Nutritional Strategies to Boost Immunity Against SARS-CoV-2

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Abstract

Currently, SARS-CoV-2 is a major and continuing global threat. The epidemic started firstly in Wuhan city of China and then spread rapidly to other provinces of the republic, leading to a span of more than two-thirds of countries worldwide. After the rapid onset, the WHO declared COVID-19 to be a worldwide pandemic. Its transmission is through air droplets via breathing or interaction with infected individuals. The latent period of the disease varies from two to fourteen days. Individuals with compromised and damaged immune systems and other heart and respiratory disorders are more vulnerable to septicity and are at risk of serious illness or even death. Typically, symptoms of the virus are fever, cough, sore throat, breathlessness, exhaustion, and much more. To reinforce gastrointestinal and respiratory tract infections and strengthen the immune system, the common food plants used may substantially affect the health of a COVID-19-infected patient. As per the consequences, a great number of people are limited to their homes, hence, the incorporation of these readily obtainable plants in the day-to-day nutrition will help to maintain the immune responses to fight against SARS-CoV-2 infection.

Keywords: SARS-CoV-2, Pandemic, Immune system, Nutrition, Antibacterial

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Introduction

This disease is different from anything I've seen before. You're probably in real trouble if you end up in the ICU. I've never seen such a thing before (van Sleeuwen, van de Laar, et al., 2020). Such phrases were written by a medical aid doctor who works at a teaching hospital in London after the initial encounter of the general public with the deadly coronavirus in 2020 (Harris, Jenkinson et al., 2021). Coronavirus is a broad positive-spectrum family of single-stranded RNA viruses that primarily cause infection of the lung and stomach tract and are genetically categorized into 4 main genera: alpha, beta, gamma, and delta coronaviruses. In the first instance, China announced a group of cases of unexplained causes of pneumonia on December 31st, 2019 (RAM 2020). The Chinese authorities described a new form of coronavirus (formerly named novel coronavirus, now it is SARS-CoV-2), which was isolated on January 7th, 2020. The virus spread aggressively around the globe, causing novelties (Khan, Adil et al., 2020). As of December 9th, 2020, 67.7M established cases and 14,509 expiries have been reported worldwide of COVID-19 as shown in Figures 1a and 1b. The outbreak was found to be associated with a wide market for seafood and livestock, especially bats. On January 20th, 2020, in Snohomish County (Holshue et al., 2020), Washington, the first individual was infected with COVID-19 as he had recently traveled back to his hometown from Wuhan, China. In Pakistan, the first case of COVID-19 was confirmed at the University of Karachi, Sindh, on February 26th, 2020. Of the various human-pathogenic coronaviruses, most are associated with moderate clinical symptoms ranging from asymptomatic to acute syndrome of respiratory disorder and multi-organ dysfunction. Fever, cough, raw throat, conjunctivitis, exhaustion, headache, myalgia, and shortness of breath are typical characteristics. Coronaviruses that occurred previously: Severe Acute Respiratory Syndrome (SARS-CoV) and Middle East Respiratory Syndrome (MERS) both belong to the beta coronavirus genera. In Guangdong, southern China, SARS-CoV appeared in November 2002, resulting in more than 8,000 human infections and recorded deaths including 774 in almost 37 countries during 2002-03 while MERS coronavirus, also of bat origin, first occurred as the intermediate host in Saudi Arabia with dromedary camels, with 2494 individuals causing 858 deaths (RAM 2020).

Current Treatment Options

During the COVID-19 pandemic, the FDA has approved many medications, including Remdesivir, which acts as an antiviral, Dexamethasone, and Bamlanivimab, intended to obstruct the SARS-CoV-2 infection from entering and contaminating human cells, but all these medicines are limited to patients 12 years or older (Gicheva Pepovska 2023). Other treatments recommended by NIH against COVID-19 were Hydroxychloroquine, Azithromycin, and Actemra, but these medicines have not proved to be so effective and are so costly to use daily. On the other hand, intake of Hydroxychloroquine may lead to a large number of cardiac events, neuropsychiatric and metabolic manifestations, gastrointestinal symptoms, abdominal pain, headache, and dizziness (Doyno, Sobieraj, et al., 2021). While some of the side effects of Actemra used by COVID-19 patients are categorized into:

1. Common side effects include diseases of the respiratory tract, migraine, and hypertension.
2. Reactions at the site of infusion that are rash, redness, inflammation, and tingling.

