

COVID-19

Coronavirus

YOUR QUESTIONS ANSWERED

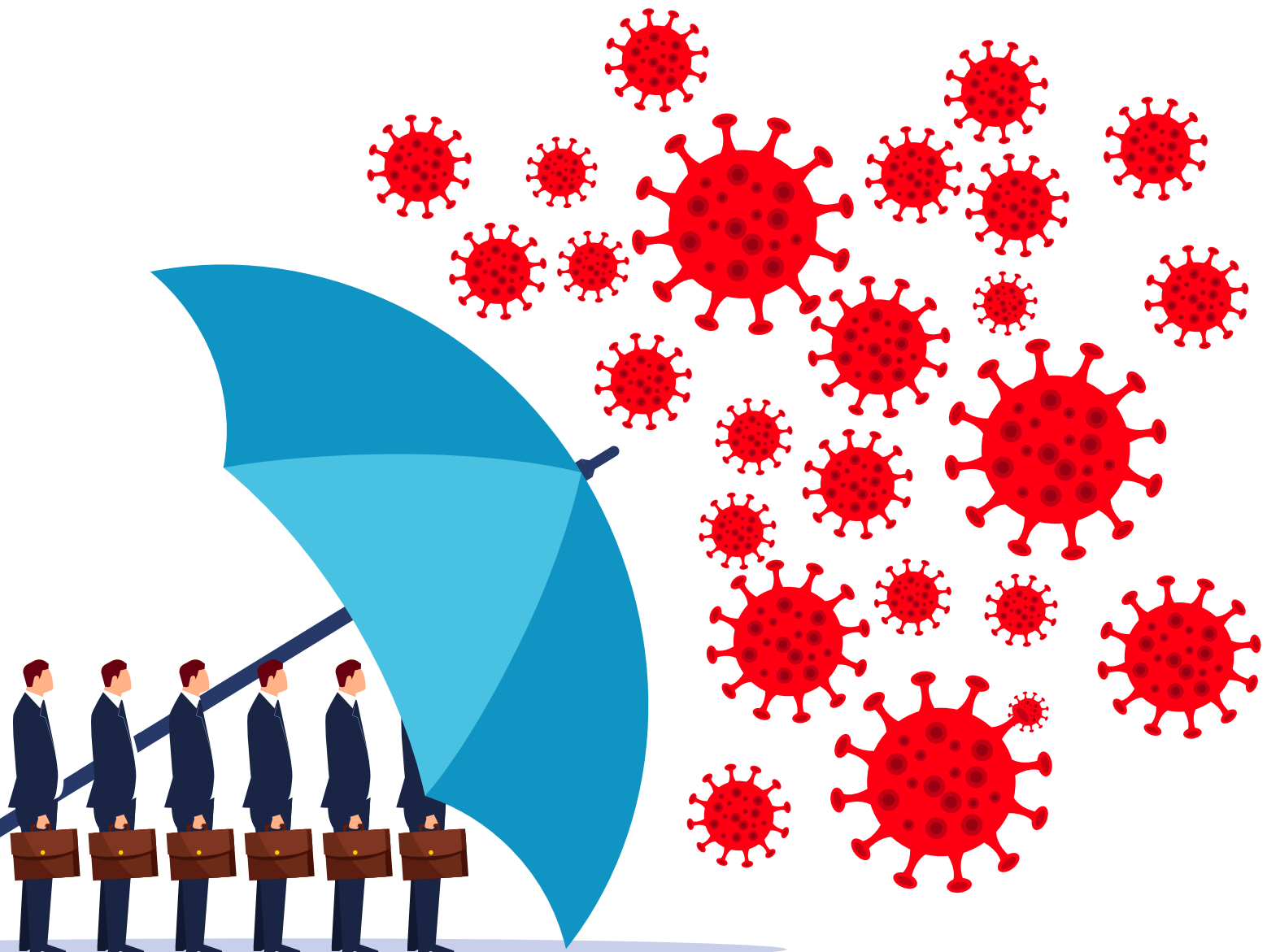
Introduction

Firstly, please be aware that the information in this guide is solely intended as a guide to best prepare your health with regards to Covid-19. It is not intended to be used as a cure or complete prevention to disease or illness.

This guide will likely be the most important we have written to date and has a few aims. It will be split into sections to provide you with some basic background information on Covid-19. It will then go on to explain how your immune system works from a genetic point of view, and then go on to show how you can add certain key foods and nutrients to improve the expression of specific genes and hence your health and wellbeing.

Please also be aware that the information isn't the typical generic "eat a healthy diet and exercise" advice, which you will undoubtedly have seen hundreds of times by now, and most probably be getting a bit tired of. Every recommendation provided is from the latest scientific research, which we have complied so that it is easy to follow, understand and digest.

Our area of expertise lies within the genetic fields of nutrigenetics, nutrigenomics as well as epigenetics, which allows for a unique understanding of how nutrients, lifestyle and your environment interact at a cellular and genetic level - and how they go on to affect your health.



What is **COVID-19**?

Unfortunately, the vast majority of people that have been heavily affected by Covid-19 have had one major thing in common, a weakened immune system. There are many factors which will contribute towards this, such as old age and genetic or pre-existing health issues (respiratory health, high blood pressure, heart disease, diabetes to obesity).

Over 70% of Covid-19 patients have been overweight, obese or clinically obese on the body mass index scale. The link below is a report from the UK's ICNARC on the first 775 patients critically ill with Covid-19. The report also highlights that men will be at a much higher risk from contracting Covid-19 with 7 out of 10 ICU patients currently being male.

Types of Coronavirus

There are lots of differing classifications of Coronaviruses, such as Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV) found in China between 2002-04. Middle Eastern Respiratory Syndrome Coronavirus (MERS-CoV) which started in Saudi Arabia in 2012, and now Coronavirus disease 2019 (COVID-19) again found in China.

All of the above are known as enveloped positive sense RNA viruses. RNA (Ribonucleic acid) is used for coding, decoding, regulation and expression of your genes.

How a virus attacks

Once the virus has actually managed to get into your system, via your nose, eyes or mouth, it will need to attach itself to a cell's receptor site, which will be located on the membrane or outside surface of the cell lining within the lungs.

It will then begin to be absorbed by this receptor site. Thereafter, the virus will need to penetrate the cell. Once the virus is within the cell cytoplasm (the fluid that fills each cell) it will hijack the cell production and release its genetic material.

This will then be translated (processed and read by your own cells) which will act as a template for the virus to create more proteins and copies of itself to be let loose and infect other cells.



ICNARC REPORT

<https://www.icnarc.org/About/Latest-News/2020/03/27/Report-On-775-Patients-Critically-Ill-With-Covid-19>

How to improve your immune system?

