Meat the Truth

What you should know about the health effects of meat consumption

We don't need to eat meat. In fact, cutting meat out of your diet will protect your health because humans are not true carnivores and meat-eating has a wide range of detrimental health effects. The more meat you eat, the more serious the consequences can be but even small amounts can harm health.

Red, white and processed meat

The definition of white and red meat is based on the level of myoglobin – the iron-containing protein in muscle – giving meat its red and pink hues. White meat contains much less and that's why it has a paler colour. There are some overlaps, for example duck meat is darker in colour but still considered as white meat because it has less myoglobin than beef or pork.

Processed meat includes meat products that have been preserved by smoking, curing, salting or adding chemical preservatives such as sodium nitrite. In general, processed meat has had something done to it to extend its shelf life or change its taste. Most processed meats contain pork or beef, but they may also contain other red or white meats, offal or blood.

- **The following are usually classified as red meat:** beef and veal, mutton and lamb, pork, venison, goat, horse, burgers and mince (burgers and minced meats do not count as processed meat unless they have been preserved with salt or chemical additives)
- **These are usually considered white meat:** chicken, turkey, duck, goose, pheasant and rabbit
- **Processed meat includes:** sausages, bacon, ham, hot dogs, salami, frankfurters, tinned meat, pâtés, beef jerky, chorizo, pepperoni and corned beef

Now we know what's what, it's time to look at the health impacts of meat.

Heart disease and stroke

The term heart disease is often used instead of cardiovascular disease (CVD) and describes a chronic disease of the heart and blood vessels. The disease usually reduces blood flow to the heart, brain or body because of fat layers clogging the inside of your arteries, hardening and narrowing them (atherosclerosis). High cholesterol levels in your blood are the main problem, contributing building material for these fat layers, also called cholesterol plaques. Narrower arteries also mean higher blood pressure – that's often the first sign that something's wrong.

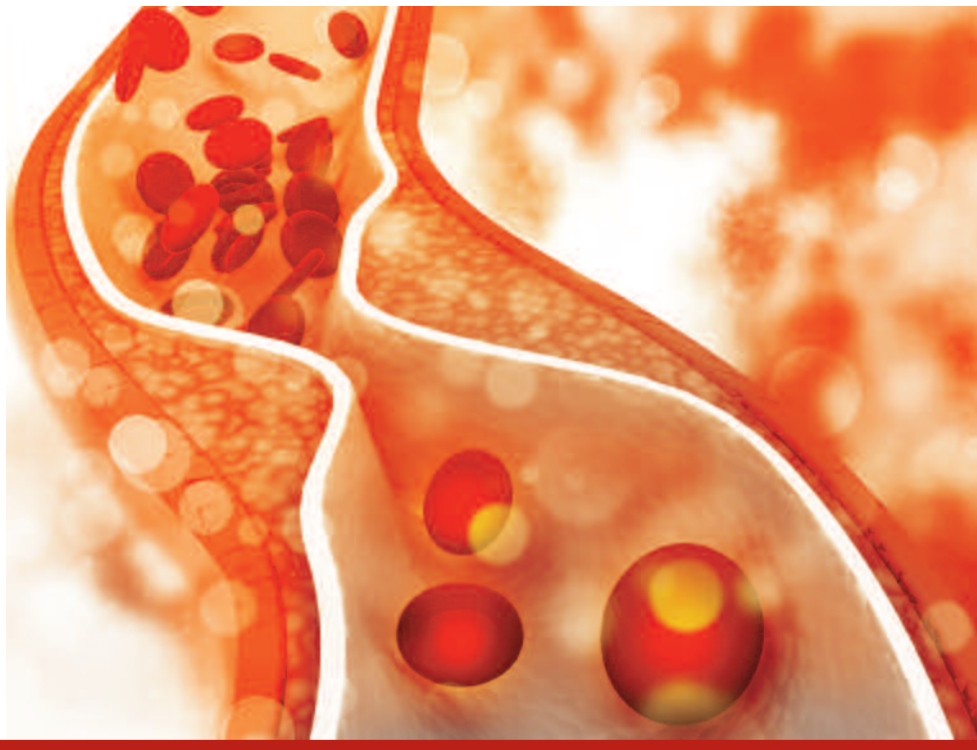
Heart attacks and strokes are mainly caused by blockages that cut off blood supply to the heart or the brain. A stroke can also be caused by a brain artery bursting.

