

# Article • Nutrition and Lifestyle Considerations During the COVID-19 Pandemic

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## ABSTRACT

**Background:** The ongoing pandemic challenges our sense of control and equanimity. Despite the current environment and unknowns associated with COVID-19, there are many things that can be done to boost the immune system and help protect against the virus. Good nutrition, supplementation, and healthy lifestyle habits can support the immune system, reduce inflammation, and prevent infection. Proper nutrients reduce susceptibility to infection and disease progression and reduce long-term complications from COVID-19.

Several of the vitamins and nutrients that support immune function include vitamins A, C, E, D, B6, B12, folate, zinc, iron, selenium, magnesium, and copper, as well as omega-3 fatty acids.

In addition to proper nutrition, other suggestions for optimizing health, supporting overall immune function, and resisting infection include regular exercise, adequate sleep, and stress management techniques such as deep breathing, meditation, and relaxation.

**Keywords:** COVID-19, exercise immune system, nutrition, omega-3 fatty acids, sleep, stress management, meditation, water intake, viral infection

## Introduction

The ongoing pandemic challenges our sense of control and equanimity. Despite the current environment and unknowns associated with COVID-19, there are many things that can be done to boost the immune system and to help protect against the virus.

A review of the literature gives some insight into those who are at the greatest risk for infection, some of the reasons for that risk, and the nutritional considerations for immunity. The elderly; minorities, including American Indians, Native Alaskans, Blacks, and Latinos; and individuals with lower income are more susceptible to disease. Those with underlying medical conditions such as obesity, diabetes, hypertension, and chronic heart disease and those with hypoxia, chronic inflammation, immunodeficiency, and neuropathology have the greatest risk for mortality and increased severity of symptoms from COVID-19. Some of the factors that result in disparities in the effects and infection sequelae of COVID-19 relate to nutrition and lifestyle. Diets high in sugars, refined carbohydrates, and saturated fats, as well as a lack of exercise, impair immunity and contribute to risk for comorbid disease. Poor nutrition leads to chronic inflammation, disrupts adaptive immunity, and causes poor defense against viruses. Long-term, poor diet and an unhealthy lifestyle not only increase the risk for infection but also increase the risk for long-term consequences of COVID-19 such as neuroinflammation, leading to dementia and neurodegenerative disease. Older populations, in particular, do not get the vitamins, minerals, and essential amino acids needed for a strong immune system. Additionally, the elderly have more difficulty extracting necessary nutrients from the digestive system.<sup>1</sup>

Good nutrition, supplementation, and healthy lifestyle habits can support the immune system, reduce inflammation, and prevent infection. Proper nutrients reduce susceptibility to infection and disease progression, and they reduce long-term complications from COVID-19.<sup>1</sup>

## Discussion

Some of the literature indicates that several vitamins and minerals play important and necessary roles in supporting the immune system. Deficiencies or inadequacies in these nutrients can increase susceptibility to infection. These nutrients are important for various immune functions, including developing and maintaining physical barriers, producing and engaging antimicrobial proteins, mobilizing both innate and phagocytic cells, producing antibodies, and activating destructive neutrophils and macrophages. They also are important for promoting and recovering from inflammation through cytokine production and antioxidant activity.<sup>1,2</sup>

Several of the vitamins and nutrients that support immune function include vitamins A, C, E, D, B6, and B12 and folate, zinc, iron, selenium, magnesium, and copper. Ideally, the intake of healthy, diverse food should provide the necessary nutrients. However, it is difficult to get all of the vitamins and micronutrients needed to maintain health and to prevent disease.<sup>2</sup>

One of the important vitamins recommended for supplementation is vitamin D3. Vitamin D3 can be synthesized from cholesterol in the body upon the skin's exposure to sunlight and is a hormone that requires fat in order to be properly absorbed. Vitamin D3 is critical not only for maintaining bone integrity, but also for proper immune function. It stimulates maturation of immune cells and can reduce the risk of respiratory infection. Rates of infection of COVID-19 appear higher in countries with higher latitudes and lower vitamin D3 levels, and vitamin D3 deficiency may be associated with increased hospital admission, disease severity, and mortality in older populations. In most adults, supplementation is necessary to achieve optimum levels and to prevent inflammation. Suggested serum levels are 50-80 mg/ml. The recommended dosage is 2000 IU daily, with up to 10,000 IU recommended short-term in those at greater risk for exposure or susceptibility to infection. Vitamin D3 can be found in cod liver oil; wild Alaskan pink, sockeye, and silver salmon; Albacore tuna; sardines; and fortified milk.<sup>2-4</sup>

