



## VITAMIN D STATUS AND SUNSCREEN USE

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### THE IMPORTANCE OF VITAMIN D

Vitamin D and its relationship to a wide number of illnesses and health parameters is presently one of the most discussed topics in medical and nutritional literature. It seems there are few, if any, diseases to which vitamin D deficiency is not related. A large number of articles in the medical literature were reviewed for discussion in this article. The best effort was made to present the current evidence in a systematic and usable fashion. At the same time, it must also be emphasized that, due to present immense interest in this topic, many more studies are still being conducted. Future knowledge will be gained from these investigations and, as is usually the case with scientific inquiry, modifications will probably occur in terms of present recommendations. However, it is clear that the effect of vitamin D levels on the incidence of numerous diseases and even on simple feelings of well-being has been greatly underestimated in the past.

### HUMAN METABOLISM OF VITAMIN D

We think only plants photosynthesize, but humans also photosynthesize vitamin D in skin after UVB rays in sunlight strike the epidermal surface. One would think that sunscreen application would prevent the formation of vitamin D in skin. Some studies have shown this decrease in vitamin D with sunscreen use, but most have not. This may be related to the public using lower amounts of sunscreen than recommended and also lower than the amounts used to determine the SPF of the sunscreen. If education encourages the public to begin using more appropriate amounts of sunscreen, a further drop in the average levels of serum vitamin D could be seen. When the SPF of sunscreen is compared to its efficiency in inhibiting the formation of vitamin D, sunscreens are actually much more efficient at blocking vitamin D production than they are at preventing sunburn. Heavily pigmented individuals living at higher

altitudes with lower sun exposure are at particular risk for decreased vitamin D levels. Persons with darker skin are now being encouraged to use sunscreen to decrease risks of sun exposure, particularly skin cancer, although the addition of sunscreen could cause their vitamin D levels to be even lower.

Vitamin D is one of the fat-soluble vitamins, along with A, E and K. Because it is stored in fat, high intakes of vitamin D can theoretically lead to toxicity. However, in the studies reviewed, the only adverse effect found was a very minimal risk in the frequency of kidney stones when taking both calcium and vitamin D. Also, the other health benefits of the supplementation far outweighed this risk. As stated in the British Journal of Dermatology (2009 Nov;161 Suppl 3:54-60) "most experts in the field agree that the evidence to date suggests that daily intake of 1000-2000 IU vitamin D could reduce the incidence of vitamin D-deficiency-related diseases with minimal risk in Europe, the US, and other countries."

There are 2 forms of vitamin D, ergocalciferol or D2 and cholecalciferol or D3. D2 is primarily found in plants and D3 in animals. In humans, D3 can be synthesized in the skin when its chemical precursor is exposed to sunlight or ingested from animal sources, although animal tissue provides only a very small amount. An exception to this is fatty wild-caught fish such as tuna, mackerel, herring and sardines which contain a fair amount of the vitamin. Farmed fish contains inadequate amounts of vitamin D. Some foods, as milk and cereal, have added vitamin D but, once again, this amount is very inadequate. D3 and D2 are both converted in the liver to 25-hydroxy-vitamin D, the primary circulating form. Conversion into the active form, 1,25-dihydroxy-vitamin D occurs in the kidney.

Vitamin D's main role is to regulate levels of calcium and phosphorus with respect to building and repairing bone.



Vitamin D encourages the absorption of both calcium and phosphorus from food in the small intestine.

#### VITAMIN D AND ILLNESS

Low levels of vitamin D are associated with the occurrence of many health problems worldwide. These include cardiovascular disease, immune deficiency (including severe infections as pneumonia, tuberculosis susceptibility, and milder viral infections such as colds and influenza), internal cancers (including breast, ovary, prostate, Hodgkin's lymphoma, non-Hodgkin's lymphoma, colon), dementia, bone health (including osteoporosis, osteomalacia, rickets), psoriasis, diabetes mellitus, hypertension, myopathies (muscle diseases), multiple sclerosis, mental illness (including depression, schizophrenia), autoimmune disease, dementia and other forms of cognitive decline. Poor serum vitamin D levels are associated with poorer physical performance and greater rate of decline in older persons.

