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Opening Extract from...

Healthy Eating

To reduce the risk of dementia

Written by

Margaret Rayman, Vanessa Ridland,
Katie Sharpe and Patsy Westcott

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healthy eating to reduce the risk of dementia

100 fantastic recipes based on years of detailed research

Photography by Will Heap

Kyle Books

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foreword

One of the things we notice as we get older is that our memory does not seem to be as good as it used to be. There is indeed evidence from many cross-sectional studies comparing old and young that some cognitive abilities are impaired in the elderly but, on the other hand, up to about the age of 60 other cognitive abilities actually improve due to greater experience. Change in the population as a whole is called 'usual ageing'. Some scientists have suggested that 'usual brain ageing' in a population is a mixture of 'disease-related ageing' in some people and 'successful brain ageing' in others. Among the factors that help to maintain 'successful brain ageing' is control of high blood pressure, prevention of diabetes and regular exercise. This welcome book looks at whether nutrition also plays a role in successful brain ageing. When you hear reports in the media about diet and the brain and wonder whether they are true or not, then look for the answers here.

Hardly a week goes by without some report in the press about how a certain diet can protect you against getting Alzheimer's disease, or against memory decline. These reports are usually based upon a single scientific paper and they are often exaggerated so the reader is left uncertain about what to do. This situation is partly because nutritional science is not as straightforward as some of the other sciences. We eat food, not a mixture of pure vitamins or minerals. Scientists want to identify which components of food are crucial for brain function and so they do clinical trials in which pure components of food are given to people for many months and carry out memory tests before and after the treatment. These trials do not always work as expected and so we need to look at particular foods and at dietary patterns as well as at pure chemicals. A well-known example is the Mediterranean diet, which is complex and not easy to define in chemical terms.

Memory decline may be relatively trivial or it may be an early part of a process that eventually leads to Alzheimer's disease. This develops slowly, over 20 to 30 years, and it is only in the last five to ten years that we begin to notice memory problems. The long gestation of the disease provides an opportunity to modify the disease process and so to prevent dementia. Our genes play a role in that some of them increase the risk that we will develop dementia but only very rarely indeed do they make it inevitable that we will get the disease. For most people who develop dementia, the causes are multiple and risk-factor genes are just one component. We now believe that nutritional factors also play a role and that they interact with each other and with the risk-factor genes. As we age, some of the components of our diet essential for brain function are not as well absorbed as when we were younger, for example vitamin B12. We need to be aware of this and eat the right kind of foods or even take a vitamin supplement. So it is a complicated story and you need a book like this to help you. As well as telling you about the science in a very clear and balanced way, the book encourages you to put into practice what we already know by providing a range of recipes. So, go for it – and help yourself and your brain to age successfully!

A. DAVID SMITH FMEDSCI

Professor Emeritus of Pharmacology, University of Oxford

Professor Smith co-founded the Oxford Project to Investigate Memory and Ageing in 1988. In 1998 OPTIMA identified raised plasma homocysteine and low-normal folate and vitamin B12 as risk factors for Alzheimer's disease and in 2009 OPTIMA completed a successful clinical trial of B vitamin supplements in people with Mild Cognitive Impairment.

Introduction

Diet and dementia

Dementia, including Alzheimer's disease (AD), is a major and growing health problem all over the world. Most of our lives are touched by it, and many of us will have relatives, friends, colleagues or acquaintances who are affected. In 2013 there were more than 44 million people with dementia worldwide and by 2050 there will be 135 million. Meanwhile, in the UK, according to the Alzheimer's Society, around 800,000 people are living with dementia, a figure set to rise to over a million by 2021. And, although a handful of drugs can help control initial symptoms and may slow its progress, there is currently no cure.

The financial cost of dementia globally is a staggering £400 billion, while in the UK the NHS, local authorities and families spend around £23 billion per year – twice as much as on cancer, three times as much as on heart disease and four times as much as on stroke. But this is small compared to the incalculable emotional, physical and psychological strain dementia places on those who have it, their families and friends.

Age is the biggest risk factor for dementia. Around one in 100 people aged 60 to 64 years has some form of it, while by age 95 one in three people is affected. Despite this, dementia is not inevitable. There are things you can do to help reduce your risk. Simple lifestyle measures such as staying physically active, not smoking, watching your weight, keeping an eye on your cholesterol and blood pressure and, above all, eating a healthy diet may help to protect your brain and keep it sharp as you age.

