

# Vitamin D and Sunlight, The Controversy

VINCENT DeLEO, MD

**A** controversy about whether exposure to ultraviolet radiation is good or bad has recently appeared in the lay press as well as in medical journals. Some of the articles suggest that a significant number of Americans considered normal may actually suffer from vitamin D levels below what is needed for optimum health. A number of them point out that such individuals may have low levels of this important vitamin because they avoid sun exposure and use sunscreens regularly. Some of the media go so far as to urge that tanning salons could improve health by exposing users to ultraviolet radiation and in this way increase vitamin D levels. So what is the connection between UV and vitamin D metabolism?

## Benefits of Vitamin D

Vitamin D is a fat-soluble vitamin, derived from food sources and also made by the body when the skin is exposed to UV radiation. Its active form, 1,25-dihydroxy Vit D<sub>3</sub>, acts to regulate normal calcium metabolism by affecting absorption of the mineral from the gastrointestinal tract. As such, the active form is necessary for bone and muscle health. Without adequate vitamin D and calcium, children develop rickets and adults get osteomalacia (thin brittle bones).

There is some evidence that adequate vitamin D levels are also important for proper immune function and may be important in the prevention of certain cancers in humans by altering cellular growth and differentiation.

## The "Right" Level

Unfortunately the level of vitamin D necessary to maintain optimal health is presently controversial. The reference ranges, that is the laboratory blood test "normals" are based on the levels necessary to keep parathormone, the hormone that regulates calcium metabolism, at plateau levels. The level of the vitamin usually measured in the blood is 25-OH Vit D<sub>3</sub> and the "normal range" is usually set at 20-110nmol/L.

There is also controversy as to how much vitamin D should be consumed daily to maintain normal blood levels. The problem is that the levels of various vitamins, minerals, and other nutrients necessary for optimum health, which are the dietary reference intakes set by the Institute of Medicine of the National

*Vincent DeLeo, MD, is Chairman, Dermatology, St. Luke's Roosevelt and Beth Israel Medical Centers, New York, and is a member of the Foundation's Medical Council.*

Academy of Sciences, are not always clear-cut. Some are determined clinically and some in the laboratory. The Institute publishes the RDA (recommended daily allowance) for many of these, and if there is insufficient information to determine an RDA, the group recommends a level known as adequate intake or AI. This is the case for vitamin D, and the published AI's are age-dependent: For individuals from birth to 50 years of age, the adequate level is 200 International Units (IU).

For individuals 51 to 70 years of age, the AI is 400 IU, and for individuals over 70, the AI is 600 IU.

## Dietary Sources

Fish and fish oils are primary dietary sources of vitamin D. A serving of salmon, for example, contains 360 IU. A tablespoon of cod-liver oil contains 2,400 IU. Since the traditional American diet does not include very much fish, milk has been fortified with this important vitamin. Fortified milk in the US contains 100 IU per 8 oz glass. It should be remembered, however, that other dairy products such as yogurt and cheese are not routinely fortified. A number of surveys looking at the dietary intake of Americans have

shown that even with fortified milk available, the diet of many individuals, especially women and in particular African American women, is deficient, based on the published adequate intake levels.<sup>1</sup>

## Reaction to Ultraviolet Rays

The other important source of vitamin D is ultraviolet radiation. This induces a complex multi-step process that begins with a photosensitized reaction in the skin. When the skin of a normal individual is exposed to the UVB (ultraviolet B) rays with a wavelength of 290-320 nanometers (nm) in natural sunshine, a series of chemical interactions takes place. One chemical compound in the skin, 7-dehydroxycholesterol, is converted to Pre-Vit D<sub>3</sub> that in turn is converted to Vit D<sub>3</sub> by body heat. This then circulates to the liver where it is converted to another chemical, 25-hydroxy-Vit D<sub>3</sub> (25-OH Vit D<sub>3</sub>), and finally goes to the kidney where it is converted to the active form of the vitamin, which in chemical terminology is 1,25-dihydroxy Vit D<sub>3</sub> (1,25-OH Vit D<sub>3</sub>).

