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**ASPECTS AND PRIORITIES OF EASY FOOD FOR PATIENTS WITH COVID-19**

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**АСПЕКТЫ И ПРИОРИТЕТЫ ЛЕГКОЙ ПИЩИ ДЛЯ ПАЦИЕНТОВ С COVID-19**

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**COVID-19 BILAN KASALLANGAN BEMORLAR UCHUN ENGIL OVQATLARNING ASPEKTLARI VA USTUVORLIKLARI**

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*При заражении вирусом SARS-CoV-2 пациенты могут временно переждать, что приводит к липотоксичности и последующему повреждению нежировой ткани, а в тяжелых случаях – к гипертрофии и цитокиновому шторму. Сбалансированное питание может улучшить здоровье, снизить риск заражения и уменьшить тяжесть острого респираторного синдрома – как COVID-19, так и SARS-CoV-2. Диетологи поощряют потребление фруктов и овощей, содержащих много злаков. 31% рекомендаций указывают на важность для поддержания хорошо функционирующей иммунной системы минералов, цинка и витаминов С, А и D.*

**Ключевые слова:** иммунитет, питание, возбудитель, ткань, вирусная инфекция SARS-CoV-2, липотоксичность, нежировые ткани, гипертрофия, COVID-19, острый респираторный синдром.

*SARS-CoV-2 virusi bilan kasallangan bemorlar vaqtincha haddan tashqari ovqatlanishlari mumkin, bu lipotoksiklikka va keyinchalik yog'siz to'qimalarning shikastlanishiga, og'ir holatlarda esa giperyallig'lanishga va sitokin bo'roniga olib keladi. Balanslangan ovqatlanish salomatlikni yaxshilashi, infeksiya xavfini kamaytirishi va o'tkir respirator sindromning (ham COVID-19, ham SARS-CoV-2) og'irligini kamaytirishi mumkin. Parhezshunoslar meva va sabzavotlarni ko'p iste'mol qilishni rag'batlantiradilar. Tavsiyalarning 31% i yaxshi ishlaydigan immunitetni saqlash uchun minerallar, rux va C, A va D vitaminlari muhimligini ko'rsatadi.*

**Kalit so'zlar:** immunitet, ovqatlanish, patogen, to'qimalar, SARS-CoV-2 virusli infeksiyasi, lipotoksiklik, yog'siz to'qimalar, giperyallig'lanish, COVID-19, o'tkir respirator sindrom.

In January 2020, the world faced an outbreak of coronavirus disease 2019 (COVID-19), caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV2). Evidence of high human-to-human transmissibility of SARS-CoV-2 has made social isolation the best preventive measure to avoid the spread of COVID-19 [35]. This pandemic is substantially affecting lifestyles, healthcare systems national and global economies. Social isolation is often an unpleasant experience that may have negative effects on mental health [14]. It has been suggested that, until quarantine ends, self-isolation is likely to cause psychological and emotional symptoms [70], changes in mood and altered sleep or eating patterns [52], worsening of chronic health conditions, weight gain and increased use of alcohol, tobacco or illegal drugs.

Optimum nutrition is one of the main determinants of health that can improve well-being and mitigate the harmful health consequences associated with social distancing by helping to prevent or control most chronic diseases (e.g., diabetes, hypertension, and excess body weight/obesity); aid in the regulation of sleep and mood; and prevent fatigue [18,59]. Nutritional modulation of the immune system is also important across the age spectrum. During early childhood, breastfeeding can provide protection against infections and respiratory diseases, as breast milk contains antibodies, enzymes, and hormones that can offer health benefits [40,61]. In older adults, the group at most risk for COVID-19, changes in dietary habits lead to significant alterations in immunity and inflammation, termed immunosenescence and inflammation [23].

Some nutrients, such as omega-3 polyunsaturated fatty acids and probiotics, have been linked to anti-inflammatory responses and enhanced resistance to upper respiratory tract infection [54]. In individuals infected with SARS-CoV-2, nutritional status is a crucial factor for optimal prognosis and can determine the clinical severity of COVID-19 [39]. Dietary enrich with selected vitamins (e.g., A, B, C, and D), minerals (e.g., selenium, zinc, and iron), and omega-3 fatty acids was suggested by Zhang and Liu [4,69] as a treatment option for COVID-19 patients and as preventive therapy against lung infection. However, the use of micronutrient supplements to prevent infections remains questionable. Since to date there is no vaccine or evidence-based treatment for COVID-19, the optimization of nutrient intake through well-balanced meals and the use of good hygiene practices in food selection, preparation, and conservation is probably the most effective approach for managing the continuous risk of viral infection. To this end, dissemination of healthy eating guidelines for healthcare professionals and the public is a crucial strategy. Despite intense efforts by international nutrition organizations and other health-related societies to produce guidelines and advice related to the COVID-19 pandemic, literature is still scarce. Meanwhile, the public has had a vast array of nutritional information from governmental authorities, the dietary supplement industry, nutrition enthusiasts, healthcare professionals, and others on how to prevent COVID-19. This information, however, may be conflicting or non-evidence based. Therefore, a systematic search of guidelines and official documents related to nutrition and COVID-19 conducted. The search-in-

cluded information obtained from several countries affected by the pandemic as well as manuscripts identified in scientific databases. The goal was to address one main question: What nutritional advice was offered for individuals in quarantine during the COVID-19 pandemic? The aim of this review was to summarize nutritional guidance related to the novel coronavirus in order to support dietary counseling provided by dietitians and healthcare professionals during this pandemic.

