

Dr. Holick's Responses to Participant Questions Following the December 10, 2008 Live Webinar Presentation "Vitamin D & Chronic Disease Risk"

VITAMIN D AND DISEASE STATES

EPILEPSY (Please go to VitaminDHealth.org for more information)

I have heard that vitamin D may play a role in epilepsy, possibly due to interaction with anti-epileptic drugs. Is this becoming an acknowledged effect? And how much vitamin D is necessary to combat the interaction to reduce seizures?

Response: Epileptic drugs will enhance the destruction of vitamin D making patients who are on anti-seizure medications at higher risk for developing vitamin D deficiency and osteomalacia or rickets. Measurement of 25-hydroxyvitamin D [25(OH)D] is important in patients on antiepileptic medications. Often twice as much vitamin D is required to maintain a blood level of 25(OH)D of > 30 ng/ml. Thus, 2,000-4,000 IU of vitamin D/d is usually needed. An alternative is to take 50,000 IU of vitamin D2 either once every week or once every two weeks depending on the serum 25-hydroxyvitamin D level.

MENTAL HEALTH (Please go to VitaminDHealth.org for more information)

What is your position on vitamin D and depression and schizophrenia?

Response: There is evidence that vitamin D deficiency during pregnancy increases the risk of the child developing schizophrenia during their adult life. There is also evidence that vitamin D receptors exist in the brain, and that the active form of vitamin D, 1,25-dihydroxyvitamin D, will stimulate the production of serotonin, and, thus, may help reduce depression.

What is relation between vit D deficiency and depression - optimal blood levels?

Response: Patients who are vitamin D deficient often have muscle weakness and aches and pains in their bones and muscles that can lead to depression. The optimal blood level 25-hydroxyvitamin D should be at least 30 ng/ml and up to 100 ng/ml is safe.

Is there a vit D connection with SAD?

Response: There is one study that suggested correcting vitamin D deficiency improved symptoms of seasonal affective disorder. This may be due to the fact that vitamin D may enhance serotonin levels in the brain and also improves muscle function and can decrease nonspecific aches and pains in bones and muscles.

AUTISM

Somali children (equatorial) move to Minnesota develop high rates of autism, could this be related to D status?

Response: There is little information regarding the cause of autism and there has been a suggestion that vitamin D deficiency may increase risk of autism. However, to date, there have not been any clinical trials that have demonstrated that vitamin D improves autism. However, it is important that everyone including children with autism have an adequate amount of vitamin D to maintain their blood level of 25-hydroxyvitamin D of between 30 and 100 ng/ml.

Any research going on about autism and the spectrum with vit D?

Response: I am not aware of any research where vitamin D is being used to treat autism. However, there is no downside to giving autistic children vitamin D to increase their blood level of 25-hydroxyvitamin D to between 30 and 100 ng/ml. This can be accomplished by them taking a multivitamin D containing 400 IU of vitamin D along with a 1,000 IU vitamin D supplement.

What do you think of Heany's theory regarding vitamin D and autism?

Response: The theory that vitamin D may be associated with autism is intriguing, but there is no proof that the two are related. However, there are vitamin D receptors in the brain and vitamin D deficiency has been associated with poor muscle function, and, thus, it is reasonable for children with autism to have an adequate amount of vitamin D as I have noted in response to related questions in this section.

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KIDNEY DISEASE (Please go to VitaminDHealth.org for more information)

Please comment about the effect of Vitamin D supplements on those with poor renal function (but not on dialysis)?

Response: All patients with chronic kidney disease (CKD) should be receiving vitamin D supplementation as recommended by the KDOQI guidelines. All patients with CKD should have a blood level of 25-hydroxyvitamin D of > 30 ng/ml and a blood level of up to 100 ng/ml is safe.

Should patients on dialysis who get active vitamin D also get D supplementation if 25 hydroxy D levels are low?

Response: Patients who are on dialysis and get an active vitamin D analogue most definitely should be receiving a vitamin D supplement to maintain their blood level of 25-hydroxyvitamin D above 30 ng/ml as noted in my response to question 8.

What about Vitamin D supplementation with patients who have Chronic Renal Insufficiency?

Response: All patients with chronic renal insufficiency, i.e., chronic kidney disease should receive vitamin D supplementation to maintain their blood level of 25-hydroxyvitamin D of > 30 ng/ml as noted in my related response above.

Do you recommend every Chronic Kidney Disease (CKD) patient take a vitamin D supplement?

Response: I recommend that all patients with chronic kidney disease receive vitamin D supplementation to maintain their blood levels of 25(OH)D of between 30 and 100 ng/ml.

Should we be checking 25(OH)D levels on ESRD patients on dialysis?

Response: I believe that it is important to monitor serum levels of 25-hydroxyvitamin D [25(OH)D] in ESRD patients on dialysis. (Please go to VitaminDHealth.org for more information).

How do you achieve optimal levels of vitamin D in a patient with stage 3 renal disease without increasing serum calcium to too high a level?

Response: There is no evidence that correcting vitamin D deficiency in patients with stage 3 renal disease or any stage of renal disease will increase their serum calcium to a high level. Often patients with chronic kidney disease can develop autonomous parathyroid gland activity leading to tertiary hyperparathyroidism. In my experience, these patients often benefit by correcting their vitamin D deficiency. Many of these patients have a favorable response whereby the serum PTH levels decline as well as the serum calcium levels. Thus, all patients with chronic kidney disease should maintain a blood level of 25-hydroxyvitamin D of between 30 and 100 ng/ml. (Please go to VitaminDHealth.org for more information).

Are your recommendations the same for people on dialysis-the National kidney foundation gives guidelines for pre-dialysis?

Response: My recommendations for people on dialysis are the same as recommended by the National Kidney Foundation KDOQI guidelines and they should be the same for predialysis patients. Patients with any stage of chronic kidney disease should receive vitamin D supplementation.

What type/dose of vitamin D do you recommend for chronic dialysis patients?

Response: I typically treat vitamin D deficiency in CKD patients on dialysis with 50,000 IU of vitamin D once a week for eight weeks as an oral capsule, and once the blood level of 25(OH)D is > 30 ng/ml, then I maintain their vitamin D status by placing them on 50,000 IU of vitamin D2 once every two weeks.

In ESRD when patients are on active vit D is it still possible to have a deficiency?

Response: Patients with ESRD that is chronic kidney disease and who are on active vitamin D analogues should also be treated for their vitamin D deficiency and maintain a blood level of 25-hydroxyvitamin D > 30 ng/ml as recommended by the KDOQI guidelines of the National Kidney Foundation. (Please go to VitaminDHealth.org for more information).

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ALS (Please go to VitaminDHealth.org for more information)

What did you say about Vit D and ALS?

Response: Vitamin D deficiency is associated with muscle weakness. There is one case report of an elderly gentleman who presented with severe muscle weakness and muscle fasciculations and the EMG and nerve conduction studies suggested that he suffered from amyotrophic lateral sclerosis (ALS). However, it was found that this patient was vitamin D deficient and correcting his vitamin D deficiency caused complete resolution of all of his neuromuscular complaints. Therefore, this study demonstrates that vitamin D deficiency can mimic many of the symptoms of ALS, and, therefore, all patients with ALS should be treated for vitamin D deficiency and maintain a blood level of 25(OH)D > 30 ng/ml to maximize their muscle strength. (Please go to VitaminDHealth.org for more information).

CANCERS (Please go to VitaminDHealth.org for more information)

Do you recommend women keep their levels above 50 given the benefit for decreased risk of breast cancer?

Response: There is one study to suggest that women who maintain a blood level of 48 ng/ml for their 25(OH)D reduce their risk of developing breast cancer by 50%. Thus, it is not unreasonable for women to be aware of their vitamin D status and to have a blood level above 30 ng/ml. Whether it needs to be above 50 ng/ml needs further investigation. There is no downside to keeping the blood level between 50 and 100 ng/ml, and, thus, in my opinion would be safe.

Do women who had ER+ breast cancer (age 50) still need vit D?

Response: All women with breast cancer should be receiving enough vitamin D to maintain their blood level of 25(OH)D of between 30 and 100 ng/ml. It does not matter whether they are ER positive or ER negative. Indeed, all women no matter what their age should be receiving a vitamin D supplement to maintain their blood level in the healthy range.

If someone is diagnosed with cancer, could they benefit from increasing Vit D?

Response: We don't know whether increasing vitamin D once a diagnosis of cancer is made will provide any benefit for reducing the growth of the cancer and outcome from the cancer. However, there is no reason not to have all cancer patients take enough vitamin D to maintain their blood level of 25(OH)D of between 30 and 100 ng/ml. It may improve muscle strength and bone strength as well as possibly enhance the therapeutic benefit of any cancer treatment.

Are Vit. D supplements safe during chemotherapy or could this interact with the action of these agents?

Response: There is no evidence that vitamin D supplements will interact with chemotherapy. Therefore, vitamin D supplementation is safe during chemotherapy. We found that more than 50% of patients with various cancers on chemotherapy were severely vitamin D deficient. (Please go to VitaminDHealth.org for more information).

Should folks with prostate cancer take more Vit D? Does it matter if they have renal impairment or does extra Vit D. impact the kidneys?

Response: Patients with prostate cancer should take enough vitamin D to maintain their blood level of 25(OH)D of between 30 and 100 ng/ml. It does not matter if there is renal impairment.

How much Vitamin D would you recommend for a patient with pancreatic cancer who has a history of MS and is currently Vitamin D deficient?

