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Nutrition and Immunity in COVID-19

Marjan Moallemian Isfahani, Zahra Emam-Djomeh, Idupulapati M. Rao, and Nima Rezaei

Abstract

Nutrition can strongly influence infection trajectories by either boosting or suppressing the immune system. During the recently emerged pandemic of coronavirus disease 2019 (COVID-19), individuals who possess diets high in fat, refined carbohydrates, and sugars have shown to be highly prone to the disease and associated adverse outcomes. Both micronutrients and macronutrients provide benefits at different stages of the infection. Thus, using appropriate nutritional recommendations and interventions is necessary to combat the infection in patients with COVID-19 in both outpatient and inpatient settings.

Keywords

COVID-19 · Immunity · Micronutrient · Nutrition · Selenium · Vitamin

28.1 Introduction

In December 2019, a novel coronavirus called severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) begun rapid transmission among people. As of writing this, the number of confirmed cases is approaching 10 million, with 500,000 deaths.

COVID-19 affects not only the respiratory tract, but it can involve other organs associated with increased morbidity (Yazdanpanah et al. 2020b; Shamshirian and Rezaei 2020; Jahanshahlu

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M. Moallemian Isfahani
Dietetics and Nutrition Experts Team (DiNET), Universal Scientific Education and Research Network (USERN), Tehran, Iran

National Nutrition and Food Technology Research Institute, Shahid Beheshti University of Medical Sciences, Tehran, Iran

Z. Emam-Djomeh
Dietetics and Nutrition Experts Team (DiNET), Universal Scientific Education and Research Network (USERN), Tehran, Iran

Department of Food Science and Engineering, University College of Agriculture and Natural Resources, University of Tehran, Karaj, Iran

I. M. Rao
Centro Internacional de Agricultura Tropical, Santiago de Cali, Colombia

N. Rezaei (✉)
Department of Immunology, School of Medicine, Tehran University of Medical Sciences, Tehran, Iran

Research Center for Immunodeficiencies, Pediatrics Center of Excellence, Children's Medical Center, Tehran University of Medical Sciences, Tehran, Iran

Network of Immunity in Infection, Malignancy and Autoimmunity (NIIMA), Universal Scientific Education and Research Network (USERN), Tehran, Iran
e-mail: rezaei_nima@tums.ac.ir

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and Rezaei 2020a; Saleki et al. 2020; Lotfi and Rezaei 2020). Older adults, patients with pre-existing conditions, in particular cardiovascular diseases, hypertension, diabetes, and cancer, and individuals harboring genes that affect immunity have shown the worst outcomes and highest mortality (Shamshirian and Rezaei 2020; Ahmadi et al. 2020; Yousefzadegan and Rezaei 2020; Darbeheshti and Rezaei 2020). After 6-month efforts to crack the spread of the COVID-19 pandemic, there are still no vaccines or effective medications to protect the body against or to treat the infection (Saghazadeh and Rezaei 2020b).

There is evidence of hyper inflammation and immune system dysregulation in people with COVID-19, especially in cases with severe and critical conditions (Rokni et al. 2020; Bahrami et al. 2020; Yazdanpanah et al. 2020a; Saghazadeh and Rezaei 2020a; Fathi and Rezaei 2020; Nasab et al. 2020). As a result, approaches helping the immune hemostasis come to attention, along with other ones that offer to target the virus-cell interaction (Sharifkashani et al. 2020; Mansourabadi et al. 2020; Pashaei and Rezaei 2020; Fathi and Rezaei 2020; Jahanshahlu and Rezaei 2020b; Basiri et al. 2020b; Saghazadeh and Rezaei 2020b; Mohamed et al. 2020b; Rezaei 2020b; Rabiee et al. 2020; Pourahmad et al. 2020; Lotfi et al. 2020).

