Journal of Medical Sciences. 24 Sep, 2024 - Volume 12 | Issue 4. Electronic - ISSN: 2345-0592
Medical Sciences 2024 Vol. 12 (4), p. 80-84, https://doi.org/10.53453/ms.2024.9.10

e-ISSN: 2345-0592
Online issue
Indexed in *Index Copernicus*

Medical Sciences

Official website:
www.medicsciences.com

Vitamin D deficiency: literature review of a growing pandemic

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Abstract

Background. Many regions of the world have high rates of clinical vitamin D insufficiency, which can lead to rickets and osteomalacia. In Europe and Australasia, rickets is also becoming more common in children from ethnic minority groups. The measurement of 25OHD in plasma is a valuable indicator of clinical vitamin D insufficiency risk.

Aim. To conduct a literature research and review vitamin D deficiency symptoms, diagnostic methods and treatment options.

Methods. A literature review was performed using a computer bibliographic medical database PubMed. A search was performed using search keywords "vitamin D", "vitamin D deficiency", "vitamin D insufficiency", "vitamin D hypovitaminosis".

Results. A 25(OH)D concentration of less than 50 nmol/L, or 20 ng/mL, is generally accepted to be indicative of a vitamin D deficiency. Vitamin D deficiency manifests as painful bones, muscle weakness, cramps and spasms, slowed growth and development in children. Adults experience osteopenia, osteoporosis, and an increased risk of fracture.

Conclusion. Both skeletal and non-skeletal health depend on vitamin D. It is generally known that a large number of individuals do not get as much vitamin D as is currently advised for good health. The main symptoms of vitamin D are muscle weakness, cramps, slow growth and development in children. Adults can experience osteoporosis, increased risk of fracture, muscle weakness. It is widely acknowledged that a 25(OH)D concentration of less than 50 nmol/L, or 20 ng/mL, indicates a vitamin D deficit. Vitamin D supplements should be taken as a precaution.

Keywords: vitamin D, deficiency, avitaminosis, hypovitaminosis.

1. Introduction

Metabolites of vitamin D (alphacaldidol, calcitriol, calcifediol) and cholecalciferol (vitamin D3). Cholecalciferol is the natural form of vitamin D that humans have received throughout the evolution period, clear details of its metabolism, regulation, storage are known processes – it is easily absorbed by the body and converted into an active form or stored in fatty tissue and released according to the need.

Cholecalciferol is the drug of first choice and the main one for the prevention and treatment of deficiency in the everyday patient (for children and adults) [1,2]. Alfacalcidol and calcifediol are second-line agents suitable for specific patients (alfacalcidol for those with kidney failure, calcifediol for those with liver and intestinal disorders (malabsorption), but when prescribing second-choice preparations, attention should be paid to safety measures: periodically monitor calcium and phosphorus levels in the serum, alkaline phosphatase activity, and despite a possible faster effect [3] they are also associated with more frequent hypercalcemia and in cases of overdose.

2. Methodology

A literature review was performed using a computer bibliographic medical database PubMed. A search was performed using search keywords "Vitamin D", "vitamin D deficiency", "vitamin D insufficiency", "vitamin D hypovitaminosis".

Publications, not older than 10 years, written in English were analysed. A total of 49 publications were reviewed, of which 25 publications were included based on the inclusion/exclusion criteria.

3. Results

3.1 Sources of Vitamin D

For the majority of people, exposure to sunlight is the primary source of vitamin D [4,5,6,7]. The two primary forms of vitamin D are D3 (cholecalciferol) and D2 (ergocalciferol). Apart from the D3 and D2 forms of vitamin D, 25-hydroxy vitamin D also makes a substantial contribution to the amount of vitamin D that is consumed by food. It is present in a lot of goods derived from animals. Dietary supplements may include 25-hydroxy vitamin D, a metabolite of vitamin D, or vitamin D3 or D2 forms. Vitamin D (D refers to D3 and/or D2) is contained in relatively few foods (> 4 μg/100 g). Examples of such foods include a variety of fish (5–25 μg/100 g), some mushrooms (21.1–58.7 μg/100 g), Reindeer lichen (87 μg/100 g), and fish liver oils (250 μg/100 g) [7,8]. Vitamin D supplements are typically advised since it is difficult to meet the European Food Safety Authority's recommended daily intake of 15 μg of vitamin D by diet alone.

