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## REPORT

### Vitamin D's Crucial Role in Cardiovascular Protection

By William Davis, MD



Health-conscious adults regularly monitor their cardiovascular risk factors—such as cholesterol, glucose, and homocysteine—in order to reduce their risk of debilitating cardiovascular disease. Now, intriguing new research suggests that vitamin D may play an essential yet overlooked role in staving off heart disease. Vitamin D deficiency may eventually be added to the list of causative factors that contribute to cardiovascular disorders.

A growing body of research indicates that vitamin D deficiency contributes to a broad spectrum of conditions such as high blood pressure, poor insulin sensitivity, inflammation, and other fundamental processes that underlie heart disease.

Alarming, vitamin D deficiency is extremely common throughout the population—affecting more than half of adults and the majority of the elderly.<sup>1</sup>

In this article, we'll explore the epidemic of vitamin D deficiency, its detrimental effects on cardiovascular and whole-body health, and how you can protect yourself by maintaining healthy blood levels of vitamin D.

If you look up “coronary risk factor” in any standard medical textbook, you'll find a list that includes high cholesterol, diabetes, smoking, sedentary lifestyle, obesity, and hypertension. However, vitamin D status is not listed. Perhaps you'll find vitamin D in the list of risks for childhood rickets and osteoporosis in females. But a coronary risk factor? You'll not see it.

New data, however, are suggesting a whole new panel of health effects previously unsuspected for this underappreciated vitamin. It may, in fact, be a crucial nutrient that plays a central role in coronary heart disease prevention.

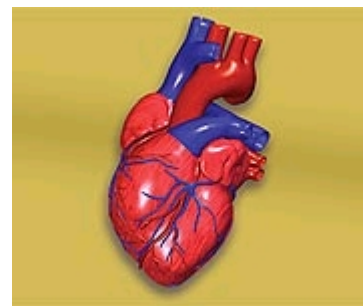
**“Vitamin D deficiency and its consequences are extremely subtle, but have enormous implications for human health and disease. It is for this reason that vitamin D deficiency continues to go unrecognized by a majority of health care professionals.”**

—Dr. Michael Holick, University of Boston

#### VITAMIN D DEFICIENCY: A MODERN EPIDEMIC

Poor diet, sedentary lifestyles, and stressful schedules have contributed to today's epidemic of cardiovascular disease. Interestingly, dietary and lifestyle factors are also linked with another potentially dangerous and possibly related epidemic—that of vitamin D deficiency.

Human skin is rich with latent pre-vitamin D, which is activated by sunlight. Humans are meant to obtain vitamin D through sunlight exposure. Vitamin D is not contained to any significant degree in food, nor was it meant to be obtained through oral intake. But over the centuries, people have migrated to colder, sun-deprived climates, work indoors in offices or factories, travel by car, exercise in gyms rather than outdoors, and wear clothes that cover all but 5% of body surface area. In fact, even adults living in sunny Miami are likely to be deficient in vitamin D for at least part of the year.<sup>2</sup> Oral intake of vitamin D has become necessary as humans developed lifestyles involving less and less sun exposure. Add to this the sun phobia fostered by dermatologists advising us that sun exposure causes skin cancer, and most of us are terribly sun-deprived and thereby unable to activate vitamin D.



There are few dietary sources of vitamin D. An eight ounce glass of milk contains 100 IU, although this is often inconsistent.<sup>3,4</sup> Other dairy products, like cheese and yogurt, tend to have little or no vitamin D added. Oily fish like salmon, mackerel, and sardines contain 200–360 IU vitamin D per 3.5 ounce serving. Many breakfast cereals contain 40–100 IU per serving.<sup>1</sup> Despite this, many people fail to obtain even the modest “adequate” intake every day. Strict vegetarians and lactose intolerant individuals

are especially likely to be substantially vitamin D deficient.<sup>5</sup> Other people at high risk for vitamin D deficiency include: the elderly, who convert less vitamin D with sunlight exposure compared to younger people; the obese; and dark-skinned individuals, due to high melanin skin content.<sup>4,6</sup>