The world is currently experiencing the pandemic of coronavirus (CoV). In late 2019, the CoV infection began in Wuhan, Hubei, China. It had been originally called 2019 nCoV and it has been renamed CoVID-19 by the World Health Organization on February 2020. This epidemic began with animal-to-human infection, and the direct cause of death is generally due to ensuing severe atypical pneumonia. COVID-19 has been declared a pandemic by the World Health Organization, and people in all countries are under quarantine in order to reduce the spread of the virus, which then also lessens the impact on medical resources. Since quarantine is associated to the interruption of the work routine, this could be result in boredom. Boredom has been associated with a greater energy intake, as well as the consumption of higher quantities of fats, carbohydrates, and proteins [15]. Further, during quarantine continuously hearing or reading about the pandemic without a break can be stressful. Consequently, the stress pushes people toward overeating, mostly looking for sugary “comfort foods” [74]. This desire to consume a specific kind of food is defined as “food craving”, which is a multidimensional concept including emotional (intense desire to eat), behavioral (seeking food), cognitive (thoughts about food), and physiological (salivation) processes [66]. Of interest, a gender difference has been reported in food craving, with a higher prevalence in women than in men. Carbohydrate craving encourages serotonin production that in turn has a positive effect on mood. In a sense, carbohydrate-rich foods can be a way of self-medicating anti stress. The effect of carbohydrate craving on low mood is proportional to the glycemic index of foods. This unhealthy nutritional habit could increase the risk of developing obesity that beyond being a chronic state of inflammation, it is complicated by heart disease, diabetes, and lung disease that have been demonstrated to increase the risk for more serious complications of COVID-19 [26].

Stress because of quarantine also results in sleep disturbances that in turn further worsen the stress and increase food intake thus giving rise to a dangerous vicious cycle. Therefore, it is important to consume food containing or promoting the synthesis of serotonin and melatonin at dinner. A considerable variety of plant species including roots, leaves, fruits, and seeds such as almonds, bananas, cherries, and oats contain melatonin and/or serotonin. These foods may also contain tryptophan, which is a precursor of serotonin and melatonin. Protein foods such as milk and milk products are the main sources of the sleep-inducing amino acid tryptophan. Moreover, tryptophan is involved in the regulation of satiety and caloric intake via serotonin that mainly

lowers carbohydrate and fat intake, and inhibits neuropeptide Y, the most powerful hypothalamic orexigen peptides [65]. Further, beyond sleep-inducing properties, milk products such as yogurt could also augmented natural killer cell activity and reduce the risk of respiratory infections [44]. An increased intake of macronutrients during quarantine the could also be accompanied by micronutrients deficiency as occurs in obesity [41], which is commonly associated with impaired immune responses, particularly cell-mediated immunity, phagocyte function, cytokine production, secretory antibody response, antibody affinity, and the complement system, thus making more susceptible to viral infections [1,24]. Thus, during this time it is important to take care of nutritional habits, following a healthy and balanced nutritional pattern containing a high amount of minerals, antioxidants, and vitamins. Several studies reported that fruits and vegetables supplying micronutrients could boost immune function. This happens because some of these micronutrients such as vitamin E, vitamin C, and betacarotene are antioxidants. Anti-oxidants increase the number of T-cell subsets, enhance lymphocyte response to mitogen, increased interleukin-2 production, potentiated natural killer cell activity, and increased response to influenza virus vaccine compared with placebo [71]. Beta Carotene is most abundant in sweet potatoes, carrots, and green leafy vegetables while sources of vitamins C include red peppers, oranges, strawberries, broccoli, mangoes, lemons, and other fruits and vegetables. The major dietary sources of vitamin E are vegetable oils (soybean, sunflower, corn, wheat germ, and walnut), nuts, seeds, spinach, and broccoli. In addition, quarantine could be associated to a less time spent outdoor, less sun-exposure, and reduced production of vitamin D as a result of lower levels of 7-dehydrocholesterol in the skin. Vitamin D deficiency in winter has been reported to be associated to viral epidemics. Indeed, adequate vitamin D status reduces the risk of developing several chronic diseases such as cancers, cardiovascular disease, diabetes mellitus, and hypertension that significantly higher risk of death from respiratory tract infections than otherwise healthy individuals [37]. Further, vitamin D protects respiratory tract preserving tight junctions, killing enveloped viruses through induction of cathelicidin and defensins, and decreasing production of pro inflammatory cytokines by the innate immune system, therefore reducing the risk of a cytokine storm leading to pneumonia. Since the time spent outdoor and consequently the sun exposure is limited, it is encouraged to get more vitamin D from diet. Foods containing vitamin D include fish, liver, egg yolk and foods (e.g., milk, yogurt) with added vitamin D. Another essential trace element that is crucial for the maintenance of immune function is zinc. It has been reported that zinc inhibited severe acute respiratory syndrome (SARS) coronavirus RNA-dependent RNA polymerase (RdRp) template binding and elongation in Vero-E6 cells [30]. Although oysters contain the most zinc per serving, the most common food to get zinc are represented from poultry, red meat, nuts, pumpkin seeds, sesame seeds, beans, and lentils. All the above-described nutrients are enclosed in Mediterranean Diet

pattern that could represent a healthy nutritional pattern to be followed in quarantine. Key ingredients of Mediterranean cuisine include olive oil, fresh fruits and vegetables, protein-rich legumes, fish, and whole grains with moderate amounts of wine and red meat. In conclusion, due to the quarantine-related situational stress eating, nutrition becomes a priority at this time [28]. Many people probably have much of what they might need at home, and so there is no reason to rush to buy groceries creating mass gatherings that could contribute to the spread of COVID-19 because during quarantine food stores stay open throughout. Keeping foods that are good sources of immune-supportive nutrients, planning times to eat, meals, portions and having a cut-off time for eating but mostly having in mind positive attitudes could be helpful to tackle the negative health effects of quarantine.

