In Depth - The roles of vitamin D in health and disease – when will we stop counting?

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We have known for nearly two centuries that sunlight is required for bone health. As early as 1822 a Polish scientist, Sniadecki, hypothesised that the devastating childhood bone disease, rickets, was associated with deprivation of sunlight following observations that urban children in Warsaw developed the disease but children living in rural areas did not. In the early 20th century Sir Edward Mellanby cured rickets in dogs by giving them cod liver oil, Huldschinski cured rachitic children by exposing them to a mercury arc lamp, and Hess and Unger showed that sunshine could cure children and experimental rats with rickets.

Eventually, vitamin D was isolated and identified as an essential micronutrient with the role of regulating bone metabolism and calcium homeostasis. Within this single role, vitamin D performs a number of different functions, including facilitating the absorption of dietary calcium via the cells lining the small intestine. The maintenance of a steady state of calcium concentration in the blood is so important, that insufficient dietary intake is quickly compensated for by removal of calcium from the bones, and when someone is deficient in vitamin D, their ability to absorb dietary calcium is reduced by 50 – 75%. Consequently, poor vitamin D status has a negative impact on bone health throughout life.

In New Zealand, where there is usually no shortage of ultraviolet radiation, one would expect that vitamin D deficiency is limited to specific “at risk” groups such as people with very dark skin, or older people who do not synthesise vitamin D very efficiently any longer. However, this is not the case. Although hard data is limited, there is now sufficient information available to suggest that a large proportion of the New Zealand population is at risk of being vitamin D deficient. Because there is not the range of vitamin D fortified foods in this country as there is in North America for instance, New Zealanders are mostly reliant on sunshine for vitamin D. Due perhaps to changes in lifestyle, together with acknowledgement of the dangers of excessive sun exposure, Kiwis are staying out of the sun. They are not alone – vitamin D deficiency is becoming recognised as a world-wide phenomenon as, concurrently, we are recognising that its role in bone health is only the tip of the iceberg.

Over the past three decades strong evidence has been accumulating for a relationship between low vitamin D status and high incidence of a variety of diseases, including cardiovascular disease, cancer and both type 1 and type 2 diabetes. Scientific interest in these observations has resulted in an exponential increase in the number of studies investigating the potential mechanisms behind the relationships, and randomised controlled trials to test the effect of vitamin D supplementation on markers of disease.

In the prevention of cardiovascular disease there are a number of roles for vitamin D including control of blood pressure, reduction of inflammatory markers, inhibition of smooth muscle proliferation in the blood vessels, and suppression of vascular calcification. In the case of cancer, vitamin D has strong anti-proliferative and pro-differentiation effects, as well as bolstering the immune system. The influence of this powerful nutrient on the immune system is itself, multi-faceted. It has long been recognised that

children with rickets have a greater likelihood of developing respiratory diseases such as pneumonia. Similarly, recent discoveries have confirmed the well-documented benefits of sunshine and clean air for patients suffering from tuberculosis. However, it is now apparent that vitamin D also helps to moderate the immune response, aiding in the recognition of “friendly” cells and preventing the over-reaction which results in auto-immune diseases such as type 1 diabetes, inflammatory bowel disease and multiple sclerosis.

The first experiments to determine the effect of vitamin D on insulin secretion took place in the 1970s and more recently studies have shown that insulin resistance is also influenced by vitamin D status. Although there is still much work to be done, the clues on hand suggest that vitamin D deficiency could play an important role in the development of type 2 diabetes. Other conditions for which strong evidence exists are muscle function and the skin disease, psoriasis.

Whilst the picture becomes clearer for the disease conditions mentioned above, questions are being asked about many more including asthma, autism and a range of psychological and mood disorders. For these, science has barely progressed past the stage of forming hypotheses but while we wait, there are more than enough well-proven reasons to ensure that our vitamin D status is good. The real question is how do we do it?

During summer, most people will get enough incidental sun exposure to keep their levels up. Twenty minutes in the summer sun in a bathing suit will result in approximately 20,000 IU (International Units) entering the circulation of a light-skinned person over the next 24 hours. However, people with very dark skin require up to 10 times longer in the sun to make the same amount of vitamin D as a pale-skinned person. Sun screens and clothing also prevent the ultraviolet-β rays penetrating the skin. During winter it becomes a lot more difficult – in the north of New Zealand there is a window of opportunity during the middle of the day, but the temperature is often not conducive to exposing too much skin. Vitamin D is a fat soluble vitamin and is stored in adipose tissue so people who build up a good supply during summer probably maintain adequate levels through into winter. Unfortunately, we don’t know much about how long those supplies last.

As previously mentioned, there is no mandatory vitamin D fortification in New Zealand, and natural dietary sources are limited and contain only small amounts. FSANZ does allow fortification of milk, yoghurt, butter and margarine, but at this point it is purely voluntary. Salmon and other oily fish are about the best dietary source, but these are very variable and tend not to be a regular part of the New Zealand diet. For those of us who want to be sure of maintaining vitamin D levels throughout winter a supplement is probably the best option. The over-the-counter dose available from a number of supplement companies is 1000 IU, and one per day will probably maintain levels in people who took advantage of the New Zealand summer. However, studies have shown that 2000 IU per day is required when people are deficient, so if you’re a sun-avoider, dark-skinned, or just getting on in years, you may need this higher amount.