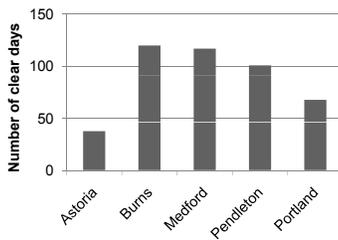


OREGON PUBLIC HEALTH DIVISION • DEPARTMENT OF HUMAN SERVICES

SHINING SOME SUNLIGHT ON VITAMIN D

Is vitamin D deficiency responsible for multiple health problems in modern society? If so, since sunlight is its main source, many Oregonians may be at risk for vitamin D deficiency because of wet, cloudy winters with short daylight hours (Figure 1.) Vitamin D is no longer about just

Figure 1. Average Annual Number Clear Days



Source: Western Regional Climate Center

bone health. In recent years, books such as “The Vitamin D Solution” and health articles have advocated higher vitamin D intake to counteract many acute and chronic illnesses.^{1,2} On the other hand, a systematic review of vitamin D and calcium supplementation by the Agency of Healthcare Research and Quality (AHRQ) recently concluded that a majority of the findings concerning the effect of these nutrients on health outcomes were “inconsistent”.³ Unfortunately, we don’t have the definitive well-conducted randomized controlled trial on which to base clinical and public health recommendations. In this *CD Summary*, we “bone up” on vitamin D deficiency.

VITAMIN D DEFICIENCY

We know that vitamin D deficiency leads to rickets and osteomalacia. But more recent research has proposed vitamin D deficiency as a contributor to cancers, autoimmune diseases, infectious diseases, and cardiovascular disease.^{4,5} As evidence, experts cite that many of these conditions have higher incidence in people living at higher latitude where there is greater seasonal variation in daylight. In addition,

data from the (in)famous Harvard-based longitudinal cohort studies, including the Nurses’ Health Study and Health Professionals Follow-up Study, have shown that participants with low 25-hydroxyvitamin D levels at baseline had higher risk of later cancer and myocardial infarction. A meta-analysis of vitamin D clinical trials also showed a mortality benefit from vitamin D supplementation,⁶ although as part of the systematic review, AHRQ re-analyzed the data and did not find a mortality benefit. At the cellular level, there are vitamin D receptors in numerous tissues, including brain, prostate, breast, and colon. As an immunomodulator, vitamin D can stimulate the production of cathelicidin, a peptide that is a “natural antibiotic”. Low vitamin D levels are associated with increased risk of progression of tuberculosis.⁷

Other experts caution that “low vitamin D levels may simply be a marker for lower health status rather than a cause of it.”⁸ Confounding may explain why vitamin D appears to be protective, as people who have greater sunlight exposure, like healthy, physically active, normal weight persons, are also likely to have higher vitamin D levels.

THE ABC’S OF D

Vitamin D is unique in that our main source is good old sunlight. Here is a refresher of vitamin D metabolism: Solar UVB radiation generates previtamin D₃ in the skin, which leads to circulating vitamin D. In the liver, vitamin D is hydroxylated to 25-hydroxyvitamin D, the main circulating metabolite. In the kidney, an additional hydroxylation step generates 1,25-hydroxyvitamin D, the biologically active form. With sufficient 1,25-hydroxyvitamin D, there is enhanced intestinal calcium absorption and decreased secretion of parathyroid hormone. The overall effect of sufficient vitamin D, in the presence

of adequate calcium and phosphorus, is strong, healthy bones.

Over 90% of our vitamin D supply is through UV-B rays. In a fair skinned person, a blast of 20–30 minutes of sunlight on the face and forearms at midday generates about 2000 IU of vitamin D, and 2–3 “doses” per week can maintain sufficient vitamin D levels.⁹ Sunscreen can decrease vitamin D generation. An important unanswered research question is whether there is a “safe” dose of sun exposure that can maintain sufficient vitamin D levels without risking skin cancer. Unfortunately in adults, it’s hard to eat your way to vitamin D sufficiency. Some good sources of vitamin D include oily fish (salmon, sardines, mackerel, tuna) and fortified milk, orange juice, cereals, yogurt, and margarine.

OPTIMAL VITAMIN D LEVELS

The current gold standard for assessing one’s vitamin D status is the 25-hydroxyvitamin D level. This is commonly reported as ng/mL. (If you see nmol/L, multiply the ng/mL by 2.5 to get the equivalent; 20 ng/mL=50 nmol/L). The prevailing cutoff point for vitamin D deficiency is 25-hydroxyvitamin D < 20 ng/mL. But some experts recommend the optimal level of 25-hydroxyvitamin D should be > 30 ng/mL, and even up to 70 ng/mL.^{4,9,10} As evidence to support higher levels, pre-modern humans living in sun-rich environments spent all their time outdoors and had “natural” 25-hydroxyvitamin D levels between 40-70 ng/mL.

For Oregonians, meeting this standard would label most of us “vitamin D-insufficient” for some or all of the year. A study from Great Britain (latitude 50–60 degrees)* found the average 25-hydroxyvitamin D level was 16.4 ng/mL in winter/spring and 24.1 ng/mL in summer/fall.¹¹ In addition, 87% of the cohort of 45 year olds had 25-hydroxyvitamin D < 30 ng/mL! Let’s face it: this summer’s beautiful weather notwithstanding, parts of Oregon (you know where!)

*Oregon’s latitude is 42–46 degrees.