3. Severe disease related to tuberculosis, sepsis, and contagious contamination.
4. Other results included hypersensitivity, malignancy advancement, activation of herpes zoster, and gastrointestinal perforation in diverticulitis patients.

A vaccine is needed to control the current pandemic situation around the world. Russia became the primary country on the planet to approve a SARS-CoV-2 antibody on August 11th, 2020. The immunization was created by the Gamaleya National Center of Epidemiology and Microbiology and was focused on two adenovirus vectors (Moscow, Russia). Chairman Vladimir Putin declared his approval (Sputnik 2023). "I know that the vaccine works quite efficiently, helps to develop strong immunity, and has passed all the tests necessary," Putin said at a senate conference. As the vaccine is in the testing process, no one knows whether it is safe for human health and the prevention of the disease, and it would take a longer time to reach other countries (Ozawa and Stack 2013). To protect the immune system, everyone needs to make his or her immune system strong against COVID-19 by managing a healthy diet. Drinking 8-10 cups of water per day or supplementing it with some citrus juices can keep the mucous membranes moist. Most importantly, food plays a vital role in determining overall health and boosting the immune system to work against invading pathogens and strengthening the body cells to protect against viruses. Since human bodies generate proteins called antibodies that destroy unhealthy cells, all fighting depends on how healthy the human body is. Eating a variety of fresh fruits rich in beta-carotene and ascorbic acid to boost immunity (Makam 2021) and eating unprocessed foods to obtain the body's necessary vitamins, minerals, dietary fiber, and antioxidants can assist against COVID-19. To minimize the risk of obesity, heart disease, and diabetes, avoiding sugar, fat, and salt is a better choice since viral infections are more likely to occur in these patients. Additionally (Awuchi, Igwe, et al., 2020), eating low-carb diets can help to relieve blood pressure issues. Individuals consume high amounts of orange juice to get their vitamin C hit. Moreover, for the functioning of T cells, certain food proteinases are necessary to protect the body from pathogens. Probiotics such as yogurt and fermented foods are an outstanding way to revitalize the composition of intestinal bacteria that play a role in the absorption of nutrients. On the other hand, it is important to avoid eating inflammatory meats and fried foods. It has been shown that these products help the immune system fight viral infections (Suardi, Cazzaniga, et al., 2021).

Powerful Immune System Against COVID-19

In the current situation of the pandemic, it is necessary to enhance and sustain immunity at the highest possible level. For that reason, the immune system must be capable of overcoming COVID-19 and other respiratory coronaviruses. Those with better immune systems are less likely to get any respiratory problems. Apart from immunity, age is an independent risk factor for disease-contracting vulnerability and death caused by the disease (Cheyette 2011). The older the age of those affected by COVID-19, the higher the risk of mortality. In the sense of immunity, older individuals possess weaker immune systems and are thus at risk of acquiring the disease. The immune system can be enhanced via natural means, such as good mental and physical health practices, consumption of balanced and essential micronutrients, trace elements, and high doses of

supplementation and vitamins to boost innate immunity. If a person following prescriptions to boost immunity develops an illness, the signs and symptoms are likely to be milder with fewer complications, and recovery would be normal (Islam, Haque, et al., 2022).

