



Health Connections

LINKING NUTRITION RESEARCH TO PRACTICE

A NEW LOOK AT NUTRIENT RECOMMENDATIONS:

Calcium & Vitamin D

Historically, nutrient intake recommendations have been set using levels needed to prevent short-term consequences of deficiency. Evidence is building, however, that the long-term impact of even marginal deficiencies should be considered when setting requirements. Recent Dietary Reference Intakes (DRIs) took some small steps towards looking at longer term chronic disease in setting recommendations.

In his E. V. McCollum Award lecture, Dr. Robert Heaney highlights this problem using examples from calcium and vitamin D (1). Arguments are put forth to indicate that requirements may need to be adjusted if these long-latency deficiency diseases are to be prevented (2). This newsletter will focus on calcium and vitamin D, two nutrients for which there is increasing evidence that prevention of long-latency diseases should be considered when setting intake recommendations.

CALCIUM

What considerations led to the current calcium requirements?

Ideally, research reveals the relationship of nutrient intake to a functional measure of inadequacy or to optimal health and reduced risk of disease (3). The nutrient requirement for calcium was set at the threshold intake for maximal retention of bone density. Bone is a dynamic tissue constantly undergoing bone resorption and bone formation. The >99% of the body's calcium in the skeleton serves to keep us upright against gravity and as a functional reserve for other physiological needs.

Is calcium intake important for conditions other than bone-related disorders?

The 1% of body calcium not in the skeleton is widely distributed in soft tissue and extracellular fluid. We are just beginning to unravel the

surprising role calcium intake plays in controlling body weight, hypertension and perhaps insulin resistance. Level of calcium intake needed to realize these benefits is within the range recommended for optimal bone health, 1000-1300 mg/day, or 3-4 servings of high-calcium foods per day.

■ **Body Weight Regulation:** In a study of hypertensive, obese black men, investigators noted that the men who added 2 cups of yogurt to their diet not only had improved blood pressure levels, but also lost about 11 pounds over the year (4). Studies in children have similarly found an inverse relationship between calcium intake and body fat (5,6), with calcium accounting for up to 34% of the variability in body fat (6). Heaney's group found that calcium intake accounted for about 3% of the variation in weight of adult women (7). Despite the smallness of this effect, the data suggest that the prevalence of obesity in women could be reduced by 60-80% if population-wide calcium intakes met the current recommendation.

■ **Improved Blood Pressure:** Several studies have investigated the role of dietary calcium in lowering blood pressure and the risk for hypertension. In a *continued on page 2*



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meta-analysis of randomized controlled trials, calcium supplementation led to a small reduction in systolic blood pressure (8). Results indicate greater effects may be seen in subpopulations. More recently, studies have found a low-fat diet including fruits, vegetables, and low-fat dairy products (DASH* diet) lowered blood pressure in normotensive and moderately hypertensive adults (9). In these studies, dietary calcium was increased to about 1200 mg/day.

- **Insulin Resistance:** In a multicenter 10-year study examining the relationship between dietary intake and insulin resistance, eating patterns of 3,157 black and Caucasian young men and women were examined. Dairy

consumption was inversely associated with insulin resistance syndrome among overweight participants, regardless of race or gender (10). Additional studies showing improvement in insulin resistance with dairy consumption need to be reported to confirm this finding.

Thus, in addition to protecting bone health, meeting the recommended intake for calcium has secondary benefits. Future research will determine whether the current recommendations are sufficient to reap these benefits. The best dietary sources of calcium include dairy products; green leafy vegetables and many fortified foods are other good sources.

*DASH = Dietary Approaches to Stop Hypertension



Connie Weaver, Ph.D.
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In an interview with Connie Weaver, Ph.D., Head and Distinguished Professor of Foods and Nutrition at Purdue University and renowned investigator on calcium metabolism and requirements, we examined further the role calcium plays in health. Every summer Dr. Weaver recruits adolescents to participate in “Camp Calcium” to investigate the effect of different levels of calcium consumption.

Q: What is the biggest barrier to adequate calcium intake in the U.S.?

A: Most health professionals would probably say “lactose intolerance.” However, our research confirms that most people can tolerate up to one cup of fluid milk. We find the “calcium barrier” isn’t physiological, it is cultural. African-American and Hispanic adolescent women we studied had just not been exposed to the frequent use of dairy products; it was not part of their habit or cultural environment. For example, in our “Camp Calcium” studies, breath hydrogen tests verified the tolerance to milk and all girls were provided 75% of their calcium intake as dairy products in a combination of fluid milk and cheese. This translates to 2-3 cups of fluid milk daily, which all tolerated without symptoms. By the end of the three-week study, breath hydrogen tests showed an improvement in lactose tolerance.

Q: How can we assure peak bone mass in our adolescent population?

