

Strong Immunity- A Major Weapon to Fight against COVID-19

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Abstract: Immune system consists of collection of cells, different processes, and chemicals that constantly defends the body against invading pathogens, which includes viruses, bacteria and other toxins. Keeping the immune system healthy and strong year-round is the key to prevent infection and diseases, this can be done by making healthy life style choices by consuming nutritious food and getting enough amount of sleep and exercise, these are the most important ways to boost the immune system. Immune system can be weakened due to smoking, alcohol consumption, and poor nutrition, temporary acquired immune deficiencies caused due to few medicines, example chemotherapy to treat cancer, also post organ transplantation. AIDS is acquired viral infection that destroys important white blood cells and ultimately weakens the immune system. These infections are called as opportunistic infections hence they take the advantage of weak immune systems. Risk factors of COVID-19 includes obesity, serious heart conditions, asthma, chronic kidney disease, chronic lung disease, diabetes, hemoglobin disorders, liver disease, and individuals with age 60 or above. Nutrition is intricately associated with immunity and to the risk of infections, in this case, consuming good quality diets is always desirable and this is important during the COVID-19 pandemic. Vitamin C, vitamin D, zinc, elderberry, turmeric, garlic, medicinal mushrooms, and along with this sound sleep, regular exercise and meditation will also boost and improve your immune system to fight against infections. The authentic dietary guidelines are studied to withstand COVID-19. These dietary supplements will boost the immune system, but these supplements are not meant to cure or prevent the disease but surely will help your body to fight against COVID-19.

Keywords: COVID-19, Immunity, Nutrition, Vitamin C, Infections.

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I. Introduction

Coronavirus are the type of viruses that typically affect the respiratory tracts of birds and mammals including Human beings. It causes common cold, bronchitis, pneumonia, severe acute respiratory syndrome (SARS). The new Coronavirus was first identified in the Chinese city of Wuhan belongs to the family of viruses that includes the common cold and more serious illnesses such as SARS (severe acute respiratory syndrome). the disease caused by new virus has been named COVID-19. In December 2019, Wuhan, Hubei province, China, became the center of an outbreak of pneumonia of unknown cause, which increased with intense attention not only within China but internationally. COVID-19 is the infectious deadly disease caused by the most recently discovered Coronavirus. COVID-19 is now a pandemic affecting many countries globally^[1]. As of May 2020 more than 4 million people have been infected and nearly 300,000 people have died. And there is no validated treatment or any vaccine is available for COVID-19 yet.

In minimizing the risk of infection, boosting your immune system may be a key weapon. Individuals with pre-existing illness like cardiovascular diseases, diabetes, hypertension and respiratory issues are at increased risk for developing COVID-19. It depends on the overall immunity of an infected person. People with strong immune system can fight against COVID-19 when compared to people with lowered immunity. Basically, immune system is comprised of two sub categories, innate immunity and adaptive immunity. Innate immunity is the first line of defense mechanism, it is activated when a pathogen initially presents itself, and this particular portion of immunity is inherited by birth and is not specific in its defense mechanism. It serves the overall immune system by alerting the specific cells of pathogen invasion to activate adaptive immune system. Innate immune system has both physical and chemical mechanism of response. These include, and are not limited to sneezing, sweating, coughing, gram positive normal flora on the skin and maintenance of normal body temperature. And adaptive immunity is a specific aspect of properly functioning immune system that will provide protection against previous infections experienced by the host, these responses are mediated by lymphocytes, which consist of natural killer (NK) cells, B cells and T cells, exposure to pathogens and vaccinations benefits the adaptive immune systems by establishing immunologic memory, in event of another

attack by the same foreign organism, the adaptive immune system is able to provide more efficient response^[14].this article explores the importance of nutrition to boost immunity to withstand COVID-19 and explains the possible ways about how to increase immunity level to fight against COVID-19.