## VITAMIN D AND CORONARY RISK: WHAT YOU NEED TO KNOW

- Noticing that people who live in northern climates experience more heart attacks, scientists began investigating the relationship between vitamin D and heart disease. Growing evidence now suggests that low levels of vitamin D may represent a significant but little-known contributor to heart disease.
- Vitamin D is produced in the skin in response to sunlight exposure. Modest amounts of vitamin D are available in foods such as dairy products, oily fish, and breakfast cereals.
- Many adults fail to consume the recommended adequate intake of vitamin D. Vitamin D deficiency is particularly widespread in elderly adults and those who spend little time in the sun.
- Studies suggest that the recommended adequate intake of vitamin D is far too low. Many health experts now advise adults to supplement with 1,000 IU or more each day.
- Measuring blood levels of 25-hydroxyvitamin D is crucial to detect deficiency and monitor the effects of vitamin D supplementation. Scientists advise adults to achieve a minimum blood level of 30 ng/mL of 25-hydroxy-vitamin D, and some studies suggest that even higher levels are advisable.
- Vitamin D deficiency contributes to high blood pressure, diabetes, and inflammation—all of which increase cardiovascular risk. Low levels of vitamin D have been noted in heart attack sufferers and those with atherosclerosis, and may contribute to the elevated cardiovascular risk that accompanies kidney disease.
- Optimal vitamin D levels may protect against conditions such as multiple sclerosis, cancer, influenza, and bone fractures.
- Ensuring optimal blood levels of vitamin D may represent a key component of a strategy to prevent and treat coronary disease.

## VITAMIN D RECOMMENDATIONS BASED ON FICTION, NOT FACTS

In 1963, when the Institute of Medicine drafted the Recommended Daily Allowance (RDA) for vitamin D, there were literally no scientific data available to help determine requirements for optimal health. It was clear, however, that vitamin D was a necessary ingredient for health, since children who failed to receive at least 300–400 IU per day, usually supplemented as cod liver oil, developed “bow legs,” or rickets, due to abnormal bone maturation in the legs. But the vitamin D dose recommended for adults was purely—and admittedly—fabrication. It was based on a disease model—that is, the amount thought to prevent rickets, rather than the amount needed to promote optimal health, which may be far greater.

**“The basis for adult vitamin D recommendations [was] arbitrary. Thirty-six years ago, an expert committee on vitamin D could provide only anecdotal support for what it referred to as ‘the hypothesis of a small requirement’ for vitamin D in adults and it recommended one-half the infant dose, just to ensure that adults obtain some from the diet.”**

—Dr. Reinhold Vieth University of Toronto

In the 1960s, the only known consequence of vitamin D deficiency in adults was osteomalacia, a form of bone softening. Administration of 200 IU per day of vitamin D was just enough to prevent osteomalacia. More recent vitamin D research, however, has uncovered the fact that exposure to just 10–20 minutes of sunlight yielded the blood-level equivalent of 10,000 units of vitamin D taken orally.<sup>7</sup> Why would the naturally-intended source of vitamin D yield levels far beyond that specified by the RDA?

Speculation grew that the true vitamin D requirement for health was far more than the RDA in the absence of substantial sunlight exposure. A study conducted during the winter months in Omaha, Nebraska, in healthy adult men showed that the participants utilized 3000–5000 international units of vitamin D per day to maintain a steady vitamin D blood level. The researchers concluded that the current RDA was inadequate to meet these requirements.<sup>8</sup> Low government-issued vitamin D intake recommendations, along with deprivation of sunlight, has therefore resulted in a nation that is frightfully deficient in a crucial nutrient.



Further investigation using blood levels of vitamin D have uncovered the extraordinary prevalence of deficiency. A study of 1500 women receiving treatment for osteoporosis showed that 52% of participants were deficient (<30 ng/mL 25-hydroxyvitamin D); and 18% were severely deficient (<20 ng/mL 25-hydroxyvitamin D).<sup>9</sup> The likelihood of vitamin D deficiency ranges from a low of 36% in healthy adults 18–29 years old, to 57% of a general adult population in the US, to as much as 100% in the elderly.<sup>1</sup> North of 37 degrees latitude (approximately a line drawn horizontally connecting Norfolk, Virginia, to San Francisco, California), sunlight is insufficient to trigger vitamin D conversion in the winter months.<sup>10</sup> Living in a southern climate is no guarantee that deficiency won't occur. A study conducted in Miami, Florida showed that approximately 40% of 212 adults were deficient in winter, with a modest improvement in summer.<sup>2</sup>

## SUNLIGHT, VITAMIN D, AND HEART ATTACK

The farther north you live, the more likely you will suffer a heart attack.<sup>11</sup> That curious observation led to the suspicion that vitamin D may somehow be related to the development of heart disease. It suggests that sunlight exposure may somehow provide a protective effect, perhaps through vitamin D. The notable exception to this pattern is the Eskimos, who eat large quantities of oily fish, a rich source of vitamin D and omega-3 fatty acids.

