

COVID-19: IMMUNITY BOOSTER FOODS AND NUTRITIONS: A SHORT REVIEW

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ABSTRACT: The novel corona virus (COVID-19) has spread rapidly to numerous countries and has been declared as pandemic by the World Health Organization. Peoples with low immunity are being mostly affected by the coronavirus. However, Plantbased foods increased the intestinal beneficial bacteria which are very much helpful to increase the immunity of people by 85%. Using various minerals like Zinc, Magnesium, selenium, etc vitamin C, D, and E rich foods, sufficient amount of water and healthy lifestyle one can easily boost immunity and can overcome various infections including COVID-19. This paper focused on the use of plant-based foods for enhancing the immunity of human being against COVID-19.

KEYWORDS: Covid-19, immunity booster foods, vitamins rich foods,

1. INTRODUCTION:

The first new corona virus, COVID-19 (previously known as SARS-COV-2) was diagnosed on 31st December 2019, in Wuhan, Hubei province, China and all the cases were linked to source infection from a seafood wholesale market [1]. Living animals like snake, bird, marmot, bat, frog, and rabbit are regularly sold at the Hunan seafood market [2]. Although the transitional source of origin and move to human beings is not well-known, the fast human to human scattering ability of this disease has been recognized. World Health Organization (WHO) declared the COVID-19 outbreak (the ongoing epidemic) as a global public health emergency on 30th January 2020 [3]. The flu-like symptoms of COVID-19 generally come into view five to six days after infection and consist of fever, coughing, sore throat, body and muscle aches [4], and even loss of smell or taste in some cases [5]. In order to develop the physical and mental health of individuals concerning the COVID-19 pandemic, vitamin rich food is essential. Noteworthy, there is a link between food and immunity. In fact, existing evidence highlights that food has a profound effect on people's immune system and disease vulnerability. It is also mentioned that nutrients may change the immunity through the activation of cells, amendment in the creation of signaling molecules, and gene expression [6]. An adequate intake of minerals like iron, zinc, magnesium and vitamins A, C, D, E, B6, and B12 are predominantly vital for the maintenance of immune function [7]. Until and unless we get a coronavirus vaccine, we have to take all preventive measures and must keep ourselves healthy and safety. Drinking sufficient water is very important in this regard. Although drinking excess water is impossible to remove the coronavirus from human body or to protect against the coronavirus, it will be helpful to reduce risk to a greater extent. Patients having coronavirus positive must take plenty of water because the mucous membrane remains moist that reduces the chances of cold and flu. Besides, homemade soup, fruit juice, Functional foods and also vitamin rich foods can enhance the immune system to assist drive away viruses [8, 9]. For example, Vitamin C (ascorbic acid) has protective role due to its immune function, consequently it is important for the growth and renovate of all body tissues [10]. Also, it is able to protect the infection of lower respiratory tract under certain circumstances [11]. In addition, to boost our immune system against COVID-19, Vitamin D and E are effective supplements [12], as the decrease in cattle's levels of Vitamins D and E could lead to infection by a bovine coronavirus [13]. Das [14] proposed that bioactive lipids (such as arachidonic acid and other unsaturated fatty acids) can help in increasing resistance

and recovery from flu-like infections e.g., SARS, MERS and SARS-CoV-2. Natural polyphenols (e.g., hesperidin, rutin), powerful therapeutic drugs, are effectively used as inhibitors of COVID-19 main protease [15]. This review article describes about the foods and nutrients which helps to enhance immunity in human body against COVID-19.

2. 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 carbohydrate consumes less calories, as this will help control high glucose and blood pressure. A low carbohydrate 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 [16]. 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 [17]. Eating a low-fat eat food may likewise be protective. Studies have indicated that restricting dietary fat helps stronger immune defences. Research additionally shows that oil may impair WBCs function and that high-fat diet may disturb the gut microbiota that supports immunity [18].