Understanding the flu v/s understanding covid-19

Symptoms	Cold	Flu	Allergies	Covid-19** (can range from mild to serious)
Fever	Rare	High(100-102 f) can last 3 to 4 days	Never	Common
Headache	Rare	Intense	Uncommon	Can be present
General aches, pains	Slight	Usual, often severe	Never	Can be present
Fatigue, weakness	Mild	Intense, can last up to 2-3 weeks	Sometimes	Can be present
Extreme exhaustion	Never	Usual(starts early)	Never	Can be present
Stuffy/ runny nose	Common	Sometimes	Common	Has been reported
Sneezing	Usual	Sometimes	Usual	Has been reported
Sore throat	Common	Common	Sometimes	Has been reported
Cough	Mild to moderate	Common, can become severe	Sometimes	Common
Shortness of breath	Rare	Rare	Rare, except from those with allergic asthma	In more serious infections

Sources: national institute of allergy and infectious diseases CDC, WHO

**information is still evolving^[20].

The mechanism of action of how Immune system responds to a Coronavirus attack:

Viral particles enter body through nose, mouth or eyes. Inhalation will carry some of these particles to lower respiratory tract in which the spike proteins of Coronavirus acting like a key which lock into the epithelial cells that line the respiratory tract and to the air sacs in the lungs. SARS-COV-2 will be undetected and its spike proteins will gain entry by unlocking the ACE2 protein on the lung cells. After entering they will hijack the cell’s mechanism, they will replicate and multiply and infect the adjoining cells. Like the defining ACE2 proteins on the epithelial cells, viruses will also have a tell-tale signature on their surfaces known as antigens and spotting these is what hits the immune system into action by producing antibodies. They will start generating signals this will trigger another class of chemicals called as cytokines and chemokines and they will alert the immune system to send an array of various kinds of cells that are specialized to destroy viral particles, these cytokines and chemokines will ultimately trigger inflammation in cells, in nose and upper regions of respiratory system, runny nose and mucus is produced by this inflammation to trap viral particles and to prevent their entry. This will also trigger sneeze to expel. Because of inflamed sinus we get headache and general moistness that we associate with cold and when hypothalamus is inflamed, we get fever. In case of SARS-COV-2 the virus seems better at penetrating deeper, the inflammation will lead to increase the fluid in the lungs, and this fluid also contains the residue of a host of specialized cells, including T-cells that will damage many of the body’s own cells as well as the viral particles. It causes dry cough, and now the characteristic features of Coronavirus infection begin. As more air sacs are infected, the lungs find difficulty in extracting oxygen from the air, and eventually this provokes breathlessness.^[20] Keeping the immune system healthy and strong always is the key to prevent infection and diseases, this can be done by making healthy life style choices by consuming nutritious food and getting enough amount of sleep and exercise, these are the most important ways to boost the immune system^[17].

The immune SARS-COV-2 infection induced immune responses have two phases. Initially during the non-severe stages, a specific adaptive immune response can be required to eliminate the virus; hence strategies to boost immune system are important. For developing endogenous protective immune response at non severe stages and incubation period, the host should be in good health and with an appropriate genetic background i.e. HLA, that will elicit the specific antiviral immunity, when a protective immune response is impaired huge destruction of the affected tissues will occur and the virus will propagate. The damaged cells will induce innate inflammation in lungs that is mediated by granulocytes and pro inflammatory macrophages. And lung inflammation is the major and severe cause of life-threatening respiratory disorders^[3].

Risk factors for weakened immune system which may fail to fight against COVID-19:

Immune system can be weakened due to smoking, alcohol consumption, and poor nutrition, temporary acquired immune deficiencies by medicines, example chemotherapy to treat cancer, post organ transplantation, and infections such as flu, virus, and measles can weaken the immune system for short period of time this is called temporary acquired immune deficiencies. AIDS is an acquired viral infection that destroys important white blood cells and ultimately weakens the immune system. Hence, they take the advantage of weak immune

systems. And most importantly autoimmune diseases, the body attacks normal and healthy tissues in type 1 diabetes – in this condition immune system attacks the cells in pancreas that make Insulin. Rheumatoid arthritis- swelling and deformities of joints, rheumatoid factor is present in the blood of some people with rheumatoid arthritis. Lupus- these attack body tissues, like lungs, kidneys and skin ^[4]. Older adults and people of any age with serious underlying medical conditions could be at higher risk for COVID-19

- According to the centers for disease control and prevention the risk factors for COVID-19 may include ^[5].