Low levels in pregnant females have been associated with increased risk of infant disease. The onset of schizophrenia later in life is associated with low maternal levels of vitamin D during pregnancy. This may be especially important in migrant black children living at high altitudes as there is also a particularly high incidence of schizophrenia in this population group. Interestingly, unusually high levels of vitamin D in infants are also associated with risk of schizophrenia. The authors postulated that in this group with high levels of D there might be an inability to metabolize the vitamin also resulting in an overall deficiency state.

There is a tendency in medical studies to focus on severe deficiency states only, and vitamin D levels within the deficient range are definitely associated with the occurrence of many diseases. Criticism is often levied at these types of studies, however, in that they imply a "low but not severely deficient" level of a nutrient is acceptable when this may not be the case. Studies are often not done to determine the level of a nutrient supportive of optimum health rather than only the absence of disease. Many medical studies therefore criticize the current dietary recommendations of

vitamin D, saying they are inadequate – and especially so during pregnancy and lactation.

Evidence from smaller regions within a country or geographic area have shown that regional variations in vitamin D levels correlate with decreased disease resistance and/or impaired response to disease treatment. In Norway, a number of cancers have been analyzed with respect to vitamin D levels. Breast cancer has a better prognosis if diagnosed in summer or autumn when serum vitamin D levels are higher. Three-year survival of colon cancer and prostate cancer patients in Norway is higher with seasonal increases in vitamin D levels. There is a beneficial effect of summer season or high vitamin D intake with outcome for lung cancer in Norway.

When very strict statistical criteria are applied, the strongest evidence that vitamin D reduces the risk of cancer exists for breast, colon and rectal cancers. There is also good evidence in this regard for bladder, esophageal, gallbladder, stomach, ovarian, renal and uterine cancer. Although there are mixed statistical findings for pancreatic, prostate cancer and melanoma, the benefit of vitamin D in helping to prevent these cancers is also reasonably strong. Considering the many effects of vitamin D on factors effecting cancer growth in general, it is not surprising that benefits are seen in so many cancers accompanying higher levels of vitamin D. This vitamin suppresses invasion of tissues by the malignancy, and inhibits metastasis and angiogenesis (new blood vessel formation required for tumor growth). Women in the United States with decreased vitamin D levels have a 253 percent risk increase for developing colorectal cancer.

Most studies claim a definite association between vitamin D levels and bone health, including osteoporosis, falls, fracture risk and bone mineral density. Some studies indicate that the evidence is best for older children and adults and inconsistent in younger children and infants. However, most of the international studies, particularly in underdeveloped areas or in more severe deficiency states, found a stronger association



between vitamin D levels and bone health in young children and infants. The Women's Health Initiative, a very large study of 68,132 postmenopausal women has been analyzed for hip fracture prevention with the use of calcium and vitamin D supplementation. Interestingly, no evidence of protection was found. There also was no association with vitamin D levels and systolic blood pressure, cardiovascular disease, overall mortality, cognitive defects or depression. However, the dose of vitamin D given in the WHI was only 400 IU daily which was lower than in most studies. Many other studies using moderate doses found improvements in bone health and the other parameters listed with vitamin D supplementation.

#### EPIDEMIOLOGIC (POPULATION) STUDIES

Large studies have been conducted in several countries to determine if taking additional vitamin D orally would decrease disease incidence and save on healthcare costs. These calculated cost savings and other data are listed below by country.

Canada—decrease annual death rate by 37,000—\$14.4 billion savings

Europe—€177,000 million annual savings after paying for costs of education and testing levels of serum vitamin D

United States—cancer savings alone of \$16-25 billion annually (dose of 1000 IU daily)—decrease 4-year overall risk of developing cancer in women by over 60% (dose of 1500 IU daily)

#### PERSONS AT RISK FOR VITAMIN D DEFICIENCY

Estimates of US adults and adolescents who are deficient in vitamin D range from 21 to 58%. At least 54% of homebound adults are deficient.

Persons who avoid sun exposure are at risk for low levels of vitamin D. Individuals with problems such as systemic lupus may avoid the sun since it causes their rash to worsen. Obese and elderly persons may avoid sun exposure. Any other mechanism that decreases solar exposure will decrease levels of vitamin D. Clothing

effectively blocks all vitamin D production. Persons who use sunscreen, particularly in the proper amounts to protect from skin cancer and photoaging, are at risk for low vitamin D. Use of "sunless tanners" which contain dihydroxyacetone-induced melanoidins also decrease vitamin D synthesis.

