

Role of Nutrition on Immune System During Covid-19 Pandemic

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Abstract

In the year 2019 a new strain of virus was came into world's knowledge which was originated from bats in Wuhan, China. COVID-19 was declared as a worldwide pandemic by the World Health Organization and keeping in mind that the World is grappling with the inevitable threat done by this virus to the mankind. As we know this virus is novel, so no vaccine, or drug is available for the treatment and the drug which is currently in use are providing the window period to our body which is helpful in development of adaptive immunity against COVID-19. The immune system is the organization of different organs and cells in which every individual performs its action in orchestral way to protect the host from any non-self-particles i.e. virus, microbes, fungi, parasites etc. Our body requires vast variety of micro (i.e. vitamins and minerals) as well as macro (like carbohydrate, protein, fat) nutrients to synthesize different kind of immune cells. Garlic, Basil leaves and Black pepper are some of the proven ancient herbs that boost the immunity. In this paper we have reviewed the literature on the immune supportive properties of micronutrient and the impact of their supplementation in up-liftment of immune system to fight against COVID-19 and other upper respiratory tract infections.

Keywords: COVID-19, Immune system, Food, Nutrition and micronutrients.

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Introduction

Coronavirus disease 2019 (COVID-19) is an infectious disease caused by Severe Acute Respiratory Syndrome Corona Virus 2 (SARS-CoV-2) [1]. It was first identified in December 2019 in Wuhan, China, and has since spread globally, resulting in an ongoing pandemic [2,3]. As of 10 June 2020, more than 7.3 million cases have been reported across 188 countries and territories, resulting in more than 413,000 deaths with more than 10% mortality rate [4].

The coronavirus (COVID-19) is having very high transmission rate among humans and it had transmitted throughout the globe, it is critical to practice the preventive measures to protect ourselves against these viruses. According to WHO's recent report viral diseases are world's highest public wellbeing challenges. (WHO, 2020). The World Health Organization (WHO) estimates occasional flu brings about 3-5 million cases every year. Today understand hygiene and social distancing are the key practices in protecting yourself as well as other people from getting an infection while additionally easing back the spread of the Virus.

COVID-19 or 2019 novel Coronavirus was declared as a pandemic by the World Health Organization in Feb 2020 and keeping in mind that the various countries are thinking about approaching threats that this virus poses to mankind, there are limited measures that people can take to battle this pandemic. There are additionally certain techniques to improve immunity which is vital at this period [5].

- Wash hands regularly for 20 seconds with soap and water or alcohol-based hand rub.
- Cover nose and mouth when sneeze or cough with a disposable tissue.
- Avoid close contact with people who are sick.
- Stay at home and self-isolate from others if feel unwell.

People in certain previous sicknesses like diabetes, hypertension, cardio vascular disease, and respiratory issues are at a higher danger of having COVID-19 entanglements, it likewise with age as the immunity decreases as you get older. In the younger age with no prolonged severe disease, COVID-19 can bring about minor symptoms on the individuals who have stronger immunity [5].

In the course of pandemic, when the whole world is affected from the disease, nutrition is should be at our highest priority, especially when we are dealing with a novel virus because here our immune system is the only barrier to deal with this Novel Coronavirus 19. In this context World Health Organization (WHO) had also released some directions on taking essential nutrients during the pandemic for healthy wellbeing. (WHO, 2020)

Immune cells require sufficient supply of energy, macronutrients and micronutrients filling in as co-factors in the advancement, articulation and maintenance of the immune response. The contribution of the healthy diet to immune function has become widely appreciated and the impact of different dietary parts

on explicit parts of immune function has been widely studied [6,7]. It is commonly perceived that the nutritional status of an individual modulates their immune capacity which can be viewed as a proportion of satisfactory nutrition.

This article will illustrate how micronutrients in food enhance the capacity of immune system to fight against COVID-19. In this article we will briefly review the role of various nutrients and minerals to boost immunity against COVID-19 after its proper intake.

