

WHAT IS SO SPECIAL
ABOUT OVER-THE-COUNTER
VITAMIN D3?

This is a set of my recommendations based on the body of evidence I have reviewed, in the form of studies, study summaries, and medical journal articles.

It is not endorsed by CVS nor is it meant in any way to be contradictory to the instructions of your physician. You remain the ultimate one responsible for your health, and your physician is an important and leading part of your healthcare support team. If you see a contradiction in what is contained herein, please talk with your doctor and explore your best interests.

I recommend that anyone under the age of 45 attempt to get sun exposure of arms, legs, and trunk of body sufficient to cause the skin to begin to “pink up”, but never ever so much as to cause a sunburn, on as near to a daily basis as possible. In the winter, that means that you can only do this while the sun is highest in the sky (your shadow must be shorter than you are).

During the summer months here in Texas, stay away from the heat of the day and get sun midmorning and midafternoon, for example. For a typical Caucasian teenager, 15 minutes to 1 hour of exposure will generate approximately 5,000iu of vitamin D3. For any teenager with naturally darker skin, it may take FIVE TIMES AS LONG to generate that 5,000iu. This has horrible ramifications in my mind for black women who are pregnant and deficient – question is, does this have anything to do with the statistic in the US that $\frac{3}{4}$ of all African-american males drop out/are in & out of the legal system?

Lifeguards have been measured to make more than 20,000 iu during a day at work at the swimming pool, and there are no adverse effects because the body will only activate and use what it needs. The rest might be stored, as Vitamin D3 is a “fat-soluble” vitamin, but it is never stored when you are deficient, and estimates are that at least $\frac{3}{4}$ of all Americans of all ages are classifiable as deficient, and it is worse as you live further north. If you are over 45, your skin has begun losing its ability to make Vitamin D3. No food has enough Vitamin D3 naturally, and the amount added to milk, for example, is of no use to anyone. After 45 or so, or if you can’t get out, you must take a tablet or capsule of D3. I vastly prefer D3 (over D2) because it is the actual chemical your body makes when the sun’s UV-B rays hit cholesterol in your skin. This is one reason why there are virtually no reports anywhere of D3 causing *any* adverse effects, even when taken in ridiculous amounts! The prescription version, called vitamin D2 (ergocalciferol), comes in 50,000iu strength only and being made by radiating mushrooms, is completely foreign to your body. Your body tries to convert ergocalciferol to cholecalciferol(vitamin D3), but is not very good at it. That is why each D2 cap has TEN times the amount of the OTC vitamin D3, and why your doctor prescribes one capsule a week, or a month, rather than every day. For most people, the body will be able to make/convert “some” D3 from the D2, but it varies wildly from person to person.

There ARE also examples in the literature of D2 causing harm when overdosed.

My first recommendation is to get tested and find out first, whether your insurance plan will cover you getting tested. If not, you need to find out up front how much your doctor/lab will charge you – mine charged \$320 out of pocket. So at the same time, I also

had ZRT Labs (www.zrtlab.com) test me, at a cost of \$75. The results were within 1 or 2 points of each other, and I have since learned that ZRT is widely considered reliable and accurate for a host of lab tests, not just 25(OH)D . (That is the name of the test that must be used – there are other versions that are useless, so make sure your dr. orders this one if you are able to get insurance coverage).

After testing, you must take enough D3 to get your blood level to at least 50 ng/ml and preferably slightly higher. I consider 100 ng/ml to be the safe and prudent upper limit goal at this point, but I am open to further studies helping me choose a different level.

To my knowledge, since your body makes and controls it, Vitamin D3 5,000iu capsules do not, repeat, not, cause any adverse effects. No constipation. No diarrhea. No indigestion. No interaction with any other medication. In short, no reason to NOT take it, other than the fact that it costs around \$16 per 100 count bottle (and often it is on sale as a “buy one, get a second one free”). There ARE a few rare people who are prone to hypercalcemia and have other rare diseases, and D3 is not for you unless your doctor says so.

As you will see in this set of documents, D3 not only helps insure that you can absorb calcium, but that it helps you avoid the flu, proven to improve muscular performance in people/elite athletes, helps avoid falls in the plus 50 set, has influence over at least 1000 different genes in the human genome, influences at least 20 cancers, and far more. It has been determined that every organ in your body has 3-D receptor sites that are specific for vitamin D3 (but NOT D2). It appears to me that virtually every organ relies on having vitamin D3 in order to work properly. There is a growing body of evidence that there is a link between D3 deficiency and: Nervous system deficiencies in babies, particularly autism, asthma, auto-immune diseases, multiple sclerosis, both forms of diabetes, the list goes on and on in a horrifying way. There is an irony, a sick joke, here and that is why I chose the word “horrifying”. Black/dark complexions actually block the formation of D3 as you get further from the equator. Somalian exiles in Sweden bore children in astonishing rates with “Swedish Disease”, they called it that because in Somalia no children are born with autism (they invented the name). The jury is still out, but the studies are coming in fast and furious and in higher numbers than ever before. It seems every researcher is just now discovering vitamin D3 has some part in a disease they have been investigating for years.

We were promised by those in the medical profession, primarily dermatology and oncology(cancer) in the late 1980’s that if we stayed out of the sun, and slathered on the newly discovered “sunblock” cream/lotion, we would be safer and healthier. This has been turned completely on its head. We are as a people, sicker and taking more and more medications than ever before. The sunblock at that time actually only blocked UV-B which is the ray wavelength necessary for your body to generate D3. So in effect, the entire population of the US was instructed to become deficient in vitamin D3 to such a level that we’ve seen skin cancers go UP, not go down, because apparently D3 actually helps to prevent skin cancers, along with everything else you will read about.

In the face of the evidence, I now believe that if every person over 45 was getting over 5,000iu per day, and every person under 45 was getting at least 15 minutes' decent sun/skin exposure per day, we would be far healthier than we are now. One study suggests that 300 billion could be saved per year if every person got D3 supplements for FREE, paid for by the federal government. That means to me that many families/children would have avoided autism, for example. Older people would not be osteoporotic in such high numbers, would not have died of heart attacks and strokes (at double the rate of those who had adequate vitamin D3 blood levels through supplements and good sun exposure). Women would not have 2.5 times the rate of breast cancer as those with good D3 levels, men would not have 2.2 times the level of prostate cancer. See Finland and Utah studies for these numbers.

And this is only the tip of the iceberg of diseases that have probably come to bloom because we have been taught to fear the sun – the sun that we evolved under for thousands of generations. Until this last generation, who may indeed turn out to be the first American generation ever to have a shorter life expectancy than the generation before it.

What should you do? Inform yourself, read these articles and search google for evidence for yourself. I suggest you start with “Utah” “Vitamin D” “foundation” (“insert your own disease as a search word here”), Finland, Scotland, Autism, Pregnancy, and read for yourself, decide for yourself. Consult your dr., but keep in mind that she/he may not be able to both see patients and stay current on the thousands (literally) of studies being published around the world in reputable medical journals revealing just how badly we screwed up when we “became afraid of the sun”. Most were taught that the RDA of 400iu was all anyone needed, which is right for rickets but horribly wrongfully low for health. Apparently to me, keeping our children sunless in the 90’s has lead to new epidemics in autism, asthma, diabetes, auto-immune diseases (where the body attacks itself), and it is worse than any crisis on wall street or in banks, to our way of life. So please read and decide for yourself whether insuring that you and yours get enough vitamin D3 (not D2) per day is worth the low, low cost compared to what the alternative might cost you or your child.

Lastly, I cannot recommend anyone take a multivitamin that contains ANY amount of vitamin A, as it has been found to be a direct antagonist of vitamin D, actually blocking it from working. Most multivitamins have absolutely NO studies showing they: reduce heart attacks/strokes/cancer/asthma/diabetes/ANYTHING, other than preventing scurvy, beri-beri, and rickets. Some even carry warning labels that they may cause osteoporosis! If you must take a multivitamin, do it once a month, not once a day. If your physician has instructed to take one daily, please follow that advice until you can talk with your dr. about “why” – and ask for studies or proof, that you will actually benefit and not be harmed by the multivitamins. I am still looking for good studies (properly run) that demonstrate that a multivitamin does any good of any kind! And remember, I do not advocate disobeying your physician but rather talking and discussing what ultimately is in your best health interests, based on science.

There are many supplements you may actually need/want, but my focus here is on D and related adjuncts which are truly basic to health. You do need to take calcium (as directed on the label), preferably those that are mixed with magnesium, manganese, and small amounts of copper and other trace elements needed. If prone to anemia as many women inherently are, some form of iron may also be necessary. If your vitamin D level is 50 or higher, you will absorb far more calcium/manganese/magnesium/iron/etc. as well as begin to store D3 properly. If you are taking a PPI that decreases stomach acid, evidence is growing that you cannot absorb calcium as well as a result, so you need even more help.

If you do start on vitamin D3 (either with or without testing before hand), keep some track of your most chronic issues that your body has symptoms of, and how they change over time as you continue taking D3. Note how often you do or do not get the flu or get sick, and compare that to before you were on D3. You just might be surprised at what is affected by a simple, cheap, safe, and readily available substance like D3 (which your body actually makes with the help of the sun). Remember, it used to be called “the sunshine vitamin” for a reason. We NEED to have sunshine in our lives, not always sitting in an office or in front of the computer/tv.

Caution: I am not saying Vitamin D3 will “do” any particular thing for any ailment you might have and you cannot expect or demand of it such behavior. I am saying that without D3 you cannot give your body its best chance for health, and the science I am seeing is continually elevating the importance of D3 in all things. Just as eating 25 different raw fruits, vegetables, and berries daily will provide fundamental nutritional building blocks, so too does D3 give you a much better chance to be healthy.

A. Ron Carmichael, R.Ph

Again, this is my personal opinion and has nothing to do with CVS, who bears no responsibility for me exercising my professional judgment to educate and help my customers make the right choices towards better health.

HAPPY READING. And I will always be willing to answer any questions I can.

This set of documents is the professional/personal opinion of Ron Carmichael and NOT in any way a policy of CVS Pharmacies. CVS does not require me to hand this out - I do so as a way to inform my patients of important studies.

Today, the FNB has failed millions...

3:00 PM PST November 30, 2010

After 13 year of silence, the quasi governmental agency, the Institute of Medicine's (IOM) Food and Nutrition Board (FNB), today recommended that a three-pound premature infant take virtually the same amount of vitamin D as a 300 pound pregnant woman. While that 400 IU/day dose is close to adequate for infants, 600 IU/day in pregnant women will do nothing to help the three childhood epidemics most closely associated with gestational and early childhood vitamin D deficiencies: asthma, auto-immune disorders, and, as recently reported in the largest pediatric journal in the world, autism. Professor Bruce Hollis of the Medical University of South Carolina has shown pregnant and lactating women need at least 5,000 IU/day, not 600.

The FNB also reported that vitamin D toxicity might occur at an intake of 10,000 IU/day (250 micrograms/day), although they could produce no reproducible evidence that 10,000 IU/day has ever caused toxicity in humans and only one poorly conducted study indicating 20,000 IU/day may cause mild elevations in serum calcium, but not clinical toxicity.

Viewed with different measure, this FNB report recommends that an infant should take 10 micrograms/day (400 IU) and a pregnant woman 15 micrograms/day (600 IU). As a single, 30 minute dose of summer sunshine gives adults more than 10,000 IU (250 micrograms), the FNB is apparently also warning that natural vitamin D input - as occurred from the sun before the widespread use of sunscreen - is dangerous. That is, the FNB is implying that God does not know what she is doing.

Disturbingly, this FNB committee focused on bone health, just like they did 14 years ago. They ignored the thousands of studies from the last ten years that showed higher doses of vitamin D helps: heart health, brain health, breast health, prostate health, pancreatic health, muscle health, nerve health, eye health, immune health, colon health, liver health, mood health, skin health, and especially fetal health. Tens of millions of pregnant women and their breast-feeding infants are severely vitamin D deficient, resulting in a great increase in the medieval disease, rickets. The FNB report seems to reason that if so many pregnant women have low vitamin D blood levels then it must be OK because such low levels are so common. However, such circular logic simply represents the cave man existence (never exposed to the light of the sun) of most modern-day pregnant women.

Hence, if you want to optimize your vitamin D levels - not just optimize the bone effect - supplementing is crucial. But it is almost impossible to significantly raise your vitamin D levels when supplementing at only 600 IU/day (15 micrograms). Pregnant women taking 400 IU/day have the same blood levels as pregnant women not taking vitamin D; that is, 400 IU is a meaninglessly small dose for pregnant women. Even taking 2,000 IU/day of vitamin D will only increase the vitamin D levels of most pregnant women by about 10 points, depending mainly on their weight. Professor Bruce Hollis has shown that 2,000 IU/

day does not raise vitamin D to healthy or natural levels in either pregnant or lactating women. Therefore supplementing with higher amounts - like 5000 IU/day - is crucial for those women who want their fetus to enjoy optimal vitamin D levels, and the future health benefits that go along with it.

For example, taking only two of the hundreds of recently published studies: Professor Urashima and colleagues in Japan, gave 1,200 IU/day of vitamin D3 for six months to Japanese 10-year-olds in a randomized controlled trial. They found vitamin D dramatically reduced the incidence of influenza A as well as the episodes of asthma attacks in the treated kids while the placebo group was not so fortunate. If Dr. Urashima had followed the newest FNB recommendations, it is unlikely that 400 IU/day treatment arm would have done much of anything and some of the treated young teenagers may have come to serious harm without the vitamin D. Likewise, a randomized controlled prevention trial of adults by Professor Joan Lappe and colleagues at Creighton University, which showed dramatic improvements in the health of internal organs, used more than twice the FNB's new adult recommendations.

Finally, the FNB committee consulted with 14 vitamin D experts and – after reading these 14 different reports – the FNB decided to suppress their reports. Many of these 14 consultants are either famous vitamin D researchers, like Professor Robert Heaney at Creighton or, as in the case of Professor Walter Willett at Harvard, the single best-known nutritionist in the world. So, the FNB will not tell us what Professors Heaney and Willett thought of their new report? Why not?

