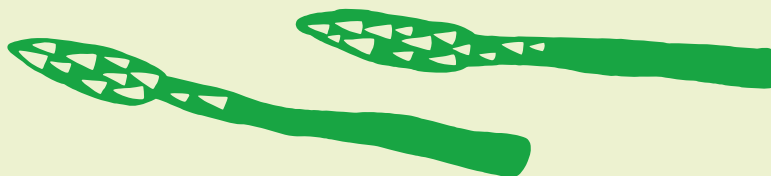
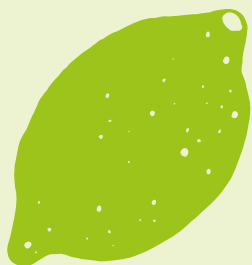


VITAMIN B12



HSIS

THE HEALTH AND
FOOD SUPPLEMENTS
INFORMATION SERVICE

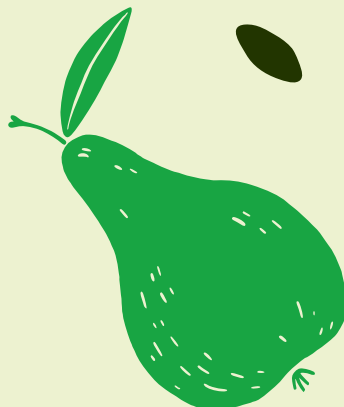


PLANT-BASED DIETS NUTRITIONAL CHALLENGES AND FUTURE HEALTH WORRIES

AN A-Z ANALYSIS



CALCIUM



OMEGA 3 FATTY ACIDS





As more and more people switch to plant-based diets, the risks of micronutrient deficiencies look set to grow both now and in the future.

FOREWORD

Professor Robert Pickard, Dr Emma Derbyshire, Dr Frankie Phillips, Dr Gill Jenkins, Dr Nisa Aslam and Dr Pamela Mason

Plant-based diets are becoming increasingly popular. More than a third (34 per cent) of 1000 adults surveyed for the Health & Food Supplements Information Service - HSIS¹ - said they do not eat meat regularly. Vegans were the smallest group at 3.4 per cent of the total, followed by pescatarians (5.4 per cent) and vegetarians (6.9 per cent). Flexitarians, who tend to dip in and out of meat-based meals, constituted more than one in six (15.9 per cent) of the total surveyed.

This year, a record 400,000 people worldwide signed up to the Veganuary campaign - more than double the number (170,000) who signed up in 2018.² Interest in cutting down or avoiding animal-derived foods is growing rapidly. A 2019 Future of Food report said that, by 2025, vegans and vegetarians would make up a quarter of the UK population and almost a half of all UK consumers would be flexitarian.³

Plant-based eating is not a new concept – rather an old-new trend in nutrition.⁴ Many early human food cultures were plant-based. The Greek philosopher Pythagoras was considered the “father of ethical vegetarianism” – a trend which more or less disappeared from Europe during the Middle Ages but has since re-emerged – mainly for health, ecological and ethical reasons.⁵

People choose plant-based diets for a variety of reasons. Almost half (44 per cent) of the respondents polled by HSIS said they switched to a plant-based diet for health reasons, 37 per cent for animal welfare concerns, with 36 per cent saying it is better for the environment. While all these reasons are not without foundation, a plant-based diet must be carefully chosen to achieve the health improvements, such as better cardiovascular health, metabolic health and reduced cancer, that are often associated with it.

A well-chosen plant-based diet may bring health improvements but no diet can be considered healthy if it fails to deliver the recommended amounts of vitamins and minerals that we all need

to fuel the health and wellbeing of our bodies daily. And a review paper soon to be published, written by independent Public Health Nutritionist, Dr Emma Derbyshire,⁶ shows that poorly-planned plant-based diets are associated with woeful shortfalls in vitamin A, vitamin B12, vitamin D, iron, zinc, selenium, iodine and omega-3s with risks to health through deficiencies of these essential nutrients.

Yet people following these diets don't seem to be aware of the risks. In fact, three quarters of the participants in the HSIS research poll disagreed with the statement that “plant-based diets can provide all nutrients in required amounts.”

But the fact is that many plant-based diets don't provide all essential micronutrients for all ages and stages. Plant-based diets take far more planning than diets containing animal proteins because nutrients from plant-based foods are less bioavailable than those from animal sources. And many people don't research or plan when they switch. Almost two thirds (62 per cent) of those surveyed did no research on nutritional health before changing their diets. And once they had switched, busy lives mean a great reliance on ready meals and takeaways, with more than eight in 10 vegans and vegetarians in the research poll admitting to using these once a week or more.

As more and more people switch to plant-based diets, the risks of micronutrient deficiency look set to grow both now and in the future. The UK National Diet and Nutrition Survey (NDNS) already shows a significant lack of micronutrients in the national diet as well as a trend towards further declines in key nutrient intakes. We don't want this situation to worsen.

To plug these gaps everyone following a plant-based diet should seriously consider taking a multivitamin and multimineral supplement, containing a wide range of micronutrients in recommended amounts, plus an omega-3 supplement suitable for vegans. This is imperative and should be actioned without delay to prevent further declines in vital nutrients for health.