3.2 Presentation of Vitamin D insufficiency

There is a lot of disagreement on what constitutes a vitamin D deficit. A 25(OH)D concentration of less than 50 nmol/L, or 20 ng/mL, is generally accepted to be indicative of vitamin D deficiency; a value of 51–74 nmol/L, or 21–29 ng/mL, is thought to suggest insufficiency; amounts greater than 30 ng/mL are seen to be sufficient [9,10,11].

Children who are deficient in vitamin D will experience growth retardation [13] as well as the typical rickets symptoms [6,13,14] such as painful bones, muscle weakness, cramps and spasms, slowed growth and development.

Adults with low vitamin D levels will experience osteopenia, osteoporosis, and an increased risk of fracture [15,16]. Vitamin D insufficiency has long been linked to muscle weakness. Skeletal muscle contains a vitamin D receptor [17]. A lack of vitamin D has been linked to proximal muscle weakening, an increase in body sway, and a higher risk of falling [18,19].

3.3 Vitamin D intoxication

It normally takes 25(OH)D values of >375 nmol/L, or 150 ng/mL, to cause vitamin D intoxication [12]. The initial indication of excessive vitamin D intake is hypercalciuria, which is followed over time by hypercalcemia, which is linked to severe and protracted morbidity [8].

Patients with Vitamin D intoxication typically have high serum 25OHD, low serum parathyroid hormone (PTH), hypercalcemia, normal or high serum phosphorus levels, normal or low levels of alkaline phosphatase (ALP), and high urine calcium/creatinine [20].

The correction of hypercalcemia is the primary objective of treatment for vitamin D intoxication. Emergency action is required when the calcium concentration is more than 14 mg/dl due to the negative effects of hypercalcemia on the heart, central nervous system, kidneys, and gastrointestinal tract. Even if the external supply of vitamin D is removed, the consequences of toxicity may persist for months because vitamin D is retained in fat tissues. The following are some of the treatments for VDI: stopping the medication, eating a diet low in calcium and phosphorus, intravenous saline hydration, loop diuretics, glucocorticoids, calcitonin, and bisphosphonates [20,21].

3.4 Vitamin D deficiency correction

The American Academy of Pediatrics and the Institute of Medicine recommended that adults and children under the age of 50 should consume 200 IU of vitamin D per day, while people over the age of 70 and those over the age of 51 should have 400 and 600 IU of vitamin D per day [22]. As of late, the National Osteoporosis Foundation advised all postmenopausal women to consume 800–1000 IU of vitamin D per day [23].

Many specialists now concur that adults and children of all ages require 800–1000 IU of vitamin D per day in the absence of sufficient sun exposure [23,24,25]. Pludowski et al suggests daily dosage of 800–2000 IU of vitamin D for adults who wish to guarantee adequate vitamin D status; for some groups, such as patients with obesity and malabsorption syndromes, as well as those with dark skin pigmentation, the recommended daily dosage may be as high as 4000 IU [26].

4. Conclusions

Both skeletal and non-skeletal health depend on vitamin D. It is now generally known that a large number of individuals do not get as much vitamin D as is currently advised for good health. The two main ways that people get vitamin D in the world are by sun exposure (UVB radiation) and cutaneous vitamin D production.

Even in nations with plenty of sunshine, primary insufficiency is very common when skin exposure to UVB radiation is restricted due to lifestyle choices and other factors. In populations with very low calcium intakes or other circumstances, such as underlying disease, that may raise the biological requirement for vitamin D, secondary insufficiency may also be common.

Despite limitations brought about by a lack of methodological uniformity, plasma 25OHD at concentrations <25 nmol/L (10 ng/mL) is an effective indication of the risk of clinical deficiency. The symptoms of the insufficiency can vary from muscle weakness and cramps to growth deficiency in children, and increased fracture risk or osteoporosis in adults.

When vitamin D deficiency is found treatments should be prescribed. Crrection doses range from 800 IU to 4000 IU per day. The dose depends on the severity of the deficiency and on the underlying conditions the patient has.

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