Sanford Medical Center

Aunt Cathy's Guide:

Vitamin D: A Quick Review of Forms, Labs and Other Things People Have Asked Me About Recently

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I regularly get questions about some of the confusing aspects about nutrition information in the news. Vitamin D issues can be especially complex and crazy-making. But there is a new understanding of the international epidemic nature of vitamin D deficiency.

Additionally, we have a rapidly-expanding understanding of its critical role in the functioning of over 200 tissues and its role as a factor in an ever increasing number of serious health problems (like cancer, heart disease, diabetes, arthritis, multiple sclerosis, lupus, fibromyalgia, immune compromise and more.)

Although serum vitamin D levels were rarely ordered until the last few years, they are now being ordered with increasing frequency because vitamin D inadequacy continues to be found so often when it is evaluated. In fact, a 25-hydroxy-vitamin D level is the number one vitamin assay now ordered in the US. In the near future it will likely become an assay standardly done annually because identifying inadequacy and correcting it has such tremendous health benefits over a wide range of conditions.

Health care professionals need to have this sorted out more now than ever. This little paper evolved from a question emailed to me recently from a dietitian. As I was typing away with an answer, it occurred to me that other health professionals might find this information helpful as well. And so … a new handout is born!

Here was the original inspiring question:

"What are all those different forms of vitamin D, what factors affect absorption or utilization, what are the right tests to order and how should they be interpreted … etc. etc."

My rambling response:

First, here are <u>two areas</u> of <u>two big distinctions each</u> in the vitamin D world.

(So what is NOT confusing about all this?!):

1. There are <u>two major forms of vitamin D that **come into the body** as food or supplements</u>:

   Cholecalciferol (D3) and **Ergocalciferol** (D2)

2. There are also <u>two major forms of vitamin D **floating around** in the body</u>:

   25-hydroxycholecalciferol (25-hydroxyD) and

   1, 25-dihydroxycholecalciferol (1,25-**di**hydroxyD)

Here's a look at all four:

1. Food and Supplement Vitamin D Forms <u>Coming in from Outside</u>	**2. Forms of Vitamin D <u>Floating Around in the Blood and/or Stored in the Body (i.e. lab tests)</u>**
<u>Ergo</u>calciferol Vitamin D-2 in plants and some supplements	**<u>25-hydroxy</u>cholecalciferol** **also called Calci<u>DI</u>ol --** a storage form of circulating non-activated vitamin D
<u>Chole</u>calciferol Vitamin D-3 In animal foods and some supplements. This is also the kind one makes in the skin from exposure to ultraviolet light.	**<u>1,25-hydroxy</u>cholecalciferol** **also called Calci<u>TRI</u>ol --** This is the active steroid hormonal form of vitamin D.

1. The difference between the plant source vs animal source

ergocalciferol (D2) vs cholecalciferol (D3)

The kind we make (out of 7-dehydrocholesterol in the skin + UV light) and the kind we use in the body is the chole type (because we are animals.)

But we can make the "chole" form out of the "ergo" form, so the questions are NOT about ABSORPTION (i.e. getting it into the body from out there in the intestinal lumen) but about whether the same number of mg or iu's of "ergo" is nutritionally equal to the same amount of "chole."

At the moment there is no official differentiation, but there have been reports that the "chole" form may be superior in certain instances especially. For example, in a recent study of elderly people with vitamin D deficiency, the cholecalciferol and ergocalciferol forms were compared as agents to correct the deficiency. They found that cholecalciferol was almost twice as potent as ergocalciferol in raising serum 25(OH)D, when administered either by mouth or as an injection. [Differences in outcomes between cholecalciferol and ergocalciferol supplementation in veterans with inflammatory bowel disease. Geriatr Gerontol Int. 2012 Jan 10. Endocrine. 2012 Jan 14. Short and Long Term Variations in Serum Calciotrophic Hormones after a Single Very Large Dose of Ergocalciferol (Vitamin D2) or Cholecalciferol (Vitamin D3) in the Elderly. J Clin Endocrinol Metab. 2008 May 20.]

