

# Role of Nutrition and Diet during COVID-19 pandemic: A narrative review

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## ABSTRACT

COVID-19 has impacted mankind drastically; whether it be physical and mental health, global economy, or social disruption, everyone has sustained losses. To prevent the spread, strict containment measures and stay at home guidelines were issued by officials. Due to this, an unanticipated and rapid change has occurred in the daily routine and lifestyle of the people. Physical distancing and quarantine measures strongly impacted people's lives, their eating habits and everyday ablutions. A comprehensive search of recent literature related to nutrition and diet during the pandemic was undertaken using electronic databases like MEDLINE, PubMed, Google Scholar, and ResearchGate. This review deals with the effects of COVID-19 on malnutrition, the foods that help in boosting the immune system, and on specific, vulnerable, age groups. Although there are various health concerns that has come up during the pandemic, through this review, we investigate some aspects related to nutrition as the recovery of every individual who was affected by COVID-19 was influenced by their nutritional intake.

**Keywords:** COVID-19 pandemic, diet, immunity, malnutrition, nutrition

## Introduction

Coronavirus disease 2019 or, as it is now called, COVID-19, is a severe acute respiratory syndrome caused by SARS coronavirus 2 (SARS-CoV-2). The virus transmitted from animals to humans and rapidly spread from Wuhan, China to the rest of the world.<sup>[1]</sup> On the 30 January 2020, because of increasing number of cases, the WHO declared it a global health emergency.<sup>[2]</sup> To prevent the spread of COVID-19, the governments of many of the affected countries decided to impose strict containment measures such as ban on public gatherings, closure of public places, etc.

Due to the strict containment measures and the stay at home guidelines issued by officials, an unanticipated and rapid change has occurred in the daily routine and lifestyle of the people. Physical distancing and quarantine measures strongly affected people's lives, their eating habits and everyday ablutions. Staying at home measures (which includes attending online classes, working from home, imposing restrictions on public gatherings, etc.) and food storage resulted in boredom, followed by excess calorie and energy intake.<sup>[3]</sup>

Moreover, stress from watching or reading news about the growing infection rates and increasing deaths from COVID-19 led to what is called "food craving" where people overeat junk foods that are rich in complex carbohydrates.<sup>[4,5]</sup> On the contrary, foods that are rich in simple carbohydrates reduces stress because they promote serotonin production which results in mental calmness.<sup>[6]</sup> In addition, the effect of carbohydrates varies, depending on the glycaemic index of foods consumed: The higher the index, the higher the chances of obesity and

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**Received:** 02-07-2021

**Revised:** 11-10-2021

**Accepted:** 16-10-2021

**Published:** 14-10-2022

### Access this article online

#### Quick Response Code:



**Website:**  
www.jfmpc.com

**DOI:**  
10.4103/jfmpc.jfmpc\_1311\_21

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**How to cite this article:** Pal J, Sethi D, Taywade M, Pal R. Role of nutrition and diet during COVID-19 pandemic: A narrative review. J Family Med Prim Care 2022;11:4942-8.

contracting other non-communicable diseases (NCDs), which ultimately increases the chances of developing complications during COVID-19 infection.<sup>[7,8]</sup>

Unexpected changes in daily routine can affect our well-being. In the present pandemic, it is very crucial to maintain an optimal nutritional status to improve immunity and recovery from diseases. A study has reported that people with a body mass index (BMI)  $\geq 40$  kg/m<sup>2</sup> are at high risk of COVID-19 complications.<sup>[9]</sup> Obesity is an excessive spread of adipose tissue, which releases inflammatory mediators and creates an inflammatory environment.<sup>[10]</sup> A recent study has shown that during the lockdown, the fear of getting infected with COVID-19 led people to adopt some healthy strategies that brought about changes in their daily routine, namely meditation, brisk exercises, and a healthy diet.<sup>[11]</sup> To prevent the spread and complications of COVID-19, a strong emphasis was placed on nutrition and dietary intake. People were encouraged to consume a balanced diet because a good nutritional status can lead to good recovery and outcome.<sup>[12]</sup>

The present review aims to look at dietary choices, the recent recommendations on nutrition, the impact of different nutrients on the immune system and COVID-19, malnutrition and COVID-19, and the general dietary recommendations for COVID-19 patients.

