

Essential Nutrient

Why vitamin D deficiency may be a hidden epidemic.

By Amanda Schaffer

You may have heard about recent scuffles between prominent dermatologists and experts on vitamin D, a crucial vitamin obtained in part by exposure to UV light. In a front-page story this April titled "BU Advocate of Sunlight Draws Ire," the Boston Globe reported on the brouhaha surrounding Dr. Michael Holick, whose recent book, *The UV Advantage*, touts the health benefits of moderate sun exposure and downplays the threat of skin cancer. (Dr. Holick, perhaps the most prominent vitamin D researcher in the country, was forced to resign from the dermatology department at Boston University's medical school in February, though he retains his appointment in medicine.) The Globe piece—and a recent article in the New York Times—also noted that Dr. Holick's work is partly funded, and actively promoted, by the Indoor Tanning Association, an industry group with obvious financial interests. It's easy to see why the conflict has escalated and why many in the public are confused about the basic issues underlying this debate.

What exactly are the health benefits of vitamin D? How much does a person need? And why is the issue so often framed in terms of sun exposure—can't you just drink fortified milk or take a multivitamin?

Let's start with the basics: Vitamin D is a fat-soluble substance (that is, it dissolves in and can be stored by fat deposits in the body). It is present in salmon, mackerel, sardines, and cod liver oil; fortified foods including milk, breakfast cereals, and some juices; and vitamin supplements. It can also be synthesized in the skin during sun exposure. Vitamin D (in its active form, which is created after several modifications by the body) functions as a classic steroid hormone, which means it binds to nuclear receptors in various tissues to influence the expression of genes, thereby affecting a range of processes, especially the regulation of calcium.

It has long been known that vitamin D is crucial for healthy bones. The presence of vitamin D in the small intestine aids in the absorption of dietary calcium—people with vitamin D deficiency are able to absorb only a third to half as much calcium as those with sufficient levels—and calcium is vital to the hardness of bone. The two diseases traditionally associated with severe vitamin D deficiency—rickets in children and osteomalacia in adults—are characterized by deformation or softening of bone. And chronic vitamin D deficiency is strongly linked to osteoporosis, a disease defined by loss of bone density and associated with increased risk of fractures.

The common assumption has been that with the fortification of milk, instituted in the United States in the 1930s, and casual exposure to sunshine, most people get all the vitamin D they need. But a small resurgence of rickets in the last few years, particularly among African-American children, has caught the health-care community off guard. As studies have probed the issue, it has become clear that vitamin D deficiency (usually defined as blood levels of less than 15 ng/mL [or nanograms/milliliter]) and insufficiency (less than 20 ng/mL,) are far more widespread than researchers had expected. The elderly, who often receive little sun, are at particular risk, as are African Americans and other dark-skinned people, since skin pigmentation, which protects against damage by UV rays, also interferes with vitamin D production. (Those with dark skin need to spend more time in the sun to produce the same amount of vitamin D.) Infants who are exclusively breast-fed are also at high risk since breast milk, for all its virtues, contains almost none of this vitamin.

Perhaps the biggest surprise, though, has been the prevalence of vitamin D deficiency among women of child-bearing age—particularly African-American women—and among healthy children and adolescents. Dr. Catherine Gordon, an adolescent-health specialist at Children's Hospital in Boston and an expert on vitamin D, told me that calling it a "hidden epidemic" would not be an overstatement. While severe cases early in life result in rickets, less-pronounced deficiencies may slip under the radar because they do not cause noticeable symptoms. Gordon and other doctors worry that for children and adolescents, insufficient vitamin D can prevent proper bone development and increase the risk of disorders such as osteoporosis later in life.

Vitamin D deficiency can easily go undetected in adults as well. In one study, published in 2003 in the Mayo Clinic Proceedings, researchers in Minneapolis tested vitamin D levels in patients suffering from chronic, non-specific, musculoskeletal pain: 93 percent of them turned out to be vitamin D deficient—a condition very likely (though not conclusively) related to their symptoms. And of the East Africans, African Americans, and Hispanics in the study, 100 percent were vitamin D deficient. As a result, the authors argue, all patients with such pain should have their vitamin D levels tested because osteomalacia may turn out to be the underlying cause.

But vitamin D's benefits may go beyond the protection of bone and muscle. There is new research to suggest that vitamin D may also guard against an array of diseases, including colon, breast, and prostate cancers. Much of the evidence here is merely suggestive: Epidemiologic studies in the United States and Europe have observed an inverse relationship between the risk of certain cancers—breast cancer, for instance—and the intensity of sunlight in a given area. More specific studies have examined levels of vitamin D in the blood directly, measuring them over time. Here, too, an inverse relationship has been found: lower vitamin D levels, higher risk of cancers. A prospective study of colon cancer published in the *Lancet*, for example, found that the "risk of getting colon cancer decreased three-fold" in people with a blood vitamin D concentration of at least 20 ng/mL, the level currently defined as sufficient.