Other studies have shown correction of vitamin D deficiency using very high dose ergocalciferol supplements, but they generally are not studied in terms of efficacy in comparison with using "chole" … just whether or not they correct the deficiency. Since the ergocalciferol must first be converted to cholecalciferol, the simple solution -- in my non-opinionated opinion ☺ -- is to just get the "chole" type and quit worrying about that particular issue.

In some cases the choice of using "chole" or "ergo" is related primarily to the relative cost or insurance reimbursement of the product. For a long time, only ergo was available, and it still tends to be cheaper. However, the cost picture is changing rapidly both in terms of treatment product and in the cost of the lab tests. Very high-dose ergocalciferol is effective for correcting vitamin D deficiency in children and young adults with cystic fibrosis. J Cyst Fibros. 2009 May 14.

One other concern would be the healthiness of the liver, since the conversion occurs there. If a person has a very sick liver or a very immature one (like preterm infants,) it would be prudent to provide the form that does not require conversion.

<u>Absorption</u> is not usually the major problem with vitamin D unless a person has a condition that makes one have significant fat malabsorption ... like steatorrhea in Cystic Fibrosis, as a major example. Anything that makes people poorly absorb fat will also make them malabsorb the fat soluble vitamins (A, D, E and K) as well.

For other people, in some comparisons the gel caps and liquids have somewhat better absorption than solid tablets, and in general, taking the supplements daily appears to be more effective than weekly or monthly supplementation regimens. Taking the vitamin D supplements with the largest meal of the day also appears to enhance absorption.

However, in general, if the amount provided is generous these last two issues become far less important. <u>The biggest problem is not these gradations of efficiency of absorption but simply failure to provide a generous amount that is sufficient to truly assure adequacy.</u>

The biggest problems with supplementation regimens are that:

1) **the <u>amount of vitamin D being supplemented is often far too low</u> to correct deficiency, let alone bring about rapid correction of deficiency.**

2) **the <u>amount currently added to milk in the US is only 100 iu/cup</u>, but people (including health professionals) assume that drink milking (at all) takes care of the vitamin D inadequacy problem.**

   (One would need to drink 4 cups daily at current fortification levels just to get the old recommended amount of 400 iu. Most people drink less than 2 cups per day … and often none. It would take 20 cups of fortified milk daily to get the amount that appears to be necessary for many people (about 2000 iu/day.) This is clearly unrealistic … and it is also bad nutrition since there would be no room for eating any other foods.**)**

3) **<u>people simply don't take the supplements reliably</u>.**

   Because of the poor adherence to therapeutic or maintenance regimens, some other approaches are being tried. For example, a one-time dose of 300,000 iu has been shown to be effective in correcting severe deficiency without

negative effects. Another approach would be to fortify many more foods with generous vitamin D … and in particular not just dairy foods.