Now of course, the best way to avoid any possible health implications is to remove yourself from the source and virus/ infection in the first place, by social distancing, washing hands, etc. There are also, a whole variety of things that we can all do to improve our immune system and overall health. We all need to start being *PRO-ACTIVE* instead of *RE-ACTIVE* with regards to our health!

There are four main areas that we should focus upon:

- Sleep and rest
- Diet
- Exercise
- Mental health and stress

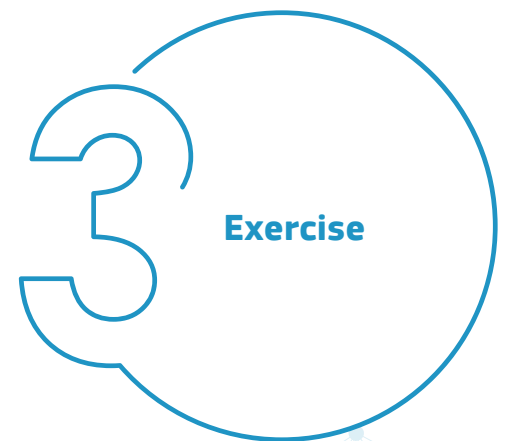
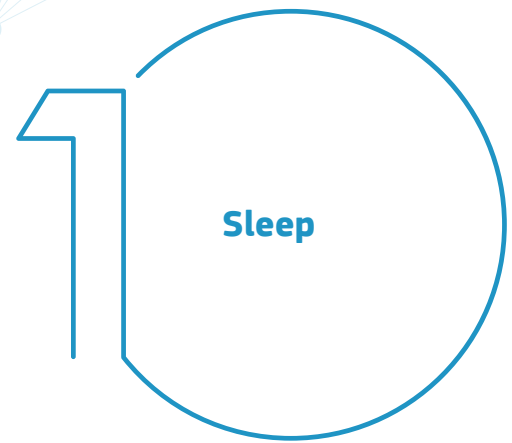
These aren't presented in any order of priority, or them being mutually exclusive, as all Four areas will largely play into each other. If you can look to improve each area even slightly, it should have a profound effect on your health.

COVID-19 and genetics

Your immune system will be affected and regulated by your genetics - but please don't think that having beneficial genes will turn you into some sort of superhero and completely mitigate your chances of contracting Covid-19, as unfortunately they won't!

What they may do, however, is reduce the severity of the symptoms of disease and/ or the length of time that you may feel unwell for.

Hopefully, the government will start genome sequencing those that have contracted the virus and interrogate that data against those which have unfortunately passed away, as there is undoubtedly be some genetic link associated?



Your Immune System and Your Genes

As humans we all have the same DNA and share roughly 25,000 genes. So, what makes us all different? Each gene has a multitude of variations, some of these are extremely easy to see with our obvious physical traits, such as eye and hair colour as well as how tall we are.

But what about the variations that we cannot see? Such as our ability to respond to certain types of exercise, how well we sleep or cope with stress. These will also be responsible for our ability to fight off a cold or virus.

These genetic variations can be affected by diet, exercise and other lifestyle choices, which can modify your genes expression (either positively or negatively). Below are a few gene descriptions, which will help explain some of their physiological functions and how they will possibly affect Covid-19. We will then go through as to how to improve that particular gene's expression through tweaks to diet and/ or lifestyle.

TNFa (Tumour necrosis factor alpha)

TNFa is a pro-inflammatory cytokine produced by the immune system to kill bacteria, viruses and parasites. TNFa, when produced in small amounts, will play an important role for the protection of your cells. Unfortunately, if it is produced in larger amounts and more frequently, it can cause your cells to become weakened and lose their function.

What To Do

How can we optimise this gene's beneficial effects?

- Exercise is extremely effective, but please be aware that excessive/ over training and or high intensity exercise increases the expression of TNFa. Please don't use this time period to try and turn yourself into an Olympic athlete. If you are a beginner or new to training, then please start off with light exercise such as walking, etc. Trying to exercise too much is one of the fastest ways to weaken your immune system, so take it easy.
- Ensure adequate amounts of sleep, as lack of sleep increase pro-inflammation markers.
- Decrease stress (easier said than done under the current circumstances) but chronic stressors can directly provoke long-term changes in pro-inflammatory production.
- Vitamin D increases TNFa production in immune cells, so get out in the fresh air and sun.
- Omega - 3 (PUFA) with 2000mg coming from EPA + DHA found in oil fish decreases TNFa synthesis by 74%.
- Allergies, as spring is finally here many will be experiencing hay fever. So, please try to minimise exposure to any known allergies.
- Sulforaphane, is a phytochemical produced in cruciferous vegetables such as broccoli sprouts, broccoli, bok choy etc. It also up-regulates vitamin D receptors, which will affect IL-6 production.
- Avoid omega 6 cooking oils such as corn, sunflower and safflower as all have been shown to increase TNFa.

IL-6 (Interleukin 6)

IL-6 is a pro-inflammatory gene, which is involved in the immune system, bone metabolism, protection from bacterial infection, as well as a host of other physiological functions.

Various pharmaceutical companies are now looking at IL-6 inhibitors as possible therapy for Covid-19, as IL-6 under normal circumstances has many positive health benefits. But data suggests if IL-6 is increasingly expressed within the lungs of those who have contracted Covid-19 then this could cause major issues.

What To Do

Below are a few areas to improve your IL-6 levels.

- Exercise is extremely effective, but please be aware that excessive/ over training and or high intensity exercise increases the expression of IL-6.
- Ensure adequate amounts of sleep, as lack of sleep increase pro-inflammation markers.
- Decrease stress, again easier said than done I under the current circumstances, but chronic stressors can directly provoke long-term changes in pro-inflammatory production. Catecholamines (stress hormones) increase IL-6 production.
- Zinc deficiency has been shown to increase IL-6 production.

Please check your Muhdo inflammation report to see your results.



GPX1 Glutathione peroxidase

GPX1 is an antioxidant gene, which neutralises hydrogen peroxide by converting it to water and oxygen. This protects cell surfaces, extracellular fluid and red blood cells, as well as other cells against oxidative damage. GPX1 is also known as a selenoprotein, meaning that selenium is required for it to function correctly. Therefore, how much GPX1 you produce will depend on your selenium levels. We will come on to selenium in later in the guide.

GPX1 will also require glutathione, which is one of the body's most important antioxidants which unfortunately decreases as we age. Trying to improve glutathione levels can be tricky and can only be achieved by increasing all the necessary nutrients/ cofactors and precursors needed to manufacture it internally.

Glutathione foods can be divided into two categories: foods that contain the glutathione molecule and foods that stimulate glutathione production and/ or up regulate the activity of glutathione enzymes.

Foods high in glutathione:

- Asparagus
- Avocado
- Spinach
- Broccoli
- Tomato

Foods/nutrients that stimulate glutathione production:

- Turmeric
- Vitamin C
- Cinnamon
- Sulphur containing foods such as beef, fish, Brussels sprouts and watercress
- Selenium

The amount of dietary glutathione that is available is relatively small compared to the amount of glutathione that is created internally and found within your body.