Maintaining a good weight can also boost the immune system. Obesity has been connected to expanded hazard for flu and different infections [19]. 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 [20]. A plant-based diet like fruits, vegetable, whole grains have additionally been appeared to reduce inflammatory biomarkers [21].

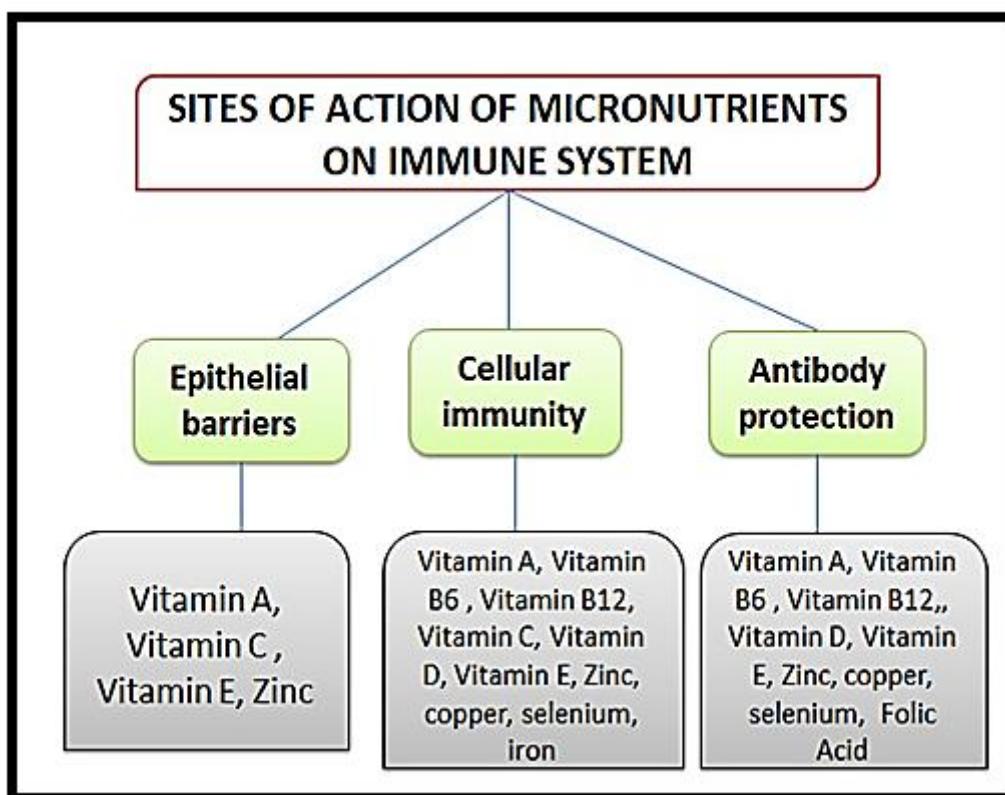


Figure 1. Sites of action of micronutrients on immune system.

3. VITAMIN C RICH FOODS:

Vitamin C helps stimulate the formation of antibodies. Eating a diet rich in vitamin C can help boost the immune system of human body and protect the cells against damage. Vitamin C (chemical name ascorbic acid) is a water-soluble substance which is generally used for various body functions e.g, the development and protection of skin, bones and also blood vessels. This essential vitamin also promotes wound healing. So it is worth mentioned that to prevent and fight our body against coronavirus infections we have to eat vitamin C rich foods regularly which can improve our immunity. Its antioxidant activity can decrease inflammation, which may help improve our immune function. Vitamin C also keeps our skin healthy by boosting collagen production, helping the skin serve as a functional barrier to keep harmful compounds from entering our body. Luckily, vitamin C is obtained from a number of fruits and vegetables [22] like amla, oranges, papaya, capsicum, guava, lemon etc. Among the immunity-boosting vitamins and supplements, vitamin C is the best for its good health benefits. A comparatively weakened person has more prone to any infections, even COVID19. So doctors always advised that old man and people with weakened immune system and underlying conditions have to take advance precautions to void coronavirus infection. Therefore, taking steps that strengthen our immunity is dominant at this moment. Among the various micronutrients, Vitamin C is regarded as one of the best Vitamin for increasing our immune system. After eating, the immersed Vitamin C is metabolised to oxalate in our body and is emitted by the kidneys. The amount of Vitamin C required daily is 90mg for adult male and 75mg for adult female and that increases to 120 mg for pregnancy women. The availability as well as functions of various fruits and vegetables rich in Vitamin C is discussed below. a) Amla: Amla is a rich source of vitamin C and it has antioxidant property. In accordance with Ayurveda, three health parameters vatta, pitta and kapha can be

