

Viral Respiratory Infections: An Ounce of Prevention Is Worth a Pound of Cure

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Abstract

The sudden outbreak and global spread of COVID-19 demanded a tremendous amount of attention for viral respiratory infections (VRIs) in modern times. Evidence accumulated over the past few decades increasingly suggests the importance of recognizing the background and context of lifestyle factors in the prevention of VRIs recurrence. The focus of attention has specifically been on how to optimize respiratory barrier function and immune function during the period of the pandemic outbreak. This viewpoint discusses the impact of a healthy lifestyle on VRIs and demonstrates a practical approach to preventing the occurrence of VRIs based on contemporary evidence.

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Coronavirus disease 2019 (COVID-19), caused by a novel coronavirus (SARS-CoV-2), was first reported on December 31, 2019, in Wuhan, China, and it has already spread rapidly across the world.¹ Through February 2, 2021, there have been 2,244,501 reported deaths, and more than 103 million individuals have been infected worldwide.² Consequently, there has been a dramatic increase in the need for medical supplies, social distancing measures, self-isolation, travel restrictions, school closures, and lockdowns. These measures have led to collective psychosocial distress,³ economic burden, and financial losses across the world.⁴ Thus, the significant morbidity and mortality resulting from COVID-19 has commanded a tremendous amount of attention for viral respiratory infections (VRIs).

Viruses, such as orthomyxoviridae and paramyxoviridae, picornaviridae, coronaviruses, and adenoviruses are the most common cause of VRIs.⁵ Viral infections most commonly affect the upper airway, which involves the nose, paranasal sinuses, pharynx, and larynx above the vocal folds. Before COVID-19, upper VRIs accounted for approximately 10 million outpatient office visits 1 year, with an annual cost greater than \$22 billion, not including the cost of influenza.⁶ Pathogens causing viral URIs include influenza

virus, adenovirus, rhinovirus, enterovirus, parainfluenza virus, respiratory syncytial virus, metapneumovirus, and coronavirus.⁷ Rhinovirus is the most common virus and accounts for approximately 80% of all respiratory tract infections during peak seasons.⁶ Viral lower respiratory tract infections (pneumonia) also cause a large disease burden, particularly in young children and older adults. Respiratory syncytial virus, adenovirus, human metapneumovirus, parainfluenza virus, rhinovirus, and coronavirus are commonly found among pediatric and adult patients with community-acquired pneumonia.⁸⁻¹¹ When outbreaks of influenza occur, the circulating strain of influenza virus becomes the most common cause of community-acquired pneumonia, with secondary bacterial infections as a major contributing factor.¹²

VRIs such as the common cold and influenza are commonplace and often innocuous. However, other viral infections like COVID-19, SARS-CoV-2, and MERS can have higher mobility and mortality, especially for those populations with chronic medical conditions such as diabetes, hypertension, diabetes, cardiovascular disease, and primary immune deficiency diseases. Therefore, prevention of recurrence of VRIs, specifically how to optimize respiratory barrier function and immune function during the period of the pandemic

outbreak, has been the focus of attention. Benjamin Franklin proclaimed, “An ounce of prevention is worth a pound of cure.” The statement was coined in 1736 when Philadelphia was threatened with fire, and it is still relevant today regarding the threat of COVID-19 and other known and potential viral respiratory pathogens.

When discussing the prevention of any disease, there are typically two aspects to consider: (1) understanding specific unhealthy behaviors that should be stopped and (2) determining positive lifestyle behaviors that need to be implemented. Certain lifestyle choices and diseases predispose individuals to VRIs, but identifying and modifying preventable behaviors can reduce risk and increase overall positive health outcomes.

DIET

A healthy diet is essential to maintain health and prevent disease. Diet patterns are much more important than single nutrients when looking at the overall health properties for humans. The Mediterranean diet is the most studied diet pattern, and it supports a high consumption of food from plant sources. This diet involves olive oil as the main source of dietary fat, a moderate intake of wine with meals, low to moderate daily consumption of fish, dairy products, and poultry, low consumption of red meat, and the use of herbs and spices instead of salt to flavor food.¹³ In addition, the diet does not use processed foods and instead uses true whole grains.

