

NATURAL IMMUNITY SUPPORT THROUGH DIET

The COVID-19 pandemic has made people more aware of immune health and whether it can be impacted by lifestyle choices, particularly diet and nutrition. This article will look at several nutrients that have a major role in normal immunity and their sources in the diet.

In a recent survey conducted by the Fruit Juice Science Centre (FJSC), 53% of Europeans (58% of UK adults) said COVID-19 has increased their awareness of immunity, while 48% said they eat a healthier diet as a result, particularly fruit and vegetables.¹ However, while 57% could identify vitamin C as a key nutrient for immunity, roughly half wrongly believed that it could be stored in the body for later use.

This increased awareness around immunity in combination with the seeming gap in knowledge highlights the importance of educating the public on the role that good nutrition can play.

OVERVIEW OF IMMUNITY

The immune system is essential for our survival, helping to protect us from infection by pathogenic microbes and viruses. Cells, organs and proteins of the immune system are spread throughout the body acting to distinguish our own cells ('self') from external threats, then mounting an appropriate immune response.

We are born with a certain level of immunity, termed our innate response. This includes physical barriers such as the skin, the cilia of the respiratory tract, which move pathogens away from lung tissue, and our stomach, which contains acid that kills most harmful bacteria. Our gut microbiota also plays an important role in immunity as, incredibly, 70-80% of the body's immune cells are found in the wall of the gut. Beneficial bacteria and their metabolites support the integrity of the gut barrier and help to fine-tune

our immune response. In contrast, an unbalanced microbiota – called gut dysbiosis – may result in the breakdown of this protection, or a greater risk of autoimmune responses – where the immune function reacts to 'self'.

Our adaptive immune system, meanwhile, develops as we are exposed to pathogens or as the result of vaccination, and involves recognising antigens – molecules which trigger an immune response. This response involves two main types of white blood cells: T-cells, developed in the thymus gland, and B-cells, produced in bone marrow. T-cells seek out and destroy antigen-carrying pathogens and infected cells, while B-cells generate antibodies specific to the antigen and are involved in conferring 'immunological memory', so that the immune response mounts faster on future exposure.

DOES DIET INFLUENCE IMMUNE FUNCTION?

A short answer to this question is yes – nutrition plays a well-established role in immune health. However, the way this plays out is complex and involves many different nutrients, tissues and organs. Deficiencies or sub-optimal intakes in any of the nutrients integral to immune health can negatively impact on immune functioning, particularly as, during infection and stress, micronutrient requirements increase.

Vitamins A, C and D, zinc, folate and long-chain omega-3 fatty acids all play key roles (see Table 1 for major sources of these nutrients) and these are discussed in more detail below.



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Declaration of interests

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REFERENCES

Please visit:
[nhdmag.com/
references.html](http://nhdmag.com/references.html)

Vitamin D

The fat-soluble vitamin D is commonly known for its effect on bone health, but it also has a role in immunity by having effects on inflammation, regulation of proteins which kill pathogens and modification of the gut microbiota. Evidence from systematic reviews suggests that low vitamin D status increases the risk of respiratory tract infections but that supplementation with vitamin D can reduce this risk.^{2,3} It is especially concerning that given the current COVID-19 pandemic, around a fifth of adults and teenagers in the UK have serum 25-hydroxyvitamin D levels below the UK cut-off for insufficiency, i.e. <25nmol/L.⁴

Folate

Folate (the food form of folic acid) is another essential immunity nutrient. It is important for cellular health and the normal functioning of the immune system by aiding antibody production and promoting the survival of regulatory T-cells in the intestine. Significant groups of people in the UK are at risk of deficiency and it is estimated that a third of women of childbearing age have blood folate levels below the optimal threshold set internationally for preventing neural tube disorders.⁴

Zinc

Zinc helps to maintain integrity and function of the skin barrier and mucous membranes and promotes the killing activity of phagocytes (white blood cells which engulf and kill pathogens). Around 10-20% of UK adults and children have inadequate zinc intakes.

Vitamin A

Vitamin A plays a key role in the development and differentiation of cells in the skin and mucous tissues, and is essential for B- and T-cell development. Emerging evidence also suggests that the carotenoid, β -cryptoxanthin, which is converted to the active form of vitamin A in the body, can positively influence immune function.⁵

Omega-3s

Management of the inflammatory response is also integral to immune function and the long-chain omega-3s (EPA and DHA) play a key role. However, the impact of omega-3s on immune function seems to be underestimated, as only

44% of respondents in the FJSC survey¹ linked these fatty acids with immunity. Long-chain omega-3s are mostly found in oily fish, yet the current UK average intake of 56g is well short of the recommendation of one serving (140g) per week, highlighting a potential shortfall.

