HYPOTHYROIDISM AND VITAMIN D DEFICIENCY: A REVIEW

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Introduction

Vitamin D (ergocalciferol-D 2 , cholecalciferol-D 3) is a steroid hormone produced in the skin when exposed to ultraviolet light or obtained from dietary sources like

- 1. Fatty Fish Like Salmon, Trout, and Mackerel
- 2. Canned Fish Like Tuna, Sardines, and Herring
- 3. Cod Liver Oil
- 4. Mushrooms
- 5. Eggs Structurally, ergocalciferol differs from cholecalciferol in that it possesses a double bond between C22 and C23 and has an additional methyl group at C24. Finally, ergocalciferol is pharmacologically less potent than cholecalciferol, which makes vitamin D3 the preferred agent for medical use.. The active form of cholecalciferol, 1,25-dihydroxycholecalciferol (calcitriol) plays an important role in maintaining blood calcium and phosphorus levels and mineralization of bone.

Daily requirements of v.D

Life Stage	Recommended Amount
Birth to 12 months	10 mcg (400 IU)
Children 1-13 years	15 mcg (600 IU)
Teens 14-18 years	15 mcg (600 IU)
Adults 19-70	15 mcg (600 IU)
Adults 71 years and older	20 mcg (800 IU)
Pregnant and breastfeeding women	15 mcg (600 IU)

Vitamin D “insufficiency” versus “deficiency

- The term “insufficiency” means a mild decrease and .“deficiency” means a greater decrease in vitamin D levels Normal vitamin D levels are a serum 25-hydroxy vitamin D – .level of 30 to 100 ng/mL Vitamin D insufficiency is defined as a serum 25-hydroxy – .vitamin D level of 21 to 29 ng/mL Vitamin D deficiency is defined as a serum 25-hydroxy – vitamin D level of 20

Cause of vitamin D deficiency:

- •Skin type: Darker skin, for example, and sunscreen, reduce the body's ability to absorb the ultraviolet radiation B (UVB) rays from the sun. •Sunscreen: A sunscreen with a sun protection factor (SPF) of 30 can reduce the body's ability to synthesize the vitamin by 95% or more •Covering the skin with clothing can inhibit vitamin D production also. •Geographical location: People who live in northern latitudes or areas of high pollution, work night shifts, or are homebound should aim to consume vitamin D from food sources whenever possible. •Breastfeeding: Infants who exclusively breastfeed need a vitamin D supplement, especially if they have dark skin or have minimal sun exposure. •Older adultsOlder adults are at increased risk of developing vitamin D insufficiency, partly because the skin's ability to synthesize vitamin D declines with age .

Vitamin D toxicity

- usually caused by large doses of vitamin D supplements — not by diet or sun exposure. That's because your body regulates the amount of vitamin D produced by sun exposure, and even fortified foods don't contain large amounts of vitamin DThe main consequence of vitamin D toxicity is a buildup of calcium in your blood (hypercalcemia), which can cause nausea and vomiting, weakness, and frequent urination.

Mechanism of vitamin D absorption

- The mechanism of absorption of nonhydroxylated species of vitamin D (i.e. vitamin D2 and vitamin D3) are suspected to be medicated by an unsaturable passive diffusion process. Furthermore, recent studies on human intestinal cell line CaCO2 (Caucasian colon adenocarcinoma) and HEK (Human embryonic kidney) transfected cells clearly demonstrated the intimacy of intestinal cell membrane protein in the absorption of these nonhydroxylated forms at the border side of the enterocytes. Absorption of cholesterol and other lipophilic compounds (tocopherol, carotenoids) is also facilitated by these proteins which are SR-BI (scavenge receptor class B type 1), CD 36 (cluster Determinant 36) and NPC1L1 (Neimann-Pick C1-Like 1).

