

# Health Matters

Great Smokies Medical Center of Asheville

A small, occasional publication

Volume 5, Issue 4

## Vitamin D: The Amazing Sunshine Vitamin

### A Vitamin by Any Other Name

Vitamins are substances (different from carbohydrate, fat, and protein) that are naturally present in foods and that are essential for normal cell function, growth, and development. To qualify as a vitamin, a substance must be provided solely through the diet.

Vitamin D is a fat-soluble vitamin, as are vitamins A, E, and K. The fact that we now know that vitamin D is not just supplied by diet but is also synthesized by the body disqualifies it from being a true vitamin. Though vitamin D would have been more accurately classified as a steroid or a hormone, history prevails and the preferred term for this versatile substance so vital to health is still "vitamin D."

### Cholesterol + Sun = Vitamin D

Also called *calciferol*, vitamin D is known as the *sunshine vitamin* because it's synthesized when cholesterol in the skin is exposed to the sun's ultraviolet (UV) rays, resulting in cholesterol's conversion to *cholecalciferol* or  $D_3$ . The liver then converts  $D_3$  to *calcidiol*, a pre-hormone form of vitamin D that is stored in fat and is also the form measured in serum testing at GSMC. Additional synthesis by the kidneys and other body tissues results in the formation of *calcitriol*, the fully active steroidal form of vitamin D.

### Enter the Industrial Age

Even though vitamins were not studied in the laboratory until the early 1900s, the *clinical* picture of the deficiency state of vitamin D, rickets, was especially evident in children of northern European ancestry who worked in factories in the late 18<sup>th</sup> and the 19<sup>th</sup> centuries. The change from sunny, rural life to sunless, urban life made getting sun in amounts needed to prevent rickets very unlikely.



### Rickets

Adults with vitamin D deficiency develop a painful softening of bones called *osteomalacia*. Afflicted children's ribs and shafts of leg bones irreversibly bow or bend, producing the classic grotesque disfigurement of rickets. Sunbathing or taking cod liver oil were eventually found to cure rickets.

### Hidden Treasure

For nearly a century, vitamin D's role in health was thought to be confined to strengthening bones and teeth and maintaining blood levels of calcium and phosphorus. Only in the last 10 years have researchers discovered the treasure trove of vitamin D's functions in health.

### Something New Under the Sun

Vitamin D is the only "key" that can fit in a Vitamin D Receptor (VDR) "lock." VDRs have only recently been discovered in the liver, intestines, kidneys, muscles, heart, pancreas, brain, thyroid, reproductive organs, pituitary, lungs, skin, and adrenals. Specialized white blood cells that play critical roles in immune health (lymphocytes, macrophages, and monocytes) are now known to have VDRs, further expanding the influence of vitamin D to include immune function, cancer, inflammation, and general health.

### Cancer

Vitamin D has been shown to impact the expression of genetic cancer markers and to inhibit abnormal cell division in breast, ovarian, colon, and prostate cancers. Statistical analysis of numerous studies of vitamin D levels and colon cancer incidence suggests that taking 2,000 IU of vitamin D per day could cut colon cancers by half. A similar analysis of breast cancer and vitamin D levels suggests that 3,500 IU of vitamin D per day could reduce breast cancer incidence by half.

### Diabetes

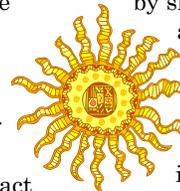
In 1966, a study and 30 years of follow-up of 10,821 northern Scandinavian babies revealed that those deficient in vitamin D had a 400 percent increased risk of developing type I diabetes by age 30 compared to those who were not deficient. Studies of vitamin D-deficient mice that were genetically prone to develop diabetes had 80 percent slowed progression to type I diabetes when given vitamin  $D_3$  compared to vitamin D-deficient control mice without treatment.

### Mood Disorders

The term "sunny disposition" speaks to vitamin D's impact on mood. Seasonal Affective Disorder (SAD) is a lowering of the mood of susceptible individuals in northern latitudes in winter, resulting in symptoms ranging from irritability to overt depression. SAD is associated with inadequate vitamin D levels and often responds well to supplementation of vitamin D.

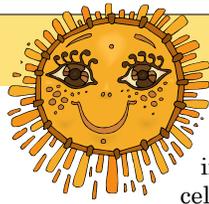
### Antibiotic Vitamin?

The increased occurrence of colds and influenza in the winter can be explained by sharply lowered vitamin D levels associated with winter's decreased intensity of solar UV radiation. Viruses are opportunistic, selectively affecting people who are genetically vulnerable or immune-compromised.



Researchers have found that people with high levels of *cathelicidin*, a substance produced in the body that signals powerful immune attack responses to fight infections, are able to resist infections far better than people with low levels. Vitamin D has been shown to be the single best inducer of cathelicidin production, raising it 100 times its baseline. Taking vitamin D is emerging as a strategy to help prevent getting winter's colds and flu. (cont. p.2)

# Vitamin D, cont.



## Obesity

Because vitamin D is fat soluble and is thus stored in fat tissue, obese people have more capacity to store vitamin D. However, the vitamin D in those who are obese is less available for the body's metabolic needs than in those who are lean. Given identical sun exposure, obese people have been shown to produce about half the vitamin D produced by normal weight people, likely because the same UV light that creates cholecalciferol begins to degrade it after a certain production level is reached.

