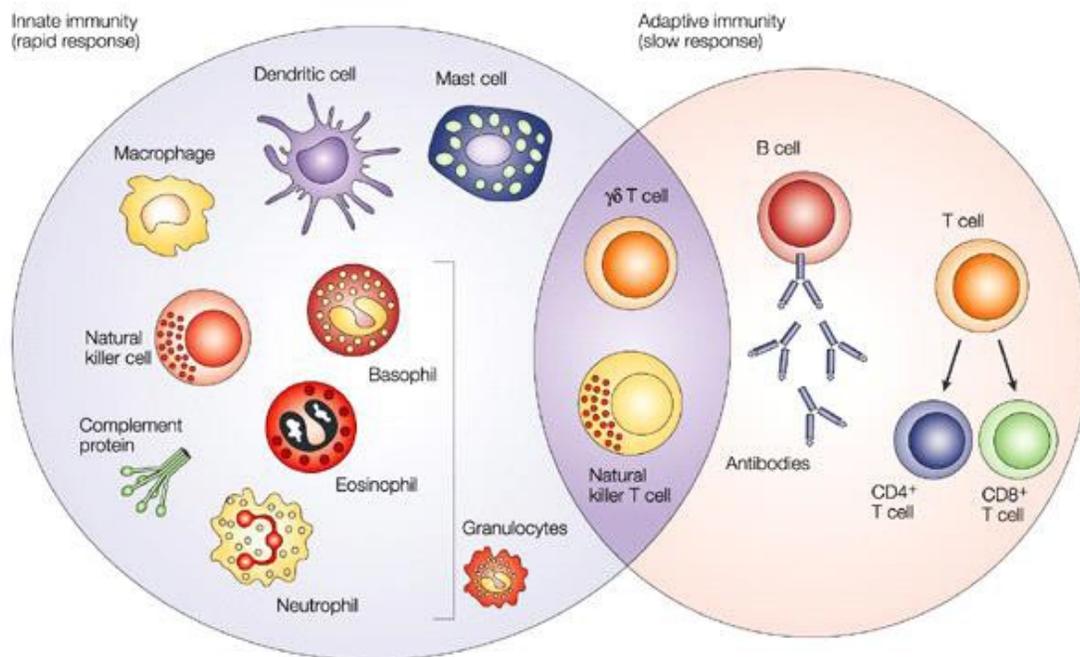


Ways to Improve Immune Function

Physiology of the Immune System: There are two subsystems within the immune system, the innate (non-specific) immune system and the adaptive (specific) immune system.

The innate arm is comprised of nonspecific defense mechanisms that respond to pathogens, which include bacteria, viruses, and fungi. Physical barriers such as mucous membranes and skin supply one layer of defense, while a variety of immune factors (macrophages, mast cells, natural killer cells, cytokines, complement proteins) also protect against foreign invaders.¹⁻³

The adaptive arm is driven by T and B lymphocytes and they detect specific pathogens, secrete signaling molecules, and coordinate an immune response. Once an initial interaction with a foreign microorganism occurs, the adaptive immune system responds and develops memory for enhanced recognition during subsequent exposures. This adaptation allows for faster secondary response.¹⁻³

