

Education News

ISSUE 6



VITAMIN D

MORE THAN A RAY OF SUNSHINE

Vitamin D, the “sunshine vitamin”, is a sizzlingly hot topic, receiving plenty of media and scientific attention. In recent years it has been the subject of countless studies linking its relevance to a healthy immune system, and its deficiency to a vast array of conditions including asthma, heart disease, depression, multiple sclerosis and cancer. Our primary source of this amazing nutrient is the sun’s UVB rays, which we can convert to copious amounts of vitamin D in the skin.



In December 2010, seven heavyweight organisations released a joint statement reevaluating the benefits of vitamin D, and acknowledging that we may not actually be producing enough from the sun, especially in the colder months. They write, “Some unprotected exposure in the hours close to solar noon may be necessary, but people should not be advised to deliberately sunbathe or expose themselves to the sun for long periods of time in order to produce more vitamin D. When it comes to sun exposure, little and often is best.” This is quite a turnaround for organisations who might usually suggest wearing sunscreen or staying out of the sun at all times, especially around midday. They add, “During winter months in the UK, there is not enough UVB for vitamin D synthesis and people rely on tissues stores, supplements and dietary sources.”

The Consensus Statement also discusses who is at most risk for deficiency¹, and poses some interesting questions around supplementation for further research. The organisations issuing the joint statement comprise the British Association of Dermatologists, Cancer Research UK, Diabetes UK, the Multiple Sclerosis Society, the National Heart Forum, the National Osteoporosis Society and the Primary Care Dermatology Society, and seems to be a response to the increasing levels of public interest in vitamin D, spurred by the wealth of new research that has arisen.

VITAMIN D AND BONE HEALTH

We usually associate vitamin D with calcium absorption, and therefore bone health. Indeed, a direct correlation has been shown between, for example, low vitamin D levels and incidence of hip fracture in the elderly². Vitamin D has long been used as part of protocols to treat and

prevent rickets, osteoporosis, osteopaenia and osteomalacia – all various manifestations of poor bone density. It should also be noted that while vitamin D can help with calcium absorption, magnesium has an important role in calcium placement in the body. This is discussed in more detail in the Nutrigold Newsletters “Preventing Osteoporosis”³ and “Simply Magnesium”⁴. Where there appears to be enough calcium in the diet, it is advisable to look at both magnesium and vitamin D status as part of your programme to help the body transport calcium to the bones and keep them strong. Calcium absorption and placement are also crucial for a well functioning nervous system, for muscle contraction and so also for heartbeat, and for many other significant functions.



GENE EXPRESSION

We now also know that vitamin D can be converted into a very powerful hormone in the body that can trigger the expression of over 200 genes, including genes that are involved in immune system response, detoxification and extinguishing cancer cells. This new information has far reaching implications, and has spurred scientists to measure and trial vitamin D with dozens of health conditions, from dermatitis to diabetes.

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MAKING VITAMIN D WHILE THE SUN SHINES

By far the most effective way of getting enough vitamin D is through skin exposure to the UVB rays from the sun, which react with 7-hydroxycholesterol in the skin to produce cholecalciferol, or vitamin D₃. The same UVB rays degrade any excess vitamin D₃ produced to avoid overdosing, and it is interesting to note that the body's own maximum allowance is around 20,000iu. This is 100 times the current RDA (200iu) and 10 times the amount that researchers are now calling for, and it seems we can surpass these levels with only a few minutes of daily exposure to the sun.

We then convert vitamin D to various forms (also referred to as vitamin D), described in more detail later in this newsletter, and we are now also able to measure the blood serum form to assess deficiency. Two recent British surveys have shown that we are barely producing the 50nmol/L considered by many to be necessary for basic health, and those on low incomes may only be measuring on average 43-46.5nmol/L of blood serum vitamin D⁵.



DEFICIENCY IN D

If we can produce so much vitamin D for free from brief but daily sessions in the sunshine, why then are so many of us deficient, especially in the colder months? First of all we need to remember that the required UVB rays are blocked by glass (so sitting in the conservatory, by the office window or in a car doesn't count), as well as clothes, sunscreen, cloud cover and smog. Suddenly it seems much clearer: how many of us really allow skin exposure to the necessary levels of sunshine? The consensus guidelines produced by the prominent charities above suggest that, although there are many factors involved that need to be taken into account, we need to be exposing one third of our body to the sun, without sunscreen, for just under 15 minutes every day, without, of course, getting burnt. What's more, to ensure we are getting sufficient UVB rays, we may need to be making use of the midday sun for our daily vitamin D top up, with the highest level of UVB available between 10am-2pm.