As for as some group scientists go said [56] that We are greatly interested in the articles by Lidoriki et al. and Recinella et al. [57] in which the authors suggested that nutrition status plays an important role in the progression of COVID-19 disease. Based on their work, we would like to hypothesize that human immunity has a pivotal role in nutrition acquisition from the pathogens and damaged body tissues during the SARS-CoV-2 virus infection, which may lead to transient over-nutrition, lipotoxicity and further tissue damage in overweight patients or patients with metabolic syndromes. Those patients are thus predisposed to escalated inflammation and susceptible to cytokine storm in severe cases of COVID-19. The interactions between nutrition, microorganism infection and immunity are very complex. On the one hand, adequate nutrition and a symbiotic microbiome ensure proper function of the immune system during infection; on the other hand, the human immune system also plays an important role in acquiring essential nutrients from living microbial cells during the elimination of the symbiotic microbiome and infectious pathogens.

During an infection, xenophagy as the specific type of autophagy mediating intracellular pathogen eradication, together with other immunological proteolytic/lipolytic processes, degrades symbiotic microbiome, pathogens, and damaged human body tissues, and turn them into nutrients. This nutrition acquisition pathway may cause transient overnutrition, lead to lipotoxicity, tissue damage, hyper inflammation and cytokine storm. Inflammation is the physiological response of the immune system to tissue damage [11]. It is a protective reaction by the organism to remove the injurious stimuli, and remove the damaged tissue as well as initiate the healing process for the tissue [12]. Yet, during acute infection, nutrition excess will prevent the tissue healing process from happening. This is because, if the nutrition from the degradation of pathogens and the damaged body tissues exceeds the nutrition needs for tissue repair, the excessive nutrition will be mostly turned into lipid intermediates and deposited in new non-adipose tissue, causing lipotoxicity in healthy non-adipose tissues and inducing further tissue damage. The breakdown of newly damaged non-adipose tissues and the

formation of lipid intermediates result in a vicious cycle. Thus, the over nutrition situation is worsened by the loss of lean body mass, coupled with escalation of inflammation, and eventually lead to cytokine storm in the severe cases of COVID-19. Clinically, early parenteral nutrition (PN) alone or PN in combination with enteral feedings are strongly discouraged in critically ill patients, and only initiative early enteral nutrition (EEN) is recommended for patients who can be fed enterally. EEN can be beneficial due to its trophic effect on gut mucosa to avoid gut mucosa atrophy and bacteria translocation, while aggressive nutritional support may be detrimental due to the transient over-nutrition discussed above. In the future, high-quality clinical trials on restrictive eating in which only very small amount of enteral nutrition will be provided to support the gut mucosa, and maintain serum fasting to dissipate the transient over-nutrition during SARS-CoV-2 viral infection should be designed to investigate the possible benefits of restrictive eating to COVID-19 recovery

According to scientists [47] nearly 70% of the documents retrieved encouraged the consumption of fruits, vegetables, and whole grain foods. Two nutrition societies, from Italy and Spain, recommended at least 5 servings of fruits and vegetables per day. Diets rich in fruits and vegetables contain high amounts of vitamins and minerals, including vitamins A, C, D, E, and B complex, as well as zinc and selenium, which are important modulators of the immune system [45]. In addition, fruit and vegetables are good sources of water, antioxidants, and fiber, all of which play a role in the control of hypertension, diabetes, and weight gain, some of the most important risk factors for COVID-19 complications [9]. Micronutrients contribute to immune function through a variety of pathways in both innate and adaptive immune responses. Vitamins A, C, D, E, B<sub>6</sub>, and B<sub>12</sub> and zinc are important for the maintenance of structural and functional integrity of physical barriers (eg, skin, gastrointestinal lining, respiratory tract, and others) as well as for the differentiation, proliferation, function, and migration of innate immune cells [68]. Meanwhile, vitamins C and E, along with zinc and selenium, protect against free radical damage during increased oxidative stress. Vitamins A, C, D, E, B<sub>6</sub>, and B<sub>12</sub> and zinc and selenium support the adaptive immune response by influencing the differentiation, proliferation, and normal function of T and B cells. These nutrients also affect antibody production and function, contribute to cell-mediated immunity, and support the recognition and destruction of pathogens. Lastly, they have antimicrobial activity and regulate the inflammatory response. Approximately one-third of the identified guidelines mentioned at least one of these nutrients as being important for optimizing the immune system, placing special emphasis on zinc and vitamins C, A, and D. Adequate intakes of these micronutrients may be attained through a daily diet that includes meat, fish, lentils and beans, dairy foods, nuts, seeds, eggs, citrus fruits (e.g., orange, lemon, grapefruit), kiwi, strawberries, and vegetables such as broccoli, cauliflower, pumpkin, spinach, sweet potato, and carrots. While vitamin D can be obtained from some dietary sources, it is mainly