Appropriate nutrient intake is necessary for the immune system to function correctly, and nutritional therapy plays a crucial role in the prevention of the disease as well as the recovery process by regulating the immunity system (Gombart et al. 2020; High 2001). The few available studies, which have investigated supportive treatment in COVID-19, suggest that nutritional assessment is necessary for all patients with COVID-19, and, accordingly, nutritional support should be provided to patients as soon as possible. It is of fundamental importance to supply nutritional requirements such as energy, protein, and micronutrients that can enhance the patient immune system (Maggini et al. 2018). In particular, micronutrients are essential to maintain the immune system healthy or improve the immune competence in viral infections such as COVID-19. They include vitamins such as A, B, D, E, and C and trace elements, including selenium, zinc, iron, and magnesium.

28.2 Nutritional Assessment

Nutritional Diagnosis and Intervention describes the critical thinking process from assessment to selection of proper, timely, and measurable diagnosis of nutritional deficiencies. Measurement of the indicators of inflammation is also a critical component of nutritional assessment.

Nutritional assessment is the first step in the nutrition care process. Such an assessment must include critical elements of the dietary patterns, food cravings and eating habits, clinical or medical history, and changes in food intake from the time of infection. Alterations in appetite, food variety, balance, and order of food meals as well as anthropometric measurements when possible and biochemical and laboratory values should be considered (Volkert et al. 2019). Also, food allergies, possible adverse effects of pharmaceutical treatments on nutritional status, and food intake condition, as well as information on the medication and herbal supplement use for potential food-drug interactions, must be considered by interviewing the patient or their live-in companion. Of significance are also the fecal extraction rate and the amount of fluid intake. Moreover, the Nutrition Risk in Critically ILL Score (NUTRIC Score) tool is recommended as a part of nutritional assessment in patients admitted to the intensive care unit (ICU) (Kondrup et al. 2003; Ballmer 2020).

28.2.1 Nutritional Care in Outpatients with COVID-19

With the immune system fighting off coronavirus, energy requirements are increased to meet physiological needs. In this regard, a liquid diet, including higher volumes of water, soups, fruit juices, milk, and tea, which needs less energy to digestion, can be considered. Adequate intake of basic food groups with a diversity of the content would help promote immunity in people with

COVID-19 to combat infection. Increased intake of whole fruits and vegetables, which are either excellent resources of vitamins such as Vit A and Vit C or contain ample amounts of pigments and some precursors of vitamin A and Vit C, play a vital role in improving nutritional status and immunity, and thus well-being.

28.2.2 Hospitalized Patients with COVID-19

Clinical nutritional societies have endorsed the Global Leadership Project on Malnutrition (GLIM) standards for the diagnosis of malnutrition. The GLIM recommends a two-step approach in which an initial screening is performed to determine the at-risk status of the patient by utilizing validated screening methods such as MUST or NRS-2002, followed by a secondary diagnostic evaluation to rate the severity of the malnutrition. According to the GLIM, malnutrition diagnosis requires at least one phenotypic criterion and one etiologic criterion (Cederholm et al. 2019; Stratton et al. 2004). The mentioned criteria can be successfully applied to patients at risk of severe COVID-19 or hospitalized due to COVID-19. Poor COVID-19 outcomes are more likely to occur in patients with a higher risk of malnourishment, such as older adults and individuals with comorbidities (Barazzoni et al. 2020).

When the nutritional status of the patient is suboptimal, the dietitian must decide on the most suitable artificial nutrition (AN) solution, e.g., enteral nutrition (EN) and parenteral nutrition (PN). In this regard, oral nutritional supplementation (ONS), tube feeding, supplementary parenteral nutrition (SPN), and total parenteral nutrition (TPN) are available and can help the recovery of patients. ONS is, however, the first choice of care. When oral intake is insufficient, the dietitian should make recommendations on the use of AN combined with either EN or PN. EN is the first tier of AN. If it were insufficient to provide requirements, it would be substituted by PN.

Effective management of a patient with COVID-19 calls for an effective and timely plan of nutritional therapy adjusted considering the clinical characteristics of the individual. The transition from PN to EN is considered when EN is predicted to meet 50% of requirements. Also, when ONS can meet 50% of requirements, the EN can be progressively reduced and finally terminated. In contrast, if ONS is unable to fulfill 50% of requirements, the EN should be continued. Elderly or malnourished patients with COVID-19 are more likely to require intensive care unit (ICU) admission and prolonged hospitalization. When hospital stay lasts longer than 48 h, nutritional therapy should be started as early as possible and no later than 72 h for patients who are unable to eat or admitted to the ICU (Singer et al. 2019; Ballmer 2020).