## Methodology

A comprehensive search of literature related to nutrition and diet in COVID-19 was undertaken using electronic databases like MEDLINE, PUBMED, Google Scholar, and Research gate.

### Influence of COVID-19 on malnutrition

The unexpected occurrence of new infectious diseases highlights our susceptibility to new, emerging, pathogenic organisms. The outcome of a variety of infections solely depends on the host's immunity and nutritional status.<sup>[13]</sup> In this paper, we describe two commonly occurring statuses of nutrition and the influence of COVID-19 on these nutritional statuses.

#### Obesity

Obesity is an excessive spread of white adipose tissue, which is an extremely active organ that interferes with immunologic, endocrine, and metabolic functions.<sup>[14,15]</sup> In obesity, certain cellular changes occur in the adipose tissue which leads to chronic low-grade inflammation due to the proliferation of effector T cells, including T and B lymphocytes as well as macrophage infiltration.<sup>[16]</sup> The proliferation of T lymphocytes leads to early activation or release of inflammatory cytokines which results in poor antigen response and alterations in the function of natural killer (NK) cells, dendritic cells, and macrophages. Such immune dysfunction results in a poor immune response to infections.<sup>[17]</sup>

Literature states that half of the world's population are now suffering from obesity, thus, strict containment measures, such as a

longer periods of quarantine or isolation should be considered.<sup>[18]</sup> An experimental study has shown that mice with higher BMI are more likely to have low antibody titre post-vaccination, so it is important to mention that obese people may not get protection from a vaccine to the same extent as other healthy individuals.<sup>[19]</sup>

Obese individuals who are vaccinated having more chances of developing influenza-like illness in comparison to healthy individuals.<sup>[20]</sup> If the same phenomena are observed in COVID-19 patients, then vaccination for them may not be an effective method of protection.

The fat is necessary for the growth of an individual, when we consume fat and energy rich food if it do not burn off the energy. The energy will be stored as fat and leads to obesity can be referred as a state of over-nutrition. on the contrary in older age there is beginning of loss of fat and muscle mass and leads to the state of under-nutrition. thus, developing a burden of malnutrition which includes both the under and over nutrition.<sup>[21]</sup> Obesity is one of the most frequently reported risk factors for contracting NCDs and organ failure, telling us how badly obesity affects health.<sup>[22-25]</sup>

In addition to that, obesity is commonly associated with micronutrient deficiencies and that's how it interferes with the metabolic and immune function, ultimately leading overweight individuals towards overwhelming infections and enhancing the burden of malnutrition.<sup>[26,27]</sup> Further, pandemic-related lockdowns have brought drastic and deleterious lifestyle changes in the obese individual's daily routine that may intensify bodyweight and its composition, ultimately leading to the risk of contracting NCDs.<sup>[28]</sup>

#### Undernutrition

Undernutrition, a pathologic state in which dietary intake fails to meet the body's energy or nutritional requirements. It can also arise from inadequate intake of macronutrients or micronutrients, abnormally increased energy expenditure, defective absorption of nutrients, or a combination of these.<sup>[29]</sup> Undernutrition is a widely prevalent problem in Non western countries. In 2017, it was reported that globally, around 821 million people are undernourished.<sup>[30]</sup> Not only protein-energy malnutrition but specific single nutrient deficiencies are also responsible for the occurrence of infections.<sup>[31,32]</sup> When a person contracts an infection, energy consumption by the immune defence mechanism increases, thereby leading to higher nutritional requirements.

