatory substances – contributing further to plaque growth (Oteng and Kersten, 2020).

In the 1990s Professor Walter Willett from Harvard Medical School and his colleagues found that the intake of trans fatty acids from partially hydrogenated vegetable oils increased the risk of heart disease by 50 per cent in those who ate the highest quantities (Willett *et al.*, 1993). Other studies followed and gradually, the knowledge of the damaging effects of

trans fats on heart health deepened. A large analysis combining data from previous studies calculated that if just two per cent of energy from polyunsaturated fats were replaced by trans fats, it would increase the risk of a heart attack or another fatal heart event by 32 per cent (Mozaffarian *et al.*, 2009). The same scenario but with trans fats replacing monounsaturated fats would increase the risk by 27 per cent.

In 2010, a scientific team compared the effects of three different types of trans fats on LDL cholesterol – industrial trans fatty acids, ruminant trans fatty acids (naturally present in milk, butter, cheese and beef) and conjugated trans linoleic acid (Brouwer *et al.*, 2010). They found that all three increase LDL cholesterol. Some researchers speculated that perhaps ruminant trans fats do not have the same effects as man-made trans fats but this study showed that while there are minor differences, all types of trans fats raise dangerous LDL cholesterol levels.

A major review published in *British Medical Journal* reported that higher than minimal intake of trans fatty acids was associated with a 21 per cent higher risk of heart disease and a 28 per cent higher risk of dying from heart disease (de Souza *et al.*, 2015).

As a result, many national health guidelines warned against trans fats and companies began changing their food manufacturing processes, so while food items such as margarine, crackers, bakery products, biscuits and deep-fried foods once contained high amounts of industrial trans fatty acids, in many countries, including the UK, this is not the case anymore. However, it's advisable to always check product ingredients because there isn't a ban on hydrogenated fat and many products may still contain it.

CHOLESTEROL LEVELS, ATHEROSCLEROSIS AND DIET

Diet plays a major role in how high or low our cholesterol levels are and there are many studies suggesting what we should be eating to lower our cholesterol levels and keep them down.

The American Society for Preventive Cardiology clearly state that saturated fats that come mainly from meat, dairy fat, eggs and tropical oils (coconut and palm oil) increase total and LDL cholesterol and should be avoided (Belardo *et al.*, 2022). However, a heart-healthy diet means much more than just replacing saturated fats in the diet.

Plant-based diets based around wholegrains, fruit and vegetables, pulses, nuts and seeds and unsaturated fats have been shown time and again to be effective at keeping blood cholesterol levels down and at lowering them in people with high levels – vegan diets in particular (Trautwein and McKay, 2020; Koch *et al.*, 2023). This effect is thought to be due to the fact that these diets are high in fibre, complex carbohydrates, plant protein, unsaturated fats, antioxidants and plant sterols, while at the same time low in saturated and trans fats, sugar and cholesterol (vegan diets contain no cholesterol).

Almost two decades ago, Dr David Jenkins introduced what is now known as the Portfolio Diet. It is based around four key foods and nutrients, all of which have a Food and Drug Administration, Health Canada and European Food Safety Authority approved health claim for cholesterol-lowering properties or

cardiovascular disease risk reduction. These four key ingredients include (daily): 42 grams of nuts (tree nuts or peanuts); 50 grams of plant protein from soya products or other pulses (beans, peas, chickpeas or lentils); 20 grams of viscous soluble fibre from oats, barley, psyllium, aubergine, okra, apples, oranges or berries; and two grams of plant sterols (originally these came in a sterol-enriched margarine but plant foods contain plenty). When the Portfolio Diet was trialled in combination with limited saturated fat and cholesterol intake, it achieved great results – compared with participants who only restricted their saturated fats and cholesterol in the diet, those who also followed the Portfolio Diet lowered their LDL cholesterol levels by 17 per cent on average (Chiavaroli *et al.*, 2018). Other results included a reduction of total cholesterol by 12 per cent, triglycerides by 16 per cent and inflammation markers by 32 per cent – all this was achieved in just four weeks. The Portfolio Diet is essentially a wholesome vegan diet.

In another study on diet and heart health, researchers asked participants to follow a low-fat vegan diet for 16 weeks (Kahleova *et al.*, 2021). By the end of the study, the participants' total cholesterol dropped by total 27-28 mg/dL (0.69-0.73 mmol/L) and LDL cholesterol by 23-26 mg/dL (0.59-0.68 mmol/L) and there were no differences between black and white participants – the diet worked the same for everyone.

Another 16-week trial compared the effects of a low-fat vegan diet with the effects of the Mediterranean diet on overweight adults (Barnard *et al.*, 2022). The latter is a diet rich in plant foods and olive oil, and also allows fish, shellfish, poultry, low-fat dairy products, eggs and very small amounts of red meat. Each participant followed each diet for 16 weeks and these periods were separated by four weeks of the participant's regular diet. When results were compared, it turned out that the vegan diet lowered total and LDL cholesterol levels by 18.7 mg/dL (0.5 mmol/L) and 15.3 mg/dL (0.4 mmol/L) respectively, while the Mediterranean diet didn't achieve any significant changes in cholesterol levels.

In a study spanning 12 weeks, participants with high cholesterol levels were given a wholesome vegan diet to follow – based on wholegrains, vegetables, fruit, soya and other beans, and nuts, while avoiding sugar, fried foods, refined carbohydrates (white bread and pastry) and ultra-processed foods (Chiu *et al.*, 2022). At the end of the study, the average decrease in total cholesterol levels was 22 mg/dL (0.6 mmol/L), while LDL cholesterol reduced by 24 mg/dL (0.6 mmol/L) – these are very powerful results.

In a study of identical twins, one of each pair ate a healthy omnivorous diet while the other one followed a healthy vegan diet for eight weeks (Landry *et al.*, 2023). At the end of the study, the twins on the vegan diet had significantly better results than their counterparts – their LDL cholesterol was lower by 14 mg/dL (0.36 mmol/L) and several other health markers improved.

When a scientific team investigated the effects of diets high in red meat, white meat and no meat on participants' cholesterol levels, each followed for four weeks, the results were clear – both red and white meat increased cholesterol levels but a meat-free diet did not (Bergeron *et al.*, 2019). The study also tested the effect of additional saturated fat – they added

high-fat dairy products and butter to the participants' diet – and found that it increased cholesterol levels in all groups.

Studies looking only at the effects of plant protein on cholesterol bring similarly encouraging results. One of them found that replacing animal protein in the diet with plant protein – swapping animal products for plant-based ones (without any other dietary changes) – generally reduced LDL cholesterol by 6 mg/dL (0.16 mmol/L) (Li *et al.*, 2017). However, this isn't only about protein – replacing animal protein also means cutting down on saturated fat and cholesterol intake, while increasing plant protein intake also means a higher intake of unsaturated fats, sterols and fibre. Another study found that eating just one portion of pulses daily (rich in plant protein) reduced average LDL cholesterol levels of participants by 6.6 mg/dL (0.17 mmol/L) (Ha *et al.*, 2014). These effects may be small, but as part of a wider change in diet and lifestyle, they can add up to make a real difference.

Comparing cardiovascular risks between vegans and non-vegans also brought important results. A scientific review of 40 studies revealed that vegans consumed 50 per cent less saturated fat than meat-eaters, had lower LDL cholesterol levels – on average by 19 mg/dL (0.49 mmol/L) – and had lower blood pressure (Benatar and Stewart, 2018). Another review found similar results – vegetarians (including vegans) had cholesterol levels on average 30 mg/dL (0.8 mmol/L) or lower than meat-eaters and the study authors remarked that vegans had even lower levels, although precise figures were not given (Yokoyama *et al.*, 2017).

An earlier European study found virtually the same results – among meat-eaters, pescatarians and vegetarians, vegans had the lowest cholesterol levels and the healthiest fat intake, with the lowest saturated and the highest polyunsaturated fat consumption (Bradbury *et al.*, 2014).

An ambitious study set out to find out the effect of various foods on LDL cholesterol levels (Schoeneck and Iggman, 2021). The authors analysed a wealth of data from previous studies and found that foods that lower LDL cholesterol include rapeseed oil; foods rich in soluble fibre, such as oats and barley; other fibre-rich foods such as wholegrains, pulses, tomatoes, avocados, almonds, hazelnuts, walnuts, flaxseeds; foods enriched with plant sterols and stanols; soya protein; turmeric; and green tea. Fruit and vegetables also had a mild LDL cholesterol-lowering effect but the authors pointed out that more research was needed.

This study also summarised what numerous guidelines recommend to lower cholesterol levels and the risk of heart disease – a diet high in fruits and vegetables, nuts, non-tropical vegetable oils, pulses, wholegrains and other high-fibre foods, fish for omega-3 fats (but these are easy to obtain from healthier plant-based sources) and soya products; and low in sugar and soft drinks, trans fatty acids (best avoided), saturated fats, red and processed meats (also best avoided), salt, alcohol, refined carbohydrates and dietary cholesterol.

All these results are no coincidence – what we eat affects what happens in our bodies and the association is very strong when it comes to cholesterol levels. A wholefood vegan diet leads to lower cholesterol levels, reducing the risk of atherosclerosis and heart disease.

HIGH BLOOD PRESSURE

Blood pressure is always recorded with two numbers – the systolic pressure (higher number) is the force at which your heart pumps blood into the body and the diastolic pressure (lower number) is the resistance to the blood flow in the blood vessels (the force of the blood pushing against the wall of blood vessels). They are both measured in millimetres of mercury (mmHg).

A healthy blood pressure is usually considered to be between 90 and 120 mmHg for the systolic pressure and 60 to 80 mmHg for the diastolic pressure. If your blood pressure is 140/90 mmHg or higher, it is considered to be high blood pressure, also called hypertension. An estimated 30 per cent of adults in the UK have high blood pressure, which means around 16 million people (British Heart Foundation, 2025a).

Rising blood pressure is closely linked with high cholesterol levels in the blood – it's because cholesterol plaques in the arteries cause narrowing so the heart has to pump with an increased force (systolic pressure) to push the essential amount of blood through. At the same time, there's increased resistance from the blood vessels that have a narrower diameter, which increases the diastolic pressure. However, it can work the other way round as well – over time, high blood pressure can damage arteries, causing micro-tears in the artery walls where excess cholesterol can collect.

Regardless of how it develops, high blood pressure always puts extra strain on blood vessels, the heart, brain, kidneys and eyes and increases the risk of blood vessel damage in these organs.

Among the main risk factors for hypertension are:

being overweight, high salt intake, unhealthy diet, excessive alcohol and caffeine consumption, smoking, being older, genetics (some people naturally have higher blood pressure) and being of Black African, Black Caribbean or South Asian descent (NHS, 2024).