Response: I treat all patients with vitamin D deficiency including patients with pancreatic cancer and patients with multiple sclerosis who are vitamin D deficient with 50,000 IU of vitamin D2 once a week for eight weeks followed by maintaining them on 50,000 IU of vitamin D2 once every two weeks thereafter to prevent recurrence of vitamin D deficiency. The blood level of 25(OH)D is checked after the initial eight weeks to make sure that the patient has a blood level above 30 ng/ml. If not, then I will give an additional course of 50,000 IU of vitamin D2 once a week for the next eight weeks. Then to prevent recurrence of vitamin D deficiency, I place the patient on 50,000 IU of vitamin D2 every two weeks thereafter. From our experience of six years, these

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patients typically have blood levels of between 40 and 60 ng/ml for 25(OH)D and there has never been any untoward toxicity in my patients following this program.

Is it necessary to have vitamin D levels between 60-80ng/ml to prevent cancer?

Response: It does appear that when the blood level of 25(OH)D is at least 30 ng/ml that it may decrease risk of many deadly cancers. It is unknown, however, the blood level needs to be 60 ng/ml. There is no harm in keeping the blood level at between 60 and 80 ng/ml. I have all of my patients on enough vitamin D to maintain their blood levels between 40 and 100 ng/ml which I believe to be both therapeutic and preventative for chronic diseases including common cancers. (Please go to VitaminDHealth.org for more information).

CARDIAC (Please go to VitaminDHealth.org for more information)

Have you heard any contraindications for vit D supplementation in people on some cardiac meds?

Response: I am not aware of any contraindications to using vitamin D supplementation in people who are taking some cardiac medicines. Since it has been demonstrated that you have a higher risk of having a heart attack and are more likely to die of a cardiovascular event, there is no reason not to give vitamin D to all patients on cardiac medications so that their blood level of 25(OH)D is between 30 and 100 ng/ml.

I have been taught that Vit D above 400 mgs a day will cause rapid heart beat and cardiac damage? Is there any truth in this claim?

Response: I presume that you mean 400 IU of vitamin D a day. Four hundred mg a day would cause vitamin D intoxication. Four hundred IU of vitamin D a day will not cause a rapid heart rate or cardiac damage. There is no truth to this claim. However, if you are vitamin D intoxicated, it can cause the heart to fail and to increase calcification of the heart and blood vessels. However, vitamin D intoxication will not occur until a person is taking more than 10,000 IU of vitamin D/d for more than six months. (Please go to VitaminDHealth.org for more information).

INFLAMMATORY DISEASE (Go to VitaminDHealth.org for more information)

Is there a role in checking both 25 vitamin D and 1,25 vitamin D in inflammatory and/or autoimmune disease as 1,25 vit D is elevated in inflammatory states?

Response: For patients with inflammatory diseases, I measure a blood level of 25-hydroxyvitamin D. I only measure a 1,25-dihydroxyvitamin D if the patient has a high blood calcium (hypercalcemia). It is true that patients with sarcoidosis, tuberculosis and other granulomatous disorders can have an elevated blood calcium along with an elevated blood level of 1,25-dihydroxyvitamin D.

How does the Marshal protocol which concerns Th1 pathogens and vitamin D receptors. It seems that they are saying vitamin D is harmful in chronic inflammatory conditions. Very confusing. Please comment.

Response: In my opinion, Marshal does not fully appreciate the expansive biologic effects that vitamin D has not only on the immune system but on the body in general. He has assumed that vitamin D either turns on or turns off Th1 and Th2 lymphocytes. Unfortunately, what he doesn't realize is that vitamin D through its active form 1,25-dihydroxyvitamin D is an immunomodulator that modulates the immune system for maximum health. There is in my opinion no evidence that vitamin D is harmful in chronic inflammatory conditions, and there has never been a report to suggest this.

THYROID/PARATHYROID

Is Vit D deficiency linked to thyroid disease?

Response: Patients with hyperthyroidism increase the destruction of vitamin D and are at higher risk of vitamin D deficiency.

What type of vitamin D supplementation and how much would you recommend for someone with hypoparathyroidism?

Response: Parathyroid hormone is important in the activation of 25-hydroxyvitamin D to its active form 1,25-dihydroxyvitamin D. Patients with hypoparathyroidism should maintain a blood level of 25-hydroxyvitamin D of

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between 30 and 100 ng/ml. They also may need to take calcitriol which is 1,25-dihydroxyvitamin D3 in order to maintain their blood calcium level within the normal range.

I treat my patients with hypoparathyroidism with 50,000 IU of vitamin D once a week for eight weeks to correct their vitamin D deficiency, and then maintain their blood level of 25(OH)D of between 30 and 100 ng/ml by keeping them on 50,000 IU of vitamin D2 once every two weeks thereafter. (Please go to VitaminDHealth.org for more information).

With no parathyroid and taking calcitriol 0.125mg a day will a patient have any problems taking vitamin D? If not, what level do you recommend?

Response: Patients who have no parathyroid hormone and take calcitriol should also take vitamin D. These patients need to maintain a blood level of 25(OH)D of between 30 and 100 ng/ml. This can be accomplished as I have noted in my responses to previous questions for treating vitamin D deficiency and maintaining vitamin D sufficiency. I treat my patients with hypoparathyroidism with 50,000 IU of vitamin D once a week for eight weeks to correct their vitamin D deficiency, and then maintain their blood level of 25(OH)D of between 30 and 100 ng/ml by keeping them on 50,000 IU of vitamin D2 once every two weeks thereafter.

Do people with hypothyroidism need to worry about increasing Vit. D levels?

Response: People with hypoparathyroidism do not need to worry about increasing vitamin D levels. These patients should be treated for vitamin D deficiency just like any other patient.

Is there any correlation with vitamin D deficiency and hypothyroidism?

Response: There is no correlation with vitamin D deficiency and hypothyroidism. Vitamin D deficiency is so common that often patients with hypothyroidism are also vitamin D deficient. All patients including hypothyroid patients should be treated for their vitamin D deficiency and prevent vitamin D deficiency by maintaining them on an adequate amount of vitamin D.

AUTOIMMUNE DISEASES

Is there any evidence that treating patients with autoimmune diseases can lessen their symptoms?

Response: There are no prospective studies that have treated patients with autoimmune diseases, and, thus, we do not know whether treating these patients will lessen their symptoms. However, vitamin D deficiency is associated with many non-specific symptoms including muscle weakness, muscle aches and pains, bone aches and pains and joint aches and pains which can be associated with autoimmune diseases including multiple sclerosis and rheumatoid arthritis. From my experience, treating patients with multiple sclerosis with vitamin D not only improves their overall feeling of well being and muscle strength, but some of my patients have had an extended honeymoon from their disease. Patients with rheumatoid arthritis who are vitamin D deficient also have improvement in muscle function and decrease in aches and pains in their bones and joints.

Autoimmune diseases seem to benefit from Vitamin D. Do you think the Celiac Disease being an immune-mediated disease would benefit and would the dose be as you recommend for the general public?

Response: Patients with Celiac disease often have malabsorption of fat soluble vitamins including vitamin D. Thus, I have found that patients with Celiac disease who are appropriately treated with a gluten free diet and who are treated for their vitamin D deficiency have significant improvement in their feeling of well being and improvement in muscle strength and decrease in aches and discomfort in their skeleton. The dose of vitamin D that I recommend for all my patients is either 50,000 IU of vitamin D2 once a week for 8 weeks to treat vitamin D deficiency and to fill the empty vitamin D tank to achieve a blood level of 25(OH)D > 30 ng/ml, and then to maintain the tank on full by either giving them 50,000 IU of vitamin D2 once every two weeks or 2,000 IU of vitamin D2 or vitamin D3 daily. (Please go to VitaminDHealth.org for more information).

How common is vitamin D deficiency with Celiac Disease?

Response: Vitamin D deficiency is very common in patients with Celiac disease. We have found in my clinic that patients who are vitamin D deficient and treated for vitamin D deficiency and don't respond often suffer from Celiac disease. Celiac disease is not always obvious and often is asymptomatic. The first evidence that a patient has Celiac disease is when we find that they cannot correct their vitamin D deficiency by taking vitamin

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D orally. Once Celiac disease is identified and the patient is put on a gluten free diet, they do well and now can absorb vitamin D and their vitamin D deficiency is easily treated.

Have there been any studies related to immunocompromised patients (i.e. AIDS) and vitamin D deficiency?

Response: There have been a few studies looking at vitamin D status in immunocompromised patients including patients who have had organ transplantation such as heart, lung and kidneys as well patients who suffer from AIDS. The medications that these patients are on increase the destruction of vitamin D making them at higher risk for vitamin D deficiency. These patients often have significant bone loss causing osteoporosis. Thus, patients who are on immunotherapy or are immunocompromised, i.e., having AIDS should be evaluated for their vitamin D status with a serum 25-hydroxyvitamin D and they should be appropriately treated. Often these patients need twice as much vitamin D to correct their vitamin D deficiency, and, thus, I place them on 50,000 IU of vitamin D2 once a week for 16 weeks followed by 50,000 IU of vitamin D2 once a week or once every two weeks to maintain their blood level of 25(OH)D > 30 ng/ml. (Please go to VitaminDHealth.org for more information).

MULTIPLE SCLEROSIS

Can vitamin D help with the symptoms of multiple sclerosis (MS)? Will Vit D supplementation delay the progression of MS in someone who has MS?