Today, the Vitamin D Council directed our attorney to file a federal Freedom of Information (FOI) request to the IOM's FNB for the release of these 14 reports.

Most of my friends, hundreds of patients, and thousands of readers of the Vitamin D Council newsletter (not to mention myself), have been taking 5,000 IU/day for up to eight years. Not only have they reported no significant side-effects, indeed, they have reported greatly improved health in multiple organ systems. My advice, especially for pregnant women: continue taking 5,000 IU/day until your 25(OH)D is between 50-80 ng/mL (the vitamin D blood levels obtained by humans who live and work in the sun and the mid-point of the current reference ranges at all American laboratories). Gestational vitamin D deficiency is not only associated with rickets, but a significantly increased risk of neonatal pneumonia, a doubled risk for preeclampsia, a tripled risk for gestational diabetes, and a quadrupled risk for primary cesarean section.

Today, the FNB has failed millions of pregnant women whose as yet unborn babies will pay the price. Let us hope the FNB will comply with the spirit of "transparency" by quickly responding to our Freedom of Information requests.

John Cannell, MD
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Children with vitamin D deficiency rickets.

This is a compilation of articles dealing with Vitamin D3 (cholecalciferol) – one of the most potent chemicals your body makes. It appears to affect EVERY organ of your body – all of which have specific receptor sites for the molecule.

D3 is created by sunlight (UV-B rays) striking your skin, starting a chemical reaction with CHOLESTEROL that scientists do not yet fully understand where it all stops.

As the following pages suggest, D3 is incredibly important for your health.

Most drug stores such as CVS and Walgreens now sell a Vitamin D3 tab/cap that is 5,000iu in strength, in bottles of 100 for around \$15.

After much consideration, I am certain that each person over the age of 45 needs to be taking at least one capsule daily. I am not aware of ANY studies that show drug interactions with any other medication, nor does it cause any adverse effects such as nausea, constipation, diarrhea, etc. This is because D3 is what your body actually makes when you expose your skin to the sun in appropriate amounts. As we age, this mechanism actually begins to stop, to fail, such that just when we need D3 the most, just when we need to absorb calcium, magnesium, and manganese, for example to prevent osteoporosis, we lose the ability to create D3 (which is required in order to absorb calcium, for example).

Children MUST be allowed to “play outside” in the sun as much as possible, avoiding burning but also avoiding sunscreen until the skin begins to “pink up”. Sunscreens > 6 spf will totally block the UVB and therefore prevent the normal production of D3. There are studies underway that seem to indicate that early exposure to adequate sun (ie, enough Vitamin D3) actually influences the health of children as they grow into adults.

Vitamin D3 is over-the-counter, it is inexpensive, and often you can “buy 1, get 1 free”, and I urge you to read this information, talk with your family doctor about the possible adverse effects weighed against the enormous and ever-mounting stack of medical evidence that vitamin D3 can provide unexpected and profound benefits to your own health picture. A year’s supply can be as little as \$20, yet can prevent far higher medical costs in my opinion. But read the studies, GOOGLE it for yourself, and talk with your doctor about this. And if possible, avoid the prescription version, D2, which is made from radiating mushrooms (xRaying them), and results in a chemical that is not only foreign to your body but ultimately must be converted to D3 before it is of any use to you.

Insurance companies often charge copays higher for one month than a year’s supply of D3, and therefore it makes little sense to me to take D2 when D3 is OTC and cheaper.

Also, I urge you to avoid any multivitamin that contains the label “caution – may cause osteoporosis” such as Centrum Silver – too much vitamin A actually defeats vitamin D3 in your body, and must be avoided. Instead I urge you to choose colorful foods in the produce area of your grocery store. If you must take a multivitamin, consider taking it once a MONTH, not every day.

Finally, please call me at the CVS pharmacy if you have any questions or doubts.

Ron Carmichael, R.Ph. (512) 267-8010.

NOTE: THE FACTS AND OPINIONS EXPRESSED IN THIS BODY OF DOCUMENTS ARE NOT AN OFFICIAL CVS POLICY – I ALONE AM RESPONSIBLE FOR THEIR PRESENCE AND HANDING OUT TO YOU.

If you decide to find out what your vitamin D level is, I recommend this company, having used it for several years. A single test is around \$70, while my St. David's lab charged me \$320 for the same test. It's a good idea to have some idea each year where your blood level falls, so that you can adjust if needed. I do not recommend taking more than 20,000iu of D3 unless supported by blood level analysis. There is no evidence of toxicity at this level. (nor even much higher levels per day). If in doubt, please ask. Ron Carmichael, R.Ph.

Vitamin D and Your Health Deficiency

Am I Vitamin D Deficient?



[Know your vitamin D level! Order your Vitamin D Test Kit here!](#)

Good Question! There is no way to know for certain until you get a [25-hydroxyvitamin D test](#), also called a 25(OH)D. Levels should be above 50 ng/ml (125 nmol/L) year-round, in both children and adults. Thanks to [Bruce Hollis](#), [Robert Heaney](#), Neil Binkley, and others, we now know the minimal acceptable level. It is 50 ng/ml (125 nmol/L). In a recent study, Heaney, *et al* expanded on Bruce Hollis's seminal work by analyzing five studies in which both the parent compound ([cholecalciferol](#)) and [25\(OH\)D](#) levels were measured. They found that the body does not reliably begin storing cholecalciferol in fat and muscle tissue until 25(OH)D levels get above 50 ng/ml (125 nmol/L). The average person starts to store cholecalciferol at 40 ng/ml (100 nmol/L), but at 50 ng/ml (125 nmol/L) virtually everyone begins to store it for future use. That is, at levels below 50 ng/ml (125 nmol/L), the body uses up vitamin D as fast as you can make it, or take it, indicating chronic [substrate](#) starvation—not a good thing. 25(OH)D levels should be between 50–80 ng/ml (125–200 nmol/L), year-round.

How Can I Order A Vitamin D Test and What Kind Should I Get?

The only blood test that can diagnose [vitamin D deficiency](#) is a 25-hydroxyvitamin D. Get your levels above 50 ng/ml (125 nmol/L) year-round.

The Vitamin D Council has partnered with ZRT Labs to make a discounted take-home [Vitamin D Test Kit](#) that you can order on the Internet. A portion of the proceeds from the sale of each test will be donated to the Vitamin D Council by

ZRT to help us in our mission to end the worldwide epidemic of vitamin D deficiency. The tests will be available to order in either a quantity of one (1) or four (4). Whether you will be testing your entire family or simply retesting yourself, consider the 4 test kit as it is much less expensive per test.

How it works

This is a home test for 25(OH)D, requiring a finger or heel stick to get several drops of blood. You order the test kit, which ZRT will ship to you. After receiving your kit either you, or someone you know in the medical field, will do a finger or heel stick and put the blood on the blotter included in the kit. You will then send the blotter paper back to ZRT in the envelope provided. ZRT will perform the 25(OH)D test in their lab and send the results directly back to you. The Vitamin D Council has verified that results obtained by ZRT are accurate and correspond very well to the results given by both LabCorp and DiaSorin RIA. These tests are good for either adults or children and avoid the venipuncture many children dislike.

However, if you have insurance, you may be able to save money by going to your doctor instead. You can have your doctor order the test—some insurance companies will pay for a 25(OH)D test, some will not. Unfortunately, about 20% of United States doctors order the wrong test. They order a 1,25-dihydroxy-vitamin D, thinking that by measuring the most potent steroid in the human body, [*calcitriol*](#), they are getting useful information. They are not. 1,25-dihydroxy-vitamin D is an adaptive [*hormone*](#); it goes up and down with calcium intake. So these doctors see the 1,25-dihydroxy-vitamin D is normal or high and tell their patients that they are ok when really, they are vitamin D deficient—advice that may prove fatal. Furthermore, most doctors who see a 25(OH)D of 30 ng/ml (75 nmol/L) will tell you that level is fine when it is not—that is, few doctors know how to correctly interpret the test results. With ZRT, you are in control of when you test, how often you test, and what you do with the results.

How Much Vitamin D Should I Take?

Again, we don't know. This is a difficult question because it relies on so many personal factors. Everyone's situation is either a lot, or at least a little, different. How much vitamin D you need varies with age, body weight, percent of body fat, latitude, skin coloration, season of the year, use of sunblock, individual variation in sun exposure, and—probably—how ill you are. As a general rule, old people need more than young people, big people need more than little people, heavier people need more than skinny people, northern people need more than southern people, dark-skinned people need more than fair-skinned people, winter people need more than summer people, sunblock lovers need more than sunblock haters,

sun-phobes need more than sun worshipers, and ill people may need more than well people.

Quite a few factors are involved, as you can see. However, don't feel bad, no one understands it. Vitamin D is used by the body—metabolically cleared—both to maintain wellness and to treat disease. If you get an infection, how much vitamin D does your body use up fighting the infection? If you have [cancer](#), how much vitamin D does your body use up fighting the cancer? If you have heart disease, how much vitamin D does your body use up fighting the heart disease? If you are a child with [autism](#), how much vitamin D does your brain need to turn on the genes that autism has turned off? If you are an athlete, how much vitamin D does your body use to make you stronger and quicker? Nobody knows the answer to these questions.

What We Recommend

If you use suntan parlors once a week or if you live in Florida and sunbathe once a week, year-round, do nothing. However, if you have little [UVB](#) exposure, my advice is as follows: healthy children under the age of 1 years should take 1,000 IU vitamin D3 per day—over the age of 1, 1,000 IU vitamin D3 per every 25 pounds of body weight per day. Well adults and adolescents should take 5,000 IU vitamin D3 per day. Around 2–3 months later have a 25-hydroxyvitamin D blood test, either through ZRT or your doctor.

Start supplementing with the vitamin D *before* you have the blood test. Then adjust your dose so your 25(OH)D level is between 50–80 ng/ml (125–200 nmol/L), summer and winter. But remember, these are conservative dosage recommendations. Most people who avoid the sun—and virtually all dark-skinned people—will have to increase their dose once they find their blood level is still low, even after two months of the above dosage, especially in the winter. Some people may feel more comfortable ordering the blood test before they start adequate doses of vitamin D. We understand. Test as often as you feel the need to, just remember, no one can get toxic on the doses recommended above and some people will need even more.

[John Jacob Cannell MD](#) Executive Director 2008.10.01

*These statements have not been evaluated by the Food and Drug Administration. These products are not intended to diagnose, treat, cure, or prevent any disease.

Vitamin D Research

Vitamin D is one of the oldest [hormones](#), having been produced by life forms for over 750 million years. Phytoplankton, zooplankton, and most animals that are exposed to sunlight have the capacity to make vitamin D. In humans, vitamin D is critically important for the development, growth, and maintenance of a healthy body, from gestation until death.

We invite you to browse the various studies to be found in the sections below and see for yourself the scientific evidence of just how vital vitamin D is to life. To view listing of studies for an area of interest, click on corresponding heading below.

Note: Lists are not all-inclusive.

Announcement: Due to the time-intensive project currently underway of our complete website overhaul, we are unable to keep our Vitamin D Research section updated with the latest research. We apologize for the inconvenience, but would like to assure you that our new website — with full PubMed integration — will have all the latest research on vitamin D, updated in real time.

Research Areas

- [Addison's Disease](#) Data suggest that [VDR genotype](#) is associated with Addison's disease and that a considerable proportion of patients on long-term [glucocorticoid](#) replacement therapy are at increased risk for osteoporosis.
- [Allergic Hypersensitivity](#) There is evidence that vitamin D3 could modulate allergic contact dermatitis by its clearly demonstrated suppressive effects on the activation of [dendritic cells](#). In one study, a 2-week course of [heliotherapy](#) caused a marked healing of atopic dermatitis.
- [Alzheimer's Disease](#) In a cross-sectional study, vitamin-D-sufficient Alzheimer patients had significantly higher Mini-Mental State Examination scores as compared to vitamin-D-insufficient ones, indicating a relationship between vitamin D status and cognition in patients.

- [Ankylosing Spondylitis](#) Evidence indicates that high disease activity in Ankylosing Spondylitis is associated with an alteration in vitamin D [metabolism](#) and increased [bone resorption](#) and that interaction of the vitamin D system, [cytokines](#), and bone could define new diagnostic and therapeutic implications.
- [Asthma](#) Evidence suggests maternal vitamin D intake during pregnancy is inversely associated with asthma symptoms in early childhood and lower vitamin D levels in children are associated with increased markers of asthma severity.
- [Autism](#) Research has shown that low maternal vitamin D3 has important ramifications for the developing brain. Vitamin D is a [steroid hormone](#) with many important functions in the brain, mediated through the nuclear [vitamin D receptor](#) (VDR). Disfunctional VDR demonstrate altered emotional behavior and specific motor deficits.
- [Autoimmune Illness](#) Researchers are discovering an increasing number of links between the [immune](#), [nervous](#), and [endocrine](#) systems. [Hormones](#) of the endocrine system, such as vitamin D, help the immune and nervous systems defend the body, with defects in this intricate system leading to autoimmune disorders.
- [Benign Prostatic Hyperplasia](#) Research shows that [VDR genotype](#) plays an important role in determining the risk of benign prostatic hyperplasia (BPH) and that [vitamin D analogs](#) are able to arrest prostate growth in BPH patients.
- [Best Science](#) Breakthrough science that has played a significant role in broadening humanity's understanding of vitamin D and its importance in the maintenance of health.
- [Bladder Cancer](#) Data suggest that [VDR](#) (Fok-I) [polymorphism](#) is associated with the risk of bladder cancer and that [UVB](#) radiation is inversely related to bladder cancer risk.
- [Brain Cancer](#) Research shows [1,25\(OH\)2D3](#) induces [glioma](#) cell death, making the [hormone](#) of potential interest in the management of brain tumors. Evidence also shows that [vitamin D analog](#) 1 alpha-hydroxyvitamin D2 inhibits growth of human neuroblastoma and that solar [UV](#) irradiance is inversely related to brain cancer risk.
- [Breast Cancer](#) Studies show women with low levels of vitamin D have a 222% increased risk for developing breast cancer. Ecologic studies have shown an inverse correlation between breast cancer mortality and sun exposure and dietary vitamin D intake. Blood levels of vitamin D at the time of diagnosis of breast cancer accurately predict a woman's survival. The cancer is much more aggressive in those with low serum vitamin D levels: they are 94% more likely to have the cancer [metastasize](#) and 73% more likely to die within 10 years of diagnosis.
- [Cancer](#) Vitamin D inhibits inappropriate cell division and [metastasis](#), reduces

blood vessel formation around tumors, and regulates proteins that affect tumor growth. It also enhances anti-cancer actions of immune system chemicals and chemotherapy drugs.