Many of these risk factors are modifiable:

- **high salt intake** – eating too much salt makes your body retain more water and that includes the water content of your blood. Higher blood volume means higher pressure
- **unhealthy diet** – plant wholefoods contain a range of minerals that help to regulate fluid balance in your body. Among them, potassium is the most important one for blood pressure regulation and a lack of fruit and vegetables in the diet can cause low potassium levels in the body which leads to increased blood pressure. Antioxidants found in plant foods help protect blood vessel walls and support their healthy function. On the other hand, processed food, meat and high-fat products not only contribute to atherosclerosis but also support inflammation in blood vessel walls, undermining their function
- **excessive alcohol intake** – within the first 12 hours of drinking, alcohol lowers blood pressure and then it increases it in the following 12 hours (Tasnim *et al.*, 2020). It is thought to be caused by alcohol increasing blood levels of the hormone renin, which makes blood vessels constrict and promotes water retention in the body – these two effects make blood pressure rise. Additionally, alcohol may increase levels of stress hormones, which directly causes blood pressure increase, and it also decreases the sensitivity of baroreceptors (blood pressure receptors) so it's harder for the body to regulate blood pressure correctly. If

excessive alcohol intake becomes a long-term habit, the blood pressure-increasing effect will last

- **excessive caffeine intake** – this depends on the individual because research suggests that caffeine has the biggest effect on people not used to drinking caffeinated beverages – coffee in particular – while people who have a regular coffee habit of up to three cups a day may not be affected as much (Surma and Oparil, 2021). There are also genetic variations in how our bodies process caffeine
- **smoking** – it is well-established that smoking increases the risk of cancer, but it is also a significant risk factor for heart disease and stroke

While all the above contribute to hypertension and should be avoided, high cholesterol remains the main risk factor that usually comes with high blood pressure and greatly increases the risk of heart disease (Williams *et al.*, 2020). In fact, high cholesterol levels usually appear first and blood pressure may rise only a few years later (Halperin *et al.*, 2006). Many people aren't aware of their cholesterol levels, so the first sign of heart disease risk may be a high blood pressure reading and only then do they find out they also have high cholesterol.

In most cases, medication alone isn't able to lower both blood pressure and cholesterol levels to those considered as healthy, so lifestyle modifications, including a diet based on plant foods, are essential to achieve meaningful risk reduction (Borghi *et al.*, 2022).

HIGH BLOOD PRESSURE AND DIET

As a part of the large, long-running study examining the impact of lifestyle and diet on blood pressure – the INTERMAP study – researchers studied people who consistently show low levels of cardiovascular risk factors (Shay *et al.*, 2012).

These people were middle-aged and had blood pressure lower than 120/80 mmHg, BMI (Body Mass Index) below 25 indicating they were not overweight, total cholesterol lower than 5.2 mmol/L (200 mg/dL) without any medication, no diabetes and no cigarette use. They discovered that these people have certain dietary traits in common – a higher intake of plant protein, fibre, magnesium (plentiful in plant foods), non-haem iron (plant iron), potassium (also plentiful in plant foods), lower overall energy intake, lower intake of cholesterol, saturated fats, animal protein and salt compared with people who are at higher risk of cardiovascular disease.

Another part of the study focused only on plant-based diets and their variations – healthy plant-based diets centred around wholefoods and unhealthy plant-based diets relying on processed foods (Aljuraiban *et al.*, 2020). It found that healthy plant-based diets (favouring wholegrain foods, fruits, vegetables, nuts, pulses, vegetable oils and tea or coffee) are directly linked to lower blood pressure, while unhealthy plant-based diets (favouring processed foods, desserts, sweetened beverages and potato products) can increase it.

In another branch of the INTERMAP study, nutrients that lower blood pressure were identified (Chan *et al.*, 2016). The study reported that intakes of plant protein,

glutamic acid (from protein-rich plant foods), total and insoluble fibre, total polyunsaturated fats and linoleic acid (omega-6 fat from plants), oleic acid from vegetable sources, total omega-3 fats and linolenic acid (omega-3 fat from plants), phosphorus, calcium, magnesium, non-haem iron (from plant sources) and total iron and starch were all linked to lower blood pressure. On the other hand, sugars, cholesterol, glycine and alanine (mostly from animal protein) and oleic acid from animal sources were all linked to higher blood pressure. An earlier part of the study that focused on protein only brought similar findings – the more plant protein people ate, the lower their blood pressure was (Elliott *et al.*, 2006).

These findings only strengthen the conclusions of earlier studies on the topic – for example a study that followed participants for 15 years discovered that the more plant-based diet they had, favouring wholegrains, fruit and vegetables, pulses and nuts, the lower was their risk of having high blood pressure (Steffen *et al.*, 2005). Conversely, the more meat the participants ate, the higher was their risk of hypertension.

Another study compiled and analysed data from three large prominent studies to determine what effect different types of meat have on blood pressure (Borgi *et al.*, 2015). It revealed that one serving of red or processed meat daily increased the risk of hypertension

by 30 per cent and one serving of poultry increased it by 22 per cent.

All this clearly points to a wholefood plant-based diet being the best at preventing high blood pressure and lowering it in people who have already developed it.

The DASH (Dietary Approaches to Stop Hypertension) diet is a dietary approach that's been tried and tested over the past two decades and has been shown to help reduce blood pressure (Filippou *et al.* 2020). It emphasises foods rich in potassium, magnesium, calcium, fibre and protein and low in sodium, sugar and saturated fats to help regulate blood pressure. In practice, it means a diet based on wholegrains, fruit, vegetables, pulses, nuts, low-fat dairy and small amounts of fish and meat. However, as the studies above show, the diet could bring even better results if it cut all animal products out, which would be better for public health too because, as science shows, fish, meat and dairy are the main sources of polychlorinated biphenyls and dioxins in the human diet (Malisch and Kotz, 2014) – these substances may have adverse effects on hormonal, nervous and reproductive health and increase the risk of cancer.

Across scientific studies, vegans consistently have been shown to have lower blood pressure than other diet groups (Alexander *et al.*, 2017; Chiu *et al.*, 2020) and when compared with meat-eaters, for example, vegans may have up to a 63 per cent lower risk of high blood pressure (Pettersen *et al.*, 2012). When scientists analysed data from the Adventist Health Study-2 and looked at blood pressure and diet of participants based on their ethnicity, they found that the effect of the vegan diet is universal – white vegan participants had a 54 per cent lower risk of hypertension compared with

meat-eaters and black vegan and vegetarian participants had a 46 per cent lower risk – unfortunately, the latter study didn't differentiate between vegetarian and vegan diets (Fraser *et al.*, 2015; Matsumoto *et al.*, 2019).

In people who suffer from high blood pressure, a switch to a wholefood plant-based diet usually achieves a significant reduction in blood pressure (Alexander *et al.*, 2017). In fact, a healthy vegan diet based on wholefoods is more effective at blood pressure lowering than a vegetarian one (Lee *et al.*, 2020). In just one week, a low-fat, low-salt, wholefood vegan diet has been shown to achieve remarkable results – on average 8 mmHg systolic blood pressure drop, 4 mmHg diastolic blood pressure drop and 0.6 mmol/L (22 mg/dL) drop in total cholesterol (McDougall *et al.*, 2014). In participants who had high cholesterol and blood pressure at the start, the reductions were even more astonishing – total cholesterol reduced by 1.0 mmol/L (39 mg/dL), systolic blood pressure by 18 mmHg and diastolic by 11 mmHg.

In an eight-week study where participants received detailed guidance on a wholefood vegan diet and followed it for the duration of the experiment, impressive results were achieved (Campbell *et al.*, 2019). Even though there was no portion or calorie restriction, the participants lost a healthy amount of weight – the obese and overweight ones lost more than the healthy-weight ones, blood pressure (both systolic and diastolic) dropped on average by 7 mmHg, total cholesterol decreased by 0.6 mmol/L (25 mg/dL) and LDL cholesterol by 0.4 mmol/L (15 mg/dL).

According to an analysis of several major studies, vegetarian and vegan diets are associated with lower blood pressure – on average a 6.9 mmHg lower

systolic and 4.7 mmHg lower diastolic blood pressure compared to meat-eaters – and clinical trials of vegetarian or vegan diets that lasted at least six weeks resulted in average decreases of 4.8 mmHg systolic and 2.2 mmHg diastolic blood pressure (Yokoyama *et al.*, 2014). However, a vegan diet tends to achieve better results than just vegetarian.

There are many mechanisms through which plant-based nutrition leads to lower blood pressure – they include improved vasodilation (the ability of blood vessels to relax and widen their diameter), greater antioxidant content and anti-inflammatory effects resulting in healthier blood vessel walls, and modification of gut bacteria – reducing those producing harmful substances and supporting bacteria producing beneficial by-products (Alexander *et al.*, 2017). Each of these is described in more detail below.

Another benefit of a wholefood vegan diet is the increased intake of dietary nitrates – natural compounds found in vegetables, particularly in green leafy vegetables and beetroot. They help blood vessels relax and so lower blood pressure. In a study of over 50,000 participants, followed for 23 years, those with the highest dietary nitrate intake had markedly lower systolic and diastolic blood pressure (Bondonno *et al.*, 2021).

HOW OBESITY CONTRIBUTES TO HEART DISEASE

As the American Heart Association states in their review of evidence, obesity directly contributes to cardiovascular risk factors, including high cholesterol and triglyceride levels, high blood pressure, blood vessel inflammation, increased blood clotting, impaired blood sugar control and also sleep disorders (Powell-Wiley *et al.*, 2021).

They highlight that obesity on its own can lead to the development of cardiovascular disease and potentially fatal events, independently of other cardiovascular risk factors. Obese people tend to develop heart disease and experience serious cardiovascular events at an earlier age and have a shorter life span than people with a healthy weight.

Abdominal obesity – large waist circumference – is considered a particular risk and is linked with fat storage in the liver and around the heart. The longer a person carries this excessive fat, the higher the risk of heart disease and related events (Powell-Wiley *et al.*, 2021). Abdominal obesity is dangerous because fat accumulation around all the organs that are housed in the abdominal cavity causes over-activation of the immune system, the production of pro-inflammatory substances, dysregulation of blood cholesterol levels and sugar metabolism, all of which contribute to the formation of atherosclerotic plaques (Korakas *et al.*, 2018; Powell-Wiley *et al.*, 2021). Inflammation induced by obesity increases LDL cholesterol oxidation, which leads to faster plaque formation and undermines the normal functioning of blood vessels.

An extensive study examining the health of 300,000 people found that being overweight increases your risk of heart disease by 32 per cent, while obesity raises it by 81 per cent (Bogers *et al.*, 2007).

Diet and lifestyle modifications are paramount to tackling obesity and reducing the health risks associated with it. A wholesome vegan diet can be a true life-changer for obese and overweight people as it makes us healthier and helps us achieve gradual weight loss (Najjar and Feresin, 2019).

Across studies, vegan diets tend to be the most successful in achieving healthy weight loss – more effective than vegetarian and other diets (Huang *et al.*, 2016). In a 16-week trial of a low-fat vegan diet in overweight and obese people, the participants lost on average 5.9 kilograms, their metabolism slightly increased (so they would naturally burn more energy), they reduced the amount of fat inside their livers by 34 per cent and they lost 10 per cent of fat from their muscles, their insulin sensitivity improved (important for diabetes prevention) and their cholesterol levels dropped (Kahleova *et al.*, 2020).

Because a healthy vegan diet is based on wholefoods, it regulates our energy intake – plentiful fibre intake increases food bulk in the digestive system and ensures slower energy release from foods, while the lower fat content of plant foods naturally reduces fat intake. Increased intake of antioxidants and other important nutrients also improves our metabolism, reduces inflammation and supports beneficial gut bacteria that have multiple positive effects on our health (Najjar and Feresin, 2019).