Another very important vitamin for immune support is Vitamin C. Vitamin C is used throughout the day for most immune functions and can reduce the risk, severity, and duration of respiratory tract infections. For those who are sick or who require immune support, recommended daily dosage is 2000 grams, although up to 5000 grams is suggested, if tolerated, taken at intervals during the day. Food sources of vitamin C include orange juice and oranges; yellow, green,

and red bell peppers; strawberries; Brussels sprouts; papaya; broccoli; cantaloupe; and kiwi.<sup>2,4</sup>

Zinc also supports immunity by building T lymphocytes and can reduce diarrhea or respiratory morbidity during infection. Recommended dosage is 8-11 mg daily, although 30-50 mg daily may be indicated for added immune support, and up to 220 mg can help with recovery for those with COVID-19. Long-term dosing should be less than 25 mg, as high zinc levels can interfere with copper levels. Zinc can be found in grass-fed beef, lamb, chicken, crab, lobster, oysters, spinach, pumpkin seeds, chickpeas, cashews, yogurt, oatmeal, and cocoa.<sup>2-5</sup>

Selenium is another nutrient important for immune function and reducing viral loads. Higher levels of selenium have been found in COVID-19 survivors versus non-survivors. Selenium is an essential cofactor in a group of enzymes that work with vitamin E to reduce oxidative stress. Selenium deficiency may negatively affect antioxidant defenses and result in an exaggerated inflammatory response. Selenium may also protect the respiratory system from viral infections and is a recommended supplement, particularly for older adults. Suggested dosage is 50 mcg. Selenium can be found in brazil nuts, tuna, halibut, sardines, shrimp, steak, turkey, liver, chicken, eggs, beans, oatmeal, rice, yogurt, lentils, and spinach.<sup>3,6</sup>

Omega-3 fatty acids support the immune system and reduce inflammation. It can also reduce coronary heart disease. Recommended daily dosage is 1000 to 2000 mg daily of EPA and DHA. Some of the highest sources of omega-3 fatty acids come from flaxseed oil and chia seeds, as well as walnuts, whole flaxseeds, salmon, herring, sardines, and mackerel. Other sources include trout, sea bass, edamame, kidney beans, and soybean and canola oil.<sup>1,7,8</sup>

Copper supports immune cell differentiation and provides defense against oxidative damage. Copper deficiency may play a role in celiac disease, cardiovascular disease, and Alzheimer's disease. The absorption of copper is influenced by the amount of dietary copper, with small amounts increasing bioavailability. The recommended copper level is 1000 mcg daily, and food sources include beef, liver, oysters, crabs, salmon, turkey, chocolate, potatoes, mushrooms, cashews, chickpeas, sunflowers, sesame seeds, millet, yogurt, avocado, figs, spinach, asparagus, tomatoes, and apples.

Magnesium supports immunoglobulin production, and the recommended dosage is 400 mg. Natural sources of magnesium include pumpkin seeds, chia seeds, almonds, spinach, cashews, peanuts, baked

potatoes, brown rice, cereal, oatmeal, kidney beans, bananas, salmon, milk, halibut, raisins, avocados, and broccoli. Prebiotics include berries, grapes, figs, whole-grain fibers, yogurt, coffee, tea, honey, and chocolate.<sup>9,10</sup>

Other suggestions to support immune and overall health include taking a multivitamin with B6, B12, E, folate, iron, magnesium, and copper, as well as additional supplementation with lutein, zeaxanthin, alpha-carotene, amino acids, peptides, cyclotides, lipoic acid, spirulina, N-acetylcysteine, and glucosamine. Turmeric, quercetin, elderberry, and probiotics are also supportive of health and proper immune function and often require supplementation. Some of the recommended dosages include 1500 mg of lipoic acid, 15 g of spirulina, 1500 mg of N-acetylcysteine, 3000 mg of glucosamine, 2000 mg of turmeric, and 1000 mg of elderberry.<sup>4</sup>