28.2.2.1 Nutritional Strategies for Non-ICU Patients Hospitalized for COVID-19

Energy Requirements

Infection with COVID-19 raises the demand for energy. It is, therefore, of importance to provide energy supply to patients with COVID-19 to avoid undesirable loss of weight and muscle mass, which may lead to poor functional results. Reliable estimation of patient's caloric needs is necessary to prevent overfeeding or underfeeding.

The gold standard for estimation of caloric needs is the time-consuming method of indirect calorimetry. The following predictive equations and weight-based formulae are helpful to estimate caloric needs simply (Ballmer 2020; Gomes et al. 2018):

- Total energy expenditure (TEE) for patients with comorbidities aged above 65 years: 27 kcal/kg body weight/day
- TEE for severely underweight patients with comorbidities: 30 kcal/kg body weight/day
- TEE for overweight and obese patients: 20 kcal/kg body weight/day

It is noteworthy to mention that chronically underweight patients should be fed carefully and gradually to arrive at the goal of 30 kcal/kg body weight/day because they are at high risk of refeeding syndrome.

Protein Requirements

Based on growing evidence from experimental and epidemiological research, age at hospitalization, muscle mass, gender, and other essential factors should be considered when selecting an appropriate protein intake for patients with COVID-19. In this regard, intake of at least 1 gram protein/kg body weight/day should be attempted for older people (Ballmer 2020; Volkert et al. 2019), particularly for those who are frail, suffer from comorbidities, or are at risk of malnutrition. In general, recent guidelines recommend maintaining the intake of protein within the range of 1.2–2 grams per kilogram of body weight per day with at least 50% of this amount should be of high biological value (HBV) proteins. The amount of protein that patients with COVID-19 and renal failure need is determined between 1 and 1.2 grams per kg body weight per day. It is decreased to 0.8–1 gram protein per kg body weight and day in patients with chronic kidney disease (CKD).

Fat and Carbohydrate Requirements

A 30:70 fat and carbohydrate ratio in patients with no respiratory impairment and a 50:50 percent for ventilated patients may be considered (9).

28.2.2.2 Nutritional Strategies for ICU Patients with COVID-19

Prolonged ICU stays might initiate or aggravate malnutrition accompanied by severe muscle mass wasting and atrophy, which can, in turn, lead to profound disability and morbidity. The situation gets worse when a controlled diet is not present, and a lack of adequate calorie and protein results in exacerbation of nutritional status. Therefore, the prevention of malnutrition is a critical part of COVID-19 management.

Recommendations for nutritional assessment to derive appropriate nutritional strategies are relevant to all critically ill patients, including patients with COVID-19. For non-intubated ICU patients with COVID-19 not achieving the defined energy target with an oral diet, ONS should be considered following EN. Notably, even for patients who can eat independently and unaided, it might be impossible to meet the increased demand for energy and nutrient requirements associated with metabolic stress and recovery. Moreover, critically ill patients dependent on endotracheal intubation and mechanical ventilation are unable to consume food orally. Impairment of chewing and swallowing and anorexia induced by pain-relieving medications are other factors contributing to the inability of oral feeding. The dietician might consider adding PPN in the case patients exhibit limitations with the enteral route or do not reach the defined energy target by oral or enteral nutrition (Gostynska et al. 2019).

Intubated and Ventilated Patients

Enteral Nutrition

ICU patients with COVID-19 who are intubated and ventilated, EN can be administered via a nasogastric tube (NGT). The prone position in itself does not pose a contraindication for EN. However, in the case that the patient shows gastric intolerance or is at high risk for aspiration, post-pyloric feeding must be considered after prokinetic treatment.

