Plant-based Diets and Cardiovascular Disease

Have a Heart – Go Veggie!

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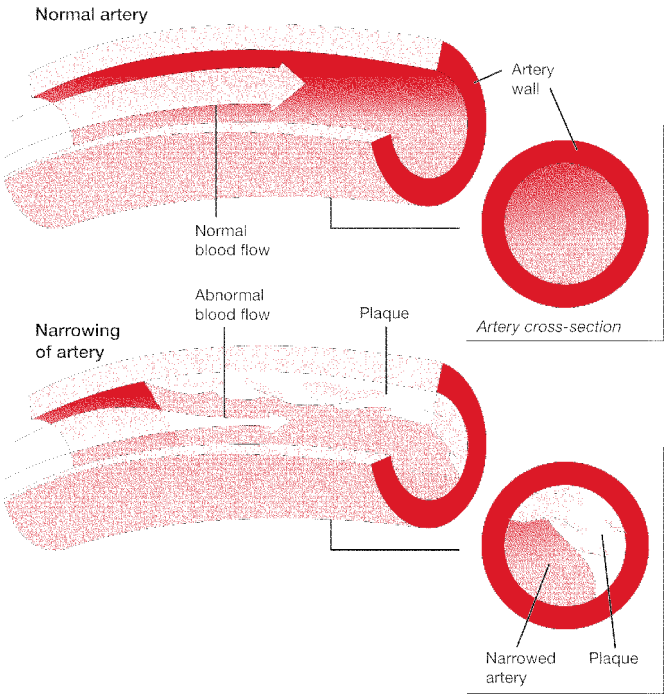
Cardiovascular disease (CVD) such as heart disease and stroke is the UK's number one killer. More people are living with this disease than ever before and numbers are steadily rising. VVF investigates the cause of CVD and explains why a plant-based diet can be used to both prevent and treat the UK's biggest health problem.

What Does the Heart Do?

The heart acts as a pump pushing blood round the body, which supplies oxygen and nutrients to all cells and removes waste products. The average adult has about eight pints of blood which the heart continuously circulates by beating around 100,000 times a day. The heart and the blood vessels (arteries, veins and capillaries) make up our circulatory system called the cardiovascular system.

How Does CVD Happen?

CVD (such as heart disease and stroke) occurs when there is a build up of fatty deposits (plaques) on the inside walls of the arteries. These plaques can clog up the arteries making them narrower and restricting the blood flow in the same way that sewerage pipes get blocked when people pour animal fat down the plughole! Reduced blood flow to the heart can then lead to chest pain and discomfort (angina). A blood clot in the coronary artery may cut off the blood supply to the heart, which can then result in a heart attack and sudden death.



Fatty deposits (plaques) build up in the lining of the arteries over time. As the artery narrows, the risk increases that a clot will form and completely block the blood flow.

If this happens in the brain, an ischaemic stroke can be the result. If a small artery is blocked, the symptoms may be minor, but if a major artery is blocked the symptoms can be severe, often fatal. A transient ischaemic attack (TIA) is also known as a mini-stroke as the blood supply to the brain is only cut off for a short time. Haemorrhagic strokes are caused by a weakened artery bursting, and then allowing blood to seep out of the artery wall and damage the brain tissue by pressing on it, other brain cells may also be damaged because they're not receiving enough oxygen. Ischaemic strokes are the most common type in the UK, causing 17 out of every 20 cases of stroke (NHS Direct, 2007).

Number Crunching

CVD is a major cause of death and ill health in the UK. Heart disease is the UK's biggest single killer, with one in every four men and one in every six women dying from the disease. In the UK, approximately 300,000 people have a heart attack each year (NHS Direct, 2007a), and someone has a stroke every five minutes. They are more common among those over the age of 65, but can happen at any age. Strokes are the leading cause of disability in the UK, and the third most common cause of death after cancer and heart disease (NHS Direct, 2007). The financial cost of this health crisis is phenomenal; in 2004, the cost of prescriptions for cholesterol-lowering drugs (including statins) was £769 million (BHF, 2005).