Relation between Good Food and Healthy Gut

A better place to begin is diet, as per health specialists, 80% of the body's immune system is in the gut. A strong gut will give a more significant level of resistance [8]. The Mediterranean diet is a healthy alternative with its focus on fresh fruits and vegetable, whole grains, fatty fish, nuts, and olive oil. The diet gives a lot of nutrients, including vitamin A, B2, B6 and B12, C, D, and E [8]. Additionally gives zinc, iron, selenium, and other plant-derived minerals and cancer prevention agents i.e. food rich in antioxidants. As per the instruction of WHO consume diet rich in fruits and vegetable locally available in market which boost the immune system i.e. Citrus fruits like orange, grape as well as banana and apples, root vegetables such as carrot, turnips and beetroot

At long last, it gives healthy fats from fish oil. Recent research propose older adults on a Mediterranean-style diet who additionally took a vitamin D supplement of 400 IU/day had demonstrated increased level of healthy T cells in one year, demonstrating a positive impact on immunity. Whole foods is always more advisable, and a healthy dosage of matured food sources i.e. fermented foods, including sauerkraut, yogurt, and kafir (fermented milk product), depending upon the nearby culture, is likewise encouraged. Fiber and lentils are likewise food to eat for a healthy gut micro-biome [8,9].

In addition, there are evidence that nutrition and other way of life estimates impact immune capacity and susceptibility to infectious illnesses [5]. Whether these measures do or don't impact susceptibility to COVID-19 or its clinical course isn't yet known.

Diet during Covid-19 to Improve Immunity

In the wake of the COVID-19 pandemic, improving the immunity assumes a significant job in keeping up optimum health. As a well-known saying "prevention is better than cure". While there is no medicine yet discovered for COVID-19, it will be acceptable to take preventive measures which help our immunity during circumstances such as the present. The food plays a key role in deciding generally health and immunity. Eat low carb consumes less calories, as this will help control high glucose and blood pressure. A low carb diet will help to alleviate diabetes and focus on a protein-rich diet routine to keep our body fit. Regularly ingest vegetables and natural products good in β-carotene, Ascorbic acid and other essential nutrients. Certain foods like mushrooms, tomato, chime pepper and green vegetables like broccoli, spinach are additionally acceptable choices to develop resilience in the body against diseases [5].

Eating a low-fat, plant-based eating habit may help give the immune system a boost. The immune system depends on

WBCs which produce antibodies to battle against microbes, viruses etc. Vegetarians have been appeared to have improved white platelets as compared to non-vegetarians, because of a high consumption of nutrients and low ingestion of fat [10]. Eating a low-fat eat food may likewise be protective. Studies have indicated that restricting dietary fat helps stronger immune defenses. Research additionally shows that oil may impair WBCs function and that high-fat diet may disturb the gut micro-biota that supports immunity [11].

Maintaining a good weight can also boost the immune system. Obesity has been connected to expanded hazard for flu and different infections [12]. Plant-based diet are effective for weight reduction, since they are rich in fiber, which help in filling the stomach, without including additional calories. Fiber can likewise regulate BMI, which is connected to improved immunity [13]. A plant-based diet like fruits, vegetable, whole grains has additionally been appeared to reduce inflammatory biomarkers[14].

Role of Nutrition in Improving the Immune System

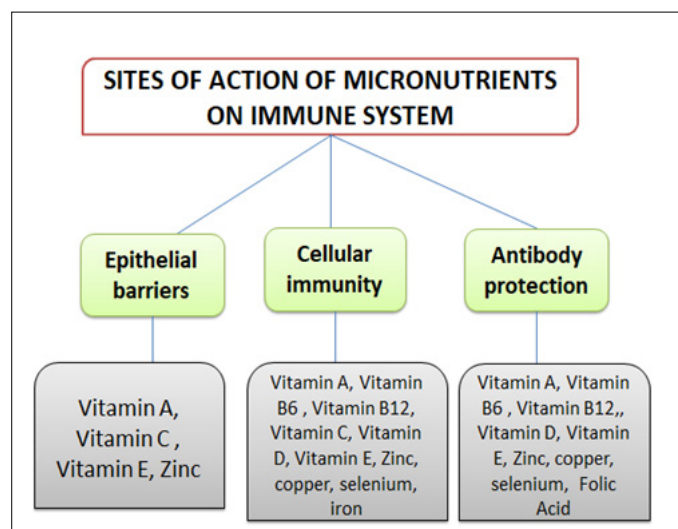


Figure 1. Sites of action of micronutrients on immune system.

Vitamin A

Vitamin A is often mentioned as the "anti-inflammation vitamin" as a result of its significant role in improving immune capacity. It has a focal role in the improvement of the immune system and assumes administrative roles in cell immune reactions and hum-oral immune processes [15]. Vitamin A is significant for epithelial cell integrity and immune capacity of the mucosa.

Animal sources of vitamin A include: pre-formed vitamin A (retinol)-liver, egg yolk, butter, milk, cheese etc.