We have been frightened off such naked exposure to the sun, although it is now also emerging that the vitamin D we produce from the UVB spectrum may help protect us from the harmful UVA rays when we allow moderate exposure of our bare skin to the sun.

Perhaps the more surprising news, however, is that those of us in temperate regions such as northern Europe are naturally deprived of the crucial UVB rays from October until April. So walking and sitting outdoors in the winter sun may still bring other benefits in terms of sunlight exposure, but vitamin D production is not one of them.

It has been suggested that if we produce sufficient quantities of vitamin D during the summer, then we may be able to maintain lower but basic levels through the rest of the year⁶. With the current culture of covering up either with clothes or sunscreen during every minute of our summertime sun exposure, I wonder how many of us are achieving sufficient sun stores of vitamin D in the summer months to see us through. For much of the year, then, we may need to be supplementing our sunshine stores of vitamin D.

FOOD SOURCES OF VITAMIN D

Food sources can provide moderate amounts, our main supply being in fish, eggs and mushrooms. For example, a cup of white mushrooms (raw or stir fried) would provide approximately 12.6iu vitamin D, and an egg will contain approximately twice this amount; oily fish will provide a better but varying amount depending on species, environment and whether it is raw, cooked or tinned⁷. Interestingly one study showed wild salmon containing 1000iu per 3oz serving, while farmed salmon only contained 375iu⁸.

It might be wise to also consider a good vitamin D supplement, especially during the colder months and for those more at risk of vitamin D deficiency, which includes the elderly, pregnant women and those who cover their skin for cultural reasons – and we might now extend that list to many of those with one of the conditions outlined below.

D₂ OR D₃ – WHICH IS THE BEST SUPPLEMENT?

Vitamin D is available for supplementation in two forms: vitamin D₃, or cholecalciferol, produced from lanolin in sheep's wool, and vitamin D₂, or ergocalciferol, produced from the mold ergot⁹. Many practitioners prefer D₃ due to a general view that the form closest to what we obtain from nature will be the better; others prefer D₂ as it can be produced without involving any animals.

D₂ decomposes more quickly than D₃, but they both have a good shelf life if stored at room temperature protected from air, nitrogen and carbon dioxide¹⁰. Storage in oil can also increase the shelf life of both forms, so it is not surprising that cod liver oil has traditionally been a good source of vitamin D₃. In fact a teaspoon of cod liver oil can provide 450iu of vitamin D¹¹, but it may be difficult to find a good quality, cold pressed, pure cod liver oil to supplement with.

The orthodox view is that both forms of the vitamin are equally well absorbed, and research would seem to endorse this¹². Although D₃ is gaining a reputation as the "better" form, vitamin D₂ has been used successfully for years to address conditions such as rickets and osteomalacia, so in terms of absorption and bone support, it seems to be a matter of personal preference rather than one being better than the other.

There is, however, evidence to suggest that the body may not convert D₂ as effectively as it does D₃ to the final form of vitamin D that is now recognised as a potent hormone¹³.

SO HOW COULD VITAMIN D BENEFIT US IN OUR EVERYDAY LIVES?



HOW OUR BODIES USE VITAMIN D

The vitamin D3 (cholecalciferol) that we make from sunshine or ingest from foods and certain supplements is sent first to the liver to be converted into calcidiol, or 25(OH)D, with the help of certain enzymes. This is the blood serum form that is now largely measured in trials and studies to determine the correlation between vitamin D levels and a whole host of illnesses and conditions, as well as to assess deficiency.



The calcidiol is then sent to the kidneys first, and then any excess to the rest of the tissues in the body. Both in the kidneys and in the tissues, it is converted to 1,25(OH)2D3 or calcitriol. This is the form that is now recognised as the hormone that triggers very fast gene expression by attaching to receptors on the actual DNA in the cell nucleus. Proteins are then produced that play a role in cellular growth, cellular death,

immune system regulation, detoxification, the regulation of blood calcium levels and the release of neurotransmitters such as serotonin. I would consider these functions to be among the fundamental basics for life and good health.