Taking vitamin D with the largest meal improves absorption and results in higher serum levels of 25-hydroxyvitamin D. J Bone Miner Res. 2010 Feb 8. Fall prevention with supplemental and active forms of vitamin D: a meta-analysis of randomised controlled trials. BMJ. 2009 Oct 1;339:b3692. Efficacy and safety of oral continuous low-dose versus short-term high-dose vitamin D: a prospective randomised trial conducted in a clinical setting. Med J Aust. 2010 Jun 21;192(12):686-9. Are commonly recommended dosages for vitamin D supplementation too low? Vitamin D status and effects of supplementation on serum 25-hydroxyvitamin D levels-an observational study during clinical practice conditions. Osteoporos Int. 2010 Jun 17. Clinical responses to a mega-dose of vitamin D3 in infants and toddlers with vitamin D deficiency rickets. J Trop Pediatr. 2010 Feb;56(1):19-26. Vitamin D: what is an adequate vitamin D level and how much supplementation is necessary? Bone. 2009 Oct;45(4):747-9. Best Pract Res Clin Rheumatol. 2009 Dec;23(6):789-95. Combination of bolus dose vitamin D with routine vaccination in infants: a randomised trial. Singapore Med J. 2010 May;51(5):440-5. A phase I/II dose-escalation trial of vitamin D3 and calcium in multiple sclerosis. Neurology. 2010 Jun 8;74(23):1852-9. Cholecalciferol loading dose guideline for vitamin D-deficient adults. Eur J Endocrinol. 2010 Apr;162(4):805-11. Vitamin D insufficiency and effect of cholecalciferol in children with chronic kidney disease. Pediatr Nephrol. 2010 Sep 25. Effect of high dose ergocalciferol in chronic kidney disease patients with 25-hydroxyvitamin D deficiency. J Med Assoc Thai. 2010 Aug;93(8):885-91.Low vitamin D status: definition, prevalence, consequences, and correction. Endocrinol Metab Clin North Am. 2010 Jun;39(2):287-301 Vitamin D intake needed to maintain target serum 25-hydroxyvitamin D concentrations in participants with low sun exposure and dark skin pigmentation is substantially higher than current recommendations. J Nutr. 2010 Mar;140(3):542-50. A phase 2 trial exploring the effects of high-dose (10,000 IU/day) vitamin D(3) in breast cancer patients with bone metastases. Cancer. 2010 Jan 15;116(2):284-91.Serum 25-hydroxyvitamin D levels in vitamin D-insufficient hip fracture patients after supplementation with ergocalciferol and cholecalciferol. Bone. 2009 Nov;45(5):870-5. Efficacy of different doses and time intervals of oral vitamin D supplementation with or without calcium in elderly nursing home residents. Osteoporos Int. 2008 May;19(5):663-71.

I am including an abstract below of a very important recent report that evaluated randomized double blind studies and addressed the question of how much vitamin D supplementation was needed to achieve health targets for risk of falls, fractures, cardiovascular disease and color cancer. It also addresses the issue of the safety of these levels. The authors are all very well known and respected researchers:

Benefit-risk assessment of vitamin D supplementation. Osteoporos Int. 2009 Dec 3. Bischoff-Ferrari HA, Shao A, Dawson-Hughes B, Hathcock J, Giovannucci E, Willett WC.

Current intake recommendations of 200 to 600 IU vitamin D per day may be insufficient for important disease outcomes reduced by vitamin D.
INTRODUCTION: This study assessed the benefit of higher-dose and higher achieved 25-hydroxyvitamin D levels [25(OH)D] versus any associated risk.

METHODS AND RESULTS: Based on **double-blind randomized control trials** (RCTs), eight for falls (n = 2426) and 12 for non-vertebral fractures (n = 42,279), there was a **significant dose-response relationship between higher-dose and higher achieved 25(OH)D and greater fall and fracture prevention**. Optimal benefits were observed at the highest dose tested to date for 700 to 1000 IU vitamin D per day or mean 25(OH)D between 75 and 110 nmol/l (30-44 ng/ml).

Prospective cohort data on **cardiovascular health and colorectal cancer prevention** suggested increased benefits with the highest categories of 25(OH)D evaluated (median between 75 and 110 nmol/l).

In 25 RCTs, mean serum calcium levels were not related to oral vitamin D up to 100,000 IU per day or achieved 25(OH)D up to 643 nmol/l. Mean levels of 75 to 110 nmol/l were reached in most RCTs with 1,800 to 4,000 IU vitamin D per day without risk.

CONCLUSION: Our analysis suggests that mean serum 25(OH)D levels of about 75 to 110 nmol/l provide optimal benefits for all investigated endpoints without increasing health risks. These levels can be best obtained with oral doses in the range of 1,800 to 4,000 IU vitamin D per day; further work is needed, including subject and environment factors, to better define the doses that will achieve optimal blood levels in the large majority of the population.

In the world of renal disease and chemotherapy adjuncts, however, there are other specialized vitamin D analogs available and questions in the professional literature about the relative efficacy of various injectable forms of D2 vs D3, etc. This is beyond the scope of this brief discussion about the most typical nutrition-related issues encountered by health professionals.

2. **The difference between the two lab values:**

25-hydroxy D vs 1,25-dihydroxy D.