Vitamin D has multiple roles in the body. It assists in:

- • promoting healthy bones and teeth • supporting immune, brain, and nervous system health • regulating insulin levels and supporting diabetes management • supporting lung function and cardiovascular health • influencing the expression of genes involved in cancer development

Vitamin D and Immune function :

- Vitamin D is critical for white blood cell production of antimicrobial compounds called cathelicidins. These compounds, found inside white blood cells, directly kill bacteria, viruses, and fungi, helping clear infections. On the flip side, vitamin D appears to have direct anti-inflammatory activity, potentially helping calm overactive immune responses. In the body, vitamin D acts to reduce “toll-like receptors” (TLRs). These receptors are a key part of the inflammatory process. By reducing TLRs, vitamin D reduces numerous inflammatory cell signaling molecules.

Mechanism of vitamin D in the immune system

- Increased immunity against antigens:macrophages showed that 25(OH)D is converted intracellularly to 1,25(OH)2D in response to the interaction of a Toll-like receptor with a bacterial antigen. This interaction activates the expression of genes for 1-α-hydroxylase and cathelicidin. This leads to an elevated production of cathelicidin, a bactericidal peptide, but only in the presence of 25(OH)D or 1,25(OH)2D. Cathelicidin is effective not only against bacteria, but also viruses such as herpes simplex and influenza. It also shows a dose–response effect of 25(OH)D in human serum. Serum containing higher levels of 25(OH) D (mean: 78 nmol/l) versus serum with lower 25(OH)D levels (mean: 22 nmol/l) increased cathelicidin gene expression by twofold.

Modulation of the immune response:

- There are two types of helper T cells, Th1 and Th2. Th2 cells are important for antibody-mediated immunity, while Th1 cells can react against ‘self’ proteins causing autoim- mune diseases . The 1,25(OH)2D directly inhibits the proliferation of Th1 cells and decreases their cytokine production . In murine models, if vitamin D is deficient or the vitamin D receptor (VDR) is absent, Th1 actions are more promi- nent . In vitro, treatment with 1,25(OH)2D inhibits the production of Th1 cells and promotes Th2 cell development . The overall effect of T cells is to increase self-tolerance .

Antigen-presenting cells

- The effects of vitamin D on macrophages have some similarities to those on dendritic cells. The 1,25(OH)2D promotes monocyte dif- ferentiation to macrophages and prevents them from producing inflammatory cytokines . By inhibiting antigen-presenting cells from produc- ing cytokines (specifically IL-2) that activate Th1 cells or stimulating their production of cytokines (IL-10) that inhibit Th1.The 1,25(OH)2D modulates the immune system to become more self-tolerant.

The association between low serum vitamin D and autoimmune thyroid diseases:

- Hashimoto thyroiditis patients have a high proportion of Th1 cells, which secrete the cytokine interferon gamma (IFN-γ) .the secretion of cytokines from Th17 is involved in the development of autoimmune thyroid disease.IF-γ and IF-17A mRNA expression is significantly higher in Hashimoto thyroiditis patients than in healthy controls. Interestingly, vitamin D plays an important role in regulating Th1, Th2, and Th17 cells, as well as the secretion of IFN-γ, IL-4, and IL-17 . These findings may explain why lower levels of vitamin D contribute to thyroid gland immune disorder.

Is vitamin D supplementation recommended for Hypothyroidism patients?

- Vitamin D supplementation has been characterized as beneficial for the primary prevention and management of some autoimmune diseases in humans . Considering the presented data about the association of vitamin D deficiency with Hypothyroidism pathogenesis, and the low cost and minimal side effects of vitamin D supplementation, screening for vitamin D deficiency and careful vitamin D supplementation with monthly monitoring of calcium and 25[OH]D levels, when required, may be recommended for patients with hypothyroidism.

Conclusions

- Vitamin D has important functions which include modulation of the innate and adaptive immune responses in addition to calcium and bone homeostasis. Vitamin D deficiency isprevalent in autoimmune disease. Cells of the immune system are capable of synthesizing and responding to vitamin D. patients with hypothyroidism present with lower vitamin D levels than healthy controls; deficiency of vitamin D was linked to the presence of antithyroid antibodies.The responding of Immune cells in autoimmune diseases to the ameliorative effects of vitamin D suggesting a beneficial effects of supplementing vitamin D for deficient individuals with autoimmune disease.