Energy Requirements

Indirect calorimetry, when available, is advised as the first-line method of evaluation of energy expenditure (EE). If not available, the second-line method is to assess EE from respiratory gases, e.g., VO2 (oxygen consumption) and VCO2 (carbon dioxide production), which are recorded by the ventilator (Elamin et al. 2012). Predictive equations are in the last line because they can lead to under or overevaluation of needs (Barazzoni et al. 2020).

Protein Requirements

Intake of 1.3 gram protein/kg body weight/day might help to improve the survival rate in frail patients. Depending on the patient's condition, there are, however, a few considerations to bear in mind. For example, preserving skeletal muscle mass is of particular importance for the patient's recovery. It necessitates additional strategies to enforce skeletal muscle anabolism with regard to the highly catabolic state of patients with COVID-19 during ICU admission (McClave et al. 2016).

Lipid Requirements

When administering intravenous lipids, it is important to adhere to the recommendation of 1 g/kg body weight/day with a tolerance of up to 1.5 g/kg/day. Administration of excess lipids may result in waste, storage, or even toxicity (Santacruz et al. 2015).

Carbohydrate Requirements

A low carbohydrate formula, at the maximum rate of 5 mg/kg weight/min, is prescribed to patients for the reduction of CO_2 production and so an improvement of the respiratory function (Taylor et al. 2016; Singer et al. 2019).

Parenteral Nutrition

PN is indicated when the patient is unable to intake sufficient nutrients orally and enterally. It is recommended to be prescribed by day 3–7 after EN intolerance. For patients with infections, PN should meet the following requirements:

Protein Requirements

1.3-grams protein/kg of ideal body weight per day is given (Romano et al. 2020; Heidegger et al. 2013).

Carbohydrate Requirements

Carbohydrates are the primary source of calories in almost all PN formulations. Glucose is the major fuel for the human body. The brain, peripheral nerves, renal medulla, leukocytes, erythrocytes, and bone marrows use glucose as the primary source of oxidative energy. The minimum daily amount of glucose required is estimated to be 100–120 g to meet the needs of the brain. If this requirement is not satisfied by exogenous nutrition, it will be satisfied by gluconeogenesis, which uses amino acid precursors provided by the skeletal muscle proteolysis. The protein-sparing effect of the parenteral provision of glucose is seen in starvation, ensuring the muscle tissue is conserved. It has remained unclear whether such sparing effectively occurs in the critically ill condition.

However, carbohydrate administration should be limited in critically ill patients with COVID-19 and respiratory failure. The carbohydrate requirement is 2 g/kg/day and must not exceed 150 g per day. The oxidation of a mole of carbohydrates leads to the production of equal amounts of CO_2. In patients with respiratory failure, CO_2 production must be avoided to decrease respiratory quotients (Singer et al. 2009, 2019; Gostynska et al. 2019).

Fat Requirements

In long-term ICU patients, lipid intake analysis is an integral part of the energy maintenance program. Due to changes in fat absorption and fat metabolism in critically ill patients undergoing PN, lipid overload and toxicity can occur with excessive intravenous injection of fat, resulting in hypertriglyceridemia and abnormal liver enzymes.

Studies show the association between glycerol concentrations and COVID-19 outcomes. The recommended daily venous fat is 1 gram/kg body weight, which should not exceed the maximum of 1.5 gram/kg body weight (Singer et al. 2009). However, the dose needs to be adjusted according to individual tolerance. Also, for newly critically ill patients with parenteral nutrition, the use of medium and long-chain fatty acids is preferred. Furthermore, the use of omega-3 fatty acids in critically ill patients has been shown to result in a lower risk of infection and death, as well as a decreased length of hospital stay.

Medium- and long-chain fatty acids and an increase in the proportion of ω-3 and ω-9 fatty acids are considered to be the most important factor. Fatty acids significantly affect the immune system. They take part in constructing cell membranes and cytokines, which are factors secreted during immune cell signaling (Ren et al. 2020; Rutting et al. 2019). As an example, ω-3 fatty acids are well-acknowledged to prevent a hyperinflammatory state by decreasing the production of eicosanoid and specific cytokines. In particular, the eicosapentaenoic acid (EPA; 20:5 ω-3) and docosahexaenoic acid (DHA; 22:6 ω-3) reduce the production of lipid mediators involved in the induction of the pro-inflammatory state. On the contrary, a ω-6 fatty acid, arachidonic acid, has been one of the most crucial eicosanoid precursors in the composition of prostaglandins and leukotrienes, which critically contribute to inflammation.

