
REVIEW ARTICLE

COVID-19 and Nutrition

Summary of Official Recommendations

**Paraskevi Detopoulou, PhD; Christina Tsouma, MSc;
Vassilios Papamikos, MSc**

Medical nutrition therapy may have a key role in the COVID-19 pandemic. Given the spread of misinformation, the present review organizes and summarizes nutrition recommendations regarding COVID-19, serving as a reference guide for health professionals. Nineteen official recommendations were included of international, US, Asian, European, Canadian, and Australian origin on (i) lactation, (ii) nutrition during quarantine, (iii) nutrition in high-risk groups, (iv) nutrition for recovery at home, and (v) nutrition in hospital. Breastfeeding is encouraged, and the role of hydration and the adoption of a healthy diet during quarantine are emphasized. Older people and/or people with comorbidities should be checked for malnutrition and follow a healthy diet. For patients recovering at home, hydration, protein, and energy intake should be ensured. For hospitalized patients, early feeding with a priority on enteral route is recommended. **Key words:** coronavirus, COVID-19, hospital, lactation, nutrition, quarantine, recommendations

THE ROLE of nutrition is critical in health and development.¹ The relationship between diet and disease is evident in several ways: malnutrition affects the immune system and thus increases susceptibility to disease; vitamin deficiencies or suboptimal intake can worsen or have a causal role in disease; and an unhealthy diet is a predisposing factor for chronic diseases such as cardiovascular dis-

ease and cancer.¹ Moreover, nutrition seems to be implicated in viral infections.¹

Taking the role of nutrition in disease prevention and therapy as a starting point, several considerations can be made on its potential role in the COVID-19 pandemic. Older individuals and/or those with comorbidities, such as diabetes, obesity, cardiovascular disease, lung problems, and kidney and liver diseases, and with special nutrition needs seem to be more vulnerable to the pandemic.² In parallel, quarantine, which has been applied in most countries as a measure to reduce the transmission of COVID-19, may affect dietary habits, with a trend toward more “comfort” energy- or carbohydrate-dense foods (stress-eating)³ and increase body weight.⁴ The prolonged duration of such behaviors, if combined with reduction in physical activity, may negatively influence health status.¹ Moreover, a special reference should be made to breastfeeding mothers with COVID-19⁵ and nutritional approaches for hospitalized COVID-19 patients^{6,9} or those recovering at home.¹⁰

Author Affiliations: Department of Clinical Nutrition, General Hospital Korgialenio-Benakio (Red Cross Hospital), Athens, Greece (Dr Detopoulou, Ms Tsouma, and Mr Papamikos); and Department of Dietetics and Nutrition, University of Peloponnese, Kalamata, Greece (Dr Detopoulou).

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Correspondence: Paraskevi Detopoulou, PhD, Department of Clinical Nutrition, General Hospital Korgialenio-Benakio (Red Cross Hospital), Erythrou Stavrou and Athanasaki 2, Ampelokipoi, Athens 11526, Greece (vivianteto@gmail.com).

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Despite the increasing scientific evidence regarding the COVID-19 pandemic, concerns have been raised about the high level of misinformation and pseudoscience.^{11,12} Health professionals (including dietitians and general practitioners) act as key players in the delivery of evidence-based information. In addition, official information regarding nutrition and COVID-19 has been launched from international and national bodies, such as the World Health Organization (WHO),¹³ the European Society of Clinical Nutrition and Metabolism (ESPEN),⁶ the American Society for Parenteral and Enteral Nutrition (ASPEN),¹⁰ and the European Food Information Council (EUFIC).¹⁴

The aim of the present review was to classify/organize nutrition recommendations and summarize key messages from official sources so as to serve as a reference guide for both health professionals and public.