Nutritional Recommendations During the COVID-19 Pandemic

The pandemic commenced with animal-to-human transmissions in the form of severe atypical pneumonia, characteristically resulting in the direct cause of death. COVID-19 is a present-day pandemic and a contagion as declared by the World Health Organization (WHO), i.e., World Health Organisation, and individuals are under quarantine in most countries to limit the transmission of the virus, mitigating the strain on medical services (Khan, Adil et al., 2020). The utilization of organic products, fruits, vegetables, and entire-grain food sources has been related to the decay of danger of illness. Two multinationals, Italy and Spain, suggest at any rate five servings of leafy foods daily. Moreover, safe wellsprings of water, cancer prevention agents, and antioxidants assume a part in the therapy of hypertension and diabetes, which are probably the main danger components of COVID-19. Furthermore, continuous ear-shots about the pandemic during quarantine can be upsetting. Subsequently, pressure factors and stress guide individuals to gorge, oftentimes picking sugar-based "comfort food sources"(Guise 2016). The inclination to eat a particular sort of food is characterized as "food craving," which is a multidimensional idea that includes passion (exceptional craving to eat), conduct (looking for food), intellectual (food thinking), and physiological measures. Starch or carbohydrate desires and cravings are found to expand serotonin creation, which thus beneficially affects the temperament or mood. Sugars and dietary fibers have likewise been accounted for and connected to the job of the immune framework (Venter, Meyer et al., 2022). Mitochondrial overload and ensuing free radical synthesis can result from the utilization of food sources with a higher glycemic index and concerning carbs. Coursing levels of inflammatory cytokines, for example, CRP, necrosis tumor factor alpha (TNF-alpha), and interleukin-6 have been accounted for to build, following the admission of these types of sugars (Ansar, Ghosh et al., 2016). It very well might be prudent to restrict the utilization of nourishments rich in these carbs. DHA and EPA supplementation can be valuable for decreasing the rate and improving the recuperation of patients with COVID-19, depending on these discoveries. Polar lipids found in food wellsprings of omega-3 unsaturated fats, for example, fish and fish oils, incorporate phospholipids, glycolipids, or sphingolipids that can impede both the platelet-activating factor (PAF) and its receptor, applying calming impacts that might be valuable for COVID-19 (Mussap and Fanos 2021). Furthermore, it was likewise perceived that the proteins associated with the biosynthesis of PAF could likewise be down-controlled and up-managed by those associated with the lipid species degradation. Obstructing platelet actuation can likewise be valuable for preventing thrombotic intricacies related to COVID-19 (McFadyen, Stevens et al., 2020). This suggestion can be met by burning through in any event 2 servings (90 g for each seven days) of marine greasy fish, for example, mackerel, salmon, sardine, herring, and smelt. Moreover, the fundamental nutritional sources of vitamin E are root vegetable oils, including soju, sunflower, corn, raw grain, pecan, nuts,

beans, spinach, and broccoli. Antioxidants increase the measure of T cells, increment the reaction of mitogenic lymphocytes, increment IL-2 creation, improve the part of regular executioner cells, and increment the reaction of influenza virus immunizations contrasted with a palliative (Tumilasci 2011). In yams, carrots, and green verdant vegetables, beta-carotene is usually bountiful, while vitamin C sources include red peppers, bananas, strawberries, broccoli, mangoes, lemons, and other field-grown foods.

In addition to numerous problems faced, quarantine can be attributed to less time spent out-of-doors, a smaller amount of exposure to sunlight, and reduced D vitamin production owed to minor levels of 7-dehydrocholesterol in the skin (Holick 2012). In winter, vitamin D lacks devours to be accounted for and connected in the direction of viral plagues. For sure, the danger of building up numerous persistent infections, for example, tumors, cardiovascular illness, diabetes mellitus, and hypertension, is essentially diminished by sufficient vitamin D status. Another fundamental trace factor that is significant for keeping up immune capacity is zinc. Zinc has been found to restrain binding and lengthening in Vero-E6 cells of the RNA-dependent RNA polymerase (RdRp). While clams provide the most noteworthy measure of zinc per meal, red meat, pumpkin seeds, nuts, sesame seeds, beans, and lentils are the most well-known sources for getting zinc (Reynolds 2023). These outcomes show that selenium utilization has all the earmarks of being identified with the clinical result in patients with COVID-19, and other supplements' useful impacts are shown in Figure 10.1. Further examination is yet required to give more extensive information on the ideal admission of this mineral. Copper is fundamental to keeping up DNA honesty by forestalling oxidative DNA harm. Studies in rat models with ongoing TNF-alpha-incited lung irritation indicated that copper supplementation could improve such aggravation. In any case, no substantial proof is accessible to suggest copper supplementation for COVID-19 (Du Laing, Petrovic et al., 2021). Table 10.1 shows a summary of nutritional guidance disseminated during the COVID-19 pandemic.