One side note to remember is that cooking will reduce the glutathione content in food, as will the length of time that it is stored. If we want to achieve higher levels of glutathione, then our vegetables need to be raw and uncooked. We can also obtain glutathione from fruit, raw eggs and dairy, as well as raw or rare meats.

What To Do

Apart from increasing glutathione as shown above or selenium with a handful of brazil nuts each day how else can you improve the expression of GPX1?

- Exercise has been shown to increase GPX1, with weight training being more effective. (Please be aware that prolonged intense exercise will increase free radical damage)
- Avoid smoke exposure as well as over consumption of alcohol.
- Lycopene, Epidemiological studies have reported that regular consumption of lycopene - a phytochemical found in red fruits and vegetables such as tomatoes, red carrots and water melons - significantly increases GPX1.
- Sulforaphane, is a phytochemical produced in cruciferous vegetables such as broccoli sprouts, broccoli, bok choy etc.

Please check your Muhdo Infection risk from cold or flu report to see your results.

FUT2 Fucosyltransferase 2

FUT2 is involved in our susceptibility to bacterial infections, which can increase your amount of healthy gut bacteria, which can affect vitamin B12 absorption. Please be aware that if you are currently following a vegetarian diet and you have the FUT2 GG genotype, then you will have significantly reduced levels of vitamin B12 compared to those with A genotype. Following a vegan diet will magnify the chances of deficiency further still, so supplementation is crucial to avoid the chances of ill health.

Skip to the Diet section for important facts about vitamin B12.

Sleep and Your Genetics

Getting a good night's sleep has many positive health benefits, from repairing your DNA to increasing your antioxidants levels, which will enhance your immune system.

But do our genes actually dictate how well we sleep?

The short answer is yes. They dictate as to whether you are a morning person or a night owl, the duration of sleep, if your sleep is fragmented, and if stress will affect you sleeping well.

For instance, stress and sleep can be the perfect chicken and the egg scenario. Having continuous stress will have a negative effect on your sleep quality and having poor quality sleep will increase your stress levels.

There are a variety of factors which affect our health, one of which is currently being studied, that is the effect of sleep and our circadian rhythm. Our circadian rhythm is thought to regulate around 15-20% of our genome and is tremendously important to keeping us fit and healthy as it affects our hormones, eating habits and reduces the chances of us becoming ill.

Sleep and our diet

Our diet also has huge connotations for how well we sleep. For instance, the "Sleep hormone" melatonin, is responsible for signalling darkness to the body and regulating daily physiological rhythms, which are dramatically affected by retinol (Vitamin A).

Studies have shown high levels of retinol (vitamin A) in the mammalian pineal gland and vitamin A deficiency causes a reduction in gene AANAT, which will reduce melatonin levels.

During our sleep, we repair damage to our DNA. One of the ways that this is done is by releasing one of our previously mentioned hormones "Melatonin". This hormone is inhibited by blue light during the day and hindered when we use our phones, laptops and tablets at night. It activates and regulates over 500 genes that are involved in repair and antioxidant function.

Sleep and the Glymphatic system

Sleeping is very important to repair a lot of the damage done during the day. It also activates the Glymphatic system, which is a complex network of blood vessels that extends from the spinal fluid all the way throughout the brain.

During our sleep we will actually release cerebral spinal fluid up into the brain to wash out all the cellular waste products that have built up during the day.

Therefore, securing a good night's sleep has many positive health associations, from repairing your DNA, increasing your antioxidants to improving the length of your telomeres (mother nature's stopwatch).



Are you not sleeping well?

There will be a whole host of reasons as to why you might be finding it hard to sleep, with stress being the number one issue at the moment. But other factors may also be contributing, such as poor dietary or lifestyle choices as well as there being a strong genetic component.

But the vast majority of people have trouble falling or staying asleep from the blue light resonating off of their phone, laptop and or TV. The advent of artificial light has also led to multiple sleep disorders as artificial light will prevent the release of melatonin the "Sleep hormone". If you are consistently getting poor quality as well as quantity of sleep, you will be fundamentally damaging your immune system and health.

The quickest and most effective way to improve your sleep is to stop using your phone, laptop and or TV in the evenings as the blue light being emitted from your device mimics the effects of the morning light, it tells your brain to stop producing melatonin and then stops you peacefully drifting off to sleep.

What To Do

How to improve your sleep

Putting an electronic curfew or tech break in place 60-90 minutes before bed will help slow the brain and reduce stimulation when we need to start unwinding and getting ready to sleep.

Our 24-hour body clock cycle is tremendously important to keeping us fit and healthy, as it affects our hormones, eating habits and reduces the chances of us become ill.

Humans are diurnal creatures not nocturnal, meaning that we thrive and function during the day. So, staying up late burning the midnight oil and checking your phone for emails, whilst snacking on a few late-night treats really will take its toll on your health.

You could also look to add foods rich in melatonin with your evening meal, such as: tomatoes, asparagus, broccoli, olives, barley, rice, walnuts or milk, in combination with foods high in tryptophan. Tryptophan is an essential amino acid found in a variety of foods and acts as a mood regulator. It also increases melatonin and serotonin levels, helping you feel more relaxed, calm and possibly sleepy.

Top 5 Tryptophan foods 100grams

- | | |
|-----------------|-------|
| • Pumpkin seeds | 575mg |
| • Soy Beans | 572mg |
| • Cheese | 570mg |
| • Beef | 410mg |
| • Chicken | 405mg |

Reduce alcohol intake. Whilst alcohol will help to make you feel drowsy and fall asleep faster due to it sedating you, sedation is not actually sleeping. Alcohol will have a negative effect on you entering deeper sleep and achieving the correct sleep cycle.



Diet and Your Genetics

Everything that you eat, or drink will, for the most part, become part of you. If you are eating cereals, sandwiches, chocolate, crisps and puddings every day, then you'll start to feel and look like a pudding.

Health is like money; we never have a true idea of its value until we lose it and unfortunately, at this current moment in time, the health of the entire world's population hangs by a thread.

What we also need to remember is just because you aren't currently sick doesn't mean you are healthy, which gives real food for thought (no pun intended) for one extremely famous quote attributed to Hippocrates...

"Let food be thy medicine and medicine be thy food".

Why we become sick, ill or develop a certain type of disease or ailment will largely be down to your body becoming malnourished and running out of the vital vitamins, minerals, proteins and fats that it requires to perform everyday functions. ***This includes your immune system.***

Simplistically, we have four phases of health that will be dependent on adequate nutrient intake.

PHASE

1

Initial depletion of micronutrients is usually characterised by changes in the metabolism of a particular nutrient. The body will use its reserves so that no disturbance to its function is detectable, but in many instances the individual will feel tired with a lack of energy.

