

## **Vitamin D Deficiency: A Global Concern**

If you live north of the line connecting San Francisco to Philadelphia and Athens to Beijing, odds are that you don't get enough vitamin D. The same holds true if you don't get outside for at least a 15-minute daily walk in the sun. African-Americans and others with dark skin, as well as older individuals, tend to have much lower levels of vitamin D, as do people who are overweight or obese.

### **How Much Do I Need?**

#### *Vitamin D*

The Institute of Medicine's recommended intake of vitamin D is 200 IU up to age 50, 400 IU between the ages of 51 and 70, and 600 IU after age 70. (7) That recommendation is under review and will likely increase, since strong evidence shows optimal intakes are much higher, with at least 1,000-2,000 IU recommended for those over age 2.

In extremely high doses—hundreds of thousands of IU or more—vitamin D is toxic and can even cause death. But in children over the age of 1 and in adults, taking up to 2,000 IU per day as a supplement is safe. Some people may need 3,000 or 4,000 IU per day for adequate blood levels, particularly if they have darker skin, spend winters at higher latitudes (such as the northern U.S.), or have little exposure to direct sunlight. If you fall into one of these groups, ask your doctor to order a vitamin D blood test.

To prevent rickets, the American Academy of Pediatrics now recommends vitamin D supplements of 400 IU per day for breastfed infants, as well as for non-breastfed infants and children who do not drink at least a liter of vitamin D fortified milk each day. (6)

Worldwide, an estimated 1 billion people have inadequate levels of vitamin D in their blood, and deficiencies can be found in all ethnicities and age groups. (1-3) Indeed, in industrialized countries, doctors are even seeing the resurgence of rickets, the bone-weakening disease that had been largely eradicated through vitamin D fortification. (4-6)

Why are these widespread vitamin D deficiencies of such great concern? Because research conducted over the past decade suggests that vitamin D plays a much broader disease-fighting role than once thought.

Being "D-ficient" may increase the risk of a host of chronic diseases, such as osteoporosis, heart disease, some cancers, and multiple sclerosis, as well as infectious diseases, such as tuberculosis and even the seasonal flu.

### **Read more: [vitamin D and H1N1 flu](#)**

Current vitamin D recommendations in the U.S. and Canada were developed more than a decade ago, based on research about what blood levels of vitamin D prevent rickets in young children and osteomalacia ("soft bones") in adults. (7) The latest science suggests that for chronic disease prevention, we need much more vitamin D than these government guidelines recommend.

In light of these findings, the Institute of Medicine has begun reviewing its vitamin D and calcium recommendations, aiming to release a new report in 2010. (8)

### **Vitamin D Sources and Function**

Vitamin D is both a nutrient we eat and a hormone our bodies make. Few foods are naturally rich in vitamin D, so the biggest dietary sources of vitamin D are fortified foods and vitamin supplements.

## Vitamin D from Food and Supplements



Very few foods naturally contain vitamin D. Good sources include dairy products and breakfast cereals (both of which are fortified with vitamin D), and fatty fish such as salmon and tuna.

For most people, the best way to get the enough vitamin D is taking a supplement, but the level in most multivitamins (400 IU) is too low. Encouragingly, some manufacturers have begun adding 800 or 1,000 IU of vitamin D to their standard multivitamin preparations. If the multivitamin you take does not have 1,000 IU of vitamin D, you may want to consider adding a separate vitamin D supplement, especially if you don't spend much time in the sun.

The body also manufactures vitamin D from cholesterol, through a process triggered by the action of sunlight on skin, hence its nickname, "the sunshine vitamin." Yet some people do not make enough vitamin D from the sun, among them, people who have a darker skin tone, who are overweight, who are older, and who cover up when they are in the sun. (1)

Correctly applied sunscreen reduces our ability to absorb vitamin D by more than 90 percent. (9) And not all sunlight is created equal: The sun's ultraviolet B (UVB) rays—the so-called "tanning" rays, and the rays that trigger the skin to produce vitamin D—are stronger near the equator and weaker at higher latitudes. So in the fall and winter, people who live at higher latitudes (in the northern U.S. and Europe, for example) can't make much if any vitamin D from the sun. (9)

## **Read more: what may increase your risk for vitamin D deficiency**

Vitamin D helps ensure that the body absorbs and retains calcium and phosphorus, both critical for building bone. Laboratory studies show that vitamin D can reduce cancer cell growth and plays a critical role in controlling infections. Many of the body's organs and tissues have receptors for vitamin D, and scientists are still teasing out its other possible functions.