- [Celiac Disease](#) Due to malabsorption, patients with Celiac Disease have a high prevalence of [calcium](#) and vitamin D deficiencies, and are therefore at increased risk of bone disease, such as rickets, osteomalacia, or osteoporosis.
- [Cerebral Palsy](#) Adequate vitamin D levels are particularly important for children with cerebral palsy or other neuromuscular disorders who are at an increased risk of osteoporosis.
- [Chronic Obstructive Pulmonary Disease \(COPD\)](#) Chronic obstructive pulmonary disease includes two main conditions: emphysema and chronic obstructive bronchitis. Research indicates an association between vitamin D binding protein (VDBP) gene, vitamin D deficiency, and COPD susceptibility.
- [Chronic Pain](#) Vitamin D deficiency is a major contributor to chronic low back pain as well as persistent, nonspecific musculoskeletal pain.
- [Cognitive Function](#) Recent research indicates vitamin D deficiency is associated with low mood and cognitive impairment in the elderly.
- [Colon and Rectal Cancer](#) Both circulating [25\(OH\)D](#) and vitamin D intake are inversely associated with colorectal adenoma incidence and recurrent adenomas. Recent studies suggest that women who are vitamin D deficient have a 253% increased risk for developing colorectal cancer.
- [Commentaries and Editorials](#) Commentaries and editorials written by vitamin D scientists and experts as published in the medical journals.
- [Cystic Fibrosis](#) The prevalence of vitamin D deficiency and poor skeletal health is high in patients with cystic fibrosis (CF). Studies show [cholecalciferol](#) increases serum [25\(OH\)D](#) concentrations significantly in CF patients, with the maximum response occurring in persons with the lowest baseline concentrations.
- [Depression and Seasonal Affective Disorder](#) Depression severity has been shown to be significantly associated with decreased serum [25\(OH\)D](#) levels. In one study, in those who had both major and minor depression, vitamin D levels were 14% lower than in people who did not suffer from depression.
- [Diabetes](#) Vitamin D helps maintain adequate insulin levels. Preliminary evidence suggests supplementation can increase insulin levels in people with type 2 diabetes. Prolonged supplementation may help reduce blood sugar levels.
- [Endometrial Cancer](#) In an ecological study of 107 countries, an inverse association was found between [ultraviolet B](#) irradiance and endometrial cancer, indicating the role of [UVB](#) and vitamin D in risk-reduction of endometrial cancer.
- [Epilepsy](#) Research shows that [cholecalciferol](#) may play an anticonvulsant role in the brain and can influence the efficacy of antiepileptic drugs.

- [Ethnicity](#) Ethnicity is an important factor in the determination of vitamin D status of an individual, due somewhat to dietary factors but mostly to skin coloration. Those with darker pigmentation are at much higher risk of vitamin D deficiency than those who are lighter-skinned.
- [Eye Cancer](#) Eye cancer includes intraocular melanoma and retinoblastoma. In [athymic mice](#) in both a large-tumor study and a long-term study, [vitamin D analog](#) 1alpha-OH-D(2) was effective in inhibiting retinoblastoma tumor growth compared with controls.
- [Gastrointestinal Function](#) Absorption of vitamin D from the intestine is negatively impacted by a number of gastrointestinal diseases and in the evaluation of a patient with vitamin D deficiency or insufficiency, a gastrointestinal etiology should be considered.
- [Gaucher's and Fabry's Disease](#) Research indicates vitamin D deficiency is frequent among Gaucher's disease patients and that vitamin D supplementation should be recommended to optimize treatment. Multivariate models of [haplotypes](#) of the [VDR](#) gene [polymorphisms](#) are significantly associated with variation in the Fabry [phenotype](#).
- [Genetics](#) The hormone [1,25-dihydroxyvitamin D3](#) influences the growth and differentiation of a number of cell types by regulating the expression of key target genes. These functions are mediated through the [vitamin D receptor](#) (VDR); therefore, an understanding of the regulation of VDR expression is important when considering the molecular mechanisms of differentiation induced by vitamin D3 and its [analogues](#).
- [Graves' Disease](#) Research shows [vitamin D receptor](#) gene [polymorphisms](#) are associated with Graves' disease in many ethnic groups and that patients with Graves' disease have a different pattern of seasonality of birth when compared with the general population.
- [Hashimoto's Thyroiditis](#) Data suggest that common [haplotypic](#) variants within the [VDR](#) gene 3' region may be involved in the [pathogenesis](#) of Hashimoto's Thyroiditis.
- [Heart Disease](#) Studies have indicated reduced [ultraviolet B](#) exposure in [CHF](#) patients during childhood, adolescence, and early adulthood. [Activated vitamin D](#) has been shown to increase survival in patients with cardiovascular disease. In one study, severe heart failure due to [hypocalcemia](#) was fully resolved after 15 months of supplementation with calcium and vitamin D.
- [HIV and AIDS](#) An inverse association between [1,25\(OH\)2D](#) concentrations and mortality has been reported from a small cohort study of HIV-infected adults, and some cross-sectional studies have indicated positive correlations between 1,25(OH)2D and [CD4+ cell](#) counts. Studies also suggest that [VDR haplotypes](#) might influence the risk of HIV-1 acquisition.
- [Hypertension](#) Clinical and experimental data support the view that vitamin D [metabolism](#) is involved in blood pressure regulation and other metabolic

processes.

- [Inflammatory Bowel Disease](#) The active form of vitamin D, [1,25\(OH\)₂D₃](#), has been shown to inhibit development of inflammatory bowel disease and play a critical role in the response of the colon to chemical injury.
- [Influenza](#) Recent discoveries indicate vitamin D upregulates the [endogenous](#) antibodies of [innate immunity](#). It is hypothesized that vitamin D's seasonal and population effects on innate immunity are a major factor in the [epidemiology](#) of influenza. (Note: Page also includes research on the effects of ultraviolet light on the influenza virus.)
- [Innate and Adaptive Immunity](#) People with low levels of vitamin D are 40% more likely to report respiratory infections such as colds and flu. Research indicates that infants and children appear more susceptible to viral rather than bacterial infections in the face of vitamin D deficiency. The connection between vitamin D, infections, and immune function in the pediatric population indicates a possible role for vitamin D supplementation in potential interventions and adjuvant therapies.
- [Liver Cancer](#) Studies indicate that Seocalcitol, a [vitamin D analog](#), is an effective growth inhibitor of hepatocellular cancer tumors and that [calcitriol](#) (activated vitamin D) inhibits the growth of MHCC-97 hepatocellular cell lines.
- [Liver Function](#) Diseases of the liver can impact the [metabolism](#) of vitamin D to its circulating form, [25\(OH\)D](#). Research shows that [VDR](#) is expressed in human hepatocytes and may play a critical role in the inhibition of bile acid synthesis, thus protecting liver cells during [cholestasis](#).
- [Lung Cancer](#) *In vitro* studies, performed with lung cancer cell lines, have shown an inhibitive effect of vitamin D derivatives on cell-growth and proliferation. In one [prospective cohort study](#), women with the highest vitamin D blood levels were 84% less likely to develop lung cancer. Young participants with the highest levels were 66% less likely to have the disease.
- [Lymphoid Cancer](#) Lymphoid cancer includes [lymphoma](#), [myeloma](#), and [leukemia](#). Studies suggest sunlight has a protective effect against non-Hodgkin lymphoma. [Epidemiological](#) data indicate season of diagnosis is a strong prognostic factor for Hodgkin's lymphoma, with approximately 20% lower case fatality for patients diagnosed during autumn (as opposed to winter) and an autumnal survival rate higher than 60% for patients younger than 30 years. This may be the result of higher [endogenous](#) levels of vitamin D in autumn.
- [Melanoma](#) An inability to tan is the number one risk factor for melanoma. Those who tan easily or who have darker skin are far less likely to develop the disease. A new theory is that melanoma is actually caused by sunlight (vitamin D) deficiency and that safe sun exposure actually helps prevent the deadly disease.
- [Mental Illness](#) Vitamin D deficiency has been implicated in various psychiatric

and neurologic disorders.

- [Mineral Metabolism](#) Vitamin D is well known for its involvement in mineral metabolism, especially its necessity in the facilitation of intestinal absorption of [calcium](#). Vitamin D also stimulates absorption of [phosphate](#) and [magnesium](#) ions.
- [Mortality](#) Low vitamin D status is being associated with a multitude of diseases and higher overall mortality. (Note: page includes studies on all-cause mortality as well as mortality related to specific health issues.)
- [Multiple Sclerosis Epidemiological](#) evidence combined with clinical and laboratory analyses, and experimental animal models, suggest a possible influence of vitamin D on MS susceptibility as well as clinical disease activity.
- [Muscular Weakness and Falls](#) Specific receptors for vitamin D have been identified in human muscle tissue. Cross-sectional studies show that elderly persons with higher vitamin D serum levels have increased muscle strength and a lower number of falls.
- [Obesity](#) Serum vitamin D is significantly lower in obese individuals, putting them at increased risk for the many health disorders related to vitamin D deficiency.
- [Osteoarthritis](#) Low intake and low serum levels of vitamin D appear to be associated with an increased risk for progression of [osteoarthritis](#).
- [Osteomalacia](#) Osteomalacia is most often caused by a prolonged lack of vitamin D. Treating osteomalacia with vitamin D and calcium has been shown to be highly effective.
- [Osteopenia](#) Vitamin D intake level in adolescence, and the course of vitamin D intake from adolescence into adulthood, are positively related with bone mineral density in adulthood.
- [Osteoporosis](#) Research indicates a diet rich in calcium, other minerals, and vitamin D in association with physical activity represents the most effective way to lower osteoporosis risk.
- [Otosclerosis](#) Research indicates vitamin D deficiency is possibly a factor in the [etiology](#) of otosclerosis. Calcium and vitamin D replacement therapy has resulted in significant hearing improvement in some otosclerotic patients.
- [Ovarian Cancer Epidemiological](#) data indicate a positive association between higher latitude and ovarian cancer incidence and mortality rates, suggesting that vitamin D insufficiency may contribute to ovarian cancer development.
- [Pancreatic Cancer](#) Ecological studies associate sun exposure with lower death rates for pancreatic cancer. In two United States cohort studies, higher intakes of vitamin D were associated with lower risks for pancreatic cancer, indicating a potential role for vitamin D in the [pathogenesis](#) and prevention of pancreatic cancer.
- [Parathyroid Function](#) Low plasma vitamin D3 is quite common in patients with parathyroid disease.

- [Parkinson's Disease](#) Chronically inadequate vitamin D intake is hypothesized, due to several lines of documented evidence, to be a significant factor in the pathogenesis of Parkinson's Disease.
- [Pediatrics](#) Research indicates vitamin D deficiency is common in children and adolescents worldwide, even if they are healthy. In a US study, the prevalence was highest in African American teenagers and during winter, although the problem seemed to be common across sex, season, and ethnicity.
- [Pharmacology](#) Though several [vitamin D analogues](#) have been shown to be effective in various studies, the effectiveness of plain vitamin D3 cholecalciferol continues to remain superior.
- [Physiology](#) Since its discovery, the nuclear [vitamin D receptor](#) (VDR) has been found to be present in over 30 tissues and organs of man, indicating a broad sphere of influence over health and vitality.
- [Postmenopause](#) Serum 25-hydroxyvitamin D levels have an independent inverse association with total body and regional fat mass in nonosteoporotic, overweight, postmenopausal women. Adequate vitamin D intake should be encouraged for all postmenopausal women to reduce bone loss.
- [Pregnancy and Lactation](#) Due to widespread vitamin D deficiency, most human breast milk is deficient in vitamin D. Studies show high-dose vitamin D (4000 IU/day) is effective and safe in increasing 25(OH)D levels in breastfeeding mothers to optimal levels, without evidence of toxicity or any vitamin D-related adverse events to mother or infant.
- [Premenstrual Syndrome](#) Studies show a significant association between low [25\(OH\)D](#) levels and higher incidence of premenstrual syndrome (PMS). Treatment with calcium plus vitamin D decreases symptom severity in women with PMS.
- [Prostate Cancer](#) Research shows that men with higher vitamin D levels are 50% less-likely to develop aggressive forms of prostate cancer than those with lower levels. [Calcitriol](#), the active form of vitamin D, significantly limits the ability of prostate cancer cells to invade healthy cells. In one study, patients with the highest vitamin D levels (>32 ng/mL) were 7 times less-likely to die from their prostate cancer over the 3.5 years of the study.
- [Renal Function](#) A high proportion of renal patients are vitamin D deficient/insufficient. Research indicates [cholecalciferol](#) supplementation is an effective treatment to correct vitamin D status in patients with chronic kidney disease.
- [Requirements](#) Research indicates that well adults and adolescents should receive at least 5,000 IU vitamin D3 per day (either from sunlight or supplementation) to achieve blood levels in the desired range of 50–80 ng/mL. For adults, the 5 microgram (200 IU) vitamin D recommended dietary allowance may prevent [osteomalacia](#) in the absence of sunlight, but much more is needed to help prevent osteoporosis, secondary

hyperparathyroidism, and all other vitamin D deficiency-related diseases.