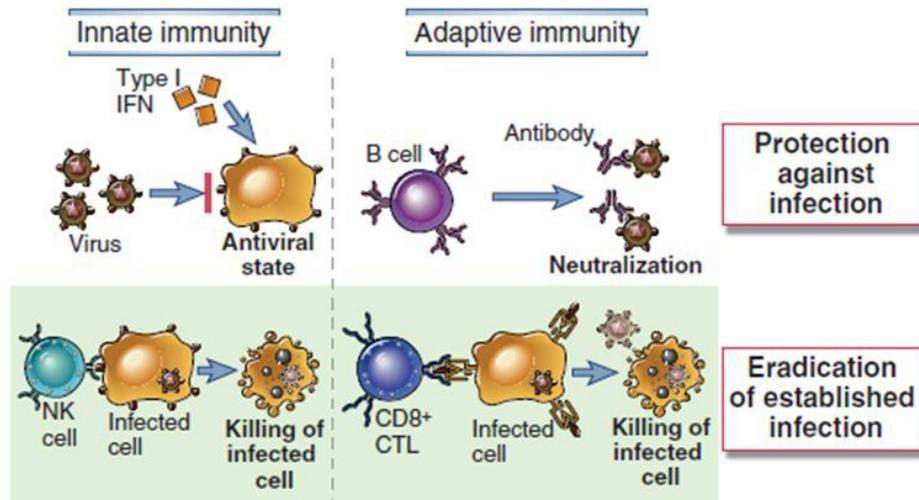


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Activation of the Immune System: The immune system can be activated by a lot of different things that the body doesn't recognize as its own, which are called antigens (protein on surfaces of bacteria, viruses, and fungi). When these antigens attach to special receptors on the immune cells, a whole series of processes are triggered in the body. Once the body has come into contact with a disease-causing germ for the first time, it usually stores information and mechanisms to fight it. If it comes into contact with the germ again, it is able to recognize it and produce a quicker response against it.²⁻³

Acute Viral Infection: Viral agents are capable of causing acute, significant illness in patients and communicable pathogens can spread rapidly in vulnerable populations, such as children and elderly. Acute infections begin with an incubation period, during which the genomes replicate, and the host innate responses are initiated. The cytokines produced early in the infection lead to classical symptoms of an acute infection: aches, pains, fever, and nausea. When an acute viral infection appears, quick response and proactive measures can significantly influence severity and duration of infection. Basic preventive measures, such as those detailed below, as well as the application of targeted nutritional therapy provide defensive strategies for supporting immune response against acute infection.³⁻⁴

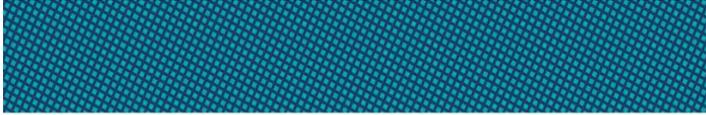
Innate and adaptive immune responses against viruses



Cellular and Molecular Immunology, 7th ed., 2012 Elsevier

Basic Preventive Measures: Behavioral and barrier strategies are warranted when a community virus strikes, especially in presence of dense populations (planes, airports, public transportation, etc.). If the virus spreads by droplets, encourage patients to sneeze into the elbow, following up with hand sanitizer or proper hand washing. Facemasks can provide a basic physical barrier against the spread of communicable pathogens, however the level of protection against the spread of viruses depends upon the mask.⁹

The Use of Facemasks: Surgical masks are loose-fitting, disposable devices that create a physical barrier between the mouth and nose of the wearer and the potential contaminants in the immediate environment. If worn correctly, surgical masks are meant to help block large-



Understanding the Difference

	 Surgical Mask	 N95 Respirator
Testing and Approval	Cleared by the U.S. Food and Drug Administration (FDA)	Evaluated, tested, and approved by NIOSH as per the requirements in 42 CFR Part 84
Intended Use and Purpose	Fluid resistant and provides the wearer protection against large droplets, splashes, or sprays of bodily or other hazardous fluids. Protects the patient from the wearer's respiratory emissions.	Reduces wearer's exposure to particles including small particle aerosols and large droplets (only non-oil aerosols).
Face Seal Fit	Loose-fitting	Tight-fitting
Fit Testing Requirement	No	Yes
User Seal Check Requirement	No	Yes. Required each time the respirator is donned (put on)
Filtration	Does NOT provide the wearer with a reliable level of protection from inhaling smaller airborne particles and is not considered respiratory protection	Filters out at least 95% of airborne particles including large and small particles
Leakage	Leakage occurs around the edge of the mask when user inhales	When properly fitted and donned, minimal leakage occurs around edges of the respirator when user inhales
Use Limitations	Disposable. Discard after each patient encounter.	Ideally should be discarded after each patient encounter and after aerosol-generating procedures. It should also be discarded when it becomes damaged or deformed; no longer forms an effective seal to the face; becomes wet or visibly dirty; breathing becomes difficult; or if it becomes contaminated with blood, respiratory or nasal secretions, or other bodily fluids from patients.