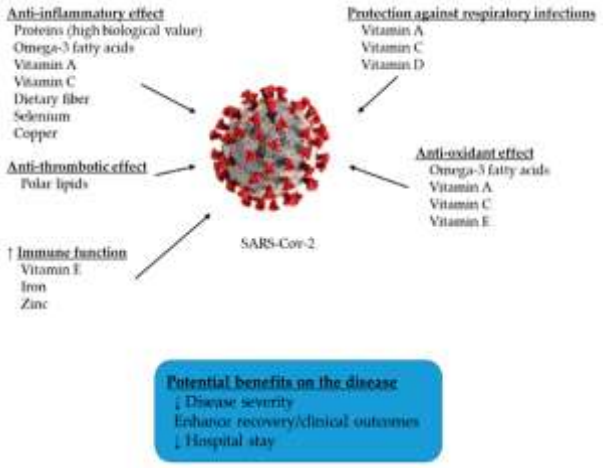

Figure 10.1: Impacts of supplements during COVID-19 contamination

↑: increment, ↓: decline (de Faria Coelho-Ravagnani et al., 2020**)**

TABLE 10.1: Summary of nutritional guidance disseminated during the COVID-19 pandemic (de Faria Coelho-Ravagnani, Corgosinho et al., 2021).

Institutions	Nutritional Guidance
ABRAN	The most essential vitamins and minerals: vitamins A, C, and D, zinc; selenium; and probiotics can be considered for COVID-19 patients with diarrhea (Caram, Silveira, et al., 2021)
AEDN & GCDN	Remain hydrated, Consumption of at least 5 daily portions of fruit and vegetables; milk and fermented milk or yogurt; option of low-fat dairy products; Consumption of whole grains and legumes (de Faria Coelho-Ravagnani, Corgosinho, et al., 2021)
ASBRAN	When preparing meals, use a minimal amount of oils, fats, salt and sugar; Limit the intake and purchase of packaged and ultra-processed foods,

	e.g. soda drinks, cookies, and ice cream that are high in calories; Avoid buying sodium, trans fat, and calorie-rich commercially prepared meals (Campos, Barreto et al., 2020).
ASN	Whole grains, vegetables, and fruits are emphasized in the healthiest meals; Limit saturated fat intake and meat portions; Limit the intake of frozen dinners prepared commercially; Stock up on packed food items that will remain fresh for a longer time (Cho, Qi et al., 2013).
DAA	Pick new items that last longer when picking foods grown from the ground; Recommend wellsprings of protein, consolidate canned fish, vegetables, and nuts. Consider a combination of grains, for instance, rice, pasta, quinoa, cereals, and oats. Food sources that are a wellspring of solace or a token of a day-by-day schedule can be advantageous for emotional well-being (Kingsolver 2010).
DIETITIANS OF CANADA	Eat a well-balanced diet rich in fruits and vegetables, and foods with high protein (Association 2003).
EUFIC	Acceptable consumptions of nutrition with copper, iron, selenium, zinc, and vitamins A, C, and D (Frydrych, Krośniak, et al., 2023).
FAO	To maintain a good immune system, eat a balanced diet; Inside each food category, consume several foods; Limit your fats, sugar, and salty food intake; Limit alcohol intake (Organization 2018).
SINU	Intake of vitamin A and C foods; Avoid consumption of soda drinks and other sugary products; Stop heavy salt intake and fat-rich seasonings (Lipman 2018).
UNICEF	Maintain the consumption of fruit and vegetables; Choose healthier canned foods if fresh produce is not available; Canned food contains omega-3 fatty acids and a high content of vitamins; Limit heavily processed food (Kaur 2022).
WHO	Several new and unprocessed foods can be obtained from vitamins, dietary fiber, protein, and antioxidants; Drink ample water; Limit sugary food, salt, and fat (Awuchi, Igwe, et al., 2020).

Food as Medicine

Measures to mitigate infection risk in the current situation are important for disease prevention. To lessen the danger of SARS-CoV-2 contamination and transmission, numerous preventive measures for overall population well-being have been proposed, counting on the cleanliness of hands and respiratory system and accumulating harmless nourishment rehearses comparable to instinctive produces that are raw (Janik, Bartos, et al., 2021). In the current pandemic, there is an incredible need to recommend compelling preventive clinical estimates that could limit the danger of disease before the antibody or other antiviral agents are formulated. Plants have been utilized for quite a long time as conventional drugs to treat numerous chronic infections, including viral sickness, in essentially all cultures around the world. For many years, researchers have attempted to experimentally prove the wellbeing-improving capability of practical and nutraceutical foods. The reason for the following examination is to record normal and effectively available functional food plants that are naturally active and equipped for regulating the safe framework against a few clinical issues emerging from respiratory tract diseases. It is accepted that functional food plants can empower people to conquer the disease by:

- Regulating the body's resistance framework,
- Producing anti-viral movement in contradiction of the disease,
- Minimising additional respirational issues.

