

Covid-19 Pandemic: Viral Infections and Vitamin D

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Introduction

Vitamin D is a steroid hormone, produced endogenously with the effect of ultraviolet radiation on the skin or available from exogenous food sources or dietary supplements. Vitamin D insufficiency is a public health problem affecting over a billion people across all life stages worldwide. In the past decade, several studies demonstrated a potential link between vitamin D deficiency and various diseases, including systemic infection. Vitamin D insufficiency affects the immune functions as vitamin D exerts an immunomodulation role, increasing innate immunity by secretion of antiviral peptides, which improves mucosal defenses [1]. In clinical studies, low levels of serum vitamin D were associated with acute respiratory tract infections including epidemic influenza.

The outbreak and fast spreading of SARS-CoV-2 are a global health threat with an unstable outcome worldwide. A recent data reported the antiviral effects of vitamin D, which can hinder viral replication directly, and also be effective in an anti-inflammatory and immunomodulatory way. It seems that SARS-CoV-2 primarily uses the immune evasion process during infection, which is followed by hyper reaction and cytokine storm in some patients, as a known pathogenic process of acute respiratory disease syndrome (ARDS) development [2]. SARS-CoV-2 uses angiotensin-converting enzyme 2 as the host receptor to enter into alveolar and intestinal epithelial cells. Subsequent dysregulation of the renin-angiotensin system may lead to excess cytokine production resulting in prospective fatal ARDS.

Considering the differences in the severity and fatality of COVID-19 in the globe, it is important to understand the reasons behind it. Improvement of immunity through better nutrition might be a considerable factor. The nutrient such as vitamin D shows significant roles in immune function. However, little is known about the role of vitamin D in preventing COVID-19 infection and fatality. This study evaluated the correlation of vitamin D concentrations with COVID-19 cases and deaths per one million of the population in 20 European countries using data from the COVID-19 pandemic data portal for 20 May 2020 (most countries after peak). This review also discussed the possible preventing role of vitamin D in acute respiratory tract infections [3]. Furthermore, the available studies that determined the role of vitamin D in COVID-19 severity and mortality have been discussed. PubMed, Google Scholar, Web of Science, Scopus, **Cochrane Central Register** of Controlled Trials, and medRxiv were searched for relevant literature about the role of vitamin D in COVID-19 infections, severity, and mortality.

Vitamin D and mechanisms to decrease viral infections

Some recent reviews demonstrated some pathways by which vitamin D decreases the risk of microbial infections. Vitamin D follows different mechanisms in reducing the risk of viral infection and mortality. To reduce the risk of common cold, vitamin D uses three pathways: physical barrier, cellular natural immunity, and adaptive immunity [4]. A recent review also supported the possible role of vitamin D in decreasing the risk of COVID-19 infections and mortality. These comprise maintaining of cell junctions, and gap junctions, increasing cellular immunity by decreasing the cytokine storm with

influence on interferon γ and tumor necrosis factor α and regulating adaptive immunity through inhibiting T helper cell type 1 responses and stimulating of T cells induction. Vitamin D supplementation was also found to enhance CD4+ T cell count in HIV infection.

One of the major manifestations of severe SARS-CoV-2 infection is lymphopenia. In both the mouse models and in human cell lines, vitamin D exerted activity in lung tissue and played protective effects on experimental interstitial pneumonitis. Several *in vitro* studies demonstrated that vitamin D plays a significant role in local "respiratory homeostasis" either by stimulating the exhibition of antimicrobial peptides or by directly interfering with the replication of respiratory viruses. Vitamin D insufficiency can, therefore, be involved in ARDS and heart failure and these are the manifestations of severely ill COVID-19 subjects [5]. Therefore, vitamin D deficiency promotes the renin-angiotensin system (RAS), which may lead to chronic cardiovascular disease (CVD) and reduced lung function. Although, many studies supported the immunomodulatory characteristics of vitamin D and its significant role in the maintenance of immune homeostasis; well-designed randomized controlled trials are required to elucidate the plausible role of vitamin D in protective immune responses against respiratory microbes and in preventing various types of acute respiratory tract infections.