synthesized endogenously through exposure of the skin to ultraviolet B irradiation. In fact, sunlight exposure can increase serum vitamin D levels to the same extent as an oral dose of 250 to 625  $\mu\text{g}$  of vitamin D. The Societa Italiana di Nutrizione Umana recommended exposure to sunlight for 15 to 30 minutes every day to promote the synthesis of vitamin D. However, in latitudes outside 40 north and south, ultraviolet B radiation is greatly reduced during winter. As a result, an increased intake of vitamin D rich foods, as well as vitamin D supplementation, might be necessary to maintain adequate serum levels in winter [51]. Almost, one-third of the organizations and societies recommended avoiding the intake of salt, fat, and sugar and encouraged reductions in sugary drinks, other sugar-rich products, meat portions, and other foods of animal origin to lower the intake of saturated fat. In addition, they suggested that low-fat dairy foods and healthy fats (e.g., olive oil and fish oil) be included in the diet and recommended sauces, spices, and herbs as salt substitutes. Over the last 30 years, the literature has described a definitive role of fat in immunity. Saturated fatty acids act on Toll-like receptor, a sensor that binds bacterial lipopolysaccharide and thus acts in the innate immune response. As a result, a high intake of saturated fatty acids favors low-grade inflammation. On the other hand, monounsaturated and polyunsaturated fatty acids are known for their favorable immune-modulatory action [33]. Omega-3 polyunsaturated fatty acids present in seafood, algal oil, marine fish, and flaxseed support the immune system by activating cells from both the innate and the adaptive immune systems [57], while omega-9 monounsaturated fatty acids found in olive, sunflower, and safflower oils and nuts have antioxidant, antimicrobial, and antiviral effects [8]. For adult males and non-pregnant/non-lactating adult females, the recommended dosage of omega-3 polyunsaturated fatty acids (eicosapentaenoic acid plus docosahexaenoic acid) is 250 mg/d [53]. This recommendation can be met by consuming at least 2 portions (90 g each) of fatty marine fish, such as mackerel, salmon, sardine, herring, and smelt, per week. Drinking water or maintaining adequate hydration was suggested in 3 documents, but no guidance on water requirements (e.g., cups or milliliters per day) was provided. The evidence in favor of a direct association between hydration status and health has been previously confirmed. Water is essential for cellular homeostasis, kidney function, body temperature control, mood regulation, cognitive function, gastrointestinal and heart function, and headache prevention [74]. It is important to note that diets low in water and rich in salt can negatively affect kidney function [73]. In addition, the consumption of sugary drinks instead of water increases the intake of carbohydrates and calories, thereby raising blood glucose and exacerbating obesity and other related chronic diseases. Because of their low water reserves, older adults can be affected more seriously by hypohydration. Furthermore, water intake comes mostly from beverages (about 75%) and food intake (about 25%), especially from fresh food such as fruits and vegetables. Therefore, advice on the importance of drinking water, tea, and milk and consuming

other water-containing foods should be delivered by dietitians and healthcare professionals during the COVID-19 pandemic. Since the daily water requirement is influenced by age, sex, level of physical activity, diet, body composition, pregnancy, environmental conditions, and the presence of disease, the recommended intake of water varies widely and can reach 3.7 L/d for older adults (including all water contained in food, beverages, and drinking water) [34]. According to the Dietary Reference Intakes for Water, Potassium, Sodium, Chloride, and Sulfate, adults with moderate levels of physical activity who consume approximately 2200 kcal/d can meet water recommendations by drinking 12 cups of water and beverages daily, while children require 4 to 5 cups per day, adolescents (9 to 18 years) 7 to 11 cups per day, and older adults 9 to 13 cups per day. While some organizations recommend choosing unprocessed foods, healthy dried, frozen, or canned foods (e.g., fish, fruits, soups) are suggested as alternatives when fresh produce is not available [5]. There is a current trend for guidelines to support homemade and fresh meals instead of processed foods. Several countries, including, Brazil [10], Chile [46], Australia [63] and Canada [19] have recommended limiting the intake of processed foods, which are linked to cancer, obesity, hypertension, and diabetes [21]. Interestingly, there has been a worldwide trend for individuals to stock up on processed foods during the quarantine. This has been recommended by governmental agencies such as the Centers for Disease and Control and Prevention [10] for individuals at risk or for the general population by Health Canada [48] to avoid social contact during the peak of the COVID-19 outbreak. It is likely that many individuals have stocked up on unhealthful food items that will eventually be consumed. Therefore, clearer guidelines and recommendations about what foods to purchase are needed. Although there is some lack of clarity and guidance regarding obesity as a risk factor for COVID-19 [72] substantial preliminary data demonstrate that higher body mass index is a considerable risk factor for hospitalization and development of severe pneumonia. [3,32] In fact, a systematic review and meta-analyses showed that 50% of the adult patients infected with the Middle East coronavirus presented with hypertension and diabetes, while obesity was present in 16% of the cases [27]. Moreover, a recent study found a significant inverse correlation between body mass index and age: young individuals admitted to hospitals were more likely to have obesity. The study suggested that obesity could shift the incidence of severe COVID-19 disease to younger ages in countries where the prevalence of obesity is high [13]. Obesity restricts respiration, weakens immune responses, and is pro inflammatory. It is also associated with an increased risk of diabetes mellitus, cardiovascular disease, and kidney disease, all of which contribute to increased vulnerability to pneumonia-associated organ failure [50]. Thus, healthy weight loss could be a good strategy to reduce the risk of COVID-19 complications. Although none of the institutions mentioned weight loss in their guidelines, 3 of them highlighted the importance of avoiding weight gain. Specific guidelines for obese in-

dividuals are nonetheless needed to promote gradual weight loss without compromising the body's lean mass.

Considering the difficulty to achieve significant weight loss through physical activity during the pandemic, protein intake of around 30% of energy requirements may be considered for adults under energy-restricted diets. This level of protein intake can prevent or attenuate the loss of lean muscle mass while also promoting greater satiety during weight loss [22]. In their discussion of nutritional recommendations during COVID-19 quarantine, Muscogiuri et al. highlighted the role of tryptophan, an amino acid and a precursor of serotonin, in the regulation of satiety and caloric intake, suggesting protein-rich foods such as milk, yogurt, seeds, and nuts as good sources. It is worth noting that web-based weight-loss approaches are becoming popular and are effective for patients with obesity [4]. Such tools may be useful during the COVID-19 pandemic. Probiotics were recommended by only one institution, 11 did not provide a specific amount or examples of food sources [2,62].