Risk Factors

It is widely accepted that certain factors such as smoking or being overweight can increase the risk of CVD. These features are referred to as risk factors. Early work dating back to the 1940s helped establish the concept of risk factors. In 1946, Los Angeles physician, Dr Lester Morrison, began a study that would later reveal the crucial role of diet in heart disease (Morrison, 1960). Morrison reduced the fat intake of 50 heart attack survivors and compared their health to 50 other heart attack survivors whose fat intake was left unchanged (the control group). After eight years, 38 of the control group had died compared to just 22 of the low-fat group. After 12 years, the entire control group had died but 19 of the low-fat diet group were still alive. Around the same time, the residents of Framingham, just outside Boston Massachusetts in the US, took part in a study to investigate the role of diet and lifestyle in heart disease. By observing who suffered from heart disease and who did not, the Framingham Study helped identify several key risk factors (Kannel *et al.*, 1961). A number of these are now firmly associated with heart disease including high cholesterol levels, hypertension, family history of heart disease, diabetes, obesity, smoking and poor diet.

Diet and Lifestyle

The World Health Organisation (WHO) states that the rise in CVD reflects a significant change in dietary habits, physical activity levels and tobacco consumption worldwide as a result of industrialisation, urbanisation, economic development and food market globalisation. They suggest that people are consuming more calorific, nutrient-poor (junk) foods and are less physically active (WHO, 2007). There is much evidence linking CVD to unhealthy diets including the high consumption of saturated fats,

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salt, refined carbohydrates (such as sugar, white bread and white flour) and the low consumption of fruits and vegetables (WHO/FAO, 2002).

Cholesterol

Cholesterol is a fatty substance most of which, contrary to popular belief, is produced by the liver. Only a small amount (15-20 per cent) comes from the diet – and only then if it contains animal foods (however eating 'bad' fats and animal protein raises cholesterol levels more than eating cholesterol itself – see below). Even high-fat plant foods such as avocados, nuts and seeds contain no cholesterol whatsoever, so a vegan diet is cholesterol-free. It is also animal fat and animal protein-free. We do not need cholesterol in our diets, the liver can manufacture as much as we need for making cell membranes and various hormones, for example. However, there is no mechanism limiting the amount produced and too much can lead to CVD.

Cholesterol is carried in the bloodstream by lipoproteins. LDL (low-density lipoprotein) takes cholesterol from the liver to the cells and is often referred to as 'bad' cholesterol because when LDL levels are high, it can accumulate on the walls of the arteries. HDL (high-density lipoprotein) carries excess cholesterol back to the liver for excretion and is called 'good' cholesterol. Evidence suggests that LDL can also harm the walls of the arteries when it is damaged, or oxidised (Galassetti and Pontello, 2006). However, research shows that LDL in vegetarians is less susceptible to oxidative damage (Lu *et al.*, 2000). This may be due to the low-fat, high-antioxidant (vitamins A, C and E) and/or soya food content of a well-balanced plant-based diet. This could be why the Mediterranean diet – also low-fat and rich in fruit and vegetables – is associated with a lower incidence of CVD (Lapointe *et al.*, 2006). Current UK guidelines state that we should aim for a cholesterol level below 5.0mmol/l. The average level for men in the UK is about 5.5 mmol/l and about 5.6 mmol/l for women.

Sat Fat Drives up Cholesterol

Saturated, hydrogenated (and trans) fats and animal protein are the main culprits in the diet that raise cholesterol levels. It used to be thought that dietary cholesterol itself was the main villain however this is not the case, although those at risk of heart disease should limit their intake or avoid it completely.

The traditional approach to lowering cholesterol levels was to reduce total fat (and cholesterol) intake. However, research shows that replacing saturated fat with unsaturated fat is more effective (Hu *et al.*, 2001). A well-balanced plant-based diet contains less saturated fat and more unsaturated fat than the typical Western diet dominated by meat, poultry, eggs and dairy. However, a vegetarian diet rich in dairy foods is not the answer as high-fat dairy products are a major source of saturated fat and cholesterol. In 1985, research published in the *Journal of the American Medical Association* suggested that ingestion of high-fat dairy products raises both total and LDL 'bad' cholesterol levels (Sacks *et al.*, 1985). Cheddar cheese contains around 35 per cent fat of which over 60 per cent is saturated. Similarly, butter contains over 80 per cent fat of which over 60 per cent is saturated (FSA, 2002). To reduce the intake of saturated fat, the UK government recommends avoiding or cutting down on egg yolks, red meat, butter, whole milk, cheese, cakes and chips (NHS Direct, 2007).