RISK FACTORS	THEIR IMPACT ON COVID-19
Severe obesity	A person with obesity if eats healthy and exercises he is still at risk for decreasing immune function, obesity is itself impairs immune system, according to some studies and some specific findings may include, decreased cytokine production, natural killer cell dysfunction, altered lymphocyte function and monocyte function, decreased response to mitogen/antigen stimulation, decreased macrophage and dendritic cell function. People with obesity leads to increased risk of infections ^[8] . Severe obesity will increase the risk of serious breathing problem known as ADRS (acute respiratory distress syndrome) and ADRS is the major complication of COVID-19 and this may cause difficulty in providing respiratory support for seriously ill patients, along with this people with severe ability can have multiple serious chronic diseases that may increase the risk of severe illness from COVID-19 ^[5] .
Serious heart conditions	The damage which caused by a heart attack will trigger an inflammatory reaction which degrades the affected tissue. This response is orchestrated by immune cells in the nearby pericardial adipose tissue. "Lymphocyte clusters play an important role in orchestrating adaptive immune responses and monitoring inflammation processes" ^[9] . Serious heart conditions may include coronary artery disease, heart failure, congenital heart disease, pulmonary hypertension and cardiomyopathies, may put people at higher risk for severe illness from COVID-19. It is known that COVID-19 is like the other viral infection such as flu, so this may damage the respiratory system which may make difficult for heart to work normally. In patients with heart failure and other serious heart conditions it may lead to worsening of COVID-19 symptoms ^[5] .
Asthma	People with asthma will have the risk of infections is almost high, the immune system in asthma patients seems to forget earlier contact with harmful microorganisms more quickly and hence worse in the fighting infections, asthma ultimately causes lung damage so it may allow more bacteria and viruses entering into the body which causes infections ^[11] . According to CDC moderate to severe asthma can put people at increased risk for severe illness from COVID-19, there has been reports suggesting that asthma may increase the risk of hospitalization from COVID-19. For those with asthma there is great fear that they will be more likely to get SARS-COV-2 (the virus that causes COVID-19). There were several reports that steroids are contraindicated in COVID-19, however people with asthma were placed on controller medications to keep their asthma under control ^[6] . COVID-19 can affect your respiratory tract i.e. Nose, throat, lungs which may cause asthma attack and may lead to pneumonia and serious illness.
Chronic kidney disease being treated with dialysis	Chronic kidney disease affects both innate and adaptive responses, end stage renal disease causes variety of changes in immune system, both proinflammatory cytokines tumor necrosis factor- α (TNF- α , IL-6) and anti-inflammatory interleukin (IL-10) are increased. Cytokine accumulation occurs as the result of decreased renal clearance and increased production, latter it may be affected by uremic toxins, volume overload, oxidative stress and other co morbidities. ^[12] . Chronic kidney disease which is being treated with dialysis may increase the person's risk for COVID-19 infection because dialysis patients are more prone to infection and severe illness because of weakened immune system, procedures and treatment to manage kidney failure, and coexisting conditions such as hypertension and diabetes ^[5] .
Chronic lung disease	Chronic lung diseases include, chronic obstructive pulmonary disease, idiopathic pulmonary fibrosis, and cystic fibrosis can put people at increased risk for severe illness from COVID-19 depending on data from other viral respiratory infections, COVID-19 may cause severe illness ^[5] . Cigarette smoke and inflammatory signaling increases the expression of SARS-COV-2 receptor angiotensin converting enzyme 2 in the respiratory tract. Chronic obstructive pulmonary disease (COPD) is considered as a complex, chronic disease, cigarette smoke will induce chronic lung inflammation and it can be considered as a key etiological factor in the development and pathogenesis of COPD, inflammatory cells in lungs will respond to cigarette smoke exposure and releases proinflammatory mediators that recruit additional inflammatory immune cells. Chronic inflammation contributes to the lung damage, this compromise innate and adaptive immunity responses, and this will facilitate the recurrent episodes of respiratory infection that further contribute to pathological manifestations of the stable disease. The phenotype of immune cells in patients with COPD compared with healthy control individuals are found extensive immune dysfunction because of the presence of and functional activity of T regulatory cells, myeloid-derived suppressor cells and CD4+PD-1+ exhausted effector T cells. In COPD immunosuppressive networks could provide a rational strategy to restore functional immune responses, improve lung function and reduce exacerbations. Cigarette smoking is regarded as principle causative factor in the pathogenesis and development of COPD ^[13] . Cigarette smoke has potential to down regulate ace2 expression in few tissues or cell types, cigarette smoking has a profound impact on lungs of chronic smokers, the prolonged smoke exposure triggers secretary cell hyperplasia, hence there will be increase in the production of mucous in the respiratory tract ^[10] . Smoking, alcohol consumption and substance abuse has direct correlation to weaken immune system, engaging in smoking will weaken your lung capacity and destroy the cells lining your respiratory tract ^[16] .
Diabetes	Patients with uncontrolled diabetes are immunosuppressed because of the negative effects of elevated blood sugar on the immune system. Chronic hyperglycemia can lead to acidosis, and this will ultimately limit the activity of immune system. Chronic hyperglycemia slows perfusion through the