An early hint that deficiency of vitamin D might be behind heart disease came from a New Zealand study of 179 people presenting with heart attacks. Heart attack sufferers proved to have lower vitamin D blood levels (25-hydroxyvitamin D) compared to people without heart attacks.<sup>12</sup>

A corroborating observation emerged from analysis of the enormous database of 259,891 heart attacks maintained by the National Registry of Myocardial Infarction. In this nationwide tabulation, heart attacks surged by 53% during sun-deprived winter months compared to summer.<sup>13</sup> Further corroboration came from observations in sub-tropical climates, where intense sun shines year-round and seasonal variation in heart attack rates doesn't occur.<sup>14</sup> Unlike the large ranges in cold or hot weather found in temperate regions, the warm climate of a subtropical region does not affect the frequency of heart attacks.

If vitamin D is indeed related to heart disease risk, then we would also expect to see fewer heart attacks in sunny climates and more heart attacks in cooler climates. Indeed, an exhaustive study performed by Dr. David Grimes and colleagues at the Blackburn Royal Infirmary in England demonstrated a consistent worldwide relationship between sunlight exposure and heart disease: the farther north in latitude, the more heart attacks occurred.<sup>11</sup> Dr. Grimes and others have suggested that the vitamin D activated by sunlight is behind the reduced risk of heart disease.

## HEALTH-PROMOTING EFFECTS OF VITAMIN D

Vitamin D has far-reaching implications that extend far beyond promoting bone health. Over the past 40 years, research has shed light on the intersecting pathways of vitamin D and many other aspects of health. Among vitamin D's crucial functions in the body are:



- Normalizing blood pressure. People deficient in vitamin D are much more likely to have high blood pressure.<sup>15,16</sup> Treatment with vitamin D and calcium significantly lowers systolic blood pressure.<sup>15</sup> Vitamin D likely exerts this effect by suppressing the expression of the blood pressure hormone renin.<sup>32</sup>
- Anti-inflammatory effects. Vitamin D appears to have a potent effect on reducing inflammation, as measured by C-reactive protein (CRP). Dramatic reductions in CRP have been documented. In contrast, statin medications may only produce modest decreases in CRP levels.<sup>17</sup>
- Anti-diabetic effects. Diabetes is more prevalent in individuals with low serum vitamin D levels.<sup>22</sup> Vitamin D administration reduces blood sugar and increases sensitivity to insulin. Improvement in insulin sensitivity is associated with a cascade of benefits, including a decreased risk of developing full-blown diabetes.<sup>18</sup>
- Chemoprevention. Vitamin D has demonstrated potent cancer-preventive effects in experimental and animal preparations and in humans.<sup>7</sup> A recent study showed that supplementing with vitamin D and calcium reduced the incidence of all types of cancer in postmenopausal women.<sup>33</sup>
- Osteoporosis prevention. Vitamin D is sorely neglected in this area. Women are prescribed expensive prescription drugs costing hundreds of dollars per month, yet are deficient in vitamin D, a crucial factor in bone health. Replacement to healthy levels substantially increases bone density more effectively than calcium supplementation. Intestinal absorption

of calcium is magnified considerably when sufficient vitamin D is present.<sup>34,35</sup>

- Prevention of stress fractures. Even young men with an average age of 19 were shown to experience more stress fractures when blood levels of 25-hydroxyvitamin D were low.<sup>36</sup>
- Prevention of multiple sclerosis. Vitamin D deficiency has been linked to an increased likelihood of developing this debilitating neurological disorder in lighter-skinned individuals; the correlation between poor vitamin D status and multiple sclerosis did not hold true in African American or Hispanic populations.<sup>37</sup> Scientists believe that the active form of vitamin D helps avert multiple sclerosis—which is considered an autoimmune disease—by selectively regulating the immune system.
- Immune Enhancement. Noting that influenza epidemics are more common in the winter months, scientists have proposed that low levels of vitamin D may predispose individuals to succumbing to these potentially dangerous respiratory infections.<sup>38</sup>

My clinic also advises that patients consume fish oil at a minimum dose of 4000 mg/day (containing 1200 mg of eicosapentenic acid and docosahexaenoic acid), along with L-arginine (3000–6000 mg twice per day) to support endothelial health.