- [Reviews](#) Peer-reviewed papers on vitamin D.
- [Rheumatoid Arthritis](#) Evidence of the role of vitamin D in the regulation of [T cells](#) and [B cells](#), [macrophages](#), [dendritic cells](#), and [keratinocytes](#) continues to accumulate and provides a link between vitamin D and many autoimmune diseases, including rheumatoid arthritis.
- [Rickets](#) Vitamin D deficiency rickets is considered to be the most common non-communicable disease of children worldwide. Research shows daily vitamin D supplementation of 400 IU/L or more prevents rickets in infants and young children.
- [Sarcoidosis](#) Many studies suggest an association between [Gc-globulin phenotypes](#) and resistance, or susceptibility, to sarcoidosis. Although sarcoidosis frequently causes a dysregulation of vitamin D production, sarcoidotic patients should generally be advised to avoid sun exposure due to a high prevalence of complications with co-existent [hypercalcemia](#).
- [Sickle Cell Disease](#) Vitamin D deficiency is common in children with [homozygous](#) SS sickle cell disease (SCD-SS) due to their increased skin [melanin](#) concentrations, reduced levels of physical activity, and poor vitamin D intake. Treatment of adult sickle cell disease with vitamin D and [calcium](#) has been shown to restore [25\(OH\)D](#) levels to normal and improve bone mineral density.
- [Skin Cancer](#) Studies reveal a critical role for [VDR](#) in the repair and removal of severely damaged keratinocytes and adaptation of the skin to chronic [UV](#) exposure.
- [Stroke](#) Low levels of [25\(OH\)D](#) and [1,25\(OH\)2D](#) are independently predictive for fatal strokes, suggesting that vitamin D supplementation is a promising approach in the prevention of strokes. Data also indicate that vitamin D3 reduces [ischemia](#)-induced brain damage.
- [Toxicity](#) One of the [least toxic substances to humans](#), overdose of vitamin D3 doesn't occur until more than 100 times (approximately one bottle of vitamin D3 tablets) the daily [RDA](#) has been taken daily for several months. Acute, one-time overdoses require over 50 mg (10,000 times the RDA).
- [Toxin and Radiation Exposure](#) Research indicates vitamin D is a significant factor in detoxification and protection against environmental toxins and that vitamin D3 may protect hair follicles from radiation toxicity.
- [Treatment](#) Vitamin D has proven to be a safe and effective treatment for a wide range of health disorders.
- [Tuberculosis](#) [Vitamin D receptor](#) (VDR) [genotypes](#) have been shown to be associated with differential susceptibility or resistance to tuberculosis.
- [Turner's Syndrome](#) Women and girls with Turner syndrome (TS) generally have a lower bone mineral density (BMD) and have been shown to have a 25% higher risk of fracture. Studies show that [1,25\(OH\)2D3](#) administration

raises serum [osteocalcin](#) levels in those with TS.

- [UV Exposure](#) Sunlight has an enormous impact on health via the skin's [neuroendocrine system](#). Exposure to UVB enables the body to build a strong skeletal structure, heart, and muscles as well as optimize the immune system and utilization of sugar. Compared with nontanners, tanners have been found to have robust levels of 25-hydroxyvitamin D at winter's end and, as a result, higher bone density.
- [Veterinary and Animal Studies](#) Animal and veterinary research wherein vitamin D is listed as a factor.
- [Vitamin D Deficiency](#) Vitamin D Deficiency is a world-wide epidemic, with over one billion people at risk for its associated diseases.
- [Worst Science](#) The Vitamin D Council reviews three studies which, due to their faulty science, have done a grave disservice to humanity by preventing adequate vitamin D nutrition.

*These statements have not been evaluated by the Food and Drug Administration. These products are not intended to diagnose, treat, cure, or prevent any disease.

Vitamin D Quotes

- Humans make thousands of units of vitamin D within minutes of whole body exposure to sunlight. From what we know of nature, it is unlikely such a system evolved by chance. ~ [Dr. John Cannell](#), Executive Director, Vitamin D Council.
- If this theory is true, the path towards effective prevention — and perhaps a treatment effect if adequate physiological doses of vitamin D are given — is so simple, so safe, so inexpensive, so readily available and so easy, that it defies imagination. ~ [Dr. John Cannell](#), Executive Director, Vitamin D Council, on his Vitamin D Theory of Autism.
- Adults with decreased serum 25(OH)D levels have significantly higher risk of death from HF and premature death, and this may beget additional justification for the study of vitamin D supplementation... ~ Howard J. Eisen MD, chief of cardiology division at Drexel University College of Medicine, Philadelphia.
- As is usually the case with medical research, once breakthroughs in knowledge firmly establish the importance of a compound such as vitamin D, interest and research dollars begin to flow. We may soon learn just how many of yesterday's maladies could have been prevented by a simple, cheap daily vitamin pill. ~ Dr. Dan Gold, board-certified family physician who treats U.S. military veterans.
- For hundreds of thousands of years, man has lived with the sun: Our ancestors were outdoors far more often than indoors. We developed a dependence on sunshine for health and life, so the idea that sunlight is dangerous does not make sense. How could we have evolved and survived as a species, if we were that vulnerable to something humans have been constantly exposed to for their entire existence? ~ Dr. Frank Lipman, internationally recognized expert in the fields of Integrative and Functional Medicine and practicing physician.
- A closer study of the action of solar radiation on the body might well reveal the nature of cancer immunity. ~ Dr. Frank Apperly, concluding remark of his 1941 study on cancer rates vs. latitude.
- The big mistake was that the idea that sun exposure causes melanoma went public before it was proved. In fact, we don't know what causes melanoma. ~ Sam Shuster, Professor Emeritus, Department of Dermatology, Newcastle University and Honorary Consultant to the Department of Dermatology, Norfolk and Norwich University Hospital.
- Suntan is an evolutionary device, it protects against burning...A suntan is just a sign of increased pigment, melanin, in the skin and is a natural biological response to the sun, not a sign of skin damage. ~ Sam Shuster, Professor Emeritus, Department of Dermatology, Newcastle University and Honorary Consultant to the Department of Dermatology, Norfolk and Norwich University Hospital.
- In terms of getting more bang for your health care buck, Vitamin D testing and supplementation for the population is one solution which is guaranteed to improve overall health of the population at a ridiculously low cost. ~ Jeffrey Dach MD.
- The danger of too much sun is minimal — the danger of too little sun is enormous. ~ Dr. Michael R. Eades.
- I would recommend that every patient, every person in America get their vitamin D checked, because so many people are low and the ramifications of having low vitamin D are so severe. ~ Dr. Richard Honaker, family practice physician.
- If you think of it evolutionarily, it's the oldest [hormone](#) on this Earth. I don't think that this is going to be a flash in the pan. ~ [Dr. Michael F. Holick](#), Vitamin D expert.
- Because vitamin D is so cheap and so clearly reduces all-cause mortality, I can say this with great certainty: Vitamin D represents the single most cost-effective medical intervention in the United States.

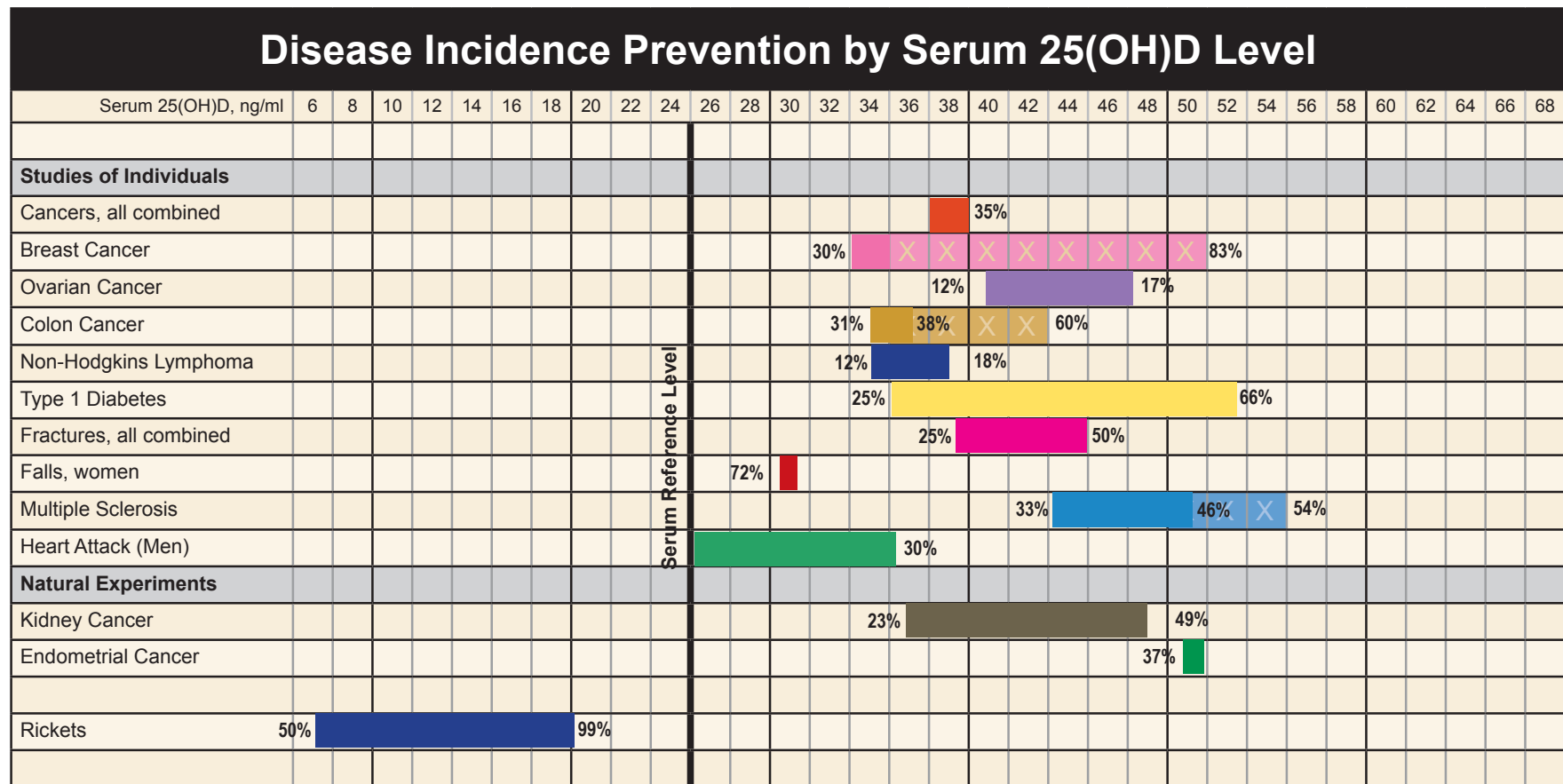
~ Dr. Greg Plotnikoff, Medical Director, Penny George Institute for Health and Healing, Abbott Northwestern Hospital in Minneapolis.

- I believe [vitamin D] is the number one public health advance in medicine in the last twenty years. ~ Dr. John Whitcomb, Aurora Sinai Medical Center.
- I do think vitamin D is one of the most promising nutrients for prevention of cardiac disease and cancer, and I believe in it strongly. ~ Dr. JoAnn Manson, Professor, Department of Epidemiology, Harvard School of Public Health, Professor of Medicine, Harvard Medical School, Chief, Division of Preventive Medicine, Department of Medicine, Brigham and Women's Hospital.
- My goal as a physician in our community is to improve the health of our community, and Vitamin D testing and supplementation is one way to achieve that goal with no adverse side effects and enormous cost savings. ~ Jeffrey Dach MD.
- Light is the basic component from which all life originates, evolves, and is energized. Light and health are inseparable. ~ Ken Ceder, former co-director Hippocrates Health Institute, Boston, Massachusetts.
- Natural sunlight's benefits are not limited to vitamin D production. As light enters the eyes, photoreceptors convert the light into nerve impulses that travel along the optic nerve to the brain. These impulses trigger the [hypothalamus](#) gland to send [neurotransmitters](#) to regulate the automatic functions of the body, such as blood pressure, body temperature, respiration, digestion, sexual function, moods, immune and hormonal modulation, and [circadian rhythm](#). ~ John Maher, DC, DCCN, FAAIM.
- This is like the Holy Grail of cancer medicine; vitamin D produced a drop in cancer rates greater than that for quitting smoking, or indeed any other countermeasure in existence. ~ Dennis Mangan, clinical laboratory scientist.
- No other method to prevent cancer has been identified that has such a powerful impact. ~ [Dr. Cedric Garland](#), Vitamin D expert.
- Vitamin D is a hormone... powerful, potent, and paleo-to-the-core. Since pre-paleolithic times, Vitamin D has been produced in our skin from the [UVB](#) radiation of sunlight. The sun indeed powers nearly all life on earth. It is essential and signals reproduction, energy and longevity for not just humans but all land and marine plants, prokaryotes, and animals. ~ Dr. BG, pharmacologist.
- I would challenge anyone to find an area or nutrient or any factor that has such consistent anti-cancer benefits as vitamin D. The data are really quite remarkable. ~ [Dr. Edward Giovannucci](#), Vitamin D expert.
- In all my many years of practice of medicine, I've never seen one vitamin, even vitamin C, have such profound effects on human health. ~ Dr. Soram Khalsa, board-certified internist and medical director for the East-West Medical Research Institute.
- We estimate that vitamin D deficiency is the most common medical condition in the world. ~ [Dr. Michael F. Holick](#), Vitamin D expert.
- Our most important [hormones](#) depend upon adequate reserves of [cholesterol](#) for their production and nowhere is this more important than as the precursor substance for the synthesis of Vitamin D, known also as [calcitriol](#). Researchers in this field are sufficiently concerned from the results of their studies to pronounce that we are in the midst of an epidemic of vitamin D deficiency of immense proportion. ~ Duane Graveline MD MPH, former NASA Astronaut, former USAF flight surgeon, and retired family doctor.
- The problem is that vitamin D is not really a vitamin, it's a [hormone](#). If your [thyroid hormone](#) level was low, you'd gain 20, 30, or more pounds in weight, your blood pressure would skyrocket, you'd lose your hair, become constipated, develop blood clots, be terribly fatigued. In other words, you'd suffer profound changes. Likewise, if thyroid hormone levels are corrected by giving you thyroid hormone, you'd experience profound correction of these phenomena. That's what I'm seeing with vitamin D: restoration

of this hormone to normal [blood levels](#) (25-OH-vitamin D3 50 ng/mL) yields profound changes in the body. ~ Dr. William Davis, cardiologist.