	<p>blood vessels which causes nerve damage as time progresses. The most common infections in diabetic patients involves urinary tract and the skin, more severe infections may also arise if blood sugars are not controlled, high glucose levels limit and dysregulate neutrophil synthesis, which is essential in immune system to attack a foreign object, if a pathogen is able to invade the host without any assistance of innate immune system, increased risk of infection will be expected. Increased blood glucose causes other undesirable changes in the function of the immune system such as decreased complement response, bactericidal activity and leukocyte adherence^[14]. The incidence of infection is increased in diabetic patients; the infections are most likely to be complicated course in diabetic patients when compared to non-diabetic patients^[7]. And may put people at higher risk of severe illness from COVID-19, because people with diabetes whose blood sugar levels are often higher than they are more likely to have diabetes-related health problems and those health problems can make it difficult to overcome COVID-19^[5]. Eat low carbohydrate diets, this will control high blood sugar and high blood pressure. A low carbohydrate diet will help to slow down diabetes and focus on a protein rich diet to keep your immune system healthy and regular consumption of vegetables and fruits rich in beta carotene, ascorbic acid, and other essential vitamins. Certain foods like mushrooms, tomato, and green vegetables are good options to build resilience in the body against infections^[16].</p>
Hemoglobin disorders	<p>Hemoglobin disorders such as thalassemia and sickle cell disease (SCD) may put people at increased risk for severe illness from COVID-19. Because living with a hemoglobin disorder possibly lead to serious underlying medical conditions such as heart disease, liver disease, diabetes, kidney disease, weakened immune system, viral infections or iron overload. And ultimately it will increase the risk of severe illness from COVID-19^[5].</p>
Immune compromised patients	<p>So many treatments and conditions may cause a person to have a weakened immune system which includes, cancer treatments, bone marrow or organ transplantation, immune deficiencies, prolonged use of corticosteroids, HIV with a low cd4 cell count, and other medications which may lead to weakened immune system, because people with weakened immune system have decreased ability to fight infectious diseases, which includes viruses like COVID-19, immune compromised patients may remain infectious for longer period of time than other covid-19 patients^[5].</p>
Liver disease	<p>Chronic liver disease like cirrhosis, may increase the risk for serious illness from COVID-19, because medications used to treat severe consequences of COVID-19 can cause strain on the liver, particularly those who are with underlying liver problems, people with severe liver diseases will have weakened immune system, because of this the body will not be able to fight against COVID-19^[5]. A new research claims that individuals who engage in heavy alcohol consumption will tend to suffer from acute respiratory distress syndrome (ARDS) this is one of the conditions caused by COVID-19 infection. If you are dependent on any of these sudden withdrawals may also be risky^[16].</p>
people aged 65 years and older	<p>Older adults are more likely to have underlying conditions such as diabetes, cardiovascular disease, or respiratory illness co morbidities a weaker immune system makes it harder for older adults to fight the infections, as a result impact on older adults is notable and according to world health organization data from April 2020 more than 95% of COVID-19 deaths were among people above 60 year of age, and more than half of the deaths occurred in people of 80 years and more. Older adults due to weakened immunity are at higher risk for severe illness and death due to COVID-19, although COVID-19 may affect any group, but the older adults are at increased risk of serious disease, eight out of ten deaths were reported in U.S. the risk of death is highest among those with 85 years of age or older, because of weakened immune system due to age, which makes harder to fight off infections, and also due to underlying diseases which can increase the risk of severe illness from COVID-19^[5] it aggravates with age as the general immunity reduces as you get older. Probiotics such as yoghurt, fermented foods and Yacolt are also excellent source for rejuvenating the composition of gut bacteria, this is important for nutrient absorption by the body; these are good options for older generation too^[16].</p>