Scarcely a week passes without some dramatic news item about the miraculous effects of this or that food or nutrient on brain health. Sadly, many are overblown and inaccurate. Despite the headlines, research – including research into nutrition – rarely progresses in a straight line. Instead, evidence accumulates bit by bit until it is too strong to ignore.

In this book we look beyond the hype to bring you reliable, up-to-date advice, based on the latest scientific research, about the foods and nutrients most likely to protect your brain and help reduce your risk of dementia. To this end we trawled through numerous studies on diet and nutrition and assessed the quality of their evidence.

As we researched, two things became clear. One is that the whole is greater than the parts. A diet high in fresh fruit and vegetables, wholegrains, pulses, fish, nuts, seeds and oils such as olive oil, but low in saturated and trans-fats and processed foods, is likely to provide you with the best combination of nutrients in the optimal amounts to help protect your brain.

The other is that, for the most part, a healthy, varied diet is likely to benefit your brain and offer better protection from cognitive decline and dementia than taking isolated nutrients as supplements.

In this book you will learn more about the nutrients, foods and dietary patterns

that make for a healthy brain, as well as how to incorporate them into your lifestyle. To help you put our findings into practice we have devised more than 100 delicious recipes that we hope will help you to choose the foods most likely to lower your risk of developing dementia and enable you to adapt your own favourite dishes.

There are no easy solutions to dementia. We cannot guarantee that you can or will avoid it. And we certainly do not promise a cure. But, we do believe that making some simple, sustainable dietary choices can help to protect the health of your brain.

Enjoy!

FOOD SYNERGY

Although many studies strongly suggest a relationship between what we eat and long-term brain health, the picture is confused and confusing. Researchers are increasingly looking at 'food synergy', the idea that, although the effects of single foods or nutrients may be small, when you combine them in a healthy diet they can pack a powerful punch. In particular a Mediterranean style of eating is associated with longer life expectancy and lower rates of chronic diseases, including dementia. See page 36.



Making sense of dietary research

Before reading what you can do to help keep your brain healthy, it will help to understand a bit about dietary research and how it is carried out.

Until recently, research into brain ageing and neurodegenerative disease was relatively poorly funded. This is slowly changing and new findings are appearing more often. These findings can be conflicting and not always easy to interpret, however, and all too often, and most frustratingly, the conclusion is 'more research is needed'. We haven't shied away from reporting negative or contradictory results, but we have tried to put them into context to help you make up your own mind.

Several different types of studies are used to examine how foods, nutrients or patterns of eating may affect the risk of disease, each of which has strengths and weaknesses. Some are performed in laboratories, some are conducted on animals and others are carried out on people. But while findings from the former can help identify underlying mechanisms, they don't necessarily translate to humans. And human studies can be equally fraught with difficulties, for reasons including:

- lack of a foolproof way to gather accurate information about food intake in groups of people
- difficulty assessing whether people are eating what they say they are
- similar foods can have different nutritional profiles depending on how and where they are grown
- gaps in our knowledge about the precise nutrient content of many foods
- not knowing whether low blood levels of nutrients in people with Alzheimer's disease are a cause or consequence of the disease process.



For more about scientific research and how to assess it see page 164.

Types of study

One way to reduce the margin of error and compensate for inaccuracy is to gather information from large numbers of people in randomised controlled trials (RCTs) that are more likely to prove cause and effect (see Appendix 2). Most evidence linking diet and dementia, however, comes from studies that draw inferences about the effects of foods, nutrients or eating patterns on groups of people by observing them over time. These observational studies can help researchers develop ideas about how certain foods and nutrients are associated with disease, but they cannot prove cause and effect.

What they can do is identify potentially beneficial nutrients, foods and dietary patterns. When lots of such studies involving thousands of participants from different places reach the same or similar conclusions – and when there is convincing evidence to explain how they may work – they can provide a basis for cautious dietary recommendations. This makes even more sense if the recommendations are safe, easy to follow and have other health benefits. This is the approach we take in this book.

Until recently, although there were clues, few parts of the diet and dementia puzzle fitted. Now more pieces have been added and we are getting a better idea of the whole picture. Some pieces are still missing, however, and others may be in the wrong place. It is likely to take years to complete the puzzle. Meanwhile, there are positive steps you can take right now to help protect your brain against dementia.

