



Vitamin D Are You At Risk?

by Tamara Liller

In an age when great achievements in medical research often go hand-in-hand with costly, high-tech diagnostic equipment and treatment protocols, it is a relief to rediscover old therapies which are not only simple and inexpensive to use but which also possess formidable powers to deter disease. Such is the case with our unassuming old friend, vitamin D. Much has been learned in recent years about the important roles which “D” plays in the human body and about its potential as a powerful ally in the field of preventive medicine, and more.

If you are young, you may not be all that familiar with vitamin D other than the fact that milk and a few ready-to-eat cereals are fortified with it. If you are older, you may recall that between the 1930’s and the 1950’s quite an assortment of foods in the United States and Europe was D-fortified to help protect people (especially children) in highly industrialized areas from developing medical conditions like tuberculosis, rickets, osteomalacia (adult rickets), and osteoporosis. Milk, bread, custard, hot dogs, soft drinks, and even beer were all fortified—at least until the 1950’s when there was a limited outbreak of vitamin D intoxication in young British children. After that, vitamin D fortification was banned in most European countries, and vitamin D was removed from all but a few foods in the U.S.¹

What hasn’t been recognized until lately is that vitamin D deficiency is still a problem for many people, particularly certain at-risk populations. According to the medical literature, the incidence of vitamin D deficiency in the U.S. general population is 25% and more than 40% in the elderly population.² Of greater concern is that the possible consequences of too little “D” are more severe than anyone ever dreamed. Researchers have discovered a variety of neurological, cardiovascular, metabolic, immune, and bone diseases linked to vitamin D deficiency.³ Before we look more carefully at who is at risk and what can be done about it, let’s take a moment to more fully understand what vitamin D really is.

How Vitamin D Differs From Other Vitamins

In its general characteristics, vitamin D differs from other vitamins in two significant ways. First, unlike vitamins A, B, and C, which can only be obtained from food, vitamin D can be manufactured in the body via a photosynthetic reaction which occurs when the body is exposed to sunlight. The substance that initially results from this reaction is only a precursor to the active form of vitamin D and must go through two transformations in the liver and then in the kidney to become usable by the body.⁴

Secondly, the active form of vitamin D which results from the just-mentioned process is actually a hormone, a chemical relative of steroid hormones, such as the sex regulators testosterone and estrogen and the stress regulator cortisol. A hormone can be defined as “a chemical substance produced by one organ and then transported in the bloodstream to a target organ where it causes a specific biological action.”⁵

When taken by mouth, vitamin D is available in two forms, vitamin D₂ (ergocalciferol) and vitamin D₃ (cholecalciferol). Of the two, D₃ is thought to yield 70% higher serum levels than vitamin D₂. Both are fat-soluble and can be absorbed in the small intestine. From there they travel to the liver and are modified, the same way substances derived from sunlight are, by a series of related enzymes in a process called



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hydroxylation which produces 25-hydroxyvitamin D (25D).⁶ Scientists have learned that there are cells in the immune system and skin which are capable of performing the 25D conversion themselves. However, the liver is the primary agent. A final conversion takes place when the biologically active form of “D” is summoned: 1,25-dihydroxyvitamin D is the result.⁷

Among its many functions, vitamin D enables the absorption of calcium and phosphorous needed for bone mineralization, growth, and repair and (in the case of calcium) for electrochemical signaling between brain cells. To ensure that there is enough vitamin D on hand when it is needed, another hormone produced by the body’s parathyroid gland is sent to the kidneys to trigger production of vitamin D hormone. That hormone tells the intestines to transfer calcium from food to the bloodstream. If calcium intake is inadequate to support bodily functions, vitamin D and the parathyroid hormone together trigger a process in which stored calcium is released from the bones.⁸

When Vitamin D Deficiency Occurs

Although not always noticed in their earliest stages, the symptoms of vitamin D deficiency include muscle weakness and pain, bone pain, and back pain. Not surprisingly, vitamin D deficiency is frequently mistaken for fibromyalgia and some other musculoskeletal conditions, thus delaying effective treatment. Of course, “D” deficiency can also occur in conjunction with musculoskeletal conditions, including fibromyalgia, magnifying muscle, bone, and/or joint pain.

Deficiency occurs when “D” intake is below recommended levels, when there is limited exposure to sunlight, when the kidney cannot convert vitamin D to its active hormone form, and/or when someone cannot adequately absorb vitamin D from the digestive tract (i.e., Celiac disease, Crohn’s disease, liver disease, etc.).⁹

The classic vitamin D deficiency diseases are rickets (which occurs in children and causes soft bones and skeletal deformities) and osteomalacia (the adult form of rickets that results in muscular weakness in addition to weak bones). Osteoporosis, usually associated with inadequate calcium intake, is also indirectly affected by vitamin D deficiency because calcium needs vitamin D for proper absorption.

