Vitamin D Nutrient Intake For All Life Stages

Abstract:

Vitamin D, unlike other nutrients, is a conditionally required nutrient being obtained from two sources predominantly by skin production upon exposure to natural ultraviolet (UV) solar radiation, and to a lesser extent by oral intake. Being a fat soluble vitamin it has a long half-life of about two weeks and is stored in fat tissues. Nearly six months of the year from October to March in Ireland, skin production is absent and the population is dependent on oral intake from natural foodstuffs, (which are consumed in small quantities only), fortified foodstuffs (most notably some milk products for the past 25 years) and vitamin D supplements, either in multivitamin tablets or in combination with calcium tablets.

There are three challenges with respect to vitamin D nutrition. The first challenge is the assessment of vitamin D status. The challenge is ameliorated greatly by the availability of an excellent indicator of vitamin D status, namely serum 25-hydroxyvitamin D (25-OHD). This is the major circulating metabolite whose concentration is substrate dependent on supply from skin and oral sources. Assays for 25-OHD are now widely available in Ireland. The second challenge is interpreting 25-OHD levels. There has been a double-paradigm shift over the past 30 years. Privalional vitamin D deficiency used to be defined as a clinical, biochemical, radiological or histological abnormality that was corrected by low dose supplementation.

Then, different thresholds of 25-OHD defined different degrees of hypovitaminosis D and risk of vitamin D deficiency. Now, the 25-OHD level determines categories such as: severe deficiency, deficiency, insufficiency, sufficiency and optimal. Poor vitamin D status is common in Ireland based on studies over the past 30 years in all age groups from preterm infants to elderly subjects. Given that it is a conditionally required nutrient, the third challenge is determining the recommended daily allowance (RDA) that maintains adequate vitamin D status in the majority. Cashman and colleagues in Ireland in a detailed study of the vitamin D intakes required to maintain 25-OHD concentrations of >37.5, >50, and >75 nmol/L in 97.5% of the sample were noted to be 800, 1120, and 1640 IU daily, respectively.

The Institute of Medicine (IOM) in North America just recently updated their 1997 dietary reference intakes for both calcium and vitamin D. In the intervening 13 years there has been a marked increase in reports suggesting a link between 25-OHD levels and non-skeletal outcomes such as associations with cancer prevention, innate immunity, auto-immune disorders, diabetes mellitus and vascular disease of heart and brain. In 1997, the IOM specified adequate intakes (AIs) rather than both estimated average intakes (EARs) and recommended daily allowances (RDAs) because the evidence was inadequate. EARs indicate the average intake for populations; RDAs specify the intake required for the majority (>97.5%) of the population.

In 2010, the IOM on the basis of bone health outcomes calculated EARs and RDAs for all life stages except infants for whom they specified AIs. The IOM assumed minimal sun exposure when establishing intakes. They determined that North Americans need on average 400 IU (10 microg) daily for those aged 1 to 70 years. The RDA is 600 IU daily. For those over 70 years the RDA rises to 800 IU daily. The AI for infants is 400 IU daily, but they indicate that the AI is likely greater than the need for most infants. The IOM made three important precautionary judgments. First, regarding the threshold for defining hypovitaminosis D, they advocated a range of 30 to 50 nmol/L; with 40 nmol/L at the targeted level for median dietary requirement, 30 nmol/L being the lower end and 50 nmol/L being the upper end. It is noteworthy that most surveys in North America report that the average intake of vitamin D is less than the EAR but that the majority have S-25-OHD levels above 50 nmol/L, indicating that sunlight exposure, not surprisingly, contributes to vitamin D status. Therefore, with few exceptions, they concluded that most North Americans were receiving enough vitamin D. Secondly, apart from bone health, they state that there is no evidence yet to support other benefits for vitamin D intake. Finally they caution against higher intakes of vitamin D that may be harmful; they quote an upper tolerable intake of 4000 IU daily that should not be misunderstood as the amount healthy person need to consume.

What impact should these new intakes have in Ireland? There are two major differences in vitamin D supply in Ireland compared to North America: fortification of milk with vitamin D is mandatory there, whereas here it is optional and until recently was only available in some low fat milk products that are usually higher-priced; Ireland is a higher latitude region and has a longer spell of absent UV ultraviolet irradiation. All age groups should be encouraged to consume fortified milk giving 400 IU per litre, pending fortification of all milk with vitamin D. Those who avoid milk should be encouraged to take low dose vitamin D supplements (about 400 IU daily) during the winter months; those who are housebound should remain on the supplement all year. All risk groups should be assessed by measurement of S-25-OHD prior to recommending higher doses. The current policy of supplementing all infants from birth to 1 year with 200 IU daily should be very effective at improving vitamin D status in infants; in our experience the duration of dosing is important because prolonged intake of 400 IU daily leads to levels well in excess of 50 nmol/L. Pharmacologic doses of vitamin D given once or twice yearly as a means to prevent or correct privalional vitamin D deficiency should be avoided in all cases especially the elderly because it is related to falls and fractures.

Public health measures should be in place to ensure that the majority of the population have sufficient vitamin D intake to maintain S-25-OHD at least above 30 nmol/L and preferably above 50 nmol/L. More research is needed to determine the benefit of vitamin D with respect to non-bone health outcomes.
References

9. Sanders KM, Stuart AL, Williamson EJ, Simpson JA, Kotowicz MA, Young D, Nicholson GC. Annual high-dose oral vitamin D and falls and fractures in older women: a randomized controlled trial. JAMA 2010;303:1815-22.