Fruit and vegetable product include: pro-vitamin A carotenoids-orange, flesh fruits (i.e. sweet potatoes, melon, and mangoes), green leafy vegetable (spinach, broccoli, carrots, pumpkins, red palm oil [16].

β-carotene is a powerful antioxidant that can reduce inflammation and boost immune function by increasing disease-fighting cells in the body [17]. Changes in body composition with age

Vitamin B6

B6 is required for maintenance of homo-cysteine levels in Blood. (Raised homo-cysteine is a hazardous for cardiovascular disease). Vitamin B6, involves 3 structures pyridoxine, pyridoxal and pyridoxamine. All three types of B6 can be changed over to the co-enzyme PLP. Vitamin B6 in its coenzyme structure is included responses and it is fair to state that vitamin B6 is required for most of biological responses in our body. While more research is important to understand B6's role in immunity examines that Vitamin B6 inadequacy impact both hum-oral and cell mediated immune reactions and in this way disables immune reaction [18].

Bioavailability of vitamin B6: if consuming a mixed diet, the bioavailability of vitamin B6 is about 75%. Vitamin B6 is destroyed by heat but it remains stable during storage [16].

Sources of vitamin B6: Chicken, liver, Fish, Nuts, Chickpeas, maize and whole grain and cereals, and vegetables (especially green leafy vegetables), bananas, potatoes and other starchy vegetables [16].

Vitamin B12

Vitamin B12 is required for appropriate red blood cell construction, nerve system capacity, and DNA combination. It cooperates with Folate and Vitamin B6, to help support blood homo-cysteine levels, at a research point of view vitamin B12 has an important role in immune modulator for cellular immunity [19].

In Mikkelsen and Apostolopoulos chapter on the role B12 on immunity they deduce that B12 along with folic acid plays a key function in the healthy working of the immune system. To be sure, they found that inadequate levels changed immune reactions by affecting improvement of nucleic acid, protein creation, restraining the activity of immune cells and hindering metabolic procedure [20].

“Changes in body composition are due to alterations in energy balance, with a positive energy balance leading to weight gain and a negative balance resulting in weight loss. However, body composition changes associated with aging often occur in the absence of weight fluctuations. Age-related changes in body composition have been observed particularly after menopause in women” [1].

Bioavailability of vitamin B12: while there is insufficient data on the absorption of vitamin B12, experts assume that about 50% vitamins B12 are absorbed by adults with a healthy digestive tract. Inadequate absorption occurs when there is not enough acid in the stomach or when a protein called intrinsic factors is not produced in the stomach. Conventional cooking methods involving high heat and long cooking times may result in some vitamin B12 losses [16].

Sources of vitamin B12: it Include mainly animal sources like shellfish, liver, some fish (herring, sardines, salmon, trout) milk and milk products [16].

Vitamin C

This specific nutrient is a crucial member in the army of immunity. It helps to prevent the regular virus. Vitamin c is a powerful antioxidant and secures against harm induced by oxidative pressure. For serious infections, including sepsis

and acute respiratory distress syndrome (ARDS), high portion intravenous vitamin C treatment has been appeared to essentially improve indications in patients [5].

Vitamin C has a significant role in wound healing and cancer prevention agent, potentially protection cells from oxidative harm caused by free radicals. Vitamin C helps in the assurance against diseases and irritation by supporting different cell capacity of both the innate and immune system. As to respiratory tract diseases a Cochrane review shows a fundamentally decrease in the frequency of infection when member were supplement with Vitamin C [21].

Bioavailability of vitamin C: Levels of vitamin C in foods depend on the growing condition, season, stage maturity, cooking practices and storage time prior to consumption. Vitamin C is easily destroyed by heat and oxygen. Absorption levels depend on the amounts consumed. About 70-90% of vitamin c is absorbed. If intakes exceed 1000 mg/day, absorption levels drop to 50% [16].

Sources of vitamin C: Fruits (especially citrus fruits like lemon, orange, amla etc.), cabbage-type vegetables, green leafy vegetables, lettuce, tomatoes, potatoes and liver [16].

Vitamin D

Research shows vitamin D supplementation may reduce the hazard for viral infections, including respiratory tract diseases, by diminishing creation of pro-inflammatory compounds in the body. Increased vitamin D in the blood has been connected to prevention of other chronic disease including tuberculosis, hepatitis, and cardiovascular ailment. Food sources of vitamin D incorporate fortified cereals and plant-based diet, milks and supplements [22].