Medical science has also found links between insufficient levels of vitamin D and several other serious medical conditions, many of which are difficult

to treat (see Table 1). A respectable body of research literature has grown in this area. Of particular interest to the public are research findings on the relationship between different forms of cancer and vitamin D. The number of studies is growing steadily.

The March 8th issue of the *Toronto Globe and Mail* offered the following on vitamin D and cancer:

John White, who has been studying the anti-microbial activities of vitamin D at McGill University in Montreal, says that ‘virtually every cell’ in the human body has receptors for vitamin D and that hundreds of different genes may be regulated by it.

Vitamin D’s most profound gene-influenced activity appears to be in keeping healthy the broad category of cells known as epithelium, which line the outside of our organs and the surfaces of the structures of our body. Even though these lining tissues amount to only two percent of the weight of our bodies, they are the source of about 85 percent of cancers, those known as carcinomas. These include cancer of the colon, prostate, pancreas, and uterus, along with the most common type of breast cancer, ductal carcinoma, which develops on milk-duct lining. (The other main type of cancer, sarcomas, appear in muscles and connective tissue and don’t have a strong association with vitamin D insufficiency.)

‘Vitamin D is a particularly effective agent in inhibiting abnormal growth or development of malignancies in epithelial tissue,’ says Cedric Garland, a professor of preventive medicine at the University of California, San Diego.

Although many researchers view cancer as a hopelessly complex disease with different causes for each tumour type, Dr. Garland, who has been studying vitamin D for more than three decades, believes the carcinomas have a common origin in low levels of the vitamin. By his estimate, up to 75 percent of these cancers could be prevented if vitamin D levels were raised through supplements. ‘I’m convinced that cancer is largely a vitamin D deficiency disease.’ he says.¹⁰

Whether one is talking about cancer, heart disease, diabetes, multiple sclerosis, respiratory infec-

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Table 1: Selected Research On Vitamin D & Health Conditions

Vitamin D & Chronic Pain

According to W. Michael Hooten, M.D., Medical Director and Anesthesiologist at the Mayo Comprehensive Pain Rehabilitation Center in Rochester, MN, medical science has known for a long time that inadequate levels of vitamin D can cause pain and muscle weakness and that pain medications do not tend to work well on pain symptoms resulting from inadequate levels of vitamin D.

A new study performed by Dr. Hooten on a diverse group of 267 adults undergoing treatment for chronic pain found that approximately one in four patients had inadequate blood levels of vitamin D and took pain medications for nearly twice as long as patients without D deficiency. Patients with low levels of vitamin D also reported lower levels of physical functioning and a poorer view of their overall health. Dr. Hooten noted that “the implications are that in chronic pain patients, vitamin D deficiency is not the principal cause of pain and muscle weakness. However, it could be a contributing but unrecognized factor.”

[Source: “Vitamin D Inadequacy May Exacerbate Chronic Pain.” Press release from 2007 Annual Meeting of the American Society of Anesthesiologists (ASA) in San Francisco, 9/26/07.]

Vitamin D & Osteoarthritis of the Knee

According to research presented at the 2007 Annual Scientific Meeting of the American College of Rheumatology (ACR) in Boston, MA, low vitamin D levels may cause greater problems for people with osteoarthritis (OA) of the knee. In a two-year trial at the Tufts New England Medical Center, researchers studied 65 women and 35 men in their sixties who showed signs of having OA of the knee. Of the 100 study participants, 47% were vitamin D deficient (less than 30 ng/ml). Study results also showed that the “D” deficiency contributed to increased pain and difficulty walking. The study authors concluded that vitamin D supplements may help with arthritis treatment and with the prevention of osteoporosis, particularly in elderly persons whose bodies are less efficient at absorbing vitamin D from food and converting it to its active form.

[Source: “Low Vitamin D Levels May Worsen Osteoarthritis of the Knee.” Press Release from the 2007 Annual Scientific Meeting of the American College of Rheumatology (ACR), Boston, MA, 11/7/07.]

Vitamin D & Cancer

Medical research is uncovering more and more evidence that vitamin D can significantly help in lowering the risk of certain types of cancer. In part, this is because the active form of vitamin D appears to stimulate the differentiation of cells for different functions in the body. By doing so, it also inhibits the uncontrolled proliferation of cells with certain mutations (i.e., cancer) which can be very dangerous to the human body. Below is a brief overview of recent research which demonstrates how vitamin D interacts with different forms of cancer.