METHODS

Two independent researchers searched PubMed, LitCOVID, and the Web by inserting the search terms “COVID OR coronavirus AND nutrition,” “coronavirus AND nutrition,” “COVID OR coronavirus AND recommendations AND diet.” Moreover, several repositories on COVID and nutrition were searched, that is, European Federation of the Associations of Dietitians (EFAD),¹⁵ the Global Resource for Nutrition Practice,¹⁶ the Global Nutrition Cluster,¹⁷ and the ASPEN Web site.¹⁸ Only sources in the English language were considered. After retrieving the selected documents, duplicates were excluded. Articles and reports were screened to identify data that met the eligibility criteria. An effort was made to include recommendations from different geographic areas. However, contributions of smaller regional bodies are not separately referenced because of the immensity and overlapping of information. Recommendations on food safety issues and hand hygiene were not included, since the focus of the present work was on nutrition.

RESULTS

Our results were categorized into 5 sections: (i) lactation, (ii) nutrition during quarantine, (iii) nutrition for disease prevention in high-risk groups, (iv) nutrition for recovery at home, and (v) nutrition in hospital (Table 1).

Lactation

Several organizations provide advice on lactation in the COVID-19 pandemic, such as the WHO, United Nations Children’s Fund (UNICEF), Centers for Disease Control and Prevention (CDC), and International Lactation Consultant Association (ILCA). The WHO recommends the immediate initiation (within the first hour) of breastfeeding, its exclusive continuation for 6 months, the introduction of complementary feeding at no earlier than 6 months, and the prolongation of breastfeeding for 2 years or more.⁵ In COVID-19-positive or suspected positive mothers, all the aforementioned official organizations encourage breastfeeding (after taking appropriate precautions, such as hand hygiene, mask during feeding, and surface disinfection), since it is the best diet for infants.^{5,19-21} In case of severe malaise, it is suggested that mothers can express milk, use donor human milk, consider having a break, and then restart breastfeeding or consider letting another woman breastfeed their child (Figure 1).⁵ UNICEF on top of other recommendations underlines that COVID-19 provides an opportunity to replace formula milk and manufactured food with freshly homemade food.²⁰

Nutrition during quarantine

The recommendations regarding healthy eating during quarantine (governmental order “stay at home” or medically determined mandate due to possible exposure) are summarized in Table 2. Almost all official sources emphasize the role of hydration and the adoption of a healthy diet with fruits, vegetables, whole grains, and healthy sources of fat.^{13,14,22-30} Several tips are given on

Table 1. Nutritional Recommendations of International and National Bodies Regarding COVID-19

	United States										Asia				Australia			
	International					Academy Nutrition/ Dietetics					Turkish Dietetic Association	India Dietetic Association	China National Health Commission	Europe ^a	Canada Dietitians of Canada	Dietitians Association of Australia	Australian Government Department of Health	
	WHO	UNICEF	WFP	ILCA	FAO	ASN	ASPN	Dietetics	USDA	sociation	USA	X	X	X	X	X	X	X
Lactation/young children	X	X		X			X											
Healthy nutrition during quarantine	X		X		X		X		X									
Nutrition for disease prevention in high-risk groups														X				
Nutrition for COVID patients recovering at home							X					X						
Nutrition for hospitalized patients	X								X									

Abbreviations: ASN, American Society for Nutrition; ASPEN, American Society of Parenteral and Enteral Nutrition; BDA, British Dietetic Association; CDC, Centers for Disease Control and Prevention; ESPEN, European Society of Clinical Nutrition and Metabolism; EUFIC, European Food Information Council; FAO, Food and Agriculture Organization; ILCA, International Lactation Consultant Association; USDA, United States Department of Agriculture; WFP, World Food Programme; WHO, World Health Organization.

^aIt is noted that further information on dietary issues has been provided by other countries (such as Spain, Germany, Greece, etc) but they were not included since it was not in the English language.

^bBDA, redirects to the guidelines provided by the Royal College of Paediatrics and Child Health and the Royal College of Obstetricians and Gynaecologists, which are similar to other recommendations presented.