1 GIN21026 HSIS OMNI, Autumn 2020 – on file. 2 www.theguardian.com/food/2020/feb/03/veganuary-signed-up-record-400000-people-campaign-reveals. 3 www.about.sainsburys.co.uk/~media/Files/S/Sainsburys/pdf-downloads/future-of-food-08.pdf. 4 Szabo Z, Erdelyi A, Gubicskone Kisbenedek A, et al. [Plant-based diets: a review]. *Orv Hetil* 2016;157(47):1859-65. doi: 10.1556/650.2016.30594 [published Online First: 2016/11/22]. 5 Leitzmann C. Vegetarian nutrition: past, present, future. *Am J Clin Nutr* 2014;100 Suppl 1:496S-502S. doi: 10.3945/ajcn.113.071365 [published Online First: 2014/06/06]. 6 Derbyshire. E Plant-Based Diets – Environmental Benefits but Better Awareness Needed to Prevent Future Micronutrient Shortcomings. In press.

SECTION 1:

WHAT IS A PLANT-BASED DIET?

Dr Emma Derbyshire, Dr Frankie Philips and Dr Nisa Aslam



Plant-based diets are becoming ever more popular. In fact, vegans and vegetarians look set to make up a quarter of the British population in 2025, with flexitarians accounting for just under half of all UK consumers.⁷ And a record 400,000 people worldwide signed up to the Veganuary campaign this year, compared with 250,000 in 2019 and 170,000 in 2018.⁸

A survey for the Health & Food Supplements Information Service (HSIS)⁹ confirms this overall trend. In fact, more than a third (34 per cent) of the 1051 adult HSIS survey participants said they did not eat meat (i.e., followed vegan, vegetarian or a pescatarian diet) or followed a flexitarian/plant-based approach. Two thirds of the poll participants were meat eaters.

But what exactly is a plant-based diet? Vegan, vegetarian, flexitarian? All of the above? Many consumers are, unsurprisingly, confused. In the HSIS survey:

- 27 per cent (26 per cent of men and 29 per cent of women) describe it as vegan
- 22 per cent as vegetarian (24 per cent of men and 18 per cent of women)
- 15 per cent as including meat-free days
- 8 per cent as flexitarian
- 4 per cent as pescatarian.

And while these numbers make for interesting reading, so too do the regional variations when the same question is posed. Almost half of people living in Stoke-on-Trent (45 per cent) and Cambridge (44 per cent) think a plant-based diet is vegan, whilst around one third of people living in Glasgow (31 per cent), Norwich (32 per cent), Bristol (33 per cent) and Stoke-on-Trent (36 per cent) think it is vegetarian. Fewer people think it is a flexitarian diet, although 14 per cent of Londoners, 21 per cent of people living in Leeds, 16 per cent of Liverpudlians and 14 per cent of Plymouth residents think a plant-based diet can be flexitarian.

So, what do 'official' bodies say?

The British Dietetic Association (BDA) defines a plant-based diet as one *"based on foods derived from plants, including vegetables, wholegrains, legumes, nuts, seeds and fruits, with few or no animal products"*.¹⁰ Other 'official' definitions can be found in Table 1. Key to the BDA definition is that it simply spells out plant-based in an

uncomplicated way. The definition also clearly states that the plant-based diet can be devoid of animal products or can contain a few.

Table 1: Definitions of plant-based diets.

British Dietetic Association (2020)	"A plant-based diet is based on foods derived from plants, including vegetables, wholegrains, legumes, nuts, seeds and fruits, with few or no animal products".
EAT-Lancet Commission (2019)	"The volume of approximately half a plate should be vegetables and fruits whilst the other half should consist of primarily wholegrains, plant protein sources, unsaturated plant oils, and (optionally) modest amounts of animal sources of protein."
McManus (2018) Harvard Medical School	"Plant-based or plant-forward eating patterns focus on foods primarily from plants. This includes not only fruits and vegetables, but also nuts, seeds, oils, wholegrains, legumes, and beans. It doesn't mean that you are vegetarian or vegan and never eat meat or dairy. Rather, you are proportionately choosing more of your foods from plant sources".
Tuso et al. (2013) Definition for Physicians	"A regimen that encourages whole, plant-based foods and discourages meats, dairy products, and eggs as well as all refined and processed foods."

What does plant-based eating look like?

People in the HSIS research study reflected the variety of opinion and practices amongst people who have limited their intake of animal-derived foods. A plant-based diet is not necessarily vegan or vegetarian, though it may be. And it may indeed be flexitarian, perhaps including animal sourced foods occasionally while majoring on fruit and vegetables, beans and grains.

⁷ www.about.sainsburys.co.uk/~media/Files/S/Sainsburys/pdf-downloads/future-of-food-08.pdf. ⁸ www.theguardian.com/food/2020/feb/03/veganuary-signed-up-record-400000-people-campaign-reveals. ⁹ GIN21026 HSIS OMNI, Autumn 2020 – on file. ¹⁰ www.bda.uk.com/resource/plant-based-diet.html

A plant-based diet may contain fish, in which case it is often called pescatarian. A vegetarian diet would include dairy and eggs whilst a vegan diet would cut out all animal-derived products, including meat, fish, dairy, eggs, honey and gelatine.

Digging a bit deeper, vegetarians can be one of three types:

- *lacto-ovo vegetarians* – eat dairy foods and eggs but not meat, poultry or seafood
- *ovo-vegetarians* – include eggs but avoid all other animal foods, including dairy
- *lacto-vegetarians* – eat dairy foods but exclude eggs, meat, poultry and seafood.

Why the increase in plant-based diets?

People choose a plant-based diet for a variety of reasons including concerns about the treatment of animals, health factors, environmental concerns, because of taste or social pressure.

In terms of global and national trend data, in 2019 veganism became more popular in the UK than any other country globally, followed by Australia and New Zealand.¹¹ In the UK alone, specific interest in veganism increased **sevenfold in five years (between 2014 and 2019)** and received four times more interest than vegetarian or gluten-free searches.¹²

A survey of 329 vegans revealed three distinct reasons for following such a diet, these being:

- 1 Animal-related motives (89.7%)
- 2 Personal wellbeing/health (69.3%)
- 3 Environment-related motives (46.8%).¹³

So, what did the HSIS survey participants say?