Hydrogenated and Trans Fats can also raise Cholesterol Levels. Some evidence suggests that the effects of trans fats may be worse than saturated fats. Trans fats are found in processed foods such as biscuits, cakes, fast food, pastry and margarines. They are also found naturally at low levels in dairy products, beef and lamb (FSA, 2007). The message is clear – replace fatty animal foods with healthier vegan options.

Stay Abreast

These dietary risk factors do not just apply to adults; there is a significant body of evidence showing that the early consumption of cow's milk and dairy products can contribute to a higher risk of CVD later in life. A review on infant feeding practices published in the US journal *Pediatrics* suggested that the consumption of whole milk should be discouraged in infants because of its potential role in heart disease (Oski, 1985). More recently the WHO stated that the current evidence indicates adverse effects of formula milk on CVD risk factors; this, they say, is consistent with the observations of increased mortality among older adults who were fed formula as infants (WHO/FAO, 2002). The WHO states that as a global public health recommendation, infants should be exclusively breast fed for the first six months of life to achieve optimal growth, development and health (WHO, 2001).

Animal or Vegetable Protein?

Diets high in animal protein have been linked to increased cholesterol levels (Campbell and Campbell, 2005). Conversely, plant protein (especially soya) has been shown to lower cholesterol. Exactly how soya protein lowers cholesterol is uncertain, although a range of theories have been proposed. All proteins, animal and vegetable, are made up of building blocks called amino acids. One hypothesis suggests that the amino acid composition of soya protein causes changes in cholesterol metabolism. Others propose that non-protein components (such as saponins, fibre, phytic acid, minerals and isoflavones) associated with soya protein affect cholesterol metabolism either directly or indirectly (Potter, 1995). The most popular theory suggests that soya protein reduces cholesterol metabolism in the liver by increasing the removal of LDL 'bad' cholesterol (Sirtori *et al.*, 1977). Whatever the precise mechanism may be, the beneficial effect of soya protein on heart health is widely accepted. In 2002 the UK government's Joint Health Claims Initiative approved the health claim: "The inclusion of at least 25 grams of soya protein per day as part of a diet low in saturated fat can help reduce blood cholesterol" (JHCI, 2002). (See VVF fact sheet *The Safety of Soya.*)

High Blood Pressure

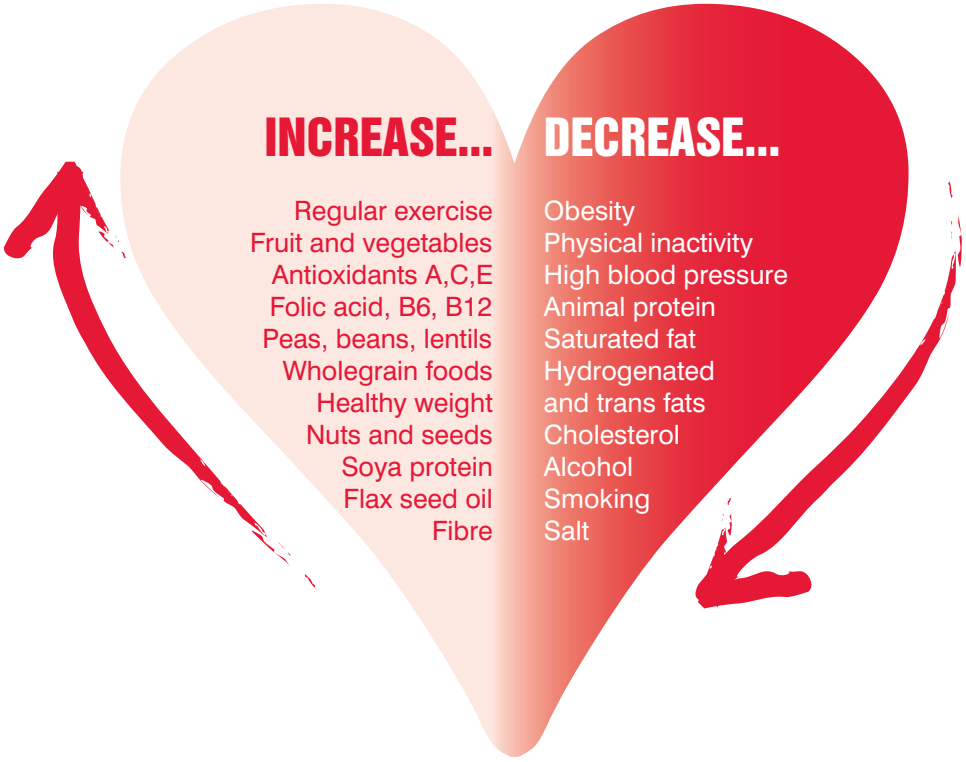
Blood pressure measures how strongly blood presses against the walls of your arteries as it flows through them. It is normal for blood pressure to increase during vigorous physical activity or when you feel stressed but if your blood pressure is consistently higher than normal it is called high blood pressure or hypertension.

