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1. Introduction

Vitamin D (VD) is a unique bio-regulatory molecule as it can be synthesized in the skin in addition to its dietary sources [1, 2]. The well-studied function of VD is associated with its ability to regulate metabolic processes in skeletal tissue by affecting mineralization, maintaining a balance between the formation and resorption of bone tissue, thereby contributing to the prevention of osteoporosis and the occurrence of fractures [1–3].

VD comes in two major forms, D$_2$ and D$_3$, with D$_3$ being the most prominent. Both forms can be sourced from food, D$_2$ from plants and mushrooms while D$_3$ can be found in fish oil [2–4]. However, the majority of the body’s VD is synthesized de novo in the skin after exposure to ultraviolet B radiation such as sunlight [2, 5].

Earlier studies have suggested that a serum level of VD should range around 40–60 ng/l lowers the risks of developing different diseases, as well as an all-cause lower mortality [1, 2]. A daily intake or production of 4000–6000 international units is required to sustain these levels [2]. While it is possible to produce the required levels of VD through 2 times in a week sun exposure for 10–30 minutes, many patients are unable to produce that much because of issues related to the environment, health and socioeconomic reasons [1, 2].

That is why, it is recommended for healthy adults at risk for VD deficiency to supplement with 1500–2000 IU with an upper limit of 10.000 IU a day orally [1, 2]. A correlation between very low VD$_3$ levels and numerous diseases and a correlation between an impact of VD levels and normal functioning of the whole organism have well-established [1].

2. COVID-19 era and Vitamin D deficiency

VD is postulated to impact innate and adaptive immunological responses [6]. Low concentrations of VD are associated to elevated autoimmunity and increased susceptibility to virus diseases [6, 7]. The implication of VD in the protective mechanisms against respiratory tract infections by COVID-19 has been reported [7]. VD produces anti-microbial peptides secretion, especially cathelicidins and defensins, thereby resulting in the replication rate of viruses and pro-inflammatory cytokines levels. Supplementation of VD in patients with COVID-19 for treatment has been made in human studies [6, 7]. Beneficial effects of VD to protect the incidence of influenza A are associated with very low VD levels due to lack of sunlight exposure [7]. VD might
help in preventing influenza by preventing a cytokine storm in the influenza state, reducing the production of IL-1 and IL-6 [7, 8]. Recently, low VD levels are linked with elevated IL-6 levels in patients with the human immunodeficiency virus disease [9].

As mentioned, VD has multiple effects on the immune system. Many studies have therefore looked into whether VD status and VD supplementation could lower the risk of contracting acute respiratory infections in general, also in some another pandemic like COVID-19 in the future.

3. Summary

Overall, VD deficiency might affect the treatment response and remission rate in different population with numerous disorders. We do not exactly know the precise mechanisms how VD deficiency might implicate in many disorders. However, we must take into account that patients with VD deficiency can be resistant to available therapeutic options, which poses a major therapeutic challenge to health experts. Thus, it is possible to suggest that VD deficiency is likely a driving factor for the development of a whole number of severe diseases.

The following recommendations can be made:

1. Each individual with VD deficiency is a unique case and needs detailed evaluation to identify the prior drug response and make a correct diagnosis.

2. Assessment of risk factors for different disorders in patients with VD deficiency is equally important to guide health professionals in tailoring an appropriate management plan for such patients.

3. There are a wide variety of options for the treatment of VD deficiency; therefore, every therapeutic paradigm needs to be utilized when helping patients with VD deficiency.

4. In light of the demonstrated importance of truly adequate VD levels to the long-term outcomes of various disorders, further randomized clinical trials involving newer drugs and therapies are needed in the future.

New technologies might offer ways to treat patients with various disorders in a association with VD deficiency more effectively.
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References