Broadly, the survey respondents picked up the same themes but with more nuance. Almost half (44 per cent) said they switched to a plant-based diet for health reasons, 37 per cent for animal welfare concerns, with 36 per cent saying it is better for the environment¹⁴. Just over a fifth (21 per cent) chose to switch to lose weight, 18 per cent because they think animal-derived foods contain a lot of 'bad' fat and 17 per cent because they think it is cheaper.

Health, the environment and animal welfare are certainly common themes in this increasingly popular dietary shift, which is the source of a significant amount of research interest in the UK and globally. Plant-based diets are attracting the attention of academic and public

health professionals¹⁵ mainly for health and environmental reasons. In 2019 the EAT-Lancet Commission published the "Food in the Anthropocene" publication, highlighting the need for food systems to support environmental sustainability and nurture human health. It emphasised the importance of fundamental dietary changes, including a shift towards plant-based diets.¹⁶

Environmental impacts

Plant-based diets are considered to be more environmentally-sustainable than diets containing meat. They generally use fewer natural resources in terms of land - including land to grow feed for livestock - and in some cases, less water as well as being less taxing on the environment.¹⁷ Global analytical modelling has shown that substituting animal-sourced foods with plant-based foods in high-income countries can reduce Greenhouse Gas Emissions (by up to 84%).¹⁸ Other models similarly show that Greenhouse Gas Emissions of diets providing the same calories are 29% less for those people following a vegetarian diet compared with an omnivorous diet.¹⁹

Health benefits and risks

Evidence also suggests that 'high-quality', well-planned, plant-based diets can confer certain health benefits, including improved cardiovascular and cardio-metabolic health,^{20,21,22} improved blood fat (lipid) profiles,²³ lower risk of type 2 diabetes²⁴ and reduced death rates from all causes in adults.²⁵ Protective effects of vegetarian and vegan diets have also been observed in relation to some types of cancer.²⁶

However, research also shows that increasing the intake of plant-based foods at the expense of animal-derived food sources can adversely affect nutrient intake, particularly intake of nutrients such as vitamin B12, vitamin D, iron, zinc, selenium, and iodine. And, even if the diet is well-planned, the risks of poor nutrient intakes do not disappear.

Lack of planning

Our research shows that people don't plan their meals and snacks. Worryingly, relatively few people seem to research and understand the health and nutritional risks and the importance of planning a plant-based diet, before they make the switch. In the HSIS research poll, almost two thirds (62 per cent), rising to 81 per cent in Belfast - did not research the nutritional health impacts before switching their diets.

Fewer than half (45 per cent) plan their meals (only 35 per cent, 37 per cent and 38 per cent in Manchester, Sheffield and Cambridge,

respectively). Fewer than a quarter (23 per cent) cook from scratch each day (9 per cent, 11 per cent, 14 per cent in Stoke-on-Trent, Plymouth and Liverpool, respectively). A total of 16 per cent of vegetarians don't cook from scratch daily nor do 17 per cent of 16-29-year olds regardless of their dietary preference.

Summary

The growth in plant-based diets, alongside a lack of knowledge of

the health and nutritional consequences of following such diets, is a worry for the health of the nation. This is worrying especially since micronutrient intakes already fall below recommended levels for many individuals who continue to eat meat and animal-derived foods. Section 2 will consider in detail the micronutrient (vitamin and mineral) issues for people following, or planning to follow, a plant-based diet.



11 Google. Google Trends Data: Veganism. 2019. 12 The Vegan Society: Statistics. 2020. 13 www.ncbi.nlm.nih.gov/pubmed/27378750. 14 Figures do not add up to 100% because participants could select more than one option. 15 www.ncbi.nlm.nih.gov/pubmed/27409633. 16 www.ncbi.nlm.nih.gov/pubmed/30660336. 17 www.ncbi.nlm.nih.gov/pubmed/24898222. 18 <https://www.ncbi.nlm.nih.gov/pubmed/30318102>. 19 www.ncbi.nlm.nih.gov/pubmed/30487555. 20 www.ncbi.nlm.nih.gov/pubmed/29496410. 21 www.ncbi.nlm.nih.gov/pubmed/28792455. 22 www.ncbi.nlm.nih.gov/pubmed/30895476. 23 academic.oup.com/nutritionreviews/article/75/9/683/4062197. 24 www.ncbi.nlm.nih.gov/pubmed/27299701. 25 academic.oup.com/jn/article/148/4/624/4965931. 26 www.ncbi.nlm.nih.gov/pubmed/26853923.

SECTION 2:

NUTRITIONAL CHALLENGES OF A PLANT-BASED DIET?



Dr Nisa Aslam, Professor Robert Pickard and Dr Gill Jenkins

SELENIUM

VITAMIN A

CALCIUM

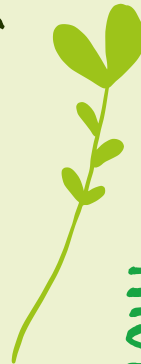
ZINC



B12



IODINE



IRON

D



VITAMIN



OMEGA 3 FATTY ACIDS



While consuming a plant-based diet may be a route to a more sustainable future for the planet, awareness is often lacking about the nutritional quality of such a diet, particularly if the diet is poorly planned. Plant-based diets can deliver good nutritional quality but many people who cut out animal-derived foods do so without considering their nutritional needs or without seeking out appropriate knowledge.