^cDietitians of Canada refer to the guidelines of the Society of Obstetricians and Gynecologists of Canada (SOGC) regarding lactation, which are similar to other recommendations presented.

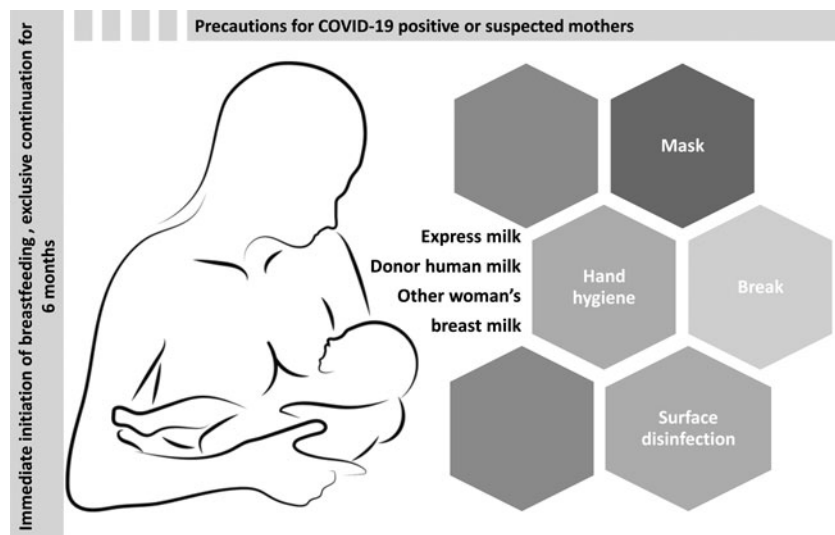


Figure 1. Recommendations for lactation. Image from www.pixabay.com

the limitation of salt (such as avoidance of canned meat, heavily processed foods, high-sodium condiments), sugar (such as sweetened beverages, sweet snacks),^{13,22,23,29} and alcohol,^{23,27-29} while other aspects of diet are also highlighted, such as variety,^{14,22,23} “fun in the kitchen,”²³ and balanced and “mindful eating.”¹⁴ Dietitians Australia provides shopping ideas so that food sufficiency is ensured along with minimal market visits during the quarantine.²⁶ ESPEN also underlines that regular physical activity should be continued during quarantine while taking precautions.⁶

Nutrition for disease prevention in high-risk groups

Groups at high risk for severe illness from COVID-19 are the elderly (aged >65 years), those who live in nursing homes, and those with comorbidities (chronic lung disease or asthma, heart problems, immunosuppression, obesity, diabetes, and kidney and liver diseases).² Moreover, people with disabilities, those who are homeless, and pregnant women need extra precautions.²

The British Dietetic Association (BDA) emphasizes that “there is no diet to prevent coronavirus”¹¹ and that there is no food or

food component with an authorized claim by the European Food Safety Authority (EFSA) to protect against infection.¹¹ With respect to obesity, the Department of Health and Social Care in the United Kingdom launched a campaign to help people lose weight, exercise more, and eat better.³¹ Other measures have been taken to tackle obesity and “protect” the British against COVID-19, such as menu labeling, ban on TV advertisements, and ban on certain supermarket deals regarding foods high in salt, sugar, and fat.³¹

The International Diabetes Federation underlines that in the era of COVID-19, individuals with diabetes should eat a balanced diet so as to have normal blood glucose levels and an enhanced immune system.³² More specifically, it recommends the consumption of low glycemic index foods (eg, vegetables, whole wheat pasta), lean proteins, fruits and vegetables, the limited consumption of high fat and sugar foods, and the avoidance of high quantities of fried foods.³²

According to the ESPEN Expert Statement on COVID-19, older people and/or people with comorbidities should be screened for malnutrition with the use of validated tools (ie, MUST, NRS-2002, etc).⁶ In the case of malnutrition, sufficient intake of energy,