Lastly, we raise blood levels of 25-hydroxyvitamin D to 50 ng/mL (125 nmol/L) using vitamin D supplementation. Most people (in the northern Midwest) require 2000–4000 IU per day in winter, and half that dose in summer. Some require as much as 8000 IU per day, while a rare person requires only 1000 IU per day. Using this approach, we now have an impressive track record of reducing CT heart scan scores. Reductions of 20-30% in the first year are not uncommon.

## VITAMIN D: ESSENTIAL FOR HEART HEALTH

Abundant evidence now points to the numerous cardioprotective functions of vitamin D. Restoring vitamin D to normal levels has been found to help reduce inflammation, normalize blood pressure, and improve insulin sensitivity—all factors that reduce heart disease risk.<sup>15-18</sup>

Vitamin D deficiency has been shown to diminish contractile function of heart muscle cells, contribute to endothelial dysfunction, distort heart muscle structure (triggering hypertrophy, or abnormal heart muscle growth), and increase smooth muscle growth in the coronary artery wall—a process that leads to atherosclerotic plaque formation.<sup>19,20</sup> Low levels of serum 25-hydroxyvitamin D have been linked with congestive heart failure, a condition in which the heart is unable to keep up with the body's demands for blood and oxygen.<sup>21</sup> A recent analysis showed that individuals with low serum levels of vitamin D had higher rates of high blood pressure, diabetes, and elevated triglycerides than those with higher vitamin D levels.<sup>22</sup>

Longstanding vitamin D deficiency is a major contributor to osteoporosis, and scientists have long known that women with osteoporosis are more likely to have coronary heart disease. The correlation between osteoporosis and heart disease may reflect common risk factors and mechanisms, such as estrogen and vitamin D.<sup>23</sup> A study in 2,500 postmenopausal women showed a four-fold greater risk of heart attack in women with osteoporosis.<sup>24</sup> A University of Illinois study showed that the computed tomography (CT) heart scan score (a measure of coronary atherosclerotic plaque) in women with osteoporosis averaged 222 (optimal is zero), while women with normal bone density had far lower average scores of 42.<sup>25</sup> Similar findings have shown that higher levels of coronary calcification are found in those with lower levels of vitamin D.<sup>26,27</sup>

Vitamin D deficiency may extend to vascular disease beyond the coronary arteries. A recent Italian study determined that the greater the vitamin D deficiency, the more carotid atherosclerotic plaque was present, as assessed by carotid ultrasound. The authors concluded that low vitamin D blood levels were an independent and strong predictor of atherosclerosis. Diabetics were also twice as likely as non-diabetics to be severely vitamin D deficient.<sup>28</sup>

Some authorities have proposed that inadequate vitamin D is part of the reason for the extremely high incidence of cardiovascular disease in people with abnormal kidney function.<sup>29</sup> People with little or no kidney function often have very low levels of vitamin D, since the kidney is required for its activation.<sup>30</sup> A Japanese study in 240 people on dialysis for severe kidney disease suggested that treatment to correct vitamin D deficiency resulted in a dramatic reduction in heart attack and death from heart disease.<sup>31</sup> Emerging science argues strongly in favor of vitamin D as an important risk factor for cardiovascular disease. Optimizing vitamin D status holds tremendous potential to safely, inexpensively, and dramatically reduce cardiovascular risk.

**“ ..there is a striking similarity between the benefits of vitamin D and the benefits of statin therapy. I believe that the unexpected and unexplained beneficial effects of statin therapy might be mediated by activation of vitamin D receptors by this group of drugs.”**



# REPORT

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### CHOLESTEROL IS NOT EVERYTHING

Judging from the constant onslaught of drug company advertising, you'd think that a cure for coronary heart disease has been discovered, and that the cure is cholesterol-lowering statin drugs. Existing data show that this is clearly not the case. Risk for heart attack is certainly reduced, usually by about 25–30%, but not eliminated. Thus, statin drugs could only prevent about one in every three heart attacks.<sup>39</sup>

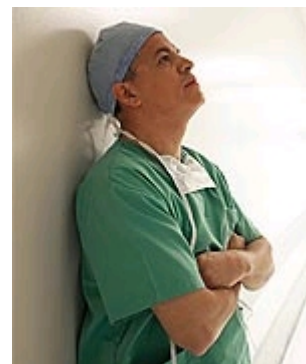
This is because there are many other causes for heart disease beyond LDL: low HDL, increased triglycerides, diabetes, inflammation, and hidden causes of heart disease like lipoprotein(a). But how about vitamin D? The scientific information so far is hugely promising.