Response: I have found in my patients with multiple sclerosis that they are often vitamin D deficient. Since vitamin D deficiency causes muscle weakness, I have found in my patients that correcting their vitamin D deficiency significantly improves overall muscle function. A few of my patients who had their first symptoms of multiple sclerosis and then were treated with 50,000 IU of vitamin D once a week for 8 weeks followed by every other week thereafter, several of them have remained in their honeymoon period. Thus, there is no reason not to be checked for your vitamin D status if you have multiple sclerosis and to be treated for your vitamin D deficiency and to prevent the recurrence of vitamin D deficiency.

Any recommendations for someone w/ a "probable MS" diagnosis in terms of preventing further disease progression?

Response: As noted in my response to the last question above, I have found from my clinical practice that some patients with a probable diagnosis of multiple sclerosis or who have evidence based on MRI of multiple sclerosis have no further symptoms when I treat their vitamin D deficiency and maintain their 25-hydroxyvitamin D > 30 ng/ml. There are no prospective studies that have evaluated whether vitamin D will prevent further progression of the disease.

What is the link between Vit D deficiency and Multiple Sclerosis (MS)?

Response: The link between vitamin D deficiency and multiple sclerosis was first observed when it was appreciated that if you live above 37° N latitude which is about the latitude of Atlanta, Georgia for the first ten years of your life, you have a 100% increase of developing multiple sclerosis for the rest of your life no matter where you live. These epidemiologic evaluations were then followed up by further observations to suggest that women who ingested more than 400 IU of vitamin D/d reduced their risk of developing multiple sclerosis by 42% compared to women that were not taking vitamin D supplementation. In addition, studies in both men and women have shown an inverse association with increased risk of developing multiple sclerosis with the serum 25-hydroxyvitamin D level. (Please go to VitaminDHealth.org for more information).

BONE HEALTH - OSTEOPENIA/OSTEOPOROSIS/OSTEOMALACIA

How does osteopenia relate to vitamin D deficiency?

Response: Vitamin D deficiency can cause loss of mineral, i.e., calcium from the skeleton. When you lose enough calcium from the skeleton, it can result in osteopenia and osteoporosis and increase your risk of fracture. Osteopenia by definition means that the amount of calcium that is lost is equal to between 1 and 2.5 standard deviations below a healthy young person who has a peak bone mineral density and is matched for both sex and race. The World Health Organization has defined osteopenia by bone densitometry and this measure using T-score of -1 to -2.5 and osteoporosis as > -2.5. Vitamin D deficiency results in a decrease in the efficiency of calcium absorption from the diet. In turn, the body makes more parathyroid hormone which goes

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to the bone and stimulates bone cells to remove calcium from the bone. Thus, vitamin D deficiency will precipitate and exacerbate both osteopenia and osteoporosis. (Please go to VitaminDHealth.org for more information).

What amount of vitamin D supplementation would you recommend for patients with eating disorders that already have documented osteopenia? Those with or without a vitamin D deficiency?

Response: I give all of my patients an amount of vitamin D that is equal to taking between 2,000-3,000 IU of vitamin D/d. For patients with eating disorders including anorexia nervosa, bulimia as well as patients who have had bypass surgery should take 50,000 IU of vitamin D2 once every two weeks to maintain vitamin D sufficiency. Monitoring serum blood level of 25-hydroxyvitamin D is helpful and should be > 30 ng/ml.

In mild to moderate osteopenia, would taking adequate D and calcium be enough to prevent osteoporosis thus eliminating need for osteoporosis medications?

Response: From my experience, many men and women who present with mild or moderate osteopenia are vitamin D deficient and calcium deficient. I typically treat them for their vitamin D deficiency and then maintain them on 50,000 IU of vitamin D2 every two weeks. In addition, for adults under the age of 50, I place them on a total of 1,000 milligrams of calcium either from dietary sources or from supplements, and for adults over the age of 50, I increase it by 200 milligrams so that they ingest approximately 1,200-1,500 milligrams of calcium a day from diet and supplements. I recommend that the calcium be taken in 2 or 3 divided doses rather than all at once because it will be more bioavailable. The vitamin D can be taken any time. I follow these patients, and often after 1-2 years, I reevaluate their bone mineral density. Often the patients either have a small increase in their bone mineral density or no significant change. Only when I see that the bone density is substantially reduced by more than 5% within a year, do I become aggressive in considering giving an osteoporotic medication. (Please go to VitaminDHealth.org for more information).

Any association with adolescent girls and scoliosis? Can Vit D supplementation help correct spinal curvature? Thank you

Response: I am not aware of any association with scoliosis and vitamin D deficiency in adolescent girls. However, many adolescent girls are vitamin D deficient, and to maximize their bone health, they should be receiving an adequate amount of vitamin D. Thus, vitamin D supplementation will not correct spinal curvature. This unfortunately is a permanent deformity. However, if the vitamin D deficiency is exacerbating the spinal curvature, correcting vitamin D deficiency may help prevent further curvature from occurring.

DOWN'S SYNDROME

Would your recommendations be the same for Down's syndrome and intellectual disability patients?

Response: I recommend that both children and adults receive at least 1,500-2,000 IU of vitamin D/d if they are not getting adequate exposure to sunlight. This also applies to patients with Down's syndrome and with intellectual disabilities.

CEREBRAL PALSY

Any research with cerebral palsy?

Response: I have several patients with cerebral palsy. They often are indoors and are at high risk of vitamin D deficiency. I find that I am able to help maintain their bone health and improve their overall health and well being by treating their vitamin D deficiency and maintaining them in a vitamin D sufficient state. Unfortunately, there is no evidence that it reduces the spasticity associated with cerebral palsy.

SARCOIDOSIS

Do people with sarcoidosis know they have it, or could it be undiagnosed easily?

Response: Most people who suffer from sarcoidosis do not know that they have it. Often the first indication that they have sarcoidosis is that when they are getting a physical examination and a blood chemistry profile that reveals the blood calcium is elevated. Some patients will present with coughing or respiratory difficulty and further workup often will lead to a diagnosis of sarcoidosis. (Please go to VitaminDHealth.org for more information).

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How much vitamin D would you recommend for a woman with sarcoidosis and also has osteoporosis?

Response: I believe that it is important for all patients with sarcoidosis to receive some vitamin D so that they are not vitamin D deficient. As a result, I carefully monitor patients with sarcoidosis when I treat them with vitamin D. I like to have their blood level of 25-hydroxyvitamin D above 20 ng/ml and preferably 25-30 ng/ml. I usually achieve this by giving 50,000 IU of vitamin D once every two weeks for 4 weeks and then to keep them on 50,000 IU of vitamin D once a month. Alternatively, taking a 1,000 IU of vitamin D/d will maintain vitamin D sufficiency without causing the serious side effect of hypercalcemia (high blood calcium). This should help prevent increased bone loss that is associated with vitamin D deficiency.

CROHN'S

How does vit D supplementation help with Crohn's and should supplements be oral or by injection?

Response: Patients with Crohn's disease especially of the proximal small intestine often have difficulty in absorbing vitamin D. I take three approaches in treating and preventing vitamin D deficiency in Crohn's patients. The first approach is to give 50,000 IU of vitamin D2 once a week or twice a week for at least 8 weeks to see if the vitamin D deficiency can be corrected. I also use the trick of having the patient cut the capsule in half and place it in milk or some other drink and to drink the content but not the capsule. The second approach is to give much higher doses of vitamin D as much as 50,000 IU of vitamin D once a day as long as the serum 25-hydroxyvitamin D reaches a level between 30-60 ng/ml and then tailor their dose to maintain this blood level. The third alternative is to have the patient go either to a tanning salon or to purchase a vitamin D producing lamp such as the Sperti lamp that you can purchase off of the web site Sperti.com. We showed in a patient with only two feet of small intestine left that she responded very well by being exposed to our tanning bed for 50% of the time recommended for tanning and wearing sun protection on her face three times a week. All of the aches and pains in her bones and muscles associated with vitamin D deficiency (osteomalacia) resolved, and her quality of life markedly improved after three months. We were able to maintain her in a normal vitamin D status by having her be exposed to the tanning bed once or twice a week thereafter. (Please go to VitaminDHealth.org for more information).

KIDNEY STONES

Do any of the studies cited demonstrate an increased incidence of kidney stones in patients taking the levels of Vitamin D you suggest?

Response: In my opinion, there is no increase risk of developing kidney stones in patients who are treated for vitamin D deficiency and maintain vitamin D sufficiency as I have recommended. Most of the studies that have reported an association were poorly designed or poorly controlled for. I have not experienced any increased risk of kidney stones in my patients who I have treated their vitamin D deficiency and maintained a normal vitamin D status. I believe that this is a myth.

LIVER DISEASE

I have a pre-liver transplant patient in the hospital right now who had a vit D2 level of <4.0ng/ml, D3 level of 21.0 ng/ml, Vit D25 level of 21.0ng/ml on 12/1/08. He is on a multivitamin and a calcium with vit D supplement right now. How much vitamin D would you recommend for this patient? His level is below the 30ng/ml that you recommend. Thanks.

Response: What you should care about is your total 25-hydroxyvitamin D level. This is accomplished by adding both the 25-hydroxyvitamin D2 and 25-hydroxyvitamin D3 levels together. Thus, in this case, the total 25-hydroxyvitamin D was 21 ng/ml. This level is essentially a vitamin D deficient level. This patient should either be treated with 50,000 IU of vitamin D2 once a week for 8 weeks followed by 50,000 IU of vitamin D2 once every other week or to take 2,000 IU of vitamin D2 or vitamin D3 daily.

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TESTOSTERONE DEFICIENCY

What role does vitamin D play in testosterone deficiency?