Lack of consumer knowledge on nutritional risks

In the HSIS omnibus poll, just 28 per cent of respondents researched the risks of nutritional shortfalls when switching to a plant-based diet whilst almost half (44 per cent) did not. And a total of 81 per cent of those surveyed had done no research since switching their diet. More than half (51 per cent) had no concerns about any current nutritional gaps in their diets, including 61 per cent of vegans. Even more (62 per cent) had no concerns about nutritional gaps before switching.

Among those who had researched and acted on their findings, 51 per cent introduced more fruit and vegetables. This is a healthy move but would not cover requirements for recommended intakes of certain nutrients such as vitamins B12 and D, iron, zinc, iodine and selenium. In fact, almost half of survey participants (48 per cent) believe – incorrectly – that it is “very easy, quite easy or easy” to get their vitamins and minerals from a plant-based diet. Worse still, almost one third (31 per cent) of poll respondents had not thought about how their nutrients would be provided by a plant-based diet.

Almost half (41 per cent) believe - again, incorrectly - that nutrients in vegan/vegetarian/plant-based foods are as well-absorbed as those in animal-derived foods. More than half (53 per cent) of 16-29-year olds and 61 per cent of vegans think this. Nutrients - in particular, minerals such as iron and zinc - are not as well-absorbed from plant-foods.

Scientific research

Evidence from scientific research shows the extent of peoples’ lack of concern and knowledge about nutrition in relation to plant-based diets.

Top-line findings from a recent research review and analysis of quality studies by Dr Emma Derbyshire (independent Public Health Nutritionist)²⁷ were that plant-based diets may lead to shortfalls in intakes and status of vitamin B12 and D as well as iron, zinc, iodine, selenium and omega-3 fatty acids. Such shortfalls can have significant impacts on health.

Digging deeper: risks of poor micronutrient intakes with plant-based diets

A large US study²⁸ using data from 17,387 individuals showed that increasing consumption of plant foods led to more people failing to meet dietary targets for vitamin A, D and calcium, resulting in unintended dietary consequences.

In the Netherlands, research evaluating the replacement of 30 or 100 per cent of meat and dairy consumption with plant-based alternatives confirmed that in the 100 per cent scenario, 60 per cent of adults had vitamin A intakes below the Estimated Average Requirement (EAR) and 10-31 per cent had zinc, thiamin and vitamin B12 intakes below the EAR.²⁹ Iron intakes were sufficient but the non-haem, plant-sourced, iron present in the diet had a lower bioavailability, meaning that less was absorbed by the body.

HSIS FACT: Haem iron is typically absorbed at a higher rate than non-haem iron derived from plant sources, which means that the body more easily absorbs iron from animal-derived products than iron derived from plant foods.

Findings in the HSIS research poll show that almost half (41 per cent) overall eat vegan or vegetarian ready-meals or vegetarian or vegan meat or dairy substitutes at least twice a week.

A French study³⁰ found that, compared with omnivores, vegetarians were more likely to be short of B vitamins (specifically thiamin, niacin, and B6) as well as zinc and potassium. In the same study, vegans tended to have the highest prevalence of shortfalls for total vitamin A, riboflavin, B12 and calcium.

Meta-analyses and systematic reviews have shown similar findings for a range of micronutrients. A 2017 analysis of 16 studies focusing on vegetarian children found shortfalls in vitamin B12 and D,³¹ while an analysis of nine studies found that pregnant vegetarians and vegans could be deficient in vitamin B12 and iron.³²

Turning to specific nutrients in more depth, vitamin B12, vitamin D, iron, zinc, selenium and iodine as well as omega-3 fatty acids are all of particular concern.

Vitamin B12

Many people following plant-based diets fail to understand the

²⁷ Derbyshire, E Plant-Based Diets – Environmental Benefits but Better Awareness Needed to Prevent Future Micronutrient Shortcomings. In press. ²⁸ www.ncbi.nlm.nih.gov/pubmed/27409633. ²⁹ www.ncbi.nlm.nih.gov/pubmed/28532520. ³⁰ www.ncbi.nlm.nih.gov/pubmed/28926931. ³¹ www.ncbi.nlm.nih.gov/pubmed/28299420. ³² www.ncbi.nlm.nih.gov/pubmed/25600902

importance of vitamin B12 in the diet, the lack of this essential vitamin in the diet if animal-derived or fortified foods are not consumed and the need to supplement with B12.

Vitamin B12 is found in animal-derived foods including meat, milk, cheese and other dairy foods. For anyone consuming a plant-based diet, fortified breakfast cereals (ideally consumed twice daily), non-dairy milk alternatives and yeast extracts would be an option to improve B12 intake.³³ However, not everyone following a diet devoid of animal-derived foods will consume these alternatives, leaving them deficient in B12.

Vitamin B12 is an essential micronutrient that contributes to normal energy metabolism, functioning of the nervous system, homocysteine metabolism, normal red blood cell formation, immune function, cell division and reduction of tiredness and fatigue. Low vitamin B12 levels have also been linked with poor cognitive function.³⁴

Of the HSIS survey participants:

- 20 per cent think vitamin B12 might be lacking in a vegetarian diet
- 17 per cent think B12 would be lacking in a vegan diet
- 13 per cent think B12 would be lacking in a plant-based diet
- 9 per cent think B12 would be lacking in a pescatarian diet
- 8 per cent think B12 would be lacking in a flexitarian diet.

In fact, more than a third (34 per cent) agree, without bias with the statement that, "all these types of diets can provide all the nutrients needed at every stage of life". Dr Derbyshire's paper clearly shows this is misconceived.

