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IMPACT OF VITAMIN D LEVEL ON BONE MASS INTENSITY AND ITS RELATION WITH SUN EXPOSURE IN DIFFERENT AGE GROUPS- A REVIEW

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ABSTRACT

Vitamin D deficiency may be a risk factor for a range of diseases. However, the optimal strategies to achieve and maintain vitamin D adequacy (sun exposure, vitamin D supplementation or both) and whether sun exposure itself has benefits over and above initiating synthesis of vitamin D. It describes the interrelationship between sun exposure and vitamin D status, and the requirement of adequate vitamin D for bone health and for various other health conditions. Sunlight exposure is needed for cutaneous vitamin D production, but the efficiency of this production is complicated by many factors. Ensuring vitamin D adequacy while promoting sun-protection strategies, requires renewed attention to evaluating the adequacy of dietary and supplemental vitamin D". The vitamin D supplementation amounts necessary to support optimal health in older children and adolescents are less. Sunlight is important for vitamin D metabolism and, consequently, healthy bone development and growth. Children and adolescents should receive at least 400 IU of vitamin D daily, and children at risk for hypovitaminosis. D should be examined for serum levels of 25-hydroxyvitamin D. Bone density tests, also known as osteodensitometry measure the level of minerals in the bones (BMD for bone mineral density measurement). Basically, in these scans x-rays are used which provide information on their permeability in the bones. The more porous and weak the bones, the more rays pass between them. The amount of rays that pass, compared to the standard mass of the healthy bone of an adult, is given through the T-score. A T score greater than -1 is considered normal and a score between -1 and -2.5 is considered low.

KEYWORDS: Vitamin D, vitamin D deficiency, sun exposure, bone mass density and related age groups.

INTRODUCTION

Vitamin D is a hormone that can be generated in the skin upon ultraviolet light exposure or ingested through supplementation. Vitamin D deficiency may have numerous deleterious effects on health. Sun avoidance strategies should be avoided due to the unwanted health risks associated with hypovitaminosis D. UV exposure is the primary method of boosting serum vitamin D levels, which accounts for numerous health benefits. Latitude, season, skin color, and sun protection determine UV absorption and vitamin D production. Studies which shows in case of time of the day- UV exposure is highest between 10am and 4pm sun rays have less distance to cover, latitude- UV exposure is highest in areas on or near the equator, where UV rays have less distance to travel before reaching the ground, season- UV exposure is highest in spring and summer months because sun is at a higher angle increases UV ray intensity and in case of altitude- UV rays are more powerful at higher elevations because they have less distance to travel.

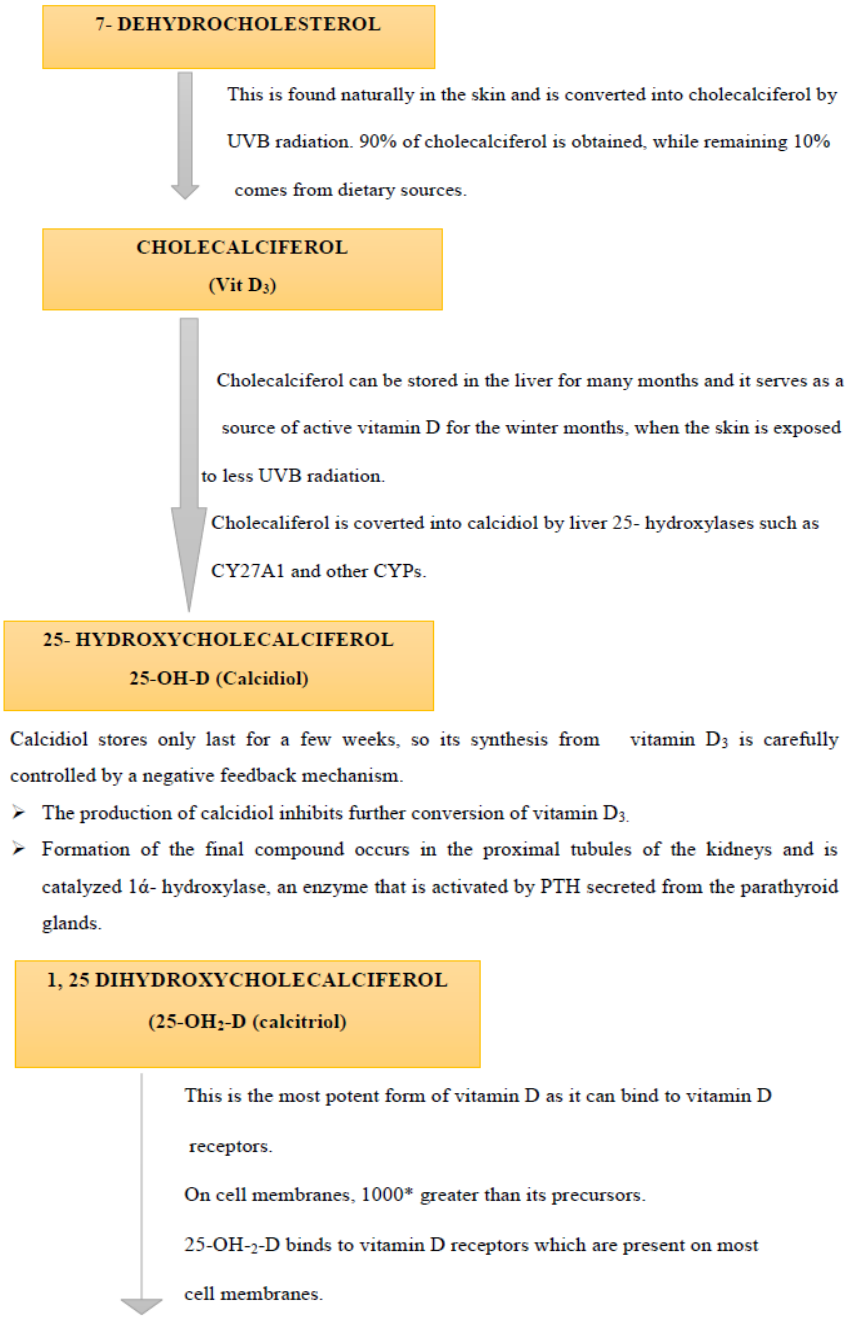
Bone density tests, also known as osteodensitometry measure the level of minerals in the bones (BMD for bone mineral density measurement). Basically, in these scans x-rays are used which provide information on their permeability in the bones. The more porous and weak the bones, the more rays pass between them. The amount of rays that pass, compared to the standard mass of the healthy bone of an adult, is given through the T-score. A T score greater than -1 is considered normal and a score between -1 and -2.5 is considered low.[1,2,3]