Response: There is no relationship between vitamin D deficiency and testosterone deficiency.

GASTRIC BYPASS

How much Vitamin D do you recommend a person that has had gastric bypass take?

Response: I recommend that patients with gastric bypass surgery to take at least twice as much vitamin D as a normal person, i.e., I give them 50,000 IU of vitamin D2 twice a week to treat their vitamin D deficiency, and then once a week thereafter to maintain their vitamin D sufficiency. Often these patients are unable to digest the gelatin capsule, so I tell the patient to cut the capsule open and to put it into a glass of skim milk, swirl it around, drink the milk without the capsule. You can go to my web site VitaminDHealth.org and the pdf of the New England Journal of Medicine review I wrote in 2007 has more information how to treat and prevent vitamin D deficiency in gastric bypass patients.

SEIZURES

Where is the article that states that insufficient D can lead to seizures?

Response: I am not aware of any studies that have demonstrated that vitamin D insufficiency per se can increase risk of seizures. The hypocalcemia associated with vitamin D deficiency can. (Please go to vitaminDhealth.org for more information).

GENETICS

What about people who have VDR altered phenotype and need more Vitamin D?

Response: Patients who have a vitamin D receptor (VDR) defect can sometimes benefit by increasing their vitamin D intake. It depends upon how severe the alteration is in the VDR gene. Most patients with VDR gene mutation known as vitamin D resistant rickets or vitamin D dependent rickets type II will sometimes benefit by having them treated not only with vitamin D but also the active form of vitamin D, 1,25-dihydroxyvitamin D3. You can go to my web site VitaminDHealth.org, and there is a pdf of my New England Journal of Medicine review that has instructions as to how to treat this disorder.

Can you please discuss the VDR polymorphisms and their effects on the dosing?

Response: Vitamin D receptor polymorphisms which are minor changes either in the expression of the vitamin D receptor or in the structure of the vitamin D receptor has been associated with increase risk of some diseases. However, there is not data to suggest that giving more vitamin D can overcome the polymorphism effect. I recommend that all patients no matter what their VDR polymorphism is should maintain a blood level of 25(OH)D > 30 ng/ml.

Does genetics play a role in the ability to maintain vitamin D status?

Response: There is some evidence that genetics does play a small role in the ability to maintain the vitamin D status. However, from my experience, if you ingest between 1500-2000 IU of vitamin D/d and you are not obese, this often will satisfy your vitamin D requirement.

DOSING RECOMMENDATIONS

Do you recommend 1000 IU/day in both summer and winter?

Response: I recommend that everyone take 1,000 IU of vitamin D/d along with a multivitamin containing 400 IU of vitamin D/d both in the winter and summer. This will not cause any build up of vitamin D in the body and by using this as a routine, you are less likely to forget it in the winter time.

Does the recommended dose of Vitamin D supplement need to be taken with fat (not in a tablet form)?

Response: The recommended dose of vitamin D supplement does not need to be taken with fat. We have shown that vitamin D in corn oil, milk and orange juice are equally bioavailable to the body.

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If a person is not vitamin D deficient , what is the best form and dose to take over the counter? and if someone is vitamin D deficient - same question as first (dosage and form?)

Response: If a person is not vitamin D deficient to maintain vitamin D sufficiency, I recommend that the person take at least 1,000 IU of vitamin D2 or 1,000 IU of vitamin D3/d. If a person is vitamin D deficient, then I double the dose and recommend that they take 2,000 IU of vitamin D/d along with a multivitamin.

How long does it take to increase serum vitamin D levels after starting supplementation?

Response: From my experience, in healthy adults taking a 1,000 IU of vitamin D/d, reached their peak blood level by 5-6 weeks. When I treat patients with 50,000 IU of vitamin D2 once a week for 8 weeks, their blood level begins to increase by the first week and levels off by the 4th through 6th weeks of treatment.

What are the recommended forms of supplementation?

Response From our experience that we have recently published and is noted on my web site VitaminDHealth.org, 1,000 IU of vitamin D2 was as effective as 1,000 IU of vitamin D3 in raising blood levels of 25(OH)D. Thus, vitamin D2 is as equally effective as vitamin D3 and either form can be used.

Do you recommend 1700 units for everyone everyday?

Response: I personally take 1,700 IU of vitamin D/d. 1,000 IU of vitamin D3 as a supplement, 300 IU of vitamin D/d in three eight ounce glasses of skim milk and 400 IU of vitamin D3/d from a multivitamin. My blood level of 25(OH)D is usually between 45-55 ng/ml. Thus, taking between 1,500-2,000 IU of vitamin D/d is what I recommend for all adults.

How many units of D does it take to raise serum levels by 1ng/ml?

Response: Based on several publications, for every 100 IU of vitamin D2 or vitamin D3 that you ingest, you raise your blood level of 25-hydroxyvitamin D by 1 ng/ml. (Please go to VitaminDHealth.org for more information).

Is there an age when Vitamin D supplementation doesn't work?

Response: Vitamin D supplementation is effective both in children and adults of all ages. Aging does not affect the body's ability to absorb vitamin D either from the diet or from supplements. There is no advantage to taking smaller doses more frequently than one large dose of 1,000 IU of vitamin D/d. Indeed, you can take 2,000 IU of vitamin D/d or 14,000 IU of vitamin D once a week or 60,000 IU of vitamin D once a month, they all work the same way. From my experience, taking adequate vitamin D supplementation, i.e., twice what is recommended to sustain vitamin D sufficiency will correct vitamin D deficiency within two months. For example, I recommend taking 3,000-4,000 IU of vitamin D/d. This will raise the blood level of 25(OH)D within 6-8 weeks to above 30 ng/ml I recommend that a 1,000 IU of vitamin D/d is appropriate for all ages, infants to geriatric patients.

Is there any advantage to taking smaller dose more frequently than one large does of 1000 IU per day?

Response: There is no advantage to taking smaller doses more frequently than a large dose of 1,000 or 2,000 IU of vitamin D/d.

How quickly can a Vit D deficiency be expected to be resolved with adequate supplementation?

Response: If you follow my regimen for treating vitamin D deficiency, it usually takes 1-2 months to correct vitamin D deficiency by giving 50,000 IU of vitamin D2 once a week for 8 weeks.

Is the recommendation to supplement with 1000 IU Vitamin D appropriate for all ages (infant-geriatric patients)? Are the adult over-the-counter supplements acceptable for children/adolescents?

Response: I believe that all infants should receive at least 400 IU of vitamin D/d and they can easily take 1,000 IU of vitamin D/d without worrying about toxicity. There was a study done in Finland where infants during the first year of life received 2,000 IU of vitamin D/d. Not only did it not cause any toxicity, it prevented them from developing rickets as children, and more importantly, reduced their risk of developing type I diabetes 31 years later by 78%. I believe that all children and adults should be taking at least a 1,000 IU of vitamin D/d along

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with a multivitamin containing 400 IU of vitamin D/d. For those individuals not being exposed to any sun light, they probably need 2,000 IU of vitamin D/d to maintain a blood level of 25(OH)D > 30 ng/ml.

What is the best supplements for adults & kids - any specific brand?

Response: I recommend that for both children and adults that they can use any national brand of vitamin D supplement. We have found them to be all effective in maintaining healthy levels of 25-hydroxyvitamin D.

How much vitamin D is needed and how long will it take to raise vitamin D levels from 32 to 60? This individual had a vitamin D level of 22, which was increased to 32 in 4 months by increasing vit D intake to 2000 IU/day.

Response: For every 100 IU of vitamin D ingested, blood level of 25(OH)D should increase by 1 ng/ml. Thus, if you were to increase the vitamin D intake to 4,000-6,000 IU of vitamin D/d, you are likely to reach a blood level of 60 ng/ml.

For a patient living in the northeast that is currently deficient in Vit. D -- what should they take to become efficient before taking the regular 1,000IU plus MVI plus 3 dairy servings?

Response: To become vitamin D sufficient, I would recommend that the patient take an additional 3,000 IU of vitamin D as a supplement for 2-3 months.

Please clarify, once you treat vitamin D deficiency with the 8 weeks of 50,000 IU, then do you give 50,000 IU every other week AND 1000 U/day or a supplement, or just choose one or the other?

Response: Sorry for the confusion. Once I have corrected vitamin D deficiency, I either will maintain vitamin D sufficiency by giving the patient as a prescription 50,000 IU of vitamin D once every two weeks, or if they prefer, they can take 1,500-2,000 IU of vitamin D/d from supplements. Both work equally fine.

So you recommend a multivitamin of 400 IU and a vit D supp. of 1000 IU for a total of 1400 IU's a day?

Response: I do recommend a multivitamin of 400 IU of vitamin D along with 1,000 IU of vitamin D supplement a day. Remember in my presentation, I also drink three glasses of skim milk a day which provides me with an additional 300 IU of vitamin D. Thus, from my experience for adults taking 1,400-2,000 IU of vitamin D/d is sufficient.

Please repeat correlation of dose (IU) of vitamin D, and the effect (increase) of serum D levels

Response: For every 100 IU of vitamin D2 or vitamin D3 you ingest, you raise your blood level of 25-hydroxyvitamin D by 1 ng/ml.

Once found to be deficient, you require 50,000 IU D2 or D3 for life?

Response: If you have been found to be vitamin D deficient, you most definitely should continue taking a vitamin D throughout your life since correcting vitamin D deficiency only lasts for a short period of time and the cause of the vitamin D deficiency is not often taken care of, and as a result, most patients who are treated for vitamin D deficiency return within six months being vitamin D deficient again.