Vitamin D2 is converted to very similar forms, but many argue that there is a slight alteration in the chemical make-up which means that it doesn't bind so readily to the enzymes in the liver that convert it to the hormonal form, and also that it doesn't attach so easily to the vitamin D receptors in each of our cells. In addition, D2 may therefore carry a higher risk for toxicity, as there will be greater levels of the unconverted form floating around in the body. There are, however, many conflicting studies surrounding vitamin D metabolism which makes it difficult to state all of this conclusively.

So the form you choose may depend on your reason for supplementation, your interpretation of the evidence so far and your degree of comfort with using a sheep's wool based product. Many choose vitamin D3 to stay as true as possible to the form we naturally obtain from sunshine and food sources.

HOW MUCH VITAMIN D SHOULD I TAKE?

The current RDA for vitamin D is 200iu, although many are arguing for a much higher level of perhaps 5-10 times that amount¹⁴. It is generally accepted that pregnant women and the elderly need more than the RDA.

The current suggested upper safety limit is 1000iu, although it is interesting to note that the skin will manufacture up to 20 times this amount from the sun before it will start using the UVB rays to destroy any surplus.

Classically there has been a concern that high levels of supplemental vitamin D may lead to hypercalcaemia and hypercalciuria, but again strong evidence is lacking. Reinhold Vieth writes in his review of the research, "Throughout my preparation of this review, I was amazed at the lack of evidence supporting statements about the toxicity of moderate doses of vitamin D." He adds that "Vitamin D deficiency can mask primary hyperparathyroidism and this could account for the occasional cases of hypercalcaemia that occur when large groups of elderly people are given vitamin D supplements."¹⁵

VITAMIN D IN PREGNANCY

A recent Belfast study has highlighted a widespread deficiency of vitamin D in pregnant women. The study demonstrated that of 99 pregnant women, 35, 44 and 16 % were classified as vitamin D deficient, and 96, 96 and 75 % were classified as vitamin D insufficient at 12, 20 and 35 weeks gestation, respectively¹⁶. Vitamin D supplementation has been shown to have numerous benefits in pregnancy, including



reducing the risk of pre-eclampsia by as much as 27%¹⁷. A 2010 review of vitamin D in pregnancy argues for vitamin D deficiency to be taken very seriously indeed:

"It appears that vitamin D insufficiency during pregnancy is potentially associated with increased risk of preeclampsia, insulin resistance and gestational diabetes mellitus. Furthermore, experimental data also anticipate that vitamin D sufficiency is critical for fetal development, and especially for fetal brain development and immunological functions. Vitamin D deficiency during pregnancy may, therefore, not only impair maternal skeletal preservation and fetal skeletal formation but also be vital to the fetal 'imprinting' that may affect chronic disease susceptibility soon after birth as well as later in life."¹⁸

When we consider vitamin D's role in gene expression and protein formation, we can well understand these concerns.

VITAMIN D AND CANCER

It is for this same reason that the hormonal role of vitamin D has been so eagerly studied by those interested in cancer prevention. DNA expression appears to be at the very heart of whether cells become cancerous or not, and there are endless studies examining the relationship between vitamin D and various kinds of cancer. One shows, for example, that vitamin D deficient women have a 222% greater risk of developing breast cancer¹⁹; another that vitamin D deficiency is correlated with a 40% increased risk of colorectal cancer²⁰; another that there is a significantly increased risk for prostate cancer²¹. What is of perhaps even greater interest, however, is the research beyond cancer prevention, looking at vitamin D's potential ability to help reduce tumours once they are already there. One study suggests vitamin D as an effective therapy for neuroblastoma patients²²; and a Mexico study demonstrates the anti-proliferative effect of vitamin D on breast cancer cells²³. Another study shows that vitamin D deficient women with breast cancer were 94% more likely to have metastases, and showed a shorter life expectancy rate²⁴ than those with acceptable levels of vitamin D. Much of this is attributed to vitamin D's role in apoptosis, or the process of natural cell death. Cancer cells are often described as being unable to die, and so there is always much interest when a



new substance is found that can help to promote this. Vitamin D in its hormone form can trigger the expression of genes that promote apoptosis, and so extinguish cells that the body no longer has a need for. It can also trigger the expression of genes that are involved in detoxification as well as antioxidant genes.²⁵ A further study looks at the hormonal ability of vitamin D to reduce progesterone and estradiol levels in women, thus providing another clue to why it might be effective in reducing the incidence of breast cancer²⁶. Countless more look at vitamin D's role in still further aspects of cancer and its progression.