This is not about any food forms or any of that business in #1 above. It is about what one does with vitamin D <u>in the body</u>.

The 25-hydroxy form is the non-activated-yet-but-stored-and-available-to-be-used form. (And that's just its nickname!) It is made in the liver from cholecalciferol (obtained from any source: food, supplement, skin production) by attaching a hydroxyl group (an OH group) at the #25 carbon of the molecule.

This form (25-hydroxycholecalciferol or 25-hydroxyD,) is the storage form that we ordinarily test to check for plain old "deficiency vs adequacy" in the person's body. (I am using the simple letter D to stand for the word

cholecalciferol in more and more of these descriptions because it is tedious to keep writing it out.)

As you know, we health professional types need to begin a habit of regularly checking this in everybody because just counting up the amount we think people took in misses the boat in most circumstances. I think an automatic 'standing order' scenario would be very informative and helpful. I just found eight more people this week who were overtly deficient in spite of taking what "should have been enough" vitamin D. You can only know for sure by checking their blood.

When we need the active hormonal form (for one of the >200 different tissues with vitamin D receptors that are looking for it,) the 25-hydroxyD storage form is sent to the kidney and another hydroxyl group is attached there at the #1 carbon on the molecule. **The product ... the active hormonal form of vitamin D ... is 1,25-dihydroxycholecalciferol … also called 1,25-dihydroxy vitamin D.**

This (the 1,25 dihydroxy form) is not something one would ordinarily check as a blood test unless the person had some sort of potentially vitamin-D related symptoms in spite of a good intake of vitamin D. It would usually be done to identify people with kidney disease to recognize when people have lost the ability to make the active 1,25 vitamin D hormonal form.

There is also a much smaller group of people who have an inborn error of vitamin D metabolism that results in the same problem. While this is likely to be rare, I have found this situation to exist in five out of five people for whom I asked to have it checked. But only rarely do I ask for it because it is not at all as common as simple insufficiency of 25-hydroxyvitamin D.

I certainly check this when their symptoms are unusual, such as extremely severe or rapidly progressing MS (e.g. in a 10-year-old.) Another time I might ask to have it checked is if the person has vitamin D deficiency symptoms but it has already been shown that their blood 25-hydroxyD level is OK. In that situation I know it is not simple inadequacy that is contributing to any problems.

Additionally, there are certain genetic factors that impair the utilization of vitamin D. For example, there are “polymorphisms” (different forms) of vitamin D receptors found on some people’s cells that contribute to having vitamin D related problems in spite of a good vitamin D intake and normal ability to activate it to the active form.

In other words, vitamin D hormone knocks on the door of a cell with a message but nobody answers the door. But this kind of metabolism problem is only a tiny part of the problem of vitamin D adequacy. Most folks just aren't getting enough sun or enough vitamin D supplementation, so that is where we need to look first in order to identify problems and do some serious good.

So, a good order of thinking about this for a patient is:

First Get a regular 25-hydroxy D level (for EVERYBODY!!!) --- ideally annually in the winter -- and if it is low give them a therapeutic supplemental amount of vitamin D to get them up to normal. Then figure out a maintenance dose to switch to once subsequent tests show that the low level has been corrected. Also, it is wise not to assume it has been corrected after some prescribed number of doses. We really need to check it. I have found that some individuals need a much higher maintenance level than expected. One was a lady who was subsequently found to have unrecognized celiac disease impairing vitamin D absorption (and other nutrients as well.)

Another was a lady for whom no explanation was ever determined, but after being treated with the therapeutic high-dose regimen that brought her up to a healthy vitamin D level, she was unable to maintain that vitamin D level taking in anything less than 4000 iu/day. The point is, our best guesses about what "should" be enough can be quite erroneous, and we miss the chance to improve an individual's health if we guess wrong.

My favorite motto: ASSURE adequacy … do not just ASSUME adequacy.

For many people, getting the level during the winter is most likely to pick up any inadequacy issues. A level drawn any time of year will help identify problems for people who are not regularly in the sun even in the summer. This includes a large number of people, for a variety of reasons.