Blood pressure is measured in terms of millimetres of mercury (mmHg). When you have your blood pressure measured two readings are taken. The first and higher measurement is the systolic pressure; a measure of the blood pressure as your heart contracts and pumps blood out. The second, lower number is the diastolic pressure; a measure of the blood pressure when the heart is relaxed and filling up with blood. Hypertension is defined as a systolic pressure of 140 mmHg or more, or a diastolic pressure of 90 mmHg or more. High blood pressure can increase the risk of clotting in the arteries and is often referred to as the 'silent killer' as there may be no symptoms. Moderately high blood pressure is found in about one in four middle-aged people in the UK and very high blood pressure in about one in 25. You can have your blood pressure measured by your doctor; the test is simple, quick and painless.

Certain factors increase the risk of high blood pressure including smoking, family history, obesity, excessive alcohol intake, lack of exercise and poor diet. A high-salt intake can increase the amount of water retained in the body and so drive up blood pressure. The UK Food Standards Agency recommends that adults should eat no more than six grams of salt per day.

Approximately 20-40 per cent of blood pressure variability is accounted for by genetics (Ward, 1980). The remaining 60-80 per cent is determined by lifestyle factors, particularly diet. An extensive review of the evidence published in the journal *Nutrition Reviews* explains how a vegetarian diet high in fruits, vegetables, legumes and nuts lowers the blood pressure by a variety of different mechanisms (Berkow and Barnard, 2005). The authors of this review explain how vegetarians tend to weigh less (see below) and how lower body weight is strongly associated with lower blood pressure. They explain how vegetarians tend to consume less saturated fat and more polyunsaturated fat and suggest this may help modulate blood viscosity (thickness or resistance to flow). They also suggest that certain nutrients (potassium, magnesium and other minerals, antioxidants and fibre) present in abundance in a vegetarian diet, may lower blood pressure.

Numerous studies confirm that vegetarian and vegan diets are beneficial for both the prevention and treatment of hypertension (Appleby *et al.*, 2002; American Dietetic Association, 2003; Leitzmann, 2005). The widespread adoption of a plant-based diet would be a major step in reducing the incidence of this potentially dangerous condition (see the VVF mini-guide *Know Your Numbers: Blood Pressure*).



A Healthy Weight

Being overweight or obese increases the risk of CVD via a range of mechanisms. It can place a strain on the heart, lungs, kidneys and other organs. As weight increases so does blood pressure and insulin resistance. Overweight and obese people tend to higher levels of LDL 'bad' cholesterol and lower levels of HDL 'good' cholesterol. On the other hand, numerous studies show that vegetarians weigh less (Appleby *et al.*, 1998; Key *et al.*, 1999; Newby *et al.*, 2005; Barnard *et al.*, 2005). In 2003, a large-scale study revealed that vegans have healthier, lower body mass index (BMI) than vegetarians, fish-eaters and meat-eaters respectively (Spencer *et al.*, 2003). A subsequent review of 40 studies revealed that, on average, vegetarians and vegans weigh between six pounds and two stones less than meat-eaters (Berkow and Bernard, 2006). This study concluded that a vegetarian diet can be used successfully for weight loss (see the VVF guide *The V-Plan Diet*).