**“I foresee an increasing number of studies linking vitamin D deficiency to most of the diseases of modern civilization. Furthermore, I foresee a backlash by many in organized medicine who simply cannot accept the possibility that such a simple and cheap compound can have such health benefits. I foresee lawsuits against practicing physicians who don't accept the importance of vitamin D. For example, researchers at Harvard just announced that the five year survival for patients with early stage, non-small cell carcinoma of the lung was almost three times better in those with evidence of the highest vitamin D levels compared to those with the lowest. Five-year survival for those with the highest levels approached 80%! I predict similar claims will be filed against cardiologists for letting heart disease patients die vitamin D-deficient as the evidence mounts that vitamin D prevents and treats heart disease.”**

—Dr. John Cannell The Vitamin D Council [www.vitamindcouncil.com](http://www.vitamindcouncil.com)

### OPTIMIZING VITAMIN D LEVELS

Given the vast benefits of vitamin D for cardiovascular and whole-body health, ensuring optimal vitamin D status is an essential part of every wellness program. The best way to know your vitamin D status is to have your doctor measure the blood level of 25-hydroxyvitamin D (not to be confused with 1,25-dihydroxyvitamin D). The minimum level of 25-hydroxyvitamin D required for health is controversial, and can also vary by the method used for measurement. However, most authorities have argued that a rock-bottom minimum 25-hydroxyvitamin D level of 30 ng/mL, or 75 nmol/L, is the point at which phenomena associated with deficiency begin to be corrected.<sup>40</sup> Noted vitamin D authority Dr. Reinhold Vieth of the University of Toronto has argued that a blood level of 40 ng/mL (100 nmol/L) should be achieved.<sup>7</sup> Dr. Michael Holick of the University of Boston proposes that serum level of 25-hydroxyvitamin D is in the range of 30-50 ng/mL (75-125 nmol/L).<sup>34</sup> Another study showed that elderly men and women were at an increased risk of bone loss when their levels of 25-hydroxyvitamin D fell below 45 ng/mL (110 nmol/L), suggesting that maintaining 25-hydroxyvitamin D above 45 ng/mL may be crucial for all aging adults.<sup>41</sup> If vitamin D levels are low, consider supplementation to help reverse a vitamin D deficiency. Re-checking your vitamin D status after several months of supplementation is prudent to ensure that a deficiency has been averted.



New studies are showing that the dose required to achieve a healthy blood level of vitamin D is somewhere in the neighborhood of 1,000–4,000 IU per day in the absence of sun exposure.<sup>42</sup> That's more than five times the Institute of Medicine's recommended adequate intake, though still less than obtained through several minutes of midday sun exposure. Vitamin D toxicity does not usually develop unless vitamin D intake exceeds 10,000 units per day or blood levels exceed 80 ng/mL (200 nmol/L).<sup>1,7</sup> In fact, some scientists believe that the tolerable upper intake level of vitamin D intake should be revised from 2,000 IU/day to 10,000 IU/day.<sup>43</sup>

### DOES VITAMIN D REVERSE CORONARY DISEASE?

While the scientific community is still debating whether vitamin D can help reverse coronary disease, my clinical experience indicates that vitamin D is a crucial part of a coronary plaque reversal program.

My clinic's program of reversing heart disease involves a multi-faceted approach. First, we document the quantity of coronary atherosclerotic plaque through a CT heart scan. Then, we achieve the following goals:

- Low density lipoprotein (LDL): 60 mg/dL or less (but not less than 40 mg/dL)
- High-density lipoprotein (HDL): 60 mg/dL or greater
- Triglycerides: 60 mg/dL or less Normal blood pressure: (<130/80 mmHg)
- Normal blood sugar: (<100 mg/dL)

My clinic also advises that patients consume fish oil at a minimum dose of 4000 mg/day (containing 1200 mg of eicosapentenic acid and docosahexaenoic acid), along with L-arginine (3000–6000 mg twice per day) to support endothelial health.

