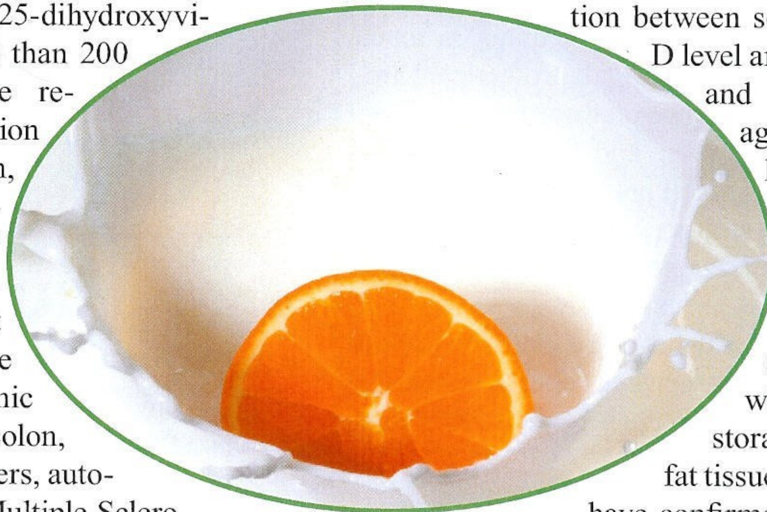
Vitamin D Deficiency: One More Health Consequence Associated With Obesity

By Sharon Lehrman, MPH, RD, LD

New research is emerging on the essential role Vitamin D plays in optimum health. A recent meta-analysis of 18 studies including almost 60,000 people found a 7% reduction in mortality in those who took daily vitamin D supplements in dosages ranging from 300-2000 IU (International Units). The mean daily dose was 528 IU.[1] In addition to healthy bone development and maintenance of bone mass, the active form of Vitamin D, 1,25-dihydroxyvitamin D, controls more than 200 genes, including those responsible for the regulation of cellular proliferation, differentiation, apoptosis, and angiogenesis.[2] Through these mechanisms, it appears that vitamin D may reduce the risk of many chronic illnesses including colon, prostate and breast cancers, autoimmune diseases like Multiple Sclerosis and Crohn's disease, diabetes and cardiovascular disease.[2] Dietary sources of vitamin D are limited to fatty fish and vitamin D-fortified foods. Historically, exposure to the sun used to give us all the vitamin D we needed.



Vitamin D deficiency is a lesser known potential health problem associated with obesity. Lumb et al first identified a relationship between body fat and vitamin D in 1971.[3] In 2000, Wortsman, et al, confirmed that, as a group, obese individuals have low plasma concentrations of 25-hydroxyvitamin D.[4] Several theories have been presented to explain the increased risk for vitamin D deficiency in obese people. These include the possible avoidance of sun exposure with clothing that exposes less skin to the sun, enhanced production of the active Vitamin D metabolite which would exert a negative feedback control on the hepatic synthesis of 25-hydroxyvitamin D, and increased metabolic clearance of vitamin D with enhanced uptake by adipose tissue. Wortsman, et al, studied 19 obese and non-obese women to assess whether obesity alters the cutaneous production of vitamin D or its intestinal absorption. They concluded that obesity-associated vitamin D insufficiency is most likely due to the decreased bioavailability of vitamin D from cutaneous and dietary sources because of its deposition in adipose tissue.

Arunabh, et al, came to a similar conclusion in their study of 410 healthy women with body masses ranging from 17-30 kg/m^2.[5] They analyzed the correlation between serum 25-hydroxyvitamin D level and percentage of body fat, and concluded that percentage of body fat is inversely related to the serum 25-hydroxyvitamin D. They suggested that the mechanism of variation is related to the availability of adipose tissue, which leads to excessive storage of the precursor in the fat tissue. Numerous other studies have confirmed this link between adiposity and vitamin D deficiency.[6-11] Additional studies have identified an inverse association between vitamin D status and diabetes[12] as well as the metabolic syndrome.[13]

The best indicator of vitamin D status is serum 25-hydroxyvitamin D. Controversy remains regarding the level representing deficiency and insufficiency. Historically, a level below 27.5 nmol/L was considered a risk factor for the development of rickets and osteomalacia. However the avoidance of long latency diseases such as cancer and diabetes may require levels as high as 80 nmol/L.[14] Additional research is needed to determine optimal levels. Several factors make it challenging to accurately measure for deficiency. Levels of this vitamin can vary greatly depending on the season, and the lowest levels are usually measured in February or March. Additionally, laboratories can use two different methods to measure 25-hydroxyvitamin D. The competitive protein binding assay often yields values 30% higher than the radioimmunoassay method.

Given these challenges and the likelihood of vita-

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min D deficiency in obese patients, it is important to review the vitamin D recommendations for at-risk patients. Sensible sun exposure can provide adequate vitamin D during the summer months. This would require the exposure of one's arms and legs without sunscreen for 10 to 30 minutes, depending on the time of day, season, and skin pigmentation. However, it is important to prevent sunburn to avoid the risk of skin cancer.

Eating fatty fish like salmon and sardines twice weekly provides both vitamin D and cardio-protective fish oils. However, dietary supplements of vitamin D3 (cholecalciferol) are recommended for most individuals in northern latitudes during the fall and winter months. Although the current Dietary Reference Intakes for Vitamin D are 400 IU from birth to 70 years, and 600 IU for those over age 71, researchers are calling for a change in these recommendations.[15] A minimum of 800 IU for children and adults allows for higher serum levels of the vitamin. Obese patients have higher needs and should take 1000-2000 IU/day to avoid deficiency.[2] If an obese patient is diagnosed with a deficiency, recommended treatment is 50,000 IU of vitamin D2 (ergocalciferol form) every week for 8-12 weeks, and repeated for another 8-12 weeks if the retesting result is <75nmol/L (30ng/ml).[2]

Vitamin D is emerging as a critical nutrient for many body processes. Counseling overweight and obese patients about ways to achieve adequate levels of this vitamin through responsible sun exposure, diet, and supplementation could be crucial for their long term health and longevity. ◙

Natural Sources	International Units
Cod Liver Oil, 1 tbsp	1,360
Salmon, 3.5 oz cooked	360
Sardines, 1.75 oz oil drained off	250
Tuna, 3 oz oil drained off	200
Egg yolk, large	20
Liver/Beef, 3.5 oz cooked	15
Fortified Foods	
Cow's Milk, 8 oz	100
Fortified Orange Juice, 8 oz	100
Fortified Margarine, 1 tbsp	60
Cereals, fortified with 10% DV (¾ - 1 cup)	40

Vitamin D in Foods
Source: NIH Clinical Center, Office of Dietary Supplements

About the Author

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