About dementia

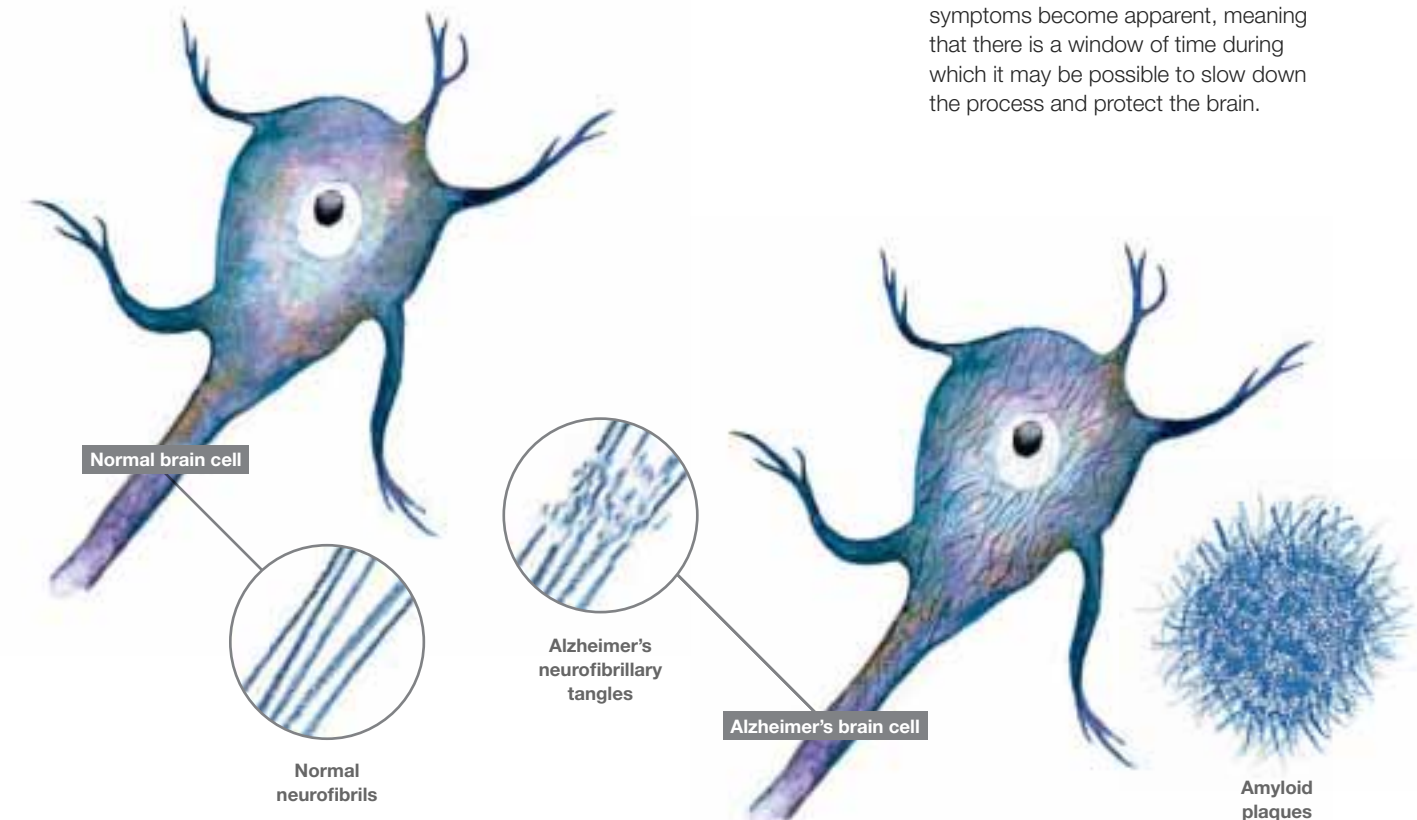
Dementia is a set of symptoms caused by several different diseases that affect the brain. Symptoms vary but include memory loss, problems with thinking (impaired cognition), mood changes and loss of coordination.

Alzheimer's disease

Alzheimer's disease (AD), which affects 62 per cent of people with dementia, is the leading cause of dementia. It has two key hallmarks – the formation of microscopic clusters or plaques of a protein known as amyloid-beta ($A\beta$) in the brain, and the build-up of twisted strands of another protein called tau, known as neurofibrillary tangles, both of which are toxic to the brain.

Over time the connections between brain cells (synapses) dwindle, stopping brain cells communicating with each other. Eventually the damage becomes so great that brain cells die and regions such as the hippocampus, which is concerned with memory and learning, shrink – a process called brain atrophy.