The Mediterranean diet decreases the risk of cardiovascular disease and diabetes. It also improves glycemic control in patients with diabetes and decreases recurrent disease in patients with cardiovascular disease.¹³ As discussed earlier, cardiovascular disease and diabetes increase the risk of VRIs, and those patients have worse outcomes if the disease is contracted; however, the Mediterranean diet has shown beneficial effects in reducing ischemic cardiomyopathy, lower blood pressure, insulin resistance, improved lipid profile, and high risk of cancer and strokes.¹⁴ These benefits have been shown in patients with COVID-19, thus showing that following the Mediterranean diet pattern can potentially decrease the risk of VRIs.¹⁵

ARTICLE HIGHLIGHTS

- Prevention of viral respiratory infections
- Lifestyle interventions to prevent viral respiratory infections
- Covid-19 prevention possibilities through healthy lifestyle

The Mediterranean diet also can decrease inflammatory cytokines, such as interleukin 6 (IL-6), C-reactive protein (CRP), and tumor necrosis factor (TNF),¹⁶ and it has robust antioxidant benefits.¹⁶⁻¹⁸ As a result, there is a potential benefit for patients with COVID-19, as some have demonstrated severe clinical deterioration with an excessive immune response termed cytokine storm; this involves high levels of inflammatory cytokines such as IL-6 and TNF.¹⁹ In addition, in patients with COVID-19, the presence of the inflammatory cytokine storm is closely related to the development and progression of acute respiratory distress syndrome.²⁰ One can infer a potential benefit of following a Mediterranean diet to prevent of severe infection in patients with COVID-19. Additional population-based studies would be helpful to further understand the association of an anti-inflammatory diet such as the Mediterranean diet, COVID-19, and other severe VRIs.

EXERCISE

Moderate exercise has numerous beneficial effects on the human body, including the immune function, which has protection against upper respiratory tract infections. Physical exercise has effects on both cellular and humoral immunity.²¹ Initial evidence has shown that after a strenuous bout of exercise, athletes pass through a period of impaired immune responses.²² However, in a more recent study, Campbell et al²² critically synthesized limited yet robust evidence supporting strenuous exercise suppresses natural cellular or soluble immunity. Physical exercise can enhance immune responses to viral, bacterial, and other antigens, instead of increasing the risk of opportunistic infections. Further long-term regular exercise might prevent, limit, or delay immunological aging.²²

Aerobic and strength-training exercises, such as yoga and tai-chi, were found to have

beneficial effects on the immune function.²³ The effects of yoga on immune system functioning has shown varying results. A recent systematic review suggested that long-term yoga practice might downregulate proinflammatory markers IL-1 β , IL-6, and TNF- α .²⁴ Twelve weeks of tai chi showed a significant increase in the ratio of T helper to suppressor cells and regulatory T cell function.²⁵

SLEEP

Sleep plays an essential role in the body's immune system function. Shorter sleep duration has been found to increase the risk of both viral and bacterial infections. One study found that shorter sleep duration before viral exposure was associated with an increased risk of the common cold.²⁶ Sleep quality is also regarded as an important predictor of immune function and infectious susceptibility. Poorer sleep quality and shorter sleep quantity are both associated with decreased resistance to VRIs.²⁷

Several therapies have been shown to improve sleep quality and duration. Cognitive-behavioral therapy is usually recommended as the first-line therapy for insomnia. Cognitive-behavioral therapy has been shown to be especially effective for anxiety, depression, posttraumatic stress disorder, and substance abuse disorder.²⁸ A specific type of meditation called *heartfulness meditation* has improved sleep in patients with chronic insomnia. The study demonstrated statistical improvements in the measures of the insomnia severity index.²⁹ Yoga nidra is another option to improve sleep by allowing the body to relax deeply. A study conducted by Livingston et al.³⁰ 2018 found that after 8 weeks of guided rest, yoga nidra program health care workers in the study showed significant improvement in sleep and mindfulness of health.