When we look at body weight across different dietary groups, vegans are the only one with consistently healthy weight and are best protected from obesity (Rizzo *et al.*, 2013; Tantamango-Bartley *et al.*, 2013; Le and Sabaté, 2014; Huang *et al.*, 2016).

HEART DISEASE CAN START IN CHILDHOOD

Both prevention and disease can start in childhood. Research shows that children as young as three years may already have fatty patches in their blood vessels. As these children grow up, the fatty patches develop into atherosclerotic plaques, which is why people in their early twenties can have extensive atherosclerosis (Desmond et al., 2018).

From an early age, children can develop a number of risk factors for cardiovascular disease later in life, including high cholesterol levels, fatty streaks and even their first atherosclerotic lesions in the arteries, high blood pressure, high blood sugar levels and obesity (Olson *et al.*, 2017; Genovesi and Parati, 2020). Being overweight or obese in childhood usually brings about other risk factors for heart disease and is an indicator of an unhealthy diet and lifestyle habits.

Having a higher intake of saturated fats and lower intake of unsaturated fats, as well as being overweight or obese in childhood, is linked to atherosclerotic changes in children's arteries (Alpsoy *et al.*, 2020; Laitinen *et al.*, 2020).

Children growing up on diets rich in meat and meat products, fat and sugar are more likely to have higher cholesterol, triglycerides and blood sugar levels and higher than healthy body weight (Shang *et al.*, 2020). On the other hand, healthy childhood diets not only lower heart disease risk in adulthood but vegan children also have lower cholesterol levels and more antioxidants in the blood – this helps to protect their blood vessels and hearts even more (Desmond *et al.*, 2018 and 2021; Alexy *et al.*, 2021).

When it comes to adolescence, the science is clear that high cholesterol, blood pressure, excess fat (body weight) and smoking harm the health of blood vessels and increase the risk of heart disease in adulthood (Desmond *et al.*, 2018).

Establishing healthy dietary and lifestyle habits from an early age is important for cardiovascular health. Even though atherosclerosis can be reversed, it takes many years, so it's best if it doesn't develop in the first place.

GUT BACTERIA AND HEART HEALTH

The bacteria that live in our gut – the large intestines to be precise – can have wide-ranging effects on our health, including the risk of heart disease. Also called the gut microbiome or gut flora, there are trillions of bacteria and what we eat determines which species thrive and which decline. Gut bacteria are usually beneficial and help us digest food and keep the gut healthy but there can also be harmful bacteria that produce toxic by-products, damage the gut wall integrity and cause inflammation.

The beneficial gut bacteria thrive on fibre-rich foods (plant wholefoods) and produce a substance called butyrate and other short-chain fatty acids (SCFAs). These products serve as sources of energy for colonocytes (gut wall cells), help maintain healthy function of the gut wall, regulate gut pH and are anti-inflammatory (Kazemian *et al.*, 2020; Trøseid *et al.*, 2020; Witkowski *et al.*, 2020). Other beneficial bacteria convert cholesterol into a substance called coprostanol, which is excreted with faeces – that way, these bacteria help to lower our cholesterol levels (Tomova *et al.*, 2019; Kazemian *et al.*, 2020).

On the other hand, the potentially harmful gut bacteria thrive on meat, eggs, high-fat and fried foods, processed foods, sugar and alcohol and produce toxins, such as lipopolysaccharide (LPS), that can damage the gut wall, cause local inflammation and get into the bloodstream, causing inflammation in the blood vessels, contributing to atherosclerosis (Kazemian *et al.*, 2020; Trøseid *et al.*, 2020; Malesza *et al.*, 2021). These bacteria and their products can also compromise the integrity of gut wall, resulting in substances from the gut leaking into the bloodstream

and undermining our health (Witkowski *et al.*, 2020).

Some of the bacteria also produce a substance called trimethylamine (TMA) from foods rich in L-carnitine (meat) and choline (eggs) and the liver then turns it into trimethylamine N-oxide (TMAO) (Campbell, 2017; Spence, 2018; Witkowski *et al.*, 2020). TMAO is dangerous because it increases the stickiness of cholesterol particles and changes cholesterol metabolism in the liver which contributes to atherosclerosis, and it stimulates platelet activity which is dangerous for blood clot formation – both of these effects are a risk factor for heart disease and stroke (Chiu *et al.*, 2020; Kazemian *et al.*, 2020; Trøseid *et al.*, 2020). Studies show that people with the highest levels of TMAO have a 2.5-fold higher risk of major a cardiovascular event (heart attack or stroke) than people with the lowest levels (Tang *et al.*, 2013; Witkowski *et al.*, 2020).

The composition of our gut bacteria also affects our blood pressure – studies show that having a beneficial bacterial population is linked to lower blood pressure while having more of the undesired gut bacteria leads

to higher blood pressure (Tang *et al.*, 2017). It is known that one of the bacterial products contributing to blood pressure lowering are SCFAs but more substances are likely to be involved (Witkowski *et al.*, 2020).

Diet plays a big role in the composition of gut bacteria and their products entering our bloodstream – research has revealed that the differences can be truly profound and meat-eaters produce TMAO, for example, at a much higher rate than vegans (Koeth *et al.*, 2019). As one study highlighted, a vegan diet can significantly reduce TMAO in people whose levels are high (Witkowski *et al.*, 2020). When researchers studied the impact of different diets – a red meat diet, white meat diet or meatless diet – on TMAO levels, they found distinctive differences (Wang *et al.*, 2019). Participants ate each diet for four weeks and had a several-week break in between each. The red meat diet (two servings of red meat daily) raised TMAO levels on average threefold but in some participants, the increase was more than tenfold! Red meat is a very rich source of L-carnitine, the primary substrate for TMAO production. When the participants stopped the red meat diet, their TMAO levels decreased again within one month.

A study by researchers from the University of Leicester examined the effects of following a vegan diet for eight weeks on TMAO levels in participants who were either obese or had increased blood sugar levels – both of which put them at a higher risk of heart disease (Argyridou *et al.*, 2021). The scientists found that the vegan diet had a profoundly positive effect – it reduced participants' TMAO levels almost by half. When the participants returned to their regular diet with meat, their TMAO levels went back up within

a month. Another study reported that vegetarians are about 90 per cent less likely to have high TMAO levels than meat-eaters (Chiu *et al.*, 2020).

People who have high-fibre diets, such as a wholefood vegan one, tend to have more beneficial bacteria and greater bacterial diversity in their gut (Tang *et al.*, 2017; Tomova *et al.*, 2019; Kazemian *et al.*, 2020). Consumption of omega-3 fats, antioxidants from plant foods and probiotics (foods with live bacterial cultures) also helps to lower inflammation and encourages the growth of 'good' bacteria (Ahmad *et al.*, 2019; Tomova *et al.*, 2019; Kazemian *et al.*, 2020; Malesza *et al.*, 2021).

In another study analysing and comparing gut bacteria and their products between vegans and meat-eaters, researchers found interesting differences (Prochazkova *et al.*, 2022). While there were only small differences in the gut microbiota, their metabolic activity differed substantially – vegans had significantly lower levels of harmful bacterial products and higher abundance of beneficial products (SCFAs and their derivatives). Aside from maintaining a healthy gut wall and toning down inflammation, higher amounts of SCFAs have also been shown to increase our immunity against a variety of pathogens, such as bacteria and viruses (Tomova *et al.*, 2019).

A high-fat Western-style diet rich in meat, dairy, eggs, processed foods and refined carbohydrates promotes unfavourable changes in gut bacteria (dysbiosis), resulting in a disturbed gut barrier, increased intestinal permeability and leakage of bacterial toxins into the bloodstream (Malesza *et al.*, 2021). A high intake of fat – saturated fat in particular – also reduces gut bacteria diversity and may reduce the overall

population of gut bacteria (Wolters *et al.*, 2019).

Studies of patients with heart disease reveal they have low levels of beneficial gut bacteria (Kazemian *et al.*, 2020; Trøseid *et al.*, 2020). Spence (2018) recommends that people at risk of stroke avoid egg yolk and red meat and consume a mostly plant-based diet. Red meat contains about four times as much carnitine as chicken or fish, and egg yolks are the richest source of choline (Spence, 2018). The good news is that when we change our diet, gut bacteria start responding and changing within 24 hours (Cani and Everard, 2016).

Dietary fibre can have a major impact on the composition, diversity and richness of our gut bacteria. In a German study of different dietary groups, fibre intake in meat-eaters did not reach the recommended 30 grams a day, while vegans easily surpassed this amount (Dawczynski *et al.*, 2022).

As all the above studies agree, eating plenty of fibre-rich plant wholefoods is key to a healthy gut bacteria population, which, in turn, is key for the reduction of heart disease risk.

DIABETES AND HEART DISEASE

Diabetes is a condition in which blood sugar levels are elevated over a prolonged period of time. This damages the inner lining of blood vessels and raises blood cholesterol levels. That's why diabetes is a significant risk factor for heart and circulatory diseases. Adults with diabetes are two to three times more likely to develop heart and circulatory diseases and are nearly twice as likely to die from heart disease or stroke as those without diabetes. In the UK, one-third of adults with diabetes die from cardiovascular disease (British Heart Foundation, 2025a).

According to one scientific review including data from all over the world, about a third of people with type 2 diabetes also have cardiovascular disease and about half of all deaths in people with diabetes are caused by heart disease or stroke (Einarson *et al.*, 2018).

About 4.6 million adults in the UK have been diagnosed with diabetes but the actual figure may be around 5.6 million, accounting for those who are yet to be diagnosed (British Heart Foundation, 2025a). Around 90 per cent of those diagnosed are living with type 2 diabetes and 10 per cent have either type 1 or rarer types.

HOW DOES TYPE 2 DIABETES DEVELOP?

When we've eaten, the sugar from food is absorbed into the blood and our blood sugar levels rise. This sugar needs to get to every one of the body's cells as the main energy source. To make this happen, the pancreas releases the hormone insulin which allows sugar to gain access into the cells – it is the key that opens the cell door. In type 2 diabetes, a condition called insulin resistance usually develops, meaning that our cells do not react to insulin correctly and do not let sugar inside. It results in blood sugar levels being too high and cells not having enough sugar energy.

Many people think that eating too much sugar causes type 2 diabetes but it's not that simple. Sugar isn't healthy, but it is not a major cause of diabetes. Several studies have demonstrated how diets high in meat, fat and processed foods drive the body to store tiny droplets of fat inside muscle and liver cells. When there's too much fat inside a cell, it stops being able to work properly and doesn't react to insulin correctly – resulting in insulin resistance (Sparks *et al.*, 2005; Morino *et al.*, 2006; Consitt *et al.*, 2009; Perreault *et al.*, 2018; Wali *et al.*, 2020).

Most people with type 2 diabetes are overweight or obese and research suggests that the inflammation triggered by the excess fat in the body is also linked to the development of insulin resistance (Saltiel and Olefsky, 2017).