Fish oil (FO) is a well-established source for EPA and DHA (Kristine Koekkoek et al. 2019). Thus, the administration of FO might be beneficial in improving the prognosis of the critical patient, for its anti-inflammatory and immunomodulatory characteristics (Lu et al. 2017). Enteral FO feeds are, in certain conditions, considered in patients with ARDS (Singer et al. 2006; Pontes-Arruda et al. 2008). Accordingly, an intake of 0.1–0.2 gram EPA + DHA per kg body weight per day is recommended for patients with COVID-19 (Das 2020).

Post-extubation Period and Dysphagia

In ICU patients with dysphagia, if swallowing is proven unsafe, texture-modified food can be considered after extubation, and EN should be administered (Barazzoni et al. 2020). During swallowing training, once the nasoenteral feeding tube is removed, post-pyloric EN can be performed, mainly where high aspiration risk exists. If post-pyloric EN is not possible, temporary PN can be attempted (Neelemaat et al. 2011; Gomes et al. 2018). A key consideration for COVID-19 patients, particularly in the elderly after prolonged extubation, is that the post-extubation swallowing disorder can result in a prolonged recovery process, lasting up to 21 days in many cases (Barazzoni et al. 2020).

The general principles are followed for fluid therapy of patients with COVID-19, to stabilize patients at 30–40 mL/kg per day. In stable ICU patients with COVID-19, it is recommended to maintain 30 mL/kg/day of fluid for adults and 28 mL/kg/day for the elderly, as well as those with large areas of pulmonary consolidation. For every 1 degree C rise in temperature, there is a need for supplemental fluid therapy calculated at 3–5 mL/kg (4 mL/kg) (Yu and Shi 2020; Singer et al. 2019).

28.3 Role of Micronutrients

Table 28.1 gives an overview of the effects of micronutrient deficiency and supplementation on the immune response. Low levels of certain micronutrients such as vitamins A, D, E, C, and B and minerals such as zinc, selenium, and iron can cause a worsening of viral infections (Gombart et al. 2020; Kakodkar et al. 2020). Patients with COVID-19 are at risk for micronutrient deficiency due to reduced intake and increased demands. Although the prevention and treatment of micronutrient deficiencies are significant, there is no evidence that supraphysiological or supra-therapeutic levels of micronutrients will improve COVID 19 outcomes (Barazzoni et al. 2020). Overall, there should be regular allowances to modify the recommendations over the intake of vitamins and trace elements, considering the patient history and clinical characteristics.

28.3.1 Vitamin A

Vitamin A plays a role against infections. Additionally, vitamin A supplementation has been shown to be effective in reducing morbidity and mortality in infectious diseases such as malaria, measles, lung infections, and measles-related pneumonia (Kantoch et al. 2002). Vitamin A, therefore, seems promising for COVID-19 treatment (Zhang and Liu 2020).

28.3.2 B Vitamins

Vitamin B6 is required in protein metabolism. It participates in over 100 other regulatory reactions in various tissues and also plays an important role in the immune system.

Table 28.1 The impact of micronutrient deficiencies and supplementations on the immune response