- The Sun is the cosmological phenomenon which is mainly responsible for what the world has become and it would be impossible to remove from the skies without ending the existences of most of all living beings in the same process. ~ Unknown.
- Vitamin D is [cholecalciferol](#), a hormone. Deficiencies of hormones can have catastrophic consequences. ~ Dr. William Davis, cardiologist.
- Vitamin D deficiency is an unrecognized, emerging cardiovascular risk factor, which should be screened for and treated. Vitamin D is easy to assess, and supplementation is simple, safe, and inexpensive. ~ James H. O'Keefe MD, cardiologist and Director of Preventive Cardiology, Mid America Heart Institute, Kansas City, Missouri.
- It has been clearly established that the only way for your body to synthesize vitamin D is in your skin once it's exposed to ultraviolet rays from the sun. Hence, the current guidelines to avoid sun exposure, and the fervent pushing of sunscreen, are perhaps some of the most misguided and dangerous health recommendations out there. ~ Leif Grunseth, certified neuromuscular therapist.
- The sun is the orchestra leader for the dance of life. Every living thing on earth vibrates to the energy of the sun, including people. For a long time people have been victims of a huge scam that made them think they were supposed to hide indoors or under a blanket of sunscreen while the rest of life basked in the glory of the sun. Now they are catching on that they too need the sun's life-giving force. ~ Barbara Minton, natural health editor.
- Sunlight is life. ~ Dr. William Meller, board-certified internist.
- Whoever wishes to investigate medicine properly should proceed thus: in the first place to consider the seasons of the year. ~ Hippocrates, the father of medicine (circa 400 B.C.).

Dr.Lee can show you what these mean. The higher the blood level of Vitamin D, the more reduction in chances of getting these. Vitamin D3 is very important! There are also studies showing that neuromuscular function is impaired by low levels of Vitamin D.



Legend:

All percentages reference a common baseline of 25 ng/ml as shown on the chart.

%s reflect the disease prevention % at the beginning and ending of available data. Example: Breast cancer incidence is reduced by 30% when the serum level is 34 ng/ml vs the baseline of 25 ng/ml. There is an 83% reduction in incidence when the serum level is 50 ng/ml vs the baseline of 25 ng/ml.

The x's in the bars indicate 'reasonable extrapolations' from the data but are beyond existing data.

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PortlandTribune

Prescription: More sun

Research suggests that a lack of sunlight could be tied to variety of illnesses

BY PETER KORN

The Portland Tribune, Jul 29, 2010



JEFFREY BASINGER / TRIBUNE PHOTO

Mari Martinez, manager of Tan Republic on West Burnside Street, uses the shop's high pressure tanning bed as a source of Vitamin D, which she says helps elevate her mood. A growing number of scientists across the country believe that lack of sun exposure and Vitamin D are responsible for Oregon's high rate for a number of diseases.

Gene Stubbs will admit that just a few years ago he might have laughed at the very research he's now involved in. He might have thought the theory he's been testing would have been better suited for zealots desperate for a simple explanation where none existed.

Here's the theory: Autism might be caused by mothers not getting enough sunlight or Vitamin D supplementation during their pregnancies.

Now, Stubbs isn't a parent of an autistic child grasping at straws. He's a respected associate professor emeritus of psychiatry and pediatrics at Oregon Health & Science University who has turned into a researcher in his retirement. And he's well aware that plenty of people have claimed to know why autism rates have skyrocketed in recent years, and that most of their explanations had little to do with hard science.

But if Stubbs is right about the autism/Vitamin D link, he and a growing legion of scientists across the country might also be right about their larger theory – that lack of sun exposure and Vitamin D explains Oregon's high rates of depression, multiple sclerosis, bone disease, cancers and dozens of other maladies, including colds and flu.

In short, if sun exposure is necessary for good health, Portland residents are in a boatload of trouble. Vitamin D pills may help, but nobody is certain the pills are as effective as sun exposure.

Vitamin D deficiency may be the latest medical fad, but this one has a fair amount of scientific evidence to support it. Even skeptics, who remember the grandiose claims made about Vitamin E a couple decades ago, are reluctant to say there's nothing to the Vitamin D theory. Instead, they preach caution to colleagues who appear too quick to rush to judgment.

But consider that in researching this story the Tribune interviewed more than a dozen physicians and scientists with an interest in Vitamin D, and every single one, including skeptics, said they take daily Vitamin D supplements themselves.

The basic theory goes like this: for the past 20 years or so, fear of skin cancer and an increasingly indoor culture have kept us out of the sun, or lathered with sun block when we do go outside. We get most of our Vitamin D, which is really more a hormone than a vitamin, from exposure to the sun. So nationally, Vitamin D blood levels have been plummeting.

In fact, they have been dropping so much that even people in Arizona and Florida now have Vitamin D levels nearly as low as people who live in Oregon, where it's almost impossible to get enough sun exposure.

That's why Michael Holick, professor of medicine at Boston University Medical Center, author of "The Vitamin D Solution," and the unofficial godfather of Vitamin D theory, says that he expects southerly climes to see a rise in the rates of diseases that historically have been more prevalent in Oregon.



TRIBUNE PHOTO: CHRISTOPHER ONSTOTT • Dozens of people soak up the sun's rays at the Ira Keller Fountain in Southwest Portland. Sunshine can be the best source of Vitamin D, and the most dangerous, according to dermatologists.

One of those diseases is autism. In November 2008, a well-publicized study in the Archives of Pediatrics and Adolescent Medicine revealed that areas of Oregon, Washington and California with the most rain had much higher rates of autism than the rest of the country – and higher rates than dryer regions in those three states.

At the time, researchers thought the explanation might come from behaviors. Maybe children in rainier areas such as Portland were spending too much time indoors, exposed to toxic chemicals, or too much television. But other studies have had researchers looking elsewhere. Among them were two studies that looked at Somali immigrants who had settled in Sweden and Minnesota.

In sun-bleached Somali, autism isn't even identified; there isn't even a word for it, according to Stubbs and others. But the Somali refugees in northern cities are having children with autism at incredibly high rates, in numbers even greater than the white-skinned residents of Sweden and Minnesota. In Sweden, Stubbs says, autism among Somali refugees is called "the Swedish disease."

It just might be a Vitamin D-linked disease, say Stubbs and others. Black skin doesn't absorb the sun's rays nearly as well as white, so dark-skinned people in northern climates are most Vitamin D deficient of all. In fact, many diseases, including hypertension and diabetes, are more common among African Americans, and some researchers believe their lower levels of Vitamin D might be at least partially responsible.

Most of the evidence linking Vitamin D deficiency and diseases is epidemiological – looking at large numbers of people and correlating their disease rates with measurable factors. And that's the primary problem with Vitamin D theories: They lack the more substantial proof that comes with double-blind, controlled clinical studies.

But what Stubbs has been doing for the past two years is slowly recruiting women from across the country who have given birth to an autistic child, and who anticipate having another child. Because autism has a genetic component, about one in 10 or slightly fewer of those second children should be autistic, all else being equal, Stubbs says.

Stubbs is giving those pregnant women 5,000 international units (IUs) of Vitamin D pills a day, and expecting that few if any of the children will develop autism.

So far, Stubbs has 14 women enrolled, 10 of whom have given birth. All the babies appear normal, but autism often takes as long as three years to be diagnosed. He knows he has to wait, and enroll many more women to have convincing evidence. But Stubbs says when he looks at the 10 newborn children and how they respond to those around them, he can't help but feel he's on to something.

"As a scientist I have to say, I don't know. Emotionally, I believe there is a connection between Vitamin D deficiency during pregnancy and autism," Stubbs says.

And count Stubbs among those who believe the autism connection is only a small part of a larger Vitamin D story.

"The whole world is Vitamin D deficient," he says. "It's a pandemic."

Miracle prevention

Michael Holick is the man most responsible for sounding alarms about the possible Vitamin D link to maladies that include osteoporosis, arthritis, diabetes, dementia and even premature birth. He says that overall, the U.S. population is 20 percent more D deficient than it was 20 years ago due to overblown fears of sun exposure. About one in four Americans take Vitamin D supplements, he says, but "everybody needs it."

Holick concedes that much of the evidence for the Vitamin D effect comes from epidemiological studies showing, for instance, higher rates from colon, breast, ovarian and prostate cancers in northern regions with diminished sun exposure. But, he says, there are a growing number of randomized clinical trials proving D has a role in causing or triggering disease.

Among Holick's favorites is a 2007 study by researchers at Creighton University School of Medicine, who followed 1,179 healthy women for four years. Half received daily doses of Vitamin D and calcium (which helps the body absorb D), and half received a placebo. After four years, the women taking the Vitamin D had a 77 percent lower cancer rate.

Holick is unabashed in proclaiming Vitamin D's role in health.



TRIBUNE PHOTO: JEFFREY BASINGER • David Kimball, lab technician specialist at ZRT Laboratory in Beaverton, runs a blood spot puncher, the first step in the process of analyzing Vitamin D levels from a take-home blood spot test.

“It’s not a miracle, it’s a miracle prevention that mother nature designed 750,000 years ago,” he says.

In Charleston, S.C., researcher Carol Wagner studied 494 pregnant women, almost all of whom were Vitamin D deficient despite living in a sunny state. Some received a placebo during their pregnancy and others received varying doses of Vitamin D. The women receiving the highest doses of D – 10 times the standard dose in most prenatal vitamins – had half as many premature births and lower rates of infection.

Wagner, a professor of pediatrics at the medical center, says she’s recommending pregnant women start taking 4,000 International Units (IUs) of Vitamin D a day, not the 400 IUs most obstetricians prescribe. And she’s frustrated that acceptance of the Vitamin D effect is so slow.

“People say we don’t want this to get out of hand, but it’s amazing,” Wagner says. “As a society we will take all these other pills, which have so many more side effects, without even hesitating. And little old Vitamin D has to prove itself.”

In Corvallis, Adrian Gombart, assistant professor at the Oregon State University Linus Pauling Institute, is using animal studies to figure out how Vitamin D deficiency can be linked to so many diseases. D plays a role in regulating thousands of genes, Gombart says, but it’s hard to study because many of its effects take place over a long period of time, rather than as a direct cause and effect.

In some cases, Gombart says, it appears childhood exposure to sunlight and Vitamin D correlate with diseases decades later. Gombart thinks the answer might lie in the immune system, and his research is focusing on genes that are regulated by Vitamin D and that help fight infection.

Holick and Gombart estimate that seven of 10 Americans have insufficient Vitamin D levels, but nobody is precisely certain what constitutes a sufficient level.

‘Is it truth yet?’

At Oregon Health & Science University, professor of medicine Eric Orwoll has studied variations in Vitamin D levels around the country. Orwoll analyzed blood samples from 5,995 elderly men in Birmingham, Ala., Minneapolis, Palo Alto, Calif., Pittsburgh, San Diego and Portland. Not surprisingly, the men in Portland, Minneapolis and Pittsburgh had the lowest levels of Vitamin D. But only San Diego men had significantly higher levels. The men in Alabama and Palo Alto had levels just a little higher than those in Portland.

And that helps explain why Orwoll says he maintains a “healthy skepticism” about all the claims being made about Vitamin D. He says there have been too many miraculous discoveries based on epidemiological data that turned out to be mistaken.

“Everybody jumps on a bandwagon and proclaims truth and knowledge until five years later, something happens and you have to change your mind,” Orwoll says. “I think we have to be careful about how much we jump on this bandwagon.”

Orwoll, an endocrinologist, says he’s convinced that Vitamin D deficiency can lead to bone disease. Without clinical trials he’s less sure about the connection to immune system diseases such as multiple sclerosis, which has been linked to Vitamin D and which has a high rate of occurrence in Oregon.

“It’s a really intriguing hypothesis,” Orwoll says. “Is it truth yet? No. If I had MS, would I make sure my Vitamin D levels were good? I would.”

Count David Leffell among the Vitamin D skeptics. Leffell, professor of dermatology and surgery at Yale University School of Medicine, represents the group most at odds with Holick and his followers – dermatologists.

Leffell, the author of “Total Skin: The Definitive Guide to Whole Skin Care For Life,” has for decades been one of the loudest voices warning people about the risk of skin cancer from unblocked sunlight. People

shouldn't go out in the sun during midday hours unprotected, he says. And they definitely shouldn't use tanning beds.

"While we don't know the truth about Vitamin D, we do know the truth about ultraviolet radiation," Leffell says. "It's the only EPA-documented environmental carcinogen."

Leffell calls the Vitamin D/cancer connection "intriguing." He recognizes D has some therapeutic effects. But all those diseases?

"When it comes to therapies, as a general rule if a pill or a vitamin or a supplement does a dozen different things, the odds are it does nothing," Leffell says.



TRIBUNE PHOTO: JEFFREY BASINGER • The D-Lite System, which produces only UVB rays, is designed for people who want the benefits of the sun without tanning. It only takes about 20 minutes to make a significant increase in your Vitamin D levels.

Adequate doses

Moving from station to station in an expansive laboratory in Beaverton, Mark Newman has no such doubts.

Newman is the vice president of Laboratory Operations for ZRT Laboratory, a company on the leading edge of Vitamin D research. ZRT has developed a mail-order Vitamin D test that requires only a pin prick and a drop of blood.

A scientist in Jordan wanted to test the Vitamin D levels of 2,000 babies in a country where women, including pregnant women, stay covered head to toe. Simple heel sticks will yield 2,000 drops of blood on collection cards mailed to ZRT in Beaverton, and the researcher will have her answer. So far, 50 samples have been analyzed and all the children had negligible Vitamin D levels.

"I can't even imagine the issues those kids must have," Newman says.

Newman says he works with a Canadian researcher who is using Vitamin D supplements in an attempt to get the serum levels of cancer patients up to 100 nanograms per milliliter (ng/mL) – more than three times the conventionally recommended level for adults.

ZRT employs 85 people and virtually all test their own levels and take Vitamin D supplements. This is a company focused on Vitamin D's health impact.