A strong immune system can be a major weapon to fight against COVID-19:

Nutrition is linked to immunity and to the risk and severity of infections, in that case, consuming good quality diets is always desirable and this is important during the COVID-19 pandemic. There are some examples of existing evidence on nutrition and immunity boosting foods and supplements that would be important to consider for fighting against COVID-19.^[18] Dietary nutrient and optimal nutrition intake will have excellent impact on the immune system; therefore, the only sustainable way to survive in current situation is to strengthen and improve the immune system, and a healthy diet can ensure that the body is in proper state to defeat COVID-19. The dietary management guidelines and the food safety management must be followed.

2,500 years ago, Hippocrates said; “*let food be the medicine and medicine be the food*”. Incidence of disease and nutrient intake usually influence the nutritional status particularly of developing nations, where every individual is struggling for food, infectious diseases and inadequate diet can lead to severe malnutrition. And currently the COVID-19 crisis around the world is leading challenge; hence the researchers and scientists are attempting to create a specific vaccine for COVID-19, to maintain a strong immune system against Coronavirus disease nutritional status and the food we eat play an important role in determining overall health and immunity.

Factors affecting the nutritional status of an individual:

Certain factors such as age, gender, past medical and medication history, life style, health status, will affect the nutritional status of an individual. During this COVID-19 pandemic the nutritional status of an individual person has been used as a measure of resilience towards destabilization. Optimal status and the dietary nutrient intake will have good impact on the immune system through gene expression, activation of cell,

and modification of signalling molecules. Various dietary ingredients are determinants of gut microbial composition and they subsequently shape the immune responses in the human body; therefore, the evidence suggests that the only sustainable way to survive in this current crisis is to strengthen the immune system. Essential elements in maintaining of immune function are adequate intake of Zinc, Iron and Vitamin-A, B12, B6, C and E. The current scenario has a new set of challenges for an individual to maintain a healthy diet. The state of lockdown, self-isolation, and social distancing are the important measures in decreasing the risk of infection. The lockdown has significant impacts on an individual's health which includes, changes in sleeping habits, changes in eating patterns, and physical activity also, this would promote sedentary behaviors which ultimately affects mental as well as physical health and lead to an increased risk of obesity. Anxiety and fear may also cause changes in dietary habits which leads to unhealthy dietary patterns and decreases the desire to eat.

A balanced diet will build a strong immune system that can help withstand any assault by the Coronavirus. Vitamin C is major constituents of water-soluble vitamins which tend to make a strong immune system; the daily recommended dietary allowance for Vitamin-C is generally 90 mg/day for men and 75 mg/day for women. In this current scenario, it is important to be aware of particular types of food that can improve our immune system in order to fight against COVID-19.

