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Vitamin D - What Everyone Needs to Know

The issue of Vitamin D deficiency as a major causal factor in immune system related illnesses ranging from seasonal cold and flu, to heart disease, to cancer, to atopic and autoimmune disorders has received a lot of attention in the last few years. Clinical journals as well as the mainstream media have been reporting evidence that modern industrialized humans are severely deficient in Vitamin D and that this deficiency is a major contributing factor to illness and lack of health and vitality.

What does vitamin D do and why is it so important for wellness and prevention?

Before we discuss the evidence regarding vitamin D sufficiency and health and vitamin D deficiency and illness let's first look at the basic science regarding the importance of vitamin D for human immune function and health. A basic understanding of why vitamin D is a genetic human requirement for wellness and prevention will allow greater understanding of why vitamin D supplementation is required.

The innate immune system is the component of our immune system that is genetically programmed to respond to antigens (viruses, bacteria, fungi, and any other threatening non-self invaders). The innate immune system uses what are termed effectors that are genetically coded to respond to antigens or invaders. The most studied of these effectors are named antimicrobial peptides or AMPs. AMPs not only attack the invaders they also trigger tissue repair and activate the adaptive or acquired immune system (the branch of the immune system that creates antibodies to specific antigens after exposure).

Recent research has shown that vitamin D up-regulates the genetic expression of AMPs in immune cells. Vitamin D also plays an important role in controlling the inflammatory response initiated by specialized immune cells called macrophages. A deficiency of vitamin D means deficient control of inflammation. In the skin vitamin D also activates the immune system against antigens.

"Thus, vitamin D both enhances the local capacity of the epithelium to rapidly produce endogenous antibiotics and, at the same time, dampens certain arms of adaptive immunity, especially those responsible for the signs and symptoms of acute inflammation." Cannell et al. 2008 Cod Liver Oil, Vitamin A Toxicity, Frequent Respiratory Infections, and the Vitamin D Deficiency Epidemic. *Annals of Otology, Rhinology & Laryngology* 117 (11): 864-870

Can Vitamin D deficiency lead to serious illness?

Let's now do a quick overview of some of the research showing that vitamin D deficiency can lead to serious illnesses. The evidence that vitamin D deficiency is related to seasonal respiratory illnesses such as cold and flu and that vitamin D sufficiency can both prevent and help to recover from these illnesses is extremely convincing.

The role of vitamin D deficiency in other serious illnesses is also being reported. "As Holick's *New England Journal of Medicine* review stressed, the litany of vitamin D

deficiency diseases is now legion. Evidence even suggests that vitamin D is involved in the triple current childhood epidemic of autism, asthma, and autoimmune diabetes. Not only do tenable mechanisms of action exist to explain vitamin D's role in all three, but epidemiological evidence suggesting a vitamin D connection to these devastating diseases is growing." Cannell et al. 2008 Cod Liver Oil, Vitamin A Toxicity, Frequent Respiratory Infections, and the Vitamin D Deficiency Epidemic. *Annals of Otolaryngology, Rhinology & Laryngology* 117 (11): 864-870

"Improving calcium and vitamin D nutritional status substantially reduces all-cancer risk in postmenopausal women." Lappe et al. 2007 Vitamin D and calcium supplementation reduces cancer risk: results of a randomized trial. *Am J of Clin, Nutr.* 85 (6): 1586-1591.

"Vitamin D is an inhibitor of the renin-angiotensin system and has anti-inflammatory and anticoagulant properties." "Low serum 25 (OH) D levels are associated with a higher prevalence of Peripheral Arterial Disease. Several mechanisms have been invoked in the literature to support a potential anti-atherosclerotic activity of vitamin D." Melamed et al. 2008 Serum 25-Hydroxyvitamin D Levels and the Prevalence of Peripheral Arterial Disease. *Thrombosis and Vascular Biology* 28: 1179-1185

There are literally thousands of peer-reviewed scientific articles establishing vitamin D deficiency as a significant causal factor in serious illnesses. At this point we can confidently state that having sufficient levels of vitamin D is essential for both wellness and prevention.

What are the human daily vitamin D requirements?

What we next need to know is whether or not we can attain sufficient vitamin D levels without supplementation. To answer this question we must first know how much vitamin D humans require and then we must learn what the natural, available sources of vitamin D are. Let's start with the human daily requirements.