COLON CANCER: The inverse relationship between higher vitamin D levels in the blood and lower cancer risk in humans is best documented for colon and colorectal cancers. In one study of over 3000 adults (96% men) who underwent colonoscopy between 1994 and 1997, there was a significantly lower risk of advanced cancerous lesions among those with the highest vitamin D uptake.

[Source: Lieberman DA, et al. “Risk factors for advanced colonic neoplasia and hyperplastic polyps in asymptomatic individuals.” *JAMA* 2003;290:2959-67 and NIH Office of Dietary Supplements Fact Sheet: Vitamin D. <http://dietary-supplements.info.nih.gov/factsheets/vitamind.asp>.]

BREAST CANCER: A team of researchers from the University of California’s Northern California Cancer Center and Wake Forest University of Medicine found that women with naturally light skin pigmentation who had higher levels of exposure to sunlight (and were therefore able to produce more vitamin D) also decreased by half their risk of developing advanced breast cancer (cancer that has spread beyond the breast).

Although the study included a multi-racial/ethnic group of women with a wide range of natural skin colors, only women with naturally light skin pigmentation showed this decreased risk of cancer. Dr. Esther John, the lead researcher for the studies believed, “It was possible that these effects were observed only among light-skinned women because sun exposure produces less vitamin D among women with naturally darker pigmentation.”

The results of this study were consistent with findings from earlier research by this same group that showed that women who reported frequent sun exposure had a lower risk of developing breast cancer than women with infrequent sun exposure.

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TABLE 1, continued

[Source: Wake Forest University Baptist Medical Center (2007, October 21). "Exposure to Sunlight May Decrease Risk of Advanced Breast Cancer by Half." As reported by *Science Daily*. www.sciencedaily.com/releases/2007/10/071018171424.htm.]

LUNG CANCER: A study of lung cancer in more than 100 countries, which was published in the December 2007 issue of the *British Medical Journal*, reports that exposure to sunlight, especially UVB light has a beneficial impact on lung cancer rates. While higher cloud cover and other factors that block UVB light as well as smoking were all associated with higher rates of lung cancer, exposure to sunlight still helped to decrease the risk of lung cancer. The study authors felt that the finding was chemically plausible because prior research has demonstrated that vitamin D "can halt tumor growth by promoting the factors responsible for cell death in the body." They concluded, "While cigarette smoking is the main cause of lung cancer, greater UVB exposure may reduce the incidence of the disease."

[Source: *British Medical Journal* (2007, December 23). "Lack of Sunlight May Increase Lung Cancer Risk." *Science Daily*. www.sciencedaily.com/releases/2007/12/071220235735.htm.]

SKIN CANCER: A new study by scientists at the U.S. Department of Energy's Brookhaven National Laboratory and colleagues in Norway suggests that the benefits of moderately increased exposure to sunlight, namely the production of vitamin D which protects against the lethal effects of many forms of cancer and other diseases, may outweigh the risk of developing skin cancer in populations deficient in vitamin D. Of particular concern are countries in northern latitudes like Scandinavia where sun exposure is extremely low.

Richard Setlow, a senior biophysicist Emeritus at Brookhaven and a well-known expert on the link between solar radiation and skin cancer, notes: "As far as skin cancer goes, we need to be most worried about melanoma, a serious disease with significant mortality." Melanoma is triggered by UVA (the long UV wavelengths) and visible light. On the other hand, vitamin D production in the body is triggered by UVB (the short UV wavelengths at the earth's surface). "So perhaps we should redesign sunscreens so they don't screen out as much UVB while still protecting us from the melanoma-inducing UVA and visible light."

Setlow also notes that increased UVB exposure may result in an increase of non-melanoma skin cancers, but these are relatively easy to cure and have very low mortality rates compared with the internal cancers against which vitamin D appears to protect.

[Source: "More Sun Exposure May Be Good For Some People." 1/7/08. Brookhaven National Laboratory. www.bnl.gov/bnlweb/pubaf/pr/PR_print.asp?prID=08-01.]

Vitamin D & Heart Disease

According to Thomas J. Wang, M.D., Assistant Professor of Medicine at Harvard Medical School, "Vitamin D deficiency is associated with increased cardiovascular risk, above and beyond established cardiovascular risk factors." This higher risk is particularly clear in persons with hypertension.