THE DIET LINK

Eating too much of the wrong type of foods can trigger these changes in the body and lead to type 2 diabetes. Many studies have examined the relationship between meat and type 2 diabetes and found that consumption of red meat increases the risk by 12 to 43 per cent, while processed meat increases the risk by 19 to 57 per cent (Micha *et al.*, 2010; Pan *et al.*, 2011; Steinbrecher *et al.*, 2011; Micha *et al.*, 2012; Zhang *et al.*, 2021). One study of vegetarians and meat-eaters found that eating just one serving of meat per week significantly increased the risk of diabetes – by up to 74 per cent (Vang *et al.*, 2008).

Meat and meat products, whole eggs and high-fat dairy products are always rich sources of saturated fat and, as Professor T Colin Campbell noted in his extensive *China Study*, as people's fat intake rises and carbohydrate falls, the risk of type 2 diabetes increases (Campbell and Campbell, 2005).

A study looking at different types of food and their links to type 2 diabetes risk found that red meat, processed meat, eggs and sugar-sweetened drinks greatly increase the risk (Schwingshackl *et al.*, 2017). Eggs on their own are also a significant risk factor – one large study revealed that people who ate an egg a day had double the risk of developing type 2 diabetes compared to those who ate less than one egg a week (Spence *et al.*, 2010). Another study of 57,000 US adults who ate eggs daily found they were 58-77 per cent more likely to develop type 2 diabetes than those who didn't eat eggs (Djoussé *et al.*, 2009). An even bigger study, by the same team, revealed that the risk of type 2 diabetes starts increasing from eating two eggs a week (Djoussé *et al.*, 2021). According to

researchers, eggs and their cholesterol in particular affect blood sugar metabolism and increase the risk of developing type 2 diabetes (Lee *et al.*, 2014). Cholesterol both inhibits the production of insulin and can lower the body's sensitivity to it.

On the other hand, plant-based diets greatly reduce the risk of type 2 diabetes. It's because plant wholefoods naturally contain less fat, saturated fat in particular, than animal products, and they contain a lot more fibre, helping to regulate blood sugar, and many beneficial phytochemicals and complex carbohydrates – put simply, they make your body work better and lower your risk of diabetes (Chen *et al.*, 2018). It may sound too good to be true, but the evidence is now so strong that many healthcare professionals recommend a plant-based diet as a part of the disease treatment.

Vegans have up to 50 per cent lower risk of type 2 diabetes (Appleby and Key, 2016; Salas-Salvadó *et al.*, 2019) and even if you already have the disease, a healthy vegan diet, low in fat and high in wholefoods, can improve insulin sensitivity, lower blood sugar levels and even help reverse the condition (Barnard *et al.*, 2009; Kahleova *et al.*, 2011; McMacken and Shah, 2017; Viguiliouk *et al.*, 2019). In several studies, many patients were able to reduce their diabetes medication and some were even able to stop taking it.

STRESS AND HEART DISEASE

Short-term stress, such as being nervous about a meeting or getting scared by a dangerous situation, is normal and harmless for a healthy person because once the situation passes, the stress is gone. However, for people who already have heart or circulatory issues, even short-term stress can be dangerous (Osborne *et al.*, 2020; Levine, 2022). It's because stress causes blood vessels to constrict and that increases blood pressure – if an artery is already narrowed by plaques, a further constriction might block it and lead to sudden events, such as a heart attack.

Long-term or chronic stress (lasting months or years), on the other hand, can play a major role in the development of heart disease and cause sudden events even in a healthy person and makes matters worse for heart disease patients (Osborne *et al.*, 2020; Levine, 2022). Chronic stress can be caused, for example, by a difficult living or financial situation, bereavement, lasting physical or mental health problems, a stressful job or family issues.

In response to stress, which is perceived as danger by the body, the sympathetic nervous system is activated and the hormones cortisol and adrenaline are released. These actions cause an increase in blood pressure, blood lipids (including cholesterol) and blood sugar because they are preparing the body for a 'fight or flight' reaction and so it's important that muscles are well-supplied with oxygen and energy. At the same time, the immune system is blunted while pro-inflammatory substances are released and blood-clotting increases (Osborne *et al.*, 2020). When there's no fight or flight and the stressful situation continues, it may lead to a lasting increase in blood pressure,

blood sugar, cholesterol levels and triglycerides, and cause or contribute to inflammation in blood vessels, which promotes the build-up of atherosclerotic plaques (Levine, 2022). At the same time, the increased blood clotting poses a risk, especially in people who already have atherosclerosis – a blood clot can block an artery (Kivimäki and Steptoe, 2018).

Chronic stress can also be dangerous in another way – often, it triggers unhealthy behaviours, such as excessive drinking, comfort eating, smoking, physical inactivity and disturbed sleep patterns (Osborne *et al.*, 2020). These are all significant risk factors for heart disease and it's another reason why stress increases the risk.

As a part of a heart-healthy lifestyle, it's important to engage in stress management techniques, such as non-competitive physical activity, mindfulness, yoga, meditation, calming breathing exercises, walking – where you connect with nature or whatever it takes for you to release some of the day's tension!

DIET AND HEART DISEASE

Before exploring what diet can do to prevent or treat heart disease, it's crucial to outline why certain foods increase the risk or accelerate atherosclerosis.

MEAT AND HEART DISEASE

Red, white and processed meats are all a significant source of saturated fats, cholesterol and haem-iron, they trigger TMAO production and contain no fibre – that's why they can greatly increase the risk of heart disease (Papier *et al.*, 2021).

When a scientific team compiled and analysed data from previous studies on diet and cardiovascular health, they found that red and processed meat increased the risk of heart disease, stroke and heart failure (Bechthold *et al.*, 2019). For each 100 grams of red meat daily, the risk of coronary heart disease rose by 15 per cent, the risk of stroke by 12 per cent and the risk of heart failure by eight per cent. For each 50 grams of processed meat daily, the risk of coronary heart disease increased by 27 per cent, the risk of stroke by 17 per cent and the risk of heart failure by 12 per cent. Another study found almost the same – each 100 grams of unprocessed red meat increased the risk of CVD by 11 per cent, while each 50 grams of processed meat increased it by 26 per cent (Shi *et al.,* 2023).

And there are more studies – one found that each 50 grams of red meat daily increased the risk of coronary heart disease by nine per cent and each 50 grams of processed meat raised the risk by 18 per cent (Paier *et al.*, 2021). This adds to the results of a previous study which found that in men, each daily portion of red meat increased the risk of cardiovascular disease by 11 per cent, while a portion of processed meat increased the risk by 15 per cent (Al-Shaar *et al.*, 2020).

In a study of almost 150,000 people from various backgrounds, those who ate the most unprocessed red meat had a 14 per cent higher risk of heart disease and those who ate the most processed meat had a 29 per cent higher risk – compared with those who ate only small amounts (Wang *et al.*, 2024). The study didn't compare this to people who ate no meat but it's likely the risk reduction would have been even greater. The authors calculated that replacing just one half of a daily serving of red meat with a half of a serving of nuts would reduce the risk of heart disease by 14 per cent.

Interestingly, another study calculated that replacing a daily 50-gram serving of processed red meat with nuts would reduce the risk of heart disease by 27 per cent, pulses would reduce it by 23 per cent and wholegrains by 36 per cent (Neuenschwander *et al.*, 2023).

One scientific team set out to find out whether the increased cardiovascular disease risk that comes with meat consumption is directly linked to increased TMAO levels (Wang *et al.*, 2022). In their study, just over one serving of meat (any meat) daily increased the risk of cardiovascular disease by 22 per cent and raised TMAO levels by 7.8 per cent. Interestingly, just over one serving of red meat raised the risk by 15 per cent and TMAO by 10.6 per cent, while animal products altogether increased the risk by 18 per cent and TMAO levels by 9.2 per cent. The authors concluded that the increase of TMAO levels caused by meat and other animal products partly explains the heightened heart disease risk.

A long-term study following almost 30,000 people, their dietary habits and heart health found that red

meat, processed meat and poultry all increase the risk of heart disease, stroke, heart failure or death from a sudden cardiovascular event (Zhong *et al.*, 2020). Another large analysis of studies on meat intake and cardiovascular death found that people who ate the most processed meat had an 18 per cent higher risk and people who ate the most red meat had a 16 per cent higher risk of dying from heart disease or stroke (Abete *et al.*, 2014). These results go hand-in-hand with yet another study that found that with each daily serving of red meat, the risk of death from heart disease increased by 18 per cent and with each daily serving of processed meat, it increased by 21 per cent (Pan *et al.*, 2012).

MEAT IRON AND HEART DISEASE

There are two types of iron in the foods we eat – haem iron in meat, poultry and seafood and non-haem iron in plants. The human body uses these forms differently – the absorption of haem iron from meat is unlimited, so we absorb it no matter what. That means high meat consumption can lead to iron overload. The main sources of haem iron are red meat, processed meat, chicken and seafood (Qi *et al.*, 2007). On the other hand, the body only absorbs as much non-haem iron as it needs, so we cannot overload on plant iron.

Too much haem iron stimulates the formation of free radicals – dangerous molecules that can damage our DNA and blood vessel walls and increase the oxidation and therefore stickiness of LDL cholesterol particles, making them more likely to form cholesterol plaques leading to atherosclerosis and heart disease (Niki, 2011; Hunnicutt *et al.*, 2014; Kobayashi *et al.*, 2018). It has also been found that atherosclerotic plaques

contain accumulated iron, which further damages the surrounding cells (Yan *et al.*, 2022).

In a study from the Netherlands, a high haem iron intake from meat was associated with a 65 per cent increase in heart disease risk (van der A *et al.*, 2005). A US study found virtually identical results – high haem iron intake from meat increased the participants' risk of cardiovascular disease by 65 per cent (de Oliveira Otto *et al.*, 2012). A review of studies on the subject concluded that high intakes of haem iron from meat increase the risk of heart disease by 57 per cent (Hunnicutt *et al.*, 2014). Intake of iron from other sources – non-haem iron – did not have such effects in any of these studies and even had a protective role in cardiovascular health.

It is clear from these results that too much meat means too much haem iron and that can lead to faster atherosclerosis progress and a much higher risk of heart disease. We are simply healthier if we don't eat meat, with its saturated fats, haem iron and carnitine that drives TMAO production.

DAIRY AND HEART DISEASE

In their *Presidential Advisory* on dietary fats and cardiovascular disease, the American Heart Association explains that 51 per cent of dairy fat consists of saturated fats and four per cent are trans fats – they go on to warn that by its very nature, dairy fat raises LDL cholesterol and therefore increases the risk of heart disease (Sacks *et al.*, 2017). Butter, ghee, cream, whole milk,

high-fat cheese, dairy desserts and ice cream all contain high amounts of saturated fat.

In a study designed to compare the effect of a diet rich in butter or cheese on participants' cholesterol levels, researchers randomly assigned participants to one of five different diets at a time and then, once everyone ate each type of diet for four weeks, they compared the

results (Brassard *et al.*, 2017). Each type of diet was followed by four weeks of 'normal eating' to clearly separate the effects of each diet. These five diets were: 1) rich in saturated fats from butter; 2) rich in saturated fats from cheese; 3) rich in monounsaturated fats from olive oil; 4) rich in polyunsaturated fats from corn oil; 5) low in fat and higher in low-fibre carbohydrates. Results showed that both butter and cheese diets increased LDL cholesterol levels compared to the other diets – and butter even more so than cheese.