Zhang et al.. give recommendations to the general public on the use of common medicinal food plants in their everyday diet to enhance and strengthen their immune system and overall health.

Immunomodulatory Foos (Functional)

The human immune reaction is the most fundamental protection system of the body against infection, and the survival of an

individual relies enormously upon this technique for fighting unfamiliar pathogenic microorganisms, including infections (Mitra, Paul et al., 2022). The conceivable immune modulator capacity of plants is a new thought in the region of phytomedicine. Notwithstanding upgrading humoral and cell-mediated immunity, immune modulators additionally induce non-specific responses, for example, cell initiation of NK cells, macrophages, granulocytes, and integral frameworks that improve non-specific contamination resistance. The activation of these immune cells brings about the production of different molecules, for example, interferons (IFNs), cytokines, and chemokines, engaged with the upgrade of resistant reactions. The quantities of numerous invulnerable cells present in the spleen, including lymphocytes [differentiation bunch (CD)4+, CD8+, CD20+], DT, and NK cells, have diminished in most SARS autopsies. Different investigations have demonstrated that the size of macrophages has expanded by over 100%, and large viral loads have been reported to infect macrophages and T-lymphocytes (Jafarzadeh, Chauhan, et al., 2020).

Garlic

Since ancient times, garlic has probably been the most well-known home-grown medication. Garlic has antiviral, antibacterial, and other natural properties, probably due to the existence of mixtures containing bioactive sulfur (for example, allicin, allyl liquor, and diallyl disulfide) that are defensive against certain sorts of microscopic organisms like salmonella and staphylococcus aureus (Keservani, Tung, et al.,. 2024). Nevertheless, research examining garlic's antiviral properties is restricted. For example, one of the investigations detailed the immune-stimulatory impacts of sulfur mixes in mice. Among the mixes contemplated, rats cured with diallyl di-sulfide designated higher amounts of White blood cells (17,900 cells/mm^3) and neutralizing than rats cured with dissimilar compounds. The immunostimulatory capability of garlic could be advantageous in a few clinical applications since it can help intrinsic and extrinsic cell immunity as well as can improve host resistance (del Rayo Camacho-Corona, Camacho-Morales et al., 2022).

Glycyrrhizin

COVID-19 diseased victims submitted to the Scientific Centre of the University of Frankfurt were screened with Glycyrrhizin isolated from glabra. The results indicated that contrasted with other tried mixes, glycyrrhizin was the best SARS-CoV-2 replication inhibitor by a discrimination list of sixty-seven in Vero cells (Al-Kamel and Grundmann 2021). Glycyrrhizin also stimulates nitrous oxide (NO) production and expression in macrophages, which greatly inhibits the replication of viruses. Furthermore, glycyrrhizin is a strong movement against the influenza A virus (H5N1), which is likewise an arising infection and focuses on the lungs, similar to SARS-CoV. Some obsessive similitudes and contrasts additionally exist in these infections. Past investigations have detailed that a 100µg/ml convergence of glycyrrhizin diminished the limit of H5N1 to influence chemokine and interleukin (IL-6) creation, just as H5N1 initiated apoptosis. H5N1 replication was found to be upgraded at the HMGB1 DNA restricting site of the high mobility group box, but glycyrrhizin limited H5N1 polymerase activity by influencing HMGB1 official DNA (Chen, Yang et al.., 2020). This compound may, therefore, be regarded as a powerful antiviral specialist and should be given sincere consideration. Additionally, the 3C-like protease of SARS-CoV is a