It is not known exactly what causes all this to happen but recently inflammation and insulin resistance – when the body is unable to use insulin properly – have been recognised as key players in the development of AD. Whatever the cause, the brain changes that lead to the disease start 20 to 30 years before symptoms become apparent, meaning that there is a window of time during which it may be possible to slow down the process and protect the brain.



Vascular dementia

Caused by problems with the brain’s blood supply, vascular dementia affects 17 per cent of people with the disease. It happens when less oxygen reaches the brain due to narrowed or blocked blood vessels. This in turn damages brain cells or causes their death. Vascular dementia can develop rapidly after a stroke or, more gradually, as a result of ongoing blood-vessel damage.

Mixed and other dementias

Dementia caused by both Alzheimer’s disease and vascular or other forms of dementia is known as ‘mixed dementia’, meaning that the symptoms have more than one cause. Rarer forms of dementia make up a small percentage of cases and dementia can also be a symptom of other conditions, such as Parkinson’s disease.

Mild Cognitive Impairment

Mild cognitive impairment (MCI) affects 3 to 19 per cent of over 65-year-olds. People with it often have problems with memory or thinking, but these do not significantly interfere with everyday life. MCI is not dementia and may remain stable or even return to normal. However, it does increase the risk of dementia and an estimated 10–15 per cent of those with it develop dementia each year.

The brain-protective diet

Antioxidants in the brain-protective diet

The antioxidant vitamins A, C, E and beta-carotene, together with the mineral selenium, help to keep us healthy in body and mind. Many scientists speculate that we need more antioxidants as we get older to combat cell damage caused by oxidative stress (see box on right), now thought to be a driving force behind many chronic diseases, including Alzheimer’s disease and vascular dementia. People with AD and dementia have fewer antioxidants in their blood than healthy people, although whether this is a cause or a consequence of the disease is not known.

Emerging evidence suggests that dietary antioxidants are likely to work in synergy. Including a combination of foods such as fruit, vegetables, nuts and seeds that are rich in vitamins E and C, the most studied in relation to brain and vascular health, as well as other beneficial vitamins, minerals, plant compounds and fibre is likely to have the best long-term benefits for your brain.

What is the evidence?

In laboratory and animal studies vitamins E and C block the cascade of damage triggered by molecules called reactive oxygen species. There is also evidence that they can reduce the vascular damage that increases the risk of heart and brain problems. However, despite their apparent promise, it has proved frustratingly difficult to show definite benefits.

In 2004 researchers from the Taub Institute for Research on Alzheimer’s Disease and the Aging Brain at Columbia University in the US examined seven studies looking at the potential links between antioxidant intake and the risk of dementia and Alzheimer’s disease. In all but one, higher intakes of vitamin C and/or vitamin E were associated with a lower risk of AD and/or dementia – especially when obtained from the diet. But not all studies are positive. For example, one study of almost 3,000 older people carried out in 2008 found no reduced risk for either Alzheimer’s disease or dementia when participants took supplementary vitamins E and C. The picture is unclear. However, one common theme is that getting your antioxidants in food appears to be more effective than taking them as supplements.

OXIDATIVE STRESS AND DEMENTIA

Oxidation is a natural process that happens when our cells use oxygen. It is the same process that causes a cut apple to go brown, iron to rust and butter to go rancid. As part of this process molecules called reactive oxygen species (ROS) or free radicals, are produced, which if unchecked can damage cells.

The body produces its own antioxidants to help control oxidation. However, if too many free radicals are produced due to lifestyle factors, such as smoking, high cholesterol, type-2 diabetes or ageing, the normal system of checks and balances can be overwhelmed, leading to oxidative stress. This is one reason, according to many ageing experts, why we are at greater risk of chronic diseases, including dementia and AD, as we get older.

The brain is especially prone to oxidative stress, partly because it uses more oxygen than any other organ – around a fifth of the body’s oxygen supply – partly because brain cells are fatty, which makes them more susceptible to oxidation, and partly because they are some of the longest lived in the body and so, over time, are more likely to accumulate damage. Markers of oxidative stress are seen in the brains of people with AD, even before the appearance of the well-known plaques and tangles. Vascular dementia too, which often occurs after a stroke, is a classic example of oxidative stress.