Cholesterol

Beef, pork, poultry and lamb all contain high levels of fat, especially saturated fat, and eating a lot of saturated fat raises cholesterol levels in the blood. When a scientific team fed volunteers a diet high in red meat, then white meat and then no meat to compare the effects on cholesterol, their results were clear – both red and white meat increased cholesterol levels but a meat-free diet did not (Bergeron *et al*., 2019). An analysis of studies focusing on the effect of swapping plant-based foods rich in protein for animal sources of protein found that the plant-based foods always had a cholesterol-lowering effect compared to animal products (Li *et al*., 2017).

Processed meats such as sausages, salami and bacon contain even more saturated fats than red meat. The amount of fat in sausages often reaches 50 per cent of the weight or even more (Rohrmann *et al*., 2013). Researchers from the Harvard School of Public Health examined 20 studies from 10 different countries and found a much higher risk of heart disease and stroke among people consuming the most processed meat (Micha *et al*., 2010).

In Europe, the extensive EPIC study, including almost half a million people, revealed that people consuming more than 160 grams of processed meat daily had a 28 per cent increased risk of dying from heart disease compared to people eating hardly any (Rohrmann *et al*., 2013).



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Animal protein

Professor Colin T. Campbell – author of hundreds of scientific papers and co-author of *The China Study* (Campbell and Campbell, 2005) found that high intakes of animal protein went hand-in-hand with heart disease. In 2010, the Nurses' Health Study reported the same – higher intakes of red meat and whole-fat dairy products led to a higher risk of heart disease (Bernstein *et al*., 2010). The study found that replacing a serving of meat with one of nuts lowered the risk of heart disease by 30 per cent. And a follow-up study found that the same swap lowered the risk of stroke by 17 per cent (Bernstein *et al*., 2012).

Another study 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). A large study of over 70,000 people 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 in general, 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).

Iron

There are two types of iron in the foods we eat – haem iron in red and processed meat, poultry and seafood, and non-haem iron in plants. Your body uses them differently – the absorption of haem iron from meat is unlimited, so you absorb it no matter what. That means high meat consumption can result in iron overload. On the other hand, your body only absorbs as much non-haem iron as it needs, so you cannot overload on plant iron.

Too much haem iron stimulates the formation of free radicals – dangerous molecules that can damage your DNA, blood vessel walls and increase the stickiness of cholesterol particles, making them more likely to form cholesterol plaques (Niki, 2011; Muñoz-Bravo *et al*., 2013; Hunnicutt *et al*., 2014; Kobayashi *et al*., 2018). In a study from the Netherlands, people with a high haem iron intake from meat had a 65 per cent increase in heart disease risk (van der A *et al*., 2004).

How to prevent heart disease

The American Heart Association's 2021 guidance on how to eat to protect your heart includes the advice to choose healthy sources of protein, such as pulses and nuts, while red and processed meat should be avoided (Lichtenstein *et al*., 2021). Another important point they make is to avoid butter, lard, coconut and palm oil as these too 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.