The bathroom at ZRT even includes a Vitamin D light, so employees can take off their shirts and get a few minutes of D-producing rays on their breaks.

“We’re very competitive with our levels,” says Amy Paoletti, the company’s business development manager.

Newman says after working with scientists studying Vitamin D, he’s convinced that if everyone in Oregon and elsewhere took adequate doses of Vitamin D supplements, cancer rates would drop dramatically. He also says there would be a lot less flu going around in the winter, due to D’s effect on immune systems.

“If this were a pharmaceutical product, there would be a movement to put it in the drinking water like fluoride,” Newman says.

Vital information on Vitamin D

- **In Oregon, the summer sun is high enough for people to produce significant Vitamin D from about 10 a.m. to 3 p.m.**

- November through February, even sunbathing Oregonians can't get rays to produce Vitamin D because the sun's angle is too low in the sky.

- **Vitamin D is stored in fat cells and later released, so that sun exposure in the summer can yield higher blood levels of D in the winter.**

- Dark-skinned people need at least twice as much (and possibly more) sun exposure to produce the same amount of Vitamin D. Researchers speculate that early humans living near the equator developed dark skin to protect against overexposure to the sun. As humans migrated away from the equator, natural selection dictated they lose their protective darker skin so they could process adequate Vitamin D from a less potent sun.

- **Most tanning beds and special Vitamin D home lights can help people raise their blood levels of Vitamin D.**

- Sunlight coming through glass will not yield any Vitamin D.

- **Sunlight destroys excess Vitamin D made in the body, making overdosing impossible, according to Michael Holick, author of “The Vitamin D Solution.” Physicians disagree on potential overdose thresholds from D supplements, though Holick says adult “Vitamin D intoxication” would require at least 10,000 IU of D a day for six months.**

- Even foods rich in Vitamin D generally won't raise blood concentrations to the levels most researchers are recommending. But foods that help the body produce Vitamin D include salmon, mushrooms and fortified foods such as milk products.

- Researchers disagree on an adequate level of Vitamin D, but nearly all agree that the current government supplement recommendation of 400 International Unit's a day is much too low. Scientists interviewed for this story reported they took daily supplements ranging from 1,000 IUs a day up to 10,000 IUs a day.

Endocrine today

CLINICAL NEWS ON DIABETES AND ENDOCRINE DISORDERS

Vitamin D: Research appears to support greater daily intake

From cancer to stroke to autoimmune diseases, research is piling up on vitamin D's potential effects.

Since its discovery in 1922, vitamin D was associated with bones and only bones. Vitamin D deficiency led to rickets in children and osteomalacia in adults, but there was little indication that it played an active part in other types of tissues or diseases.

In 1971, the active form of vitamin D, 1,25(OH)₂D₃, was discovered by the laboratory of **Anthony W. Norman, PhD**, who is currently a distinguished professor emeritus of biochemistry and biomedical sciences at the University of California, Riverside, ushering in an ongoing era of discovery. Recently, the pace of discoveries has stepped up, and the vitamin D receptor is now known to be present in over 35 tissues. Now it is known that vitamin D plays a role in conditions including cancer, heart disease and autoimmune disease, all systems that have vitamin D receptor. Because of these discoveries, and evidence that higher daily intake may be beneficial to improve bone mineral density and bolster the immune system, some experts are calling for substantial increases in the recommended daily intake of the vitamin.

Keeping pace with the multitude of papers published yearly on vitamin D is difficult, but there are a number of areas of research that experts point to as particularly promising. One of these is the link between lower levels of vitamin D and myocardial infarction and stroke.

“Vascular smooth muscle has vitamin D receptors, and cardiomyocytes have vitamin D receptors,” said **Michael Holick, MD, PhD**, a professor in Boston University's department of endocrinology, diabetes and nutrition. “We think that vitamin D is playing a role in both modulating vascular tone as well as cardiomyocyte regeneration.”

This mechanism may be responsible for a remarkable increase in MI risk in people with vitamin D deficiency. In a study published in June 2008 in the *Archives of Internal Medicine*, men who were deficient (≤ 15 ng/mL) in 25-hydroxyvitamin D



Anthony W. Norman, PhD, Distinguished Professor Emeritus of Biochemistry & Biomedical Sciences at the University of California, Riverside.

(25[OH]D) — the precursor hormone to vitamin D's active form and the best indicator of vitamin D status — had a relative risk of MI of 2.42 (95% CI, 1.53-3.84) compared with those who were considered sufficient (≥ 30 ng/mL). Researchers prospectively assessed the 25(OH)D levels of 18,225 men in the Health Professionals Follow-up Study and found the increased risk remained even after adjustment for numerous confounders including family history of MI, BMI, history of diabetes and hypertension, ethnicity, cholesterol levels and triglyceride levels (adjusted RR=2.09 [95% CI, 1.24-3.54]). Men with intermediate levels of 25(OH)D also were at higher risk than those with sufficient levels.

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[What would you recommend for the appropriate daily intake of vitamin D?](#)

Another study published in September 2008 in *Stroke* showed that increasing levels of both 25(OH)D and the active form, 1,25(OH)₂D, were associated with substantially decreased risk of fatal stroke. Another June 2008 paper also published in the *Archives of Internal Medicine* showed that both cardiovascular mortality and all-cause mortality were associated with vitamin D levels among patients referred for coronary angiography. The multivariate-adjusted HR for all-cause mortality for individuals in the lowest quartile of 25(OH)D (median 7.6 ng/mL) vs. those in the highest quartile (median 28.4 ng/mL) was 2.08 (95% CI, 1.60-2.70). For CV mortality, the HR was 2.22 (95% CI, 1.57-3.13). These associations were found to be independent of coronary artery disease, physical activity level and other confounders.

Hector DeLuca, PhD, a professor in the biochemistry department at the University of Wisconsin-Madison, said that while the data on CV outcomes and other associations are promising, it is important to remember that the vast majority of data on vitamin D is only correlative in nature. "It's starting to look impressive, but it certainly isn't cause and effect," he said.

Cancer and vitamin D

DeLuca said that another realm where this correlative data have become relatively convincing is in certain types of cancer. For example, results of a September 2008 meta-analysis published in the *Journal of Steroid Biochemistry and Molecular Biology* showed a trend toward less breast cancer among women with a daily intake of vitamin D of at least 400 IU.



**Michael
Holick**

In one of the few prospective, interventional studies of vitamin D that have been conducted outside the realm of bone health, 1,179

postmenopausal women were randomized to receive either calcium supplementation alone, calcium supplementation plus 1,100 IU vitamin D or placebo. The unadjusted RR for all cancers was 0.402 ($P=.01$) in the vitamin D group, and the RR was not significant in the calcium alone group.

Holick said that the potential for reducing risk of other specific malignancies may be substantial as well. "It has been estimated that if you increase your vitamin D intake by at least an additional 1,000 units of vitamin D per day, you reduce your risk of developing colon cancer by 50%," he said.

FAST FACTS

Issues of Concern

- 1** Research into the action of vitamin D continues to add to a body of evidence about the effects of the vitamin on tissues and disease.
- 2** Recent research has helped elucidate the role of vitamin D in risk for MI and stroke, breast cancer, and risk of type 1 diabetes, among other diseases. The American Academy of Pediatrics now recommends 400 IU per day for children; the National Osteoporosis Foundation recommends 800 IU to 1,000 IU per day for adults over 50.
- 3** A change in adult recommendations for vitamin D intake may be coming soon. Some of the experts interviewed by ENDOCRINE TODAY stressed a need to move slowly, however, before making population interventions a reality. A randomized, controlled, long-term clinical trial of vitamin D in early CHD prevention is necessary to support the epidemiological research that has been done to date.

Autoimmune disorders

Another relatively new realm of vitamin D research is its role in autoimmune diseases. A landmark birth-cohort study of type 1 diabetes looked at mothers in a region of northern Finland who gave birth in 1966 and followed the children through 1997. Of 10,366 children studied, 81 were diagnosed with type 1 diabetes. Regular vitamin D supplementation with 2,000 IU daily during infancy was found to substantially decrease the risk of developing diabetes (RR=0.22 [95% CI, 0.05-0.89]) compared with children who had lower intake of vitamin D. Furthermore, children who were suspected of having rickets in their first year of life were three times as likely to develop diabetes compared to those with no suspicion of rickets.

"The vitamin D receptor is found in T cells and other cells of the immune system," DeLuca said. He added that the discovery of the receptor in such diverse areas of the body has led to the explosion in research. "Finding it in these places is key to expanding our view of this substance and how it might help public health." With regard to other autoimmune disorders, there is evidence that vitamin D may play a role in multiple sclerosis, rheumatoid arthritis and other conditions.

Vitamin D intake in children

The role in development of type 1 diabetes aside, vitamin D levels in children have long been considered a crucial part of bone development and bone health. According to **Mark A. Sperling, MD**, a professor in the department of pediatrics at the University of Pittsburgh, rickets is still an issue in northern areas of the United States and elsewhere.

“We don’t get more than half a dozen cases of rickets each year, but we shouldn’t even get that,” he said, adding that there is a need to “make people aware that there is a widespread relative deficiency of vitamin D intake throughout the population, and that it has wide benefits if taken, both for immediate bone health and for future bone health. What you lay down in your years of putting down bone is what you have when you start losing bone.”



**Mark A.
Sperling**

Rickets can also lead to other musculoskeletal problems later in life. Recently, the American Academy of Pediatrics changed its recommended intake of vitamin D in children to a minimum of 400 IU per day, up from 200 IU.

“Some of us think that even that may not be adequate and they could have been even more liberal,” said Sperling, who is also a member of the *Endocrine Today* Editorial Board. “But I do understand their cautious, conservative approach, and it’s a step in the right direction.”

The AAP has taken that step, and the National Osteoporosis Foundation has joined them by recommending 400 to 800 IU daily for adults under 50 and 800 to 1,000 IU for adults over 50 years. The U.S. government, however, has yet to change its recommendations from 200 IU, 400 IU and 800 IU for individuals up through age 50, ages 51 to 70 and older than 71 years, respectively. These recommendations were established in 1997 by a committee formed by the Institute of Medicine; a new committee has recently been formed to revise these guidelines.

Is more better?

Diseases and Conditions Potentially Affected by Vitamin D	
Condition	Potential mechanism
Myocardial Infarction, Stroke	Vitamin D receptor found in vascular smooth muscle and cardiomyocytes; renin-angiotensin regulation and coagulation response modulation could have effect.
Prostate Cancer, Breast Cancer, Colon Cancer	Vitamin D may be involved in cell cycle regulation and cell proliferation inhibition.
Type 1 Diabetes, Multiple Sclerosis	VDR found in T-cells and dendritic cells, regulating adaptive immune system response.
Rickets/Osteomalacia	Vitamin D is a regulator of calcium homeostasis, affecting bone remodeling.
Type 2 Diabetes	Vitamin D receptor found in pancreatic B-cells; play a role in mediating insulin secretion.

“The concern at the present time is that since our government’s advice about how much vitamin D we should be taking is old-fashioned and out of date, what should be the next steps?” asked Norman.

He goes on to state: “The feeling is that the experts in the vitamin D field are already recommending taking 1,000 to 2,000 or more U a day. But ideally our government needs to conduct evidence-based research first to justify a significant increase in ‘official advice’ concerning daily vitamin D intake levels for our citizens. Everyone needs to know how much vitamin D to really take on a daily basis. Is it 2,000 U a day? Or 3,000 or 4,000?”

As some experts contend that much higher intake vitamin D would be even more effective, the question of toxicity arises. Toxic levels of circulating vitamin D are commonly cited as being above 200 ng/mL, and Norman said taking several thousand IU daily will not bring blood levels close to that threshold.

“We have to be careful, because we’re sort of in a grey zone here,” he said. “We know that people really need a higher vitamin D nutritional status than they have, but they can’t go bonkers. Presently the government says that the upper safe level is 10,000 U a day. The vitamin D community ... would say that probably could go up to 50,000 and maybe even 100,000 U.”

With regard to potential negative effects outside of hypervitaminosis D and associated hypercalcemia, one study showed a slight trend toward an increased risk of aggressive prostate cancer with higher levels of vitamin D. Holick said that the men in that study also ingested close to two grams of calcium per day, and questioned the trend toward increased risk.

“We can’t fully relate the high vitamin D intake to increases in prostate cancer,” he said. “In my opinion, based on all of the data that we’ve seen to date, if anything it will decrease your risk.”

Cause for caution

Supplementing the entire population with vitamin D may seem attractive, but there are some reasons to move slowly. Norman pointed out difficulties involved with racial differences in vitamin D metabolism.

“Because of their skin color, black people don’t make anywhere near the amount of vitamin D that white people do,” he said. “It is a really complicated question to answer. When you talk about intervention, it should be one that would apply to all the ethnicities in America.”



**Michael
Kleerekoper**

There also remain questions of causality, with the bulk of literature taking the form of observational, correlative studies. Still, “every time we turn around, we’re finding more and more links,” said **Michael Kleerekoper, MD**, an endocrinologist at Saint Joseph Mercy Hospital in Ann Arbor, Mich.

“The vitamin D receptor is a ubiquitous receptor, it’s in many tissues. What we don’t know is how often it is turned on, and what level of vitamin D turns it on. But the potential for vitamin D to have an impact on many tissues is really quite remarkable,” added Kleerekoper, who is also a member of the *Endocrine Today* Editorial Board.

There are interventional studies ongoing to try and answer questions of causality. One such study is comparing no vitamin D supplementation to 1,000 IU, 2,000 IU and 4,000 IU in black men and examining the effect this has on colon and prostate cancer prevention. Researchers with another small prospective study are examining how 2,000 IU daily vitamin D might lower the risk of type 1 diabetes in children. Another randomized trial will examine the effect of 2,000 IU daily vitamin D on CV risk factors and endpoints in patients with diabetic kidney disease. There are many others as well.

With the pace of research on vitamin D clearly continuing to accelerate, Holick stressed the need and opportunity involved with this one substance.