If you are constantly tired or fatigued, then this is a useful warning sign that you may need to introduce more vegetables into your diet and/ or a supplement.

PHASE

2

In this next phase your body will start to reduce certain biochemical functions, which will affect various enzymatic reactions. Homeostasis, which is your body's ability to regulate itself, will then be affected causing a variety of physiological functions, such as gaining weight, low blood sugar, irregular heartbeat. This phase will luckily be easy to spot, as you will start to get cravings for chocolate, fizzy drinks, etc.

PHASE

3

If we enter this third phase more issues will arise which can get extremely dangerous for your health. They will be characterised by serious medical symptoms or extreme changes in metabolic functions such as obesity, onset of diabetes, depression, panic attacks. Everything will then be magnified with your cravings being more noticeable, with possibly uncontrollable cravings.

PHASE

4

The final phase that we will enter for a mineral deficiency will be seen and characterised by the onset of a full-blown disease such as heart attacks, obesity, diabetes, etc. This clinical phase can, in many instances, be reversed, but only if the correct nutritional advice and habits are put in place, if not, the health of an individual can eventually, if left unchecked, lead to death.

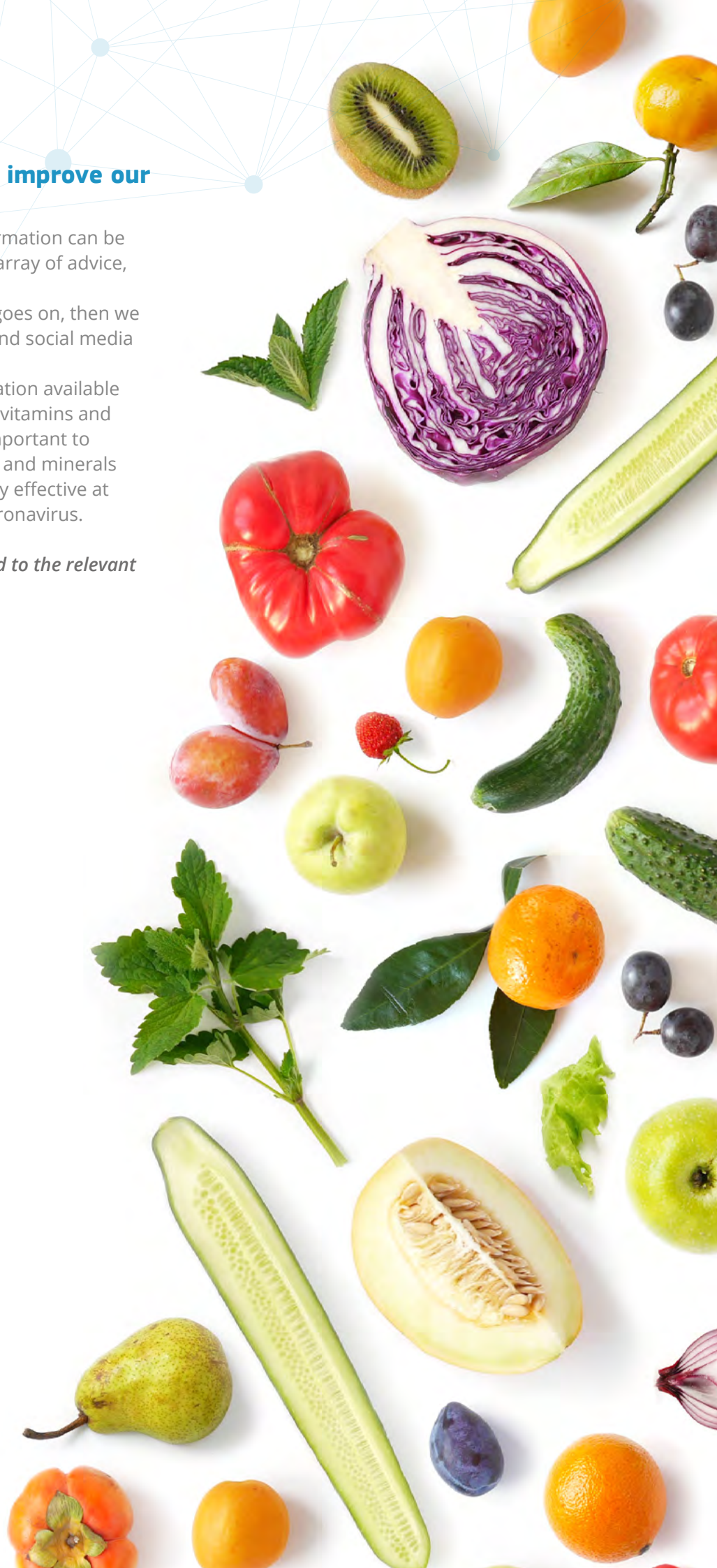
Can we improve our diet to improve our immune system?

Trying to find the correct dietary information can be difficult, as each week there is a vast array of advice, which seems to contradict itself.

Keto, vegan, paleo, fruitarian the list goes on, then we can add the vast array of Instagram and social media experts...

To help simplify the wealth of information available we've compiled a short list of specific vitamins and minerals, which are fundamentally important to your immune system. These vitamins and minerals have also been shown to be extremely effective at mitigating various viruses, such as coronavirus.

(All recommendations below are linked to the relevant studies)



Vitamin A

Vitamin A is more than just a single nutrient, but a broad group of related nutrients, each providing us with differing health benefits. Vitamin A is also called “anti-infective” vitamin and many of the body’s defences against infection depend on an adequate supply.

Retinoids

There are some specific immune, inflammatory, genetic and reproductive-related benefits of vitamin A that can only be obtained from the retinoid (animal source) forms of the vitamin.

Carotenoids

These act much in the same way as retinoids in providing us with unique health benefits. They function as antioxidant and anti-inflammatory nutrients, with some having a special role to play in the protection of our health.

The two forms aren’t just chemically different - they also provide us with different types of health benefits. Each offer specific immune, inflammatory and genetic benefits of vitamin A, with some that can only be obtained from the retinoid (animal source) forms of the vitamin.

In most instances we will be required to consume both retinoids and carotenoids, with carotenoids converting to retinol in the body. However, conversion of the most important carotenoid, beta-carotene, differs between individuals based on their genetic variances.

Top Five Vitamin A Retinoids Foods

Shrimp	4oz	102mcg
Eggs	1 medium	75mcg
Cheese	1oz	73mcg
Yoghurt	250g	65mcg
Salmon	4oz	56mcg

Top Five Vitamin A Carotenoids Foods

Sweet Potato	1 cup	3800mcg
Carrots	1 cup	2000mcg
Spinach	1 cup	1880mcg
Kale	1 cup	1760mcg
Mustard Greens	1 cup	1730mcg

Pro Tip

Retinoids are especially important with respect to pregnancy and childbirth, childhood growth, night vision, red blood cell production and resistance to infectious disease. However, retinoids in high dosages can cause birth defects and, therefore, it is unwise to supplement retinoid-based supplements when pregnant unless otherwise specified by your physician.