### **New Vitamin D Research: Beyond Building Bones**

Several promising areas of vitamin D research look far beyond vitamin D's role in building bones. And, as you might expect, the news media release a flurry of reports every time another study links vitamin D to some new ailment. What these stories often fail to mention is that vitamin D's role in many of these diseases has not been proven through a randomized trial. That means it's too early to tell if there's merely an association between vitamin D levels and development of the disease, or if high vitamin D levels prevent these diseases. More answers may come from planned trials, such as the VITamin D and OmegA-3 Trial (VITAL), which will enroll 20,000 healthy men and women to see if taking 2,000 IU of vitamin D or 1,000 mg of fish oil daily lowers the risk of cancer, heart disease, and stroke.

Here, we provide an overview of some of the more promising areas of vitamin D research, highlighting the complex role of vitamin D in disease prevention—and the many unanswered questions that remain.

### **Vitamin D and Bone and Muscle Strength**

Several studies link low vitamin D levels with an increased risk of fractures in older adults, and they suggest that vitamin D supplementation may prevent such fractures—as long as it is taken in a high enough dose. (10-14)

The latest evidence comes from a combined analysis of 12 fracture prevention trials that included more than 40,000 elderly people, most of them women. Researchers found that high intakes of vitamin D supplements—of about 800 IU per day—reduced hip and non-spine fractures by 20 percent, while lower intakes (400 IU or less) failed to offer any fracture prevention benefit. ([14](#))

## Your Questions Answered

### *Vitamins*

#### **Q. What type of vitamin D is best?**



Two forms of vitamin D are used in supplements: vitamin D2 (“ergocalciferol,” or pre-vitamin D) and vitamin D3 (“cholecalciferol”). Vitamin D3 is chemically indistinguishable from the form of vitamin D produced in the body.... **Read more about what type of vitamin D is best.**

Vitamin D may also help increase muscle strength, which in turn helps to prevent falls, a common problem that leads to substantial disability and death in older people. ([15-17](#)) Once again, vitamin D dose matters: A combined analysis of multiple studies found that taking 700-1000 IU of vitamin D per day lowered the risk of falls by 19 percent, but taking 200-600 IU per day did not offer any such protection. ([18](#))

Vitamin D’s muscle-strengthening effects may not be limited to the elderly: There’s new evidence that vitamin D may be associated with muscle strength in adolescent girls. ([19](#))

#### **Vitamin D and Heart Disease**

The heart is basically a large muscle, and like skeletal muscle, it has receptors for vitamin D. (20) So perhaps it's no surprise that studies are finding vitamin D deficiency may be linked to heart disease. The Health Professional Follow-Up Study checked the vitamin D blood levels in nearly 50,000 men who were healthy, and then followed them for 10 years. (21) They found that men who were deficient in vitamin D were twice as likely to have a heart attack as men who had adequate levels of vitamin D. Other studies have found that low vitamin D levels were associated with higher risk of heart failure, sudden cardiac death, stroke, overall cardiovascular disease, and cardiovascular death. (22-25) How exactly does vitamin D help prevent heart disease? There's evidence that vitamin D plays a role in controlling blood pressure and preventing artery damage, and this may explain these findings. (26)

### **Vitamin D and Cancer**

Nearly 30 years ago, researchers noticed an intriguing relationship between colon cancer deaths and geographic location: People who lived at higher latitudes, such as in the northern U.S., had higher rates of death from colon cancer than people who live closer to the equator. (27) The sun's UVB rays are weaker at higher latitudes, and in turn, people's vitamin D levels in these high latitude locales tend to be lower. This led to the hypothesis that low vitamin D levels might somehow increase colon cancer risk. (27)

## Nutrition In-Depth

### **Vitamin D and Geographic Location**



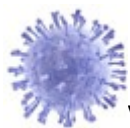
Many scientific hypotheses about vitamin D and disease stem from studies that have compared solar radiation and disease rates in different countries. These can be a good starting point for other research but don't provide the most definitive information.... **Read more about [vitamin D studies and geographic location](#).**

Since then, dozens of studies suggest an association between low vitamin D levels and increased risks of colon and other cancers. (1,28) The evidence is strongest for colorectal and breast cancers, with most (but not all) observational studies finding that the lower the vitamin D levels, the higher the risk of these diseases. (29-39) Vitamin D levels also seem to predict cancer survival. (28) Yet finding such associations does not necessarily mean that taking vitamin D supplements will lower cancer risk. That requires testing in randomized controlled trials.