Table 2. Specific Recommendations of International and National Bodies on Healthy Nutrition During Quarantine^a

	WHO	WFP	ASN	FAO	Academy of Nutrition and Dietetics	Turkish Dietetic Association	China National Health Commission	EUFIC	Dietitians of Canada	Dietitians Association of Australia	Australian Government Department of Health
Hydration	Water (8-10 cups)	Hydrate	Water (6-8 cups)	Hydrate	Adequate water	Fresh fruits, frozen or precooked	Drink boiled water or tea	1.6-2 L	Hydrate		Plenty of water
Fruits	2 cups (4 serv)	Build a colorful plate	Plenty	Plenty	Fresh fruits, frozen or precooked	Fresh fruits, frozen or precooked	Fresh fruits, rather than juice	Plenty	Plenty	Choose fresh that last longer	Plenty
Vegetables	2.5 cups (5 serv)	Build a colorful plate	Plenty	Plenty	Fresh vegetables, frozen, or precooked	Fresh vegetables, frozen, or precooked	Fresh vegetables, deep color, mushroom, agaric, and kelp	Plenty	Plenty	Choose fresh vegetables that last longer	Plenty including different types and color
Grains	180 g	Whole grain bread and mixed-grain rice	Whole grains	Whole grains	Whole grains	Whole grains	Whole grains, mixed beans, and potatoes are preferable	Whole grains	Whole grains	Rice, pasta, quinoa	Mostly whole grain and/or high cereal fiber varieties
Protein foods (meat/beans/fish)	160 g Red meat 1-2 times/wk poultry 2-3 times/wk	Limit the consumption of canned meat	Small meat portions to limit saturated fat	Small meat portions to limit saturated fat	Consume high-protein foods, fish twice a week, legumes may be consumed daily, probiotics	Consume high-protein foods, fish twice a week, legumes may be consumed daily, probiotics	Avoid fatty or smoked meats, and say no to meat of wild animals; dairy products, especially yogurt	Legumes, eggs, fish, meat	Legumes, eggs, fish, meat	Canned fish, legumes (canned or dried)	Lean meats, poultry, fish, eggs, tofu, nuts, seeds, legumes or beans

(continues)

Table 2. Specific Recommendations of International and National Bodies on Healthy Nutrition During Quarantine^a (Continued)

	WHO	WFP	ASN	FAO	Academy of Nutrition and Dietetics	Turkish Dietetic Association	China National Health Commission	EUFIC	Dietitians of Canada	Dietitians Association of Australia	Australian Government Department of Health
Fats/oils	Moderate amount of fat and oil (unsaturated)			Nuts, olive/sesame oil			Avoid fried foods	Healthy fats	Nuts and seeds	Nuts and seeds (including nut butters)	Limit foods containing saturated fat
Salt	<5 g/d	Limit					Avoid salty foods	Limit			Limit foods containing added salt
Sugar	Less sugar	Limit, avoid sweetened beverages		Less sugar				Limit			Limit foods containing added sugars
Other	Avoid eating out	Variety	Limit commercially prepared frozen dinners	Variety Limit alcohol	Healthful choices, "fun in the kitchen"	Avoid alcohol; vitamin and mineral supplements as an alternative for a short period of time	Balance, balanced diet including grains, fruits, vegetables, meat, and eggs	Balance, No single food is authorized to fight COVID-19	No single food is authorized to fight COVID-19	Shopping tips	Limit alcohol intake

Abbreviations: BDA, British Dietetic Association; EUFIC, European Food Information Council; FAO, Food and Agriculture Organization; WFP, World Food Programme; WHO, World Health Organization.
^aThe United States Department of Agriculture (USDA) recommends a mix of self-stable, frozen, and fresh foods and provides links to more specific dietary guidance. (www.choosemyplate.gov).