Some basic dietary recommendations include rotating foods and increasing the intake of fruits and vegetables. Organic foods can increase the absorption of nutrients and best provide the vitamins and minerals needed. Limiting sugars, carbohydrates, and processed foods, including drinks with excess sugar such as concentrated juices and sodas, will decrease inflammation and support overall health. Eating foods, drinks, condiments, and spices with anti-viral properties is also recommended.<sup>4</sup>

Some of the anti-viral foods include the aforementioned fish, seafood, nuts, seeds, avocado, Brussels sprouts, broccoli, and grapes. Additionally, other beneficial foods include arugula, cabbage, cauliflower, dates, legumes, and radishes. Carrots and pumpkin provide both alpha- and beta-carotene, collard greens provide lutein and alpha-carotene, and spinach is an excellent source of lutein and beta-carotene. Sweet potato is a good source of beta-carotene, and green peas, kale, and turnip greens provide lutein. Bell peppers, goji berries, and yellow corn provide zeaxanthin, and grapefruit and tomatoes are good sources of lycopene. Apples, blueberries, and cranberries provide anti-viral polyphenols and quercetin.

Antiviral fruits and vegetables with anti-inflammatory and antihistamine properties include carrots, lemons, limes, grapefruit, eggplant, pumpkin, yellow peppers, squash, and zucchini. Anti-viral drinks include coffee and green, black, and hibiscus teas. Anti-viral condiments include garlic, onions, ginger, extra-virgin olive oil, and balsamic vinegar. Anti-viral herbs and spices include basil, cilantro, cinnamon,

clove, cumin, echinacea, elderflower and elderberry, eucalyptus, horseradish, lemon balm, lemongrass, licorice root, olive leaf, oregano, rosemary, sage, spearmint, thyme, and turmeric.<sup>4</sup>

In addition to proper nutrition, there are a number of other suggestions for optimizing health, supporting overall immune function, and resisting infection. One of the most important factors is staying properly hydrated. Drinking plenty of water helps maintain hydration and supports detoxification. Suggested intake is half one's body weight in ounces daily.<sup>4</sup>

Exercise is also extremely important to overall wellness and supports cardiovascular, respiratory, metabolic, and immune health. A sedentary lifestyle and physical inactivity can compromise the immune system, resulting in systemic inflammation, oxidative stress, and immunosuppressive mechanisms. Moderate exercise can increase natural killer cells, neutrophils, and macrophages, and more intense aerobic exercise can increase monocytes that are critical for anti-viral activity in the body. Prolonged moderate exercise increases T-helper cells and enhances T-cell proliferation in some at-risk populations.<sup>11</sup>

Another key recommendation for good immune health involves sleep. Sleep is essential for proper immune system function. Circadian cycles influence the number of T cells and the production and presence of inflammatory and natural killer cells. For example, pro-inflammatory cytokines are highest during early nocturnal sleep, and anti-inflammatory cytokines and killer cells are highest during the daytime. Sleep appears to promote inflammatory homeostasis and may also play a role in the formation of immunological memory.<sup>12</sup>

Many studies now show that there is an optimal number of hours for sleep and that too little or too much sleep can be detrimental to health. In fact, sleep and immunity are linked such that the immune system alters sleep and sleep affects both the innate and adaptive immune response. An inflammatory response can induce an increase in sleep duration and intensity as well as cause sleep disruption. Increased sleep during an infection promotes immune defense, and sleep is associated with reduced infection risk, improved infection outcome, and improved response to vaccination. Decreased sleep, in contrast, can result in chronic, low-grade inflammation and is associated with inflammatory diseases such as diabetes, atherosclerosis, and neurodegeneration. The general recommendation is to obtain more than 7 hours but less than 10 hours of sleep each night. However,

considerations such as sleep quality, sleep deprivation, hormonal activity, and aging may factor into the amount of sleep needed for an individual.<sup>13,14</sup>

Stress management is important for overall health and wellness and allows for adaptability to diverse and difficult environments. Stress is a complex phenomenon, and some stress is necessary to mount responses to our environment. However, stress can also have deleterious effects on the body. Stress can be acute or chronic and can have differing effects on the immune system depending on the condition. Acute stress can enhance both innate and adaptive immune responses, such as activating neutrophil, macrophage, lymphocyte, and cytokine production and function. Chronic, sustained stress can suppress immune function by reducing immune cell numbers and activity, increasing immunosuppressive mechanisms, and inducing low-grade inflammation. Chronic stress can increase susceptibility to infections and diseases such as cancer, asthma, allergies, and autoimmune or inflammatory disease. The effects of stress may be variable as a function of the type of stress, age, and disease.<sup>15-17</sup>