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particle droplets, splashes, sprays, or splatter that may contain germs (bacteria and viruses), keeping it from reaching your mouth and nose. Surgical masks do not filter or block very small particles in the air that may be transmitted by coughs and sneezes. Surgical masks do not provide complete protection from germs and other contaminants because of the loose fit between the surface of the facemask and the face.⁵

An N-95 face mask or respirator is a respiratory protective device designed to achieve a tight facial fit and very efficient filtration of airborne particles. The N-95 designation means that when subjected to careful testing, the respirator blocks at least 95% of very small (0.3 micron) test particles.⁵ If properly fitted, the filtration capabilities of the N-95 respirators exceed those of the surgical face masks. They are most commonly used in the healthcare setting. However, even a properly fitted N-95 respirator does not completely eliminate the risk of illness or death.⁵⁻⁶

Studies have shown that wearing a mask was effective at preventing the spread of viruses. One study looked at how surgical masks could help lower the spread of the seasonal flu and overall, researches found that masks led to a more than threefold reduction in how much virus people sprayed in the air.⁷ Researchers also found that flu rates were lower when masks were paired with proper hand hygiene.⁸ Although surgical masks and N-95 respirators may be helping in preventing against the spread of the flu, CDC does not recommend its use for protection of respiratory disease including COVID-19.⁹

Ways to Boost Your Immune System: Keeping your immune system healthy year-round is key to preventing infection and disease. Making healthy lifestyle choices by consuming nutritious foods, getting adequate sleep, exercise, and staying up to date with immunizations are the most important ways to boost the immune system. In addition, research has shown that

supplementing with certain vitamins, minerals, herbs, and other substances can improve immune response and potentially protect against illness. However, it is important to understand that no supplement will cure or prevent disease. With the COVID-19 pandemic, it is especially important to understand that no supplement, diet or other lifestyle modification other than social distancing and proper hygiene practices can protect against COVID-19.⁹



Supplements That Help Improve Immune Function:

Vitamin D: a fat-soluble vitamin essential to health and functioning of your immune system. Vitamin D enhances the pathogen fighting effects of monocytes and macrophages and it also decreases inflammation, which helps promote immune response.¹⁰ Low vitamin D levels

are associated with an increased risk of upper respiratory tract infections, including influenza and allergic asthma.¹¹ A 2019 study showed that supplementing with vitamin D significantly reduced the risk of respiratory infections in people deficient in the vitamin and lowered infection risk in those with adequate vitamin D levels.¹² Depending on blood levels, anywhere between 1000 to 5000 IU of supplemental vitamin D per day is sufficient for most people, though those with more serious deficiencies often require higher doses.¹⁰

Vitamin C: supports the function of various immune cells and enhances their ability to protect against infection. It is also necessary for cellular death, which helps keep the immune system healthy by clearing out old cells and replacing them with new ones.¹³ Vitamin C also functions as a powerful antioxidant, protecting against damage induced by oxidative stress. Supplementing with vitamin C has been shown to reduce the duration and severity of upper respiratory tract infections, including the common cold.¹⁴ A large review study demonstrated that regularly taking vitamin C supplements reduced the common cold occurrence in individuals by up to 50%.¹⁵ Additionally, high dose intravenous vitamin C has been shown to significantly improve symptoms in people with severe infections, including sepsis and acute respiratory distress syndrome (ARDS) resulting from viral infections. Supplemental daily doses of vitamin C typically range from 250-2000 mg.¹⁶

Zinc: a mineral that is commonly added to supplements and healthcare products like lozenges to help boost immune function. Zinc is needed for immune cell development and communication and it plays an important role in the inflammatory process. A deficiency in this nutrient significantly affects your immune system's ability to function properly, resulting in an increased risk of infection and disease.¹⁷ Numerous studies reveal that zinc supplements may protect against respiratory tract infections such as the common cold and it may also help reduce the duration of the infection.¹⁸⁻¹⁹ Supplementing with 40 mg of zinc a day has shown to benefit the immune response.¹⁷

Elderberry: also known as sambucus nigra has been used to treat infections and has positive effects on immune health. Studies have demonstrated potent antibacterial and antiviral properties against bacterial pathogens responsible for respiratory tract infections and strains of the influenza virus. Elderberry has been shown to enhance immune system response and may help shorten the duration and severity of colds, as well as reduce symptoms related to viral infections.²⁰ A review of 4 randomized control trials found that elderberry supplements significantly reduced upper respiratory symptoms caused by viral infections. A study in 2004 also showed that people with the flu who supplemented with 15 ml of elderberry 4 times daily experienced symptom relief 4 days earlier than those who did not take elderberry and they were also less reliant on medication.²¹