## Periodontal Disease

In 2004, a study evaluating more than 11,000 subjects found that, after age 50, the subjects with the lowest serum levels of vitamin D had the highest risk of developing periodontal disease. Women were more likely than men to be affected.

## Other Conditions

Adequate levels of vitamin D have been shown to benefit the following conditions, just as insufficient levels have been shown to contribute to them: autism, high blood pressure, metabolic syndrome, muscle weakness, heart disease, heart failure, osteoporosis (*osteomalacia and osteoporosis are indistinguishable on bone density tests*), auto-immune diseases (e.g., multiple sclerosis, Crohn's disease, rheumatoid arthritis, lupus), unexplained bone and muscle pain, infertility, mental illness, preeclampsia, cystic fibrosis, fall and fracture risk, psoriasis, and cognitive function.

## Who's At Risk

Risk factors that contribute to vitamin D deficiency include being post-menopausal or elderly, living in northern latitudes or in cloudy or rainy climates, avoiding sun exposure, wearing long pants and long-sleeved clothing, being homebound, living in nursing homes, using sunscreens, eating strict vegetarian or low-fat diets, and having dark skin (melanin, the pigment in skin, acts like a sunscreen). The CDC states that African-Americans are 10 times more likely to be vitamin D deficient than people of northern European ancestry. Newborns of vitamin D-deficient mothers and breast fed infants are also at risk.

Conditions that predispose to poor *absorption* of vitamin D include insufficient pancreatic enzymes, gall bladder disease, and partial removal of the stomach or intestines.

Diseases that impair the *synthesis* of vitamin D include Crohn's disease, celiac disease, cystic fibrosis, liver and kidney disease, and underactive parathyroid glands.

## Solar Powered Health

Considering the vital legacy of sunshine in human history and health, total avoidance of sun exposure as a general precaution seems ill-advised. Getting enough sunshine wasn't a concern 200 years ago. However, living and working indoors 24/7 is common in modern western cultures and has resulted in widespread vitamin D deficiency.

Exposure of the skin to peak summer sun generates the production of 20,000 IU of vitamin D in 20 minutes. Properly applied SPF 8 sunscreen blocks 95 percent of vitamin D production.

While intense, skin exposures to UV light (i.e., sunburn) constitute risk factors for developing skin cancer later in life, experts state that brief, frequent skin exposure to UV rays over time can help normalize immune function, enhance the production of immune cells, and boost vitamin D levels. Moderation is the key to sensible sun exposure. Daily sun exposure of shoulders, arms, and back (without sunscreen) on a clear day between 11 a.m. and 2 p.m. (15 minutes in summer and 20 minutes in spring and fall) has been shown to maintain serum vitamin D at low-normal levels.

## Artificial UV Tanning

America is addicted to UV artificial tanning. Although tanning by artificial UV radiation can boost vitamin D levels, it can't come close to those produced through supplementation. Race, skin type, nutritional status, medical history, genetics, lifestyle risk factors for cancer, and pre-existing sun damage must be considered by a physician before recommending artificial UV tanning to boost vitamin D levels for patients who are unable to absorb or synthesize it.

## Fortification/Natural Sources

Fortification of foods with vitamin D began in the 1930s and now includes milk (400 IU of vitamin D<sub>3</sub> per quart), orange juice, some breakfast cereals, soy beverages, and margarines. Thanks to fortification, classic symptoms of rickets are rarely seen today. Yet fortification falls short of supplying vitamin D<sub>3</sub> in levels needed to *optimize* health.

Natural food sources of vitamin D supply modest amounts at best and include cod liver oil, egg yolks, liver, shrimp, and fish (the highest is sockeye salmon followed by albacore tuna). It is not practical or possible to optimize vitamin D levels through diet alone.

## RDA in Need of Updating

The vitamin D Recommended Dietary Allowance (RDA) for *adults* was set in 1941 at 400 IU, a number based on the vitamin D in one teaspoon of cod liver oil, the amount historically used to prevent rickets in *infants*. The current RDA is considered by many scientists to be inadequate. Scientists from the Council for Responsible Nutrition (CRN) reviewed 21 clinical studies that evaluated varying levels of vitamin D in 2007, resulting in their calling for a five-fold increase of the upper limit of vitamin D intake from the current 2,000 IU/day to 10,000 IU/day. Vitamin D has proved to be safe in doses far higher than the RDA.

## Supplementation

Vitamin D<sub>3</sub>, the preferred form for supplementation, is far more bioactive than vitamin D<sub>2</sub> (*ergocalciferol*), the plant-based form of vitamin D. Healthy individuals may require a minimum of 1,000 to 2,000 IU of D<sub>3</sub> a day, though higher doses are routinely recommended for at-risk individuals whose vitamin D levels are monitored by serum testing of calcidiol, 25(OH)D. GSMC practitioners aim for 55-80 ng/mL as a target that optimally supports health and also factor in clinical response to determine the optimal dose. There is no one-size-fits-all dosing. Vitamin D toxicity is rare, avoidable, and possible only through excessive supplementation.

## The Nature of Science

Cholesterol's importance in health is once again brought to our attention, this time for its starring role as a precursor of vitamin D. The fact that the majority of vitamin D's health-promoting benefits were hidden in plain view until late in the 20<sup>th</sup> century speaks to the inherent limitations of science to comprehend nature's innate wisdom and provides ample reason to be humbled by how little we know about human nutrition.



All content in this newsletter is intended to be informational and is not to be taken as medical advice or to replace medical care.