Vitamin C

Vitamin C is often associated with immune health, as it supports immunity in a range of ways, including:

- supporting the physical barrier function
- growth and function of immune cells
- anti-inflammatory activity
- white blood cell movement to infection sites
- antibody production and pathogen destruction

As a demonstration of its importance, levels of vitamin C in white blood cells are 10-100 times higher than in plasma. Current recommendations for vitamin C are 40mg/day in the UK and 80mg/day for labelling purposes. However, research has shown that 200mg/day may be required for optimal blood levels in healthy individuals.⁶ Although mean intakes are similar to the reference nutrient intake (RNI) of 40mg,⁴ this may be too low for optimal protection, particularly in vulnerable groups or those dealing with active infections.⁶ Recent evidence highlights the beneficial effects that vitamin C might have on promoting recovery from respiratory complications in COVID-19 patients. High dose vitamin C has been shown in randomised controlled trials to reduce length of ICU stay and mortality of sepsis patients, and to shorten the duration of mechanical ventilation.⁷

Fibre

Fibre helps to promote a more favourable balance of species within the gut microbiota; in particular, certain fibres termed prebiotics act as fuel for beneficial species such as lactobacillus or bifidobacteria. As mentioned already, having a stable, diverse microbiota is important for immune health, highlighting why high fibre diets should be promoted. Plant polyphenols found in vegetables, tea, coffee and a range of fruits, including citrus juices, have been shown to interact with the gut microbiota, potentially stimulating positive

Table 1: Sources of nutrients important for immune health

Nutrient	Rich sources	Example sources and servings (% of RNI)
Vitamin A	Liver, whole milk, cheese, green leafy vegetables, carrots, sweet potatoes	Cooked curly kale, 280µg in an 80g serving (43%) Whole milk, 76µg in a 200ml glass (12%)
Vitamin C	Citrus fruits, 100% orange juice, berries, peppers, tomatoes, green vegetables	100% orange juice, 68mg in a 150ml glass (170%) Strawberries, 45.6mg in an 80g serving (114%)
Vitamin D	Oily fish, eggs, liver, fortified foods (eg, cereals, spreads)	Baked trout, 11.5µg in 140g (115%) Eggs, 6.4µg in 2 boiled (64%)
Folate	100% orange juice, green veg, pulses, liver, fortified cereals	Steamed broccoli, 57.6µg in an 80g serving (29%) 100% orange juice, 32µg in a 150ml glass (16%)
Zinc	Shellfish, meat, eggs, nuts, seeds, wholegrains	Grilled fillet steak, 4.2mg in 80g (51%) Chickpeas, 1.32mg in ½ tin (16%)
Long-chain omega-3s	Oily fish, fish liver oil, white fish, algae oil, omega-3 enriched eggs	Farmed salmon, 1897mg in 140g (422%) Haddock, 224mg in 140g (50%)

Note: for omega-3s, the SACN recommendation of 450mg per day has been used.

changes to microbial composition and thereby strengthening the gut barrier against pathogens.

EMERGING SCIENCE ON VIRAL INFECTIONS

Hesperidin is a citrus flavanone within the group of polyphenol compounds and is known for its antioxidant and anti-inflammatory effects. A 150ml glass of 100% orange juice contains 78mg of hesperidin. Despite whole oranges containing twice the hesperidin content of orange juice, uptake by the body is similar, indicating that absorption is more efficient from juice. In addition, processing methods are known to boost the hesperidin content of commercial orange juices by threefold compared with home-squeezed juice. The known benefits of hesperidin in human intervention trials relate to vascular effects⁸ and anti-inflammatory⁹ and antioxidant properties.¹⁰ Interestingly, hesperidin pills appear less effective than hesperidin consumed in the natural citrus food matrix.

Pharmaceutical grade hesperidin is currently being evaluated as a potential agent for blocking the entry of SARS-Cov-2 (the virus which causes COVID-19) into body cells and limiting viral replication. A recent review describes *in silica* research, which suggests that hesperidin strongly binds to the SARS-Cov-2 'spike' protein on the surface of the virus.¹¹ This study

also suggests that hesperidin could inhibit the release of viral proteases used to break down cell proteins – an important step in viral replication. Another recent study, using advanced computer modelling, screened over 1000 candidate drugs and substances used in complementary medicine as potential targets for viral binding.¹² Of all the substances screened, hesperidin was found to be the leading candidate for blocking the entry of SARS-Cov-2 into cells, with even more binding affinity than known anti-viral drugs. It's important to note that there is a long way to go before we know if hesperidin is a potential candidate for medicines in the fight against COVID-19. The next steps in this research pathway would be *in vivo*, animal and human studies.

CONCLUSION

Chronically low intakes of certain nutrients in the diet, such as zinc and vitamins D and C, can have a detrimental impact on immunity. Individuals could do more to support their natural immunity by having a balanced, nutrient-rich diet and an understanding of the importance of supplementation when diets fall short. Fruits, 100% fruit juices, vegetables, wholegrains, fortified foods and fish are valuable foods, which contribute key nutrients for optimal immunity.