Compared to meat-eaters, vegans have a 63 per cent lower risk of high blood pressure (Pettersen *et al*., 2012). If you already suffer from it, a healthy vegan diet can help you lower your blood pressure more effectively than other diets, including a vegetarian one (Lee *et al*., 2020). Wholesome plant-based diets not only reduce the risk of heart disease and stroke, they also halt disease progression and may even reverse it (Esselstyn *et al*., 2014; Freeman *et al*., 2017; Kahleova *et al*., 2018; Chiu *et al*., 2020). Vegans and people who eat predominantly wholefood plant-based diets have lower blood pressure and cholesterol levels than all other diet groups and a much lower risk of heart disease – 25-57 per cent (Bradbury *et al*., 2014; Le and Sabaté, 2014; Appleby and Key, 2016; Dinu *et al*., 2017; Benatar and Stewart, 2018; Kahleova *et al*., 2018; Korakas *et al*., 2018; Matsumoto *et al*., 2019).

Type 2 diabetes

Type 2 diabetes tends to develop later in life, largely due to an unhealthy lifestyle. However, more and more young people are being diagnosed and the link between the disease and the foods we eat is strong (Pan *et al*., 2011). Several studies demonstrated that diets high in meat, fat and processed foods (Western style diets) drive your body to store tiny droplets of fat in your 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 (sugar-regulating hormone) correctly – resulting in insulin resistance, which is typical for type 2 diabetes (Sparks *et al*., 2005; Morino *et al*., 2006; Consitt *et al*., 2009).

A large study of vegetarians and non-vegetarians showed 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). Many other studies examined the relationship between meat and type 2 diabetes and found that consumption of red meat increases the risk by 12-43 per cent, while processed meat increases the risk by 19-57 per cent (Micha *et al*., 2010; Pan *et al*., 2011; Steinbrecher *et al*., 2011; Micha *et al*., 2012; Zhang *et al*., 2021).

One of the studies that found a connection between type 2 diabetes and red meat, processed meat and poultry listed the many components of meat that can contribute to the problem: saturated fats, animal protein, haem iron, sodium, nitrites and nitrosamines as well as other harmful substances (Feskens *et al*., 2013). Of course, meat isn't the only culprit – high-fat dairy products, eggs, processed and junk foods, pies and cakes also play a role – but it's clear that meat plays a very important role in the development of type 2 diabetes.

How to reverse type 2 diabetes?

The good news is that a wholesome vegan diet can help prevent type 2 diabetes – in fact, vegans have up to 50 per cent lower risk (Appleby and Key, 2016; Salas-Salvadó *et al*., 2019).

Even if you already have type 2 diabetes, a healthy vegan diet low in fat and high in wholefoods can help reverse it (Barnard *et al*., 2009; Kahleova *et al*., 2011; McMacken and Shah, 2017). In several studies, many patients were able to reduce their diabetes medication and some were able to discontinue it altogether, because they were no longer diabetic!

Cancer

There are many harmful components in meat that may cause cancer. Some people are more susceptible, some less but in general the more meat you eat, the bigger the risk.

Haem iron from meat – described above – is a risk factor not just for heart disease; it may also contribute to cancer by damaging your DNA. Then, there are three groups of compounds that are not present in raw meat but can form when meat is exposed to high temperatures or chemicals – during cooking, roasting, processing, smoking or preserving:

- N-nitroso-compounds (NOCs) form during meat preservation (in foods such as bacon or ham) and also in your gut during meat digestion – they have a strong cancer-causing effect (Joosen *et al*., 2009; Abid *et al*., 2014).

- Polycyclic aromatic hydrocarbons (PAHs) form during cooking meat over an open flame and have a strong potential to cause cancer (Phillips, 1999; Abid *et al.*, 2014).
- Heterocyclic amines (HCAs) form during cooking at high temperatures and also can cause cancer (Jägerstad and Skog, 1991; Abid *et al.*, 2014).

All these compounds, when consumed regularly over long periods of time, can lead to cancer. In 2015, the World Health Organisation (WHO) classified processed meat as carcinogenic (causing cancer) and red meat as probably carcinogenic (Bouvard *et al.*, 2015). According to their data, just 50 grams of processed meat (less than two slices of bacon) daily increases the risk of bowel cancer by 18 per cent and 100 grams daily of red meat increases the risk by 17 per cent. They also found links between red meat and pancreatic and prostate cancer, and processed meat and stomach cancer.