Additionally, malnutrition depletes the number of immune cells in the body.<sup>[33-35]</sup> Both under- and over-nutrition alter the cytokines and hormones secreted by tissues, and reduces nutrient consumption by the cells and tissues. As a result, the person becomes a susceptible host to many infectious diseases.<sup>[36]</sup>

Since older adults are frequently present with reduced mobility, poor nutrition, and decreased muscle mass, digestive tract symptoms of COVID-19 are even more harmful in malnourished and older patients.<sup>[37]</sup> However there is little data that shows that a

significant proportion of the population affected with COVID-19 was under or malnourished at the time of hospitalization.<sup>[38]</sup>

### Malnutrition and vulnerable age group

Paediatric and older populations are at higher risk of developing malnutrition, including both under and over-nutrition; this risk is directly proportional to the sum as well as the standard of the food intake.<sup>[39,40]</sup> However, it would not be wrong to say that nutritional status is something that has always been overlooked. Malnutrition could exaggerate the deleterious effects of the COVID-19 infection, by altering immune response and putting individuals at increased risk of infections, irrespective of whether they belong to the paediatric or older population.<sup>[41-43]</sup> Malnutrition affects the body's repair and maintenance capacity which further imposes risk of complications.<sup>[44]</sup>

COVID-19 itself affects one's nutritional status by several mechanisms such as, increased metabolic rate, increased energy requirements, as well as digestive tract symptoms (i.e., nausea, loss of taste and smell, vomiting, diarrhoea) which may further aggravate undernutrition.<sup>[45-47]</sup> However directly or indirectly, this pandemic has affected nutritional status in across the globe.

During the pandemic, lockdown has affected people in many ways; people in developing societies in particular were highly affected as most who depended on daily wages faced food shortages leading to limited food intake. People in developed societies, however, were surrounded by an obesogenic environment and resulted in excessive calorie intake.<sup>[48-50]</sup> It would not be wrong to say that this pandemic grossly exacerbated social inequalities.

Sometimes, people encounter manipulated news that encourage an increased intake of food during COVID-19. In fear of being infected, people start consuming more foods that contain saturated fats, refined carbohydrates, low fiber content, antioxidants, and unsaturated fatty acids. Even after consuming all of these people might fall ill as excessive consumption of any nutrient leads to deficiency of another. Ultimately the chances of developing obesity and contracting NCDs goes up along with poor recovery from COVID-19.<sup>[51]</sup>

Altered nutritional status, in COVID-19 infection, may adversely impact two vulnerable age groups: children and older adults. In younger individuals, the peak of the disease occurs in later stages of illness but in the older generation, they experience immediate deleterious effects that may lead to even death.<sup>[52]</sup>

### Geriatric population

As we have already mentioned, COVID-19 can directly and indirectly affect the nutritional status of an individual in many different ways. Direct effects on nutritional status can be immediately seen in the older population. Not only the respiratory tract, but the digestive system can also be affected by SARS-CoV-2 infection with symptoms like nausea, diarrhoea, vomiting, and anorexia.<sup>[53-55]</sup> A highly catabolic state in COVID-19

results in an intensified inflammatory environment and may result in muscle wasting.<sup>[56]</sup>

Thus it becomes obvious how COVID-19 can bring drastic changes in the physiological functioning of the older population and place them at risk of undernutrition. It has been seen that during hospitalization, these physiological developments bring about a negative outcome of COVID-19.<sup>[57]</sup> Various studies have reported that most of the hospitalized population were malnourished, and older individuals composed of a large number. However, half of the population were not malnourished at the time of admission and became weak during the illness.<sup>[58-60]</sup>

Containment measures have had an impact on the lives of the geriatric population; due to the lockdown, they were not able to go outside for routine walks and meeting their peers. This has also harmed their mental health. Moreover, many older individuals were not able to access preventive care or any sort of nutritional counselling.<sup>[61,62]</sup>