Several studies have found shortfalls of vitamin B12 in people following plant-based diets.^{35,36,37,38,39,40} Of note, in a British study involving over 600 men, half of the vegans were categorised as vitamin B12 deficient and at risk of clinical signs and symptoms.⁴¹ Unsurprisingly, another study found that vitamin B12 intake was negligible in vegans,⁴² and another that vitamin B12 intakes were significant lower in vegans than in non-vegetarians.⁴³ In Dr Derbyshire's analysis of four studies comprising 948 adults, vitamin B12 intakes amongst vegans fell below dietary targets for males and females alike.^{44,45,46,47}

Vitamin D

Vitamin D contributes to normal absorption/utilisation of calcium and phosphorus and blood calcium levels, and is essential for the maintenance of bone health, teeth, muscle and immune function.

It is almost impossible to obtain recommended amounts of vitamin D in any diet because vitamin D is found in so few foods. Examples include oily fish like mackerel, herring, tuna and salmon, which vegans and vegetarians would not usually consume, and fortified dairy products, fortified margarines, or fortified breakfast cereals.

In the HSIS research study, no one mentioned lack of vitamin D as a cause for concern in vegan and vegetarian diets. Just 8 per cent mentioned a lack of vitamin D in relation to flexitarianism.

Shortfalls in vitamin D have been observed in adults^{48,49} and children⁵⁰ following plant-based diets. In part of Dr Derbyshire's analysis that included six studies comprising 16,262 participants, vitamin D intakes fell below UK government guidance of 10 micrograms daily in all studies

Everyone, eating a plant-based diet or not, should follow Public Health England's new recommendation to consider taking a daily vitamin D supplement all year round. It is extremely worrying that no one in the HSIS survey seemed to have any awareness that vitamin D could be lacking in vegan or vegetarian diets.

Iron

Iron is an essential mineral that contributes to normal energy metabolism, cognitive function, formation of red blood cells and haemoglobin, oxygen transport in the body and the reduction of tiredness and fatigue. The Nutrient Reference Value for iron is 14mg – an amount which is difficult to obtain in a readily-bioavailable form from plant-based diets

Animal-derived foods, in particular, red meat, are a rich source of highly bioavailable iron. Whilst plant sourced foods such as fortified grains and bread also provide iron, the iron (non-haem iron) in plant sources is not as bioavailable to the body as animal-derived iron (haem iron). Iron bioavailability is reduced with increased dietary fibre and phytates (found in wholegrain or bran-based cereals and

33 BDA. Plant-based diet: Food Fact Sheet. 2020. 34 www.ncbi.nlm.nih.gov/pubmed/22221769 35 www.ncbi.nlm.nih.gov/pubmed/28299420 36 www.ncbi.nlm.nih.gov/pubmed/25600902 37 www.ncbi.nlm.nih.gov/pmc/articles/PMC4844163/ 38 www.ncbi.nlm.nih.gov/pmc/articles/PMC6391582/ 39 www.ncbi.nlm.nih.gov/pubmed/24667752 40 www.ncbi.nlm.nih.gov/pmc/articles/PMC6950550/ 41 www.ncbi.nlm.nih.gov/pmc/articles/PMC2933506/ 42 www.ncbi.nlm.nih.gov/pubmed/26502280 43 www.ncbi.nlm.nih.gov/pmc/articles/PMC4739591/ 44 www.ncbi.nlm.nih.gov/pubmed/26502280 45 www.ncbi.nlm.nih.gov/pmc/articles/PMC4739591/ 46 www.ncbi.nlm.nih.gov/pubmed/27101764 47 www.ncbi.nlm.nih.gov/pmc/articles/PMC4628270/ 48 www.ncbi.nlm.nih.gov/pmc/articles/PMC4739591/ 49 www.ncbi.nlm.nih.gov/pmc/articles/PMC4628270/ 50 www.ncbi.nlm.nih.gov/pubmed/28299420



There is substantial evidence to show that people following plant-based diets have shortfalls in a range of vitamins and minerals

bread).⁵¹ Absorption of non-haem iron from plants is increased in the presence of vitamin C, but iron deficiency has still been observed, particularly in children and teenagers, even in cases of high vitamin C intake.⁵²

Evidence from a super study (meta-analysis) and systematic review of 30 studies found that adults consuming both vegetarian and semi-vegetarian diets have lower iron stores than their non-vegetarian counterparts. These effects were seen to a greater extent in men than women.⁵³ Low iron status has also been observed in pregnant women following vegetarian diets.⁵⁴

Again, relatively few participants in the HSIS survey were aware that lack of iron could be a problem in a plant-based diet. Just over a quarter (28 per cent for vegetarian diets, 26 per cent for vegan diets and 21 per cent for plant-based diets) think that lack of iron could be a problem in these diets.

Zinc

Zinc is an important part of many enzymes, some of which have key roles in the formation of new proteins – one of the processes involved in tissue growth. Zinc has an essential role in immune function as it is required to aid growth of the immune cells. It is also essential for the health of the hair, skin and nails. Superoxide dismutase (a powerful antioxidant enzyme that neutralises potentially damaging free radicals) requires zinc. Zinc is also essential for reproduction.