controlled by amla. Moreover, a current study also explained that antioxidants present in amla can significantly diminish the injury caused due to oxidative stress and recover blood fluidity in human body which is published in the journal of Contemporary Clinical Trials Communications 2020. b) Papaya: Papaya is generally used to improve the digestive system of our body because of its natural laxative property. We know very well that it is an adequate source of vitamin C. In addition to that, the antioxidants in papaya can help in detoxification of the body and overturn the damage occurred due to oxidative stress. Also papaya helps in cell regeneration. c) Guava: Apart from being a good source of vitamin C, guavas are also rich in fiber and mineral like potassium that help in boosting immunity as well as keeps several diseases at bay. Apart from that, the nutrients present in guava keep the heart health well and decrease the sugar level. d) Capsicum: Capsicum is a green vegetable which contains numerous vitamins like C, E, A and minerals such as potassium and folate. Folate works as hemoglobin booster and it also helps the digestion of food molecules. e) Orange: Orange is rich in vitamin C, fiber and minerals like thiamine, potassium etc. Moreover, Antioxidants in orange look after skin from free radical damage i.e. signs of aging. f) Lemon: Lemon is a good source of both vitamin C and citric acid. Due to the presence of citric acid it helps to lose the excessive fat from our body. In fact, drinking lukewarm water with lemon juice and honey regularly in empty stomach removes a number of diseases far away and help in weight loss. g) Kiwifruit: kiwifruit or Chinese gooseberry is a nutrient-dense food. It acts as a healthful food because it has high vitamin C, low calorie and high nutrients. Its antioxidants, fibre, flavonoids and carotenoids help to protect our cells. A medium-sized kiwi contains about 70 mgs of vitamin C. h) Tomato: Tomato is a nutritious food containing several vitamins and minerals. It contains vitamin C, vitamin K, potassium and folate. Lycopene, an antioxidant, present in it which helps to reduce the risk of cancer and heart disease. A medium-sized tomato can give us about 20 mgs of vitamin C. i) Red pepper: Another great source of vitamin C is red pepper. It also contains vitamins A, B, E and K and several nutrients such as potassium, manganese, folate and phosphorus. A half-cup of red pepper contains around 95 mgs of vitamin C. j) Broccoli: It is one of the green vegetable which is rich in dozens of nutrients. It has antioxidants which help our body in a diversity of ways. High amount of vitamin C is obtained from Broccoli, which is very effective for immunity. Besides, broccoli has flavonoids that help recycle the vitamin C competently. It is also enriched with carotenoids lutein, zeaxanthin, beta-carotene and other power packed antioxidants. Moreover, it contains high levels of both calcium and vitamin K, both of which are significant for bone health and prevention of osteoporosis. In addition to that, broccoli has some valuable nutrients like zinc, magnesium and phosphorous. Due to these properties, broccoli is particularly suitable for children, elderly and lactating mothers. k) Strawberry: It is an excellent source of Vitamin C and manganese and also contains decent amount of folate and potassium. It has high number of antioxidants that control the sugar level in blood and also good for heart health.