Obese persons have lower levels of vitamin D. At first this was thought to be related solely to decreased time in the sun but when obese persons who sunbathe are evaluated, they too have lower vitamin D levels.

Persons with chronic kidney disease and those on dialysis have lower vitamin D levels. This is because they live mostly indoors and in addition, due to diseased kidneys, have impaired production of the active form of the vitamin.

The aged are at increased risk for deficient vitamin D status. They have decreased sun exposure, often inadequate dietary intake and, secondary to metabolic decline, have impaired synthesis of vitamin D at all levels in the body.

Darker-skinned individuals with more melanin in their skin have lower vitamin D levels.

Living in a sunny area does not assure a healthy level of vitamin D. In fact, low levels of vitamin D are pervasive in all geographic areas, including heavily sun-exposed locations. Ten percent of persons in Queensland had levels below 25 nmol/liter – which is a level considered to be definitely deficient. Thirty-two percent of this same population had slightly higher but still insufficient levels. Levels were even lower in darker-skinned individuals in this population compared to fair-skinned.

Asian women were studied in 1999 and found to have adequate D levels in spite of age. They lived in a rural community, however, and may have spent more time outside. There also may be other unknown factors involved in their adequate levels.

Patients having had organ transplants are strongly



advised to always wear sunscreen and protective clothing when outside because squamous cell skin cancer is more aggressive in this group and occurs more frequently related to the use of immunosuppressive medication for their clinical condition. This group tends to have very low levels of vitamin D, which further increases the risk of solid organ tumors (breast, colon, prostate, ovary) – especially when combined with the use of immunosuppressive medicines.

Infant breast-feeding is often recommended up to 6 months of age due to benefits on child survival and lower disease incidence. Several studies have shown that adequate vitamin D intake cannot be provided with human milk as the sole source. Also, mothers themselves are often deficient in vitamin D during pregnancy and lactation. These factors can put the young infant at risk for vitamin D-associated problems.

#### DIET AND SUPPLEMENTATION TO RAISE VITAMIN D LEVELS

Since sunlight provides for the synthesis of vitamin D, it is tempting to think that more solar exposure will correct deficient levels. Studies have actually shown this is false. UV radiation is not a reliable method of raising levels of D. Furthermore, the evidence linking solar exposure to skin cancer is overwhelming and, for this reason, increasing time or intensity in the sun is not safe. UVB rays are the spectrum required for synthesis of vitamin D and they are related to increased risk of actinic keratoses (a precancerous condition), squamous cell carcinoma and basal cell carcinoma. Melanoma is primarily related to UVA exposure.

#### SUMMARY

Low levels of vitamin D are found in epidemic proportions in all populations and in all climates, even those experiencing bright sunlight for most of the year. Low vitamin D levels are also found in persons avoiding sunscreen use as well as in those using sunscreen. Medical research documents a strong association between low serum vitamin D levels and the incidence of numerous diseases as well as “quality of life” measures such as cognitive ability, resistance to the common cold, feelings of well-being, and physical

strength and resilience. Vitamin D is synthesized in the skin, further metabolized in the liver and converted to its active form in the kidney. Sunlight on skin triggers vitamin D synthesis so sunscreen use is a risk factor for low levels of vitamin D. However, avoiding sunscreen use is by no means protective of vitamin D levels and further predisposes to risks of skin cancer.

Epidemiologic studies in the US, Europe and Canada have demonstrated that supplementing with even 1000-2000 IU of vitamin D daily can significantly lower risk of malignancy, other health problems and result in millions to billions of dollars in cost savings annually.

The safest recommendation for an individual would seem to be to see one's doctor for evaluation, have a serum level (blood test) of vitamin D drawn and consult with the physician regarding recommendations. Considering the weight of medical evidence it also seems prudent to use sunscreen in order to lessen skin cancer risk as well as avoid photoaging. Vitamin D supplementation may be recommended in very large groups of people, independent of location and/or lifestyle, because low levels of the vitamin are so pervasive.

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