I continue to hear every week from a surprising number of health professionals (including dietitians, physicians, pharmacists and nurses) who have had their own levels checked after hearing me go on and on about the vitamin D deficiency problem. They had been startled to find that they were themselves vitamin D deficient. This is in spite of "eating right" and taking a multivitamin!

What would be the likelihood that non–health-care-professionals might also have this kind of problem? Answer: Pretty darn high.

Second If the person has good blood levels of 25-hydroxyD but still looks "suspicious" in terms of vitamin D-related conditions, then one might get a 1,25 D level to see if they have a metabolic defect in hydroxylation in the kidney or some other condition like kidney disease that is impairing production of the hormonal form. In that situation, one would utilize a special prescription form of supplemental vitamin D to get around the problem: the ready-to-go form of the active hormone 1,25-dihydroxyD which is usually ordered as **calcitriol.**

This problem is much less common than the problem of simple inadequacy of vitamin D, but I have found four individuals with this as the unrecognized basis of some very severe symptoms. These people were not kidney patients. That tells me that the problem is likely more common than we think but generally unrecognized.

Here is an example to illustrate why I think doing this in the order described above is potentially useful:

1. It was recently found in an observational study that **pre-dialysis kidney patients who start earlier on calcitriol supplementation may have improved survival and quality of life, etc.** *(Arch Intern Med*. 2008;168:397-403) compared with those who began to use it later. By "early," they appeared to mean not waiting for severe deficiency symptoms to show up before providing it, or not waiting until the person had to go on dialysis because of kidney failure. This meshes nicely with another recent finding of an association between increased risk of death from all causes and low vitamin D status, including cardiovascular disease, and contribution of adequate vitamin D in decreasing the risk of progression to kidney disease in people with diabetes.

[E.g.: Vitamin D and chronic kidney disease. Ethn Dis. 2009 Autumn;19(4 Suppl 5):S5-8-11.Vitamin D, proteinuria, diabetic nephropathy, and progression of CKD. Clin J Am Soc Nephrol. 2009 Sep;4(9):1523-8. 25-hydroxyvitamin D and risk of myocardial infarction in men: a prospective study. Arch Intern Med. 2008 Jun 9;168 (11):1174-80. Low serum levels of 25-hydroxyvitamin D predict fatal cancer in patients referred to coronary angiography. Cancer Epidemiol Biomarkers Prev. 2008 May;17(5):1228-33. Vitamin D, cardiovascular disease, and survival in dialysis patients. J Bone Miner Res. 2007 Dec;22 Suppl 2:V95-9. Can vitamin D reduce total mortality? Arch Intern Med. 2007 Sep 10;167(16):1709-10, 1730-37.]

Interestingly, in the pre-dialysis study described above, apparently plain old 25-hydroxy D levels were not regularly evaluated, so although calcitriol was shown to be helpful in many ways for preventing deficiency consequences, it may NOT have been a kidney-related hydroxylation problem that needed the earlier

intervention. It may have been just the same old unrecognized common inadequacy of vitamin D intake that was the limiting factor for many of these folks.

For many people with serious kidney disease, foods like milk and salmon are restricted. As these are about the only reliable and rich food sources of vitamin D in our diet, simple inadequacy of vitamin D should not be an unexpected finding … if we check for it. This possibility was not addressed in the study, but I think it has important implications for patient care:

> **Although giving calcitriol** (a significantly more expensive and prescription-only pharmacy product) **was clearly associated with benefit in this situation, assuring vitamin D adequacy with generous plain old cheap vitamin D supplementation may have done the trick just as well for many of the people involved.**

This is another argument for a regular planned 25-hydroxy D level check for everybody. We could save the big guns (calcitriol) for those who really need it. Additionally, as described in the report below, there is evidence that even folks for whom calcitriol IS actually needed, there are other roles for 25-hydroxy vitamin D and therefore there is a good reason to maintain that level in the safe and adequate range at the same time as providing ready-made calcitriol.

Vitamin D in Health and Disease. Clin J Am Soc Nephrol. 2008 Jun 4.