When scientists analysed data from three large studies including over 220,000 participants whose health and diet were followed for a minimum of 20 years, they found a clear effect of dairy fat on cardiovascular health (Chen *et al.*, 2016). Substituting five per cent of total daily calories consumed as dairy fat with polyunsaturated fats was associated with a 24 to 26 per cent lower risk of cardiovascular and coronary heart disease and a 22 per cent lower risk of stroke. Substituting the same amount of calories from dairy fat with carbohydrates from wholegrains was associated with a 28 to 34 per cent lower risk of cardiovascular and coronary heart disease and a 16 per cent lower risk of stroke. Refined carbohydrates (sugars, white flour), however, did not have the same effect.

In an experimental study where each group of people ate 50 grams of different fat daily – butter or vegetable oils – for four weeks, the participants who ate butter had the worst cholesterol results (Khaw *et al.*, 2018). Their total and LDL cholesterol levels shot up compared to the other groups. And another study investigating the effect of additional saturated fat – high-fat dairy products and butter – on participants' cholesterol levels found that these foods also invariably increased cholesterol (Bergeron *et al.*, 2019).

A study examining dairy intake and premature coronary artery disease (atherosclerosis in the arteries surrounding the heart) in over 800 people found that dairy consumption was associated with an increased risk of the disease (Mohammadifard *et al.*, 2025). However, severe atherosclerosis was only linked with higher intake of high-fat dairy.

Previously, Finland had a very high rate of heart disease so a nationwide health campaign to reduce the intake of saturated fat was launched in 1972 (Pietinen *et al.*, 1996). The project managed to successfully reduce people's intake of high-fat milk and butter and increase their fruit and vegetable consumption, which lowered total cholesterol by 13 per cent in men and 18 per cent in women. By 1992, heart disease death rates had fallen by 55 per cent in men and 68 per cent in women.

There's much debate about the effect of dairy products – and dairy fat in particular – on heart health but while there are a number of studies with mixed results (Nestel and Mori, 2022), there's a large body of scientific data showing the detrimental effects of dairy, particularly frequent consumption of high-fat, non-fermented dairy products (butter, whole milk, cream, etc). Some research suggests that certain fermented dairy products, such as yoghurt and cheese, may have a neutral or even heart-protective effect (Companys *et al.*, 2020) but it's only small and usually seen when they replace unhealthier foods (Nestel and Mori, 2022). Soya yoghurt is still better for you because not only does it contain healthy unsaturated fats, it also offers healthful fibre, phytosterols and quality protein.

SOYA AND HEART HEALTH

Scientists agree that soya can promote heart health – a fact supported by dozens of scientific studies (Messina, 2016). A meta-analysis of studies on the subject revealed that soya food consumption lowers the risk of heart disease, stroke and cardiovascular disease (Yan *et al.*, 2017).

This is likely due to several health-supporting properties of soya, such as its antioxidants (including isoflavones), healthy fats and fibre content but also compounds that directly improve blood vessel lining resilience and reduce the stickiness of cholesterol (Yan *et al.*, 2017).

Soya protein has cholesterol-lowering properties and according to scientists, 25 grams of soya protein daily can reduce your cholesterol levels – this claim was approved by official health bodies in more than 10 countries (Messina, 2016). A meta-analysis of clinical trials showed that soya consumption not only lowers cholesterol levels but also has a positive effect on other blood lipids (Tokede *et al.*, 2015). The authors pointed out that these effects were stronger with whole soya foods (soya milk, edamame) than with soya protein extracts.

It is thought that soya lowers LDL cholesterol because during its digestion, several peptides are formed and these stimulate specific cells in the liver that break down cholesterol that's already in the blood and also reduce the synthesis of new cholesterol in the liver (Caponio *et al.*, 2020; Macchi *et al.*, 2021).

What's more, soya isoflavones and certain soya peptides may prevent artery plaques from forming (Sekikawa *et al.*, 2019; Kim *et al.*, 2021). And because isoflavones are strong antioxidants, they prevent LDL cholesterol from oxidising and therefore lower the risk of atherosclerosis or slow down its progress (Sekikawa *et al.*, 2019). In fact, a systematic review and meta-analysis of studies on isoflavones and cardiovascular disease revealed that their regular intake lowers your risk of the disease – the more you eat, the lower your risk (Naghshi *et al.*, 2024). That is not to say you should eat soya at every meal, but one or two daily servings of soya foods may significantly reduce your risk of heart disease.

Research has also revealed that soya isoflavones help to maintain blood vessel health because they have a protective effect on blood vessel lining and help to relax blood vessel walls which may slightly lower your blood pressure (Yamagata, 2019; Kim *et al.*, 2021).

EGGS AND HEART DISEASE

Eggs are a rich source of dietary cholesterol, which may raise blood cholesterol levels, and also choline, from which TMAO is produced – both may raise the risk of heart disease as discussed above.

An average egg contains around 187 milligrams of cholesterol. A large analysis of six US studies on egg and cholesterol intake and the risk of heart disease brought interesting results – for each 300 milligrams of cholesterol consumed, the risk of heart disease increased by 17 per cent and for each half egg consumed, the risk increased by six per cent (Zhong *et al.*, 2019).

In a study of postmenopausal women, following their health and diet for over 17 years, researchers found that those who ate one egg a day or more had a 14 per cent higher risk of heart disease compared to women who ate less than one egg a week (Chen *et al.*, 2021). A long-running French study of women's health found that those who ate the most eggs (around an egg a day) had a 22 per cent higher risk of high blood pressure compared to those who ate hardly any (McDonald *et al.*, 2020).

A study of over 20,000 US male physicians that lasted for over 20 years revealed that participants who ate an egg a day had a 28 per cent higher risk of heart failure and those who ate two eggs a day had a 64 per cent higher risk compared to those who rarely ate eggs (Djoussé and Gaziano, 2008).

When it comes to the risk of dying from cardiovascular disease and egg consumption, science also has a lot to say. A large study of over 500,000 people found that each half egg consumed daily increased the risk of cardiovascular death by seven per cent (Zhuang *et al.*, 2021). Another large study found that each 50-gram egg consumed per day increased the risk of death from heart disease by nine per cent (Zhao *et al.*, 2022). An Italian study found even more unsettling results – people who ate more than four eggs a week had a 75 per cent higher risk of dying from cardiovascular disease than people who ate just one egg a week or less (Ruggiero *et al.*, 2021). People who ate two to four eggs had a 43 per cent higher risk.

One study investigating the effect of plant and animal protein on death from various diseases analysed data from over 400,000 people (Huang *et al.*, 2020). They found that substituting just three per cent of daily energy intake from egg protein with plant-based protein can lead to a 26-28 per cent lower risk of dying from cardiovascular disease, a 24-28 per cent lower risk of dying from heart disease and a 25-33 per cent lower risk of fatal stroke.

At the same time, other studies, such as a multinational study following the health and diet of over 170,000 people, didn't find such clear-cut results (Dehghan *et al.*, 2020). In this study, researchers came to the conclusion that there was no direct association between egg intake of up to one egg daily and cardiovascular disease. However, as they admitted, they didn't account for other dietary and lifestyle factors that can affect the outcomes and the average egg consumption of participants was relatively low.

While more research will bring more clarity, it's obvious that eggs are not heart protectors and may increase the risk of heart disease.

OMEGA-3 FATS, FISH OILS AND HEART DISEASE

We obtain omega-3 fats from plants in the form of alpha-linolenic acid (ALA) and from fish and microalgae in the form of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). There are small amounts of these fatty acids in some other animal products as well but they are too small to provide a nutritionally relevant dose.

The human body converts ALA into EPA and DHA but this conversion is not very efficient. In some people, conversion works better than in others but more research is needed to understand the mechanisms. That's why many people opt to take EPA and DHA directly in the form of supplements made from microalgae or fish oil. Of the two, supplements made from microalgae are far superior to fish oil because they are more sustainable and don't contain dangerous environmental pollutants that are often found in fish oil (Roszko *et al.*, 2018). However, as shown below, eating ALA from plant sources has its advantages.

Omega-3 fats are essential for us – we need them for good health because they are a natural component of many of our tissues. However, when it comes to the claims that they also protect us from heart disease, the picture becomes a little blurry.

Cochrane reviews, as stated, are considered to be the gold standard quality in science. The most comprehensive Cochrane review of evidence on the subject found that increasing EPA and DHA has little or no effect on cardiovascular events (eg heart attack) or death (Abdelhamid *et al.*, 2020). They also found that omega-3 supplements do not reduce the risk of heart disease, stroke or death caused by cardiovascular events and that there was little evidence of effects of eating fish. However, eating ALA (from flaxseeds or flaxseed oil, chia seeds, hemp seeds, walnuts or rapeseed oil) may help slightly reduce cardiovascular events, heart irregularities and death. They concluded that increasing plant based ALA may be mildly protective for some heart and circulatory diseases.

When it comes to fish oil supplements, another scientific review found a concerning effect – they may actually increase the risk of atrial fibrillation (irregular heartbeat) by 25 per cent and if you take more than one gram daily, the risk may increase by 49 per cent (Gencer *et al.*, 2021). On the other hand, ALA from plants reduces the risk (Abdelhamid *et al.*,2020).

A major review on omega-3 fatty acids and the risk of heart disease found that a regular intake of both ALA and DHA reduces the risk of fatal heart disease by about 10 per cent for each (Del Gobbo *et al.*, 2016). And another recent study found that people with higher ALA intakes had 8 to 11 per cent lower risk of dying from cardiovascular and heart disease (Naghshi *et al.*, 2021). An earlier study showed that regular ALA intake lowered the risk of cardiovascular disease developing in the first place by about 10 per cent and the risk of fatal events by 20 per cent (Pan *et al.*, 2012). While these results are more positive than the Cochrane review results, it's clear that plant sources of omega-3s can help protect our cardiovascular health while fish oils do not.

An interesting study compared the effects of daily ALA intake with the same dose of daily omega-6 fatty acids in a 12-week experiment (Liu *et al.*, 2022). The participants didn't know which group they belonged to as the oils were delivered in identical capsules. At the end of the study, participants who took the ALA capsule had reduced their total and LDL cholesterol levels compared to the omega-6 group. In this study, participants were asked not to change anything about their lifestyle so we can only imagine the likely positive effect that a healthy diet in combination with ALA would have.

In a nutshell, omega-3 fats are essential for our health but are no magic bullet when it comes to heart disease. Eating ALA-rich foods may offer slight protection from cardiovascular disease and events – taking an algal EPA and DHA supplement helps to supply sufficient amounts to the body, while taking fish oil has likely no protective effect and may even have adverse health effects.

HEART-HEALTHY DIET

According to the American Society for Preventive Cardiology, 90 per cent of cardiovascular risk is attributable to nine modifiable factors: abnormal blood lipids (cholesterol and triglycerides), smoking, hypertension (high blood pressure), diabetes, abdominal obesity, psychosocial factors, low consumption of fruit and vegetables, too much alcohol and a lack of regular physical activity (Belardo *et al.*, 2022).