significant objective for drug discovery and improvement since it is associated with proteolytic parade during the development of the infection. Chen et al. tried various mixes got from Clonorchis sinensis, including tannic acid, 2-iso theaflavin 3-gallate (TF2B), and a few catechins, on 3CL protease movement. It has been proposed that catechins do not show inhibitory potential; nonetheless, both tannic acid (IC50 = 7μM) and TF2B (IC50 = 3μM) were discovered to be powerful inhibitors (Junaid, Akter et al., 2022). These discoveries demonstrate that the tea plant, which is a wellspring of Glycyrrhizin, has a groundbreaking job against SARS-CoV contamination, however, further examination of its potential inhibitory activity on CoV replication in cell culture could fortify its case for antiviral action. Respiratory syncytial infection (RSV) additionally causes intense respiratory diseases and is viewed as a significant danger to people of various ages internationally, like SARS-CoV and flu infections. Berberine, a B-detached alkaloid, has been tried and found to essentially lessen RSV replication by diminishing mRNA and viral protein combination in epithelial cells (Cervantes-Ortiz, Zamorano Cuervo, et al., 2016). Such hindrance could be because of the repression of RSV-induced p38 mitogen-activated protein kinase phosphorylation, which is vital for fruitful RSV disease. Likewise, C-determined curcumin, longa decreased flu infection by over 90% at 30μM concentration in cell culture, which might have been because it influenced the blend of viral proteins, for example, hemagglutinin, neuraminidase, and lattice protein. By restraining its replication and growth in the nasal epithelial cells of people, curcumin has additionally been discovered to be viable against RSV, and it has likewise improved epithelial boundary action (Pal and Sahu 2023).

Quercetin

Quercetin is a flavonoid found in foods grown from the ground that have particular natural properties that can improve mental or physical health and diminish the danger of disease. These properties incorporate numerous possible advantages, including antiviral, cell reinforcement, and psychostimulant exercises, for overall health and infection obstruction. Quercetin is found in therapeutic items, for example, Ginkgo biloba, Sambucus Canadensis, and Hypericum perforatum. With its half-maximal inhibitory concentration (IC50) somewhere in the range of 7,756 and 1,931g/ml, Quercetin repressed flu disease with an expansive range of strains. Investigations of the system find that quercetin likewise collaborates with the subunit of the HA2 Influenza virus (Aghababaei and Hadidi 2023). Consequently, the collaboration of quercetin with HA2 may have an antiviral impact. In addition, quercetin could restrain the passage of the H5N1 infection. This investigation showed that quercetin's inhibitory movement at the beginning phase of flu disease offers a likely remedial option for the creation of solid, protected, and reasonable normal items for the treatment and prophylaxis of IAV contaminations. Quercetin represses the ACE, a perceived SARS docking station, similar to some different flavonoids (Arya, Sethiya, et al., 2023).

Curcumin

Antiviral and antibacterial movement against flu infection, hepatitis C, HIV, and Staphylococcus, Streptococcus, and Pseudomonas strains is shown by curcumin. A few distinctive infections, including hepatitis infections, flu infections and arising arboviruses, for example, Zika

infection (ZIKV) and chikungunya infection, have been seen with antiviral movement (CHIKV). As a docking score, the affinities of the formed bonds were reflected.

Epigallocatechin Gallate (EGCG)

EGCG compounds mostly show cell reinforcement and anti-inflammatory responses. A wide range of antiviral exercises against DNA infections, for example, HSV, adenovirus also called the Adenoviridae, HPV, and Hepatitis B virus have been accounted for in EGCG. RNA infections, for example, hepatitis C infection, Zika infection (ZIKV), dengue infection (DENV) (Sharifi-Rad, Pezzani, et al.,. 2020), West Nile infection (WNV), CHIKV and (-) RNA infections, for example, HIV, Ebola infection (EBOV) have likewise appeared to help prevent (+)-(Orthomyxoviridae). Antiviral instruments can be derived from EGCG connections to DNMTs, ACE-2, and helicase.

Vitamins

All forms of vitamins, vitamin C and vitamin D play a major role in improving one's immunity. There should be more citrus fruits and vegetables available for the same, such as amla, lemon, orange and others. Additionally, egg yolks and mushrooms are a healthy source of Vitamin D (Kone and Samayamanthula 2021). People who have been infected with COVID-19 are given vitamin C via IV (intravenous therapy), which moves fluids directly into a vein.