THE GENETIC CONNECTION

Several genes have been linked to an increased risk of dementia. The most studied are versions (variants) of the ApoE gene, which enables fats to be carried around the bloodstream and delivered to cells. The ApoE ε2 version is linked to a lower risk of AD. The ApoE ε4 version is linked to a higher risk of late-onset AD, the kind that develops after age 65. Only half of people with AD have the ApoE ε4 gene, however, reflecting the many other factors involved in AD.

RISK FACTORS FOR DEMENTIA

Some you cannot do anything about:
Age – The older you are, the greater your risk.
Genes – Some genes are associated with a greater or lesser risk of dementia.
Gender – Women are more at risk of AD. Although is not yet known why, it is not just because women live longer than men.

Some you can modify:
Risk factors for heart disease and stroke – High cholesterol, high blood pressure, overweight, high blood glucose levels and type-2 diabetes all increase the risk of dementia and AD – so looking after your heart can help protect your brain.

Physical activity – Being physically active can help reduce the risk of cognitive decline and dementia and research suggests that it works in synergy with nutrients to help protect the brain.
Smoking – Smoking increases the risk of vascular dementia and vascular aspects of Alzheimer’s disease. This risk goes down within two to four years of stopping smoking.
Diet – As you will see throughout this book, paying attention to what you eat is one of the things you can do yourself to help protect your brain against dementia.



Know your antioxidants

Vitamin C

Vitamin C (ascorbate) is a water-soluble antioxidant. One of its major roles is to mop up free radicals. Because it dissolves in water it is not stored in the body, so you need to consume vitamin C-rich foods every day to ensure good levels in your bloodstream.

Food sources

Most fruits and vegetables contain vitamin C. Blackcurrants, kiwi fruit, citrus fruit and raw peppers are some of the best sources, but even the humble potato can add to your daily intake. In fact, potatoes and potato products contribute more vitamin C to the UK diet than any other food.

Because it is water-soluble, vitamin C is easily lost in cooking water and can be destroyed by high heat. Cooking methods such as steaming or stir-frying can help minimise losses, as can putting vegetables in casseroles. Be sure too to eat plenty of fresh, uncooked fruit and vegetables to make the most of vitamin C.

What is the evidence?

Some studies suggest that regular consumption of 80–250 milligrams a day (which should be from food rather than supplements) may be optimum for cognitive function, but researchers all agree that one of the most vital roles for this vitamin is to support the antioxidant activities of vitamin E (see opposite).

How does it work?

Many antioxidants work both together and alone to exert their effects. So, for example, vitamin C can enhance the action of vitamin E. Specifically, vitamin C works by:

- scavenging free radicals in the blood and inside cells
- helping to recycle vitamin E so it keeps on working
- increasing the total amount of antioxidants that can be stored and used in our tissues
- stabilising other chemicals in blood and cells to keep blood vessels healthy.

Are we getting enough?

The amount of vitamin C needed for optimal health is unknown. However, it has been suggested that in older people and smokers, who are at high risk of oxidative stress, intakes may be too low. In the UK the recommended intake for adults is 40 milligrams a day; however, other countries recommend more: 75 milligrams a day in the US, for example. There is much debate among scientists about whether recommended amounts should be increased, especially for groups at high risk of oxidative damage.

Recommendations

Ways to ensure you get plenty of vitamin C include:

- eating plenty of raw or lightly cooked fruit and vegetables daily – citrus fruits, berries and peppers are all good sources
- smokers, the elderly and other at-risk groups might want to consider taking a modest supplement.

NB The amount of vitamin C in general multivitamin and mineral supplements sold over the counter should be safe.

However, avoid doubling up on vitamin supplements to prevent overdosing.

Points to note

- At low intakes, we absorb vitamin C efficiently but at high intakes (more than 1.5 grams a day) we absorb little.
- High-dose supplements of vitamin C (>2g/day) may cause abdominal discomfort and/or diarrhoea.
- If long-term supplementation is stopped suddenly, some people may show symptoms of scurvy.

Vitamin E

Although vitamin E is often thought of as just one nutrient, there are in fact eight different fat-soluble forms. The two main ones are alpha- and gamma-tocopherol. Until recently, alpha-tocopherol was thought to be the most biologically active, but it is now thought other forms may be equally important for health. As well as its antioxidant activity, vitamin E may play a role in brain health by helping to dampen down inflammation and prevent the production of potentially damaging inflammatory chemicals. In animal and laboratory investigations, gamma-tocopherol has been found to be a more potent anti-inflammatory than alpha-tocopherol. It also appears to be more efficient at scavenging certain free radicals. Vitamin E has been much studied in relation to heart disease and a high dietary intake has also been linked to a reduced risk of some cancers (prostate, colorectal, lung and oesophageal).