They recommend a diet consisting predominantly of fruit, vegetables, pulses, nuts, seeds, plant protein and fatty fish (for omega-3s), replacing saturated fat with polyunsaturated and monounsaturated fats, reducing dietary cholesterol intake and increasing intake of fibre-rich foods. The European Society of Cardiology recommendations are virtually the same and they also highlight that sugar intake should be minimised and trans fats are to be avoided completely (Visseren *et al.*, 2021).

In 2019, the American College of Cardiology and American Heart Association Task Force on Clinical Practice Guidelines published a comprehensive report on how to prevent heart disease (Arnett *et al.*, 2019). Among their main recommendations are the following points:

- **a diet emphasising intake of vegetables, fruit, pulses, nuts, wholegrains and fish for omega-3 fats. However, as described in the previous chapter, there are healthier and more sustainable sources of omega-3s**
- **replacement of saturated fat in the diet with monounsaturated and polyunsaturated fats (from plant foods)**

- **a diet containing reduced amounts of cholesterol and sodium (salt)**
- **minimising the intake of processed meat, refined carbohydrates and sweetened drinks**
- **trans/hydrogenated fats should be avoided**

The report highlights that plant foods have a heart-protective effect across many studies and so our diets should be centred around them.

Finally, the American Heart Association's 2021 guidance on how to eat to protect the heart advises people to choose healthy sources of protein, such as pulses and nuts, while red and processed meat should be avoided (Lichtenstein *et al.*, 2021). They explain that this advice is based on studies showing that red and processed meat increase heart disease risk because they contain saturated fat and haem iron and promote harmful gut bacteria, and processed meat also contains an extra dose of toxins. Another important

point they make is to avoid butter, lard, coconut and palm oil as these are all high in saturated fat. They encourage everyone to eat more fruit, vegetables, wholegrains and unprocessed foods, and to limit sugar, salt and alcohol.

As you can see, all these major institutions agree that a plant-based diet is a heart-healthy one. Plants contain a wide range of antioxidants that help to protect blood vessels from damage, tone down inflammation, decrease LDL cholesterol oxidation and can improve

In his large-scale *China Study*, Professor T Colin Campbell found that high intakes of animal protein went hand-in-hand with heart disease (Campbell and Campbell, 2005). He discovered that animal protein contributed to higher cholesterol levels, while plant protein lowered cholesterol. A later analysis of studies focusing on the effect of swapping plant-based foods rich in protein for animal sources of protein supported his conclusions when it found that the plant-based foods always had a cholesterol-lowering effect compared to animal products (Li *et al.*, 2017).

A large study of over 70,000 people looking at their animal and plant protein intake and health found that those who ate the most plant protein and the least animal protein were 27 per cent less likely to die from heart disease, 28 per cent less likely to die from a heart attack and also 28 per cent less likely to die from stroke compared to people who ate the most animal protein (Budhathoki *et al.*, 2019).

A US study showed that swapping one portion of unprocessed red meat daily for plant-based protein sources, such as pulses, soya or nuts, cuts the risk of cardiovascular disease by 13 per cent and replacing a portion of processed meat with these foods cuts the risk by 17 per cent (Al-Shaar *et al.*, 2020).

In a recent review of plant-based diets and cardiovascular health, the authors concluded that studies consistently show that plant-based diets reduce the risk of heart disease and stroke (Del Re and Aspry, 2022). They highlighted that to achieve this effect, the diet has to be healthy and not based on processed and sugary foods. This is an important distinction because, as a large Harvard University study of almost 200,000 people showed, a healthy plant-based diet can reduce the risk of heart disease by 25 per cent, while an unhealthy one can increase the risk (Satija *et al.*, 2017). The authors classified wholegrains, fruits, vegetables, nuts, pulses, oils, tea and coffee as healthy, whereas juices, sweetened beverages, refined grains (white flour), potatoes, chips and sweets were classified as unhealthy.

A meta-analysis of studies on the topic came to a similar conclusion – a healthy plant-based diet reduces the risk of cardiovascular disease (Gan *et al.*, 2021). Every 25 per cent increase in the healthy plant-based diet score reduces the risk by 16 per cent.

Looking specifically at vegan and vegetarian diets, several major reviews found matching results – these diets are associated with lower cholesterol levels and an 18-41 per cent lower risk of heart disease (Appleby and Key, 2016; Dinu *et al.*, 2017; Kahleova *et al.*, 2017; Glenn *et al.*, 2019; Dybvik *et al.*, 2023; Ocagli *et al.*, 2023).

An analysis combining data from three Seventh Day Adventist studies, including over 150,000 people, found that vegans had a 75 per cent lower risk of hypertension and up to 55 per cent lower risk of heart disease (Le and Sabaté, 2014). Men had greater risk reduction than women in these studies.

In an interesting study of Ethiopian Orthodox Christians who followed a vegan diet for seven weeks for Lent, researchers compared the participants' blood lipids, blood pressure and body weight before Lent with results at the end of the Lent period and then

blood sugar control (Korakas *et al.*, 2018). A wholefood plant-based diet is naturally low in saturated fat, devoid of cholesterol, high in fibre and healthy carbohydrates, and contains healthy unsaturated fats, natural nitrates (that help dilate blood vessels), a wealth of antioxidants and other health-protective compounds, and supports the growth of health-beneficial gut bacteria – all of these factors are the reason why it's so beneficial for the heart (Kahleova *et al.*, 2017; Satija and Hu, 2018; Gan *et al.*, 2021).

seven weeks later when they resumed their usual diet that contained meat (Sisay *et al.*, 2020). The results showed that even the relatively short period of vegan eating for Lent achieved significant changes. The participants' cholesterol, blood pressure and weight decreased to healthier levels but when they returned to their usual diet, the levels increased again.

As mentioned in previous chapters, the Mediterranean diet – which is largely plant-based – has been useful in the prevention and treatment of heart disease. However, a study comparing it with the effects of a low-fat vegan diet where participants consumed each for 16 weeks showed that the vegan diet achieved greater total and LDL cholesterol reductions (Barnard *et al.*, 2022). Both diets lowered the participants' blood pressure, while only the vegan diet also led to a healthy weight loss.

One study set out to investigate which plant foods are best for cardiovascular risk reduction and how much we should be eating daily (Aune, 2019). The results of this thorough review show that fruit, vegetables, wholegrains and nuts seem to offer the best protection for the heart and blood vessels and that we should aim for these quantities daily: 800 grams (around eight to 10 portions) of fruit and vegetables, 225 grams of wholegrain foods and 15 to 20 grams of nuts.

Other studies also highly recommend pulses as heart-healthy protein sources that can reduce cardiovascular risks (Mariotti, 2019). Soya in particular can be extremely helpful in reducing the risk of heart disease because its protein has LDL cholesterol-lowering properties (Ramdath *et al.*, 2017; Chatterjee *et al.*, 2018). In the US and

Canada, they approved the claim that 25 grams of soya protein daily can reduce the risk of heart disease. It appears that it's not just the protein in soya that has health-beneficial effects but other bioactive compounds as well, such as isoflavones and antioxidants, so foods made from whole soya beans are recommended over soya protein isolates (Ramdath *et al.*, 2017). Whole soya bean products include tofu, tempeh, natto, soya milk, edamame, miso, etc.

A wholefood vegan diet doesn't just lower the risk of heart disease; it also cuts the risk of dying from it. A study analysing data from over 130,000 participants found that people who favour plant protein over animal protein have a lower risk of premature death and particularly of dying from cardiovascular disease (Song *et al.*, 2016). In people with at least one unhealthy lifestyle factor, such as physical inactivity or obesity, each additional three per cent of plant protein in the diet lowered the risk of premature death by 10 per cent and the risk of dying from heart disease or stroke by 12 per cent. When the same amount of plant protein was used to replace processed meat, the risk of premature death fell by 34 per cent; when it replaced red meat, the risk fell by 12 per cent; and for eggs, by 19 per cent.

Another study looking at diet and the risk of dying from heart disease found that vegetarians and vegans (the study combined the two) had a 30 per cent lower risk (Jabri *et al.*, 2019).

Research is clear – diets high in meat, saturated fats, sugar, processed foods and salt, and lacking in fruit and vegetables, wholegrains, pulses, nuts and seeds can greatly contribute to cardiovascular disease and fatal cardiovascular events. A healthy vegan diet, on the other hand, can protect our cardiovascular system better than any other diet.

STROKE RISK AND DIET

Although stroke is a part of the cardiovascular disease family, there is a lack of research looking at the links with diet.

Stroke is a sudden and life-threatening event in which an artery supplying the brain is blocked (ischaemic stroke) or a blood vessel in the brain bursts (haemorrhagic stroke). Ischaemic stroke is much more common than haemorrhagic – about 87 per cent of strokes are ischaemic (Mozzafarian *et al.*, 2016).

There are many risk factors for stroke, including advanced age, high blood pressure, diabetes, high blood fats and cholesterol, atrial fibrillation, smoking, physical inactivity, poor nutrition, family history, chronic kidney disease, obesity, coronary heart disease, sleep apnoea and depression (Campbell, 2017; Chiu *et al.*, 2020). Some of these are beyond our control, such as age or genetics, but most of them are linked to lifestyle. As Spence (2018) puts it: "When ranked in order of importance, among the interventions available to prevent stroke, the three most important are probably diet, smoking cessation and blood pressure control."

According to multiple studies, the higher the blood pressure, the higher the risk of stroke (Boehme *et al.*, 2017). One study found that each 20 mmHg increase in systolic blood pressure or each 10 mmHg increase in diastolic blood pressure more than doubles the risk of death from stroke, while a reduction of 5 mmHg in systolic blood pressure leads to a seven per cent reduced risk of all-cause mortality, a nine per cent reduced risk of

heart disease and a 14 per cent reduced risk of stroke (Kahleova *et al.*, 2017).

Vegans consistently have the lowest risk of hypertension among all other diet groups and in people who suffer from high blood pressure, a switch to a wholefood vegan diet usually achieves a significant reduction in blood pressure (Alexander *et al.*, 2017).

A recent review summarised the key dietary recommendations for stroke prevention – a plant-based diet, low in saturated fats, avoiding trans fats, low in salt and sugar and rich in fruit and vegetables (Boehme *et al.*, 2017). A healthy diet is crucial to prevent atherosclerosis in the brain, which is one of the major causes of stroke worldwide (Banerjee and Chimowitz, 2017). The condition is so dangerous because there's always the risk that one of the atherosclerotic plaques will tear off and block a blood vessel in the brain, causing a stroke.