Vitamin A

A few studies have shown that vitamin A supplementation has helped children who have had intestinal surgery or suffered from serious types of infections. In controlling the inherent immune response (through NK cells, macrophages, and neutrophils) and cell-mediated immunity, vitamin A plays a role in the growth and differentiation of B cells (Stephensen 2001). It is also involved in the immunity of humoral antibodies and the signaling of cytokines, with a resulting role in the inflammatory response. In addition, in six patients with indirect measurements of monocyte and macrophage function and cytokine production, vitamin A supplementation studies showed a decrease in TNF-alpha reduction relative to patients who did not take vitamin A supplements. More experiments have been performed on HIV-infected pregnant women who have not affected vaginal secretion concentrations of IL-1beta. In the above studies, the role of vitamin A supplementation in controlling the secretions of certain cytokines, such as TNF and IL-6, was indicated. Research carried out on Kenyan women found that a single shot of vitamin A did not affect the CD4+ count, but a substantial increase in the CD4+ counts resulted when vitamin A supplementation was given daily for 6 weeks. The daily dose of vitamin A for children aged 3 years resulted in an improvement in CD4+ cells in the extended sample. It is therefore inferred that Vitamin A or Pro-Vitamin A carotenoids can increase the number of immune cells. Since HIV infection is also a viral infection that attacks the body's immune system, it is possible to further investigate vitamin A supplementation that has a positive impact on HIV-infected patients against patients with the COVID-19 virus (Taha, Abureesh, et al., 2021).

Foods Rich in Vitamin E & C

For newborn children, grown-ups, or even old people, vitamin C is a fundamental factor in improving immunity. Vitamin C is wealthy in organic products, for example, bananas, papaya, kiwi, and guava, and ought to be remembered for the eating regimen (Rane, Keservani, et al., 2023). Furthermore, certain vegetables are viewed as high in

vitamin C and are useful for immunity, for example, eggplant, red peppers, beetroots, spinach, and cauliflower. A couple of boosters important for the immune system that can be remembered for the diet compromise involve green vegetables, for example, broccoli and mushrooms. They are quickly building up the immunity arrangement of more seasoned individuals. In the treatment of sepsis and septic shock, a hazardous condition brought about by aggravation incited by pathogenic species, water-dissolvable nutrients have significant advantages. Different structures in which vitamin C advantages the body are immune cells as antioxidants (Pradhan, Tripathy et al., 2018), epithelial lung cell antioxidants, and immunosuppressive effects. To save the overall strength of old individuals, including their resistance, vitamin E is likewise a fundamental part. Vitamin E is a strong cell reinforcement that can shield from different diseases, infections and microbes. To get a day-by-day portion of vitamin E, people are advised to eat almonds, peanut butter, sunflower seeds, and even hazelnuts. Vitamin E principally works as an unspecific, chain-breaking cancer preventive agent that precludes lipid peroxidation from spreading. In plasma films and lipoproteins, vitamin E is additionally a radical peroxyl forager that protects polyunsaturated fats. The main files of in vivo free radical development and oxidative lipid degradation are F2-isoprostane quantification. F2-isoprostans are expanded, and by taking vitamin E supplements, their outflows can be limited. The impact of vitamin E supplements on the immune and inflammatory response to delayed exercise is not yet completely contemplated and is misjudged.

Vitamin D Rich Foods

The role of vitamin D is presently acknowledged in improving the impacts of both NCDs and CDs. Vitamin D assumes a significant part in adaptive immunity, using the production of antimicrobial peptides (Sharma 2021), including cathelicidins and defensin, diminishes intense contamination of the Susceptibility to viral diseases, including multiple cancers, diabetes, and CVDs, is associated with the respiratory tract and its deficiency. The late investigation into the vitamin D component in the counteraction of COVID-19 and flu viral diseases has gained traction through multiple reviews and meta-examinations, especially given that people susceptible to SARS-CoV-2 contamination are typically high-risk individuals with multiple NCDs, such as diabetes and CVD, recommending that vitamin D may be the missing connection among NCDs and viral CDs. Several compounds are used based on this statement to determine if adequate nutrient D accessibility can reduce the risk of viral diseases and COVID-19. During the COVID-19 quarantine, sleep disorders may also be alleviated by maintaining ample amounts of vitamin D within the body (Mamatalieva 2022). This could be achieved primarily by exposure to the sun and, to a lesser degree, through dietary intake or supplementation (Tsiaras and Weinstock, 2011). In controlling sleep cycles and circadian rhythms, improving sleep quality, and indirectly improving sleep apnoea, vitamin D plays a vital role. In brain regions involved in sleep regulation, vitamin D receptors and chemicals that manage its initiation and debasement have been found. Further, vitamin D is likewise associated with melatonin improvement pathways and can cause restless legs syndrome and obstructive sleep apnoea disorder. Exposure to daylight is the best wellspring of vitamin D, even though it is accessible in different food sources, including slick fish,