Probiotics are defined as "live microorganisms that, when administered in adequate amounts, confer a health benefit on the host" [58]. They can act through diverse mechanisms, including modulation of immune function, production of antimicrobial compounds and organic acids, improvement of gut barrier integrity, formation of enzymes, and interaction with resident microbiota [2,36]. Studies of probiotic species belonging to the *Lactobacillus* and *Bifidobacterium* genera have shown promising results regarding improved immune function [6]. Fermented dairy products might be a good option to improve the gut microbiota, although further studies are needed to better elucidate the modulatory mechanisms of the microorganisms in these foods. Only one agency provided guidance on alcohol consumption. The Food and Agriculture Organization of the United Nations 20 recommended that alcohol intake be limited, but no specific amounts were provided. Excessive alcohol consumption is associated with reduced host immunity to viral infections and increased susceptibility to tuberculosis and bacterial and viral pneumonia in humans and animals [7]. On the other hand, some benefits of moderate alcohol consumption have been reported, including reduced risk of cardiovascular disease, alleviation of acute stress, improved mood, and increased relaxation [42]. Current guidelines for moderate intake recommend no more than 1 drink per day for women and no more than 2 drinks per day for men. It should be noted that individuals who do not drink alcohol should not start drinking. Finally, generic terms and phrases such as "healthy diet," "variety of foods in each group," "variety of fresh and unprocessed foods," and "varied diet" were observed in the majority of the documents. These messages might not be clear enough to encourage people to make healthy food choices. Specific recommendations, including examples of food and instructions for food preparation, would improve the public health message.

All documents reported that there are currently no known supplements to prevent COVID-19. Only 2 documents mentioned that it might be possible to use supplements to meet dietary recommendations. Some vitamins and minerals improve immunity; however, the

idea that more is better is a misconception. Megadoses of vitamins and minerals can induce toxic and adverse effects [11,16] or interact with medications, leading to enhanced or reduced pharmacological effects [29]. On the other hand, it is important to note that Dietary Reference Intakes have been established for healthy individuals and are based on a diet providing 2000 kcal/d [20]. Thus, healthcare professionals should individualize dietary plans by considering factors that can increase nutrient requirements, such as specific diseases/conditions, medications, dietary patterns (eg, vegetarianism), and exercise intensity. For this purpose, the range from the Recommended Dietary Allowance to the Tolerable Upper Intake Level can be used to optimize the dietary plan [55]. The Brazilian Association of Clinical Nutrition<sup>11</sup> reported that vitamin C supplementation might be useful for individuals at risk of respiratory viral infections. Vitamin C is a recognized antioxidant nutrient that can enhance chemotaxis, phagocytosis, generation of reactive oxygen species, and, ultimately, microbial killing [32]. However, a systematic review involving 10 708 participants showed that doses of vitamin C exceeding 1 g/d were not beneficial in reducing the incidence of colds among the overall population [43]. On the other hand, such doses might be effective in reducing the duration of colds by 8% to 18%. In addition, vitamin C may be useful to prevent the development of colds in people exposed to brief periods of intense physical activity or to cold temperatures [64]. Vitamin D is another antioxidant that has been associated with a reduction in pulmonary infections [17,38]. Evidence that vitamin D can prevent or treat influenza is inconclusive [75], but vitamin D status has been associated with the severity of COVID-19. Potential mechanisms include increased secretion of antimicrobial peptides, decreased production of chemokines, inhibition of dendritic cell activation, and altered T-cell activation [26]. None of the documents reviewed here suggested vitamin D supplementation as preventive therapy against COVID-19. However, Rhodes et al 31 suggested that countries south of latitude 35 north have low population mortality, which might indicate a role of vitamin D in determining outcomes from COVID-19. When deficiency is detected, oral supplementation with doses between 2000 and 4000 IU/d is indicated.<sup>11</sup> Although a higher dose has been recently proposed with the aim of reducing the risk of infection (vitamin D3, 10 000 IU/d for a few weeks to rapidly raise 25(OH)D concentrations, followed by 5000 IU/d) [67], this is still controversial and contradicts other recommendations. Since it is not feasible to recommend biochemical analysis of vitamin D levels during a pandemic, targeting vulnerable populations for vitamin D supplementation can mitigate the health risks associated with COVID-19, especially since vitamin D deficiency has been shown to correlate with hypertension, diabetes mellitus, obesity, and darker skin pigmentation. Although it may be controversial, vitamin D supplementation to prevent deficiency may at the very least, provide benefits by sustaining bone mass during lockdown [25,60]. Zinc and selenium are antioxidant micronutrients often considered for supplementation. Zinc is a co-

factor of superoxide dismutase, an enzyme present in the mitochondria and cytosol of cells that suppresses oxidative stress. Excess zinc, however, also causes cellular oxidative stress [34,39]. A narrative review showed ample evidence of the antiviral activity of zinc (10 mg/kg of body weight, up to 600 mg/d total) against a variety of viruses, such as influenza [56]. In addition, zinc is critical in generating both innate and acquired (humoral) antiviral responses. However, the authors concluded that further research is needed on the antiviral mechanisms and clinical benefits of zinc supplementation as a preventative and therapeutic treatment for viral infections. A recent study suggested that the elderly are at risk for zinc deficiency, which increases susceptibility to infections such as pneumonia. Zinc supplementation (i.e., elemental zinc, 30 mg/d) might be adequate to improve immune function and to reduce the risk of infections in this group [49]. Selenium has been found to increase the activity of glutathione peroxidase, another antioxidant enzyme, and to augment a number of host immune responses, including interferon  $\gamma$  production, T-cell proliferation, antigen stimulation, and natural killer cell activity. In fact, an experimental study with mice and influenza virus showed that selenium deficiency led to more severe disease and an increased pro inflamma-