According to Dr. Robert Heaney humans utilize approximately 4000 IUs of vitamin D3 per day. Heaney et al. 2003 Human serum 25 hydroxycholecalciferol response to extended oral dosing with cholecalciferol. *Am. J Clin. Nutr.* 77: 204-210. Dr. John Cannell MD, the Executive Director of the Vitamin D council stated in a recent Vitamin D Council on-line newsletter <http://www.vitamindcouncil.org/vitaminDToxicity.shtml> entitled 'The Truth About Vitamin D Toxicity' that there is no evidence anywhere in the published literature that even 10,000 IUs per day of vitamin D is toxic to humans and that human toxicity does likely not occur until over 40,000 IUs of daily consumption. "Vieth reports human toxicity probably begins to occur after chronic daily consumption of approximately 40,000 IU/day (100 of the 400 IU capsules)." He goes on to state that "Physician ignorance about vitamin D toxicity is widespread" and concludes by stating that "In fact, living in America today while worrying about vitamin D toxicity is like dying of thirst in the desert while worrying about drowning." In other words any danger associated with vitamin D is from deficiency NOT toxicity.

The Food and Nutrition Board of the US Institute of Medicine has set the tolerable upper intake level (TUIL) for vitamin D at 2000 IU per day for adults. As you can see above many vitamin D experts disagree with this low setting and state that human adults can require supplementation with up to 4000 IUs per day in the winter months. With all this in mind it appears that it would be prudent to ensure a minimal daily intake of 1000 IUs of vitamin D3 for children, 2000 IUs for adults, and 4000 IUs for pregnant and lactating women who have not previously been sufficient. A pregnant or lactating woman who has maintained

sufficient vitamin D levels for years prior to pregnancy will likely not require an increase in daily intake. It would also be prudent to have vitamin D levels tested.

What are the sources of vitamin D? How do we get sufficient amounts?

The answer is SUNLIGHT. In order to get the daily requirement of vitamin D from sunlight you would need to have direct summer month sun exposure on your arms and legs for a minimum of 10-15 minutes per day. This is why vitamin D deficiency is so common in non-tropical climates, especially in the winter months. Of course in the industrial nations neither the climate nor the season are accurate determinants of the amount of sun exposure because most people spend the majority of their time inside or covered up when outside.

So, if you are not getting a minimum of 15 minutes per day of direct summer sunlight on bare arms and legs (without sunscreen) then you need another source of vitamin D. What are the other available sources of vitamin D you ask? Great question!

The simple fact is that humans were never meant to get their vitamin D from food. Genetically humans are designed to get vitamin D from sunlight. As we have outlined above this is simply not a realistic option for most humans living and working indoors or who live in areas where sunlight levels change with the seasons. It should be noted here that humans with pigmented skin (non-caucasians) require significantly more sun exposure to achieve sufficient vitamin D levels. This means these people are at an even greater risk for illnesses caused by vitamin D deficiency.

As humans migrated away from the equator we had to devise ways of replacing the sun as a source of vitamin D. In other words, in order to survive non equatorial climates humans had to find a source of vitamin D other than sunlight. Over thousands of years of experimentation virtually every human culture learned that the best way to stay sufficient in vitamin D in environments with reduced sun exposure was to consume marine animal liver or liver oil. Cod liver oil is probably the best known and widely recognized as the best source of dietary vitamin D for humans. For centuries humans have used cod liver oil as a safe and effective way to achieve sufficient vitamin D levels in the absence of sun exposure.

Is there a concern about vitamin A toxicity with cod liver oil?

Although cod liver oil has been successfully used as a source of vitamin D for centuries there has been some recent concern raised regarding the possibility of vitamin A toxicity with cod liver oil. A closer look at the actual research reveals that these concerns are unfounded.

Perhaps the first thing that should be pointed out is that research is very clear that our hunter-gatherer ancestors, the healthiest human beings ever studied with respect to freedom from chronic illness, consumed an average of 3000 IUs of vitamin A per day. Eaton, Eaton & Konner. 1997 Paleolithic nutrition revisited: A twelve year retrospective on its nature and implications. Eur J. of Clin Nutr. 51: 207-216. Further, many of the non equatorial ancestral humans ingested much higher amounts with no signs of toxicity. Innate Choice® Natural A & D Sufficiency™ genuine Norwegian cod liver oil contains between 1800 and 3400 IUs of naturally occurring Vitamin A per teaspoon.