According to age groups - recommended sufficient intake of vitamin D supplementation
For children- 400IU (10mcg) upto 12 months
For adults- 600IU (15mcg) from 1- 70 year
For older adults – 800IU (20mcg) above 70 years.[4]

Vitamin D synthesis and mechanism of action

Vitamin D exerts its effects on bone and mineral metabolism mainly by altering the expressions of several genes in the small intestine, kidneys, parathyroid glands, and bone. Activation of VDR by 1, 25 (OH) 2D promotes intestinal calcium and phosphate absorption and renal tubular calcium reabsorption, which help maintain an adequate calcium−phosphate product that crystallizes in the collagen matrix in the bone. 25-hydroxyvitamin D (25(OH) D).[5]

Parathyroid hormone pulls calcium off bones to release into the blood and dumps phosphorus into the urine. On the other hand, hypervitaminosis D can lead to hypercalciuria and hypercalcemia, with weakness, headaches, confusion, and polyuria manifesting as some common symptoms. Such high amounts of vitamin D ingestion are needed to achieve hypervitaminosis D that toxicity is rare. This is due to the final regulatory mechanism the kidneys perform in hydroxylation Vitamin D asserts its effects by binding to the nuclear vitamin D receptor (VDR). These are distributed in most human tissues. In vitro within the epidermis, 1, 25 (OH) D acting through the VDR reduces the proliferation of keratinocytes and melanocytes and promotes differentiation and migration into the epidermis. VDR functions as a tumor suppressor, and a decrease in its expression is associated with an increase in malignant melanoma progression. CYP11A1 derivatives regulate skin functions through retinoic-acid orphan receptors (ROR) alpha and gamma expressed within the skin.[6,7.8]



- This forms a complex with the retinoid –X receptor, which then binds to vitamin D response elements on DNA to mainly increase, but sometime decreas gene expression.

- Increased intestinal absorption of calcium.
- Decreased renal excretion of calcium.
- Increased mineralization of bone through increased influx of calcium through osteoblastic / osteocytic cell membranes.

Fig. 1: Mechanism of vitamin D synthesis.

Impact of bone mass intensity test

Vitamin D levels are essential in the development of osteoporosis because vitamin D plays a key role in the absorption of calcium to develop bones. Low levels of vitamin D indicate a possible diagnosis of osteoporosis. Bone density tests, also known as osteodensitometry measure the level of minerals in the bones (BMD for bone mineral density measurement). This procedure uses a specialized x-ray technique called dual energy x-ray absorptiometry. Basically, in these scans x-rays are used which provide information on their permeability in the bones. The more porous and weak the bones, the more rays pass between them. The amount of rays that pass, compared to the standard mass of the healthy bone of an adult, is given through the T-score. A T score greater than -1 is considered normal and a score between -1 and -2.5 is considered low.[9]