Homocysteine

Since the early 1990s there has been much interest in the role of homocysteine in CVD. High homocysteine levels may cause damage to the lining of the blood vessels, increasing the risk of clotting. Homocysteine is an amino acid (a building block of protein) produced in the body during the breakdown of another amino acid called methionine. It may also be converted back into methionine. This reaction relies on sufficient supplies of folic acid and vitamins B6 and B12. If any of these are in short supply, homocysteine levels can rise. Ensuring adequate intakes of these vitamins can prevent this. Indeed ensuring an adequate folic acid intake has been shown to significantly reduce the risk of stroke (Wang *et al.*, 2007). Folic acid and B6 are found abundantly in plant foods and B12 is found in fortified foods. A daily serving of breakfast cereal fortified with folic acid, B6 and B12 can improve blood levels of these vitamins and reduce homocysteine (Tucker *et al.*, 2004). (See the VVF fact sheet *B12 and the Vegan Diet*.)

Other Risk Factors

There are of course other factors that contribute to the risk of CVD. Exercise is important as it increases 'good' HDL cholesterol levels, which in turn helps keep 'bad' LDL cholesterol levels down. Exercise also helps control weight. Smoking is a major risk factor as it hardens the arteries, causing them to narrow. Excessive alcohol consumption can increase the risk of CVD by increasing blood pressure, heart rate and cholesterol as well as contributing to weight gain.

Defeating CVD with Diet Good News for Veggies

Heart Disease

Vegetarians have lower cholesterol levels (by about 0.5mmol/l), lower blood pressure, weigh less (on average between six pounds and two stone less) and have a lower risk of dying from heart

disease by a massive 25 per cent! A well-balanced low-fat high-fibre plant-based diet reduces the risk of obesity, high cholesterol, hypertension and can be used to prevent, treat and even reverse heart disease.

Dr Dean Ornish, Clinical Professor of Medicine at the University of California in San Francisco, is best known for his *Lifestyle Heart Trial* in which he treated severe heart disease patients with lifestyle changes alone. The experimental group ate a low-fat wholegrain plant-based diet containing lots of fruits, vegetables and pulses. They also followed an exercise programme, practised various forms of stress management and did not receive medication. They were monitored against a 'control' group of similar patients who received conventional treatments. After just one year, 82 per cent of patients on this lifestyle change regime had regression of their heart disease with a 91 per cent reduction in chest pain and reduced cholesterol levels; whereas the control group experienced a 165 per cent increase in the frequency of chest pain; cholesterol was worse and blockages of arteries became worse (Ornish *et al.*, 1990; Ornish *et al.*, 1998). This trial has continued with similar results and continues to achieve better results than conventional surgical or medical intervention.

More recent work shows that vegetarians generally have a much lower risk of heart disease than meat-eaters. One major study shows that vegetarians have a massive 25 per cent lower risk of dying from heart disease! The authors of this study conclude that the widespread adoption of a vegetarian diet could prevent approximately 40,000 deaths from heart disease in Britain each year (Key *et al.*, 1999).

Stroke

The role of animal-based foods in stroke has raised some controversy with a number of scientists suggesting that animal foods may contain some component that has a protective effect against stroke (Ding and Mozaffarian, 2006). We know that animal products increase the build up of fatty deposits in the coronary arteries so how could they protect arteries in the brain? The theory is yet to be proven but suggests that certain fatty acids (arachadonic acid), mainly obtained from animal sources, may help maintain the integrity of the smaller blood vessel walls in the brain and protect against stroke.

However, the research suggests that the protective effect of animal products may be largely confined to haemorrhagic stroke (Sauvaget *et al.*, 2003), whereas the majority of strokes in the UK are ischaemic (caused by blockages). Furthermore, the supposed protective role may be restricted to those with low cholesterol and high blood pressure. It would be better to change to a healthier diet to lower the blood pressure than to attempt to avoid a stroke by eating more of the types of food that lead to high blood pressure, obesity and heart disease!