3. VITAMIN D AND E RICH FOODS:

Consumption of medicines generally rises with age. Supplementation with vitamin D also develops the production of anti-oxidation-related genes (glutathione reductase and subunit controller glutamate cysteine ligase). Glutathione has antimicrobial property and it may be used for COVID-19 prevention and treatment. Current research has recommended that growing Vitamin D intakes may diminish the menace of infections and also COVID19 [23]. Lack of Vitamin D can also cause other health problems, like osteoporosis, heart disease, type-1 diabetes, as well as some serious cancers of the breast, prostate, ovaries, lymphatic system, etc. Vitamin D shortage can enhance the risk of infections and immune system disorders. Particularly older people who have lower levels of vitamin D may affected easily

by coronavirus. So, to stay healthy and fit our body needs vitamin D. It is also pointed out that there was a relation between low levels of vitamin D and higher numbers of Covid-19 cases [24] and mortality. Vitamin D may defend from viral infection and reorganize the symptoms of Covid-19, including the cytokine storm [25]. Vitamin D plays a vital role to develop immune system and prevents white blood cells from discharging massive inflammatory cytokines. It helps to reduce the Covid-19-induced cytokine storm. Vitamin D also assists to diminish lung injury and decreases the risk of acute respiratory tract infections. Some important foods containing Vitamin D and their functions are illustrated below.

- a) Whole eggs: While egg whites are high in protein, egg yolks are an excellent source of vitamins, mineral and omega-3 fats. Besides, egg yolks contain folate and vitamin B12 which improve our health. It is also mentioned that one egg yolk gives around 37 IU of vitamin D.
- b) Salmon: A popular fatty fish, salmon is another great source of vitamin D. According to the USDA Food Composition Database, 100-gram salmon contains 526 IU of vitamin D. Furthermore, salmon contains protein, omega-3 fats, potassium and other several nutrients.
- c) Mushrooms: A plant-based high rich source of vitamin D is Mushroom. The cooked fungus can produce vitamin D2 in our body whilst exposed to UV light, similar to humans – animals synthesize vitamin D3.
- d) Fortified foods: As we know that natural sources of vitamin D are limited, we have to eat various fortified foods to maintain the necessity of this nutrient in our body. These foods include cow's milk, soy milk, orange juice, oatmeal and cereal and that contain around 54-136 IU per serving. Vitamin E is very essential for maintaining the overall health of elderly people, including their immunity. It is a strong antioxidant which protects our body from different infections, viruses and bacteria. To obtain the daily dose of vitamin E we should consume various foods like peanut butter, soaked almonds, hazelnuts and even sunflower seeds. It functions mainly as nonspecific, chainbreaking antioxidant which prohibits the increase of lipid peroxidation. It is worth mentioned that vitamin E supplements would reduce severe discomfort, oxidative stress, and inflammatory cytokines [26]. The most vital function of Vitamin E is production of red blood cells in human body. Some examples of fruits and vegetables [27] riched in Vitamin E are i) Several vegetable oils e.g., sunflower, wheat germ, corn, safflower and soybean oils ii) Various nuts like peanuts, almonds and hazelnuts iii) Seeds like sunflower seeds iv) Green vegetables for example broccoli and spinach.

4. ZINC AND MAGNESIUM:

Zinc is an essential nutrient that plays a vital role in immune system response, wound healing, synthesizing proteins and DNA, and many other bodily functions. It is used in DNA synthesis and cell propagation [28]. Moreover, it is involved in the regulation of innate and adaptive immune responses, cell signaling, and production of immune cells [29]. As a trace element Zinc is used for the development of immune cells and plays an important role in various enzymes [30]. Examples of Zinc riched foods are- red meat, shellfish, oysters, beef patty, Alaska king crab, fortified breakfast cereal, cooked lobster, baked beans, dark meat chicken, beans, nuts, oats, seeds, wheat germ, etc. Several studies have noticed that zincbased lozenges could help to decrease the extent of cold in a day and lessen the number of upper respiratory infections in children [31]. It has also mentioned that zinc may be used to combat against COVID-19 by reducing viral replication and decreasing the effects of the gastrointestinal and lower respiratory symptoms [32]. Magnesium is a vital mineral for our immune system. It is also an important electrolyte that helps our body strengthen our immune system's natural killer cells and lymphocytes. ATP (adenosine triphosphate), the chief source of energy in cells, must bind with magnesium ion to form biologically active Mg-ATP. It is so important that our cells cannot function accurately without this energy. Magnesium assists the hemoglobin for delivering oxygen from our lungs to the whole body, which helps to fight

against COVID-19 infection because the virus initially attacks the upper respiratory system [33]. Dark chocolate, avocados, black beans and whole grains [34] are the good examples of magnesium rich food.