Can one make it a standard practice of taking a 1000 IU supplement every day of the week?

Response: You can take either 1,000 IU of vitamin D/d once a day or seven 1,000 IU of vitamin D supplements once a week. It will work the same way.

When treating a deficiency of Vit D as a physician, where do we find the form of Vit D for 50,000U?

Response: In the United States, the only vitamin D form available by prescription for physicians is vitamin D2 also known as ergocalciferol. It comes either in a capsule with 50,000 IU of vitamin D2 or it comes in a liquid form for pediatric patients as 8,000 IU of vitamin D2 per 1 ml. You can go to my web site VitaminDHealth.org for more information about this and a table that provides information on all of the supplement and pharmaceutical forms of vitamin D.

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Does aggressive supplementation of Vitamin D work as well in adults as it does in children who are deficient?

Response: Aggressive vitamin D supplementation works equally well in adults as it does with children who are vitamin D deficient. You can find more information about this on my web site VitaminDHealth.org.

Is 5,000IU vit D day too much?

Response: I don't recommend that people take 5,000 IU of vitamin D/d. Although I doubt that it will cause toxicity, my preference is to recommend that you take no more than 3,000 IU of vitamin D/d. I have had most experience with people taking an equivalent of 3,000 IU of vitamin D/d and not experiencing any untoward toxicity.

What is the best supplements for adults & kids - any specific brand?

Response I recommend that for both children and adults that they can use any national brand of vitamin D supplement. We have found them to be all effective in maintaining healthy levels of 25-hydroxyvitamin D.

Should supplements be taken with food or milk or on empty stomach? Best at bedtime with Calcium/magnesium?

Response: Vitamin D supplements can be taken with food, with milk or on an empty stomach. It doesn't matter how it is taken or at what time of day it is taken.

I have heard that it is important to take magnesium along with Vitamin D. Is there any reason for this?

Response: There is not need to be taking magnesium along with vitamin D. Vitamin D is efficiently absorbed with or without magnesium.

If Vit D is a fat-soluble vitamin, why are you not able to absorb extra during the summer to use during the winter?

Response: I recommend that everyone stay on a vitamin D supplement year around and it does not matter whether it is the summer or winter. The fact that you make vitamin D in the summer and ingest vitamin D from a supplement will not cause any untoward toxicity.

Given the concerns with integrity on the part of the vitamin manufacturing industry, are there any particular concerns regarding specific brands of vitamin D?

Response: I have found that most reputable national brands of vitamin D are perfectly adequate.

How much calcium should you have with 1000IU vit D/day?

Response: The Institute of Medicine recommends that all adults up to the age of 50 ingest 1,000 milligrams of calcium a day, and adults over the age of 50, 1200 milligrams of calcium/d.

Is it okay to take vitamin D without taking calcium supplements?

Response: It is okay to take vitamin D without taking calcium supplements. However, to maximize the vitamin D effect on skeletal health, you need to ingest either from supplements or diet, a 1,000-1200 milligrams of calcium/d depending on your age.

Is there a downside to taking a combination Vit . D with Calcium and Vit. K?

Response: There is no downside to taking the combination of vitamin D, calcium and vitamin K. The only concern about vitamin K is that it should not be taken if your are on a blood thinner.

Should one be taking calcium along with vitamin D and how much calcium with 1000IU of vitamin D

Response: As I have suggested to other questioners, the amount of calcium that you should take from diet and supplemental sources is 1,000 milligrams/d for adults up to the age of 50 and 1200 milligrams/d for adults above the age of 50.

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To promote optimal bone mineral density without abnormal calcification of arteries/soft tissues, does increasing one's vitamin D intake decrease calcium needs?

Response: There is some evidence by increasing your vitamin D intake you may be able to sustain your bone density with less calcium intake. However, it should be at least 800-1000 mg/d.

Do carbonated beverages affect vitamin D or calcium levels?

Response: Carbonated beverages do not affect your vitamin D or calcium levels.

Do high intakes of vitamin D affect normal phosphorous metabolism in a positive or negative way?

Response: Vitamin D taken in the doses I recommend will not affect phosphorus metabolism other than to maintain adequate phosphorus levels for bone mineralization and metabolic processes.

TESTING/MONITORING

Once levels are back to normal range, how often do you monitor?

Response: Once I have a patient on an adequate amount of vitamin D which is 50,000 IU of vitamin D every two weeks or its equivalent, I monitor the patient once a year.

How often should this individual have their vitamin D levels checked? A red-haired, fair-skinned female living in North Dakota had low vit D level, (22ng) at the end of the summer. Currently taking 400 IU supplement, plus MVI with 400 IU, with a plan to increase to 800 IU supplement, plus MVI.

Response: From my experience, all adults should be on at least 1500-2000 IU of vitamin D/d to satisfy their body's vitamin D requirement.

Do you recommend testing children's Vit D levels?

Response: It is not unreasonable if you are concerned that your child may be vitamin D deficient to have your pediatrician measure your child's 25-hydroxyvitamin D. However, if your child is taking a multivitamin along with 1000 IU of vitamin D supplement, it is likely that your child will be vitamin D sufficient and not require a blood level of 25-hydroxyvitamin D.

During the September '07 NIH conference, speakers noted that laboratories often give Vit D levels that are not accurate, and due to high cost, don't advocate tests for the whole public. Comments?

Response: There are several reputable reference laboratories that provide patients with an accurate blood level of 25-hydroxyvitamin D. It is true that it can be expensive. Thus, if you do not have any type of fat malabsorption syndrome, if you are ingesting 1500-2000 IU of vitamin D/d, it's likely that you are vitamin D sufficient and do not require a blood level of 25-hydroxyvitamin D.

How expensive is the 25(OH) VitD test? If the MD found you were Vit D deficient, prescribed the 50,000 units weekly, but did not limit length of time to take the Vit D, should patient call and have level rechecked?

Response: The 25-hydroxyvitamin D test cost varies depending upon which laboratory is doing it and whether a large number of assays are being performed by an individual doctor's office or hospital. The assay cost can range anywhere from approximately \$50-\$225 per test. If you are treating patients with 50,000 IU of vitamin D once a week for 8 weeks and want to know if you corrected their vitamin D deficiency, it is reasonable to have it rechecked after 2-3 months. (Please go to vitaminDhealth.org for more information).

As a physician what is the timing in checking Vit D levels to assess treatment?

Response: The best time to check the 25(OH)D levels to assess treatment is after 2-3 months. You will not see a significant rise in the serum 25(OH)D levels after one week of therapy and the maximum effect is seen 2-3 months later.

Should someone stop taking Vit. D supplements before having his/her Vit. D Status checked?

Response: There is no need to stop your vitamin D to have your serum 25(OH)D checked. It will have no influence on it.

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Is it expensive to run a serum vit D level? Average cost? This is important to low-income individuals.

Response: As noted above, the average cost for a 25-hydroxyvitamin D test is between \$50 and \$225 depending upon the laboratory that is doing it. Medicare will cover the costs.

How do you interpret different vit D lab numbers, i.e. do you look at 25-OH-Vit D2 or D3 or Total Vit D?

Response: When you obtain the blood level of 25-hydroxyvitamin D, the only number that is important is the total 25-hydroxyvitamin D which should be above 30 ng/ml. The 25(OH)D2 is a reflection of the vitamin D2 intake usually from the vitamin D2 prescription and the 25(OH)D3 is reflective of the vitamin D3 ingested from diet, supplements and from sun exposure.

Are PTH levels a good way to monitor effective dose of vit D?

Response: PTH levels help in monitoring the effectiveness of vitamin D. However, it often takes several months to several years for the PTH levels to return to normal if it has been elevated, and, thus, you cannot directly relate it to the dose of vitamin D.

How often should a patient have a Vit D2 lab re-drawn if the baseline lab shows deficiency?

Response: The patient should have their blood level of 25(OH)D drawn 2-3 months after treating vitamin D deficiency. Once you have corrected their vitamin D deficiency and have them on an adequate amount of vitamin D, then I would recommend once a year is appropriate. Note you only need to know the total 25(OH)D which should be 30-100 ng/ml.

SAFETY/TOXICITY

Can a dose of 50,000 IUs Vit D (to correct deficiency) cause fatigue?

Response: I do find that some of my patients who take 50,000 IU of vitamin D feel fatigued. I believe that this may be due to the gelatin capsule rather than the 50,000 IU of vitamin D. Try cutting the capsule and dumping it into milk and drinking the content without the capsule.

Is it possible to get vitamin D toxicity with vit D supplementation and a diet high on vitamin D fortified foods?

Response: In my opinion since very few foods contain vitamin D and the amount of vitamin is relatively small in comparison to what the body requires, it is doubtful that you could become vitamin D toxic by taking a vitamin D supplement of a 1,000 IU of vitamin D/d. Most of the literature suggests that you have to ingest more than 10,000 IU of vitamin D/d for at least six months before you have to begin to be concerned about vitamin D toxicity.

So then what is the tolerable upper limit?

Response: In my opinion, the tolerable upper limit can be substantially increased for both infants, children and adults. I consider the tolerable upper limit or what I prefer to call the safe upper limit for infants to be 2,000 IU of vitamin D. For children up to the age of 18 years, I consider the safe upper limit to be 5,000 IU of vitamin D, and for all adults, 10,000 IU of vitamin D/d. The only exception is that if you are suffering from a granulomatosis disorder such as sarcoidosis or tuberculosis in which case you can discuss this with your physician first. Please see my New England Journal of Medicine review on this subject that can be found on my web site VitaminDHealth.org.