Lastly, we raise blood levels of 25-hydroxyvitamin D to 50 ng/mL (125 nmol/L) using vitamin D supplementation. Most people (in the northern Midwest) require 2000–4000 IU per day in winter, and half that dose in summer. Some require as much as 8000 IU per day, while a rare person requires only 1000 IU per day. Using this approach, we now have an impressive track record of reducing CT heart scan scores. Reductions of 20-30% in the first year are not uncommon.

If you live in the northern US (states like Massachusetts, New York, Pennsylvania, Wisconsin, Michigan, the Dakotas, etc.), Canada, or northern Europe, there's a high likelihood that you're deficient. If you're like most Americans, you get sun sporadically during summer weekends, and virtually none from September to April. Dark-skinned individuals are at even greater risk of vitamin D deficiency, since melanin pigment in skin acts as a natural sunscreen. Dark-skinned individuals require around five times longer sun exposure to obtain the same amount of vitamin D as fair-skinned persons. African-Americans, for this reason, are among the most vitamin D deficient of all.

Ten minutes of sun exposure in midday, wearing shorts and t-shirt to expose skin surface area, will provide most Caucasians plentiful vitamin D during the summer. This limited time minimizes the risk of skin cancer. (If you are especially fair-skinned, you might do fine with somewhat less.) If you are in the sun any longer than this, you should apply a sunscreen (which blocks both sunlight as well as vitamin D activation in the skin).

However, if sun exposure is sporadic, supplementation is crucial to obtain the full benefit of vitamin D's panel of biologic effects. Vitamin D3 (cholecalciferol) is preferable to vitamin D2 (ergocalciferol), as it is absorbed 70% better than D2 and it more effectively increases blood levels.<sup>44</sup> Many vitamin D supplements contain only 400 IU per capsule or tablet. More and more manufacturers are producing 1,000 and 5,000 IU capsules to suit the growing demand for higher dose vitamin D supplements. In northern climates or sun-deprived lifestyles, 1,000 IU per day is a reasonable starting dose. You may wish to consult your physician and check your blood level of vitamin D to determine if even higher doses of vitamin D are appropriate for you.



To obtain a dose of 1,000–2,000 IU or more per day, a specific vitamin D supplement will be required, rather than a combination supplement with calcium or other nutrients. Note the quantity of vitamin D (if any) included with your other supplements, such as calcium and multivitamins (usually 200–400 IU), and reduce the amount of specific vitamin D accordingly (to equal your total desired dose).



Supplementing with very high doses of vitamin D over an extended period of time can lead to elevated blood calcium levels, which can adversely affect nerve and muscle function, and can contribute to kidney stones.<sup>45-48</sup> Individuals using large doses of vitamin D should be carefully monitored for signs and symptoms of vitamin D toxicity such as poor appetite, constipation, weakness, heart arrhythmias, and elevated blood levels of cholesterol, calcium, or liver enzymes.<sup>49</sup> Individuals with hypercalcemia (high blood calcium levels) should not take vitamin D.<sup>49</sup> If you have kidney disease or if you use digoxin or other cardiac glycoside drugs, consult a physician before using supplemental vitamin D.<sup>4</sup>

**“Personally, I take 5,000 units in the late fall, winter, and early spring, and then I vary doses the rest of the time depending on sun exposure. I also have my 25-hydroxyvitamin D level checked twice a year, once in the early spring and again in the early fall. My 10-year old daughter takes 2,000 units a day in the winter months, and my three year old takes 1,000 units a day in the winter.”**

## CONCLUSION

The understanding of vitamin D is rapidly evolving. Compelling and substantial evidence suggests that most people—particularly those living in northern climates or with limited sun exposure—are substantially deficient. Replenishing vitamin D can help normalize blood pressure, support healthy blood sugar, improve insulin resistance, and dampen inflammation—all processes that contribute to heart disease. Growing evidence is adding support to the idea that vitamin D deficiency contributes to coronary risk, and that replacement of vitamin D can reduce risk. The vitamin D in dairy products and foods fails to provide sufficient quantities for the majority of Americans. In the absence of substantial sun exposure every day, vitamin D replacement is required in order to achieve adequate blood levels of this essential nutrient.



Dr. William Davis is an author and cardiologist practicing in Milwaukee, Wisconsin. He is author of the book, *Track your Plaque*:

The only heart disease prevention program that shows you how to use the new heart scans to detect, track, and control coronary plaque. He can be contacted through [www.trackyourplaque.com](http://www.trackyourplaque.com).

If you have any questions or wish to discuss any aspect of this article, please call one of our Health Advisors at 1-800 226-2370.

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