5. IRON

Iron is fundamental for the development of haemoglobin 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 [35]. Research recommends a low iron level affects our capacity to have a sufficient immune reaction [36]. It is required for immune cell production and development especially lymphocytes, which are connected to the specific reactions to infection [36].

Iron sequestration is a significant intrinsic host defence 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 [37].

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 in organic iron are Vitamin C and animal protein. Factors that inhibit inorganic iron absorption include phytates, polyphenol, vegetable protein and calcium [35].

SOURCES OF IRON: red meat, fish, poultry, shellfish, eggs, legumes, grains, and dried fruits.

6. 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 [35]. 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 [38].

Interestingly research shows that lacking selenium status is connected to the occurrence, seriousness, or disease of some viral infections [39,40]. 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 [41].

BIOAVAILABILITY OF SELENIUM: selenium from food sources is highly bioavailable [35].

SOURCES OF SELENIUM: Seafood, meat, whole grains, dairy, fruits and vegetables etc. [35].

7. TURMERIC AND GARLIC

The bright yellow spice, Turmeric, contains a compound called curcumin, which boosts the immune function. Garlic has powerful anti-inflammatory and antiviral properties which enhances body immunity [16]. 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 [42,43]. The Ministry of AYUSH has recommended the following self-care guidelines as preventive measures and to boost immunity with special reference to respiratory health [44].

- 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, Blackpepper, Dry Ginger and Raisin [45].
- sugar and replace it with jaggery if needed.
- Ghee (clarified butter), Sesame oil, or Coconut oil in boththe nostrils to keep the nostrils clean[46].
- Chyavanprash 10 gm (1 tsf) in the morning. Diabeticsshould 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 [47].

Milk-Half tea spoon Haldi (turmeric) powder in 150 ml hot milk-once or twice a day.

5. LIFESTYLE:

With the help of following heath strategies people may easily boost their immune system and stay protected himself from several viral infections like common cold, COVID-19 etc. a) Drinking water: We have to drink 2-3 liters of water throughout the day so that our body is sufficiently hydrated. If you have dehydrated, your body will be weakened and the immune system will also be weakened. b) Stress: Stress negatively alters the immune system responses within the body [48]. So keepping away from the media and TV is also very important in letting one's mind distress from the world a bit. c) Sleep: We have to required sleep at least 7-8 hours daily and to complete rest our body regularly. It has huge influence on the immune system. It gives the body an opportunity to heal and rest, especially in critical illnesses [49]. Moreover, doctors always suggest their patients to sleep at least 7-8 hours daily for recovery during the Spanish Flu Pandemic [50]. d) Exercise: Exercising helps raise the levels of white blood cells and antibodies that fight off infections [51]. Exercise is particularly significant after illness to develop muscle strength and elasticity [52]. In addition, exercise can help to build up mental strength and concentration of mind of people who have close contact with COVID-19 patients [53]. e) Food habit: It is well known that food gives us energy. So, to maintain a good health it is necessary to eat a well-balanced and healthy diet (not junk food). It also helps to develop our immune system properly. Food can affect our health at risk for certain diseases. So we must need to change some of our daily food habits. Some items are normally picked at the peak of the season and then frozen or fermented straight away [51], also, make sure to eat sufficient protein [54].

