

VITAMIN D

HOW TO
SUPPLEMENT
WITH AND WHY
YOU SHOULD
DO IT



ingredientologist

Vitamin D, sometimes called the ‘sunshine vitamin’, is in fact a hormone that plays a major role in our overall health. It is one of the fat soluble vitamins which includes vitamin A, D, E and K. It differs from other vitamins in the fact that it is produced within the body. We can get small amounts of vitamin D from food sources, but the main source is a stepwise process that starts in your skin when exposed to ultraviolet (UV) light from the sun, and continues in our liver and kidneys where the final product is formed: active Vitamin D₃.

For those who love to geek out on science (like I do), I’ll briefly explain the pathway of how vitamin D is made in our body. For those who don’t, you’re welcome to skip the next two paragraphs!

Vitamin D₃ is produced in the skin via a two-step process. In the skin, **7-dehydrocholesterol (7-DHC)** is broken down by the UV radiation of the sun - specifically UVB radiation - into **pre-D₃** which is then converted into **D₃** via a heat-sensitive process. None of these ‘reactions’ are caused by enzymes; they are all a result of the UVB radiation from the sun.

Now, the vitamin D₃ gets converted into **calcidiol** or **25 hydroxyvitamin D₃ (25OHD₃)**, mainly in the liver but also elsewhere in the body. The next step occurs in the kidneys, but again, in other tissues too, where 25OHD₃ is converted into the active form of vitamin D called **calcitriol** or **1,25 hydroxyvitamin D₃ (1,25(OH)₂D₃)**. These reactions are carried out by a group of enzymes known as CYPs. This is the steroid hormone and metabolically active form of vitamin D as it is what binds the vitamin D receptor (VDR). When it binds the VDR, it can attach to our DNA, controlling hundreds of genes as a result, turning genes on and off, and this is why it has a huge impact on multiple biological processes in the body. If you think about it, this is epigenetics at work! - *The change in an organism as a result of something causing a change in the way the genes are expressed, and not because of a change in the actual DNA sequence.*

For those of you who skipped the details, briefly, the sun’s UV energy converts a chemical in your skin into Vitamin D₃, which is taken to your liver and kidneys to be converted into the active form of vitamin D.

Vitamin D and our health

Recent research has shown that every cell in the body has a vitamin D receptor (VDR). That alone helps to explain why it is so fundamental to our health. As I explained above, when vitamin D binds to the VDR, a whole host of genes are affected which influence how our bodies function.

Currently, it is estimated that 70% of the people in the United States have a vitamin D deficiency while over 40% of the global population are deficient.



This is probably due to lifestyle changes over time that have reduced our exposure to the sun and therefore affected our vitamin D levels directly. We work mostly from indoor offices, compared to working on farms in the past. We eat in restaurants or in our houses, we spend most of our time glued to screens indoors and we even exercise indoors!

We're now seeing that even people living closer to the equator, where sun exposure is sufficient, are vitamin D deficient. Because vitamin D deficiency is associated with many diseases and mortalities, this has become a pandemic that a lot of research has gone into, with many drugs being produced that are structurally similar to vitamin D as well as foods like cereals and milk that are fortified with vitamin D.

Most commonly known is rickets, a disease caused by poor bone mineralization causing soft bones and is mostly seen in children in developing countries where vitamin D deficiency is common. Vitamin D deficiency is also associated with an increased risk of diabetes, high blood pressure, heart disease, various forms of cancer, autoimmune and inflammatory diseases, decreased immune defenses and increased mortality. Vitamin D plays an essential role in the regulation of blood glucose and insulin levels, which are important for healthy weight control, and attenuating inflammation that is caused by obesity.

With that said, it is obvious that this vitamin has important functions, but perhaps two of the most vital are the absorption of calcium and phosphorus which influence bone health, and the regulation of the immune system.

The former helps us to maintain healthy and strong bones. Low bone calcium stores, increases our risk for fractures and bone diseases - something you really don't want as you age! Without vitamin D, we can only absorb 10-15% of dietary calcium, but this is improved by 30-40% when we have normal reserves. Additionally, lower calcium and phosphorus stores cause a rise in a hormone called parathyroid hormone (PTH) which acts to release calcium from our bones (to try and compensate for the lower calcium absorbed from the gut), leading to low bone mineral density.

There is a strong correlation between Vitamin D levels and immune function. It is no coincidence that the hype around supplementing with vitamin D has skyrocketed since the spread of the Coronavirus.

Vitamin D influences the proliferation and differentiation of immune cells. Without vitamin D, our immune cells aren't able to fight off infections. Studies continue to show how low vitamin D levels are associated with upper respiratory tract infections (URTI), acute lung injury, tuberculosis and other respiratory diseases like asthma.