Although more clinical test is required promising outcomes have been appeared in studies to date. Apparently supplementation with vitamin D brings down the probability of creating intense respiratory tract infections to varying degrees [23,24] among the individuals who were infected, influenza manifestations experienced were less with recovery sooner if higher dosages of Vitamin D more prominent than 1000 IU were managed [25]. The advantages seem more prominent in those with vitamin D inadequacy than in the individuals who had adequate levels.

Sources of vitamin D: our exposure to sunlight, given the right season (not or limited during water depending on latitude) and enough time in the sun, has an important role in determining our vitamin D status. With the help of sunlight, Vitamin D is synthesized in the skin from a precursor derived from cholesterol. Vitamin D exists as either Vitamin D2 (ergocalciferol) or vitamin D3 (cholecalciferol).

Natural food sources: Oily fish-such as salmon, herring, mackerel, red meat, Liver, egg yolk, fortified foods such as-most fat spread and some breakfast cereals [16].

Vitamin E

Vitamin E goes about as an amazing cancer prevention agent preventing cells against oxidative harm from free radicals. Nutrient E has been appeared to have a significant role in regulating immune capacities. Indeed, even a single vitamin E inadequacy has been appeared to weaken the immune reaction

and its role in advancing an immune system especially obvious in aged people [26, 27].

An investigation by Lee and Hang additionally showed an especially defensive role against a few infectious diseases [28].

Bioavailability of vitamin E: Vitamin E is a fat soluble nutrient. As such, absorption of this vitamin is enhanced in the presence of fat in a meal. Individual on diets consisting mostly of starchy staples-with inconsistent intake of edible oils or other vegetables sources of Vitamin E-are at a higher risk of inadequate vitamin E intake [16].

Sources of vitamin E: edible vegetable oils (i.e. wheat germ, sunflower and rapeseed), leafy green vegetables (spinach, chards etc.), nuts, avocados, sunflower seed, mango and kiwi fruit [16].

Iron

Iron is fundamental for the development of hemoglobin in red platelets; which transports oxygen around the body. Iron additionally serve as a cofactor to enzyme in oxidation/decrease responses (i.e., acknowledges or gives electrons). These responses are vital to cells' energy metabolism [29].

Research recommends a low iron level affects our capacity to have a sufficient immune reaction [30]. It is required for immune cell production and development especially lymphocytes, which are connected to the specific reactions to infection [30].

Iron sequestration is a significant intrinsic host defense system because numerous pathogens rely upon this fundamental component. As a result, availability of body iron is carefully controlled and bound to proteins, for example, transferrin and ferritin [31].

Bioavailability of Iron: Iron is carefully regulated by the body and absorption rates vary by the size of a person's iron stores. Many factors affect the absorption of iron. Factors that enhance absorption of inorganic iron are Vitamin C and animal protein. Factors that inhibit inorganic iron absorption include phytates, polyphenol, vegetable protein and calcium [29].

Sources of iron: red meat, fish, poultry, shellfish, eggs, legumes, grains, and dried fruits.

Zinc

Practically all cells in our body contain zinc, an important supplement for development and improvement. The most concentrations are found in muscle, testicles and bone. The body firmly controls zinc levels. Stress and infections for instance cause plasma zinc levels to fall [29].

Much proof focuses to zinc having a strong role in the immune system and wound healing. Research shows that zinc influences various components of the immune system, from the barrier of the skin to gene regulation with lymphocytes [32]. Maywald and partners revealed that both zinc deficiency just as abundance prompts changes in immune cell numbers and activities, which brings about expanded susceptibility to diseases and improvement of provocative infections [33]. Curiously, zinc can diminish oxidative pressure which has been appeared to help avoid illness.

Bio availability of Zinc: like Iron, Zinc absorption will depend on the zinc body pool, with those having poor zinc status able to absorb zinc more efficiently in the gut. Foods rich in phytate lead to previously absorbed zinc being lost in the faeces. Protein may enhance absorption of Zinc [29].

Sources of Zinc: meats, some shellfish, legumes, whole grains and some fortified cereals [29].

Selenium

Selenium is a significant part of the body's antioxidant system, ensuring the body against oxidative pressure, a natural by-product of the body's metabolism. There is currently extensive proof that selenium assumes a key role in the functioning of the immune system [29].

This identifies with its role in controlling oxidative pressure, redox, and other cell forms in almost all tissues and cell types, incorporating those associated with innate and adaptive immune reactions [34].