Authentic dietary guidelines to withstand COVID-19:

- Eat fruits daily (apple, guava, banana, strawberry, grape fruit, cantaloupe melon, pine apple, papaya, Longman fruit, orange, blackcurrant, pumelo) with a serving size of two cups (4 servings).
- Eat fresh vegetables (garlic, ginger, green bell peppers, kale, lime, coriander (dried), broccoli, green chili pepper) 2.5 cups of vegetables (5 servings) legumes (lentils and beans).
- Eat whole grains and nuts, 180 g of grains (oats, wheat, millet, and brown rice, roots such as yam, potato, cassava or taro, unprocessed maize).
- Consumption of nuts like almonds, coconut, and pistachio.
- Red meat can be consumed once or twice per week, and poultry 2-3 times per week, consumption of foods from animal sources (example: fish, eggs, and milk) and 160 g of meat and beans.
- Choose fresh fruits and raw vegetables for snacks rather than foods that are rich in sugar, fat or salt. Avoid regular snacks, and junk foods.
- Do not overcook vegetables because it leads to the loss of important nutrients such as vitamins and minerals.
- While using dried or canned fruits and vegetables, choose a variety without added sugar or salt.
- Make sure the food is prepared and served at acceptable temperatures only.
- Limit a salt intake to 5 g a day.
- Consumption of unsaturated fats (unsaturated fats are found in avocado, nuts, fish, olive oil, soy, corn oil, and sunflower) rather than saturated fats (saturated fats are found in butter, coconut and palms oil, fatty meat, cheese, ghee, and cream)^[15].
- Drink 8-10 glasses of water every day, it helps the transport of nutrients in the blood, gets rid of waste, and also regulates the body temperature. Avoid consumption of all fizzy, concentrated juices, carbonated juices, and all drinks which contain sugar.
- Maintain a healthy life style, workouts, exercise, meditation, and regular sleep will surely build the immune functioning.
- Avoid eating outside, eat at home to avoid the contact with other people and try to reduce the chance of being exposed to COVID-19.
- Sleep at least 7-8 hours in a day is the best way to help your body-built immunity. Lesser sleep will lead to tiredness and this may impair your brain activity, the lack of sleep will prevent the body from resting due to these other bodily functions are impaired, this will have direct impact on your immunity^[16].

The proper diet can boost the immune system and help to ensure that the body is in the strongest possible state to battle the virus. Researchers have found that there is no source of contamination of virus via food or food packaging, avoid smoking, alcohol and other additive substances. Because they are directly linked between weak body defenses and respiratory illness. Supplementing with certain Vitamins, herbs, minerals and other substances can improve immune response and potentially protect against illness. A certain amount of nutrient saturates into cells and prevents any kind of nutritional deficiency. Individuals consuming well balanced diets will be safer with better immune system and decreases the incidence of chronic diseases and infections. And maintain physical and mental health of the individual^[15].

All you need to know about immunity boosting foods:

All the above-mentioned tips will definitely help boost your immunity system; few common super foods which can help to boost immunity are:

Vitamin C: Vitamin is a crucial participant in the army of immunity; it will help to prevent the common cold. It acts as powerful anti-oxidant and it will protect against damage which is induced by oxidative stress, in serious infections like sepsis and acute respiratory distress syndrome (ARDS), high dose intravenous Vitamin C treatment has shown to improve symptoms in patients^[16]. Vitamin C is the most popular supplement to protect against infections due to its important role in immune health. It is also an important factor for cellular death, which helps in keeping immune system which helps keep immune system healthy by leaving out cells and replacing them with new cells, Vitamin C is a powerful antioxidant, protecting against damage induced by oxidative stress, occurs with the accumulation of reactive molecules “free radicals” Vitamin C supplements reduce the duration of severity of upper respiratory tract infections which includes common cold, oxidative stress can negatively affect immune health. High dose intravenous Vitamin C treatment reported to improve symptoms in people with severe infections, including sepsis and acute respiratory distress syndrome (ARDS)^[17].

Vitamin D: Vitamin D supplements have mild protective effects against respiratory tract infections; people with Vitamin D deficiency should consult a doctor about taking Vitamin D^[16]. Vitamin D is a fat-soluble nutrient and it is essential to the health and functioning of immune system, Vitamin D will enhance the pathogen-fighting effects of monocytes and macrophages, white blood cells are important parts of immune defense and decreases the inflammation which ultimately promotes immune response^[17].