A recent study showed that vitamin D supplementation could reduce the risk of getting a respiratory tract infection by up to 50%, with a greater effect for those who were already deficient.



Calcitriol, a drug that is the metabolically active form of vitamin D, influences host immunity in two different important ways: it suppresses adaptive immunity, while it stimulates innate immunity, two processes that regulate our immune response to infection. It is understood that

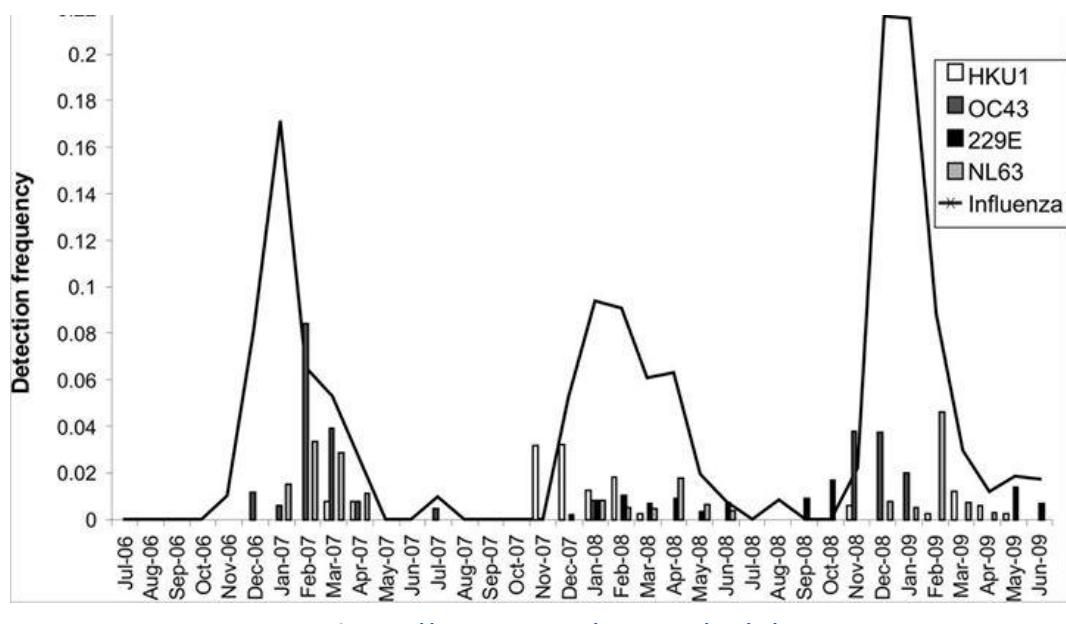
when vitamin D is converted to its active form, it turns on genes that make cells and proteins that are essential for a robust immune response.

Evidence that Vitamin D influences the immune system

There are a few points to highlight that support the fact that vitamin D is indeed one very important vitamin when it comes to our immune system's strength.

1) Seasonality of viruses:

The main source of vitamin D is the sun's UV radiation, and because it varies in intensity throughout the seasons and at different geographic locations, we see that **vitamin D deficiency is common** during the winter months (Oct - Mar) in northern latitudes 20 degrees above and (Apr - Sep) in the southern hemisphere 20 degrees below the equator. With this, we see that coronaviruses and influenza viruses show a strong seasonality with high rates and appearances in the winter months.



Source: <https://jcm.asm.org/content/48/8/2940>

"Generally, coronaviruses displayed marked winter seasonality between the months of December and April and were not detected in summer months, which is comparable to the pattern seen with influenza viruses."

- 2) A well-known study showed that children who were exposed to UV light had a 2x lower incidence of upper respiratory tract infections, the flu and sore throat compared to children who were non-exposed.
- 3) We see a difference in influenza virus rates in rural vs urban areas, with rural people having lower infection rates and higher vitamin D levels - due to working and spending more time outside, compared to city dwellers who spend most of their time indoors.
- 4) As mentioned above, there is a profound preventative effect of vitamin D supplementation bacterial and viral chest infections. A low vitamin D status is associated with a greater URTI incidence. This is because vitamin D increases immunity and decreases inflammatory responses, lowering the risk of infection.

These points tell us that it is very likely that a low vitamin D status can increase your risk of getting some sort of respiratory disease. As we will discuss, this is extremely important during the current period we are in with the global coronavirus pandemic.