At what daily amounts does vitamin A become toxic?

The truth is that this question cannot be answered without an understanding of some very important facts. First, one must understand that naturally occurring vitamin A from cod liver oil is much less toxic, and much more beneficial, than synthetic sources of vitamin A.

"Myhre et al. performed a meta-analysis, from which they concluded that the ingestion of large amounts of vitamin A as liver or oil-based supplements caused an increase in retinol, retinoic acid, and related retinoids, but not as great an increase as that resulting from the ingestion of comparable doses in water-miscible and emulsified forms (SYNTHETIC VIT A). A postprandial increase in serum retinol concentration may be blunted when vitamin A is ingested with either food or ample dietary fat, whereas a significant amount of free (unesterified) retinol may circulate when vitamin A is consumed without dietary fatty acids, which leads to excessive production of retinoic acid." Penniston & Tanumihardjo 2006. The acute and chronic toxic effects of Vitamin A. Am J Clin Nutr 83 (2): 191-201

"Chronic hypervitaminosis A is induced after daily doses of 2 mg retinol/kg in oil-based preparations for many months or years. In contrast, doses as low as 0.2 mg retinol/kg/day in water-miscible, emulsified, and solid preparations for only a few weeks caused chronic hypervitaminosis A. Thus, water-miscible, emulsified, and solid preparations of retinol are 10 times as toxic as are oil-based retinol preparations. The safe upper single dose of retinol in oil or liver seems to be 4-6 mg/kg body wt. These thresholds do not vary considerably with age."

"The results of the present study indicate that the physical form of retinol supplements is a major determinant of toxicity. The use of water-miscible, emulsified, and solid preparations of retinol should therefore be carefully considered before being used in supplements and fortifications." Myhre et al. 2003 Water-miscible, emulsified, and solid forms of retinol supplements are more toxic than oil-based preparations. Am. J. Clin. Nutr. 78 (6); 1152-1159

Second, the actual amount of vitamin A that is required to be toxic would NEVER be ingested from the recommended amounts of cod liver oil. The fact is that the ACTUAL SCIENTIFIC DATA indicate vitamin A toxicity occurs from VERY large amounts of vitamin A. In fact in a very comprehensive summary by Myhre et al. the authors defined toxicity as 25,000 IU per day for greater than SIX YEARS or 100,000 IU per day for greater than six months. They state that children are particularly sensitive to toxicity and then state that 1500 IU PER KG of BODY WEIGHT can produce toxicity.

These "toxic" amounts equate to the ingestion of a teaspoon of naturally occurring cod liver oil for every two pounds of body weight for a child (i.e. 20 teaspoons per day for a 40 lb child) and to 12 teaspoons of cod liver oil per day for over six years for an adult! "Daily intakes of > 25 000 IU for > 6 y and > 100,000 IU for > 6 mo are considered toxic, but there is wide inter-individual variability for the lowest intake required to elicit toxicity. Children are particularly sensitive to vitamin A, with daily intakes of 1500 IU/kg body wt reportedly leading to toxicity. Similarly, the elderly may be at significantly greater risk of toxicity than are younger adults with a chronic high intake of preformed vitamin A, but the mechanisms for this greater risk are not known." Myhre et al. 2003 Water-miscible, emulsified, and solid forms of retinol supplements are more toxic than oil-based preparations. Am. J. Clin. Nutr. 78 (6); 1152-1159

Is there a possibility that Vitamin A from cod liver oil can lead to osteoporosis or losses of bone density?

Clearly there is no danger of vitamin A toxicity from cod liver oil. However, there have still been some concerns raised regarding the possibility that high Vitamin A consumption could lead to an interference of vitamin D in terms of building strong bones. Again one must look at all the available research in order to come to a valid conclusion. What the research

shows, to no surprise, is that ingesting large amounts of vitamin A by itself, or, more importantly, in relation to vitamin D, can pose a problem. However large amounts of any single vitamin can cause problems. This neither negates the importance and benefits of vitamin A nor does it substantiate claims of toxicity. What it does show is that tampering with nature is much less effective than consuming naturally occurring vitamins and minerals as they occur in nature.