Food sources

Vegetable oils, wheatgerm, nuts (especially almonds, Brazil nuts and



SOURCES OF GAMMA-TOCOPHEROL

Gamma-tocopherol has potent anti-inflammatory effects and can remove damaging chemicals known as reactive nitrogen species (RNS). Good sources include:

- Rapeseed (vegetable) oil
- Wheatgerm
- Pecan nuts
- Cashew nuts
- Brazil nuts
- Walnuts
- Peanuts
- Sesame seeds
- Blackberries

pecans) and seeds (particularly sunflower and sesame) all contain vitamin E, as do cereals and cereal products. Alpha-tocopherol is the main source of vitamin E in the UK due to its presence in sunflower oil, which is much used in cooking and food-processing. In the US, where corn oil is more widely used, gamma-tocopherol is the main form.

Dark green leafy vegetables such as kale, watercress and spinach also contain

some vitamin E, with smaller quantities found in some beans and pulses. Avocados, blackberries and salmon contain moderate amounts and egg yolks a small amount.

Fish such as tuna and sardines that have been canned in oil containing vitamin E can contribute a small amount to intake. Bought salad dressings, spreads, biscuits, pastries and other baked goods also contain vitamin E as vegetable oils are often used in their production. However, they can be high in calories, sugar, salt and saturated fat and low in beneficial nutrients, so are not the best source.

What is the evidence?

Vitamin E has been much studied in relation to dementia, with mixed results. For example, a large European study published in 2010, with almost 6,000 participants, found that those who obtained the most vitamin E from food (18.5 milligrams a day) were 25 per cent less likely to develop dementia than those with low-to-moderate intakes (9–13.5 milligrams a day). Similar results were reported for the risk of AD. In 2005, when over 1,000 men and women over 65 were assessed over a six-year period, researchers found that there was a 25 per cent reduction in risk for every 5 milligrams a day by which alpha- and gamma-tocopherol from the diet increased. The benefits of high dietary (rather than supplemental) intakes strongly suggest that a combination of different tocopherols may be most effective in maintaining brain health. This finding is supported by several reviews of evidence confirming that vitamin E forms other than alpha-tocopherol may be beneficial and that vitamin E supplements – generally alpha-tocopherol – are unlikely to be



protective against Alzheimer’s disease, dementia, vascular or heart disease.

One thing is clear: most research suggests that getting your vitamin E from food rather than supplements is more likely to protect your brain.

How does it work?

- Vitamin E:
- breaks the chain of oxidative damage set off by free radicals
 - works in the blood vessels to prevent the first step towards atherosclerosis
 - has other effects that may reduce cell ageing and neurodegeneration
 - works alone and with vitamin C to help protect against oxidative stress and cell damage
 - has other protective functions. Along with vitamin C, it can slow the production of enzymes and other chemicals that could reduce the efficiency of blood circulation. They both also reduce inflammation in several systems in the body.

Are we getting enough?

Although there is no recommended intake, in the UK men consume around 10.6 milligrams and women around 8.1 milligrams of vitamin E a day. The amount needed to maintain good antioxidant status is thought to depend on the amount of polyunsaturated fats (PUFAs) in your diet. The more PUFAs you consume, the more are stored in your body and the more vitamin E you need to protect them from oxidation. Deficiency is rare, although consuming a very low-fat diet, which is likely to be low in vitamin E, may put you at risk.

Recommendations

- Easy ways to maximise your intake of the different forms of vitamin E include:
- using rapeseed oil (which has good levels of gamma- as well as alpha-tocopherol) for cooking
 - sprinkling wheatgerm on your breakfast cereal
 - snacking on almonds, pecans or sunflower seeds.

Points to note

- Do not take a vitamin E supplement if you have a clotting disorder or are taking anticoagulant medication, such as warfarin.
- Avoid high-dose supplements (more than 200 IU or 133 milligrams a day).
- Prolonged high doses may increase your risk of haemorrhagic stroke, caused by rupture of a blood vessel in the brain.
- In an RCT, a supplement of 400 IU alpha-tocopherol a day increased the risk of prostate cancer by 17 per cent.
- Taking a standard over-the-counter (OTC) multivitamin product is known to be safe and will not provide excess amounts of either vitamin C or vitamin E.