Figure 2. Recommendations for high-risk groups.

vitamins (such as vitamins A, C, D, E, B complex), omega-3 fatty acids, and minerals (such as zinc, selenium, and iron) should be ensured and expert advice should be taken in order to optimize nutritional intake.⁶

The role of proper hydration is also critical in the management of malnourished patients.¹¹ Moreover, oral nutritional supplements (ONSs) should be ingested, if necessary, in order to cover nutritional needs.⁶

For critically ill patients with acute kidney injury undergoing renal replacement therapy, increased protein intake is recommended (2-2.5 g/kg adjusted body weight [ABW] per day).⁷

The aforementioned recommendations are summarized in Figure 2.

Nutrition for recovery at home

The nutritional status of each infected patient should be evaluated before the administration of general treatments.⁶ Patients with COVID-19 recovering at home should ensure that they are eating and drinking regularly to maintain good nutrition status.³³ Older people and/or people with comorbidities and COVID-19 should be checked for malnutrition and treated accordingly, as underlined by ESPEN.⁶ ASPEN also highlights

the importance of addressing malnutrition, emphasizing the role of hydration and energy and protein intake, and providing practical ideas for the general public (ie, rehydration recipes and ideas for protein-rich foods).¹⁰ This step is of particular importance since malnutrition may delay recovery and increase frailty. More particularly, the recommendations for energy, protein, and fluids are shown in Figure 3.^{6,10} If nutritional needs are not met after dietary counseling and food fortification, ONSs should be used.^{6,10} A supplement providing at least 400 kcal/d and 30 g or more of protein per day should be started for at least 1 month and then reevaluated.⁶

Nutrition in hospital

It is suggested that nutritional status should be assessed before treatment initiation.^{7,34} Malnutrition should be detected and adequately treated.⁶ Indeed, patients with COVID-19 with high nutritional risk scores had worse outcomes and higher mortality rates.³³ As stressed by recent guidelines, patients with high nutritional risk scores should be referred to a dietitian for evaluation and individualized nutrition therapy.^{35,36} Patients should be routinely screened at least weekly (for non-ICU [intensive care unit] patients) or more regularly.³⁵ It is noted that rapid