Studies Linking Vitamin A to viral infection

The studies referenced below will highlight the importance of vitamin A with regards to maintaining a healthy and strong immune system.

Pro Tip

Studies have shown that an impaired immune response is largely due to the deficiency of specific nutrients. Vitamin A deficiency is strongly involved in various diseases such as measles and diarrhea.

Vitamin A and immunity to viral, bacterial and protozoan infections.

"Vitamin A supplementation reduced morbidity and mortality in different infectious diseases, such as measles, diarrheal disease, measles-related pneumonia, human immunodeficiency virus (HIV) infection, and malaria"

<https://www.ncbi.nlm.nih.gov/pubmed/10604208?dopt=Abstract>

Vitamin A supplements ameliorate the adverse effect of HIV-1, malaria, and diarrheal infections on child growth.

"Vitamin A supplementation improves linear and ponderal growth in infants who are infected with HIV and malaria, respectively, and decreases the risk of stunting associated with persistent diarrhea. Supplementation could constitute a low-cost, effective intervention to decrease the burden of growth retardation in settings where infectious diseases are highly prevalent"

<https://www.ncbi.nlm.nih.gov/pubmed/11773574?dopt=Abstract>

Effects of dietary vitamin A content on antibody responses of feedlot calves inoculated intramuscularly with an inactivated bovine coronavirus vaccine.

"Low vitamin A diets might compromise the effectiveness of inactivated bovine coronavirus vaccines and render calves more susceptible to infectious disease. The effect of infection with infectious bronchitis virus (IBV), a kind of coronaviruses, was more pronounced in chickens fed a diet marginally deficient in vitamin A than in those fed a diet adequate in vitamin A"

<https://www.ncbi.nlm.nih.gov/pubmed/24066921?dopt=Abstract>

Retinoids inhibit measles virus through a type I IFN-dependent bystander effect.

"These results demonstrate that retinoids inhibit MeV replication by up-regulating elements of the innate immune response in uninfected bystander cells, making them refractory to productive infection during subsequent rounds of viral replication"

<https://www.ncbi.nlm.nih.gov/pubmed/19447880?dopt=Abstract>

Vitamin A and Coronavirus

Retinoids (vitamin A animal source) forms of the vitamin could be useful for the treatment of coronavirus and the prevention of lung infection.

Retinoids and animal sources contain the active form of vitamin A already, and thus conversion is not needed.

Pro Tips

Your ability to convert Beta-carotene from plants into retinol effectively will depend on your genetic variation of gene **BCO1** (beta-carotene oxygenase 1).

If you are following a vegan diet and or have a poor gene variant of BCO1, then you'll be more than likely to develop certain health concerns.

Please check your Muhdo results for beta-carotene conversion.

B Vitamins

B vitamins - are made up of 8 key vitamins that form the B vitamin family. They both individually and collectively offer a whole variety of health properties.

The B vitamins and where they're found

- **B1 (Thiamine)**, asparagus, pork, navy beans, sunflower / flax seeds.
- **B2 (Riboflavin)**, spinach, almonds, eggs, steak, soya beans.
- **B3 (Niacin)**, tuna, brown rice, chicken, peanuts, green peas.
- **B5 (Pantothenic acid)**, shiitake mushrooms, sweet potato, salmon, lentils.
- **B6 (Pyridoxine)**, tuna, turkey, pistachios, sweet potato, banana.
- **B7 (Biotin)**, almonds, egg yolk, sweet potato, onions, tomatoes.
- **B9 (folate)**, lentils, soy beans, asparagus, broccoli, beet root.
- **B12 (Cobalamin)**, sardines, salmon, eggs, yogurt, mushrooms.

Each of the above B vitamins has its own special function, some of these will be listed below with a brief explanation into each vitamin.

B Vitamins and associated studies

The below studies will highlight the importance of B vitamins with regards to maintaining a healthy and strong immune system.

Riboflavin (vitamin B-2) and health.

"Poor riboflavin status in Western countries seems to be of most concern for the elderly and adolescents, despite the diversity of riboflavin-rich foods available"

<https://www.ncbi.nlm.nih.gov/pubmed/12791609?dopt=Abstract>

Pro Tip

Vitamin B2 (riboflavin) is extremely important for recycling the body's strongest antioxidant, glutathione, which is labelled "The Mother" of antioxidants.

Top 5 vitamin B2 foods

• Beef	100 g	0.9 mg
• Soybeans	1 cup	0.5 mg
• Spinach	1 cup	0.38 mg
• Beet root	1 cup	0.37 mg
• Yogurt	1 cup	0.35 mg

Inactivation of Middle East respiratory syndrome coronavirus (MERS-CoV) in plasma products using a riboflavin-based and ultraviolet light-based photochemical treatment.

"Riboflavin and UV light effectively reduced the titer of MERS-CoV in human plasma products to below the limit of detection, suggesting that the treatment process may reduce the risk of transfusion transmission of MERS-CoV"

<https://www.ncbi.nlm.nih.gov/pubmed/27805261?dopt=Abstract>

C/EBPε mediates nicotinamide-enhanced clearance of Staphylococcus aureus in mice.

"Exposure to the epigenetic modulator nicotinamide (**vitamin B3**) increased expression of C/EBPε in WT myeloid cells (**immune system**). Further, nicotinamide increased the activity of C/EBPε and select downstream antimicrobial targets, particularly in neutrophils"

<https://www.ncbi.nlm.nih.gov/pubmed/22922257?dopt=Abstract>

Vitamin B3 has been found to raise the formation of collagen and decrease dark spots on the skin. They are essential to the immune system and oxidation-reduction reactions in the release of energy from carbohydrates, fats and proteins. Below is a list of niacin-rich foods.

Top 5 Foods Rich In B3

* Majority of meats are excellent sources

• Tuna	4oz	25.03mg
• Chicken	4oz	15.55mg
• Peanuts	0.25	4.40mg
• Brown Rice	1 cup	2.98mg
• Sweet Potato	1 cup	2.97mg

Nicotinamide exacerbates hypoxemia in ventilator-induced lung injury independent of neutrophil infiltration.

"Vitamin B3 treatment significantly inhibited neutrophil infiltration into the lungs with a strong anti-inflammatory effect during ventilator-induced lung injury. However, it also paradoxically led to the development of significant hypoxemia"

<https://www.ncbi.nlm.nih.gov/pubmed/25875775?dopt=Abstract>

Pro Tip

B6 is crucially involved at several points during the metabolism of protein, carbohydrates and fats. It's most importantly involved with the enzyme that draws carbohydrates (glycogen) out of storage from inside the cell which requires B6 for its activity. It also plays an important role in body immune function as well.