Inflammation of the blood vessel lining is also a big part of atherosclerosis and stroke risk. One study found that the more pro-inflammatory foods people ate, the higher was their risk of stroke, increasing the risk by up to 28 per cent (Li *et al.*, 2020). Foods such as processed, red and organ meats, refined carbohydrates and sweetened drinks were labelled as pro-inflammatory. Foods such as green leafy vegetables, yellow vegetables, wholegrains, fruit, tea, coffee and
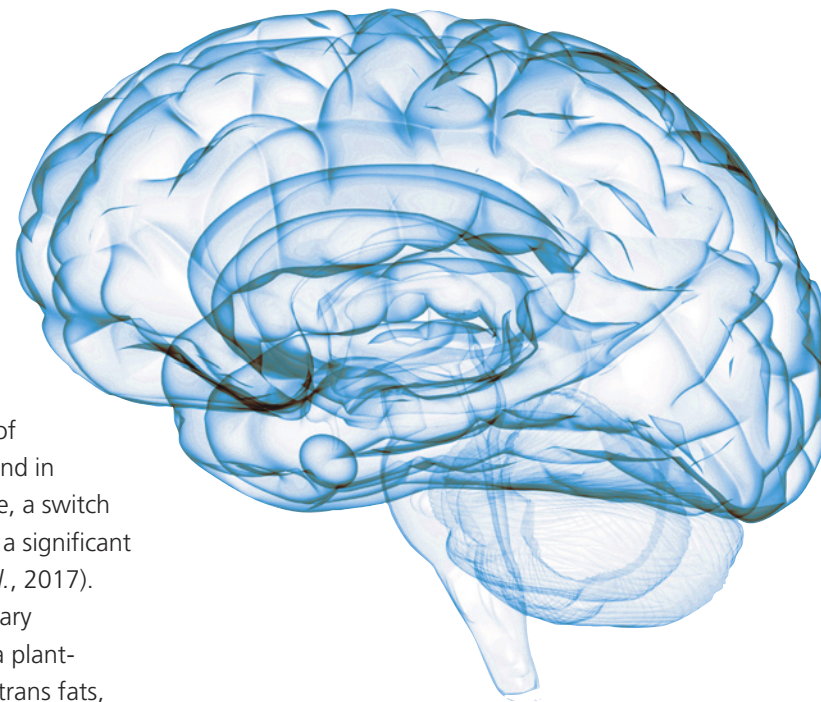
moderate amounts of wine were labelled as anti-inflammatory.

A large study conducted in Taiwan, comparing diets and stroke risk of vegetarians and meat-eaters, found a stark division (Chiu *et al.*, 2020) – vegetarians had half the risk of stroke, 60-74 per cent lower risk of ischaemic stroke and 65 per cent lower risk of haemorrhagic stroke. It is worth noting that vegetarians in this study had a relatively low intake of eggs (0.3 servings a day) and dairy (0.2-0.3 servings a day), making their diet almost vegan.

In the *Adventist Study* in the US, vegetarians had a 29 per cent lower risk of stroke and this risk reduction was predominantly seen in men (Kwok *et al.*, 2014).

Data from China show how a dietary shift changes population health – over the past few decades, traditional Chinese diets have been in decline due to

the increasing popularity of Western foods, resulting in a higher intake of meat and eggs and a decreased intake of fruit, vegetables and wholegrains. This shift has brought about a marked rise in cardiovascular disease. Between 2003 and 2013, heart disease deaths in China increased by 213 per cent, while deaths from stroke increased by 27 per cent (Spence, 2018).

A comprehensive study of diets and health of meat-eaters, pescatarians and vegetarians – the EPIC-Oxford study – brought somewhat unexpected results that are in contrast with other studies (Tong *et al.*, 2019). The study found that although vegetarians had 22 per cent lower rates of ischaemic heart disease than meat-eaters, they had 20 per cent higher rates of total stroke – haemorrhagic stroke in particular.

When the scientists divided the group into vegetarians and vegans, the latter had an 18 per cent lower risk of ischaemic heart disease but a 35 per cent higher risk for total stroke than meat-eaters. However, these results were not statistically significant because the number of vegans in the study and stroke cases among them were so low. It is therefore possible that an odd case skewed the results.

As the results of the EPIC study are in stark contrast with the Taiwanese study described above (Chiu *et al.*, 2020), the authors of the latter offered an explanation – nearly 80 per cent of vegetarians in the EPIC-Oxford study drank alcohol but most vegetarian participants in Taiwan did not. It's been suggested that alcohol consumption may negate the protective effect of low cholesterol levels (typical of vegetarians) on haemorrhagic stroke risk (Chiu *et al.*, 2020). Spence (2018) also highlighted that high alcohol consumption increases the risk of haemorrhagic stroke – the risk increases from about nine standard drinks per week for women and 14 for men. The EPIC-Oxford vegetarians also had a higher cheese consumption than meat-eaters – this fact is important because cheese is high in saturated fat and salt, both of which contribute to high blood pressure and cholesterol. As mentioned above, the Taiwanese vegetarians had minimal intakes of dairy, so this difference may help to explain the different study results.

Campbell (2017) points out that although plant-based diets seem to confer protection from stroke, there's one inconsistency in population data – haemorrhagic stroke used

ATRIAL FIBRILLATION

Atrial fibrillation is one of the most common forms of abnormal heart rhythm (arrhythmia) and a major cause of stroke (British Heart Foundation, 2025a). Around 1.5 million people in the UK have been diagnosed with atrial fibrillation. People with this condition are five times more likely to have a stroke. The good news is that a plant-based diet can significantly lower the risk of atrial fibrillation. As the latest review explains, plant based diets may reduce the likelihood of many atrial fibrillation risk factors such as hypertension, obesity, diabetes, atherosclerosis and inflammation (Storz and Helle, 2019).

to be more common in some Asian countries, notably in Japan, when they still had a more traditional diet. With the increasing popularity of Western foods, Japan's rates of obesity, diabetes and heart disease have also increased but haemorrhagic stroke has decreased. It's been suggested that this may be a coincidence since traditional Japanese diet is very high in salt and over the past several decades, there have been many initiatives to reduce salt intake as it's linked to high blood pressure – a major risk factor for stroke (Campbell, 2017). At the same time, the healthcare system in Japan has also improved hypertension treatment and monitoring, so that would have played a role in reducing stroke risk as well. High salt intake causes water retention and so increases blood pressure through different mechanisms than diets high in animal protein and fat, which may lead to atherosclerosis.

A meta-analysis of studies on diet and the risk of stroke revealed that vegetarian diets were associated with a 29 per cent lower risk of haemorrhagic stroke, a 22 per cent lower risk of ischaemic stroke and a 16 per cent lower risk of stroke in general (Liu *et al.*, 2022a). The results also showed that high consumption of fruit was particularly protective against stroke.

A comprehensive review of evidence on diet and the risk of stroke looked at foods and food groups to determine which lower the risk and which increase it (Guo *et al.*, 2022). The results were clear – fruit and vegetables lowered the risk, while red and processed meat increased the risk. In fact, fruit and vegetable consumption has been found to be protective against stroke in multiple studies – people who eat the most fruit and vegetables have a 21 per cent lower risk

compared to people who eat very little, with several studies revealing similar results (Campbell, 2017). According to one study, the strongest risk reduction was seen at an intake of 800 grams a day of fruit and vegetables (Aune, 2019).

Another study found that fibre (only found in plant-based foods) lowers the risk of stroke – for each 10 grams of fibre per day, the risk reduced by 12 per cent (Chen *et al.*, 2013).

On the other hand, scientists found that each 100 grams of total meat daily increases the risk of stroke by 10 per cent, 100 grams of red meat increases it by 13 per cent and each 50 grams of processed meat

increases it by 11 per cent (Chen *et al.*, 2013a). This adds to the wealth of studies described in previous chapters which brought similar results.

While stroke risk prevention has its specifics, the diet recommendations are the same as for heart disease prevention – a wholefood vegan diet, low in salt, alcohol and sugar. We don't need any animal products in the diet and the same applies for sugar and alcohol. However, we do need some salt and the general guidelines by health bodies across the world recommend that we eat no more than five to six grams of salt a day (2.3-2.4 grams of sodium) – that's around one teaspoonful.

CAN HEART DISEASE BE REVERSED?

As clinical trials show, heart disease can be halted and in many cases even reversed with the right kind of diet and lifestyle changes.

In the 1980s, the fact that atherosclerosis, and therefore heart disease, could be reversed became apparent in The Lifestyle Heart Trial led by Dr Neil Ornish. In his ground-breaking trial, coronary heart disease patients agreed to change their diet to one that was based on fruits, vegetables, grains, pulses and soya products without any caloric restriction (Ornish *et al.*, 1990). No animal products were allowed with the exception of egg white and one cup of non-fat milk or yoghurt daily. Salt and alcohol were limited, caffeine was not allowed, sugars and sugary foods were discouraged and all patients were advised to take a vitamin B12 supplement. As a part of the trial, smoking was not allowed, patients engaged in stress-management techniques and were encouraged to do moderate exercise for at least three hours each week. The trial lasted for a year and the researchers also followed a control group of patients who didn't change anything about their diet and lifestyle.

After 12 months, the trial participants had excellent results – their total cholesterol fell by 24 per cent, LDL cholesterol by 37 per cent and the plaques clogging up their coronary arteries had reduced, allowing for more blood flow to the heart muscle. They reported a 91 per cent reduction in the frequency of angina (chest pain caused by reduced blood flow to the heart muscle), a 42 per cent reduction in duration of angina and a 28 per cent reduction in the severity of angina. In contrast, the control group patients' coronary artery plaques had increased and they reported a 165 per cent rise in frequency, a 95 per cent rise in duration and a 39 per cent rise in severity of angina.

Based on the success of The Lifestyle Heart Trial, Dr Ornish's team extended it by another four years to find out how much patients would improve after five years (Ornish *et al.*, 1998). Atherosclerosis develops slowly over many years so their theory was that it would also take many years to reverse it. It turns out they were right – after five years, the atherosclerotic plaques further diminished in the trial group, while they continued growing and clogging the coronary arteries in the control group. This was despite the fact that some people in the control group started taking cholesterol-lowering drugs, yet without any diet and lifestyle changes, their atherosclerosis continued to progress.

Another famous trial was led by Dr Caldwell Esselstyn, employing a wholefood vegan diet to treat patients with heart disease. His diet consists mainly of wholegrains, pulses, fruit and vegetables, with the addition of a vitamin B12 supplement and ground flaxseeds to provide a daily dose of omega-3 fats. Patients were advised to avoid added oils and processed foods that contain oils, sugary foods and drinks, fish, meat of any kind, dairy products, avocado, nuts and excess salt. Exercise was encouraged but not required. In the biggest trial, 198 participants with heart or vascular disease were enlisted and received detailed dietary instructions (Esselstyn *et al.*, 2014). They were followed for over three and a half years on average.

Out of the 198 patients, 21 did not adhere to the diet and 13 of those experienced at least one adverse event each – two sudden cardiac deaths, one heart transplant, two strokes, four heart procedures with stent placement, three coronary artery bypasses and one carotid artery surgery. Out of the 177 adherent patients, 112 reported angina at the beginning and 104 of them experienced either improvement or disappearance of their symptoms during the follow-up period. Out of the patients with coronary artery disease who followed the vegan diet, tests revealed disease reversal in 39, while 27 were able to avoid surgical procedures previously recommended for their condition. There was only one adverse event among the adherent patients and that was a non-fatal stroke. These are extremely positive results and show how powerful a diet change can be.

A trial which recruited children and their parents who were overweight and had high cholesterol levels assigned half of them to a plant-based diet and the other half to the standard diet recommended for heart disease patients (Macknin *et al.*, 2015). The plant-based group were instructed to avoid all animal products and added fat and to limit intake of nuts and avocado in order to restrict the amount of fat consumed. After four weeks, the children in the plant-based group reduced their systolic blood pressure by 6.4 mmHg, total cholesterol by 0.6 mmol/L (22.5 mg/dL) and LDL cholesterol by 0.3 mmol/L (13.1 mg/dL), and they lost on average three kilograms of excess body weight. Their parents reduced their systolic blood pressure by 8 mmHg, total cholesterol by 0.9 mmol/L (33.8 mg/dL) and LDL cholesterol by 0.7 mmol/L (27 mg/dL), and they lost on average 3.6

kilograms of excess body weight. The other group also achieved some positive results but their improvements were not as profound as in the plant-based group.