tory immune response, resulting in increased pathology in the lungs. Selenium is an important trace element that can be found in nuts, breads, grains, meat, poultry, fish, and eggs and is easily obtainable from dietary sources (see the Dietary recommendations section). In summary, it is preferable to obtain antioxidants from food rather than from supplements. However, supplements are recommended for individuals who have specific challenges in meeting dietary requirements. The key message regarding dietary supplements is that individuals should not rely on supplements to prevent COVID-19. Further studies into the effects of vitamin and mineral supplementation on outcomes related to COVID-19 (e.g., disease severity, inflammatory status, hospitalization, death, etc) are warranted. Currently, several clinical trials on vitamin D (n = 21), vitamin C (n = 15), zinc (n = 15), and selenium (n = 1) supplementation are under way ([www.clinicaltrials.gov](http://www.clinicaltrials.gov)). It is hoped that the results of these studies will lead to a better understanding of the relationship between micronutrients and COVID-19.

Figure 1 describes the rationale behind the dietary guidance and the personal hygiene practices recommended during the COVID-19 pandemic, along with the potential mechanisms linking diet and the prevention of COVID-19 complications (Fig. 1).

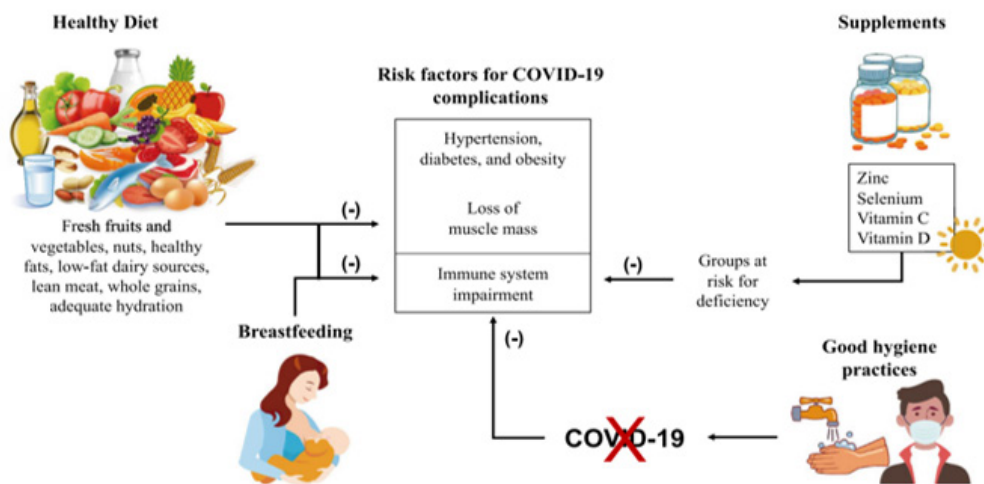


Fig. 1. Rationale for dietary recommendations during the coronavirus disease 2019 (COVID-19) pandemic.

Key nutrients that support the immune system can be obtained through dietary components that include fresh foods (e.g., fruits and vegetables), fish, lean meat, dairy, water and other non-sugary beverages, and healthy fats. A healthy diet can also decrease the risk of, or help control, hypertension, diabetes, obesity, and muscle atrophy, which are all considered risk factors for COVID-19 complications. There are no known supplements that can prevent COVID-19; however, in populations at risk of deficiency, supplements can mitigate the public health risks associated with COVID-19. Breastfeeding benefits an infant's immune system, protecting against viruses and bacterial infections. The use of personal protection, such as masks, along with good hygiene practices, such as frequent hand washing with soap and water or alcohol-based sanitizers, can prevent

COVID-19 transmission and immune system impairment. Symbol: (-): inhibitory effect.

De Faria Coelho-Ravagnani et al. gave own conclusions in own article [12]: This review summarizes recent scientific literature and existing recommendations from national and international nutrition agencies on an optimal diet, vitamin and mineral supplementation, and good hygiene practices for food preparation during the COVID-19 pandemic. The findings can be used to help dietitians and healthcare professionals better address dietary recommendations during the COVID-19 pandemic. Guidance related to the safe handling of food, from production to consumption, is critical to reduce the risk of viral dissemination. The general recommendation is to consume a diet based predominantly on fresh foods such as fruits, vegetables, whole grains, low-fat dairy sourc-



es, and healthy fats (olive oil and fish oil) and to limit intakes of sugary drinks and processed foods high in calories and salt. Dietary supplements (ie, vitamins C and D, zinc, and selenium) should be administered to individuals with, or at risk of, respiratory viral infections or in whom deficiency is detected [25,60]. Breast milk is the safest and healthiest food for infants, and breastfeeding should be encouraged, even in women diagnosed with COVID-19.

**Nutrition advice for adults during the COVID-19 outbreak (WHO, 2021).** Proper nutrition and hydration

are vital. People who eat a well-balanced diet tend to be healthier with stronger immune systems and lower risk of chronic illnesses and infectious diseases. So you should eat a variety of fresh and unprocessed foods every day to get the vitamins, minerals, dietary fibre, protein and antioxidants your body needs. Drink enough water. Avoid sugar, fat and salt to significantly lower your risk of overweight, obesity, heart disease, stroke, diabetes and certain types of cancer (Fig. 2-3).