Supplementing with Vitamin D₃

There are only 3 ways you can get vitamin D:

- Sun exposure
- Food Sources
- Supplements

Before supplementing with vitamin D₃, you should make sure you're getting sufficient sun exposure every day and eating enough food sources of D₃. You should also consider getting your levels tested.



IMPROVE YOUR HEALTH BY SUPPLEMENTING VITAMIN D3

VITAMIN D SUPPLEMENT BENEFITS

Vitamin D is vital to several different aspects of health. Although it's most well-known for:

- Supporting Bone Health
- Enhancing Immunity
- Preventing Deficiency. It's really hard to get enough of it naturally and if you're living in a northern latitude, it's quite difficult.
- May Help Protect Against Cancer
- Improves Mood

It also improves outcomes in all kind of colds, flu infections or allergies involving the immune system.

VITAMIN D SUPPLEMENTS CAN BE SUPERCHARGED BY YOUR MEAL

Combining it with a fatty meal may improve the effect of Vitamin D3 on your system by 32 percent!

DEFICIENCY SYMPTOMS

THE ONLY WAY TO KNOW YOU ARE DEFICIENT IS TO HAVE YOUR DOCTOR PERFORM A ROUTINE BLOOD TEST. POSSIBLE SIGNS OF VITAMIN D3 DEFICIENCY INCLUDE:

- WEAKNESS
- CHRONIC FATIGUE
- DEPRESSION
- ANXIETY
- TROUBLE SLEEPING
- WEAK OR BROKEN BONES
- WEAKENED IMMUNE SYSTEM
- INFLAMMATION AND SWELLING

TESTS INCLUDE: '25 HYDROXYVITAMIN D3 TOTAL' OR '25(OH) D3 TOTAL'

KEEP THESE NUMBERS IN MIND WHEN READING YOUR TEST RESULTS.

Reference range of the total 25(OH)D level Range

<20ng/mL
= Vitamin D deficiency

20-29ng/mL
= VItD insufficiency

30-80ng/mL
= optimal

Know your levels

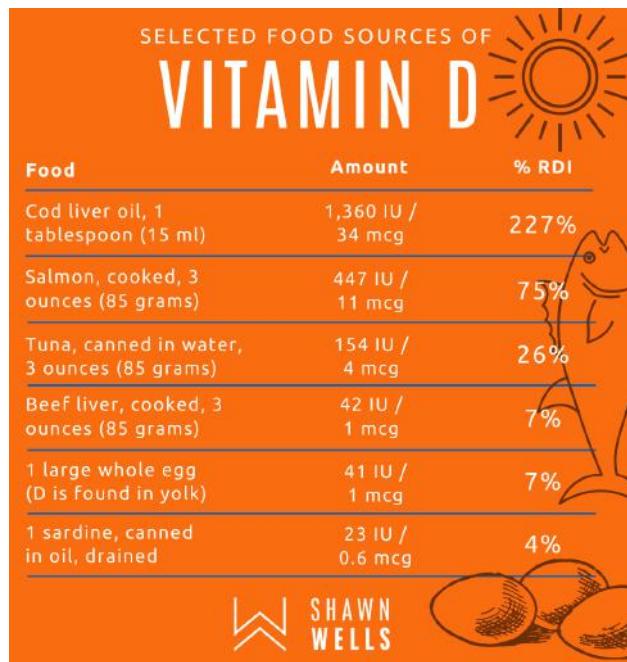
The best way is to test for '25 hydroxyvitamin D3 TOTAL' or '25(OH)D3 TOTAL' by getting a blood test from your doctor.

Preferred levels are between the range of 30 - 60ng/ml, but vitamin D deficiency is a problem all over the world and 42% of Americans are vitamin D deficient! Levels of 20ng/ml reflect vitamin D inadequacy, while 20-30ng/ml are borderline deficiency.

Vitamin D from the sun

Researchers found that one full-body exposure to UV radiation that causes slight pinkness in the skin - which they called the minimum erythema dose, 1 MED - is equal to supplementing with 10,000 - 25,000IU of vitamin D. That's a lot!

We definitely can get enough vitamin D produced in our bodies from the sunlight, but we need to be conscious about making this a routine part of our lives. More recent recommendations say that 15 minutes of sun exposure, or until the skin turns slightly pink, between 10am and 3pm can produce roughly 3000IU of vitamin D in the body. Another bonus is that vitamin D produced from the sun can last twice as long in the blood compared to vitamin D from the diet.



Vitamin D from food

Relying on foods as a source of vitamin D alone is not ideal as it is hard to reach the amount you need since very few foods contain significant levels. Food sources include: cod liver, eggs, liver, fatty fish like salmon (which all contain D₃), and mushrooms (mushrooms contain D₂).