## How Much Sunlight Is Enough?

Studies have revealed that vitamin D levels decrease during the wintertime in northerly locations, decline with sunscreen usage, and are lower in dark-skinned individuals. But the vast majority of the individuals in

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those studies were found to have levels within the “normal” reference ranges.<sup>2,3,4</sup>

If an individual chose to utilize sunlight alone as a means of maintaining normal levels, which is not recommended, only minimal exposure would be necessary. Exposing the skin of the hands, arms, and face for 10-15 minutes, two to three days per week is sufficient for adequate production in non-elderly white skin. Darker-skinned individuals and the elderly require more UV to maintain the same levels.

### The Case for Strong Bones

Recently, researchers led by Dr. Heike A. Bischoff-Ferrari from Harvard and her colleagues have questioned the validity of the old adequate intake values and the normal reference ranges in evaluating adequate vitamin D metabolism. In the first of two studies, published in the *American Journal of Medicine*, the researchers compared bone density and vitamin D levels in 13,000 men and women of various racial groups. There was a significant correlation between increased bone density and higher vitamin D levels in all age groups, both sexes, and all races. The important information revealed by this study was that bone density continued to increase through the higher end of the normal range of vitamin D levels. This means that bone health was poorer for lower levels of vitamin D even when those levels were within the normal reference range.<sup>5</sup>

The second study, described in the *Journal of the American Medical Association*, was a meta-analysis of a number of previously-published studies that looked at falls of elderly nursing home residents who had been given oral supplementation of vitamin D. Falls are considered a measure of musculo-skeletal health in these populations. There was a significant decrease in the number of falls in women who received vitamin D supplements, compared to women who did not. The differences for the men were not significant. Interestingly, the levels of daily intake that improved the response the best were levels of 800 IU and above, suggesting that the usual recommendations of 400-600 IU daily were probably too low for optimum health in this setting.<sup>6</sup>

These two studies are thought-provoking and further research needs to be done in this area. It should focus on which blood levels of vitamin D relate to optimum health. The proper recommendations for dietary sources of vitamin D must be reconsidered with reference to amounts needed. Most important are further studies to determine the true association between vitamin D metabolism and health concerns other than those of the musculoskeletal system, such as cancer and immune function.

### The Controversy Evaluated

In summary, there is evidence that the presently accepted normal reference ranges for measuring vitamin D are set incorrectly. Also, it appears that the ranges for daily adequate intake of this important vitamin are set at levels that are too low for optimum health. Further, there is evidence that certain segments of the population—women and darker-skinned individuals—do not ingest adequate amounts of vitamin D. Finally, lower ultraviolet-induced vitamin D production can occur under certain circumstances. These include seasonally-decreased sun exposure, the possession of skin that is darkly pigmented, and sunscreen usage, especially in the elderly. Such decreases may contribute to inadequate vitamin D metabolism, but are easily avoided or corrected.

As pointed out earlier, some individuals, among them, physicians, have suggested increased natural and artificial ultraviolet exposure to insure adequate vitamin D metabolism. However, we know that both natural sun exposure and artificial exposure in tanning salons are linked to many deleterious effects, especially skin cancer, including its most dangerous form, melanoma. Therefore, it seems foolhardy to recommend increased exposure to maintain optimal vitamin D levels, especially since oral intake of sufficient vitamin D is easily attained with supplementation.

A rational approach to the vitamin D controversy is to urge adequate oral intake by diet and supplementation, with a goal of 800-1000 IU per day for all adults. Dosage should not exceed 2000 IU per day to avoid the possibility of toxicity: More is not necessarily better.

*Editor's Note: The Food and Drug Administration and the American Academy of Dermatology recently sponsored a meeting of scientists in Washington, DC, to discuss the issues surrounding vitamin D metabolism. Vincent DeLeo, MD, the author of this article, participated in that meeting, which was chaired by Henry Lim, MD, a member of the Skin Cancer Foundation's Photobiology Committee.* SCFJ

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