A very important fact to be pointed out is that "modern" cod liver oils do NOT contain naturally occurring vitamin A and D. Virtually all cod liver oils on the market today remove the naturally occurring vitamin A and D during the deodorization process and then add back synthetic vitamin A and D. Sadly they are allowed to claim on the label that their products contain "natural" vitamin A and D. Another very important thing to understand is that they often add back these vitamins in ratios that are not naturally found in cod liver oil. The natural ratio of vitamin A to D in cod liver oil, and the ratio that has been found to maximize the health benefits of BOTH vitamin A and D is 10:1. This is the ratio of vitamin A to vitamin D found in Innate Choice® Natural A & D Sufficiency™ genuine Norwegian cod liver oil.

Let's take a closer look at the evidence. The following article has been the source of much of the vitamin A toxicity concerns. Cannell et al. 2008 Cod Liver Oil, Vitamin A Toxicity, Frequent Respiratory Infections, and the Vitamin D Deficiency Epidemic. *Annals of Otolaryngology, Rhinology & Laryngology* 117 (11): 864-870

The basic premise of this article is that the relatively high Vit A to Vit D levels in "modern" cod liver oil are responsible for decreasing benefit with respect to defense against seasonal colds and flu and to potentially increased potential harm due to Vit A toxicity.

The authors cite a very small study involving 47 children that were given 600-700 IU of Vit D and 3,500 units of Vit A as cod liver oil and a multivitamin. The authors state that this regimen "slightly reduced ($p=0.04$) the mean number of upper respiratory tract visits over time" but that "the total number of visits for upper respiratory tract infections was slightly higher in the treatment group (68 vs 61)" vs the "medical record control group".

If one does not know how to read research and does not understand research methodology or statistical analysis they might miss the blatant and alarming bias in the above statements. First of all, the authors use of the adjective "slightly" when describing a STATISTICALLY SIGNIFICANT reduction in the mean number of doctor visits for respiratory tract infections for the treatment group vs the control group is not only inaccurate but also scientifically inaccurate. In statistical analysis something is either significant or insignificant. The only scientifically valid way to describe the reduction in visits for the treatment group vs the control group is SIGNIFICANT. Furthermore the actual p level the authors cite ($p=0.04$) actually means that based on the statistical analysis the results reported have a 96% likelihood of being due to the treatment provided rather than random chance or coincidence.

They next go on to say that "the total number of visits for upper respiratory tract infections was slightly higher in the treatment group (68 vs 61)" vs the "medical record control group". What this ACTUALLY means is that although the treatment group showed a significant reduction in doctor visits for respiratory tract infections the total number of visits was about the same for both groups. What this ACTUALLY means is that the cod liver oil group started off with higher numbers of doctor visits - they were a sicker group than the controls to start and a healthier group than the controls by the end of the study!

The study actually represents quite good evidence in support of the use of "traditional" cod liver oil such as Innate Choice® Natural A & D Sufficiency™ genuine Norwegian cod liver oil. Sadly this paper has caused many to incorrectly come to the conclusion that cod liver oil is not beneficial and perhaps toxic due to the relatively high Vit A to Vit D ratio found in many "modern" cod liver oil products which have had the naturally occurring vitamin A and D removed and replaced with synthetic vitamins in an unnatural ratio.

What is very important to note is that these authors report excellent results from cited studies on "traditional" cod liver oil. The authors actually state: "In contrast, 2 larger, controlled studies in the 1930s found more robust results: the first found that cod liver oil given to 185 adults for 4 months reduced the incidence of colds by 50%, and the second study found that cod liver oil given to 1,561 adults reduced the incidence of respiratory infections by 30%. We suggest that the much higher vitamin D content in the 1930s cod liver oil may explain the different results."

Again let's review why "traditional" cod liver oil gave such excellent results in the 1930s and why "modern" cod liver oil only marginal results in recent studies. First, the vast majority of "modern" cod liver oils REMOVE ALL THE NATURALLY OCCURRING Vit A and Vit D and then replace this with SYNTHETIC VITAMINS. Further, they often replace high amounts of Vit A and relatively very low amounts of Vit D. The result is problematic for two reasons. One of course is that synthetic vitamins are not only less helpful but can do harm.