A: Peak bone mass is achieved by a combination of genetic determination plus lifestyle choices. To maximize genetic potential adolescents need an adequate calcium intake coupled with weight-bearing exercise. In our

studies, conducted in the Indiana summer, we see no vitamin D deficiency; however, in some settings vitamin D sufficiency may be an issue. Also, amenorrhea in women who suffer from anorexia nervosa or due to extreme exercise routines leads to decreased bone formation. Smoking and alcohol use in the adolescent population make a minor contribution to decreased adolescent bone acquisition.

Q: In your opinion, how should we meet our calcium intake requirement?

A: The top priority is to MEET calcium requirements. I recommend “foods first” because of the other nutrients in dairy products that support bone density. Fortified foods provide calcium plus some other nutrients, while calcium supplements deliver only calcium. I have a concern of ongoing compliance with fortified foods and supplements.

Q: What are your research plans for the future?

A: My laboratory is interested in the role of calcium intake modulating body fat metabolism and possibly playing a role in weight maintenance or body fat balance. I look forward to inviting overweight adolescent boys and girls to our research camp this summer and exploring the impact of calcium supplementation on body fat metabolism.

Many health professionals hear the complaint that their clients have lactose intolerance and can't drink milk. In the US there are about 72 million lactose maldigesters, many of whom are of Asian, African, and Hispanic descent. It is difficult to meet calcium nutrient requirements if dairy is eliminated from the diet, however, and fortunately there are methods to manage lactose intolerance (see Table 1).

Table 1: Managing Lactose Intolerance

FACTORS AFFECTING LACTOSE DIGESTION	DIETARY STRATEGY
Dose	Consume no more than 1 cup at a time. Symptoms are related to dose.
GI Transit	Consume milk with other foods to slow transit time.
Yogurt	Lactose in yogurt is better digested, especially those with active cultures.
Digestive Aids, Lactose-reduced products	Over the counter lactase supplements are effective. e.g. Lactaid.
Colon adaptation	Consume lactose-containing foods daily to increase colonic bacteria's ability to handle undigested lactose.

VITAMIN D

A resurgence in the incidence of rickets in the U.S. was the topic of a recent National Institutes of Health conference (Oct. 9-10, 2003), where the incidence of vitamin D deficiency was estimated to be at least 25% for adolescents and adults. A decrease in sun exposure, coupled with a reduced consumption of vitamin D-fortified foods, is thought to be the primary cause of this growing health issue.

What considerations led to the current Vitamin D requirements?

Vitamin D requirements are pegged to the prevention of rickets in children and osteomalacia in adults. Vitamin D, found in very few foods naturally, is photosynthesized in the skin by the action of solar ultraviolet B radiation (11). Its major function is to maintain serum calcium and phosphorus concentration by enhancing the efficiency of intestinal absorption of these nutrients from foods. Individuals who live in northerly climates, breast-fed infants (older than 6 mo), and homebound elderly may need additional vitamin D supplementation. As one ages the cutaneous capacity to produce vitamin D decreases (11) and dietary recommendations increase accordingly.

Food sources for vitamin D include fatty fish and fortified foods such as milk, breakfast cereals, and some orange juices.

Many health professionals presume that in the absence of rickets or osteomalacia, vitamin D intake is sufficient (1). However, recent research has uncovered physiological roles for vitamin D beyond assisting with calcium absorption.

- In disease states such as the myelodysplasias psoriasis, and in various cancer cell lines in culture, vitamin D has been shown to induce cell differentiation and to control cell proliferation (2). This function of vitamin D is probably dependent on adequate plasma

vitamin D concentrations.

- Investigators have shown that prostate cancer incidence and mortality are inversely associated to sunlight exposure and plasma vitamin D status (12).
- In a more recent report, patients with persistent, nonspecific musculoskeletal pain syndromes were found to have low plasma levels of vitamin D, especially patients with darker skin living in the northern US (13). This study suggests screening patients who have nonspecific, otherwise unexplained, musculoskeletal pain for hypovitaminosis D.

CONCLUSION AND CALL TO ACTION

- Although dietary recommendations are set based on a specific nutrient function, nutrients usually have more than one role in the body.
- Global improvements in food accessibility have eradicated most deficiency diseases, however many individuals still have deficient or marginal intakes of some nutrients.
- Health professionals are in a position to assess dietary intake, or make an appropriate referral to a dietitian, to ensure not just short-term but long-term health and prevention of chronic disease.

Ask these questions to assess nutritional health:

- Do you regularly consume adequate servings from all five food groups?
- Do you get adequate sunlight exposure?
- Do you participate in regular weight-bearing activities (jogging, walking, dancing)?
- Do you use supplements regularly? If so, which ones?
- Do you rely primarily on fortified foods to get nutrients you need? (Keep in mind other nutrients that may be short-changed in fortified foods.)
- Is lactose intolerance limiting the amount of dairy foods you consume?

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