Other studies agree – even small amounts of red and processed meat can increase your risk of bowel, stomach, lung, kidney, bladder, pancreatic, thyroid, breast and prostate cancer (Grant, 2014; Wolk, 2017; Huang *et al.*, 2021). One of these studies also highlighted that while meat increases the risk of cancer, it doesn't offer any health benefits (Huang *et al.*, 2021).

Professor Colin T. Campbell believes that animal-based foods lead to an increased cancer risk while wholesome plant-based foods reduce the risk (Campbell and Campbell, 2005). According to other scientific studies, vegans have a 16-19 per cent lower risk (Tantamango-Bartley *et al.*, 2013; Key *et al.*, 2014).

Hormone-sensitive cancers – breast and prostate

Meat may also play a role in hormone-sensitive cancers. A large study of women found that postmenopausal women eating the most plant-based foods had a 30-63 per cent lower risk of breast cancer than women eating more meat and processed foods (Butler *et al.*, 2010). Another major study found that women who ate one-and-a-half servings of red meat daily had a 22 per cent increased risk of breast cancer compared with women who ate one serving a week (Farvid *et al.*, 2014). The authors calculated that replacing one daily serving of red meat with pulses (peas, beans and lentils) could lower breast cancer risk by 15 per cent among all women and 19 per cent among premenopausal women.

In a US study of men, weekly consumption of three or more servings of red meat, one-and-a-half or more servings of processed meat, one or more serving of grilled red meat and one or more serving of well-done red meat were each associated with a 50 per cent increased risk of developing advanced prostate cancer (John *et al.*, 2011).

Lung cancer

Smoking is a major risk factor for lung cancer but meat isn't far behind. A review of 33 studies from all over the world found that that both red and processed meat consumption increased the risk of lung cancer (Xue *et al.*, 2014). With every 120 grams of red meat daily, the risk of lung cancer increased by 35 per cent and with every 50 grams of processed meat, the risk increased by 20 per cent. And another study found that a high intake of red meat increased the risk of lung cancer by 35 per cent (Yang *et al.*, 2012).

In a large study, a healthy diet based on vegetables, fruit and soya reduced lung cancer risk, while red and processed meat increased the risk (Sun *et al.*, 2016). A UK Biobank study supports this conclusion with the findings that each 50 grams of red meat daily increased the lung cancer risk by 36 per cent, while just 25 grams of processed meat upped the risk by 30 per cent (Wei *et al.*, 2021). On the other hand, fruit, vegetables, breakfast cereals and fibre had a protective effect and lowered the risk.

Bowel cancer

Bowel cancer (also called colorectal or colon cancer) is strongly linked to meat consumption because not only do meat residues (including their cancer-causing components) simply rot in the colon, they also feed toxic gut bacteria that can damage your gut wall and encourage cancer growth. Many studies agree – red and processed meat considerably increase the risk of bowel cancer (Bouvard *et al.*, 2015; Händel *et al.*, 2020; Cheng *et al.*, 2021; Veettil *et al.*, 2021).

Gout

Gout develops when uric acid crystals accumulate in the joints, causing chronic inflammation and irritation. During gout attacks, people experience intense joint pain. High levels of uric acid in the body have also been linked to kidney and heart disease – particularly to sudden events, such as heart attack or stroke, heart failure and atrial fibrillation (irregular heartbeat) (Maloberti *et al.*, 2021).

Your body produces uric acid when it breaks down purines and the richest purine sources by far are red meat and organ meats, such as liver or kidneys, and fish and shellfish. One review put it simply – seafood, red meat, alcohol and fructose syrup increase the risk, while soya and other pulses (peas, beans and lentils) and coffee lower the risk (Li *et al.*, 2018). This highlights that there's no need to avoid pulses as was once recommended because of their purine content – they contain much less than meat and offer a wide range of healthful nutrients.