## Nutrition advice for adults during #COVID-19

### What you need to know

Proper nutrition is vital. Eat a well-balanced diet every day to get the vitamins, minerals, dietary fibre, protein and antioxidants your body needs to be healthier with a stronger immune system and to lower your risk of chronic illnesses and infectious diseases.

- Eat fresh and unprocessed food** such as dark green leafy vegetables, orange/yellow coloured fruit and vegetables, legumes (e.g. lentils, beans), nuts and whole grains (e.g. unprocessed maize, millet, oats, wheat, brown rice or starchy tubers or roots such as potatoes), and proteins (e.g. meat, fish, eggs, milk).
- Drink 8–10 cups of water every day.** Water is the best choice, but you can also consume other drinks (e.g. lemon juice diluted in water and unsweetened, tea and coffee – not too much), and eat fruits and vegetables that contain water (e.g. cucumber, tomatoes, spinach, mushroom, melon, broccoli, Brussels sprouts, oranges, apples, blueberries).
- Eat healthy fats** found in white meat (e.g. poultry), fish, avocado, nuts, olive oil, soy, canola, sunflower and corn oils, rather than fats found in fatty meat, butter, coconut oil, cream, cheese, ghee and lard. Avoid fats found in processed food, processed meats, fast food, snack food, fried food, frozen pizza, pies, cookies, margarines and spreads.
- Limit your salt intake.** When cooking and preparing food, limit the amount of salt and high-sodium condiments (e.g. soy sauce, fish sauce). Limit your daily salt intake to less than 5 g (approximately 1 teaspoon), and use iodized salt. Avoid snack foods that are high in salt.
- Limit your sugar intake.** Choose fresh fruits instead of sweet snacks (e.g. cookies, cakes, chocolate). Limit your intake of soft drinks or sodas, still drinks and other drinks that are high in sugar (e.g. sweetened fruit juices, fruit juice concentrates and syrups, flavoured milks, yogurt drinks).
- Avoid eating out.** Eating out during this COVID-19 pandemic increases your contact with other people and your chance of being exposed to the virus. So eat at home. Home-cooked food is the best choice, and is healthier and more nutritious for you than calorie-filled food from outside the home.
- Reach out for help.** During this COVID-19 pandemic, you may need support with your mental health and diet to ensure you keep in good health, especially if you are living with a chronic illness and have suspected or confirmed COVID-19. If you feel overwhelmed, seek help from trained professionals and through other trusted sources (e.g. digital, social, print, broadcast).

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Fig. 2. Nutrition advice for adults during the COVID-19 outbreak (WHO EMRO, 2021).

# Nutrition advice for adults during the COVID-19 outbreak

Proper nutrition and hydration are vital. People who eat a well-balanced diet tend to be healthier with stronger immune systems and lower risk of chronic illnesses and infectious diseases. So you should eat a variety of fresh and unprocessed foods every day to get the vitamins, minerals, dietary fibre, protein and antioxidants your body needs. Drink enough water. Avoid sugar, fat and salt to significantly lower your risk of overweight, obesity, heart disease, stroke, diabetes and certain types of cancer.

## Eat fresh and unprocessed foods every day

- » Eat fruits, vegetables, legumes (e.g. lentils, beans), nuts and whole grains (e.g. unprocessed maize, millet, oats, wheat, brown rice or starchy tubers or roots such as potato, yam, taro or cassava), and foods from animal sources (e.g. meat, fish, eggs and milk).
- » Daily, eat: 2 cups of fruit (4 servings), 2.5 cups of vegetables (5 servings), 180 g of grains, and 160 g of meat and beans (red meat can be eaten 1–2 times per week, and poultry 2–3 times per week).
- » For snacks, choose raw vegetables and fresh fruit rather than foods that are high in sugar, fat or salt.
- » Do not overcook vegetables and fruit as this can lead to the loss of important vitamins.
- » When using canned or dried vegetables and fruit, choose varieties without added salt or sugar.

## Eat moderate amounts of fat and oil

- » Consume unsaturated fats (e.g. found in fish, avocado, nuts, olive oil, soy, canola, sunflower and corn oils) rather than saturated fats (e.g. found in fatty meat, butter, coconut oil, cream, cheese, ghee and lard).
- » Choose white meat (e.g. poultry) and fish, which are generally low in fat, rather than red meat.
- » Avoid processed meats because they are high in fat and salt.
- » Where possible, opt for low-fat or reduced-fat versions of milk and dairy products.
- » Avoid industrially produced trans fats. These are often found in processed food, fast food, snack food, fried food, frozen pizza, pies, cookies, margarines and spreads.

## Counselling and psychosocial support

While proper nutrition and hydration improve health and immunity, they are not magic bullets. People living with chronic illnesses who have suspected or confirmed COVID-19 may need support with their mental health and diet to ensure they keep in good health. Seek counselling and psychosocial support from appropriately trained health care professionals and also community-based lay and peer counsellors.

## Drink enough water every day

- » Water is essential for life. It transports nutrients and compounds in blood, regulates your body temperature, gets rid of waste, and lubricates and cushions joints.
- » Drink 8–10 cups of water every day.
- » Water is the best choice, but you can also consume other drinks, fruits and vegetables that contain water, for example lemon juice (diluted in water and unsweetened), tea and coffee. But be careful not to consume too much caffeine, and avoid sweetened fruit juices, syrups, fruit juice concentrates, fizzy and still drinks as they all contain sugar.