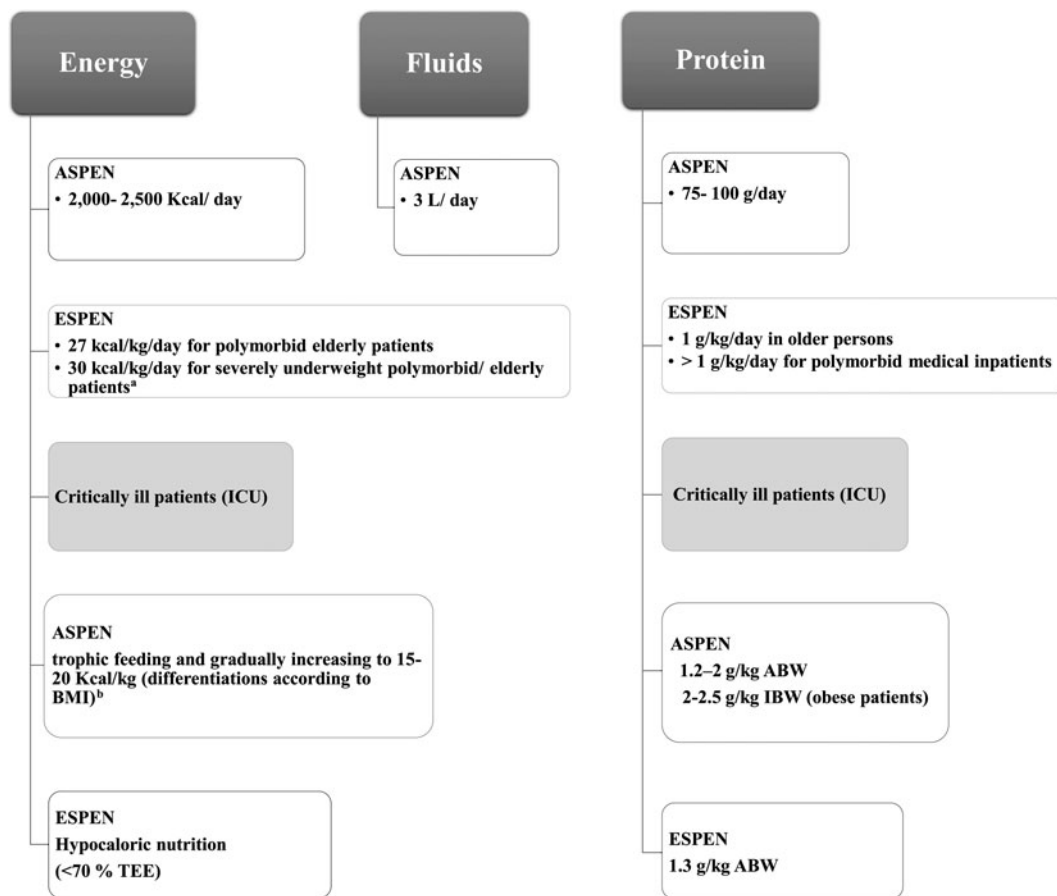


Figure 3. Nutrition recommendations for patients with COVID-19 for energy, fluids, and protein. Data from references Barazzoni,⁶ Martindale,⁷ and ASPEN.¹⁰ ^aIt is noted that recommendations should be individualized and that risk of refeeding syndrome is high in this group. Consultation by nutritional experts is recommended.⁶ ^bEnergy recommendations are 11 to 14 kcal/kg ABW per day in patients with BMI from 30 to 50 and 22 to 25 kcal/kg ideal body weight per day in patients with BMI more than 50. ASPEN indicates American Society for Parenteral and Enteral Nutrition; ESPEN, European Society of Clinical Nutrition and Metabolism; ICU, intensive care unit; TEE, total energy expenditure; BMI, body mass index; ABW, adjusted body weight; IBW, ideal body weight; kcal, kilocalories; L, liters.

deterioration in food/drink intake may occur in COVID-19 patients.³⁵

Fever and respiratory distress may increase energy needs of patients with COVID-19, while isolation and bed rest gradually lead to reductions in muscle tissue.³⁷ The lack of visitors in hospitals may reduce access to snacks.³⁵ Moreover, shortness of breath, dry mouth, as well as loss of smell and taste may render oral intake difficult.³⁵ Medications such as chloroquine may cause gastroin-

testinal (GI) distress, which, in turn, may influence food intake.³⁸

Nutrition recommendations are differentiated along with severity of disease and ventilation initiation, as presented later, but they follow the basic principles of hospital nutrition. For malnourished patients, gradual increases in food/energy intake should be considered to avoid refeeding syndrome.^{6,7,35} ASPEN raises a concern for early enteral nutrition (EN) in the subset of patients

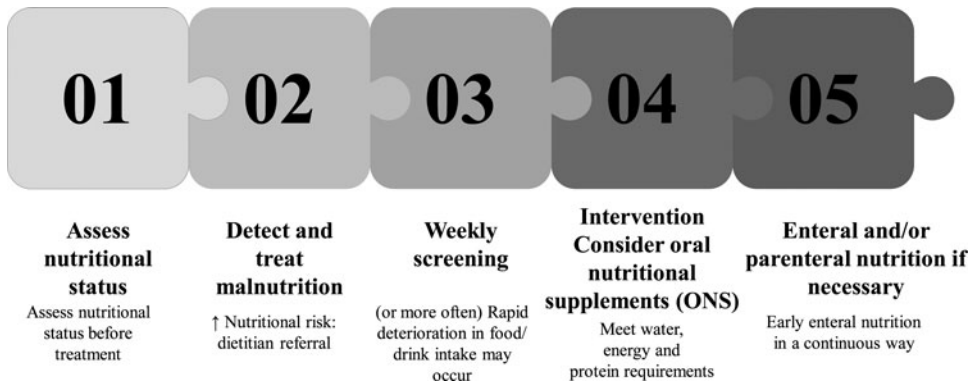


Figure 4. Steps to prevent malnutrition in nonventilated hospitalized patients. ONS indicates oral nutritional supplements.