Numerous studies do confirm that increasing the amount of fruit and vegetables in the diet can reduce the risk of stroke (Gillman *et al.*, 1995; Johnsen *et al.*, 2003, Pomerleau *et al.*, 2006). One review quantified the effect by examining a group of studies involving a total of 114,279 adults of whom 570 experienced a stroke (Joshipura *et al.*, 1999). Results showed that those consuming the most fruit and vegetables (around 10 servings per day) had a 31 per cent lower risk of stroke. A more recent review of eight studies (including 257,551 people and 4,917 stroke events) concurred fruit and vegetables had a significant protective effect (He *et al.*, 2006). The authors said these results provide strong support for the recommendations to consume more than five servings of fruit and vegetables per day, which is likely to cause a major reduction in strokes.

Cross-Cultural Studies

Examining the incidence of CVD in other cultures allows us to draw conclusions about the role of diet in disease. Several studies show that death rates from CVD are linked country-by-country with the consumption of cow's milk and dairy products (Moss and Freed, 2003). In his book *The China Study*, Professor T. Colin Campbell (Professor of Nutritional Biochemistry at Cornell University, Ithaca, NY), observes the low rates of heart disease in the southwest Chinese provinces of Sichuan and Guizhou; between 1973 and 1975 not one single person died of heart disease before the age of 64 among 246,000 men and 181,000 women (Campbell and Campbell, 2005). Campbell suggests these figures reflect the important protective role of low blood cholesterol levels observed in rural China.

Veggies Eat Better

Vegetarians consume a third less saturated fat and only half as much cholesterol as meat-eaters. Vegans consume even less – half the amount of saturated fat eaten by meat-eaters and no cholesterol (Davis *et al.*, 2003). A large-scale study investigating cholesterol levels among vegans, vegetarians, fish- and meat-eaters found that the vegans had the lowest levels, vegetarians and fish-eaters had intermediate or similar values and the meat-eaters had the highest (Appleby *et al.*, 1999). This study showed that as consumption of meat and cheese rises, so do cholesterol levels but as fibre intake increases, cholesterol levels fall. Fibre reduces blood cholesterol levels either by interfering with cholesterol absorption or production (Queenan *et al.*, 2007). More good news for vegetarians who tend to eat more fibre than meat-eaters.

A healthy vegetarian diet, characterised by a higher intake of fruits and vegetables, wholegrains, pulses and nuts results in higher intakes of antioxidants as well as fibre compared with non-vegetarian diets (Rajaram, 2003). A large body of experimental and epidemiological data indicates that antioxidant vitamins may be able to reduce atherosclerosis – the progressive thickening and hardening of arterial walls that results from the build up of fatty deposits (Azen *et al.*, 1996). In other words a high intake of fruit and vegetables can help strengthen the arteries and inhibit the build up of plaques.

Vegans Rule

Vegans have healthier levels of total cholesterol, LDL and HDL in their blood compared to vegetarians, which in turn have better levels than meat-eaters. A study published in the *Journal of the American College of Nutrition* investigating the risk factors associated with CVD found that African-American vegans exhibit a more favourable serum lipid profile (a healthier balance of fats in the blood) compared to vegetarians who ate milk, milk products and eggs (Toohey *et al.*, 1998). The major factors contributing to this result were thought to be the lower saturated fat intake and higher fibre intake of vegans.

The message could not be more simple: animal-based foods (meat, poultry, eggs and dairy) lead to high cholesterol levels, high blood pressure, obesity and other risk factors linked to CVD. A well-balanced vegan diet containing plenty of fruit and vegetables, wholegrains, pulses, nuts and seeds lowers the risk of CVD. As stated above, this applies to people wishing to avoid CVD and people who already have CVD. As the research shows, you can reverse heart disease by making lifestyle and dietary changes alone. It's never too late!

Wake up to plant-based diets

The scientific evidence is compelling – the best way to protect your heart is to go veggie, or better still, vegan!