Are there side effects from 50,000 IU at one time?

Response: From my experience, there are no side effects from taking 50,000 IU of vitamin D at one time. However, some patients are not able to tolerate it or have some GI issues. I believe that this is due to the gelatin capsule not the vitamin D. For these patients, I recommend that they cut the capsule open and dump it into a glass of milk or orange juice and then to drink the contents without the capsule.

What does Vit D toxicity look like?

Response: Vitamin D toxicity is often difficult to diagnose. The diagnosis is made based on the blood biochemistries that include a high elevated blood calcium along with a markedly elevated level of 25-hydroxyvitamin D that is usually > 200 ng/ml. The hypercalcemia and hyperphosphatemia associated with

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vitamin D intoxication can cause the kidneys to calcify, increase risk of developing kidney stones, increase risk of calcifying blood vessels that ultimately can lead to death. The elevated blood calcium also causes constipation, confusion, depression, increased thirst and increased urination and changes in the electrocardiogram. You can go to my web site VitaminDHealth.org for more information about this.

Please comment on the fact that textbooks still call vit D the most toxic vitamin.

Response: You are correct. Most textbooks still call vitamin D to be the most toxic vitamin. It definitely is not. Vitamin A is much more toxic and can rapidly cause death in very high concentrations. This was found out by early explorers in Alaska where they began eating polar bear liver and became severely vitamin A intoxicated leading to death.

Some of our patients complain of GI upset and muscle weakness with supplemental vitamin D Besides sun what would you suggest as a substitute?

Response: I too have found that some of my patients complain of GI upset and muscle weakness with vitamin D supplementation. However, I believe that this is due to the gelatin capsule or the formulation rather than the vitamin D. However, sun exposure and exposure either to a tanning bed that emits UVB radiation or a vitamin D producing lamp such as a Sperti lamp are good substitutes. (Please go to vitaminDhealth.org for more information).

DRUG INTERACTION

Do Vit D supplements interact with any drugs (warfarin, cardiovascular drugs, commonly taken drugs)?

Response: Vitamin D supplements do not interact with any of these drugs.

Does vitamin D interact with any medications?

Response: Vitamin D does not interact with any medications. However, some medications like antiseizure medications and prednisone will increase the destruction of vitamin D requiring patients to increase their vitamin D intake. (Please go to vitaminDhealth.org for more information).

What is the risk for Vitamin D deficiency in someone taking Orlistat and how much should someone supplement Vitamin D who is on Orlistat?

Response: Patients on Orlistat are at increased risk of vitamin D deficiency since the drug decreases vitamin D absorption. For these patients, I recommend that they increase their vitamin D intake from 2,000 IU of vitamin D/d to 3,000-4000 IU of vitamin D/d.

Are there many medications that interfere with absorption?

Response: No but Olestra and cholestyramine will decrease absorption.

A lot of women are being given gabapentin for hot flashes instead of estrogen. Does gabapentin, like phenytoin, lower Vitamin D levels?

Response: We do not know whether Gabapentin used for treating hot flashes will lower vitamin D levels. However, we do know that many drugs and even St. Johns Wort will enhance the destruction of vitamin D in the body. Thus, at a minimum, I would recommend being on at least 2,000 IU of vitamin D/d and to have your blood level of 25-hydroxyvitamin D monitored.

PREGNANCY/BREASTFEEDING

What are your recommendations for Vit. D during pregnancy?

Response: I recommend that all pregnant women take a prenatal vitamin that contains 400 IU of vitamin D/d along with a vitamin D supplement of 1,000 IU of vitamin D/d. At a minimum, all pregnant women should be taking at least 1,400 IU of vitamin D/d and 2,000 IU of vitamin D/d is perfectly safe.

What is your recommendation for dispensing vitamin D to breastfeeding infants?

Response: The American Academy of Pediatrics recently came out with the recommendation that all infants including breastfed infants should receive 400 IU of vitamin D/d. I agree with this recommendation.

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Can you provide the source(s) of studies for recommendation of 1000 IU Vit D in pregnancy (+ prenatal). And safety? Also, I believe ACOG may still be recommending 200-400 IU.

Response: There are no recommended guidelines for giving pregnant women 1,000 IU of vitamin D/d. However, from my experience and from the literature, it's clear that pregnant women on a prenatal vitamin and drinking two glasses of milk a day, thus, ingesting 600 IU of vitamin D/d are at high risk for vitamin D deficiency. We reported 76% of moms and 81% of newborns were vitamin D deficient at the time of birth with a 25(OH)D < 20 ng/ml. Since healthy adults need at least 1,400-2,000 IU of vitamin D/d to maintain a blood level of 25(OH)D > 30 ng/ml in my opinion so do pregnant women. There is no evidence that this will cause any toxicity either to the woman or her fetus. The ACOG recommendation of 200-400 IU of vitamin D/d is in my opinion inadequate.

Is the recommendation for 1,000 IU daily the same for pregnant and lactating women?

Response: The recommendation of 1,000 IU of vitamin D/d is inadequate for both pregnant and lactating women. In my opinion, they need to be on at least 1,400 and up to 2,000 IU of vitamin D/d to maintain their blood level of 25(OH)D > 30 ng/ml. There is a study underway suggesting that lactating women can take as much as 4,000-6,000 IU of vitamin D/d without causing any toxicity either to themselves or to their infants, and more importantly, it takes this amount of vitamin D to be transferred into her milk to satisfy the infant's requirement. This is an on-going study, and we do not know whether or not there are any long term consequences for either the mother or the infant when the mother is ingesting 4,000-6,000 IU of vitamin D/d. From my experience, I would suspect that the study will show no untoward toxicity and that it is perfectly safe to take this amount of vitamin D.

What vit D supplement should I give a breast-fed infant- and how much?

Response: Give the infant 400 IU of vitamin D2 or vitamin D3/d.

Are you advocating 4000-6000 IU Vit D for breast feeding mothers?

Response: I am not advocating that breast feeding mothers take 4,000-6,000 IU of vitamin D/d. However, as I have stated, there is an ongoing study by Dr. Hollis and we are waiting the results to know whether or not this is a good strategy for providing breast fed infants with all of their vitamin D requirement. Based on safety data whereby adults can take up to 10,000 IU of vitamin D/d for at least six months without any untoward toxicity, I suspect that women who take 4,000-6,000 IU of vitamin D/d during their breast feeding period will not cause any untoward toxicity to the mom or infant and may likely be of benefit to the infant.

Is it safe to supplement with 50,000 IU during pregnancy and while breastfeeding?

Response: There are patients who have hypoparathyroidism which means that they are less sensitive to vitamin D and often have a low blood calcium. When these patients receive 50,000 IU of vitamin D once a week or once every two weeks to correct their vitamin D deficiency, there have not been any reports of any untoward toxicity either to the mother or to the developing fetus. The same is true during breast feeding. I have treated pregnant women and breast feeding women with 50,000 IU of vitamin D2 once a week for 8 weeks followed by once every two weeks without any untoward toxicity.

Do you recommend the same supplementation for infants on formula as with breast milk?

Response: I recommend that all infants whether breast fed or formulae fed receive 400 IU of vitamin D/d as soon as possible as recommended by the American Academy of Pediatrics.

If already taking 400IU of prenatal vitamin, how much more is needed during pregnancy and after pregnancy with breastfeeding?

Response: I encourage all pregnant and lactating women to take the prenatal vitamin containing 400 IU of vitamin D/d along with an additional 1,000 IU vitamin D supplement for a total of at least 1,400 IU of vitamin D/d. I believe that pregnant and lactating women can easily take 2,000 IU of vitamin D/d without causing any untoward toxicity.

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We used to think too much vit. D in pregnant women would cause the head growth of the fetus head to be stunted. Is that a myth?

Response: You are correct. It is a myth. I'm not sure what you mean by taking too much vitamin D, but certainly taking the recommended 1,400-2,000 IU of vitamin D/d will not cause head growth of the fetus to be stunted.

CHILDREN & INFANTS

Why are infants only to receive 400IU? How about premature infants?

Response: Infants appear to satisfy most of their vitamin D requirement by receiving 400 IU of vitamin D/d. This is the recommendation made by the American Academy of Pediatrics and the Canadian Pediatric Society. There is some evidence that premature infants may not be able to metabolize vitamin D as efficiently, but there are no data to suggest that giving a premature infant more than 400 IU of vitamin D/d has any additional benefit. Thus, I would recommend that infants including premature infants receive at least 400 IU of vitamin D/d, and I believe that up to 1,000 IU of vitamin D/d is safe for them.

Your advice for vegan children?

Response: I recommend all children including vegan children ingest at least 400 IU of vitamin D/d and preferably 1,000 IU of vitamin D/d along with a multivitamin especially if they are not getting adequate exposure to sunlight.

How many IUs of Vit D should preschoolers have?

Response: Based on the Finish study that demonstrated that children during their first year of life could ingest 2,000 IU of vitamin D/d and reduce their risk of developing type I diabetes later in life, makes me very comfortable to recommend that all preschoolers take at least 400 IU of vitamin D/d as recommended by the American Academy of Pediatrics. I would prefer that they be on 1,000 IU of vitamin D/d. This can be in addition to them taking a multivitamin such as the Flint Stone vitamin which contains 400 IU of vitamin D.

In terms of children, what age should they start taking 1000 ID/d?