As one recent review summarised – vegan or almost-vegan diets have been the only ones to show success in reversing heart disease and reducing atherosclerotic plaques (Kahleova *et al.*, 2017). And another review, aimed at clinicians, concludes that scientific evidence shows clear cardiovascular benefits of a diet consisting of plant-based proteins, omega-3 fats (plant-based

showing an advantage over fish oils), adequate intake of vitamin B12, mushrooms, pulses, coffee, tea, low if any alcohol, fermented foods and seaweed (Freeman *et al.*, 2018).

Cardiovascular disease can be halted or reversed – it depends on the condition's severity and other health factors but with diet and lifestyle changes, it certainly doesn't have to keep progressing. A wholefood vegan diet is just the prescription needed to regain control over your heart health.

SIX STEPS FOR A HEALTHY HEART – HOW TO REDUCE THE RISK OF HEART DISEASE OR REVERSE IT

Based on comprehensive research, clinical trials and latest studies described in previous chapters, we bring you Viva!'s Six Steps for a Healthy Heart.

1. EAT ONLY PLANT-BASED, FOCUS ON WHOLEFOODS

This rule naturally follows on from all the official recommendations for a heart-healthy diet. A fully vegan diet is the best for your heart and blood vessels. Plant-based foods provide:

- **complex carbohydrates, including fibre** – these supply healthy energy for your body and feed your beneficial gut bacteria
- **plant protein** – the kind that's been shown to be so good for the heart by many studies. Best sources are pulses, soya products, wholegrains, nuts and seeds
- **healthy fats** – mostly mono- and polyunsaturated essential fats from nuts, seeds and vegetable oils
- **antioxidants, vitamins and minerals** – important for good health, anti-inflammatory, keeping blood vessels in good shape and helping to regulate blood pressure

- **phytosterols** – these are the natural compounds that block the absorption of cholesterol in the gut

In practice, this means building your diet from wholegrain foods (wholemeal bread, oats, wholewheat pasta, brown rice, quinoa, rye crackers), pulses (beans, lentils, soya, chickpeas, peas and products made from them), fruit, vegetables, nuts and seeds. Older studies focused on low-fat diets but newer evidence shows that choosing the right kind of fat is more important than reducing all fat. Avoid adding lots of oil to foods but there's no need to avoid nut butters or the occasional avocado.

Green leafy vegetables, such as kale, cabbage, rocket, broccoli, watercress or Brussels sprouts, reduce arterial stiffness and blood pressure and have an anti-inflammatory effect (Freeman *et al.*, 2017). They should be on your daily menu.

See the sample meal plans below.

2. MINIMISE REFINED FLOUR, SUGAR, PROCESSED FOODS, EXCESS SALT AND ALCOHOL

These are all the foods that are also plant-based but not healthy and can even raise your risk of heart disease. That's why you should keep their consumption to a minimum or cut them out completely. This means avoiding foods such as white bread, cakes, pastries, pies, sugary or salty processed snacks, anything deep-fried, sugar-sweetened drinks and alcoholic drinks. Processed foods that contain hydrogenated or partially hydrogenated fats should be avoided altogether.

3. DAILY DOSE OF OMEGA-3S

It's important to get your daily dose of the essential omega-3 fats because not only are they needed for healthy cells and tissues, they also support healthy gut bacteria and tone down inflammation in your blood vessels.

A daily dose of ALA (1.1 grams for women and 1.6 grams for men) can be obtained from one of these:

- a heaped tablespoon of ground flaxseeds OR two teaspoons of flaxseed oil
- a heaped tablespoon of chia seeds – it's best to let them soak a little or blend them in a smoothie to make their nutrients more available
- two tablespoons of shelled hempseeds
- 10 walnut halves
- two tablespoons of rapeseed oil (used for cooking or baking)

OR you can take an algae-derived vegan supplement providing 250-500 milligrams of EPA and DHA combined.

4. TAKE ESSENTIAL SUPPLEMENTS – VITAMINS B12 AND D

We need a regular supply of vitamins B12 and D for our bodies to work as they should. These two vitamins are vital for a healthy cardiovascular system, blood formation, nerve function, regulation of body functions, immune system and bone health. They are essential for everyone and because they are hard to obtain from the diet, many people have low levels or are deficient regardless of what type of diet they eat.

For vitamin B12, take a daily dose providing 50 micrograms or a weekly dose providing 2,000 micrograms. Vitamin B12 is produced naturally by bacteria that live in the soil and traditionally, people and animals would have got it from eating unwashed plants. Food production is now so sanitised that there's not a trace of B12 left and we need a supplement. Cyanocobalamin is the stable 'inactive' form of B12 used in supplements and to fortify foods and it becomes activated once it passes through the stomach – it's cheap and suitable for most people. Methylcobalamin is the 'active' form and costs more but may be a better option for smokers or people with kidney problems as their B12 metabolism is somewhat compromised. Both forms are suitable for vegans.

Lack of vitamin B12 can lead to too much homocysteine in the blood. Homocysteine is a metabolic product of the amino acid methionine and it is further processed with the help of vitamins B6, B12 and folate. High levels of homocysteine in the blood can damage the lining of the arteries and may also make the blood clot more easily, which can increase the risk of blood vessel blockages and contribute to cholesterol plaque build-up, increasing the risk of heart disease and stroke (Chiu *et al.*, 2020).

For vitamin D, take a daily dose providing 10 micrograms (400 international units) from October to April if you live in the Northern Hemisphere or all year round if you always cover up, protect your skin with sunscreen, have very dark skin or don't spend any time outside in sunny weather. Vitamin D is made in the skin when it's exposed to sunlight, in particular the UVB radiation. In spring and summer, most people in the UK can make enough through daily exposure to sunlight for five to 25 minutes. This short time minimises the risks of sunburn and skin cancer. The lighter your skin, the less exposure time you require –

'little and often' is the best approach for most people.

In the colder months, there simply isn't enough of the UVB radiation in sunlight, there's less sunshine in general and the days are shorter. Even if you work outside, you may still need a supplement in autumn and winter. There are two types of vitamin D and both are suitable to cover your needs – vitamin D2 is always vegan, whereas D3 is usually of animal origin but can also be obtained from algae or mushrooms. If it's the latter, it's usually declared on the packaging.

5. BE ACTIVE

Physical activity is a simple, yet very effective heart protector. It can be in the form of a daily 30-minute walk, a moderate workout twice or three times a week, any outdoor activity that increases your heart rate, or indoor exercise, yoga or even housework if you do it vigorously!

If it's a low-level activity, a daily routine is recommended, while for moderate and higher intensity activity, twice or three times a week is sufficient.

6. PRACTICE STRESS MANAGEMENT

Stress can be bad news for your heart and circulation. It can cause all sorts of symptoms that are certainly not good for you, such as high blood pressure, insomnia, altered metabolism and digestive issues. We cannot avoid stress, but we can use smart tools to help us deal with it, for example breathing exercises, mindfulness techniques, meditation, yoga, tai chi, arts, music or even gardening. Spending quality time socialising and/or relaxing is also important.

Even if your diet is perfect, you don't smoke or drink alcohol, keep your salt intake low and engage in physical activity, you can still be at high risk of cardiovascular events if your stress levels are high and unregulated.

SAMPLE MEAL PLANS FOR A HEALTHY HEART

To help you put our Six Steps for a Healthy Heart in practice, here are three sample meal plans. The meals should serve as inspiration and offer guidance but are not an exact prescription.

Note that each meal contains a good source of protein (wholegrains, pulses, nuts or seeds), complex carbohydrates (wholegrains, root vegetables), healthy fats and fruit or vegetables for added nutritional value.

MEAL PLAN FOR A HEALTHY HEART 1

Breakfast: Unsweetened muesli with plant milk, chia seeds and fresh fruit
Snack: Plant-based yoghurt with fresh or dried fruit
Lunch: Wholewheat tortilla wraps with beans, fresh vegetables, salsa or your favourite sauce
Snack: Oatcakes with hummus and carrot or celery sticks
Dinner: Wholewheat pasta with tomato sauce, green vegetables (spinach, kale or broccoli), vegan mince or grated tofu
After-dinner snack: A small handful of nuts, a couple of squares of dark chocolate

MEAL PLAN FOR A HEALTHY HEART 2

Breakfast: Wholemeal toast with nut butter, thin layer of jam (naturally sweetened) or low-salt yeast extract, fresh fruit on the side
Snack: Seeded crispbreads, half a bell pepper or a few cherry tomatoes
Lunch: Tomato and lentil soup with wholemeal bread roll(s), fresh vegetable sticks on the side
Snack: A handful of walnuts and dried fruit, a piece of fresh fruit
Dinner: Veggie burgers, roast potatoes (low-salt), Brussels sprouts or green beans on the side
After-dinner snack: A couple of oat biscuits

MEAL PLAN FOR A HEALTHY HEART 3

Breakfast: Porridge with flaxseeds and fresh fruit
Snack: Rye crackers with a bean dip, celery or cucumber slices
Lunch: Wholemeal sandwich with mock-meat or smoked tofu slices, a little vegan mayo, rocket and fresh vegetables
Snack: Banana and oat biscuits or a handful of nuts
Dinner: Chickpea curry with brown rice and spinach
After-dinner snack: A handful of lentil crisps

These are a few suggestions but you will find a wealth of inspirational yet simple heart-healthy recipes at veganrecipeclub.org.uk

CONCLUSION

Heart disease in all its forms is a major cause of death and disability worldwide. Most cases are preventable or treatable with diet and lifestyle changes and this approach is more effective than drug therapy.

All major health institutions concerned with heart health agree on the same guidelines when it comes to prevention and treatment of heart disease, which is a rare thing. It goes to show that the strength of scientific evidence is so convincing that there's no room for doubt. These guidelines recommend a plant-based diet, low in saturated fat, salt, sugar and alcohol, and devoid of trans fats. This kind of diet should be centred around wholegrains, fruit and vegetables, pulses, nuts and seeds, and include omega-3 fats, as well as vitamins B12 and D. The diet may also include moderate amounts of tea and coffee.

Studies show that a wholefood vegan diet can be a true lifesaver when it comes to heart disease, reducing the risk and helping to reverse atherosclerosis. On the other hand, diets based on meat, eggs, dairy, processed, fatty, salty and sugary foods are a recipe for a heart disaster. It's not an overstatement to say that it's not heart disease that runs in families, it's just bad diet and lifestyle habits. Of course, there are genuine cases of genetic predisposition to cardiovascular diseases but those are much rarer than we tend to think. Most heart health issues are caused by a combination of dietary and lifestyle factors and that is something you can change.

Adopting a healthy vegan diet, engaging in regular physical activity and not smoking are three key factors that would surely dethrone heart disease as one of the global leading causes of premature death and these simple changes could improve the quality of life for millions of people.

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