## Conclusion

The persistence of the pandemic, as well as the significant changes to the lives of many, is a chronic stress on society. The pandemic has disrupted supportive social networks, challenged financial security, induced fear, caused loss of life and livelihood, and has led to reduced coping mechanisms for sustained stress. Managing stress is crucial to maintaining health and peace of mind during a prolonged pandemic. There are a number of evidence-based techniques that have been demonstrated to reduce stress. These activities include diaphragmatic breathing, guided imagery, progressive muscle relaxation, biofeedback, autogenic training, mindfulness, meditation, emotional freedom techniques, and cognitive behavioral therapy. When stress levels are ongoing, it is important to recognize when they are interfering with everyday life. Managing emotions by feeling them, communicating about them, and taking action in effective ways is necessary during stressful times. Techniques such as slow breathing, stretching, meditation, and seeking support from trained professionals may be required to support and maintain a healthy immune system.<sup>18</sup>

As primary care providers, it is critical that optometrists understand the importance of nutrition and lifestyle recommendations that can support overall health and reduce the risk of infection and

complications from COVID-19. Given the mounting evidence of the benefits of the proper nutrients for prevention and reduction of infection, optometrists should be at the forefront of healthcare providers making recommendations for good nutrition and healthy practices in their patient population. Of particular concern are those patients who are in high-risk groups, such as those who are elderly or who have comorbid diseases or limited resources. Simple lifestyle recommendations and nutritional consultation may make a positive difference toward preventing and overcoming COVID-19 infection. In light of the stress that the pandemic has had on the general population, proper nutrition, exercise, hydration, sleep regulation, and stress management can do a great deal to support the immune system and maintain health.

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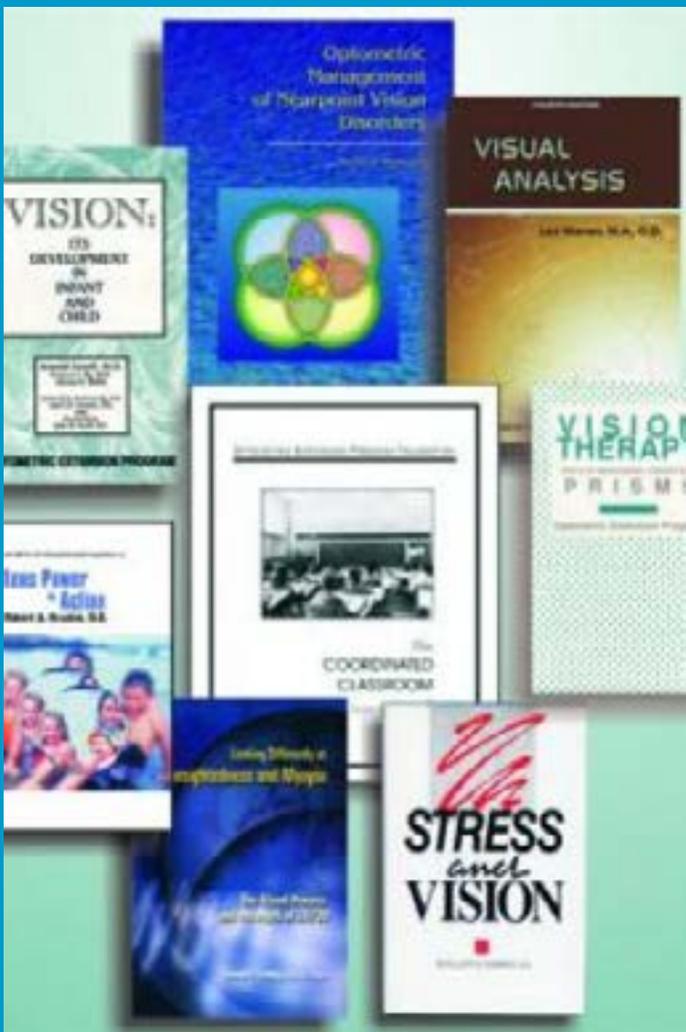
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