Due to lockdown measures the older population has also experienced difficulties in accessing groceries and other food items; thus, to fulfill their basic requirements, they had to rely on others. They have had to face financial difficulties as well. All of these obstacles have ultimately resulted in reduced access to food items and minimal to no physical activity. These practical problems faced by older individuals made them more vulnerable to the disease. Individuals or older adults those who are healthy they are also at risk of malnutrition because during lock-down difficulty in accessing the basic food requirements and work from home promoted the on line purchasing and sedentary lifestyle. thus, pandemic not only affecting the people from low income families, in fact it is affecting the nutrition all around the globe. During the lockdown, not only the older but young generation as well have lost their previously healthy status.<sup>[63,64]</sup>

### Paediatric population

Humanitarian programmes organized by NGOs and other social welfare societies have been slowed down due to the lockdown, resulting in minimal or no access to safe water and adequate nutrition, as well as cut down of health care services. Severe nutritional deficiencies in children have been exacerbated to such an extent that chances of recovery are very low.<sup>[60]</sup>

This pandemic has predisposed children to experience not only protein-energy malnutrition but other problems as well; for example, due to the lockdown, the school education system has collapsed and this has affected the psychosocial and physical growth of the child.<sup>[65]</sup> Food insecurity is not the problem of only non-western countries, but also that of western countries. Children from low-income families had so far relied on the government-led school system and midday meals; but now due to containment measures, that is also not available.<sup>[60,63]</sup>

On the other hand, surveys carried out during lockdowns have described children from economically stable families as indulging

in bad dietary choices and excessive food consumption. This coupled with a sedentary lifestyle may result in detrimental effects of COVID-19.<sup>[66]</sup>

Thus, COVID-19 not only affected older adults but also children. A sedentary lifestyle and lack of food supply led to an obesogenic and leptogenic environment, which in turn led to an increase in the number of cases of obesity, stunting, and retarded growth in children.<sup>[67]</sup> SARS-CoV-2 is unavoidable, and it is even affecting the nutritional programs implementation to overcome under-nutrition and over-nutrition.<sup>[60]</sup>

### Effect of dietary nutrients on immune defence mechanism

A healthy nutritional status plays a crucial role in an individual's life because it is the health status that fights infections. In this section, the advantageous effects of various nutrients, which are present in different food resources, and supplements on the body's immune system and overall health are discussed. However, just as there are no known evidence-based cure or treatment strategies to contain and prevent the spread of COVID-19, there is no single food, nutrient, supplement or any other natural remedy that has been proven to prevent COVID-19 infections, as stated by the WHO.<sup>[68]</sup>

However, previous studies have made it clear that nutritional status plays an important role in the patient's outcome. Thus, for patients with comorbidities who have been infected with COVID-19, nutrition is an utmost concern. Likewise, for those who have not been affected by the virus, following a healthy diet is vital for a good immune response.<sup>[69]</sup>

Various food items have anti-inflammatory and immunomodulatory properties and their consumption reduces the risk of developing cardiovascular diseases, respiratory diseases and various other infections.<sup>[70-72]</sup>

A healthy lifestyle consists of physical activities like running, walking, exercising, meditation and avoiding stressful situations as much as possible.<sup>[73,74]</sup> In fact, age itself is a risk factor for contracting COVID-19.<sup>[75]</sup> As age advances, our body's defence abilities begin to decrease: This process or phenomenon is known as immunosenescence.<sup>[7,76]</sup>

Poor nutrition occurs due to many different reasons, such as low socioeconomic status, mental status, social status, and a host of other multifactorial issues. Even after consuming an adequate amount of food, people suffer from nutritional deficiencies because they lack some of the essential nutrients in their diet.<sup>[77,78]</sup> These nutritional deficiencies can hamper the functioning ability of the immune system in the elderly, and put them at risk of infections.<sup>[79]</sup> A healthy, balanced diet includes macro- and micronutrients, prebiotics, and probiotics that can rebuild, reinstitute, replace and support cells of the immune system, thus enabling resistance functions against chronic inflammation-related NCDs and infections.<sup>[80]</sup>

In this section, the nutrients described have been chosen because of their unique immunomodulatory properties. Though, there are other nutrients that are worthy of more intensified experimentation, including some trace elements and various probiotics and nutraceuticals. Maintaining a healthy balanced diet is essential and it should consist of all the necessary nutrients required of the body.