According to the results of a comprehensive study, plant-based diets do not put you at risk of gout even if you consume purine-containing pulses, vegetables or mock-meat products – they simply aren't as high in purines as meat and fish (Jakše *et al.*, 2019). In fact, the study authors concluded that plant-based diets help to prevent gout and maintain healthy uric acid levels.

Obesity

Obesity is dangerous because it increases your risk of heart disease, high blood pressure, diabetes, arthritis, gallstones and some cancers. Being obese also weakens the immune system and slows down recovery time after an illness or injury.

Large studies of people with different eating habits found that people who ate the most meat were around 27-37 per cent more likely to be obese and 33 per cent more likely to have central

(around the waist) obesity compared to those eating the least (Wang and Beydoun, 2009; Vergnaud *et al*., 2010; Rouhani *et al*., 2014).

A comprehensive research study analysed data from 170 different countries and revealed that meat intake was directly linked to excess weight. In fact, meat turned out to be as bad as sugar for weight gain (You and Henneberg, 2016; You and Henneberg, 2016a). The likely reasons are that meat always contains considerable amounts of saturated fat but also that excess protein (that your body cannot immediately use) is also stored as fat. Recently, a large study on foods and the risk of obesity found that whole grains, vegetables, fruit and pulses help to prevent obesity while red meat, refined grains and sugar-sweetened drinks increase it (Schlesinger *et al*., 2019).

When it comes to healthy weight loss, wholefood vegan diets are extremely effective at achieving and maintaining a healthy weight, even without portion restriction (Huang *et al*., 2016; Turner-McGrievy *et al*., 2015 and 2017; Najjar and Feresin, 2019).

Bone and kidney health

Meat is a rich source of protein and if you eat a lot of it, it can be a problem for your kidneys and bones. This is because meat protein contains more sulphur-containing amino acids than plant protein. These amino acids produce other acids when digested which puts a strain on your kidneys because it makes them work harder and requires calcium to neutralise them. If you have enough calcium in your diet, your bones won't be affected but if you have a low calcium intake, your body may use calcium from your bones to try and balance the acidic effects of animal protein (Weikert *et al*., 2005; Mangano *et al*., 2014).

In people with compromised kidney health, eating too many acid-forming foods may make matters worse, contribute to bone and also muscle loss (Dargent-Molina *et al*., 2008; Frassetto and Sebastian, 2013; Scialla and Anderson, 2013). But even in healthy people, a meaty diet may undermine bone health. Several studies show that whether it's children or adults, a diet high in meat leads to worse bone health than a plant-based diet (Campbell and Tang, 2010; Zhang *et al*., 2010; Dai *et al*., 2014).

According to a major review by the US National Osteoporosis Foundation (Weaver *et al*., 2016), bones need a good protein supply and plant protein does the job better than animal protein. The authors also concluded that fruit and vegetables have a positive effect on the bones, while carbonated (fizzy) drinks may have a negative effect. Lastly, they highlighted how important physical activity is for bone health, growth and development – bones need to be stimulated to be strong.

Food poisoning

Food poisoning is caused by eating contaminated food and usually results in vomiting and diarrhoea as your body attempts to get rid of the invaders – bacteria, viruses or toxins. Symptoms may also include fever, chills, stomach cramps, lack of energy and dizziness. In general, most people get better within a few days without treatment. Occasionally, food poisoning can lead to serious or long-term conditions or even death.

In most cases of food poisoning, the food is contaminated with bacteria such as *Salmonella*, *Campylobacter*, *Listeria* or *Escherichia coli*, or a virus such as norovirus. Most cases of food poisoning are caused by animal products (meat, poultry, eggs, fish and dairy) as plants tend not to carry the types of bacteria that cause food poisoning in humans. If plant foods do cause food poisoning it is generally because they have been contaminated with animal faeces, human sewage or handled with unwashed hands during preparation.