In some countries there are fortified foods like cereals and milk, however one glass of milk contains only 100IU. So coupling sun exposure with a good diet is key.

Cod liver is the single best source of vitamin D. Just 1 tablespoon (15ml) can give you more than you need per day. Fatty fish like salmon is also good, but you would need to be eating this everyday, which is unlikely.

Factors leading to lower Vitamin D levels

Several factors influence how much of the precursor chemical in our skin gets converted into the active form of vitamin D₃. Below are some of the major ones to consider, and could help determine whether you should be supplementing or not.

- *African American* → Darker skin means a higher amount of melanin in the skin - a protein that protects us from the sun's UV radiation. It is hypothesised that humans adapted as they migrated north to less sunny regions by getting whiter skin, so that more vitamin D could be produced in the skin. Having darker skin is protective against too much sun exposure near the equator (at least before urbanization).
- *Obesity* → Research shows that the more obese a person is, the lower their vitamin D levels will be.
- *Elderly* → As we age, rates of vitamin D deficiencies are higher.

- *Sun protection* → Concerns about skin cancer have prompted people to wear sunscreen and protective clothing in the sun, which limits sun exposure and vitamin D production significantly.
- *Season & latitude* → The angle of the sun in the winter prevents people in the northern hemisphere from producing enough vitamin D. In the countries north of 35°N, no vitamin D is produced during the winter months. Smog/pollution and cloud cover also significantly reduce UV radiation.
- *Outdoor behavior* → There is an ongoing trend towards less outdoor activities, either for work or preferred leisure activities, increasing our susceptibility to vitamin D deficiency.

Taking these factors into account, you may need to be increasing your levels of vitamin D through supplementation.

Two different Vitamin D

When looking for vitamin D supplements it is important to know that there are two forms of vitamin D:

- *Vitamin D₂ (ergocalciferol)* → Found in some plants and fungi (mushrooms). Humans do not make D₂.
- *Vitamin D₃ (cholecalciferol)* → Found in oily fish, fish liver oil and egg yolks. This is the form found in humans.

D₃ is more effective than D₂ as it raises and maintains elevated blood levels of vitamin D for a longer time. A study showed that 50 days after a period of supplementing with vitamin D, people who had D₂ form had their levels return to baseline, whereas those who had D₃ had elevated levels.

Vitamin D and Vitamin K work as a team

It's not as simple as supplementing with vitamin D alone. **Combining vitamin D with vitamin K₂** is important because of how they work together in the body.

The role of vitamin D

To **maintain adequate calcium levels** in the bloodstream by two ways:

- Enhancing absorption of calcium from the food we eat in the gut.
- Releasing calcium from the body's 'calcium stores' - our bones, when we don't have enough calcium in our diet.

Calcium is essential for bone health, but also other vital functions in the body like muscle contraction and nervous system function.

The role of vitamin K

While vitamin D maintains calcium levels, it does not control where that calcium goes. Vitamin K does two things:

- Promotes calcification (the buildup of calcium) of bone - which means it ensures that the calcium goes to the right places like bones and teeth.
- Reduces calcification in soft tissues - this means that vitamin K prevents calcium from accumulating in tissues where a build up would be harmful, like our blood vessels and kidneys.

Together, vitamin D and K₂ regulate calcium levels and its action in the body making sure that we have calcification in the right places.

There are two main types of vitamin K₂: MK4 and MK7, with the latter being the biologically active form so I recommend looking for the MK7 version to stack with your vitamin D supplement. Vitamin K₂ can also be found in leafy green vegetables, fermented legumes or vegetables as well as fatty animal-based foods like liver, egg yolk and cheese.

Vitamin D is a fat soluble vitamin, and so taking it with a source of fat can be helpful. It is also stored in our adipose tissue, and is released as needed if intake is too low. Supplements that have vitamin D in an oil based form have proven to be more bioavailable than those in a dry powder form, likely due to its fat soluble properties.

My top brands are:

- [Now Foods](#)
- [Life Extension](#)

- [Sports Research](#) (a Vitamin D₃ form that is vegan, combined with coconut oil and vitamin K₂ MK7)

Dose

The US Institute of Medicine recommends 400-800IU (or 10-20mcg) per day, but recommendations are continuously adjusted upward as some recommend 2000 IU/day or 60IU/kg. It really depends on your current levels, and the other lifestyle factors mentioned above. The upper limit is 4000IU per day, but taking vitamin D is generally very safe with little to no negative risks.

