J Med Biochem 2012; 31 (4) DOI: 10.2478/v10011-012-0031-z

UDK 577.1 : 61 **ISSN 1452-8258**

J Med Biochem 31: 263–264, 2012 *Editorial*

VITAMIN D: A D-LIGHTFUL SOLUTION FOR GOOD HEALTH

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Adequate vitamin D nutrition is associated with the prevention of rickets in children and therefore little thought is given to the consequences of vitamin D deficiency in adults. However, it is now becoming 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 significant for the prevention of common cancers, hypertension, type 1 diabetes, as well as a host of other common maladies that afflict elders (1–4).

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 mackerel, three to four times a week or ingestion of cod liver oil on a daily basis are natural sources as is UV irradiated mushrooms. Some foods in the US such as milk, orange juice and some breads and cereals and UV irradiated mushrooms are also fortified with vitamin D. However, the vitamin D content in milk in the past has been found to be highly variable and, in some cases, 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 D3. 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 D3 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, aging and covering the skin with clothing all dramatically influence the cutaneous production of vitamin D3. The topical application of a sunscreen with an SPF of 30 will reduce the cutaneous production of vitamin D3 by 95–99%.

Vitamin D deficiency is extremely common in children and adults worldwide. More than 50% 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% 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% of African American women of child bearing age (15–49 years) were found to be vitamin D deficient at the end of the winter. Recently a study from NHANES III revealed that 50 and 70% of children aged 1–5 years and 6–11 years were vitamin D insufficient.

Indeed vitamin D deficiency is not only common in the US, Canada and Europe but is a global health issue. Reports from Brazil, Australia, India, New Zealand, Middle East, Far East and Africa have documented that both children and adults are at high risk for vitamin D deficiency.

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

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)2D] that 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)2D is one of the most potent inhibitors of cellular growth. In addition, 1,25(OH)2D alters both activated T and B lymphocyte function and macrophage killing activity of TB. VDR is present in most tissues and cells in the body.

It is now recognized that the kidney is not the sole source for the production of 1,25(OH)2D. Many other organ systems, including the colon, prostate, breast, and skin, have the enzymatic machinery to produce 1,25(OH)2D 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)2D treatment was effective in preventing multiple sclerosis-like disease and type 1 diabetes. The observation that vitamin D supplementation of children resulted in a decreased risk of type 1 diabetes by 8% is noteworthy (7–10).

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. It is now estimated that 1,000 IU of vitamin D a day is required for children and 2,000 IU a day for adults to satisfy the body's needs and maintain circulating concentrations of 25(OH)D of at least 30 ng/mL, which is thought to be important to maximize bone health and cellular health.

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