Zinc is found in a variety of food sources including fortified cereals, nuts, oysters, poultry, and red meat. Its bioavailability is, like that of iron, higher from animal sources. Also, as for iron, the bioavailability of zinc from plant-based foods is lower when the intake of dietary fibre and phytates (found in wholegrain cereals) is high.⁵⁵

Research has shown significant shortfalls of zinc in vegetarians. A 2013 review evaluated evidence from 34 studies and found that both serum (blood) levels and zinc intakes were significantly lower in those with habitual vegetarian diets compared with non-vegetarians, with females being particularly vulnerable.⁵⁶ A systematic review of six studies by the same authors concluded that zinc intakes of pregnant vegetarians were significantly lower (about 1.53mg lower) compared with non-vegetarians.⁵⁷

In the HSIS research poll, a lack of knowledge about zinc again prevailed. Only 10 per cent of respondents identified a lack of zinc as a problem for vegetarians, 12 per cent for vegans, 9 per cent for plant-based diets, 7 per cent for pescatarians, and 6 per cent for flexitarians.

Iodine

Iodine is an essential trace element used to form thyroid hormones (thyroxine and tri-iodothyronine) which regulate metabolic rate. Food sources include saltwater fish, shellfish and dairy produce. It can also be found in seaweed, kelp and iodised salt.

Intakes of iodine in vegans have been shown to be suboptimal.^{58,59,60} Lack of iodine is particularly important during pregnancy as it may be associated with impairments in cognition and school performance in the offspring.⁶¹

In the HSIS research study, only 4 per cent thought a vegetarian diet would lack iodine, with 8 per cent and 7 per cent respectively thinking that a vegan or flexitarian diet might lack this essential element.

Selenium

Selenium is an essential trace element and part of an antioxidant system. It protects the body's cells from damage and is part of the body's defence system.

Good food sources include whole wheat, meat, eggs, offal, fish, shellfish and Brazil nuts. In plant foods, the content of selenium is affected thanks to the soil they are grown in where the mineral is depleted. Poor selenium status and suboptimal intakes of selenium have been observed in the UK and other European countries.⁶²

Shortfalls of dietary selenium have also been found in vegetarian⁶³ and plant-based diets⁶⁴ with low selenium status amongst vegans.⁶⁵ Low selenium status has been associated with increased risk of mortality, poor immune function, and cognitive decline.⁶⁶ A recent study published in the *American Journal of Clinical Nutrition*⁶⁷ indicates a link between severity of COVID-19 disease and poor selenium status.

Omega-3 fatty acids

Omega-3 fatty acids are essential for all the cells in the body, particularly for the brain, retina, nervous system, immune system and circulation. These key benefits are thought to come from the long-chain omega-3s, DHA and EPA, which are found mainly in oily fish and seafood. Intakes are low in vegetarians and virtually absent in vegans.⁶⁸ DHA and EPA can be synthesised in the body from the shorter chain omega-3 fatty acid, ALA which is found in seeds, nuts and vegetable oils. However, the conversion takes place very slowly and inefficiently.

Plasma levels of DHA and EPA are also lower in vegetarians than non-vegetarians.^{69,70} Vegans, too, have low levels of omega-3⁷¹ but no lower than omnivores who rarely eat oily fish.



In the HSIS research poll, a lack of knowledge among participants was again evident in that only 20 per cent and 17 per cent of participants respectively think that vegans and vegetarians would have a shortfall of omega-3s.

Summary

There is substantial evidence to show that people following plant-based diets (with most studies to date focusing particularly on vegan and vegetarian diets) have shortfalls in a range of vitamins and minerals, including:

- Vitamin B12
- Vitamin D
- Iron

- Zinc
- Iodine
- Selenium
- Omega-3 fatty acids.

The HSIS research study demonstrated poor engagement with nutrition, poor planning of diets and meals and significant reliance on vegan and vegetarian ready-meals and take-aways when switching to plant-based diets. Knowledge of the risks of poor micronutrient intake was very limited.

Given the increasing popularity of plant-based diets, more attention should be paid to micronutrient intake and consideration given to supplementing the diet – which is the topic of Section 3.

51 www.ncbi.nlm.nih.gov/pubmed/31722049 52 www.ncbi.nlm.nih.gov/pubmed/31722049 53 www.ncbi.nlm.nih.gov/pubmed/27880062 54 www.ncbi.nlm.nih.gov/pubmed/25600902 55 www.ncbi.nlm.nih.gov/pubmed/31722049 56 www.ncbi.nlm.nih.gov/pubmed/23595983 57 www.ncbi.nlm.nih.gov/pmc/articles/PMC4488799/ 58 www.ncbi.nlm.nih.gov/pubmed/27101764 59 www.ncbi.nlm.nih.gov/pubmed/29462974 60 www.ncbi.nlm.nih.gov/pubmed/26840251 61 www.ncbi.nlm.nih.gov/pubmed/30642416 62 *Nutrients* 2015, 7, 1494-1537; doi:10.3390/nu7031494 63 www.ncbi.nlm.nih.gov/pubmed/31232583 64 www.nature.com/articles/s41598-018-22691-1 65 www.ncbi.nlm.nih.gov/pubmed/26840251 66 www.ncbi.nlm.nih.gov/pubmed/22381456 67 academic.oup.com/ajcn/advance-article/doi/10.1093/ajcn/nqaa095/5826147 68 www.ncbi.nlm.nih.gov/pubmed/25369925 69 *Ibid* 70 www.ncbi.nlm.nih.gov/pubmed/18305382 71 www.ncbi.nlm.nih.gov/pubmed/24679552

SECTION 3:

THE NEED TO SUPPLEMENT

Dr Nisa Aslam and Dr Emma Derbyshire



Well-planned, nutritionally-balanced plant-based diets have been linked with health benefits including:

- Improved cardiovascular health^{72,73}
- Reduced risk of obesity/excess weight⁷⁴
- Reduced risk of type 2 diabetes⁷⁵
- Reduced inflammatory biomarkers⁷⁶
- Improved diversity of healthy gut bacteria⁷⁷
- Reduced risk of some types of cancer⁷⁸