Zinc: Zinc is the most important component of WBC (white blood corpuscles) which will fight infections. The deficiency of zinc often make one more susceptible to cold, flu and other viral infections, it is advisable to take zinc supplements, in older people.^[16] zinc is commonly added to supplements and other health care products like lozenges which are meant to boost immune system , because zinc is an essential component for immune system functioning. Supplemental zinc may also reduce the duration of common cold^[17].

Elderberry: Elderberries are full of nutrients which includes Minerals like Phosphorous, Iron, Potassium, Vitamins and Copper, such as Vitamin A, B, C proteins and dietary fiber. Elderberries will have antibacterial and antiviral qualities which help to fight cold and influenza^[16] elderberry has been used to treat for infections. In test-tube studies this supplement acts as a potent antibacterial and antiviral potential against bacterial pathogens which are responsible for upper respiratory tract infections and strains of the influenza virus. And also, after a review of four randomized control studies in 180 people found that elderberry supplements will significantly reduce symptoms related to viral infections^[17].

Turmeric and garlic: Turmeric contains a compound which is called as curcumin, which boosts and increases the immune function; garlic has powerful antiviral and anti-inflammatory properties which will enhance body’s immune system^[16]. Garlic has powerful anti-viral properties it enhances immune health by stimulating protective white blood cells, like macrophages and NK cells^[17].

Medicinal mushrooms: Medicinal mushrooms have been used since ancient times for prevention and treatment of infections and infectious diseases, different types of medicinal mushrooms have been studied for immunity boosting potential. Over 270 species of medicinal mushrooms are known to have immune enhancing properties, few examples include: cordyceps, lion’s mane, maitake, shaitake, reishi, and turkey tail are beneficial for human health^[17].

Measures That May Boost The Immune System:

Don’t compromise on sleep: sleeping for at least 7 to 8 hours in a day. is the best way to help your body to build immunity, less sleep will make you tired and it may impair the activity of brain, due to lack of sleep body cannot rest properly and this will impair other bodily functions that will have direct impact on your immunity.

Stay hydrated: Try to drink up to 8-10 glasses of water every day, to stay hydrated because hydration will help reducing and flush out the toxins from the body and lower the chances of flu, and you can use juices made of citrus fruits and coconut water.

Regular exercise: A good diet can be followed by an exercise routine, exercise regularly; even light exercise will help in releasing toxins from your body. Depending on your stamina it is recommended to exercise for 30 to 40 minutes, regular exercise improves metabolism, which has direct correlation with immunity.

Distress yourself: Try to be free from all kind of stress, there are few steps we can follow regularly to help relieve our stress, and stress is known to have an adverse effect on immunity. By following the steps below:

Practice meditation/yoga : Taking so much stress may release the hormone called as cortisol, this will impair your response to immediate surroundings and makes your body susceptible to infections, and this will lead to anxiety, meditation can relieve stress, it is tested that meditation or yoga can calm the nerves.

Avoid smoking, alcohol, and other additive substances: Smoking, drinking alcohol and other substance abuse have direct correlation between weakened body defense mechanism and respiratory illness, will weaken the lung capacity and also destroy the cells lining the respiratory tract, and these cells are crucial to fight the viruses that will enter through nasal orifices, and individuals consuming heavy alcohol tend to suffer from acute respiratory distress syndrome (ARDS) and ARDS is one of the condition which is caused by COVID-19 infection. Practice moderation, sudden withdrawal can also be risky.

Avoid travelling: Avoid all kind of travels which are non-essential, because most of the COVID-19 positive cases are due to travel history, which later spread to communities and avoid exposure to public transport system and public places to avoid the exposure. In travelling condition make sure to cover your mouth with a mask and carry an alcohol-based hand sanitizer to sanitize each time you touch any surface. Because COVID-19 viruses can stay on the surfaces for few hours to few days. And follow all the precautionary measures.^[16]

Note: these dietary supplements will boost the immune system, but these supplements will not cure or prevent the disease but surely will help your body to fight against COVID-19.