Response: I believe that all children would benefit by taking 1,000 IU of vitamin D/d. I do not see any downside to taking this amount of vitamin D and there may be several upsides including decreasing risk of developing multiple sclerosis, type I diabetes and other chronic illnesses later in life.

How do you dose newborns?

Response: The American Academy of Pediatrics and I agree all newborns as soon as possible should be receiving 400 IU of vitamin D/d. I believe that all newborns and infants during the first year of life can easily tolerate 1,000 IU of vitamin D/d. I would not go any higher than this until more studies are done to show that this dose is both safe and effective.

Can you recommend a supplement I could provide to a 5 year old?

Response: When my children were growing up, we would give them a Flint Stone chewable vitamin which contained vitamin D. I am not certain now what products are on the market that are in a chewable form, but I believe that the Flint Stone vitamin is still available and does contain 400 IU of vitamin D.

How much vitamin D supplementation is needed for children?

Response: As noted in my previous responses, I believe that during the first year of life that all children should be taking at least 400 IU of vitamin D/d and can probably easily tolerate and benefit by taking 1,000 IU of vitamin D/d. All children after the age of one should be on 1,000 IU of vitamin D/d.

Should children that do not drink much milk and wear sunscreen get their blood levels of vit. D checked?

Response: It's not unreasonable if you are concerned about your child being vitamin D deficient because they don't drink milk or wear sunscreen all the time to be tested. This will help convince yourself and the pediatrician that the child is vitamin D deficient and requires vitamin D treatment. Thus, obtaining a blood level of 25-hydroxyvitamin D is appropriate. However, because this test is rather costly, I often simply recommend that children take 1,000 IU of vitamin D/d along with a multivitamin containing 400 IU of vitamin D/d.

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The American Academy of Pediatricians believe that the daily requirement for children should be increased to 400 IU per day. Do you believe that is enough? If not, what would you recommend?

Response: The American Academy of Pediatrics has made a major contribution in now recommending that all infants and children be on 400 IU of vitamin D/d from the time of birth. This is definitely enough to prevent rickets and to preserve bone health. What we do not know is whether it is enough to prevent other diseases from occurring later in life including multiple sclerosis and type I diabetes. Based on my understanding of the literature, I feel very comfortable in recommending that all children be on 1000 IU of vitamin D/d along with a multivitamin.

What is the safest way for toddlers to ingest Vit D pills and is the 30 ng same for over 1 year?

Response: For infants and toddlers, Poly Visol is a liquid vitamin supplement that contains 400 IU of vitamin D in 1 ml. Alternatively, I have suggested to parents that they can buy the 1,000 IU of vitamin D tablet and grind it up and put it into the toddler's orange juice or milk and then have them drink it. I presume what you mean by 30 nanograms same over one year is that in my opinion all children and adults should maintain a blood level of 25(OH)D of at least 30 ng/ml all the time.

What form would you suggest to give infants 400 IU/day?

Response: Either vitamin D2 or vitamin D3 is okay.

What are your recommendations for supplementations in premature infants specially those with cardiac diagnosis that are in diuretics?

Response: I am not aware that there is any difference in the requirement for vitamin D for premature infants who are on a diuretic. I see no reason not for them to be on 400 IU of vitamin D/d. As I have suggested in a previous answer, there is some information to suggest that premature infants may not have the liver capacity to convert vitamin D to 25-hydroxyvitamin D. Thus, giving more vitamin D may not overcome this deficiency. Therefore, I am not aware of diuretics or cardiac diagnosis would make any difference in the recommended vitamin D intake.

What is the best supplement form for toddlers to receive vit. D supplements? 400 IU?

Response: You can give toddler either Poly Visol which contains vitamin D and other vitamins and minerals. One milliliter contains 400 IU of vitamin D. Alternatively, you can take a 1,000 IU or 400 IU supplement grind it up and put it into either a juice product or milk and have them drink it.

How much vitamin D should be given infants and in what form?

Response: As noted in my recommendations above, I believe that all infants should follow the American Academy of Pediatrics recommendation to take at least 400 IU of vitamin D2 or vitamin D3/d. A 1,000 IU of vitamin D may have some additional health benefits and should not cause any untoward harm or toxicity to the infant.

Please explain why children should get 1,000 IU and not 400 IU as recommended.

Response: I am not sure which age you mean? My reason for suggesting that children get a 1,000 IU of vitamin D/d is based on a recent study in Lebanon where they gave children between the ages of 9 and 18 yrs 2,000 IU of vitamin D/d and found that it was very effective in maintaining their blood level above 30 ng/ml and improving muscle strength and bone health.

At what age do you recommend children start taking 1000 iu/day? How much do you recommend for infants?

Response: I believe that all children over the age of one year should be on a 1,000 IU of vitamin D/d. Infants should be on at least 400 IU of vitamin D/d, and as I have discussed above in my responses to other questions, a 1,000 IU of vitamin D/d should not cause any harm and may provide additional benefits.

Would there be concern if my child is low on the growth charts for height and high for weight?

Response: A child who is low on growth charts for height and high for weight may have some other medical problem that should be evaluated by a pediatrician. The pediatrician, obviously, should check the child's vitamin

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D status to be sure that the child is not vitamin D deficient. However, if the child is overweight, the child may need more vitamin D to be vitamin D sufficient.

AFRICAN AMERICANS

How much Vit D do you recommend for African Americans?

Response: African Americans are at higher risk of vitamin D deficiency. However, from my experience, they respond to treatment as well as my white patients. Thus, I recommend that African Americans, who are vitamin D deficient, receive 50,000 IU of vitamin D2 once a week for eight weeks, and to sustain vitamin D sufficiency, to take 50,000 IU of vitamin D2 once every two weeks thereafter. If the person is obese, they may need twice as much vitamin D. (Please go to VitaminDHealth.org for more information).

LEAN INDIVIDUALS

Do very lean people require a lower dosed supplement?

Response: Normal weight people and very lean people do not require lower dose of vitamin D. However, anorexic patients have been found to have marginally higher blood levels of 25-hydroxyvitamin D for the same amount of vitamin D that a normal weight person would take. However, this is of little clinical significance.

OBESE INDIVIDUALS

Do you feel 1,000 IU per day of Vitamin D is adequate for individuals who have a BMI >35? Or would you recommend a higher level?

Response: 1,000 IU of vitamin D/d is inadequate in maintaining a blood level of 25(OH)D > 30 ng/ml in healthy normal weight adults in Boston last winter. All adults who are normal weight need to be on at least 1,500-2,000 IU of vitamin D/d. For patients with a BMI of > 30, they need to double the dose of vitamin D since the body fat will sequester the vitamin D and make it less available for the body to use. (Please go to VitaminDHealth.org for more information).

Do you recommend higher amounts of Vit D supplementation for those who are obese?

Response: I do recommend for obese people that they double their intake of vitamin D so instead of taking 2,000 IU of vitamin D/d to take between 3,000-4,000 IU of vitamin D/d.

GERIATRICS

Should vitamin D screening be a part of a comprehensive geriatric physical based on the high prevalence of deficiency and its association with many chronic diseases? How should this be billed/coded?

Response: It is not unreasonable to measure the serum 25-hydroxyvitamin D as part of the comprehensive geriatric physical especially since vitamin D deficiency is associated with osteoporosis and muscle weakness as well as many serious chronic diseases. The vitamin D deficiency CPT code is 268.9.

PATIENTS WHO CANNOT EAT

What is the recommended IV dose for those who can't eat?

Response: Unfortunately, the IV dose typically given is 400 IU in a solution that contains other nutrients. Thus, it is difficult to get vitamin D intravenously by itself. The alternative is to have sensible sun exposure or to be exposed to either a vitamin D producing lamp, the Sperti lamp, or by going to a tanning salon as I have recommended to another questioner.

What are the recommendations for supplementing vitamin D in TPN?

Response: Patients who are on TPN often have metabolic bone disease. This is due both to micronutrient, macronutrient deficiencies in fat soluble vitamins including vitamin D. I typically encourage these patients to get some sensible sun exposure which can be found on my web site VitaminDHealth.org or to use a vitamin D producing lamp such as the Sperti lamp or a tanning bed to produce vitamin D in their skin to satisfy their

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body's vitamin D requirement. You could go to my web site for the New England Journal of Medicine review of 2007 which has more information about this.

PRISONERS

Are there any thoughts on the Vit D status of incarcerated populations (limited outdoor time, institutional feeding, etc), especially r/t aggressive or addictive behaviors?

Response: For incarcerated populations and the infirmed, it is reasonable for all of them either to be on 50,000 IU of vitamin D2 once every two weeks or 2000 IU of vitamin D2 or vitamin D3 once a day to maintain their blood level of 25(OH)D between 30-100 ng/ml.

SOURCES

SUNLIGHT & UV LIGHTS

Do full-spectrum lights work to produce vit D in humans as well as animals?

Response: Full-spectrum lights will produce vitamin D in humans but as noted above, the output is too little to be effective. Thus, either a tanning bed or a Sperti lamp is preferred.

Can you receive vit D from sunlight through windows?

Response: Excellent question. Sunlight coming through window glass will not produce any vitamin D in the skin. Your skin must be exposed to direct sunlight in order to make vitamin D.

Do tanning beds increase serum vitamin D levels?

Response: Tanning beds that emit UVB radiation will increase blood levels of vitamin D and sustain serum 25-hydroxyvitamin D levels in a healthy range of about 40-50 ng/ml. Tanning beds that only emit UVA radiation will not produce any vitamin D in the skin. (Please go to vitaminDhealth.org for more information).

How much exposure to a tanning bed would induce vitamin D production?