"Vitamin D functions in the body through both an endocrine mechanism (regulation of calcium absorption) and an autocrine mechanism (facilitation of gene expression). The former acts through circulating calcitriol, whereas the latter, which accounts for more than 80% of the metabolic utilization of the vitamin each day, produces, uses, and degrades calcitriol exclusively intracellularly.

In patients with end-stage kidney disease, the endocrine mechanism is effectively disabled; however, the autocrine mechanism is able to function normally so long as the patient has adequate serum levels of 25(OH)D, on which its function is absolutely dependent.

For this reason, calcitriol and its analogs do not constitute adequate replacement in managing vitamin D needs of such patients**. Optimal serum 25(OH)D levels are greater than 32 ng/mL (80 nmol/L). The consequences of low 25(OH)D status include increased risk of various chronic diseases, ranging from hypertension to diabetes to cancer.**

The safest and most economical way to ensure adequate vitamin D status is to use oral dosing of native vitamin D. (Both daily and intermittent regimens work well.) Serum 25(OH)D can be expected to rise by about 1 ng/mL (2.5 nmol/L) for every 100 IU of additional vitamin D each day. Recent data indicate that cholecalciferol (vitamin D3) is substantially more potent than ergocalciferol (vitamin D2) and that the safe upper intake level for vitamin D3 is 10,000 IU/d."

The levels described as "normal" in many research studies set the level of insufficiency and deficiency at significantly lower levels than what appears to be needed for optimal health benefit. This accounts for some of the confusing research outcomes.

For example, a study finding no benefit of supplemental vitamin D on some outcome in a population would not be surprising if only low levels of supplementation were tested. This was typical of many of the initial studies in which people in nursing homes were given the RDA for vitamin D (400 iu, at the time) but it failed to have any effect on risk of fractures. Researcher's conclusion: "Vitamin D supplementation is not helpful in old people."

It also misses the boat when the only outcome measured in research studies is bone related, and when they are also measuring only a severe and late-appearing bone-related outcome (e.g. fractures.) For example, benefits of correcting vitamin D deficiency (not "giving the RDA") is seen in many areas in this population besides decreasing fractures, including improving muscle strength and immune competence, and decreasing falls and congestive heart failure.

In most cases, blood levels were most often not evaluated to determine the success of the supplementation for achieving "adequacy." Additionally, the ranges perceived to be "normal" were often set too low so that true comparisons of adequacy vs inadequacy did not take place…only "gradations of inadequacy."

In fact, one of the old books in my collection actually had two sets of "normal values" to evaluate vitamin D adequacy. The cut-off to use in winter was much lower because it was "average" and "expected" to have a much lower level during those months. It is a classic illustration that just because something is average or expected does not mean it is good or safe. Live and learn …

Here's another report with some information about what serum vitamin D levels might be better indicators of adequacy:

Optimal serum 25-hydroxyvitamin D levels for multiple health outcomes.
Adv Exp Med Biol. 2008;624:55-71.

"Recent evidence suggests that higher vitamin D intakes beyond current recommendations may be associated with better health outcomes. In this chapter, evidence is summarized from different studies that evaluate threshold levels for serum 25(OH)D levels in relation to bone mineral density (BMD), lower extremity function, dental health, risk of falls, admission to nursing home, fractures, cancer prevention and incident hypertension. **For all endpoints, the most advantageous serum levels for 25(OH)D appeared to be at least 75 nmol/l (30 ng/ml) and for cancer prevention, desirable 25(OH)D levels are between 90-120 nmol/l (36-48 ng/ml). An intake of no less than 1000 IU (25 mcg) of vitamin D3 (cholecalciferol) per day for all adults may bring at least 50% of the population up to 75 nmol/l. Thus, higher doses of vitamin D are needed to bring most individuals into the desired range.** While estimates suggest that 2000 IU vitamin D3 per day may successfully and safely achieve this goal, the implications of 2000 IU or higher doses for the total adult population need to be addressed in future studies

2. The risk of injury from overdose in an individual is much higher if the active hormone form is given instead of just a precursor form. This is analogous to the higher potential for injury from giving high dose retinol (an active hormonal form of vitamin A primarily in liver and some supplements) compared with high doses of the pre-cursor form of vitamin A, the orange pigment beta-carotene in fruits, vegetables and some supplements. [Remember that the upper level of known safety of "regular" vitamin D is now described as a chronic intake of 10,000 iu/day. It is WAY less toxic than most of us were taught. "Therapeutic" levels to correct deficiency are often something like 50,000 iu/week for 8 weeks, or as described earlier, a one-time dose of 300,000 iu.]