Micronutrient	Effects of deficiency	Effects of supplementation
Vitamin A	Increased susceptibility to COVID-19 infection	Enhances innate immune response to viral replication
B Vitamins	Depressed host immune responses	Enhances immune response Vitamin B3 provides robust anti-inflammatory response to respiratory tract infection Recommended daily amount for total parenteral nutrition (TPN): 40 mg of vitamin B3 and 6 mg of vitamin B6
Vitamin C	Increased oxidative damage Increased severity of infection	Antioxidant properties prevent the susceptibility to lower respiratory tract infection of COVID-19 Recommended supplementation dose: 1–2 g/day for patients
Vitamin D	Increased susceptibility to acute respiratory tract infections and the severity of infection Increased morbidity and mortality	Reduced acute respiratory tract infection Recommended supplementation dose: 500,000 IU for all ICU patients in the first week
Selenium	Increased oxidative stress Increased viral virulence Induces impairment of host immune function	Improves immune response to COVID-19 in deficient individuals Suppresses the release of free radicals Reduces oxidative damage Recommended supplementation dose: 100 μg/day
Zinc	Depressed immune responses Increased susceptibility to COVID-19 infectious	Recommended supplementation dose: 20–40 mg/day for adults
Iron	Reduced capacity for adequate immune response Increased recurrent acute respiratory tract infection	Its impact can be a double-edged sword: improves immune response to infectious diseases, while irrational abuse of supplementing may increase the availability of iron for pathogen and enhances viral replication

Hyaluronic acid (HA), an extracellular matrix component, is distributed in the lung parenchyma of humans. Based on several studies, increased levels of HA occur in lung tissue of humans with acute respiratory distress syndrome (ARDS). HA can increase the capacity of absorption of water within the lung up to 1000 times its molecular weight. Patients with COVID-19 show dysregulation in the production and regulation of HA (Esposito et al. 2017). Also, they have shown high levels of inflammatory cytokines, which are potent inducers of HA synthase 2 (HAS2) in the alveolar epithelial cells and fibroblasts, and this might explain difficult breathing in COVID-19 patients. Consequently, reducing or inhibiting the production of HA might be promising to ease breathing in COVID-19 patients (Shi et al. 2020).

Vitamin B3 can inhibit HA synthase and diminish the effects of HA. Y. Vitamin B3 supplementation has been shown to significantly reduce neutrophil infiltration into the lungs and also produce a strong anti-inflammatory effect in ventilator-induced lung injury (Shi et al. 2020).

28.3.3 Vitamin C

It is known as an important antioxidant and enzymatic cofactor for physiological reactions such as hormone production, collagen synthesis, and immune potency. Human beings are unable to synthesize ascorbic acid (vitamin C); as a result, it must be obtained from dietary sources. It has been suggested that supplementation with vitamin C may hinder the susceptibility to respiratory tract infections (Hemilä and Louhiala 2013; Kim et al. 2018; Padhani et al. 2020). Vitamin C (1–2 gram per day) is, therefore, suggested for COVID-19 treatment (Chen et al. 2020; Ran et al. 2018).

Also, studies have shown that high-dose intravenous injection of vitamin C (3–10 gram per day) can substantially improve disease outcomes in critically ill patients. So, in addition to the oral intake of vitamin C, some authors suggest the use of high-dose intravenous vitamin C in critically ill patients (Wang et al. 2019; Boretti and Banik 2020). ICU patients who are in the early stages of COVID-19 are candidates for a brief duration of high-dose intravenous vitamin C therapy (Cheng 2020). High-dose vitamin C therapy can induce an inflammatory response. Adding intravenous (IV) glucocorticoid to high-dose vitamin C can help to diminish the inflammatory effect of high-dose vitamin C therapy (Carr 2020) while keeping the other effects of high-dose vitamin C in places, such as improvement of alveolar fluid clearance and epithelial cell functions (Boretti and Banik 2020).

28.3.4 Vitamin D

Vitamin D receptors exist in a variety of immune cells. As a result, vitamin D can affect immunity responses (Zdrenghea et al. 2017). It has been shown to promote the production of monocyte-derived macrophages and modulate the production of inflammatory cytokines. Also, metabolites of vitamin D tend to control the development of different antimicrobial proteins that specifically kill pathogens and are thus likely to help minimize infection, including those occurring in the lungs (Anderson et al. 2020). Deficiency in vitamin D increases the risk of developing respiratory infections (Martineau et al. 2017; Jolliffe et al. 2013; Pham et al. 2019). Observational studies indicate an association between low levels of 25-hydroxyvitamin D (the primary metabolite of vitamin D) in the blood and vulnerability to acute respiratory tract infections. In agreement with these findings, meta-analyses have concluded that supplementation with vitamin D may reduce the risk of respiratory tract infection in children and adults (Gruber-Bzura 2018). While a substantial number of healthy adults, often at the end of the winter season, present with low vitamin D levels.