According to a large study of food contamination in the UK, Canada, Denmark, the Netherlands, the US and the EU (Lund *et al*., 2015), this is how much meat carries bacteria causing food poisoning:

- *Campylobacter* – 40-90 per cent of poultry; up to 40 per cent of red meat
- *Clostridium perfringens* – 40-50 per cent of beef and lamb, up to 20 per cent of poultry
- *Salmonella* – up to 40 per cent of poultry, up to 20 per cent of pork, beef and lamb each
- *E. coli* O157 – 40-70 per cent of beef and lamb
- *Listeria* – up to 50 per cent of red meat, up to 20 per cent of other meats

Campylobacter is a major cause of food poisoning in Europe and the world. The main source of infection is poultry, followed by beef, pork and sometimes game (Brown *et al*., 2014; Lund *et al*. 2015; Chlebicz and Slizewska, 2018).

E. coli is found almost everywhere but only some strains cause food poisoning. Major sources of the tummy bug infection are beef, dairy and cattle faeces (Larsen *et al*., 2014; Stein and Katz, 2017).

Listeria is another dangerous bacterium causing more than just food poisoning – it's fatal for 20-30 per cent of people who get the infection. The foods responsible are predominantly meat products, milk, butter, soft cheese, cottage cheese, fish and shellfish (Larsen *et al*., 2014; Chlebicz and Slizewska, 2018).

Salmonella is a notorious bacterium most commonly linked to eggs. Even though most UK egg producers are now required to vaccinate their flocks, it's still found at chicken farms. Chickens raised for meat may carry the disease, as well as pigs and fish (Larsen *et al*., 2014).

Norovirus, notorious for causing severe cases of vomiting and diarrhoea, can usually be traced to raw or undercooked meat and seafood, ready-to-eat products and fruit and vegetables (Tuan Zainazor *et al*., 2010). The latter is usually due to animal manure used as fertiliser or irrigation water contaminated with animal faeces (Tuan Zainazor *et al*., 2010).

Antibiotic-resistant bacteria

Factory farms are the ideal breeding grounds for deadly bacteria that are constantly evolving. This is why some farmers use antibiotics not just to treat sick animals but also to prevent the spread of diseases. Shockingly, it's estimated that worldwide, 80 per cent of all antibiotics are used on livestock (Haskell *et al*., 2018). This massive use of antibiotics has a dangerous side-effect – bacteria develop antibiotic-resistance. It means that if you're infected by antibiotic-resistant bacteria, your illness will be difficult or even impossible to treat with the medicines we have.

One example is MRSA – an antibiotic-resistant type of *Staphylococcus aureus*. MRSA first appeared in Belgian cattle, later at Dutch pig farms and has since spread to farms across Europe, North and South America, Asia and North Africa. It is found in pigs, cattle, horses, poultry, sheep, rabbits, cats, dogs and many species of wild animals – and of course people too (Aires-de-Sousa, 2017). A recent study confirmed that MRSA is found at farms that routinely use antibiotics (Haskell *et al*., 2018).

Once bacteria develop antibiotic-resistance, they can cause serious health issues, such as life-threatening sepsis. It develops when bacteria get into the blood and do not respond to antibiotic treatment. In the UK, 46,000 people die of sepsis every year (Antibiotic Research UK, 2019). Currently, around 700,000 global deaths are caused by antibiotic-resistant superbugs each year, this number could rise to 10 million per year by 2050 if no action is taken to curb the overuse of antibiotics (O'Neill, 2016).

The overuse of antibiotics on livestock and fish farms and its dangerous consequences are well documented but with the sheer numbers of farmed animals, it's difficult to control disease any other way (Mathew *et al*., 2007; Manyi-Loh *et al*., 2018). It seems our only option to limit antibiotic resistance and its threats is by not eating animals.

Eating meat is harming your health but it's also unsustainable as animal farms pose a major environmental problem and, of course, it's cruel to the animals too. Living meat-free brings so many benefits that it should be a fundamental public health recommendation.

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