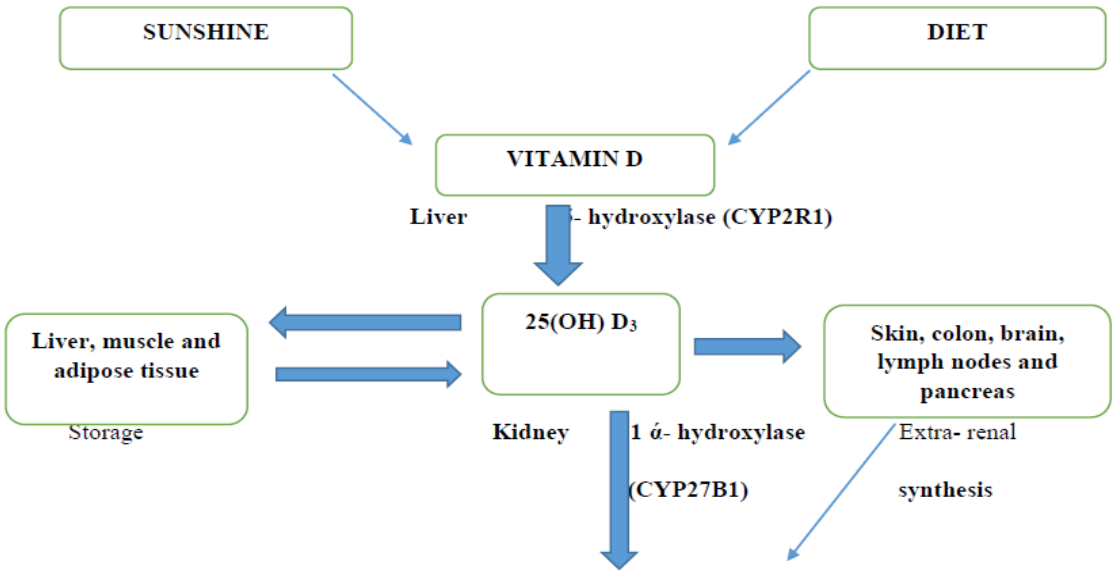
According to the World Health Organization, osteoporosis is defined based on the following bone density levels:

- A T-score within 1 SD (+1 or -1) of the young adult mean indicates normal bone density.
- A T-score of 1 to 2.5 SD below the young adult mean (-1 to -2.5 SD) indicates low bone mass.
- A T-score of 2.5 SD or more below the young adult mean (more than -2.5 SD) indicates the presence of osteoporosis.[10]

Benefits of sun protection and risks of sun exposure

There are multiple factors that can reduce vitamin D production. Skin color, qualitatively measured using the Fitzpatrick scale, may have detrimental effects of maintaining vitamin D production. As the Fitzpatrick type increases on the scale from I to VI, going from lighter skin to darker skin, vitamin D production decreases. This suggests that darker skin requires larger doses of UV radiation to generate the same amount of vitamin D that lighter skin generates. Higher melanin level, expressed in darker skin as compared to lighter skin, provides protection from UV radiation. Fitzpatrick scale types I and II have lower minimal erythema doses, the amount of UV radiation needed to induce sunburn, compared to types V and VI.[11,12] This allows higher amounts of UV penetration and higher amounts of vitamin D production for types I and II skin. However, it also increases the risk of developing skin cancer and other UV-induced dermatoses. Darkly pigmented groups of individuals may suffer from vitamin D deficiency due to melanin competing with 7-DHC for UV absorption. Individuals with lighter skin can generate >50 nmol/L of 25(OH)D from 30 minutes of sun exposure daily, but darker skin requires upwards of two hours of exposure to reach the same amount produced.[13,14,15]