Though the role of vitamin D in protecting against cancer has not been conclusively proved, the research is promising—in part because a plausible mechanism has been identified. The active form of vitamin D can initiate a range of responses, one of which is to inhibit cell growth and proliferation—processes known to spiral out of control in cancer. For this reason, it seems likely that vitamin D can either prevent normal cells from becoming cancerous, or can slow the growth of tumors, or both. Dr. Holick is studying the progression of colon cancer in two groups of mice—one vitamin D deficient and one not. Preliminary results suggest that tumors grow substantially larger in mice without sufficient vitamin D.

The potential role of vitamin D in forestalling other diseases, particularly autoimmune conditions such as multiple sclerosis, Type 1 diabetes, and rheumatoid arthritis, has generated widespread interest as well. The strongest studies have tested the role of vitamin D directly, with some fairly suggestive results: A 2004 study in the *European Journal of Clinical Nutrition* found that mice and rats that received activated vitamin D were less likely to develop multiple sclerosis. Another study, published in the *Lancet* in 2001, concluded that children who were given vitamin D supplementation were less likely to develop Type 1 diabetes. Although individual mechanisms are not well-established, it is known that active vitamin D interacts with cells of the immune system and very likely plays an anti-inflammatory role in the body.

So, one of the biggest questions facing vitamin D researchers now is: How much vitamin D should people actually be getting? And are dietary sources sufficient, or should supplementation and/or moderate sun exposure be encouraged as well?

The guidelines established by the National Academy of Sciences currently recommend daily values of 200 IU (or International Units) for children and adults up to age 50, 400 IU for adults ages 51-70, and 600 IU for adults over 70. But the threshold required for healthy bones may be lower than that needed for protection from cancer or from autoimmune diseases. While no one yet knows precisely what these levels are, most vitamin D researchers believe that a daily value closer to 800-1000 IU would be beneficial. Dr. Mona Calvo, an expert regulatory review scientist at the FDA, said recently that an increase in suggested daily intake for vitamin D was likely to be considered—"we hope very soon."

Most vitamin D experts also argue that moderate UVB exposure—without sunscreen—is a key part of achieving adequate blood levels (except for people with a history of skin cancer or with medical conditions that make them abnormally sensitive to sun). The main reason for this is simply a pragmatic one: It is difficult to eat enough salmon and drink enough milk to attain the amount of vitamin D recommended. (Click [here](#) to see how much vitamin D different foods contain.) Children and adolescents drink much less milk than they used to, and, between lactose intolerance and calorie counting, most adults don't drink milk at all. In addition, the vitamin D content in fortified milk has been found to be erratic, often differing from the amount promised on the label. Multivitamins too generally contain only 400 IU of

vitamin D each, and it is dangerous to take extras, given the high toxicity of vitamin A. While it is certainly possible to buy separate vitamin D supplements and to take them regularly, for many, this is impractical or simply inconvenient—one more health mandate that is easy, in the long run, to let slide. (While vitamin D toxicity from supplements is rare—the upper limit for adults is 2,000 IU per day—it can occur, especially since vitamin D is stored in fat; symptoms of overdose may include vomiting, weakness, weight loss, and calcium deposits in the kidney.)

Only a small amount of casual sun exposure is needed to trigger enormous vitamin D production. Exact amounts are difficult to pinpoint since they depend on a person's skin type and age, as well as on latitude, season, time of day, and amount of skin exposed. But Dr. Gordon (as well as Dr. Holick himself, along with other vitamin D experts with no ties to the Indoor Tanning Association) argue that 10 minutes of sun a few times a week is all that's needed to produce thousands of units of vitamin D. (This is for Caucasians living at mid-latitudes—say, New York City or Boston. Slightly more time is required for people with dark skin.) In addition, when vitamin D is obtained through sun exposure, there is no risk of toxicity, since UV light breaks down any excess vitamin formed. (This is why lifeguards, for instance, do not suffer from overdoses of vitamin D.)

Of course, any favorable mention of UV light is likely to cause some skin-cancer experts to balk. In interviews, several noted that UV light is a known carcinogen and that any unprotected exposure necessarily increases a person's risk. What also worries dermatologists is that a change in public health dogma may cause confusion, leading people to believe that if some is good, more sun is better.

In the end, however, it doesn't seem terribly hard to find a middle ground. It is true that UV exposure can cause skin cancer; it is true that this reality has been distorted, perhaps deliberately, by commercial interests; and it is true that vitamin D is available in the form of oral supplements—for those determined to seek it out. But it is also true that many people simply aren't getting enough of this crucial vitamin. And for most people, given its myriad benefits, both proven and potential, the advantages of a little sunshine very likely outweigh the risks.

Sources of Vitamin D		
Food	Serving	Amount*
Cod liver oil	1 tbs	1,360
Mackerel (cooked)	3.5 oz	345
Salmon (cooked)	3.5 oz	360
Sardines (canned in oil, drained)	1.75 oz	250
Tuna (canned in oil)	3 oz	200
Eel	3.5 oz	200
Fortified milk	1 cup	100
Fortified margarine	2 tsp	53
Egg	one whole	20
* IU of Vitamin D		