Top 5 B6 Foods

• Tuna	4oz	1.20mg
• Turkey	4oz	0.90mg
• Spinach	1 cup	0.45mg
• Cabbage	1 cup	0.35mg
• Bok Choy	1 cup	0.30mg

Vitamin B12

Vitamin B12 is involved in energy metabolism, formation of red blood cells and the development and normal functioning of the brain and nervous system.

Below are a few important facts about vitamin B12:

1. Unlike other B vitamins no plant or animal can make vitamin B12, except for microorganisms like fungi and bacteria, this is why only animal sources contain B12 since plants cannot manufacture or store it.

2. Mushrooms can often contain B12, but in extremely small amounts.
3. B vitamins are not stored well in the body normally, but vitamin B12 can be stored from anywhere between 3 to 5 years.
4. Most B vitamins are more easily absorbed than vitamin B12, which has more complicated requirements for absorption.
5. Vitamin B12 is also the only vitamin that contains a metal element (cobalt), hence the chemical name cobalamin.

Top 5 B12 Foods

• Sardines	3oz	8.00mcg
• Salmon	4oz	5.00mcg
• Tuna	4oz	2.50mcg
• Cod	4oz	2.45mcg
• Scallops	4oz	2.40mcg

Vitamin B12 alongside a whole array of other nutrients such as folate, choline as well as the other B-vitamins is crucial in keeping our DNA and genes healthy through a process called methylation.

B12 and Methylation

DNA methylation (DNAm) is a process where tiny chemical markers called methyl groups will attach to one of the Four nucleotide bases on your DNA (adenine [A], cytosine [C], guanine [G], or thymine [T]).

Pro Tip

As we naturally age these methyl groups will either hypo (low) or hyper (high) methylate regions across your genome, which will then affect how specific genes and biological processes function.

A B-complex supplement could prove useful and possibly a wise choice to add to your shopping list.

Please check your Muhdo results for genetic B6 and B12 deficiency risk.

Vitamin D

Vitamin D, or the sunshine vitamin, is a hormone that has many positive health benefits. It enhances immune cells and controls around 900 genes, or 1/24 of your entire genome.

Pro Tips

Research is clearly demonstrating the importance of Vitamin D on our health; and unfortunately, vitamin D deficiency affects almost 50% of the world's population.

Some of the elements contributing towards this include lifestyle factors, such as: reduced outdoor activities, old age, obesity; environmental factors, such as living in northern hemisphere and air pollution; poor dietary choices; and genetic factors.

Two of these (reduced outdoor activities/ housebound and old age) immediately jump off the page in relation to Covid-19.

Both of these in many instances go hand in hand, and we also need to remember that Covid-19 made its appearance during the winter months when vitamin D levels will be diminished.

The science of Vitamin D and the immune system

Below are just a few studies highlighting the importance of vitamin D in relation to autoimmune disease.

Acute phase response elicited by experimental bovine diarrhea virus (BVDV) infection is associated with decreased vitamin D and E status of vitamin-replete preruminant calves.

"The reduced vitamin D serum levels in calves had been shown to induce the infection of bovine coronavirus. Therefore, vitamin D could work as another therapeutic option for the treatment of this novel virus"

<https://www.ncbi.nlm.nih.gov/pubmed/25022687?dopt=Abstract>

Sunlight and vitamin D for bone health and prevention of autoimmune diseases, cancers, and cardiovascular disease.

"Vitamin D deficiency has been associated with increased risks of deadly cancers, cardiovascular disease, multiple sclerosis, rheumatoid arthritis, and type 1 diabetes mellitus. Maintaining blood concentrations of 25-hydroxyvitamin D above 80 nmol/L (approximately 30 ng/mL) not only is important for maximizing intestinal calcium absorption but also may be important for providing the extrarenal 1 α -hydroxylase that is present in most tissues to produce 1,25-dihydroxyvitamin D3"

<https://www.ncbi.nlm.nih.gov/pubmed/15585788?dopt=Abstract>

Randomized trial of vitamin D supplementation to prevent seasonal influenza A in schoolchildren.

"This study suggests that vitamin D (3) supplementation during the winter may reduce the incidence of influenza A, especially in specific subgroups of schoolchildren"

<https://www.ncbi.nlm.nih.gov/pubmed/20219962>

Genetics and Vitamin D

Your genes encode for a variety of predispositions and traits, such as your ability to process and absorb vitamins and mineral such as vitamin D.

One such gene is named Cytochrome P450 2R1 (CYP2R1), which encodes for an enzyme that is located in your liver, and converts pre vitamin D3 into 25-hydroxyvitamin D.

From there it continues its journey to the kidneys where it will again be converted into the main circulatory form known as 1, 25- dihydroxyvitamin D3.

Pro Tip

Your genetic variant of CYP2R1 determines how effectively you convert vitamin D; this will affect your ability to feel the health benefits which vitamin D offers.

Please check your Muhdo results for genetic vitamin D deficiency risk.

Omega 3

There are basically 3 main types of omega 3: A-linolenic acid (ALA) which cannot be made within the body and is found in plants such as flaxseed, pumpkin seeds, tofu and walnuts.

Then we have Docosahexaenoic acid (DHA) and Eicosapentaenoic acid (EPA) which are found from animal sources such as salmon, tuna and eggs.

Both will offer a variety of health benefits which include protection from free radical build up due to oxidation damage within the body, to improving your immune system and insulin sensitivity.

Omega 3 fatty acids are fundamentally important for your inflammatory and immune responses.

Omega 3 and their scientific relation to immunity

The studies referenced below will highlight the importance of Omega 3 with regards to maintaining a healthy and strong immune system.

The lipid mediator protectin D1 inhibits influenza virus replication and improves severe influenza.

"Omega-3 polyunsaturated fatty acid (PUFA)-derived lipid mediator protectin D1 (PD1) markedly attenuated influenza virus replication via RNA export machinery"

<https://www.ncbi.nlm.nih.gov/pubmed/23477864?dopt=Abstract>

Anti-HCV activities of selective polyunsaturated fatty acids.

"In this study, we found that several polyunsaturated fatty acids (PUFAs) including arachidonic acid (AA), docosahexaenoic acid (DHA), and eicosapentaenoic acid (EPA) are able to exert anti-HCV activities"

<https://www.ncbi.nlm.nih.gov/pubmed/15110784?dopt=Abstract>

Pro Tips

The vast majority of us obtain little to no Omega 3s on a daily basis. And even then, your ability to utilise Omega 3 will largely be due to the specific genes associated, such as APOA5, ADIPOQ, PPARG and FTO to name but a few.

Certain variants of these genes will place you at risk of possible deficiency, so knowing which variants you have could prove extremely beneficial for tweaking your diet to maintain or improving your health.