MIND AND BODY

John Kabat-Zinn observed, "Mindfulness is the awareness that arises through paying attention, on purpose, in the present moment, non-judgmentally." Mind-body techniques encompass different modalities to aid an individual's ability to be mindful of different sensations in the body. These modalities have been shown to decrease susceptibility to VRIs.^{31,32} The positive social ties have been

shown to decrease susceptibility to the common cold.³¹ Positive emotional style has been associated with a lower risk of developing viral upper respiratory tract infections.³²

A systematic review indicated that mind-body interventions could improve immune function.²⁸ The review examined relaxation training, cognitive-based stress management, and hypnosis. Immunoglobulin A played a key role in the body's immune system from mind-body medicine. Relaxation training had the strongest scientific evidence affecting the immune outcomes.³³

Studies have shown that mindfulness meditation could improve self-reported measures of disease symptomatology, whereas the effects on biological mechanisms are less clear. When biologic function examined included circulating and stimulated inflammatory proteins, immune aging, immune cell count, and antibody response. Study results indicated possible effects of meditation therapy on specific inflammation markers, biological aging, and cell-mediated immunity. Although the results were tentative, this area of focus might be worthy of further investigation.³⁴

STRESS

Psychological distress is associated with statistically significant increases in the proportion of B cells. Persisting psychological stress has been linked with promoting proinflammatory immune dysregulation.³⁵ In a meta-analysis conducted by Segerstrom and Miller³⁶ exploring the association between psychological stress and immune function, brief stressors seemed to suppress cell-mediated immune response while preserving humoral immune response. Chronic stress was associated with suppression of both above immunities.

Stress is sensed by the innate immune system in the brain.³⁷ Inflammation is the immune system's response to microbial infection and tissue injury. Furthermore, increasing data in animal models, supported by human data, strongly implicate the inflammasome in the initiation, development, and progression of diseases.³⁸ These findings suggest that stress alters the balance in the immune system, leading to excessive inflammation and increased risk of infectious diseases. Methods to mitigate stress through

mindfulness, exercise, and meditation are further warranted.

TOBACCO USE

Cigarette smoking alters both barrier and immunologic function in the respiratory tract. Smoking-induced barrier changes include enhanced mucosal permeability, impaired mucociliary clearance, changes in pathogen adherence, disruption of the respiratory epithelium, and peribronchiolar inflammation and fibrosis.³⁹ Cigarette smoking alters both humoral mediated and cell-mediated immune responses and inflammatory processes in the lung.⁴⁰⁻⁴² Individuals who smoke have a higher incidence of bacterial and viral infections of the upper and lower respiratory tracts.³⁹ Considering the limited current evidence, tobacco use appears to be associated with disease progression and worse outcomes in COVID-19.⁴³

ALCOHOL

It is well-established that long-term alcohol intake increases the risk of bacterial and viral respiratory infections.⁴⁴ Ethanol is known to inhibit CD-8 T cell response in the influenza virus.⁴⁴ Mild to moderate alcohol consumption does not have an effect on the immune system in healthy adults.^{45,46} Red wine appears to have more favorable effects from an immune system standpoint.^{45,46} The key take-away is to keep alcohol intake at no more than one drink per day for women and two drinks for men, in light of alcohol's effect on other physiologic functions.

DIABETES, CARDIOVASCULAR DISEASE, OBESITY, AND LIVER DISEASE

Diabetes and obesity are both associated with increased risk of respiratory tract infections.^{47,48} One possible cause is the effect on the innate immune system, as both are associated with lower levels of surfactant protein-D.^{47,49} Patients with diabetes, cardiovascular disease, obesity, and liver disease had increased prevalence of COVID-19 infection, along with associated higher risks of hospitalization, intensive care unit admission, and death.⁵⁰ Current evidence is insufficient regarding hypertension being a contributing factor to COVID-19 infections or outcomes.⁵¹ The preceding factors stress the importance of

prevention and treatment of chronic diseases to prevent VRIs. At no time has this been more apparent than those during the current COVID-19 pandemic. A focus on modifiable lifestyle factors is of utmost importance.

CONCLUSION

Prevention of viral infections and VRIs is of paramount importance; never has this need been greater than with the current COVID-19 pandemic. Adopting healthy lifestyle factors to include a Mediterranean diet, regular exercise, good sleep habits, mind body practices, and stress-reduction measures can significantly improve the immune system and reduce risk for infection. Abstaining from tobacco, limiting alcohol, maintaining a healthy weight, and preventing diabetes and heart disease are also important for a healthy immune system.

Our review supports the notion that a healthy lifestyle can serve as a preventive measure against the recurrence of VRIs, and in turn it can positively affect lives and overall health costs. This notion is particularly applicable during these times of uncertainty and crisis resulting from the COVID-19 pandemic and should be taken under consideration for improving population health.

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Abbreviations and Acronyms: COVID-19 = Coronavirus disease 2019; IL-6 = interleukin 6; TNF = tumor necrosis factor; VRI = viral respiratory infection

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