VITAMIN D AND OBESITY

Apoptosis is often also of interest in the area of obesity, as fat cells are notoriously difficult to get rid of. This may go some way to explain the greater weight loss success that has been noted with people with higher blood serum levels of vitamin D²⁷, and the lower levels of abdominal and general body fat noted in teenagers with higher vitamin D levels²⁸. Two studies of adolescent girls also showed increased levels of muscle fat in those who were vitamin D deficient, resulting in increased muscle weakness²⁹. It is not clear from the studies whether the vitamin D deficiency has contributed to the situation, or whether blood serum levels of vitamin D are low because this fat soluble vitamin is being stored in the fat cells. Either way, those with higher fat levels may do well to consider their vitamin D intake.

ASTHMA AND ALLERGIES

Vitamin D deficiency has been related to a higher incidence of asthma in children, and also to the severity of the condition – the greater the deficiency, the worse the condition³⁰. In addition, a study has shown that vitamin D may be of benefit to asthma and CF patients suffering with mold allergy: "We found that adding vitamin D not only substantially reduced the production of the protein driving an allergic response, but it also increased production of the proteins that promote tolerance," said researcher Dr. Kolls³¹.

There may also be a link here with some of the research carried out to explore vitamin D's role in immune system activity.



IMMUNE SYSTEM RESPONSE

Vitamin D has now been shown to be instrumental in triggering T-cell response in the immune system. "When a T cell is exposed to a foreign pathogen, it extends a signaling device or 'antenna' known as a vitamin D receptor, with which it searches for vitamin D," explains Prof Geisler. "This means that the T cell must have vitamin D or activation of the cell will cease. If the T cells cannot find enough vitamin D in the blood, they won't even begin to mobilize." ³²

CROHN'S DISEASE AND COLITIS

A 2008 study measured the incidence of vitamin D deficiency in 130 Inflammatory Bowel Disease patients (94 with Crohn's disease and 36 with colitis) aged 8-22, and found a convincing correlation.³³ Two years later a further study showed that this was no coincidence: vitamin D deficiency actually seems to play a causative role, at least with Crohn's disease. The researchers started with the premise that the inflammation in the intestines is caused by the immune system's inability to respond correctly to intestinal bacteria. They showed that vitamin D is directly involved in the expression of the NOD2 gene, which signals the presence of invading microbes in the intestines, and its failure to be expressed has previously been linked to Crohn's disease. The team writes: "Our observation that 1,25D signaling is a direct inducer of NOD2 expression argues strongly that vitamin D insufficiency/deficiency does play a causative role in the prevalence of Crohn's disease."³⁴

MULTIPLE SCLEROSIS AND PARKINSON'S DISEASE

Recent research suggests that vitamin D may also be important in the expression of genes that regulate MS³⁵, which seems to support a Harvard study of military personnel that showed a 62% reduction in incidence of MS in those with higher blood serum levels of vitamin D. Moreover, a 2005 study of 79 identical twins studies where just one of each pair of twins had been diagnosed with MS, showed that the affected twin had received less sun exposure than the healthier twin prior to diagnosis.³⁶ The healthier twin would therefore have had more frequent opportunities to manufacture good levels of vitamin D. A separate study shows a 55% higher incidence of Parkinson's disease where

there is vitamin D deficiency.³⁷ A pilot scheme is currently looking at the effect of supplementation of varying levels of vitamin D with those already diagnosed with Parkinson's, and it will be interesting to see if the vitamin's role as a gene expression trigger and its activity within the central nervous system can help to reverse any of the symptoms related to the disease.