The second reason is that it appears from the research that the most important factor determining benefit vs toxicity is not the gross amount of either vitamin A or vitamin D but the ratio of the two vitamins because they work synergistically. Simply studying the effects of large amounts of vitamin A without taking into consideration the intake of vitamin D is totally invalid and has led to the false conclusion that vitamin A amounts in cod liver oil can be detrimental. Aburto, et al., "The influence of Vitamin A on the Utilization and Amelioration of Toxicity of Cholecalciferol, 25-Hydroxycholecalciferol, and 1,25-Dihydroxycholecalciferol in Young Broiler Chickens," Poultry Science, 77 (1998) 570-577. Metz, et al., "The Interaction of Dietary Vitamin A and Vitamin D Related to Skeletal Development in the Turkey Poult," J. Nutr. 115 (1985) 929-935.

In fact research shows the exact opposite - that the naturally occurring vitamin A and vitamin D found in "traditional" cod liver oil like Innate Choice® Natural A & D Sufficiency™ genuine Norwegian cod liver oil are highly beneficial. As mentioned above the optimal ratio for Vit A and Vit D is about 10:1 respectively and this is what naturally occurs in Innate Choice® Natural A & D Sufficiency™ genuine Norwegian cod liver oil.

Most cod liver oils do not replace the synthetic vitamins in this naturally occurring ratio and even if they did the synthetic vitamins will very likely work less well synergistically and have a much greater potential for toxicity. Myhre, et al., "Water-miscible, emulsified, and solid forms of retinol supplements are more toxic than oil-based preparations," Am J Clin Nutr, 78 (2003) 1152-9.

Vit A and D - Is Innate Choice® Natural A & D Sufficiency™ genuine Norwegian cod liver oil the best solution?

YES!

FACT: Vitamin D is essential for wellness and prevention for people of all ages. From birth onward humans require sufficient vitamin D for health and vitality and for protection against vitamin D deficiency related illnesses.

FACT: Unless you are getting your required amount of sunlight every day you will almost certainly be deficient in vitamin D.

FACT: Research is clear that the vast majority of people living in industrialized society are deficient in Vitamin D.

FACT: Your serum 25(OH)D level should be between 40 and 60 ng/ml. The only way to be sure of your vitamin D levels are to measure your serum level of 25(OH)D.

FACT: You cannot get adequate amounts of vitamin D from your diet. Humans are genetically designed to get vitamin D from sun exposure not our diets.

FACT: Vitamin D deficiency can have severe consequences and is linked to very serious illness in people of all ages. Vitamin D deficiency is linked to seasonal colds and flu, cancer, heart disease, asthma, allergies, autism, autoimmune diabetes, and a plethora of other serious illnesses.

FACT: The best source of naturally occurring vitamin A and D with all the required cofactors and in the proper matrix of fats is cod liver oil with the naturally occurring vitamin A and D in the proper 10:1 ratio.

FACT: Most available cod liver oils have had the naturally occurring vitamins removed and have added synthetic vitamin A and D which research shows have a greater risk of toxicity.

FACT: Innate Choice® Natural A & D Sufficiency™ genuine Norwegian cod liver oil contains 100% naturally occurring vitamin A and D in the proper 10:1 ratio and is 100% free of synthetic vitamins.

FACT: Studies on naturally occurring cod liver oils like Innate Choice® Natural Vit A and D Sufficiency™ have shown great benefit and no evidence of toxicity.

FACT: Innate Choice® Natural A & D Sufficiency™ genuine Norwegian cod liver oil is also rich in Omega-3 essential fatty acids.

FACT: There is no better choice for vitamin A and D than Innate Choice® Natural A & D Sufficiency™ genuine Norwegian cod liver oil.

FACT: If you choose to utilize an isolated vitamin D supplement clearly the BEST OPTION is to ensure you are ALSO getting naturally occurring vitamin A and D with the full spectrum of cofactors and proper fats as found in Innate Choice® Natural A & D Sufficiency™ genuine Norwegian cod liver oil.

FACT: If you choose to utilize an isolated vitamin D supplement there is no better solution than adding Innate Choice® D-Sufficiency™ vitamin D3 Drops to Innate Choice® Natural A & D Sufficiency™ genuine Norwegian cod liver oil.