The relevance of vitamin D to COVID-19

Yet, it is important to fully elucidate the virulence mechanisms of COVID-19, several cellular mechanisms including Papain-like protease (PLpro)-mediated replication, dipeptidyl peptidase-4 receptor (DPP-4/CD26) binding, disruption of M-protein mediated type-1 IFN induction and MDA5 and RIG-I host-recognition evasion have been recognized in the closely-related COVID-MERS virus. Of the above processes, human DPP-4/CD26 has been exhibited to connect with the S1 domain of the COVID-19 spike glycoprotein, suggesting that it could also be a salient virulence factor in Covid-19 infection. The expression of the DPP-4/CD26 receptor is reduced significantly *in vivo* upon the correctness of vitamin D insufficiency [6]. There is also an indication that maintaining of vitamin D may reduce some of the unfavorable downstream immunological sequelae thought to extract poorer clinical outcome in Covid-19 infection, such as interleukin 6 elevation, delayed interferon-gamma response, and, a negative prognostic marker in subjects with acutely-ill pneumonia, including those having Covid-19.

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Epidemiological and clinical observations regarding COVID-19

Some clinical and epidemiological studies support to outline the hypothesis regarding COVID-19 and its relationship with vitamin D status. Recent studies indicated that COVID-19 is associated with the increased generation of pro-inflammatory cytokines, C-reactive protein (CRP), ARDS, pneumonia, and heart failure. In China, chronic fatality rates were 6-10% for people with chronic respiratory tract disease, cardiovascular disease, hypertension, and diabetes [7]. In other studies, serum concentrations of 25(OH) D were inversely associated with pro-inflammatory cytokines, IL-6, increased CRP, and increased risk of pneumonia, ARDS, diabetes and heart failure. In randomized control trials, vitamin D supplementation has been shown to reduce the risk of respiratory diseases. A placebo-controlled trial with 5660 subjects showed that vitamin D supplementation significantly reduces the risk of respiratory tract infections. A review included five clinical studies reported that respiratory tract infections were significantly lower in the vitamin D supplementation group than the control group [8]. Another study included 25 randomized controlled trials, with 10,933 participants in total from 14 different countries indicated the beneficial effects of vitamin D supplementation in reducing the risk of at least one acute respiratory tract infection.

References

1. M.F. Holick (2017) The vitamin D deficiency pandemic: approaches for diagnosis, treatment and prevention. *Rev Endocrine Metab Disord* 18: 153-165.
2. W. Dankers, E.M. Colin, J.P. van Hamburg, E. Lubberts (2017) Vitamin D in autoimmunity: molecular mechanisms and therapeutic potential. *Front Immunol* 7: 697-702.
3. M. Infante, C. Ricordi, J. Sanchez, M.J. Clare Salzler, N. Padilla et al. (2019) Influence of vitamin d on islet autoimmunity and beta-cell function in type 1 diabetes. *Nutrients* 11:2185-2190.
4. R. Bouillon, C. Marcocci, G. Carmeliet, D. Bikle, J.H. White et al. (2019) Skeletal and extraskelatal actions of vitamin D: current evidence and outstanding questions. *Endocrine Rev* 40: 1109-1152.
5. C.L. Greiller, A.R. Martineau (2015) Modulation of the immune response to respiratory viruses by vitamin D. *Nutrients* 7: 4240-4270.
6. A.F. Gombart, N. Borregaard, H.P. Koeffler (2005) Human cathelicidin antimicrobial peptide (CAMP) gene is a direct target of the vitamin D receptor and is strongly up-regulated in myeloid cells by 1,25-dihydroxyvitamin D3. *FASEB J* 19: 1067-1077.
7. T. Wang, B. Dabbas, D. Laperriere, A.J. Bitton, H. Soualhiine et al. (2010) Direct and indirect induction by 1,25-dihydroxyvitamin D3 of the NOD2/CARD15-defensin β 2 innate immune pathway defective in Crohn disease. *J Biol Chem* 285: 2227-2231.
8. J.J. Cannell, R. Vieth, J.C. Umhau, M.F. Holick, W.B. Grant et al. (2006) Epidemic influenza and vitamin D. *Epidemiol Infect* 134: 1129-1140.