## Eat less salt and sugar

- » When cooking and preparing food, limit the amount of salt and high-sodium condiments (e.g. soy sauce and fish sauce).
- » Limit your daily salt intake to less than 5 g (approximately 1 teaspoon), and use iodized salt.
- » Avoid foods (e.g. snacks) that are high in salt and sugar.
- » Limit your intake of soft drinks or sodas and other drinks that are high in sugar (e.g. fruit juices, fruit juice concentrates and syrups, flavoured milks and yogurt drinks).
- » Choose fresh fruits instead of sweet snacks such as cookies, cakes and chocolate.

## Avoid eating out

Eat at home to reduce your rate of contact with other people and lower your chance of being exposed to COVID-19. We recommend maintaining a distance of at least 1 metre between yourself and anyone who is coughing or sneezing. That is not always possible in crowded social settings like restaurants and cafes. Droplets from infected people may land on surfaces and people's hands (e.g. customers and staff), and with lots of people coming and going, you cannot tell if hands are being washed regularly enough, and surfaces are being cleaned and disinfected fast enough.

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Fig. 3. Nutrition advice for adults during the COVID-19 outbreak (WHO EMRO, 2021).

Eat fresh and unprocessed foods every day

Eat fruits, vegetables, legumes (e.g. lentils, beans), nuts and whole grains (e.g. unprocessed maize, millet, oats, wheat, brown rice or starchy tubers or roots such as potato, yam, taro or cassava), and foods from animal sources (e.g. meat, fish, eggs and milk).

Daily, eat 2 cups of fruit (4 servings), 2.5 cups of vegetables (5 servings), 180 g of grains, and 160 g of

meat and beans (red meat can be eaten 1–2 times per week, and poultry 2–3 times per week).

For snacks, choose raw vegetables and fresh fruit rather than foods that are high in sugar, fat or salt.

Do not overcook vegetables and fruit as this can lead to the loss of important vitamins?

When using canned or dried vegetables and fruit, choose varieties without added salt or sugar.

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Eat moderate amounts of fat and oil.

Consume unsaturated fats (e.g. found in fish, avocado, nuts, olive oil, soy, canola, sunflower and corn oils) rather than saturated fats (e.g. found in fatty meat, butter, coconut oil, cream, cheese, ghee and lard).

Choose white meat (e.g. poultry) and fish, which are generally low in fat, rather than red meat.

Avoid processed meats because they are high in fat and salt.

Where possible, opt for low-fat or reduced-fat versions of milk and dairy products.

Avoid industrially produced trans fats. These are often found in processed food, fast food, snack food, fried food, frozen pizza, pies, cookies, margarines and spreads.

Eat less salt and sugar.

When cooking and preparing food, limit the amount of salt and high-sodium condiments (e.g. soy sauce and fish sauce).

Limit your daily salt intake to less than 5 g (approximately 1 teaspoon), and use iodized salt.

Avoid foods (e.g. snacks) that are high in salt and sugar.

Limit your intake of soft drinks or sodas and other drinks that are high in sugar (e.g. fruit juices, fruit juice concentrates and syrups, flavoured milks and yogurt drinks).

Choose fresh fruits instead of sweet snacks such as cookies, cakes and chocolate.

Avoid eating out.

Eat at home to reduce your rate of contact with other people and lower your chance of being exposed to COVID-19. We recommend maintaining a distance of at least 1 meter between yourself and anyone who is coughing or sneezing. That is not always possible in crowded social settings like restaurants and cafes. Droplets from infected people may land on surfaces and people's hands (e.g. customers and staff), and with lots of people coming and going, you cannot tell if hands are being washed regularly enough, and surfaces are being cleaned and disinfected fast enough.

Counselling and psychosocial support.

While proper nutrition and hydration improve health and immunity, they are not magic bullets. People living with chronic illnesses who have suspected or confirmed COVID-19 may need support with their mental health and diet to ensure they keep in good health. Seek counselling and psychosocial support from appropriately trained health care professionals and also community-based lay and peer counsellors.

### Conclusion

1. In this article we have discussed nutritional recommendations for COVID-19 disease, nutrition acquisition by human immunity, transient over nutrition and the cytokine storm in severe cases of COVID-19 and dietary recommendations during the COVID-19 pandemic. We have analyzed the opinions and conclusions of several scientists on this topic. We believe that this article can be an impetus for further in-depth research.

2. Many nutritionist guidelines encourage the consumption of fruits, vegetables, and whole grains. 31% of recommendations indicate the importance of minerals, zinc and vitamins C, A and D in maintaining a well-functioning immune system.

3. Nutrient diversity is the basis for a protective diet for patients with COVID-19. A diet high in dietary fiber, vitamins, minerals, probiotics and prebiotics is a priority in keeping patients healthy.

### The list of references can be found in the editorial

#### ASPECTS AND PRIORITIES OF EASY FOOD FOR PATIENTS WITH COVID-19

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*When infected with the SARS-CoV-2 virus, patients can temporarily overeat, leading to lipotoxicity and subsequent damage to non-adipose tissue, and in severe cases, hyperinflammation and a cytokine storm. A balanced diet can improve health, reduce the risk of infection, and reduce the severity of acute respiratory syndrome - both COVID-19 and SARS-CoV-2. Nutritionists encourage the consumption of fruits and vegetables that are high in grains. 31% of recommendations point to the importance of minerals, zinc and vitamins C, A and D for maintaining a well-functioning immune system.*

**Key words:** Immunity, nutrition, pathogen, tissue, SARS-CoV-2 virus infection, lipotoxicity, non-adipose tissues, hyperinflammation, COVID-19, acute respiratory syndrome.

