

Impact and role of vitamins as immunonutrition in children during COVID-19 pandemic

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Key message

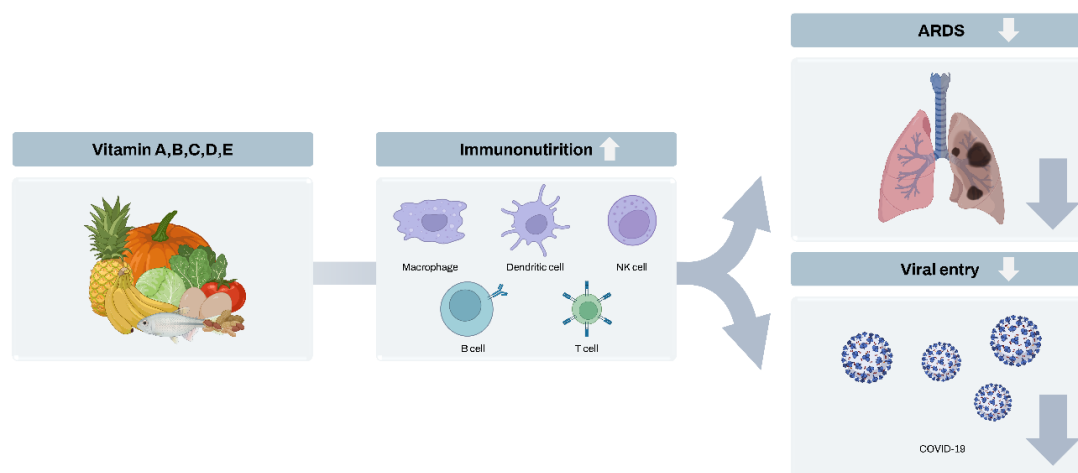
- Vitamins have effector mechanisms in the innate and adaptive immune systems and potential roles in preventing and reducing the severity of coronavirus disease 2019 (COVID-19).
- Vitamins may be immunonutrients in the treatment of COVID-19 infections and prevention of patient deterioration due to critical illness, thus demonstrating the significance of a nutritious, well-balanced diet.

Introduction

Numerous clinical trials are currently evaluating treatment options for coronavirus disease 2019 (COVID-19), a disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Under circumstances in which treatment and vaccination efficacy have not been established, especially in children, it is important that individuals maintain good hygiene, wash their hands, and wear face masks. Another notable factor that prevents such viral infections is enhanced immunity; only robust immunity can overcome any virus and ensure an individual's continued

health. Immunonutrition, a method of therapy that provides specific nutrients that benefit the immune system and other bodily functions, is a novel method of increasing one's immunity.¹⁾

The role of optimal nutrition in managing COVID-19 infection cannot be underestimated. Several nutritional therapies are currently in trial or clinical use to reduce the mortality associated with acute respiratory disease in patients with COVID-19. An optimally functioning immune system is closely linked to an adequate micronutrient supply. Severe deficiencies of these micronutrients impair the immune response and increase one's vulnerability to infections.²⁾ Vitamins, even in small amounts, enable cell metabolism, which is essential for an individual's growth and maintenance. Vitamins protect the body against various respiratory viral infections. Vitamin A reduces the production of proinflammatory cytokines such as tumor necrosis factor (TNF)-alpha and interleukin (IL)-6, whose secretions increase during viral infections.³⁾ Vitamin C also enhances antiviral and virucidal activities and interferon production and acts as an effector in the innate and adaptive immune systems. Since its first synthesis in 1933, vitamin C has been widely used as an adjuvant treatment for respiratory infections.⁴⁾ Similarly, vitamin



Graphical abstract. ARDS, acute respiratory distress syndrome; COVID 19, coronavirus disease 2019; NK, natural killer.

D promotes monocyte differentiation into macrophages, which destroy respiratory viral pathogens; its metabolites also act upon respiratory viruses by regulating the formation of certain antimicrobial proteins.⁵⁾ Here we discuss the roles of vitamins in immunonutrition during the ongoing COVID-19 pandemic.

Vitamin A

Retinoic acid and carotenoids heighten T-cell function, thereby enhancing the adaptive immune response in cases of invasion by external pathogens such as SARS-CoV-2 and act as antioxidants to decrease the production of reactive oxygen species. Moreover, retinoids stimulate the secretion of macrophage-induced IL-1 and IL receptor antagonists in the alveoli by pulmonary neutrophils. This role of vitamin A prevents the progression of the pathogenesis that leads to acute respiratory distress syndrome, a detrimental complication seen in COVID-19 patients.³⁾

Vitamin B

Vitamin B acts synergistically with ascorbic acid to reduce anaerobic respiration and oxidative stress. This combination may improve mortality and organ recovery in critically ill patients with septic shock through vasoactive effects, bacteriostatic actions, and immune cell mediation.³⁾

Vitamin C

Vitamin C inhibits the production of the inflammatory cytokines that influence the critical phase of COVID-19 infection, such as TNF, IL-1, IL-8, and intercellular adhesion molecule-1. By decreasing reactive oxidative species and inhibiting nuclear factor kappa B, it also hinders neutrophil extracellular trap formation. Moreover, it prevents the progression of oxidative injury to the pulmonary endothelium and suppresses inflammation in the lungs.^{4,6)}

Vitamin D

SARS-CoV-2 enters host cells via the endosomal pathway through the angiotensin converting enzyme 2 (ACE2)–spike protein interaction, which triggers the endocytosis of viral particles via internalization with ACE2.⁷⁾ Vitamin D binds the viral S1 spike protein to ACE2. Such interactions cause translocation of the virus and enzyme into the cell through endocytosis, thereby reducing ACE2 surface expression and possibly contributing to pulmonary disease progression. It also mediates the immune response to infective agents by enhancing regulatory T and Th2 cell functions and attenuating cytokine storm, presumably the key pathogenic mechanism of acute respiratory distress syn-

drome.⁵⁾

In a cross-sectional analytical study of children infected with COVID-19 aged 1 month to 13 years, a statistically significant increase in vitamin D deficiency was observed in COVID-19 patients and in those with high severity.⁸⁾ Maintaining a high vitamin D level may effectively manage COVID-19 infection and minimize its severity; however, further pediatric randomized controlled trials are necessary to confirm this hypothesis.

Vitamin E

In COVID-19 patients, the oxidant-antioxidant balance is severely altered, resulting in excessive lipid peroxidation and biological membrane failure. Diffuse alveolar damage, hyaline membrane formation, and pulmonary edema are the pathological outcomes exhibited in the most severely affected patients.⁹⁾ Vitamin E acts on the adaptive immune system to inhibit such series of processes caused by COVID-19, reducing its severity.⁹⁾

The World Health Organization recommends the following for feeding babies and young children during the COVID-19 outbreak: breastfeeding exclusively; providing fresh and unprocessed food; ensuring adequate consumption of water and healthy fats; limiting salt and sugar intake; and cooking at home.¹⁰⁾

Vitamins have effector mechanisms in the innate and adaptive immune systems; thus, they have a provable role in the prevention and treatment of COVID-19 infection. Based on copious evidence supporting immunonutrition, it is essential that individuals maintain a healthy diet containing well-balanced vitamins by consuming fresh animal- and plant-based foods.

Footnotes

Conflict of interests: No potential conflict of interest relevant to this article was reported.

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