VITAMIN E AND THE VASCULAR SYSTEM

Vitamin E appears to be especially important for the health of the blood vessels and circulation, which are vital for a healthy brain. A large review of almost 50 studies, which included an analysis of the vitamin E intake of over a million men and women, found that those with the highest intake from food and/or higher levels in their blood, which reflects dietary intake, had a lower risk of problems such as heart attacks and strokes. By contrast, taking a vitamin E supplement did not improve blood vessel health.

Selenium

Selenium, a trace mineral found in soil, is known for its antioxidant effects and other benefits. Though we only need small amounts, according to several studies it may help protect against dementia. In fact, it is so important for a healthy brain that, if the diet lacks selenium, the brain conserves it at the expense of other tissues. Studies also show that selenium deficiency causes irreversible brain damage – at least in a study looking at mice.

Food sources

Selenium levels in food vary from country to country. In North America, which has selenium-rich soil, bread and cereals are the main source. In the UK and Europe, where soil levels are lower, meat and poultry are key sources. Brazil nuts are the richest food source but they also contain barium and radium, which may damage health, so be careful not to overindulge. Offal, especially kidney, fish and seafood are other good sources (see Appendix 3).

What is the evidence?

Animal and laboratory studies suggest that selenium may help prevent brain cells from dying by preventing Alzheimer’s plaques and tangles from forming. There are fewer human studies; however, one, which measured selenium levels in the blood of people with mild AD, showed that they had significantly lower selenium concentrations than a comparable group of healthy people. As with other nutrients, it is not known whether this was a cause or an effect of the disease.

Some of the most persuasive evidence that selenium may protect the brain comes from a long-running study of older inhabitants of Nantes in western France. In a group of 1,166 people with healthy brains at the outset, those with low blood levels of selenium were more likely to show signs of cognitive decline four years later. Nine years on from the start of the study, those with the steepest fall in selenium levels had the largest decline in cognitive function.

As with other nutrients, not all research on selenium and dementia points the same way. A study of 4,809 Americans carried out as part of the US government’s third national nutrition survey, for example, found no association between memory and blood levels of selenium. By contrast, among 2,000 rural Chinese people aged over 65, those with the lowest levels of selenium in their toenails (a good way to measure selenium), scored lower in four out of five tests of cognitive function.

One small but encouraging clinical trial has examined the effects of selenium as a sole nutrient. Thirty people with Alzheimer’s disease were assigned to take either 100 micrograms of organic selenium or a placebo every other day in ten three-week cycles over the course of a year. At the end of this time, the condition of 13 of the 15 taking selenium had stabilised, compared to only eight of the 16 who took the placebo.

How does it work?

Many selenoproteins, a family of proteins with selenium at their core, are antioxidant enzymes. Two selenoproteins in particular may be

especially important in protecting the brain:

- **Selenoprotein M**, which in animal studies reduces Aβ production and protects brain function.
- **Selenoprotein P**, which appears to have a special role in delivering selenium to the brain – by latching on to a receptor on the surface of brain cells rather like a key in a lock. In the laboratory, it helps neurons to survive oxidative stress caused by Aβ. The nerve cells of mice that cannot synthesise selenoprotein P are more likely to degenerate, leading to tight, stiff muscles, abnormal movements and spontaneous seizures.

Are we getting enough?

Official recommendations for selenium intake vary around the world but average 60 micrograms a day (men) and 53 micrograms a day (women). Intakes are high in Venezuela, Canada, the USA and Japan and lower in the UK and Europe, especially Eastern Europe. In China intakes range from very low to very high. In Europe, the average intake is around 40 micrograms a day. In the US, it is around 95 micrograms a day (women) and 135 micrograms a day (men). Selenium supplements are popular, especially in the US, where some 50 per cent of people take dietary supplements.

Supplementary benefits

Getting enough selenium is important not just for your brain but also for immune function, greater resistance to viruses and a lower risk of autoimmune thyroid disease. Selenium is also essential for fertility in both men and women. Higher selenium levels may

also help reduce the risk of prostate, lung, bowel and bladder cancers according to observational studies, although findings from clinical trials have been mixed. This may be because, as with other nutrients, supplementation is only likely to benefit those with inadequate intake.