Interestingly research shows that lacking selenium status is connected to the occurrence, seriousness, or disease of some viral infections [35,36]. Arthur and associates while inspecting selenium and community presumed that insufficiency can bring about the production of pro-inflammatory intensifies that would impact hazard toward illnesses, for example, coronary illness and disease [37].

Bioavailability of selenium: selenium from food sources is highly bioavailable [29].

Sources of selenium: Seafood, meat, whole grains, dairy, fruits and vegetables etc. [29].

Turmeric and garlic

The bright yellow spice, Turmeric, contains a compound called cur-cumin, which boosts the immune function. Garlic has powerful anti-inflammatory and antiviral properties which enhances body immunity [5].

Apart from maintaining a healthy lifestyle and taking supplements, the Indian health ministry is also suggesting few organic and natural ways to practice as preventive measures to fight COVID-19 [38,39]. The Ministry of AYUSH has recommended the following self-care guidelines as preventive measures and to boost immunity with special reference to respiratory health [40].

- warm water throughout the day.
- Meditation, Yoga-Sana, and Pranayama.
- the intake of Turmeric, Cumin, Coriander and garlic.
- herbal tea or decoction of Holy basil, Cinnamon, Black pepper, Dry Ginger and Raisin [41].
- sugar and replace it with jaggery if needed.
- Ghee (clarified butter), Sesame oil, or Coconut oil in both the nostrils to keep the nostrils clean [42].
- Chyavanprash 10 gm (1 tsf) in the morning. Diabetics should take sugar free Chyavanprash.

- herbal tea/decoction (Kadha) made from Tulsi (Basil), Dalchini (Cinnamon), Kalimirch (Black pepper), Shunthi (Dry Ginger) and Munakka (Raisin)-once or twice a day. Add jaggery (natural sugar) and/or fresh lemon juice to your taste, if needed [43].
- Milk-Half tea spoon Haldi (turmeric) powder in 150 ml hot milk-once or twice a day.

Factors Affecting Immune System

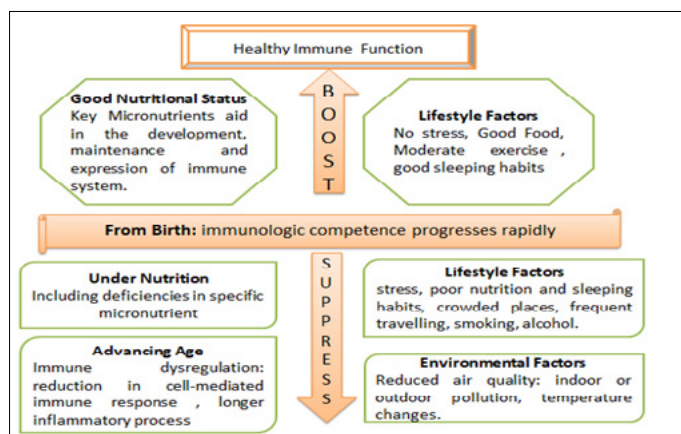


Figure 2. Factors affecting Immune System.

Conclusion

Great nutrition is central to improving immunity. The immune system is the body's protection against disease and virus and it has long been studied that few variables impact the capacity of the immune system including stress and nutrition. Vitamins and minerals, known as micronutrients, are supplements required by our body for ideal function and frequently required in just limited quantities. These micronutrients are not delivered in the body and in this way should be acquired from our food. Many researches show the key role nutrition plays in powerful working of our immune system. Giving a diet high in nutritious food rich in vitamins and minerals supports ideal capacity of the immune system by giving cancer prevention agents to slow harm of cells brought about by free radicals or aiding T-cell creation.

Although, there is no information concerning nutritional components according to the hazard and seriousness of viral disease, such as, COVID-19 the role of nutrition in immunity has been established. The European Journal of Clinical Nutrition concluded that without satisfactory nutrition, the immune system is clearly deprived of the components expected to create a successful immune reaction. Great nutrition is in this way significant in supporting an ideal immune system which can lessen the danger of viral diseases

Vitamin C, vitamin D and zinc have immune improving and immune regulating properties and assume synergistic role in supporting parts of both innate and adaptive immunity which contain epithelial obstructions, cell resistance and antibodies comprising the three primary lines of resistant protection. Then again, lacks of vitamin C, vitamin D and of zinc seriously discourage immune reactions and lead to an expanded hazard for infection for model in the respiratory tract.

Micronutrients are accepted to work all things considered to

help an ideal immune system. Based on a variety of systematic and clinical information, vitamin A, B, C, D, E, folate, zinc, iron, copper, and selenium are especially imperative to boosting immune response.

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