BRAIN FUNCTION AND DEMENTIA

A recent study of 858 adults over the age of 65 showed vitamin D deficiency to be related to a decline in brain function. The Italian adults were given regular cognitive function tests over 8 years alongside blood tests to assess their vitamin D status, and the most severely deficient showed the most substantial decline.³⁸ A similar study of 752 women over the age of 75 showed comparable results.³⁹

Some studies have gone further to link vitamin D deficiency with dementia and Alzheimer's. One such study tested 231 women and 109 men aged 65 to 99, and demonstrated that those with vitamin D deficiency were 2.3 times more likely to have dementia and 2.5 times more likely to have Alzheimer's.⁴⁰



VITAMIN D AND MENTAL HEALTH

The brain is suffused with vitamin D receptors, prompting much research into its relevance for mental health, from depression to schizophrenia. A 2008 Dutch study of 1282 people aged between 65 and 95 noted higher levels of depression amongst those with the lowest levels of vitamin D and highest levels of blood parathyroid hormone.⁴¹ A similar

Italian study of 531 women and 423 men over the age of 65 showed a correlation particularly in women between low vitamin D levels and depression.⁴²

John McGrath spent several years studying the relationship between prenatal and early vitamin D deficiency and schizophrenia. His 2003 study of Finnish men and women who had taken vitamin D supplements during the first year of life. The study showed no correlation in females, but in males, the use of either irregular or regular vitamin D supplements was associated with a reduced risk of schizophrenia. The most reduced risk was found in those supplementing with at least 2000iu vitamin D daily.⁴³

HYPERTENSION AND HEART DISEASE

There has been a great deal of interest in vitamin D's relationship to our cardiovascular health. A recent review of 11 randomised, controlled trials showed an ability of vitamin D to help lower blood pressure in some cases.⁴⁴ More striking results were shown in a study that followed 548 heart attack patients over 6 years, and showed that those with the lowest vitamin D levels had a 378% increased risk of death from a further cardiovascular event.⁴⁵ "This study provides compelling evidence that a high vitamin D status is associated with improved survival in heart failure patients. Until an intervention study has been designed and completed, it seems that we should advise patients with heart failure to maintain appropriate vitamin D levels by taking supplements, by eating oily fish or eggs, or simply by exposure to sunlight," said Liu, who led the study. Further research links vitamin D deficiency with the build up of cholesterol in arteries. ⁴⁶"Vitamin D inhibits the uptake of cholesterol by cells called macrophages," explains lead researcher Carlos Bernal-Mizrachi, MD. "When people are deficient in vitamin D, the macrophage cells eat more cholesterol, and they can't get rid of it. The macrophages get clogged with cholesterol and become what scientists call foam cells, which are one of the earliest markers of atherosclerosis."

A 2010 review of 28 studies in the UK showed that middle aged and elderly adults have a 33% greater chance of avoiding heart disease if their blood serum vitamin D levels were sufficiently high.⁴⁷ The same study showed a 55% reduction in type 2 diabetes and a 51% reduction in the risk of metabolic syndrome compared to those with the lowest vitamin D levels.

VITAMIN D AND DIABETES

Further studies have looked at vitamin D's relationship to both types of diabetes, and lower concentrations of blood serum vitamin D have been noted with both types. Of particular note is vitamin D's ability to lower, and therefore improve, insulin resistance, which is important for those with type 2 diabetes. A 2009 New Zealand study put forward that optimal blood serum levels for insulin sensitivity are between 80-119nmol/L⁴⁸, which is much higher than the levels

usually denoted as adequate. This is really just the tip of the iceberg. With so many vitamin D receptors on so many cells throughout the body, and an involvement in the expression of over 200 genes, it can be no surprise that vitamin D is implicated in so many aspects of our health. We are learning more all the time, and the more we study the hormonal form of vitamin D, the more crucial it appears to be to our fundamental wellbeing.

Of course, the body doesn't use vitamin D in isolation: its immediate co-factors include magnesium, zinc, boron, vitamin

K2, the isoflavin genestein, and a small amount of vitamin A – vitamin D relies on these for its conversion and utilisation so it can perform its various tasks. In the bigger picture, vitamin D takes its part in the dance among all the vitamins, minerals and other nutrients, each of them key factors in a continual and kaleidoscopic cascade of events that keeps us healthy and alive. Of all these key nutrients, however, vitamin D may have been the most underestimated until now, so it's a good time to ask: are you getting enough sunshine in your life?



Should you need a more detailed approach, or should you have any questions or concerns that are not addressed in this article, you are always welcome to contact our nutritional advice team on 01395 227850 (9.00am – 5.00pm Monday – Friday).

Alternatively if you would like a more personalised approach, addressing dietary recommendations, lifestyle changes etc., we would suggest you consider consulting a qualified nutrition adviser or therapist, which you can do by either asking us for details of your local

practitioners, or contacting The Federation of Nutritional Therapists on **0870 312 0042** or by emailing them at **admin@fnfp.org.uk**

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