Recommendations

- If you live in a part of the world such as the UK or Europe where intakes are less than 60 micrograms a day (men) or 53 micrograms a day (women), try to include good sources of selenium, such as kidneys, liver, fish, shellfish and occasionally Brazil nuts, in your diet.
- If you never eat these foods, go for a low-dose selenium supplement of 50–100 micrograms a day, maximum.
- Multivitamin and mineral supplements often contain selenium. Check the label and if it contains 30–50 micrograms, that is sufficient.

Point to note

Extra selenium may benefit you if you have a low intake of selenium. If you have an adequate-to-high intake (e.g. you live in North America, Venezuela, Japan or some parts of China) do not take a selenium supplement; it could increase the risk of health problems such as non-melanoma skin cancer and type-2 diabetes.

Polyphenols in the brain-protective diet

Polyphenols are naturally occurring chemicals produced by plants to deter pests, protect against disease and defend against UV damage. The bitter flavour of coffee, the astringent aftertaste of certain red wines, the deep blue and purple of blueberries and aubergines, and the rich scent of vanilla all stem from polyphenols.

Polyphenols can help protect against heart disease, certain cancers, diabetes and high blood pressure. There is also increasing evidence that they may reduce the risk of dementia and AD. Foods rich in polyphenols also often contain other beneficial nutrients such as vitamins, minerals and fibre, as well as being generally low in calories. We still have much to learn about polyphenols and how they work but it is clear that we need to include plenty of polyphenol-rich foods in our daily diet.

Food sources

Scientists have identified more than 8,000 polyphenols, of which around 200 are consumed in the diet. Widely found in fruit, vegetables, peas, beans and lentils, cereals and drinks, the ones most studied for their brain benefits include those in cocoa, red wine, grapes, berries, citrus fruits, soya products, coffee and green and black tea.

What is the evidence?

Extensive evidence from animal studies shows that polyphenols in cocoa, wine, grapes and berries can improve memory and learning. In other studies, polyphenols from the flesh and skin of citrus fruits have

been found to slow the formation of tau protein tangles.

Consumption of red wine, vegetable and fruit juices has been found to delay the onset of dementia and/or Alzheimer's disease. These benefits may be most marked in carriers of the ApoE ε4 gene variant, as well as in smokers and the physically inactive, according to a study of Japanese-Americans.

A French study revealed that people with a high intake of polyphenols had a smaller decline in brain function over a ten-year period. A 2013 review of 16 clinical studies, meanwhile, confirmed that a diet high in fruit and vegetables was linked to healthier blood circulation and lower blood pressure, both of which can contribute to brain health. In this review, beetroot – the deep-purple colour reflects its polyphenol content – was especially beneficial.

How do they work?

- Polyphenols may act in several different ways including:
- as antioxidants
 - as anti-inflammatory factors
 - preventing deterioration in brain cells
 - improving blood flow to the brain
 - helping to maintain stable blood glucose levels – this can reduce damage to blood vessels in the brain
 - improving brain function – some flavonoids may act on specific brain regions to improve memory and learning and even stimulate new protein production and new connections between brain cells.

Are we getting enough?

Unlike traditional vitamins, polyphenols are not essential to day-to-day health and



there is no recommended intake in the UK or elsewhere. Estimating how many of the different polyphenols we consume can be difficult, but in the UK average total intake is probably around 780 milligrams a day (women) and 1,000 milligrams a day (men), although some people may be getting as little as 30 milligrams and others as much as 2,300 milligrams a day.

Recommendations

- Polyphenols and their products in the body may not be stored for long in the bloodstream. The best way to ensure a steady supply is to include a wide variety of different polyphenol-containing foods in your daily diet.
- Aim for between five and nine 80-gram portions of fruit and vegetables a day – opt for apples, onions, aubergines, berry fruits, beetroot, carrots, citrus fruit (including zest and/or pith), grapes, apricots, cruciferous vegetables (such as broccoli, red and green cabbage, kale, watercress) and tomatoes.

- Drinking up to six cups a day of black or green tea, three to four cups of coffee and one or two small glasses of red wine a day could have benefits.
- Herbs and spices are rich in polyphenols and an excellent way to add flavour and extra beneficial nutrients.
- Include soya foods such as soya beans, soya milk, tofu and tempeh in your diet several times a week.
- Regularly eating moderate amounts of nuts, particularly pistachios, will also help to keep your blood vessels healthy.

Points to note

- Drinking too much alcohol increases the risk of many chronic diseases, so keep your intake of red wine within safe limits (see page 38).
- If you don't drink, simply choose polyphenols from other sources such as grapes and berries.