Selenium

Selenium is an essential trace mineral that is an extremely important antioxidant, which prevents cellular and subcellular lipids and fats from being peroxidised. This means it prevents body fats from going rancid, which are seen externally as "Age and Liver spots".

Pro Tip

If you have a high intake of polyunsaturated oils such as those found in olive, coconut, fish oil, salad dressing and margarine at the same time as having a selenium deficiency, you could increase the chances of illness and disease.

Selenium and the body's defence system

Getting rid of toxins is crucial to your health. Selenium has been well publicised for the activity of a group of enzymes called glutathione peroxidases, which forms the front line of the body's antioxidant defence system.

These enzymes play a critical role in the body's detoxification pathways; they are also involved in recycling of vitamin C from its used form back to active.

What To Do

Apart from Brazil nuts that contain healthy amounts of selenium, which are the key foods to include to increase your selenium levels.

Top 5 Selenium Foods (Animal)

• Tuna	4oz	120.50mcg
• Shrimp	4oz	55.00mcg
• Sardines	3oz	45.50mcg
• Salmon	4oz	42.00mcg
• Cod	4oz	30.50mcg

Top 5 Selenium Foods (Plants)

• Tofu	4oz	19.50mcg
• Brown Rice	1 cup	19.00mcg
• Sunflower seeds	0.25 cup	18.50mcg
• Mushroom, Shiitake	0.5 cup	18.00mcg
• Asparagus	1 cup	10.50mcg



Studies relating selenium to immune function

Selenium and human health.

"Low selenium status has been associated with increased risk of mortality, poor immune function, and cognitive decline"

<https://www.ncbi.nlm.nih.gov/pubmed/22381456?dopt=Abstract>

Micronutrients and host resistance to viral infection.

"Previous work in our laboratory demonstrated that a virus could undergo rapid mutation in a host deficient in Selenium, leading to a normally avirulent virus acquiring virulence due to genome changes. Once these mutations occur, even a host with adequate Selenium-nutriture is susceptible to the newly virulent virus"

<https://www.ncbi.nlm.nih.gov/pubmed/11115793?dopt=Abstract>

Selenium, Selenoproteins and Viral Infection.

"Selenium deficiency, which is the main regulator of selenoprotein expression, has been associated with the pathogenicity of several viruses. In addition, several selenoprotein members, including glutathione peroxidases (GPX), thioredoxin reductases (TXNRD) seemed important in different models of viral replication. Finally, the formal identification of viral." selenoproteins in the genome of molluscum contagiosum and fowlpox viruses demonstrated the importance of selenoproteins in viral cycle"

<https://www.mdpi.com/2072-6643/11/9/2101>

Review: Micronutrient selenium deficiency influences evolution of some viral infectious diseases.

"Recently emerged viral infectious diseases (VIDs) include HIV/AIDS, influenzas H5N1 and 2009 H1N1, SARS, and Ebola hemorrhagic fevers. Earlier research determined metabolic oxidative stress in hosts deficient in antioxidant selenium induces both impaired human host immunocompetence and rapidly mutated benign variants of RNA viruses to virulence"

<https://www.ncbi.nlm.nih.gov/pubmed/21318622?dopt=Abstract>

Combined adjuvant effect of ginseng stem-leaf saponins and selenium on immune responses to a live bivalent vaccine of Newcastle disease virus and infectious bronchitis virus in chickens.

"Results showed that ginseng stem-leaf promoted significantly higher NDV- and IBV-specific antibody responses with the highest antibody response detected in ginseng stem- leaf and selenium group. The increased antibody was capable of neutralizing NDV and IBV. In addition, (GSLs-Selenium) enhanced lymphocyte proliferation and production of IFN- γ and IL-4"

"More importantly (GSLs-Selenium) was found to promote early production and prolong the duration of the antibody responses"

<https://www.ncbi.nlm.nih.gov/pubmed/31220864?dopt=Abstract>

Pro Tip

In conclusion it seems that selenium supplementation could be an effective choice for enhancing your immune system and hopefully reducing the severity of Covid-19.

Zinc

Zinc may be a less familiar mineral than iron, calcium or magnesium, but it's still extremely important to consume in small amounts every day to support metabolism and maintain your health.

Zinc has a variety of important functions such as improved immune, hormone and regeneration capabilities and deficiency can cause an array of symptoms such as loss of taste or appetite, impaired vision to a lack of energy and inability for wounds to heal.

It is easily sourced in from a variety of foods or supplements such as gels or lozenges, with highest concentrations in animal proteins such as meat and dairy.

Beware of any zinc fortified cereals or grains, as unfortunately they contain high levels of phytates, which are considered to be "anti-nutrients as they bind to minerals stopping them from being absorbed.

For zinc to be affective it will need to combined with other compounds to allow it to be pushed within the cell such as chloroquine (malaria drug), which is also found in small amounts in tonic water and allows zinc to pass directly into the cell and was found to inhibit the replication of various RNA viruses, including influenza virus, respiratory syncytial virus and several picornaviruses.

We can also increase intracellular zinc with another compound such as EGCG (epigallocatechin gallate) which is polyphenol found in green tea and has been shown to transport zinc across the plasma membrane.

Top 5 Zinc Foods

• Beef	4oz	4.0mg
• Lamb	4oz	3.8mg
• Sesame Seeds	0.25cup	2.8mg
• Pumpkin Seeds	0.25cup	2.5mg
• Lentils	1cup	2.5mg

Can zinc inhibit Coronaviruses? The science

The information below is taken from a study which looks at the effects of Zinc to inhibit various RNA viruses and provides the basis for a new anticoronavirus mechanism.

Zn²⁺ Inhibits Coronavirus and Arterivirus RNA Polymerase Activity In Vitro and Zinc Ionophores Block the Replication of these Viruses in Cell Culture.

"Interestingly, in cell culture studies, high Zn²⁺ concentrations and the addition of compounds that stimulate cellular import of Zn²⁺, such as hinokitol (HK), pyrrolidine dithiocarbamate (PDTC) and zinc pyrithione (PT), were found to inhibit the replication of various RNA viruses, including influenza virus, , respiratory syncytial virus and several picornaviruses

<https://journals.plos.org/plospathogens/article?id=10.1371/journal.ppat.1001176>

"Although these previous studies provided limited mechanistic information, this suggests that intracellular Zn²⁺ levels affect a common step in the replicative cycle of these viruses".

Effect of Zinc and Other Chemical Agents on Foot-and-Mouth Disease Virus Replication.

"Zn²⁺ inhibits post-translational cleavages of other picornavirus precursor polypeptides"

<https://aac.asm.org/content/13/5/731.short>

Exercise and Your Genetics

Exercising is extremely important for us all to do, and unless you have underlying health issues where mobility is a problem then everyone should be able to go out for a walk each day.