Factors Affecting Immune System:

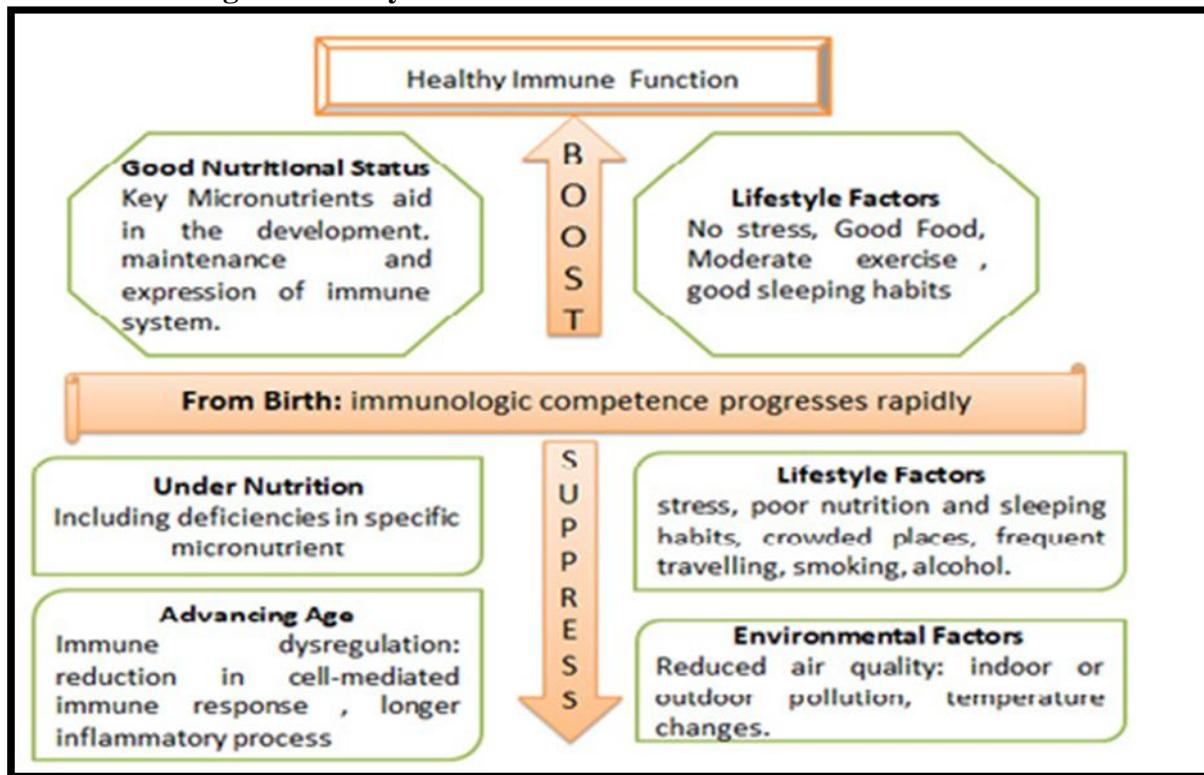


Figure 2. Factors affecting Immune System.

CONCLUSION:

The COVID-19 pandemic is an important threat to human life worldwide. As there is no known effective cure or treatment for COVID-19 so far, all probable therapeutics, mitigation interventions, and prevention strategies which may decrease the occurrence or severity of infection are of basic significance. Nutrients such as vitamin C, vitamin D, zinc, magnesium and selenium may help for the treatment of COVID-19. 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. 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.

Likewise, nutrients with antioxidant, anti-inflammatory and antithrombotic properties may prevent the inflammatory and vascular symptoms related with COVID-19. Therefore, the accountability of the persons during the COVID-19 pandemic lies in making an endeavor to desire a healthy lifestyle, eat sufficient amount of fruits and vegetables, exercise regularly, try to control body weight and sleep for certain time and take plenty of water. In addition to that, the broad responsibility of individuals is to avoid the spread of misinformation connected to nutrition and dietary intake, and the COVID-19. This is particularly significant for the susceptible in our society.

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