3. **Regularly monitoring 1,25-dihydroxyD levels would be a reasonable plan for folks with kidney disease so we can catch them when production just starts to decrease.** That way we can intervene BEFORE they suffer the multiple severe consequences associated with inadequacy of this vital steroid hormone. I would also like to see a one-time-only 1,25-dihydroxy D level for people with autoimmune diseases like MS, arthritis, lupus, diabetes, etc., for reasons beyond the scope of this paper. (Details are available in the other handouts listed earlier.)

For more information, please see

"My Current Top Five Easy Ways to Improve Your Family's Nutrition (subject to change at any moment! ☺)" This paper addresses vitamin D as one of the Top Five issues, but in much less detail than the Vitamin D paper described above. It is designed for those who want just a cut-to-the-chase version of why this matters so much and what are we supposed to do about it.

I also have papers available with abstracts from searches of the scientific literature about vitamin D and selected health problems, such as: "**Some recent abstracts (2008-2010): Cardiovascular and Diabetes Issues x Vitamin D (plus odds and ends)"**

As always, my handouts are intended to provide some summarizing of interesting nutrition information in the news. They are not intended to take the place of the guidance and recommendations of an individual's health care providers.

And of course everything is way more complicated than my descriptions suggest, but this is just an attempt at a nice simplified discussion trying to sort things out sufficiently to give direction in thinking about functional applications and doing some good.

Here are few other references regarding the prevalence of vitamin D deficiency in various folks and associations with a broad range of health problems from my first edition of this paper in 2008. Lots more references are in my other papers, and there are now many more reports published that are newer than the ones I initially listed here … all are in the same direction ☺ I will try to update the list here soon, but in the meantime, here are examples of just a few of the 2011-2012 reports out there ….

Vitamin D deficiency is a predictor of reduced survival in patients with heart failure; vitamin D supplementation improves outcome. Eur J Heart Fail. 2012 Feb 3. Vitamin D status and mortality risk in CKD: a meta-analysis of prospective studies. Am J Kidney Dis. 2011 Sep;58(3):374-82. Low 25-hydroxyvitamin D levels and mortality in non-dialysis-dependent CKD. Am J Kidney Dis. 2011 Oct;58(4):536-43. Vitamin D receptor and Alzheimer's disease: a genetic and functional study. Neurobiol Aging. 2012 Feb 3. Vitamin D receptor gene as a candidate gene for Parkinson disease. Ann Hum Genet. 2011 Mar;75(2):201-10. Translating the role of vitamin D(3) in infectious diseases. Crit Rev Microbiol. 2012 Feb 5. Prevalence and predictors of low vitamin D concentrations in urban Canadian toddlers. Paediatr Child Health. 2011 Feb;16(2):e11-5. High prevalence of vitamin D insufficiency in patients with head and neck cancer at diagnosis. Head Neck. 2012 Jan 27. 25-Hydroxyivitamin D3 levels in patients