However, the nutritional quality and health value of a real-life plant-based diet chosen in the context of busy lifestyles may be quite a different matter. More than 41 per cent of people surveyed in the HSIS research poll admit to using vegan or vegetarian ready-meals three times a week or more, and more than one in six cooks from scratch once a week or less. Although it cannot be assumed that all ready-meals are unhealthy, the fact that people switching to plant-based diets are not making time to research, plan and cook their meals indicates that the nutrition and health benefits may not be as expected. In fact, research has shown that meat-free diets based on unhealthy foods are actually associated with higher cardiovascular risk,⁷⁹ with no benefits to obesity⁸⁰ or inflammatory markers.⁸¹

Micronutrients are forgotten or ignored

Looking at the potential health and environmental benefits of a plant-based diet, the micronutrient content of the diet is often forgotten. No diet is healthy unless it provides the full range of essential nutrients in recommended amounts. As research by Dr Emma Derbyshire reveals, this is far from the case with shortfalls seen in vitamin A, vitamin B12, vitamin D, iron, zinc, iodine, selenium and omega-3 fatty acids.

Given the increasing popularity of plant-based diets related to concerns about the environment, animal welfare and health, as well as the evidence suggesting that their popularity is set to grow further, it is imperative that micronutrient supplementation is considered immediately.

While some plant-based foods such as breakfast cereals and some brands of plant-based milk alternatives are now fortified with some micronutrients, this is not universal. Plus, fortified foods would not

be a panacea for micronutrient requirements if people choose non-fortified versions.

Limited recognition of risk

In the context of nutrient shortfalls in a plant-based diet, it is worrying that relatively few people seem to recognise the risk. Only 21 per cent of those polled in the HSIS research study expressed concern about nutritional gaps in their diet, and almost two thirds (62 per cent) had not thought about the potential nutrient gaps before switching to a plant-based diet.

Not surprisingly, given this lack of concern, knowledge of specific nutrient risks in the HSIS research poll was very poor.

- No one mentioned a lack of vitamin D in relation to vegan and vegetarian diets
- Only 17 per cent mentioned vitamin B12 in relation to vegan diets and 21 per cent in relation to vegetarian diets
- Although more people picked up on risks of iron shortfall, this was still only 28 per cent of respondents for vegetarian diets and 26 per cent for vegan diets
- Risk of low zinc intakes was identified by 10 per cent of respondents for vegetarian diets and 12 per cent for vegan diets with equivalent figures for iodine of 4 and 8 per cent.

Yet several participants experienced symptoms that could be related to poor nutrition and nutrient gaps or less-healthy choices in their diets.

- More than a quarter (28 per cent) experienced tiredness even after a good night's sleep. Lack of iron and vitamin B12 can result in tiredness and fatigue.
- One quarter (25 per cent) experienced dry skin. Vitamin A contributes to the health of the skin and shortfalls of this nutrient were noted in studies included in Dr Derbyshire's review paper.
- Depression, memory problems and irritability were noted by 22, 15 and 12 per cent respectively. Vitamin B12, which is often lacking in vegan diets, is essential for the health of the nervous system. Low vitamin B12 levels have been linked with depression⁸² and impaired cognition and memory.⁸³ Both iodine and iron are also essential for cognitive function.
- More than one in 10 noted hair loss (12 per cent) or dry hair (11 per

72 www.ncbi.nlm.nih.gov/pubmed/29496410 73 www.ncbi.nlm.nih.gov/pubmed/30895476 74 www.ncbi.nlm.nih.gov/pubmed/31324022 75 www.ncbi.nlm.nih.gov/pubmed/27299701 76 www.ncbi.nlm.nih.gov/pubmed/27299701 77 www.ncbi.nlm.nih.gov/pubmed/31058160 78 www.ncbi.nlm.nih.gov/pubmed/26853923 79 www.ncbi.nlm.nih.gov/pubmed/28728684 80 www.ncbi.nlm.nih.gov/pubmed/31324022 81 www.ncbi.nlm.nih.gov/pubmed/31405709 82 www.ncbi.nlm.nih.gov/pubmed/32304285 83 www.ncbi.nlm.nih.gov/pubmed/32206454



cent) and 9 per cent noted brittle nails. Both zinc and selenium are essential for the integrity of the hair and nails.

- Only 26 per cent of participants reported none of these symptoms
- **In the HSIS survey, almost a quarter (24 per cent) had been diagnosed with a nutrient deficiency at some point with larger proportions being diagnosed in some towns and cities (45 per cent in Stoke-on-Trent, 36 per cent in Cambridge, 30 per cent in London, 29 per cent in Leeds)**

Who takes vitamin supplements? The short answer is, not as many as would benefit...

Overall, almost half (48 per cent) of HSIS research study participants take no supplements at all. The figure is with more than half in Glasgow and Oxford (54 per cent), Manchester (55 per cent), Leeds (58 per cent), Liverpool (59 per cent), Sheffield (63 per cent) and Belfast (72 per cent). Most worryingly, 42 per cent of vegans take no supplements.