Top Tips for a Healthy Heart

The VVF has devised 12 steps to help you stay healthy and avoid CVD

1. DITCH SATURATED ANIMAL FATS. Swap meat, eggs and dairy foods for healthier plant-based options including fruit and vegetables, wholegrains (wholemeal bread, wholemeal pasta, brown rice, oats), pulses (peas, beans and lentils), nuts and seeds.
2. SWITCH TO HEALTHY PLANT-BASED FATS. Omega-3 essential fatty acids protect your heart. Flax seed (linseed) oil is an excellent source. Keep it in the fridge and add to dressings, sauces and cooked food only as heating destroys its beneficial properties. Other sources include walnuts, soya beans, rapeseed and hemp seed oils and green leafy vegetables. In oily fish, pollutants such as mercury, polychlorinated biphenyls (PCBs) and dioxins may outweigh any potential benefits (see VVF fact sheet *Fishing for Facts*).
3. FABULOUS FIBRE. Fibre from fruits, vegetables, pulses and wholegrains lowers blood pressure and cholesterol. 10 grams of fibre a day reduces the risk of heart attack by 14 per cent and the risk of dying from heart disease by 27 per cent. A medium-sized apple contains around 3.0 grams of fibre, a slice of wholemeal bread contains 1.5 grams and a small portion of broccoli about 2.7 grams. Rice bran is an excellent source of fibre and has been shown to lower cholesterol. Buy it from health food shops and sprinkle it on breakfast cereals and use in stews and soups.
4. GET YOUR 5-A-DAY. Eat at least five portions of fruit and veg a day. Not just for the fibre but for the disease-busting antioxidants vitamins A, C and E. These can boost heart health as well as protecting against cancer and other diseases. Choose brightly-coloured varieties to optimise your antioxidant intake: sweet potato, purple sprouting broccoli, red cabbage, asparagus, curly kale, blueberries, raspberries and avocados.
5. INCLUDE SOYA FOODS. 25 grams of soya protein per day can lower cholesterol levels. A 250ml glass of Alpro soya milk (blue carton) contains 9.3 grams of protein and 100 grams of Cauldron Organic Tofu contains 12 grams.
6. MAINTAIN A HEALTHY WEIGHT. Obesity has trebled since the 1980s and well over half of UK adults are either overweight or obese. A waist measurement of more than 88 cm (35 inches) in women and 102 cm (40 inches) in men increases the risk of heart disease and diabetes. A vegetarian or vegan diet can help weight loss and losing just a few centimetres from your waist can significantly lower your risk of heart disease. (See the VVF's new guide *The V-Plan Diet*.)
7. TAKE REGULAR EXERCISE. Lack of physical activity raises the risk of heart disease. A well-balanced vegetarian or vegan diet, coupled with regular exercise, can help shed those excess pounds! Set yourself a daily target of 10,000 steps and walk your way to health and fitness with the new VVF pedometer (available from our webshop at www.vegetarian.org.uk/shop or by telephoning 0117 970 5190).
8. CUT OUT THE SALT. A high salt intake can increase blood pressure. The government recommends no more than 6.0 grams per day for adults. Use fresh herbs and spices to flavour your food and get rid of the salt-cellar – your taste buds will adapt very quickly.
9. WATCH OUT HOMOCYSTEINE'S ABOUT. This amino acid (a building block of protein) is produced in the body and can cause serious problems if it accumulates to high levels. You can reduce homocysteine levels by ensuring an adequate intake of folate (folic acid) and vitamins B6 and B12. Folate and B6 are available in yeast extract, green leafy vegetables, pulses (peas, beans, lentils), wholegrains (wholemeal bread, wholemeal pasta, brown rice, oats), nuts and fortified breakfast cereals. B12 is found in fortified foods including yeast extracts, soya milks, breakfast cereals and margarines.
10. CHILL OUT. Take time out just for yourself with a gentle activity such as yoga or Tai Chi, or just take a moment to relax.
11. DON'T SMOKE. Smoking is a major risk factor and stopping can halve your risk of CVD after just one year.
12. CUT BACK THE BOOZE. Too much alcohol increases the risk of CVD. Avoid binge drinking.

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