The VITAL trial will look specifically at whether vitamin D supplements lower cancer risk. It will be years, though, before it releases any results. In the meantime, based on the evidence to date, 16 scientists have circulated a "call for action" on vitamin D and cancer prevention: (28) Given the high rates of vitamin D deficiency in North America, the potential cancer-fighting benefits of vitamin D, and the low risk of vitamin D supplementation, they recommend widespread vitamin D supplementation of 2000 IU per day. (28)

**Read more: [vitamin D trials for cancer prevention](#)**

### **Vitamin D and Immune Function**



Vitamin D's role in regulating the immune system has led scientists to explore two parallel research paths: Does vitamin D

deficiency contribute to the development of multiple sclerosis, type 1 diabetes, and other so-called “autoimmune” diseases, where the body’s immune system attacks its own organs and tissues? And could vitamin D supplements help boost our body’s defenses to fight infectious disease, such as tuberculosis and seasonal flu?

***Vitamin D and Multiple Sclerosis:*** Multiple sclerosis (MS) rates are much higher far north (or far south) of the equator than in sunnier climes, and researchers suspect that chronic vitamin D deficiencies may be one reason why. One prospective study to look at this question found that among white men and women, those with the highest vitamin D blood levels had a 62 percent lower risk of developing MS than those with the lowest vitamin D levels. (40) The study didn’t find this effect among black men and women, most likely because there were fewer black study participants and most of them had low vitamin D levels, making it harder to find any link between vitamin D and MS if one exists. No randomized controlled trials have been conducted on vitamin D and MS, and more research is needed.

***Vitamin D and Type 1 Diabetes:*** Type 1 diabetes is another disease that varies with geography—a child in Finland is about 400 times more likely to develop it than a child in Venezuela. (41) Evidence that vitamin D may play a role in preventing type 1 diabetes comes from a 30-year study that followed more than 10,000 Finnish children from birth: Children who regularly received vitamin D supplements during infancy had a nearly 90 percent lower risk of developing type 1 diabetes than those who did not receive supplements. (42) Other European case-control studies, when analyzed together, also suggest that vitamin D may help protect against type 1 diabetes. (43) No randomized controlled trials have tested this notion, however, so more research is needed.



***Vitamin D, the Flu, and the Common Cold:*** The flu virus wreaks the most havoc in the winter, abating in the summer months. This seasonality led a British doctor to hypothesize that a sunlight-related “seasonal stimulus” triggered influenza outbreaks. (44) More than 20 years after this initial hypothesis, several scientists published a paper suggesting that vitamin D may be the seasonal stimulus. (45) Among the evidence they cite:

- Vitamin D levels are lowest in the winter months. (45)
- The active form of vitamin D tempers the damaging inflammatory response of some white blood cells, while it also boosts immune cells’ production of microbe-fighting proteins. (45)
- Children who have vitamin D-deficiency rickets are more likely to get respiratory infections, while children exposed to sunlight seem to have fewer respiratory infections. (45)
- Adults who have low vitamin D levels are also more likely to report having had a recent cough, cold, or upper respiratory tract infection. (46)

But don’t skip your flu shot just yet: No large-scale randomized controlled trials have been done on vitamin D supplements and the flu in general, or on vitamin D and the H1N1 flu virus strain (“swine flu”). Until such studies provide more evidence, it is too early to recommend high doses of vitamin D to prevent or treat colds or flu. (45)

***Vitamin D and Tuberculosis:*** Before the advent of antibiotics, sunlight and sun lamps were part of the standard treatment for tuberculosis (TB). (47) More recent research suggests that the “sunshine vitamin” may be linked to TB risk. Several case-control studies, when analyzed together, suggest that people diagnosed with tuberculosis have lower vitamin D levels than healthy people of similar

age and other characteristics. (48) Such studies do not follow individuals over time, so they cannot tell us whether vitamin D deficiency led to the increased TB risk or whether taking vitamin D supplements would prevent TB. There are also genetic differences in the receptor that binds vitamin D, and these differences may influence TB risk. (49) Again, more research is needed. (49)

### **Vitamin D and Risk of Premature Death**

A promising report in the *Archives of Internal Medicine* suggests that taking vitamin D supplements may even reduce overall mortality rates: A combined analysis of multiple studies found that taking modest levels of vitamin D supplements was associated with a statistically significant 7 percent reduction in mortality from any cause. (50) The analysis looked at the findings from 18 randomized controlled trials that enrolled a total of nearly 60,000 study participants; most of the study participants took between 400 and 800 IU of vitamin D per day for an average of five years. Keep in mind that this analysis has several limitations, chief among them the fact that the studies it included were not designed to explore mortality in general, or explore specific causes of death. More research is needed before any broad claims can be made about vitamin D and mortality. (51)

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