II. Conclusion:

The global COVID-19 crisis is leading challenge across the globe, to fight against COVID-19 it is mandatory to attain and maintain good nutritional status. And the nutritional status of individual is affected by several factors which include age, gender, body weight, health condition, life style and history of previous illness under medication. Balanced diet is a key to strengthening the immune system in fighting against COVID-19. Body has its own natural defense mechanism but due to some factors such as obesity, serious heart diseases, asthma, kidney and lung diseases, diabetes, smoking, drinking alcohol, hemoglobin disorders, and sleep disturbances natural defense mechanism fails to produce its activity against infectious diseases. A proper diet can boost up the immune system and by following the authentic dietary guidelines individuals consuming well balanced diets will be safe with good immune system and body will have increased stamina to fight against COVID-19 or other chronic infectious diseases, because a healthy balanced diet will give rise to a strong immune system that can help withstand any assault by the virus and the preventive measures to prevent infection and transmission of COVID-19 includes washing hands regularly with soap or clean them with alcohol based hand rub, maintaining distance from people who are coughing or sneezing, avoid touching face, cover your mouth while coughing/sneezing, stay home if you feel unwell, refrain from smoking and other activities that weaken the lungs and practice physical distancing with people. The main objective of this article is to induce healthy dietary habits that help to maintain the physical as well as mental health of the individual because strong immunity can be a major weapon to fight against COVID-19 as well as many other diseases and infections.

References:

- [1]. Medical news today, Medically reviewed by Meredith Goodwin, MD, FAAFP on May 21, 2020 New, Written by Adam Felman. Available at <https://www.medicalnewstoday.com/articles/256521>. Accessed: May 28,2020.
- [2]. Yufang Shi, Ying Wang, et al., COVID-19 infection: the perspectives on immune responses in china. 23 March (2020) 27:1451–1454. Available at <https://www.nature.com/articles/s41418-020-0530-3?fbclid=IwAR2ZxeCwG6GQEZTC1GQbizfu0d5i1wIqREmK5IKRgeR2TsUc1dg8ta1GYyA>. Accessed May 28, 2020.
- [3]. Xu Z, Shi L, Wang Y, Zhang J, Huang L, Zhang C, et al. Pathological findings of COVID-19 associated with acute respiratory distress syndrome. *The Lancet Respiratory medicine*. April 8 2020 available at [https://doi.org/10.1016/S2213-2600\(20\)30076-X](https://doi.org/10.1016/S2213-2600(20)30076-X). Accessed: May 28,2020.
- [4]. University of Rochester medical center. Immune system disorders. Available at <https://www.urmc.rochester.edu/encyclopedia/content.aspx?ContentID=123> [HYPERLINK](https://www.urmc.rochester.edu/encyclopedia/content.aspx?ContentID=123&ContentTypeID=134)
["https://www.urmc.rochester.edu/encyclopedia/content.aspx?ContentID=123&ContentTypeID=134"&](https://www.urmc.rochester.edu/encyclopedia/content.aspx?ContentID=123&ContentTypeID=134) [HYPERLINK](https://www.urmc.rochester.edu/encyclopedia/content.aspx?ContentID=123&ContentTypeID=134)
["https://www.urmc.rochester.edu/encyclopedia/content.aspx?ContentID=123&ContentTypeID=134"ContentTypeID=134.](https://www.urmc.rochester.edu/encyclopedia/content.aspx?ContentID=123&ContentTypeID=134)
Accessed: May 28,2020.
- [5]. Centers for disease control and prevention COVID-19 groups at higher risk of severe illness. Available at <https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/groups-at-higher-risk.html>. Accessed: May 28,2020.
- [6]. American Academy of allergy asthma and immunology. COVID-19 and asthma. Available at <https://www.aaaai.org/conditions-and-treatments/library/asthma-library/covid-asthma>. Accessed: May 28,2020.