“Globally, probably 50% of the world’s population is deficient in vitamin D,” he said. “Preventive medicine is certainly much less expensive than interventional medicine. If you could correct vitamin D deficiency, and if it was to substantially reduce the burden of many of these serious chronic diseases later in life, that would be pretty impressive.” – *by Dave Levitan*

POINT / COUNTER

[What would you recommend for vitamin D intake, and what is a safe upper limit to keep in mind?](#)

PERSPECTIVE**Early CHD prevention trial is necessary**

The essence of the vitamin D database is now such that a carefully controlled randomized large scale long-term clinical trial in early CHD prevention will be necessary to evaluate these promising findings. Without such a trial, the epidemiologic data gathered thus far is suggestive but not definitive evidence of causation linkage between vitamin D and CHD. Population interventions should not be based solely on such evidence but require more careful evaluations of the benefits and also the risks of such interventions.



**Alan J.
Garber**

– **Alan J. Garber, MD, PhD**

Professor, Departments of Medicine, Biochemistry and Molecular Biology, and Cellular and Molecular Biology, Baylor College of Medicine, Houston, and *Endocrine Today* Chief Medical Editor

For more information:

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Millions of American Men at Undue Risk for a Heart Attack

a problem remedied by 3000 units of supplemental vitamin D per day

by **Bill Sardi**
by Bill Sardi

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If a study of 18,225 American men (health professionals) age 40–75 years is reflective of the entire population of middle-aged males, three-quarters of adult males in the U.S. face a doubling of their risk for a heart attack due to low vitamin D levels. A vitamin D deficiency is far more predictive of a future heart attack than cholesterol, says a report due to be published in the Archives of Internal Medicine on Monday, June 9, 2008. Vitamin D deficiency is almost totally preventable with dietary supplementation.

High cholesterol combined with a vitamin D deficiency served to increase the risk of a heart attack by about 2.4 times, but a vitamin D deficiency alone accounted for 2.0 times of that risk, or 83% of the increased risk.

The study compared men with vitamin D levels at or below 15 nanograms of vitamin D per milliliter of blood (37.4 nanomoles per liter) to men with vitamin D levels above 30 nanograms per milliliter (74.8 nanomoles per liter). Men with a low (less than 15 nanograms/milliliter) level of vitamin D would need about 3000 international units (IU) of supplemental vitamin D3 per day to reach a 30 nanogram blood concentration, say study researchers. Most multivitamins provide a paltry 400 IU of vitamin D.

Men in the study group averaged 200–205 total cholesterol, which is considered a healthy range. Most of the decreased risk for a heart attack among men who had higher vitamin D levels was attributed to vitamin D's ability to prevent arterial calcification, not cholesterol

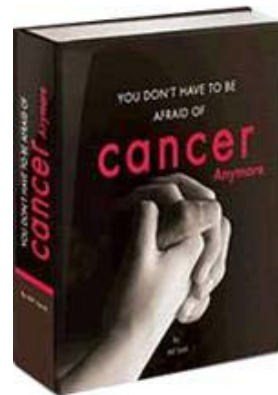
plaque.

Researchers at the Institute of Physical Medicine, University Hospital Zurich, Zurich, Switzerland, cite that vitamin D has widespread health benefits (reduced risk for falls, admission to nursing homes, fractures, cancer prevention, less high blood pressure and even fewer dental cavities), with the most advantageous serum levels at least 30 nanograms per milliliter (75 nanomoles/liter), with a higher optimal range for cancer prevention, 36–48 nanograms/milliliter (90–120 nanomole/liter). [Advances Experimental Medicine Biology 624: 55–71, 2008] This translates to more than the suggested 3000 IU in the Archives of Internal Medicine study.

This study means the Recommended Daily Allowance (RDA) for vitamin D is woefully inadequate, particularly for a population that is being advised to avoid midday sun exposure because of risks for skin cancer. Most natural vitamin D is produced in the skin upon exposure to solar ultraviolet radiation. (It takes about 18 minutes of total-body midday summer sun exposure to produce 3000 IU of natural vitamin D3.) Furthermore, many Americans falsely believe their diet, or fortified milk, provides sufficient amounts of vitamin D.

This study also indicts public health authorities for being remiss in re-establishing a higher RDA for vitamin D, an essential vitamin discovered by Professor Edward Mellanby in 1922.

The millions of lives lost due to a common vitamin D deficiency is a failure that is indefensible. Anytime in the past 8 decades this increased risk could have been identified. Instead, modern medicine chose to combat heart attacks with near useless statin drugs. According to Dr. John Abramson of Harvard Medical School, statin drugs have not been shown to reduce the risk for a mortal heart attack. [Lancet 2007 Jan 20; 369(9557):168–9] The Therapeutics Letter says statin drugs like Lipitor prevent only 1 non-mortal heart attack for every 70 healthy adults taking a statin drug for prevention. [Therapeutics Letter 2003; 48:1–2]



According to the US Census Bureau, there are about 37 million men age 45–64, who fall within the age group in this study. Each year,

approximately 543,000 men suffer heart attacks.

Source: Giovannucci E, Liu Y, Hollis BW, Rimm EB, 25-Hydroxyvitamin D and Risk of Myocardial Infarction in Men. Archives Internal Medicine 168: 1174–80, June 9, 2008.

June 9, 2008

Bill Sardi [[send him mail](#)] is author of the new book: [You Don't Have To Be Afraid Of Cancer Anymore](#).

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Vitamin D in a New Light

by **Donald W. Miller, Jr., MD**

by Donald W. Miller, Jr., MD



There are thirteen vitamins humans need for growth and development and to maintain good health. The human body cannot make these essential bio-molecules. They must be supplied in the diet or by bacteria in the intestine, except for vitamin D. Skin makes vitamin D when exposed to ultraviolet B (UVB) radiation from the sun. A light-skinned person will synthesize 20,000 IU (international units) of vitamin D in 20 minutes sunbathing on a Caribbean beach.

Vitamin D is also unique in another way. It is the only vitamin that is a hormone, a type of steroid hormone known as a *secosteroid*, with three carbon rings.

Steroid hormones such as cortisone, estrogen, and testosterone have four carbon rings. Ultraviolet B radiation in sunlight breaks open one of the rings in a steroid alcohol present in the skin, *7-dehydrocholesterol*, to form vitamin D (cholecalciferol). The liver changes this molecule into its circulating form, *25-hydroxyvitamin D* (calcidiol, 25[OH]D), the "vitamin D" blood tests measure. Cells throughout the body absorb 25-hydroxyvitamin D and change it into *1,25-dihydroxyvitamin D* (calcitriol), the active form of vitamin D that attaches directly to receptors on the DNA of genes in the cell's nucleus.

The vitamin D hormone system controls the expression of more than 200 genes and the proteins they produce. In addition to its well-known role in calcium metabolism, vitamin D activates genes that control cell growth and programmed cell death (apoptosis), express mediators that regulate the immune system, and release neurotransmitters (e.g., serotonin) that influence one's mental state.

Severe deficiencies of some vitamins cause vitamin-specific diseases, such as beriberi (from a lack of vitamin B1, thiamine), pellagra (B3, niacin), pernicious anemia (B12), and scurvy, (vitamin C). A

deficiency in iodine produces a goiter, mental retardation, and, when severe, cretinism.



Rickets, a softening and bending of bones in children, first described in 1651, is another nutritionally-specific disease. It reached epidemic proportions following the industrial revolution, which began in the 1750s. In the 19th century,

before the importance of exposing children to sunlight was recognized, the majority of children that lived in cities with sunless, narrow alleyways and pollution developed rickets. An autopsy study done in Boston in the late 1800s showed that more than 80 percent of children had rickets.

Early in the 20th century an investigator found that cod liver oil could prevent rickets in puppies. The nutritional factor in the oil that promotes skeletal calcium deposition was named "vitamin D," alphabetically after already-named vitamins A, B, and C. Rickets was thought to be another vitamin-deficiency disease, and the curative agent, a steroid hormone, was mislabeled a "vitamin."

Now, a century later, a wealth of evidence suggests that rickets, its most florid manifestation, is the tip of a vitamin D insufficiency/deficiency iceberg. A lack of Vitamin D can also trigger infections (influenza and tuberculosis), autoimmune diseases (multiple sclerosis, Type 1 diabetes, rheumatoid arthritis, and inflammatory bowel disease), cardiovascular disease, and cancer. Practitioners of conventional medicine (i.e., most MDs) are just beginning to appreciate the true impact of vitamin D deficiency. In 1990, medical journals published less than 20 reviews and editorials on vitamin D. Last year they published more than 300 reviews and editorials on this vitamin/hormone. This year, on July 19, 2007, even the *New England Journal of Medicine*, the bellwether of pharmaceutically-oriented conventional medicine in the U.S., published a review on vitamin D that addresses its role in autoimmune diseases, infections, cardiovascular disease, and cancer (*N Engl J Med* 2007;357:266–281).

Up until 1980, doctors thought that vitamin D was only involved in calcium, phosphorus, and bone metabolism. Then two investigators

[proposed](#) that vitamin D and sunlight could reduce the risk of colon cancer. A growing body of evidence indicates that they were right and that vitamin D can prevent a whole host of cancers – colon, breast, lung, pancreatic, ovarian, and prostate cancer among them. Colon cancer rates are 4 to 6 times higher in North America and Europe, where solar radiation is less intense, particularly during the winter months, compared to the incidence of colon cancer near the equator. People with low blood levels of vitamin D and those who live at higher latitudes are at increased risk for acquiring various kinds of cancer. Many epidemiological, cohort, and case control studies prove, at least on a more likely than not basis, that vitamin D supplements and adequate exposure to sunlight play an important role in cancer prevention (*Am J Public Health* 2006;96:252–261).

There is now strong scientific evidence that vitamin D does indeed reduce the risk of cancer. Evidence from a well-conducted, randomized, placebo-controlled, double-blind trial proves beyond a reasonable doubt that this is the case, at least with regard to breast cancer. A Creighton University study has shown that women over the age of 55 who took a 1,100 IU/day vitamin D supplement, with calcium, and were followed for 4 years had a highly statistically significant ($P < 0.005$) 75% reduction in breast cancer (diagnosed after the first 12 months) compared with women who took a placebo (*Am J Clin Nutr* 2007;85:1568–1591).

Some of the genes vitamin D activates make proteins that halt cancer by inducing apoptosis (programmed cell death), which destroys aberrant cells before they become cancerous, like adenoma cells in the [colon and rectum](#). Others promote cell differentiation and reining in of out-of-control growth of cancer cells (like [prostate cancer cells](#)). Vitamin D-expressed genes inhibit angiogenesis, the formation of new blood vessels that malignant tumors need to grow, as studies on [lung](#) and [breast cancers](#) show. Other genes inhibit metastases, preventing cancer that arises in one organ from spreading its cells to other parts of the body, as studied in [breast](#), and [prostate](#) cancers.



Vitamin D also expresses genes that curb cardiovascular disease. One gene controls the renin-angiotensin system, which when overactive causes hypertension (high blood pressure). Others stifle the immune system-mediated inflammatory response that propagates atherosclerosis and congestive heart failure (*Curr Opin Lipidol* 2007;18:41–46).

Multiple sclerosis (MS) is a neurologically devastating disease that afflicts people with low vitamin D levels. Its victims include the cellist Jacqueline Du Pré, whose first symptom was loss of sensation in her fingers, and some 500,000 Americans who currently suffer from this malady. MS is an autoimmune disease, where the body's immune system attacks and destroys its own cells. With multiple sclerosis, T cells in the adaptive immune system, Th1 cells (CD4 T helper type 1 cells), attack the myelin sheath (insulation) of the axons (nerve fibers) that neurons (brain cells) use to transmit electrical signals. The Vitamin D hormone system regulates and tones down the potentially self-destructive actions of Th1 cells. These cells make their own 1,25-dihydroxyvitamin D if there is a sufficient amount of vitamin D (25-hydroxyvitamin D) circulating in the blood. Researchers have shown that the risk of MS decreases as the level of vitamin D in the blood increases (*JAMA* 2006;296:2832–2838). People living at higher latitudes have an increased risk of MS and other autoimmune diseases. Studies show that people who live below latitude 35° (e.g., Atlanta) until the age of 10 reduce the risk of MS by 50% (*Toxicology* 2002;181–182:71–78 and *Eur J Clin Nutr* 2004;58:1095–1109).

In a study published earlier this year, researchers evaluated 79 pairs of identical twins where only one twin in each pair had MS, despite having the same genetic susceptibility. They found that the MS-free twin had spent more time outdoors in the sun – during hot days, sun tanning, and at the beach. The authors conclude that [sunshine is protective against MS](#) (*Neurology* 2007;69:381–388).

New research suggests that influenza is also a disease triggered by vitamin D deficiency. Influenza virus exists in the population year-round, but influenza epidemics are seasonal and occur only in the winter (in northern latitudes), when vitamin D blood levels are at their nadir. Vitamin D-expressed genes instruct macrophages, the front-line defenders in the innate immune system, to make antimicrobial peptides, which are like antibiotics (*Science* 2006;311:1770–1773). These peptides attack and destroy influenza

virus particles, and in human carriers keep it at bay. (Neutrophils and natural killer cells in the innate immune system and epithelial cells lining the respiratory tract also synthesize these virucidal peptides.) Other vitamin D-expressed genes rein in macrophages fighting an infection to keep them from overreacting and releasing too many inflammatory agents (cytokines) that can damage infected tissue. In the 1918 Spanish flu pandemic, which killed 50 million people, of which 500,000 were Americans, young healthy adults (as happened to my 22-year-old grandmother) would wake up in the morning feeling well, start drowning in their own inflammation as the day wore on, and be dead by midnight. Autopsies showed complete destruction of the epithelial cells lining the respiratory tract due, as researchers now know, to a macrophage-induced overly severe inflammatory reaction to the virus. These flu victims were attacked and killed by their own immune system, something researchers have found vitamin D can prevent (*Epidemiol Infect* 2006;134:1129–1140).

Randomized clinical trials need to be done to test the vitamin D theory of influenza. With what we know now, however, perhaps an annual shot of 600,000 IU of vitamin D (*Med J Aust* 2005;183:10–12) would be more effective in preventing influenza than a jab of flu vaccine.