Pro Tip

Exercise increases the expression of gene BDNF (Brain-derived neurotrophic factor), which will improve cognitive performance, memory and help alleviate anxiety and the physical symptoms of stress. As little as 15 minutes each day may be all you need to help.

Too much exercising

A couple of points to remember here is that overtraining, in many ways is bad for keeping your immune system healthy and firing on all cylinders.

As we have previously mentioned within the genetic section, various genes can be enhanced through exercise, but if you are exercising too frequently and or at a higher intensity then this can cause major issues with regards to your inflammatory response and immune health.

Exercise and nutrition

One other major point to remember is that exercising will cause you to sweat. Now this in itself isn't really an issue as most people will quite rightly equate this to being dehydrated and should drink plenty of water both during and after they've finished. But unfortunately, the vast majority still do not realise that they are also becoming malnourished as well.

What we need to remember is, sweat isn't just water, but a cocktail of all the vital vitamins and minerals being lost from your body. If these aren't being replenished each time then your nutritional fuel tank (and immune health) will be getting depleted day after day, which as we have explained previously in greater detail with the Four phases of health, will have a severe effect.

What To Do

We recommend you exercise as long as you are getting sufficient rest as well, and that you are replenishing your body with lots of fresh fruits and vegetables each day.



Mental Health, Stress and Your Genetics

With everyone's stress levels seemingly on tenterhooks, we thought we'd ask the questions;

1. Is being prone to stress in our genes?
2. Is there anything that we can do to fight it?

To answer these, we firstly need to understand stress in slightly more detail. Stress in simplistic terms has 3 types.

1. Acute Stress

Acute stress happens to most people throughout the day, but it's usually fleeting.

From running for the train and losing your temper at not getting a seat, to the occasional bungee jump, you can encounter the effects of acute stress from a variety of situations, but usually it results in no harm. Short-term stress can be seen from a variety of tell-tale signs, such as:

- Headaches, neck and back pain.
- Heart burn, digestion problems, constipation.
- Increased anger, depression and anxiety.
- Increased blood pressure, rapid heartbeat, problems relaxing/sleeping.

2. Episodic acute stress

Episodic acute stress is when you continually have episodes of acute stress. You will find that people who have busy working or family lives, or cannot quite get the work - life balance, will fall into this category easily. Episodic acute stress can be seen from a variety of tell-tale signs, such as:

- Muscle tension, tension in shoulders, headaches and migraines.
- Higher risk of colds and flu, as your immune system will be affected.
- Increased risk of anxiety, depression and a negative effect on mental fatigue.

3. Chronic stress

Chronic stress is by far the most serious, as a pronounced stress response over an extended time period will damage both your physical and mental health significantly.

As mentioned, when your stress levels rise, you'll

release the hormone cortisol, which is responsible for a whole variety of metabolic functions, such as helping to regulate your thyroid hormone.

The thyroid regulates nearly every major metabolic function in your body, and as such, a poor functioning thyroid can have a detrimental effect on nearly every area of your health. Multiple examples of poor thyroid function include weight gain, reduced metabolic rate, fatigue, feeling depressed or moody, dry hair and skin, and many more.

Dealing with Stress

The way we deal with stress is highly important. Methods to reduce stress may include breathing exercises, meditation, eating certain foods, going to the gym or for a run, yoga, etc. However, some people are more likely to keep themselves isolated when chronically stressed and research has shown that it is better to talk with others instead of going into isolation.

What To Do

There has also been some correlation between those who are more likely to isolate themselves and certain genetic variants. It's important during these times of self-isolation that we reach out with phone or video call when we need to.

Stress leading to physical Symptoms

Stress can cause a magnitude of physical symptoms. Acute stress can cause tremors, muscle twitches, sweating, flushing, increased heart rate, skin itching, headaches and more.

Chronic stress can cause increased blood pressure, muscle aches and can lead to a limitless number of diseases such as diabetes, obesity and migraines. Genetic variants are linked to how we may respond to stress from a physical perspective.

Caffeine and Stress

Caffeine is a stimulant and as such can help to “perk” you up if you are feeling fatigued or tired. It is often utilised to help with focus before training or learning. Caffeine, like all drugs, affects people in different ways and as such may or may not be a good choice in times of stress. In general, caffeine will increase heart rate, and this may be negative for any stressful situation.

Energy drinks containing caffeine are often used in times of exams and tests and so understanding how you may respond in these stressful situations is vital for making the correct choice.

You can easily see from the examples above of the differing forms that stress can manifest itself. One of the keys to combating this is firstly knowing that you may be genetically predisposed to having a specific outcome, this would hopefully give you some reassurances in knowing that you are in fact “hardwired” to feeling this way.



What To Do

How to alleviate stress

Increasing foods, which are high in antioxidants such as Vitamin E, selenium and glutathione, will have a beneficial effect for reducing free radicals and oxidative stress which may lead to physical symptoms. We can increase glutathione through 2 different pathways.

The first is by consuming foods high in glutathione such as avocado and asparagus. The second - and more effective - pathway would be to give the body the relevant cofactors that stimulate glutathione production and/or up regulate the activity of glutathione enzymes, such as cinnamon or turmeric.

Vitamin D - Having low Vitamin D levels has been shown to affect cognitive function and affect how you may approach stressful scenarios, so it's extremely important to maintain healthy levels throughout the year. Supplementation is essential during the autumn and winter months.

Potassium can really help to improve high blood pressure, which can be just one of the effects associated with a stressful environment.

Top 5 Potassium Foods

• Beet Greens	1 cup	1300.20mg
• Avocado	1 med	1050.00mg
• Swiss Chard	1 cup	950.10mg
• Sweet Potato	1 cup	942.20mg
• Spinach	1 cup	840.00mg

Taking deep breaths in acutely stressful situations can help bring down heart rate and help improve the response to stress. Magnesium is also important for heart rate and rhythm so making sure you consume foods high in magnesium is key.

Top 5 Magnesium foods

• Pumpkin Seeds	1 cup	190.92mg
• Spinach	1 cup	156.60mg
• Swiss Chard	1 cup	150.50mg
• Soybeans	1 cup	147.92mg
• Sesame Seeds	1 cup	126.36mg

A network diagram with blue nodes and lines connecting them, set against a white background.

Summary

Muhdo's area of expertise lies within the genetic fields of nutrigenetics, nutrigenomics as well as epigenetics. This allows for a unique understanding of how nutrients, lifestyle and your environment interact at a cellular and genetic level, and how they go on to affect your immune system and health.

Many people usually fear, what they in many instances, do not understand. Whilst diet, exercise, etc. will not mitigate your chances of contracting Covid-19, they may, however, help you make small incremental steps in the right direction to enhance various genes associated with your immune health. This, in turn, should reduce the severity of your symptoms or the potential time you are unwell for.

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