In a study of 1,739 offspring from Framingham Heart Study* participants, researchers discovered that individuals whose vitamin D level was lower than 15 ng/ml had twice the risk of such cardiovascular events as stroke, heart attack, or heart failure in the next five years compared to those with higher levels of "D." (Note: Study participants had no prior cardiovascular disease and were tested for vitamin D status over an average period of 5.4 years.)

When the researchers adjusted for traditional risk factors (i.e., high cholesterol, diabetes, and high blood pressure), a significant risk remained with a 62% higher risk of a cardiovascular event in persons with low levels of vitamin D compared to those with higher levels.

Dr. Wang cautioned, however, that "What hasn't been proven yet is that vitamin D deficiency actually causes increased risk of cardiovascular disease. This would require a large, randomized trial to show whether correcting the vitamin D deficiency would result in a reduction in cardiovascular risk."

[Source: "Lack of vitamin D may increase heart disease risk." Press release from the American Heart Association, 1/7/08.]

Other Medical Conditions

Other medical research continues to investigate the relationship between vitamin D and the following medical conditions and concerns, among others:

- immune system modulation
- calcium metabolism (osteoporosis, osteomalacia, and osteopenia)
- insulin secretion, glucose tolerance, diabetes
- blood pressure regulation and hypertension
- multiple sclerosis
- rheumatoid arthritis
- fibromyalgia
- respiratory infections (tuberculosis, pneumonia)
- inflammatory bowel diseases (Crohn's, colitis)
- psoriasis

*The Framingham Heart study is a longitudinal study of cardiovascular disease in Framingham, MA, initiated in 1948, by Asst. Surgeon General Joseph Mountin and administered by the NIH. It continues today under the auspices of the NIH and Boston University.

tions, or any of the other medical conditions being studied in relation to Vitamin D, one important scientific question remains to be answered: Does vitamin D deficiency increase the risk of certain diseases or is increased intake of the vitamin protective against some diseases? Also important to consider is the role that genetic, dietary, and environmental factors still play in a given disease.

In the meantime, most experts agree that we need to make a much better effort to ensure that people get adequate levels of “D” through their diet, supplements, and/or adequate exposure to sunlight. Until recently, 200 IU’s/day of “D” for children and 200-600 IU’s/day for adults (depending on age and special needs) were considered adequate. Now, many experts feel that these levels are much too low, and that 1,000 IU’s/day, and possibly a lot more, are necessary, especially when sunshine is limited. Good food sources of vitamin D include fatty fish like salmon, mackerel, sardines, and tuna; cod liver oil; and to a much lesser extent, fortified milk, orange juice, and cereals.

Because exposure to the sun is the most effective source of vitamin D for many people, and it has no record of producing toxic levels of “D” in the body, the following regimen of sun exposure is recommended by experts: 10-15 minutes of midday sun (between 11 am and 2 pm) on the face, arms, hands, or back without sunblock, 2-3 times a week. At all other times, a sunblock of at least 15 SPF should be worn to protect the skin.¹¹

Who Is At Risk For Vitamin D Deficiency?

Not everyone is able to easily obtain vitamin D. Elderly individuals who spend little time outdoors and whose capacity to produce vitamin D through the skin is diminished because of age are at risk of “D” deficiency. Office workers and the homebound and/or chronically ill may likewise be unable to access adequate sunshine. Cloud cover, smog, and wearing sunscreen or clothing that covers the entire head/body are also significant impediments to receiving too little UVB radiation from the sun. In addition, liver disease may interfere with “D” absorption while too much caffeine can inhibit “D” receptors in the body. Steroid medications may possibly block “D’s” metabolism.

Arguably, the persons with the greatest risk of severe vitamin D deficiency from sun exposure are those who live at northern latitudes (especially during the winter) and those with darker skin (which contains the pigment melanin which reduces the skin’s



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ability to produce vitamin D from sunlight). A recent article in *Scientific American* notes that: “White skin synthesizes vitamin D six times faster than dark skin because higher levels of melanin in darker skin block UV penetration. As a result, African-Americans generally have levels of 25D that are approximately half those of whites in the U.S. In fact, data gathered for the U.S. National Health and Nutrition Examination Survey showed that 42% of African-American women tested were seriously 25D deficient, with serum concentrations of less than 15 ng/ml.”¹²

As for persons with fibromyalgia, the jury is still out. Although vitamin D deficiency is reportedly not uncommon in individuals with FM, it is not clear whether their deficiency rate is any greater than that of healthy controls or even other persons with musculoskeletal conditions. However, because having both FM and D deficiency together is undesirable (!), keeping a sharp eye on sun exposure and vitamin D consumption and having serum 25-hydroxyvitamin D levels tested, as needed, deserve serious consideration.

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