Medicinal mushrooms: have been used since ancient times to prevent and treat infections and diseases. Many types of medicinal mushrooms have been studied for their immune-boosting potential and over 270 recognized species are known to have immune-enhancing properties. Some examples include: cordyceps, lion's mane, maitake, shitake, and turkey tail.²² Research demonstrates that supplementing with specific types of medicinal mushrooms may enhance immune health in several weeks and reduce symptoms of asthma and lung infections.²³ A randomized 8-week study showed that supplementing with 1.68 grams of cordyceps extract led to a significant 38% increase in the activity of natural killer cells, a type of white blood cell that protects against infection.²⁴ Many other medicinal mushrooms have been studied for their beneficial role on immune health and they can be found in the form of tinctures, teas, and supplements.

Echinacea: a coneflower that has been one of the most popular herbal medications used to help treat colds and flus. It is thought to work by stimulating the immune system by increasing antibody production, raising white blood cell counts, and stimulating the activity of white blood cells. Echinacea has shown promise for reducing symptoms and duration of colds and aborting a cold once it has started.²⁶⁻²⁸ One double-blind, placebo-controlled trials demonstrated that individuals with early cold symptoms who received echinacea recovered significantly faster 6 days versus 9 days among the placebo group.²⁵ Another trial of 246 participants looked at reduction of the severity of cold symptoms and found that echinacea significantly improved cold symptoms such as runny nose, sore throat, sneezing, and fatigue.²⁹

Probiotics: are healthy organisms that colonize the digestive tract. Not only can they help preventive intestinal infections, they appear to help prevent colds as well. A double-blind, placebo-controlled trial of 571 children found that the use of probiotic bacteria lactobacillus modestly reduced the number and severity of respiratory infections.³⁰ Benefits were also seen in three other large clinical studies, in which probiotics alone or combined with multivitamins and minerals helped prevent colds and or reduced duration and severity in adults.³¹⁻³³

The Importance of Diet: Eating a low-fat, plant-based diet gives the immune system a boost by increasing activity of white blood cells, which produce antibodies to combat against bacteria, viruses, and other invaders. Maintaining a healthy weight can also benefit the immune system,

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as obesity has been linked to increased risk for influenza and other infections such as pneumonia. Plant-based diets are effective for weight loss, because they are rich in fiber and fiber can lower BMI, which is linked to improved immunity. A plant-based diet has also been shown to reduce inflammatory biomarkers.³⁴⁻³⁵ Studies have shown that fruits and vegetables provide nutrients like beta-carotene, vitamin C, and vitamin E, which can boost immune function. Because many vegetables, fruits, and other plant-based foods are also rich in antioxidants, they help reduce oxidative stress.

Beta-Carotene: Beta-carotene is a powerful antioxidant that when consumed is converted to vitamin A, which can reduce inflammation and boost immune function by increasing disease-fighting cells in the body. Excellent sources include sweet potatoes, carrots, kale, mangos, and papayas.³⁶

Vitamins C and E: Vitamins C and E are antioxidants that help to destroy free radicals and support the body's natural immune response. Sources of vitamin C include red peppers, oranges, strawberries, broccoli, mangoes, lemons, and other fruits and vegetables. Vitamin E sources include nuts such as almonds and hazelnuts, sunflower seeds, spinach, and broccoli.³⁷

Vitamin D: Research shows vitamin D supplementation may reduce the risk for viral infections, including respiratory tract infections, by reducing production of proinflammatory compounds in the body. Increased vitamin D in the blood has been linked to prevention of other chronic diseases including tuberculosis, hepatitis, and cardiovascular disease. Food sources of vitamin D include fortified cereals and plant-based milks and supplements.¹¹

Garlic: garlic has powerful anti-inflammatory and antiviral properties. It has been shown to enhance immune health by stimulating protective white blood cells like NK cells and macrophages.³⁸

Zinc: zinc is a mineral that can help boost white blood cells, which defend against invaders as outlined above. Sources include chickpeas, cashews, pumpkin seeds, sesame seeds, beans, and lentils.³⁹

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