generally fish, salmon, and milk in addition to egg yolk. Prescribed supplementation to raise vitamin D levels over 40-60ng/mL in people at most elevated danger of COVID-19 contamination. Higher vitamin D3 doses are suggested for the treatment of individuals who are contaminated with COVID-19 (Barros-Neto, Vasconcelos, et al., 2020).

Magnesium

Magnesium, a basic mineral for the immune system, is additionally a significant electrolyte that assists the human body with fortifying the NK cells and lymphocytes of the innate immune system (Alghamdi, Gutierrez, et al., 2022). It is additionally a vital source of energy for our cells called adenosine triphosphate (ATP), which is important to such an extent that without this energy, our cells cannot work properly. Magnesium supports our blood hemoglobin, which is responsible for supplying oxygen from our lungs to the entire human body, which has been related to COVID-19 since the infection influences the respiratory tract. Magnesium-rich nourishments are dark chocolate, dark beans, avocados, and entire grains.

Selenium

Another micronutrient that assumes a basic part in supporting human health is selenium. Selenium influences all parts of the immune system: endogenous, non-adaptive, and adaptive (Yadav, Mondal, et al., 2020). Selenium has appeared to expand the movement of glutathione peroxidase, another antioxidant agent, and to build various host immune reactions, including interferon production, T-cell expansion, antigen stimulation, and NK cell activity. It additionally assumes a part in the modulation of inflammatory reactions and cytokine creation. Truth be told, a trial concentrated on mice and flu infection indicated that selenium deficiency prompted more genuine and expanded support of provocative resistant reaction, prompting expanded pathology in the lungs. Selenium supplementation upgrades the response of the immune system in people to infections. Selenium is a fundamental minor component that can be found in nuts, bread, grains, meat, poultry, fish, and eggs and is handily gotten from nutritional bases (Earle 2024).

Copper

Copper is an important micro-nutrient for the human body, especially for iron metabolism, neuroendocrine function, lung elasticity, cardiovascular integrity, and neo-vascularization (Valle Tenney, Rebolledo, et al., 2018). A new study at the University of Southampton has shown that copper can effectively prevent respiratory viruses from spreading. Particularly those related to the outbreaks of SARS and MERS. A method worth considering would be the implementation of a similar strategy against COVID-19. Copper alloys are said to be anti-microbial, and it was studied that within a few minutes, it was inactivated when the coronavirus came into contact with it. The lack of copper in the body results in reduced levels of proliferation of IL-2 and T cells and also decreases the capacity to produce superoxide anion and destroy the microorganisms ingested. Some of the foods rich in copper include oysters, nuts, beans, shitake mushrooms, lobster, liver, leafy greens, and dark chocolate (Pruteanu, Bailey *et al*., 2023).

Conclusion

This review emphasizes the role of nutrition, particularly micronutrients, in aiding COVID-19 recovery. Consuming enough macro- and micronutrients can help control the condition, but it is not a COVID-19 treatment. It's critical to comprehend the intricate virology and virus transmission, particularly to manage possible spread pathways like fecal-oral transmission. Although Moderna and

Pfizer-BioNTech vaccines are in late-stage studies, vaccination is greatly expected. However, availability and cost are still unknown, especially in rural and low-income countries like Pakistan. Food-based preventive strategies become more important in light of this uncertainty, as minerals, proteins, carbs, polyphenols, flavonoids, and vitamins D, C, and E all play critical roles in promoting immunity. It's also advised to stay hydrated and eat a diet high in nutrients like zinc and magnesium. Flavonoids, in particular, which are Polyphenolic chemicals, can suppress the transmission of SARS-CoV-2. Overall, strengthening the immune system against COVID-19 requires a diet and lifestyle high in nutrients.

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