Current RDA's are as follows:

- 400 IU → Infants (0-12 months)
 - 600 IU → Children & Adults (1-70yrs) including breastfeeding and pregnant women
 - 800 IU → Adults (70yrs and older)
- (1mcg = 40IU)

The most obvious benefits from vitamin D supplementation is seen in people who have vitamin D deficiency (<20ng/ml) or insufficiency (20-29ng/ml). It was also found that higher doses taken monthly were less effective than taking a lower dose daily or weekly.

So, how do you get more vitamin D?

1) Sensible sun exposure:

Getting at least 15 minutes of sunlight between 10am and 3pm can produce 3000IU naturally. Don't wear sunscreen, sunglasses or other protective gear for the 15 minutes.

2) Supplement daily:

Consider a vitamin D supplement remembering to combine it with vitamin K₂ (MK7 form) and a fat source.

Bottom line?

- Get at least 15 minutes of sunlight each day
- Don't use sunscreen all the time
- Supplement with Vitamin D₃ (and K₂)
- Opt for daily or weekly doses instead of monthly



Vitamin D and Respiratory Tract Infections

I'd like to bring your attention to a study published in the British Journal of Medicine. It is a meta-analysis, which means the authors gathered many different studies on the topic and analyzed the data together to give an overall result, thus delivering high-quality evidence.

The study looked at the preventative effect of vitamin D supplementation on respiratory tract infections. The data showed that taking vitamin D as a supplement could reduce the risk of bacterial and viral chest infections.

Why is this important? Well, for two reasons:

- We know that respiratory diseases are a major cause of death globally and account for 10% of emergency department cases!
- Infection with the coronavirus is associated with a respiratory condition, specifically ARDS (acute respiratory distress syndrome).

Briefly, how ARDS affects the lungs is by causing a major inflammatory response in the 'air sacs' of the lungs when a bacteria or virus infects us. This prevents the flow of oxygen and carbon dioxide between the blood and the air we breathe, and our immune system overreacts.

This study shows that vitamin D has the ability to control this overactive immune response, by downregulating the inflammatory response and increasing the number of immune cells that can fight infection, like lymphocytes, neutrophils, monocytes and dendritic cells.

It also showed that taking vitamin D daily or weekly gave a far more profound benefit compared to taking it in monthly doses, and that the benefits were greater in those who already had a low vitamin D baseline level.

This is profound evidence and from this we can take away an important message: If we are unable to change our lifestyle habits so that we can produce more vitamin D, we should consider a vitamin D supplement as it could potentially reduce our risk of getting respiratory complications associated with COVID-19.

I am by no means claiming that vitamin D is the answer to COVID-19 or any other sort of disease, but what I am saying is that we can all take action to at least reduce our risk of being infected or lessen the impact of a bacterial or viral chest infection by bringing our levels of vitamin D up to optimal levels.

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References

Vitamin D Metabolism, Mechanism of Action, and Clinical Applications Daniel D. Bikle, VA Medical Center, Department of Medicine and Dermatology, University of California, San Francisco, San Francisco, CA 94121, USA <http://dx.doi.org/10.1016/j.chembiol.2013.12.016>

<https://www.frontiersin.org/articles/10.3389/fendo.2019.00103/full>

<https://www.healthline.com/nutrition/how-much-vitamin-d-to-take#How-Much-Vitamin-D-Should-You-Take?>

Covid-19 and Vitamin D Information. Dr Gareth Davies (PhD), Dr Joanna Byers (MBChB), Dr Attila R Garami (MD, PhD)

<https://ods.od.nih.gov/factsheets/VitaminD-HealthProfessional/>

<https://www.ncbi.nlm.nih.gov/pubmed/29644951>

Martineau AR, Jolliffe DA, Hooper RL, et al. Vitamin D supplementation to prevent acute respiratory tract infections: systematic review and meta-analysis of individual participant data. BMJ. 2017;356:i6583. Published 2017 Feb 15. doi:10.1136/bmj.i6583

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3356951/>

<https://www.healthline.com/nutrition/vitamin-d-101#deficiency>

The Relationship between Ultraviolet Radiation Exposure and Vitamin D Status Ola Engelsen. Nutrients 2010, 2, 482-495; doi:10.3390/nu2050482

Hansdottir S, Monick MM, Hinde SL, Lovan N, Look DC, Hunninghake GW. Respiratory epithelial cells convert inactive vitamin D to its active form: potential effects on host defense. *J Immunol.* 2008;181(10):7090–7099. doi:10.4049/jimmunol.181.10.7090

<https://www.nutraingredients.com/Article/2015/04/13/Vitamin-D2-vs-D3-Same-for-boosting-D-levels-but-D3-superior-for-sustaining-levels>