



Health Connections

LINKING NUTRITION RESEARCH TO PRACTICE

DRIs FOR CALCIUM & VITAMIN D

How Much and for Whom?

The recent release of the much-anticipated Food and Nutrition Board, Institute of Medicine's (IOM) "Dietary Reference Intakes for Calcium and Vitamin D (2011)" generated considerable media coverage and point/counterpoint discussions among the scientific community. Conflicting opinion can confuse consumers seeking guidance about the benefits of these important nutrients. This issue of *Health Connections* summarizes what is new in the recommendations and offers tips so clients can meet the new RDAs through food choices.

Background

Dietary Reference Intakes (DRIs), the basis for nutrition program standards set by government agencies, are also used by health professionals to counsel individuals about dietary intake. Varying by life-stage group, the DRI reference values estimate an intake level to meet the requirement of 50 percent of the population (Estimated Average Requirement [EAR]); 97.5 percent of the population (Recommended Dietary Allowance [RDA]); and establish a boundary upper level (UL) to minimize harm.

Development of reference values is a work in progress, subject to change with significant advances in the science base. DRIs are developed for the general healthy population, yet incorporate chronic-disease indicators when data support a strong causal relationship to health outcomes. Establishing RDAs and ULs is complex, as chronic diseases are multifactorial and take years to develop. Because some data suggests a U-shaped relationship between certain nutrients and health conditions, DRI development also considers the totality of evidence for both benefit and risk in subgroups as well as the general public.

Although emerging evidence makes a case that vitamin D and calcium's importance for health extends beyond bone—including the potential to protect against some types of cancer, metabolic syndrome,

hypertension and other health conditions—according to the IOM, limited data from randomized clinical trials and observational studies with inconclusive results have left unanswered questions about their roles in nonskeletal health.

What's New in the DRIs

The 2011 DRIs establish for the first time an EAR and an RDA for calcium and vitamin D, replacing previous Adequate Intake (AI) values and further highlighting the importance of these nutrients in their established function in bone health. The evidence base for calcium now is larger and its physiology and metabolism better understood, enabling the establishment of an RDA ranging from 1,000 – 1,300 mg/day (excluding infants and children) and a UL ranging from 2,000 – 3,000 mg, depending on life stage. The vitamin D RDA (600 IU to age 70 and 800 IU for those 71 and over) is tripled or quadrupled from the 200 IU level, previously considered adequate for most adults. The UL for vitamin D was raised from 2,000 IU to 4,000 IU for most age groups.

The dynamic interplay between calcium and vitamin D is described by the IOM as an 'extreme' nutrient-nutrient inter-relationship and complicates interpretation of data relative to requirements, deficiency states and excess intake. Adequate calcium intake lessens the need for vitamin D relative to bone health. Thus, the *continued on page 2*



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requirement for each nutrient—calcium and vitamin D—is based on the assumption that the requirement for the other is being met.

Vitamin D Status—Biomarker of Exposure

Vitamin D is essential for the adequate production of the physiologically active, cell-signaling steroid hormone 1,25-dihydroxyvitamin D (1,25(OH)2D) that is tightly regulated at the tissue level.¹ The link between vitamin D and health is largely associated with the intermediate metabolite 25-hydroxyvitamin D (25OHD), commonly used as the biomarker for exposure to the two sources of vitamin D: sun and diet. Vitamin D occurs naturally only in a few foods (some fatty fish/salmon, eggs, mushrooms); in fortified foods (milk and some dairy products, orange juice, cereals); and supplements.

Serum 25OHD is influenced by adiposity, skin pigmentation and physical activity, as well as metabolic and disease processes. The IOM identified 50 nmol/L (20 ng/mL) as the 25OHD level associated

with benefits for most of the population (RDA). However, others believe that this level should be higher.²

As clients request or health professionals order laboratory tests for vitamin D status, consider:

- 25OHD, a biomarker for exposure to sources of vitamin D, is not yet considered a validated biomarker causally related to and predictive of a specific health outcome.
- Health benefits may be different at different 25OHD cut points and may differ by baseline status of the individual and for different segments of the population. Continued investigation is needed to ensure that vitamin D recommendations are targeted to individuals who stand to benefit most, while protecting vulnerable subgroups from risk of overexposure.
- Health conditions ranging from cardiovascular disease to all-cause mortality may present at intakes lower than the UL—and can appear at serum 25OHD levels achievable through current supplement use.



Patsy Brannon, Ph.D., R.D.

INTERVIEW

Patsy Brannon, Ph.D., R.D.; Member, IOM Committee on DRIs for Calcium and Vitamin D; Professor of Nutritional Sciences and Director, Dietetic Internship Program, Cornell University, Ithaca, NY

Q. How can the apparent discrepancies in recommendations from the IOM report and the “2010 Dietary Guidelines for Americans”—which identified both calcium and vitamin D as shortfall nutrients—be explained?

A. A high prevalence of inadequate dietary intake of a nutrient among any segment of the population, generally more than 10 percent, constitutes a shortfall nutrient. Although it is common to think of intake only in terms of food, distinctions need to be made between food intake and total dietary intake (food and supplements), because about half of the population reports supplement use of some type. In addition, comparing intake data to biochemical indices of nutrient status and disease-prevalence data is problematic—food-recall data, although getting better, often is an underestimate; and supplement intake can be inconsistent.