Response: I recommend for those who wish to use a tanning bed to obtain their vitamin D that they go in for 50% of the time recommended by the manufacturer for tanning and to wear sun protection on the face. Arms, legs, abdomen and back are more than an adequate area to produce enough vitamin D to satisfy the body's requirement. The exposure time is dependent on the manufacturer of the tanning bed. Thus, be exposed for 50% of the time recommended for tanning for your skin type.

What impact does cloud cover have?

Response: Cloud cover will decrease the amount of UVB radiation penetrating to the earth and can reduce vitamin D3 synthesis by 50-75%.

Does time of day matter for recommended sun exposure?

Response: The time of day does matter since the angle of the sun is different. You will not make any vitamin D in the early morning or late afternoon even in the summer time, and you will make more vitamin D at 12 n-2 pm than you will either make at 10 am or 3 pm.

Are there any vitamin D stimulating light bulbs for humans?

Response: Vitamin D will not be produced when you are exposed to light bulbs. You need to be exposed to a vitamin D producing lamp which has a high output of ultraviolet B radiation. The Sperti lamp is the only FDA sanctioned vitamin D producing lamp.

You talk about east coast exposure but what about the northwest?

Response: The amount of exposure depends upon time of day, season, latitude and cloud cover. The northwest is not very much different than the northeast when the sun is shining. If you know from your skin sensitivity that you will get a mild pinkness to your skin 24 hours after exposure, I recommend that you go outside for about 50% of the time that would cause this minimal erythema dose. Typically in the northeast, that would be about 10-15 minutes for a white person on a Cape Cod beach in June at noon time.

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10-20 minutes a day of sun exposure, is this with or without sunglasses or does it matter?

Response: 10-20 minutes a day of sun exposure of arms and legs 2-3 times a week between the hours of 10 am and 3 pm depending upon time of day, season of the year, latitude and degree of skin pigmentation should be adequate. I always recommend some protection of the face and to always wear sun glasses or some eye protection to reduce risk of cataracts.

Would the light that was bought for the iguana be harmful for a human to expose him or herself to? If NOT harmful, how long should the exposure be and what would be the equivalent amount in IUs of Vitamin D made?

Response: The lamps that are used for iguanas probably will not be very effective for humans since it would take a very long time of exposure to make any significant amount of vitamin D. The reason that these lamps work well for them is that they are exposed to them for up to 12 hours/d. However, the Sperti lamp which is a very high output UVB lamp is very effective in making vitamin D. (Please go to vitaminhealth.org for more information).

FORTIFIED FOODS

Does boiling cows milk destroy Vitamin D?

Response: Boiling cow's milk will not destroy vitamin D. Vitamin D is heat stable at least until you get to a temperature of about 300° F.

Can the doctor clarify whether D is better absorbed from fortified dairy or fortified juice?

Response: We have recently completed a study and found that vitamin D is equally bioavailable from fortified juice, fortified milk and from a vitamin D supplement in a capsule.

Do you recommend cod liver oil capsules and how much do you recommend taking?

Response: Cod liver oil capsules can be a good source of vitamin D. They, however, contain vitamin A, and, thus, you should only take the amount recommended by the manufacturer otherwise you could take too much vitamin A. Some cod liver oil capsules contain up to 1,000 IU of vitamin D which is perfectly safe.

Related to the US population, do you suggest that additional foods and beverages should be fortified with Vit D and, if so, is it necessary to include Calcium with the inclusion of Vitamin D?

Response: I believe that it is important to increase the number of foods and beverages that can be fortified with vitamin D to at least double if not triple the amount per serving. A good example would be to fortify pasta with vitamin D. I would increase the vitamin D fortification to at least 200 IU of vitamin D 8 oz in milk, yogurt, cheeses and juice products.

Can you talk about vitamin D absorption with orange juice and other fortified foods?

Response: Vitamin D is efficiently absorbed from orange juice, milk and other fortified foods. Vitamin D in orange juice is equally bioavailable as it is in milk.

Is the level of vitamin D in milk consistent? Is the fortification process reliable?

Response: We have found as well as the FDA has found in the past that the amount of vitamin D in milk is highly variable. I am aware not of any recent studies that have reevaluated this issue.

Is there any discussion about increasing the amount of vitamin D added to milk?

Response: The only way that vitamin D content can be increased in the fortification of milk and other products is if the Institute of Medicine comes out with new recommendations for adequate intakes that are much higher than the present recommended levels.

I've heard that Vitamin D in skim or nonfat milk isn't as bioavailable. Is this true?

Response: Vitamin D is perfectly bioavailable from skim nonfat milk as it is in whole milk. (Please go to vitaminhealth.org for more information).

Isn't vitamin D fat soluble? Is there a water soluble form of vitamin D that is used to fortify orange juice and skim milk?

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Response: The vitamin D that is used in orange juice is in a micronized form. The vitamin D in skim milk is the same vitamin D in whole milk and is perfectly bioavailable.

Do you have to take Vitamin D with a certain amount of dietary fat for best absorption?

Response: You do not need to take vitamin D with dietary fat for best absorption.

What interferes with absorption?

Response: Patients with fat malabsorption syndromes including Crohn's disease, celiac disease as well as patients who ingest cholestyramine or olestra will have difficulty in absorbing vitamin D.

You mentioned Vit D could be taken w/ or w/o food, but I thought it needed fat for absorption. Please elaborate.

Response: As I mentioned above, it doesn't matter whether you take vitamin D with or without food. Fat is not necessary for vitamin D to be absorbed.

Are you familiar with IV forms of Vit D available for those that can't take oral Vit D?

Response: There are no IV forms of vitamin D other than for patients on total parental nutrition. The amount is so little that it provides little vitamin D to the user. The alternative is to either use a vitamin D producing lamp or a tanning bed or exposure to sunlight. There is also no intramuscular form of vitamin D available in the United States. (Please go to vitaminDhealth.org for more information).

Should you take Vit D supplements spread out through the day for better absorption?

Response: It does not matter whether you take your vitamin D supplement once a day, once a week or even once a month as long as the total amount is the same, i.e., 1,000 IU of vitamin D/d or 7,000 IU of vitamin D/w or 30,000 IU of vitamin D/mo.

Do certain brands of OC vit D are know for adequate quality control? What should we look for for quality control?

Response: I recommend that vitamin D supplements be purchased from a reputable national manufacturer.

What is the best supplement for children who cannot swallow pills?

Response: The best supplement for children who can't swallow pills is either to use Poly Visol liquid or to find one of the liquid vitamin D supplements on the internet from a reputable manufacturer.

What brand of vitamin D supplement you recommend?

Response: I recommend any national brand of vitamin D supplement.

Does it matter what type of Vit D supplementation- OTC vs. Prescription, certain brands, purchased at drugstores or health stores?

Response: It does not matter what type of vitamin D supplementation, i.e., over the counter or prescription as long as it is a reputable national brand.

Do you recommend that everyone take a Vit D supplement, regardless of how many Vit D sources you eat in the diet?

Response: You are correct. Everybody should be taking at least a 1,000 IU of a vitamin D supplement if you are not getting adequate exposure to sunlight or ingesting at least a 1,000 IU of vitamin D/d from dietary sources. You should also take a multivitamin.

OTHER QUESTIONS

My sister and I had rickets as children because of raw milk--what are the long term risks even if taking enough Vit D today?

Response: As long as the rickets has been treated and you are getting enough vitamin D today, you are doing all that you can to prevent the long term consequences of childhood vitamin D deficiency which includes increased risk of osteoporosis, type I diabetes, multiple sclerosis, infectious diseases.

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How much vitamin D is stored in the liver?

Response: Vitamin D is not stored in the liver, but it is stored in your body fat. This is a misconception because it is known that vitamin D is stored in cod liver and that is why cod liver oil is such a good source of vitamin D. However, for humans, there is very little vitamin D present in the liver. It is found in the body fat.

Why is there not a greater outcry of support from the medical community for increasing awareness of this issue?

Response: It is mainly because of the press and grass root effects that has been most effective in alerting the medical community about the vitamin D deficiency epidemic and its insidious health consequences. Everyone needs to be aware of the vitamin D deficiency pandemic.

Why do you interchange the IU measure with ng/ml?

Response: I do not interchange IU measure with ng/ml. What I have suggested based on our experience and the literature is that for every 100 IU of vitamin D you ingest, you can expect your blood level of 25(OH)D to rise by 1 ng/ml. One IU is equal to 25 nanograms of vitamin D.

How do we put the information today in the context of the big picture--aging process (skin, liver, and kidneys) and regular physical activity?

Response: The best way to put the information I discussed into context of the big picture is that it does not matter age, liver or kidney disease or regular physical activity, the bottom line is that all children in my opinion should be taking at least 1,000 IU of vitamin D/d and all adults should be on 1500-2000 IU of vitamin D/d along with a multivitamin.

When will the IOM group that met in 2007 to update guidelines for Vit D intake from 1997 have its recommendations out?

Response: The IOM group is just beginning their deliberations and plan to have their recommendations for vitamin D intakes out by the middle of 2010.

We would like to thank Dr. Holick for agreeing to answer these participant questions, which were submitted but not answered due to time constraints during the live December 5, 2008 webinar presentation of "Vitamin D & Chronic Disease Risk."

- The archive of Dr. Holick's webinar, Vitamin D & Chronic Disease Risk, is available at <http://www.thebeverageinstitute.org/webinars/vitamind/index.shtml>.
- For more information about vitamin D, visit Dr. Holick's website: <http://www.vitaminDhealth.org/>

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