Our species evolved in equatorial Africa where the sun, shining directly overhead, supplies its inhabitants with year-round ultraviolet B photons for making vitamin D. Our African ancestors absorbed much higher doses of vitamin D living exposed in that environment compared to the amount most humans obtain today. A single mutation that occurred around 50,000 years ago is responsible for the appearance of white skin in humans. It turns out that a difference in one rung, or base pair, in the 3 billion-rung DNA ladder that constitutes the human genome determines the color of one's skin (*Science* 2005;310:1782–1786). White skin, with less melanin, synthesizes vitamin D in sunlight six times faster than dark skin. People possessing this mutation were able to migrate to higher latitudes, populate Europe, Asia, and North America, and be able to make enough vitamin D to survive.

The majority of the world's population now lives above latitude 35° N and is unable to synthesize vitamin D from sunlight for a period of time in winter owing to the angle of the sun. At a large solar zenith angle, ozone in the upper atmosphere will completely block UVB radiation. In Seattle (47° N) and London (52° N), from

October to April UVB photons are blocked by the atmosphere so one's skin cannot make vitamin D. (The half-life of circulating vitamin D is approximately one month.) Making matters worse, even when UVB radiation is available in sunlight, health authorities, led by the American Academy of Dermatology, warn people to shield themselves from the sun to avoid getting skin cancer.

Except for oily fish like (wild-only) salmon, mackerel, and sardines and cod liver oil – and also sun-dried mushrooms – very little vitamin D is naturally present in our food. Milk, orange juice, butter, and breakfast cereal are fortified with vitamin D, but with only 100 IU per serving. One would have to drink 200 8-oz. glasses of milk to obtain as much vitamin D as skin makes fully exposed to the noonday sun.

The U.S. Food and Nutrition Board in the Institute of Medicine puts the Recommended Dietary Allowance (RDA) for vitamin D at 200 IU for children and adults less than 50 years old, 400 IU for adults age 50–70, and 800 IU for adults over the age of 70. Most multivitamin preparations contain 400 IU of vitamin D. These guidelines are directed towards maintaining bone health and are sufficient to prevent rickets – but not cancer, cardiovascular disease, multiple sclerosis, or influenza. Without evidence to support it, the board arbitrarily set the safe upper limit for vitamin D consumption at 2,000 IU/day.

Vitamin D (25-hydroxyvitamin D) blood levels, the barometer for vitamin D status, are measured in nanograms per milliliter (ng/ml) or nanomoles per liter (nmol/l), where ng/ml = 0.4 nmol/l. Children and adults need a vitamin D blood level >8 ng/ml to prevent rickets and osteomalacia (demineralization and softening of bones) respectively. It takes a concentration >20 ng/ml to keep parathyroid hormone levels in a normal range. A level >34 ng/ml is required to ensure peak intestinal calcium absorption. Finally, neuromuscular performance steadily improves in elderly people as vitamin D levels rise up to 50 ng/ml. Accordingly, a vitamin D blood level <8 ng/ml is regarded as *severely deficient*; 8–19, *deficient*; and 20–29, *insufficient*, i.e., too low for good health. A level >30 ng/ml is *sufficient*, but experts now consider 50–99 ng/ml to be the *optimal* level of vitamin D. Levels 100–150 ng/ml are *excessive* and >150 ng/ml, potentially *toxic*.

A majority of Americans have insufficient or deficient vitamin D blood levels. In veterans undergoing heart surgery at the Seattle VA

hospital, I found that 78% had a low vitamin D level: 12% were insufficient; 56%, deficient; and 10% were severely deficient.

In order to enjoy optimal health, we should maintain a vitamin D blood level of ≥ 50 –99 ng/ml. Without sun exposure, to reach a level of 50 ng/ml requires taking a 5,000 IU/day vitamin D supplement. There are two kinds of vitamin D supplements: vitamin D3 (cholecalciferol), the kind our skin makes, and vitamin D2 (ergocalciferol), a synthetic variant made by irradiating plants. Vitamin D2 is only 10–30% as effective in raising 25-hydroxyvitamin D blood levels compared to vitamin D3, leading the authors of a recent study conclude, "Vitamin D2 should not be regarded as a nutrient suitable for supplementation or fortification" (*Am J Clin Nutr* 2006;84:694–697).

Concerns about vitamin D toxicity are overblown, along with those about sun exposure. As one researcher in the field puts it, "Worrying about vitamin D toxicity is like worrying about drowning when you're dying of thirst." The LD50 of vitamin D in dogs (the dose that will kill half the animals) is 3,520,000 IU/kilogram. One can take a 10,000 IU vitamin D supplement every day, month after month safely, with no evidence of adverse effect. (*Am J Clin Nutr* 1999;69:842–856). A person must consume 50,000 IU a day for several months before hypercalcemia (an elevated calcium level in the blood, which is the initial manifestation of vitamin D toxicity) might occur. Vitamin D in a physiologic dose (5,000 IU/day) prevents the build up of calcium in blood vessels. (*Circulation* 1997;96:1755–1760). If one takes 10,000 IU of vitamin D a day and spends a lot of time in the sun, it would be prudent to check vitamin D blood level to ensure that it does not exceed 100 ng/ml.

Sensible sun exposure should be encouraged, not maligned. If one avoids sunburn, the sun's health-giving benefits far outweigh its detrimental effects. A large body of evidence indicates that sunlight does not cause the most lethal form of skin cancer, malignant melanoma. A U.S. Navy study found that melanoma occurred more frequently in sailors who worked indoors all the time. Those who worked outdoors had the lowest incidence of melanoma. Also, most melanomas appear on parts of the body that are seldom exposed to sunlight (*Arch Environ Health* 1990;45:261–267). Sun exposure is associated with *increased* survival from melanoma (*J Natl Cancer Inst* 2005;97:195–199). Another study showed that people who had longer lifetime exposure to the sun without burning were less likely to get melanomas than those with less exposure (*J Invest Dermatol*

2003;120:1087–1093.)

The rise in skin cancers over the last 25 years parallels the rise in use of sunscreen lotions, which block vitamin D-producing UVB radiation but not cancer-causing ultraviolet A radiation (UVA). (Newer sunscreen lotions also block out UVA.) Each year there are 8,000 deaths from melanoma and 1,500 deaths from nonmelanoma (squamous and basal cell) skin cancer. Surgical excision of nonmelanoma skin cancers cures them, except in rare cases where the growth has been allowed to linger for a long time and metastasize. Dr. John Cannell, Executive Director of the Vitamin D Council, makes this point: 1,500 deaths occur each *year* from non-melanoma skin cancer, but 1,500 deaths occur each *day* from other cancers that vitamin D in optimal doses might well prevent. (The Vitamin D Council [website](#) is an excellent source of information on vitamin D.)

The U.S. government and its citizens currently spend \$2,000 billion dollars (\$2 trillion) on "health care," i.e., sickness care, each year. The cost of taking a 5,000 IU supplement of vitamin D every day for a year is \$22.00. The cost for 300 million Americans taking this supplement would be \$6.6 billion dollars. The number and variety of diseases that vitamin D at this dose could prevent, starting with a 50 percent reduction in cancer, is mind-boggling. If everyone took 5,000 IU/day of vitamin D, the U.S. "health care" industry would shrink. It would no longer account for 16 percent of the gross domestic product.

Health food stores typically do not sell vitamin D3 in 5,000 IU tablets, but they are readily available online. [BIO-TECH Pharmacal](#) produces both 5,000 and 50,000 IU tablets of Vitamin D3, which online sites sell. Some people prefer to take one 50,000 IU table a week (equivalent to 7,100 IU a day) and a three-day course of 150,000 IU vitamin D at the first sign of a cold.



Two sites that sell both "D3-5" (5,000 IU) and "D3-50" (50,000 IU) are [here](#) and [here](#).

September 10, 2007

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[Int J Sport Nutr Exerc Metab.](#) 2008 Apr;18(2):204-24.

Should we be concerned about the vitamin D status of athletes?

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A surprisingly high prevalence of vitamin D insufficiency and deficiency has recently been reported worldwide. Although very little is known about vitamin D status among athletes, a few studies suggest that poor vitamin D status is also a problem in athletic populations. It is well recognized that vitamin D is necessary for optimal bone health, but emerging evidence is finding that vitamin D deficiency increases the risk of autoimmune diseases and nonskeletal chronic diseases and can also have a profound effect on human immunity, inflammation, and muscle function (in the elderly). Thus, it is likely that compromised vitamin D status can affect an athlete's overall health and ability to train (i.e., by affecting bone health, innate immunity, and exercise-related immunity and inflammation). Although further research in this area is needed, it is important that sports nutritionists assess vitamin D (as well as calcium) intake and make appropriate recommendations that will help athletes achieve adequate vitamin D status: serum 25(OH)D of at least 75 or 80 nmol/L. These recommendations can include regular safe sun exposure (twice a week between the hours of 10 a.m. and 3 p.m. on the arms and legs for 5-30 min, depending on season, latitude, and skin pigmentation) or dietary supplementation with 1,000-2,000 IU vitamin D3 per day. Although this is significantly higher than what is currently considered the adequate intake, recent research demonstrates these levels to be safe and possibly necessary to maintain adequate 25(OH)D concentrations.

PMID: 18458363 [PubMed - indexed for MEDLINE]

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Key feature of immune system survived in humans, other primates for 60 million years

CORVALLIS, Ore. – A new study has concluded that one key part of the immune system, the ability of vitamin D to regulate anti-bactericidal proteins, is so important that it has been conserved through almost 60 million years of evolution and is shared only by primates, including humans – but no other known animal species.

The fact that this vitamin-D mediated immune response has been retained through millions of years of evolutionary selection, and is still found in species ranging from squirrel monkeys to baboons and humans, suggests that it must be critical to their survival, researchers say.

Even though the "cathelicidin antimicrobial peptide" has several different biological activities in addition to killing pathogens, it's not clear which one, or combination of them, makes vitamin D so essential to its regulation.

The research also provides further evidence of the biological importance of adequate levels of vitamin D in humans and other primates, even as some studies and experts suggest that more than 50 percent of the children and adults in the U.S. are deficient in "the sunshine vitamin."

"The existence and importance of this part of our immune response makes it clear that humans and other primates need to maintain sufficient levels of vitamin D," said Adrian Gombart, an associate professor of biochemistry and a principal investigator with the Linus Pauling Institute at Oregon State University.

In a new study in the journal *BMC Genomics*, researchers from OSU and the Cedars-Sinai Medical Center describe the presence of a genetic element that's specific to primates and involved in the innate immune response. They found it not only in humans and their more recent primate ancestors, such as chimpanzees, but also primates that split off on the evolutionary tree tens of millions of years ago, such as old world and new world primates.

The genetic material – called an Alu short interspersed element – is part of what used to be thought of as "junk DNA" and makes up more than 90 percent of the human genome. That genetic material, however, is now understood to often play important roles in regulating and "turning on" the expression of other genes.

In this case, the genetic element is believed to play a major role in the proper function of the "innate" immune system in primates – an ancient, first line of defense against bacteria, viruses and other pathogens, in which the body recognizes something that probably doesn't belong there, even though the specific pathogen may never have been encountered before.

"Many people are familiar with the role of our adaptive immune system, which is what happens when we mount a defense against a new invader and then retain antibodies and immunity in the future," Gombart said. "That's what makes a vaccine work. But also very important is the innate immune system, the almost immediate reaction your body has, for instance, when you get a cut or a skin infection."

In primates, this action of "turning on" an optimal response to microbial attack only works properly in the presence of adequate vitamin D, which is actually a type of hormone that circulates in the blood and signals to cells through a receptor. Vitamin D is produced in large amounts as a result of sun exposure, and is available in much smaller amounts from dietary sources.

Vitamin D prevents the "adaptive" immune response from over-reacting and reduces inflammation, and appears to suppress the immune response. However, the function of the new genetic element this research explored allows vitamin D to boost the innate immune response by turning on an antimicrobial protein. The overall effect may help to prevent the immune system from overreacting.

"It's essential that we have both an innate immune response that provides an immediate and front

line of defense, but we also have protection against an overreaction by the immune system, which is what you see in sepsis and some autoimmune or degenerative diseases," Gombart said. "This is a very delicate balancing act, and without sufficient levels of vitamin D you may not have an optimal response with either aspect of the immune system."

After years of research, scientists are continuing to find new roles that vitamin D plays in the human body. It can regulate the actions of genes that are important to bone health, calcium uptake, and inhibition of cell growth. It helps regulate cell differentiation and, of course, immune function.

"The antimicrobial peptide that we're studying seems to be involved not just in killing bacteria, but has other biological roles," Gombart said. "It recruits other immune cells and sort of sounds the alarm that something is wrong. It helps promote development of blood vessels, cell growth and healing of wounds. And it seems to have important roles in barrier tissues such as skin and the digestive system. Vitamin D is very important for the health of the skin and digestive system, and putting the cathelicidin antimicrobial peptide gene under its regulation may be important in this function."

Any one, or some combination of those biological roles may be why vitamin D-mediated regulation of the antimicrobial peptide has been conserved in every primate species ever examined for its presence, researchers said, and did not disappear long ago through evolutionary variation and mutation. The evolution of primates into many different families and hundreds of species has been carefully tracked through genetic, molecular sequence and fossil studies, but the presence of this regulatory element in primates is still largely the same as it's been for more than 50 million years.

The evolutionary survival of this genetic element and the placement of the cathelicidin antimicrobial peptide gene under the regulation of the vitamin D pathway "may enable suppression of inflammation while potentiating innate immunity, thus maximizing the overall immune response to a pathogen and minimizing damage to the host," the researchers wrote in their conclusion.

Vitamin D deficiency is an issue of growing concern among many scientists, due to changing lifestyle or cultural trends in which many people around the world get less sun exposure and often inadequate dietary levels of the vitamin. It's a special problem with the elderly, which often have reduced exposure to sunlight and less ability to produce vitamin D in their skin – and at least partly as a result, are more susceptible to bone fractures, chronic inflammation and infectious disease.

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