Because the body can make vitamin D upon exposure to sun, dietary-intake data on vitamin D can't stand alone and must be considered in context of serum 25OHD levels. Thus, we talk about vitamin D exposure to all sources. Few

meet even the EAR 400 IU recommendation, yet National Health and Nutrition Examination Survey (NHANES) data indicate that more than 80 percent of Americans have adequate vitamin D blood levels. That also means 20 percent do not, are not doing as well as others and can be considered at increased risk for vitamin D inadequacy. While there is no widespread epidemic of vitamin D deficiency, there are some groups who are not exposed to enough vitamin D to raise concern.

Although median total intake of calcium from all sources ranges from 900 to 1,300 mg/day, median calcium intakes from foods is close to the 800 mg EAR. There are large population segments, particularly girls and adult females, sufficiently below even the average intake of calcium from foods to make calcium a nutrient of concern. On the flip side, about 5 percent of women 51 years and over are above the 2,000 mg UL due to supplement use. It is important for health professionals to identify individuals at risk at both ends of the intake spectrum and advise accordingly.

Q. How can clients/consumers meet the RDA for calcium and vitamin D from food?

A. Both MyPyramid and the 2010 Dietary Guidelines for Americans include three servings of milk or milk products per day—forming the basis to meet both calcium and vitamin D requirements. Three servings of milk supply 900 mg calcium, slightly more than the 800 mg EAR for adult women and slightly less than the 1,100 mg EAR for adolescent girls, who have the highest requirement. Based on a client's preferences and life stage, build a healthy-eating pattern around that base of milk and milk products to bring intake up to the 1,000 – 1,300 mg RDA:³

- 1 cup dark, leafy green vegetables such as Chinese cabbage/bok choy, spinach, collard greens, kale (70 – 120 mg) or
- ½ cup calcium-fortified orange juice (200 – 260 mg) or
- 1 ounce calcium-fortified ready-to-eat cereal (250 – 1,000 mg)

To meet vitamin D requirements, three servings of vitamin D-fortified, fat-free or low-fat milk would provide about 360 IU—close to the 400 IU EAR. To bring intake up to 600 IU, choices could include:³

- 8 – 12 ounces of fish per week, as recommended by the Dietary Guidelines. A 6-ounce portion of fatty fish such as salmon and tuna would average about 40 to 230 IU over the week.
- ½ to 1 cup of vitamin D-fortified orange juice (70 – 130 IU)
- 1 ounce vitamin D-fortified cereal (40 – 100 IU)
- 1 egg (about 25 IU)

Q. How far are we from establishing recommendations for individuals at lower risk of other chronic diseases?

A. At this time, the committee reviewed and made decisions based on the totality of the evidence—benefit, no effect and possible harm. Evidence for vitamin D's role in non-skeletal health lacks randomized clinical trials (RCT), and health outcomes from observation studies were inconsistent and/or conflicting or did not demonstrate causality. In some conditions, such as pancreatic cancer, there was increased risk at higher blood vitamin D levels.

Opinions among scientists can and do differ. You cannot assume that a dose response for skeletal health is the same for non-skeletal health, although there is some agreement in some of the studies to date. Many non-skeletal health data in animals help establish mechanism, a biological plausibility. But you can't assume a positive outcome in an RCT without evaluation. Therefore, decisions on vitamin D research in particular were complicated—as high-quality, long-term dose-response studies and relevant outcomes at each life stage and in understudied populations to account for genetic variability are needed. Large National Institutes of Health (NIH) trials to be completed in the next 10 years, such as the Vitamin D and Omega-3-Trial (VITAL) in older adults and risk of cardiovascular disease and cancer, may help provide some answers.

REFERENCES

- ¹ Toner CD, Davis DC and Milner JA The vitamin D and cancer conundrum: Aiming at a moving target. *J Am Diet Assoc.* 2010;110:1492-150.
- ² Heaney, R. P. and Holick, M. F. (2011), Why the IOM recommendations for vitamin D are deficient. *Journal of Bone and Mineral Research*, 26: 455-457. doi: 10.1002/jbmr.328.
- ³ See <http://ods.od.nih.gov/factsheets/Calcium-HealthProfessional/> and Appendices 7-9, 14 and 15, 2010 Dietary Guidelines for Americans <http://www.cnpp.usda.gov/Publications/DietaryGuidelines/2010/PolicyDoc/Appendices.pdf>
- ⁴ http://books.nap.edu/openbook.php?record_id=13050&page=413

Practice Points for Health Professionals

- Read the Dietary Reference Intakes for Calcium and Vitamin D (2011) online: <http://www.iom.edu/Reports/2010/Dietary-Reference-Intakes-for-Calcium-and-Vitamin-D.aspx>.
- To adapt the USDA food pattern to meet individual preferences for sources of calcium and vitamin D, see Appendices 7-9, 14 and 15, "2010 Dietary Guidelines for Americans" <http://www.cnpp.usda.gov/Publications/DietaryGuidelines/2010/PolicyDoc/Appendices.pdf>.
- Adolescent girls continue to be at risk for low intake of calcium from food sources, putting their bones at risk for fracture and osteoporosis later in life. A calcium gap exists for many subgroups (see http://www.dairycouncilofca.org/PDFs/Calcium_monograph_2011.pdf) who can benefit from counseling on food sources—dairy foods, green leafy vegetables, beans, almonds and some fortified foods.
- Focus on dietary sources of calcium, which seem to be protective against kidney stones. Calcium supplements have been linked to increased risk of stones in some studies.⁴
- Daily values (DVs) used on the *Nutrition Facts* panel for calcium (1,000 mg) and vitamin D (400 IU) have not changed at this time. Check the *Nutrition Facts* panel or front-of-package icons for specific information