- **Proteins:** Protein deficiency is always associated with impaired immune system function because it affects both the number of functional immunoglobulins and gut-associated lymphoid tissue. When it comes to strengthening the immune system, not only the quantity but the quality of protein also matters. Amino acids like arginine and glutamine are known for their beneficial effects on the immune system. Thus always choose proteins which are high in their biological value because they exert anti-inflammatory effects.<sup>[81]</sup>
- **Lipids:** Lipids help in modulating the immune system function. Among these, omega-3 fatty acids, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) deactivate the enveloped viruses by interrupting the favourable and optimal host conditions for viral replication. EPA and DHA help to suppress pro-inflammatory prostaglandin production as well.<sup>[82]</sup>
- **Carbohydrates:** Highly processed carbohydrates or carbohydrates with a high glycaemic index (GI) are not good for health as they generate free radicals. It has been reported that consuming highly processed carbohydrates leads to an increased level of inflammatory mediators which causes cell destruction and respiratory infections.<sup>[83]</sup> So it is advisable to limit the intake of such food products.
- **Fibre:** It has been proved that fibre is important for our body's correct metabolic functioning. Adequate fibre intake of 25–35 g/day may help to systemically reduce gut inflammation because it helps in lowering the levels of inflammatory cytokines.<sup>[84]</sup>
- **Vitamins and trace elements:** Vitamins play a crucial role in building up immunity and reducing susceptibility.<sup>[85,86]</sup> Vitamins A, C, D, E, B6, B12 and minerals are crucial as they take part in the production of inflammatory mediators, the proliferation of lymphocytes, antibody formation and generation of memory cells. Not only this, they play a major role in the development of physical barriers and antimicrobial proteins, and regulate the overall inflammatory response.<sup>[87,89]</sup>

### Crucial role of primary care physician in balanced diet and nutrition counselling

Optimal nutrition will strengthen the immune system to combat COVID-19 infection and other various complications. The need of the hour is to remain healthy during the pandemic and for this, consuming nutritious food is the only choice. The crucial role of the primary care physician in preventing COVID-19 with the help of nutritional status is very diverse. People of weak financial status cannot afford to have a dietitian or nutritionist nor follow the food choices suggested by them. To make them aware of why a healthy nutritional status is of utmost importance, the primary care physician in coordination with local authorities like sarpanch,

ASHA, ANMs, etc., can start a dedicated setup for all visitors and patients to have mandatory nutritional counselling at subsidized rates. When people come for treatment and consultation, they should be counselled about what to eat to prevent the illness, during the illness, and post recovery. Posters and pamphlets should be distributed so that people can be conscious of those food groups in their surroundings that are rich in different nutrients and are helpful in improving their nutritional status.

## Conclusion

In the present paper, we provide a review of the studies done on malnutrition, immunity, and diet during COVID-19, how vulnerable age groups have been affected, and the foodstuffs that have been recommended by various nutritional guidelines, based on current knowledge. Furthermore, the altered status of nutrition has affected individual more radically. People in extremes of age have also shown more vulnerability towards the infection. Regarding the effects of the nutritional compounds present in foodstuffs, many studies have described the benefits of consuming food rich in various nutrients. Due to the novelty of this pandemic, information regarding every aspect of infection, nutrition, and health management is still scarce. And that is why there is still scope for extensive research on the aspects related to the COVID-19.

## Key message

Malnutrition is already a prevalent condition around the globe, and during the present pandemic, the condition became worse as malnutrition increased tremendously. Therefore, it is crucial for healthcare professionals to come with a diet plan which includes the foodstuffs which are readily available and contain all the essential nutrients. Counselling and education should be imparted to the common man regarding the vitality of nutrition.

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

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