with systemic lupus erythematosus and its association with clinical parameters and laboratory tests. Rev Bras Reumatol. 2012 Feb;52(1):60-65. Risk Factors for Variation in 25-Hydroxyvitamin D3 and D2 Concentrations and Vitamin D Deficiency in Children. J Clin Endocrinol Metab. 2012 Jan 25. Can vitamin D deficiency cause diabetes and cardiovascular diseases? Present evidence and future perspectives. Nutr Metab Cardiovasc Dis. 2012 Feb;22(2):81-7.Pre-diagnostic 25-Hydroxyvitamin D, VDR and CASR Polymorphisms, and Survival in Patients with Colorectal Cancer in Western European Populations. Cancer Epidemiol Biomarkers Prev. 2012 Jan 25. 25-Hydroxyvitamin D deficiency is associated with fatal stroke among whites but not blacks: The NHANES-III linked mortality files. Nutrition. 2012 Jan 18. High prevalence of vitamin D deficiency in the sunny Eastern region of Saudi Arabia: a hospital-based study. East Mediterr Health J. 2011 Apr;17(4):317-22. Prevalence of Vitamin D Deficiency and Response to Oral Vitamin D Supplementation in Patients Receiving Home Parenteral Nutrition. JPEN J Parenter Enteral Nutr. 2012 Jan 12. The relation of serum 25-hydroxyvitamin-D levels with severity of obstructive sleep apnea and glucose metabolism abnormalities. Differences in outcomes between cholecalciferol and ergocalciferol supplementation in veterans with inflammatory bowel disease. Geriatr Gerontol Int. 2012 Jan 10. Endocrine. 2012 Jan 14. Nutrition: High prevalence of vitamin D deficiency in Australian adults. Nat Rev Endocrinol. 2012 Jan 10. Nutr Clin Pract. 2012 Feb;27(1):122-8. Prevalence of vitamin d insufficiency among breast cancer survivors. Premature Atherosclerosis Is Associated With Hypovitaminosis D and Angiotensin-Converting Enzyme Inhibitor Non-use in Lupus Patients. Am J Med Sci. 2012 Jan 4. Vitamin D deficiency as a risk factor for allergic disorders and immune mechanisms. Allergy Asthma Proc. 2011 Nov;32(6):438-44.Vitamin D intake and mental health-related quality of life in older women: The Iowa Women's Health Study. Maturitas. 2011 Dec 28. Association between plasma 25-OH vitamin D and testosterone levels in men. Clin Endocrinol (Oxf). 2012 Jan 2. The beneficial role of vitamin D in Alzheimer's disease. Am J Alzheimers Dis Other Demen. 2011 Nov;26(7):511-20. 25-Hydroxyvitamin D levels and juvenile idiopathic arthritis: Is there an association with disease activity? Rheumatol Int. 2011 Dec 25. Impact of Circulating Vitamin D Binding Protein Levels on the Association Between 25-Hydroxyvitamin D and Pancreatic Cancer Risk: A Nested Case-Control Study. Cancer Res. 2012 Jan 13. Vitamin D deficiency: a worldwide problem with health consequences. Am J Clin Nutr. 2008 Apr;87(4):1080S-6S. Hypovitaminosis D among healthy children in the United States: a review of the current evidence. Arch Pediatr Adolesc Med. 2008 Jun;162(6):513-9. Prevalence of vitamin D deficiency among healthy infants and toddlers. Arch Pediatr Adolesc Med. 2008 Jun;162(6):505-12.]

SOME THOUGHTS ABOUT VITAMIN D and LATITUDE

https://www.health.harvard.edu/newsweek/images/latitude-vitaminD.jpg

"Except during the summer months, the skin makes little if any vitamin D from the sun at latitudes above 37 degrees north (in the United States, the shaded region in the map) or below 37 degrees south of the equator. People who live in these areas are at relatively greater risk for vitamin D deficiency."

(Actually, that's where **I** live … but you can see why it's a really big deal "Up North!")

But just by the way, many of the people whom I have met in my travels who have turned out to be seriously vitamin D deficient actually live in the South. Why is this?

1. It's hot out there and people like to stay in their nice air conditioned homes, offices and shopping malls.

2. People are cautious about sun exposure because of melanoma risk.

3. People use sunscreen because of concerns about melanoma and also to avoid "premature wrinkles."

4. People's skin becomes much less able to make vitamin D as we age, so some of us old folks are not very good at making vitamin D even if we ran around in the buff (… which we won't … I promise.)

5. Many of us keep covered up due to modesty, for religious reasons … and some of us just stay covered up as a public service. Bottom line … EVERYBODY needs to have some attention to assuring vitamin D adequacy … not just those of us way up North.