COVID-19 was first identified in winter 2019 and has mostly affected elderly and middle-age people. Hence, it may be supposed that the virus has infected people who may already have had vitamin D insufficiency (Grant et al. 2020; Jakovac 2020).

Patients with COVID-19 undergoing EN and PN should be tested for vitamin D deficiency. If the amount of vitamin D is less than 12.5 ng/mL (insufficiency), cholecalciferol is given by intramuscular injection or via the route of administration of EN with a maximum single dose of 100,000 IU solution and 500,000 IU per week.

28.3.5 Selenium

Selenium deficiency may induce oxidative stress, which can cause a mild or moderate pathogenic virus to become highly virulent (Rayman 2012). Selenium deficiency induces not only impairment of the host immune system but also can evoke mutations in the RNA viruses (Singer et al. 2019).

Selenium assists a group of enzymes working in conjunction with vitamin E to prevent the formation of free radicals and oxidative damage to cells and tissues (Calder et al. 2020). Synergistic effects of selenium with some herbal products might help to improve immune response to coronavirus infections. Hence, 100 micrograms of selenium supplementation per day may be an important option for the supplemental treatment of the novel coronavirus infection. These, however, should be recommended based on the Dietary Reference Intakes (DRI) for infected patients with renal failure (Zhang and Liu 2020; Jayawardena et al. 2020).

28.3.6 Zinc

Zinc deficiency induces both humoral and cell-mediated immunity dysfunction and increases the vulnerability to infectious diseases. Intracellular zinc can effectively inhibit the replication of a variety of RNA viruses. Furthermore, the low concentration of zinc and pyrithione prevents the replication of SARS coronavirus (SARS-CoV) (te Velthuis et al. 2010). For adults, a recommended dosage is 20–40 mg/day (Gombart et al. 2020). Zinc supplement can, therefore, be an option for the treatment of COVID-19-related symptoms (Zhang and Liu 2020).

28.3.7 Iron

Iron deficiency was confirmed to be a risk factor for persistent acute respiratory tract infections. Furthermore, iron is essential for viral replication (Wessling-Resnick 2018). In other words, iron is necessary for both the host and pathogen, and iron deficiency can inhibit host immunity, whereas iron excess can allow oxidative stress to spread dangerous viral mutations (Liu et al. 2020).

28.4 Conclusion

Infectious disease outbreaks have ever been challenging for humanity in terms of diagnosis and treatment (Basiri et al. 2020a). It is the COVID-19 case as well, though the origin of COVID-19 comes back to coronaviruses, which previously have caused epidemics (Jabbari et al. 2020; Hanaei and Rezaei 2020). Indeed, COVID-19 caused a more widespread pandemic involving both the society and healthcare system (Rezaei 2020a; Moazzami et al. 2020). It has raised many concerns about the risk of infection and reinfection in frail older people who are malnourished; people in special physiological conditions, for example, pregnant women, neonates, and children; people with medical conditions who suffer from an immune deficiency or are immunocompromised; and patients from lower socioeconomic groups (Ahanchian et al. 2020; Babaha and Rezaei 2020; Mirbeyk and Rezaei 2020; Sahu et al. 2020; Jabbari and Rezaei 2020). During the pandemic, prompt and appropriate nutritional therapy play a critical role in the management of COVID-19 in all phases of care. Nutritional therapy can provide highly effective results, ensuring that all patients have a fair chance to fight COVID-19. The current status is, however, different; research has focused on pharmaceutical treatment of COVID-19, while the importance of nutrition is being overlooked with grave consequences. It calls a need for global recommendations on the role of nutrition in the ongoing and future pandemics (Momtazmanesh et al. 2020; Mohamed et al. 2020a; Rzymski et al. 2020; Moradian et al. 2020; Kafieh et al. 2020).

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