Of those who do take supplements:

- 42 per cent take a multivitamin
- 18 per cent take a multivitamin and multimineral
- Less than a third (30 per cent) take vitamin D, which the government recommends everyone should take in autumn and winter
- A fifth (20 per cent) take vitamin B12
- A total of 22 per cent take iron
- 14 per cent take calcium
- 10 per cent take zinc
- 4 per cent opt for iodine
- A fifth (20 per cent) take an omega-3 supplement and 5 per cent a plant-based omega-3

Amongst those who do take supplements, most are not taking them often enough to benefit:

- Only 22 per cent take their multivitamin daily
- 18 per cent consume vitamin D daily
- 13 per cent take a multimineral daily
- 13 per cent opt for an iron supplement, B12 or omega 3 daily
- A total of 11 per cent consume a calcium supplement daily
- 9 per cent opt for zinc daily
- 4 per cent consume iodine daily

Depending on the supplement:

- 5-8 per cent take them when they remember
- 2-4 per cent once a month
- 5-7 per cent every week or two
- 5-7 per cent 4-5 times a week
- 4-7 per cent 2-3 times a week

When first switching their diet to a plant-based option, which is often a time of great nutritional risk, only a fifth of respondents introduced a vitamin supplement and 14 per cent a mineral supplement.

Yet micronutrient supplements boost nutrient intakes. Micronutrient supplements have been shown to increase intakes of vitamins and minerals in vegans⁸⁴ and help to fulfil micronutrient requirements in both vegans and vegetarians.⁸⁵

Importance of a multivitamin and multimineral supplement

People planning or currently consuming a plant-based diet should be advised to take a multivitamin and multimineral supplement

containing a wide variety of vitamins and minerals in recommended amounts. Taking a plant-based long-chain omega-3 supplement providing DHA and EPA is also wise, given that the richest source of this nutrient is oily fish, which vegan and vegetarian diets will omit.

This advice should be actioned without delay if potential health risks from micronutrient gaps are to be avoided. Switching to a plant-based diet is of interest to adults of all ages but vegan diets, for example, are 2-3 times as popular in 18-34-year-old adults, compared with older adults.⁸⁶

Young adults may be **storing up health problems associated with micronutrient shortfalls** both for later life and in the case of women, risking the health of the next generation if they become pregnant. For older people, the increased risks of micronutrient shortfalls are likely to be compounded by age-related changes in gut function which reduce the body's ability to absorb nutrients.⁸⁷ For all age groups there is the risk of reduced bioavailability of nutrients from plant-based diets in general due to the presence of dietary fibres.

Five tips before you start a vegetarian or vegan diet

- 1 Read up on your new diet before you take the plunge. Check out the websites for the Vegan Society or the Vegetarian Society for advice on how to get started and choose appropriate foods for a balanced diet.
- 2 Make sure you take an appropriate vitamin and mineral supplement, ideally containing 100 per cent of the Nutrient Reference Value for vitamin B12, vitamin D, selenium, iron, zinc and iodine. Also, consider an algae-based omega-3 supplement if you don't intend eating fish.
- 3 Borrow or buy a good recipe book with vegan and vegetarian recipes, or take a look on the internet and have fun experimenting with new meals.
- 4 Stock up on vegan-friendly foods including nuts and seeds, nut butters, tins of beans and pulses, fortified breakfast cereals and spreads, fortified plant milk alternatives, and packs of frozen peas and vegetables.
- 5 If you start to notice any new health problems or feel excessively tired make sure you see a healthcare professional - GP, pharmacist, dietitian or registered nutritionist for advice.

LAST WORD

The growth in plant-based diets together with the alarming lack of knowledge about the risks of low micronutrient intake is deeply worrying.

Well-planned, balanced plant-based diets may improve some aspects of health like cardiovascular and metabolic disease, but as research from Dr Derbyshire's paper shows, the risk of shortfalls in a whole range of micronutrients is huge. It is not just a few nutrients, but many – vitamin A, vitamin B12, vitamin D, iron, zinc, selenium, iodine, omega-3 fatty acids.

Yet people switch to these diets without research, planning and proper knowledge, focusing on important issues but at the expense of their health as they often believe that plant-based diets are inherently healthy. This is not necessarily the case, particularly when there is a great reliance on ready meals and take-aways, as was the case in the HSIS survey.

No diet lacking in micronutrients is healthy. In the drive to embrace values around care for animals and the planet, as well as reducing calories and fat, micronutrient health gets forgotten.

If people following a vegan and vegetarian diet make up a quarter of the population and flexitarians half of the population within five years, we could face a tide of micronutrient deficiencies with worrying consequences for our health. These may include:

- Brain and cognitive health
- Heart and vascular health
- Metabolic health including inflammation
- Bone health

We need action now to prevent this from happening. Everyone, whatever diet regime you follow, should be advised to take a multi-vitamin and multimineral supplement containing a wide variety of micronutrients as this will bridge potentially serious dietary health gaps.

For more information on vitamin, mineral and food supplements visit www.hsis.org

For further information or to arrange an interview with an HSIS spokesperson, please contact the HSIS press office HSIS@junglecatsolutions.com or call 020 3600 0228. Out of hours please call 07867 513 361.



ABOUT HSIS

HSIS (the Health and Food Supplements Information Service) is a communication service providing accurate and balanced information on vitamins, minerals and other food supplements to the media and to health professionals working in the field of diet and nutrition. Find out more at www.hsis.org.



SELENIUM



VITAMIN D

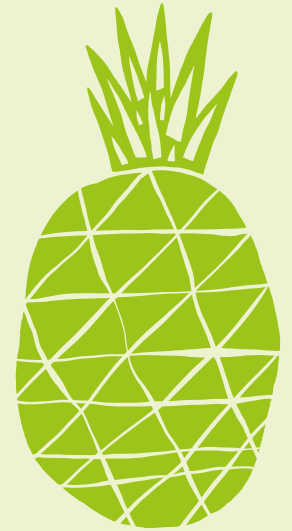


ZINC



HSIS

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