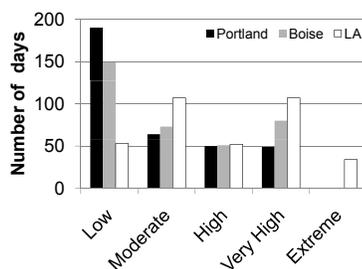


If you need this material in an alternate format, call us at 971-673-1111.

IF YOU WOULD PREFER to have your CD Summary delivered by e-mail, zap your request to cd.summary@state.or.us. Please include your full name and mailing address (not just your e-mail address), so that we can purge you from our print mailing list, thereby saving trees, taxpayer dollars, postal worker injuries, etc.

are not what we would euphemistically call “high UV ray risk” (Figure 2). Although vitamin D is fat-soluble and can supply the body for months,

Figure 2. 2009 UV index forecast



Source: National Weather Service

seasonal variation in vitamin D levels results in lower levels in the winter and spring.

CURRENT DIETARY RECOMMENDATIONS

The current recommended intake of vitamin D, per the Institute of Medicine, is 200 IU/d from birth to age 50 (including pregnant women), 400 IU/d for adults aged 50-70, and 600 IU/d for those older than 70.¹² Note that these levels are inadequate in the setting of established osteomalacia or rickets, which require much higher doses to replenish vitamin D stores. The IOM is currently completing a 24-month long review of the vitamin D dietary reference intake, and is supposed to release updated recommendations this fall. Others have advocated that adults without adequate sun exposure should consume 800-1000 IU/day.⁴

The American Academy of Pediatrics recently upwardly revised the minimum daily intake of vitamin D

to 400 IU for all infants and children, including adolescents. Breastfed and partially breastfed infants should be supplemented with 400 IU/day of vitamin D.¹³ Other children should receive vitamin D supplements unless they take in sufficient vitamin D through fortified formula, milk or other foods. All formulas contain >400 IU/L of vitamin D, and vitamin D-fortified milk and orange juice contains 100 IU/8 oz.

VITAMIN D SUPPLEMENTS

Vitamin D supplements are D₂ (ergocalciferol, plant-derived) and D₃ (cholecalciferol, fish-derived), but D₂ is only 30% as effective as D₃ so would require three times the dose. As a supplement to maintain higher 25-hydroxyvitamin D levels, experts recommend 1000 IU of vitamin D₃ per day or 3000 IU of vitamin D₂ per day.⁴ Before we all rush out to buy vitamin D supplements, however, there is scientific consensus that not enough is known about the safety of long-term exposures to aggressive vitamin D supplementation.¹⁴

BOTTOM LINE

More than 150 clinical trials of vitamin D are in process to answer vitamin D's role in multiple health conditions.⁹ Physicians slow to recommend vitamin D may be missing out on the next medical breakthrough. On the other hand, the history of medicine is filled with products that initially generated great enthusiasm only to fall by the wayside as further research became available (see vitamin E, beta carotene, hormone replacement therapy, Redux, Vioxx, Avandia). Physicians who demand more evidence to support vitamin D supplementation may be rewarded.

FOR MORE INFORMATION

See CDC Grand Rounds session on “The Importance of Monitoring Vitamin D Status in the U.S.” www.cdc.gov/about/grand-rounds/archives/2010/08-August.htm (Accessed 19 Sep 2010).

REFERENCES

1. Holick MF. The Vitamin D Solution. Hudson Street Press, 2010.
2. Brody J. “What do you lack? Probably vitamin D. New York Times, July 26, 2010.
3. Chung M et al. Vitamin D and Calcium: Systematic Review of Health Outcomes. Evidence Report/Technology Assessment No. 183. AHRQ Publication No. 09-E015, Rockville, MD: Agency for Healthcare Research and Quality. August 2009.
4. Holick MF. Vitamin D deficiency. N Engl J Med 2007; 357:266–81.
5. Giovannucci E, Liu Y, Hollis BW, Rimm EB. 25-hydroxyvitamin D and risk of myocardial infarction in men. Arch Intern Med 2008; 168:1174–80.
6. Autier P, Gandini S. Vitamin D supplementation and total mortality: A meta-analysis of randomized controlled trials. Arch Intern Med 2007;10:1730–7.
7. Talat N et al. Vitamin D deficiency and tuberculosis progression. Emerg Infect Dis 2010;16:853–5.
8. Grey A, Bolland M. Vitamin D: A place in the sun? Arch Intern Med 2010; 170:1099–1100.
9. Pearce SHS, Cheetham TD. Diagnosis and management of vitamin D deficiency. BMJ 2010; 340:142–7.
10. Cannell JJ, Hollis BW. Use of vitamin D in clinical practice. Alt Med Rev 2008; 13:6–20.
11. Hypponen E, Power C. Hypovitaminosis D in British adults at age 45 y: Nationwide cohort study of dietary and lifestyle predictors. Am J Clin Nutr 2007; 85:860–8.
12. Institute of Medicine, Food and Nutrition Board. Dietary Reference Intakes: Calcium, Phosphorus, Magnesium, Vitamin D, and Fluoride. Washington, DC: National Academy Press, 1997.
13. Wagner CL, Greer FR. Prevention of rickets and vitamin D deficiency in infants, children, and adolescents. Pediatrics 2008; 122:1142–52.
14. Brannon PM et al. Summary of roundtable discussion on vitamin D research needs. Am J Clin Nutr 2008; 88(suppl):587S-92S.