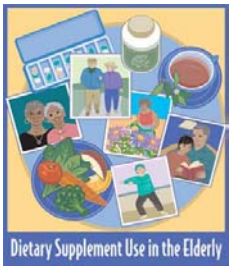

Importance of Vitamin D in the Prevention of Osteoporosis, Prostate, Colon, and Breast Cancer, Hypertension, and Heart Disease

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Adequate vitamin D nutrition is associated with the prevention of rickets in children, and therefore, little thought is given about the consequences of vitamin D deficiency in adults. However, it is clear that vitamin D plays an important role in maintaining bone health from birth until death. Of equal importance is that vitamin D has a multitude of other biologic functions in the body that may be important for the prevention of common cancers, hypertension, as well as a host of other common maladies that afflict elders.

Unlike most fat soluble and water soluble vitamins that are plentiful in a healthy diet, very few foods naturally contain vitamin D. Consumption of oily fish, such as salmon or makerel, three to four times a week or ingestion of cod liver oil on a daily basis are two natural sources. Some foods such as milk, breads, cereals also are fortified with vitamin D. However, the vitamin D content in milk in the past has found to be highly variable, and in some cases, is absent. It is not appreciated that most of our vitamin D requirement (i.e., 80-100%, comes from our exposure to sunlight).

The body has a huge capacity to produce vitamin D_3. A person in a bathing suit exposed to sunlight or ultraviolet B radiation for an amount that would cause a light pinkness to the skin (1 minimal erythemal dose; 1 MED) will raise the blood levels of vitamin D_3 to the same degree as if the individual took between 10,000 and 25,000 IU of vitamin D. Anything that alters the amount of ultraviolet B radiation that penetrates into the skin will have a dramatic influence on the cutaneous production of vitamin D. Increase in skin pigmentation, use of sunscreens, increase in latitude, increase in the Zenith angle of the sun due to seasonal changes, and aging all dramatically influence the cutaneous production of vitamin D_3. The topical application of a sunscreen with an SPF of 8 will reduce the cutaneous production of vitamin D_3 by 97.5 percent.

Vitamin D deficiency is extremely common in the U.S. adult population. More than 50 percent of free-living and institutionalized elders have been reported to be vitamin D deficient. It has been assumed that young and middle-aged adults are not at risk for vitamin D deficiency. However, the lifestyle of the young and middle-aged adults is such that they are constantly working indoors, and when outdoors, they wear a sunscreen because of their concern of sun exposure and risk of skin cancer. A study in Boston reported that 32 percent of medical students and residents aged 18-29 years were vitamin D deficient at the end of the winter. The NHANES III study reported that 41 percent of African American women of child-bearing age (15-49 years) were found to be vitamin D deficient at the end of the winter.

Chronic vitamin D deficiency has subtle and insidious consequences for bone health, overall health, and for well-being for all adults and in particular elders. Vitamin D deficiency can precipitate and exacerbate osteoporosis due to the accompanying secondary hyperparathyroidism. Vitamin D deficiency also causes osteomalacia, which is often associated with muscle pain, weakness, bone pain, and increased risk of fracture.

Vitamin D is biologically inert and is metabolized in the liver to its major circulating form 25-hydroxyvitamin D [25(OH)D]. 25(OH)D is converted in the kidney to 1,25-dihydroxyvitamin D [1,25$(OH)_2$D]; this is responsible for regulating intestinal calcium absorption and stimulating osteoclastogenesis. Vitamin D receptors (VDR) are present in most tissues and immune cells in the body. 1,25$(OH)_2$D is one of the most potent inhibitors of cellular growth. In addition, 1,25$(OH)_2$D alters both activated T and B lymphocyte function. VDR is present in the kidney, and recently, it was demonstrated that 1,25$(OH)_2$D down regulates the renin/angiotension system.

It is now recognized that the kidney is not the sole source for the production of 1,25$(OH)_2$D. Many other organ systems, including colon, prostate, breast, and skin have the enzymatic machinery to produce 1,25$(OH)_2$D locally. This may be the explanation for why chronic vitamin D deficiency, often associated with living at higher latitudes, is associated with increased risk of dying from colon, prostate, breast, and ovarian cancer. Exposure to ultraviolet B radiation was effective in treating moderate hypertension. In animal models 1,25$(OH)_2$D, treatment was effective in preventing multiple sclerosis-like disease.

There is a great need to increase our awareness of vitamin D nutritional status and its health implications. The only method to determine vitamin D status is to measure circulating concentrations of 25(OH)D. Recently, the National Academy of Sciences has recommended that vitamin D intakes be increased for elders to 600 IU/day. However, in the absence of exposure to any sunlight, this is probably inadequate. It is now estimated that 1,000 IU of vitamin D a day is required to satisfy the body's needs and maintain circulating concentrations of 25(OH)D at least 20 ng/mL, which is thought to be important to maximize bone health and cellular health.

Research needs are: (1) to determine whether passive ultraviolet B irradiation is the most cost effective way to provide an adequate source of vitamin D for elders; (2) does aging affect the activity of the 25-hydroxy-1-hydroxylase in non-renal tissues? (3) a prospective study should be initiated to determine the impact of vitamin D supplementation on common cancers, hypertension, and diabetes mellitus.

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