VITAMIN D METABOLISM AND FUNCTIONS



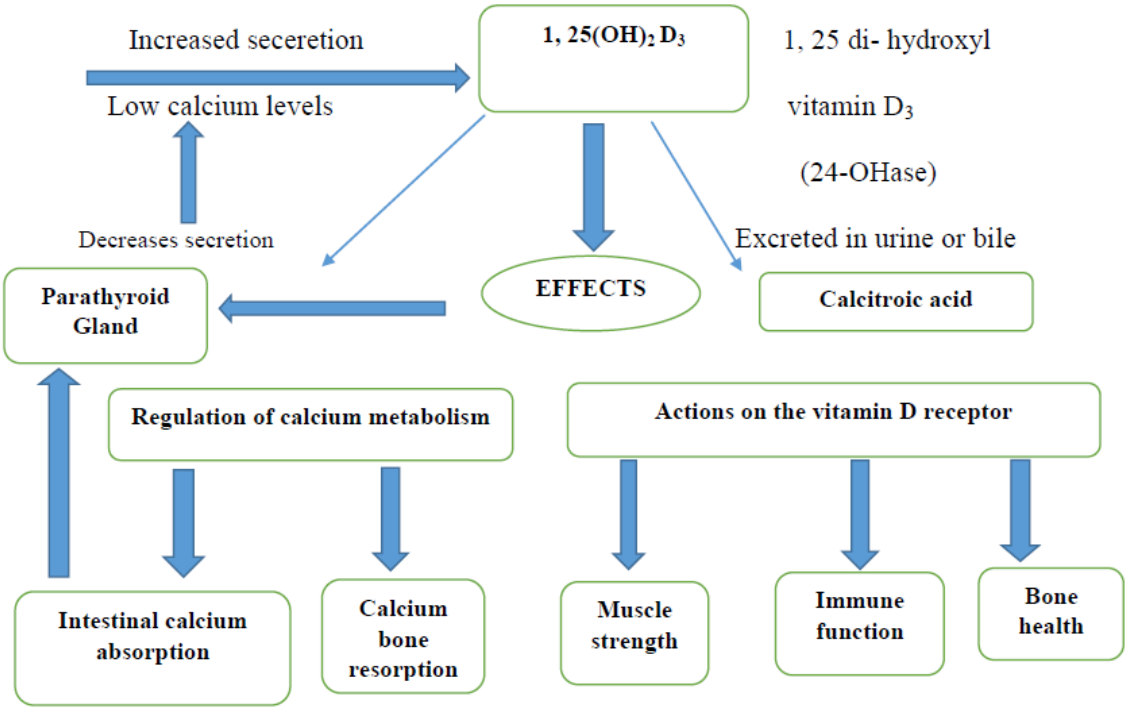


Fig. 2: Functions of vitamin D metabolism.

Recommendations

Specific recommendations for pediatrics include the following:

Sun-protection practices tend to wane in early childhood. Beginning at age 9 or 10 years, it may be helpful for pediatricians to discuss sun protection with children, together with parents, to encourage joint responsibility for the child's sun protection. Infants younger than 6 months should be kept out of direct sunlight and covered with protective clothing and hats. When sun avoidance is impossible, parents may apply sunscreen only on exposed areas. Absorption of sunscreen ingredients may be higher in preterm infants. Pediatricians should become familiar with chemical photosensitizing agents. People using these oral or topical agents should limit sun exposure and avoid all UVA from artificial sources. When sun exposure is inevitable, they should wear fully protective clothing and high SPF sunscreen that also blocks UVA wavelengths.[16,17]

Breast-fed and formula-fed infants and other children should receive vitamin D supplementation in accordance with guidelines, for a total intake of at least 400 IU of vitamin D daily. Children at risk for hypovitaminosis D may need laboratory testing of 25-hydroxyvitamin D concentration.

Pediatricians should advocate for adoption of sun-protective policies (eg, shaded playgrounds, outdoor time before 10 AM, and allowing hats at schools and child care facilities).

In addition to describing new evidence on the association of exposure to sun and artificial sources of UVR with skin cancer and other health risks, the report also highlights sun-protection methods, vitamin D, community skin cancer–prevention efforts, and the pediatrician's role in preventing skin cancer. Ensuring vitamin D adequacy while promoting sun-protection strategies, therefore, requires renewed attention to evaluating the adequacy of dietary and supplemental vitamin D. Daily intake of 400 IU of vitamin D will prevent vitamin D deficiency rickets in infants. The vitamin D supplementation amounts necessary to support optimal health in older children and adolescents are less.[18,19,20]

DISCUSSION

Our study shows vitamin D level is considered a key determinant for bone health. Vitamin D deficiency leads to lower BMD and osteoporosis. Several studies have shown higher serum 25(OH) D levels improve bone health and thus reduce the risk of osteoporosis and fragility fractures. Vitamin D deficiency cause an increase in parathyroid hormone secretion results in high bone turnover and increases bone resorption. In one study reported that vitamin D supplementation can delay bone mass in which vitamin D promotes calcium absorption and may have a positive effect on cortical bone mass density. In our study found that high vitamin D status has significant protective effects in case of elderly women aged >65 years. According to relationship between 25(OH) D levels and BMD changes in several studies in elderly men and women.[21,22]

CONCLUSION

Vitamin D insufficiency is common in children and adolescents according to bone mass intensity. Ensuring vitamin D adequacy while promoting sun-protection strategies, therefore, requires renewed attention to

evaluating the adequacy of dietary and supplemental vitamin D. Vitamin D supplementation amounts necessary to support optimal health in older children and adolescents are less. Sunlight is important for vitamin D metabolism and, consequently, healthy bone development and growth.[23] Children and adolescents should recommend at least 400 IU of vitamin D daily and children at risk for hypovitaminosis D should be examined for serum levels of 25-hydroxyvitamin D. Further studies are needed to define the optimal vitamin D dose and the potential beneficial skeletal effects and overall health benefits of vitamin D sufficiency varies in different age groups.[24,25]

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