with COVID-19 presenting with GI symptoms (such as diarrhea, nausea, and vomiting).⁷

Nonventilated patients

A basic nutritional goal for hospitalized patients is the prevention and treatment of malnutrition (Figure 4). For this purpose, high-energy, high-protein meals, snacks, and drinks should be considered and consistency of food should be modified if required.³⁵ Soft/moist foods may be better tolerated in patients with shortness of breath and/or dry mouth, while foods with a strong taste may be useful for patients with loss of smell and taste.³⁵ Personalized meals may be of added value, as shown from clinical practice.³⁷ Feeding assistance should also be offered if needed.³⁵

According to Australian recommendations, energy needs are about 25 kilocalories per kilogram per day (kcal/kg/d) (up to 30 kcal/kg/d in cases of malnutrition) after the first 5 days in the ICU.³⁶ The protein goal should be at least 1.2 g/kg/d.³⁶ ONSs should be considered in nonventilated patients.⁶ More specifically, 2 oral supplements per day should be administered to patients consuming less than 50% of their usual intake.⁸ An energy-dense formula providing 1.25 to 1.5 kcal/mL is recommended.³⁷ The next step is EN if nutritional needs cannot be met by the oral route.⁶ Early EN (within 24–48 hours of admission) via continuous infusion rather

than bolus is recommended.^{6,7,9} Continuous EN may reduce the exposure of the health care providers to the virus and may possibly reduce the risk of diarrhea.⁷ Specific recommendations on nasogastric feeding and minimizing its associated risks in patients requiring noninvasive ventilation or continuous positive airways pressure have been launched by a collaboration of British Scientific Societies.³⁹ Parenteral nutrition (PN) can also be considered as a second-choice option if contraindications for EN are present or if the nutritional goals are not reached.^{6,7,9}

Ventilated patients

Early EN is preferred over PN, if possible,^{6,7,9} as stated earlier. Australian recommendations suggest commencing EN support within 24 hours of ICU admission in low-risk patients with mechanical ventilation, while for high-risk patients, nutrition consultation should initially take place.³⁶

For several patients with COVID-19 and acute respiratory distress syndrome, prone position may be indicated to reduce the risk of pulmonary complications,⁴⁰ but this position is compatible with enteral feeding.^{6,7,9} It is noted that the Critical Care Specialist Group of BDA has launched detailed recommendations for feeding in the prone position regarding the tube position, feed delivery, choice of feed, monitoring of feed tolerance, and managing potential food intolerance.⁸ If

EN is not possible, PN can be provided.^{6,7,9} Energy and protein requirements for ICU patients are shown in Figure 3.

Rehabilitation after extubation

Patients who gradually recover and are extubated may experience dysphagia and difficulties in swallowing,⁶ and referral to a speech and language therapist should be considered.³⁵ In this case, food with adapted texture can be considered as a first option.⁶ If not tolerated, EN can be initiated or resumed.⁶ It is noted that Australian guidelines recommend keeping enteral tubes in place after extubation since patients' recovery may be prolonged.³⁶ In case that EN is contraindicated because of high aspiration risk, temporary PN can be administered.⁶ At the stage of rehabilitation, active mobilization should also be encouraged to preserve muscle mass.^{6,9}

DISCUSSION

The scientific community has promptly responded to the emerging needs of nutritional recommendations in the COVID-19 pandemic in an effort to limit its consequences. Although there is a striking dearth of evidence concerning applied clinical nutrition protocols for patients with COVID-19,^{37,41,42} there is a consensus of international bodies regarding the nutritional management of healthy adults and children in quarantine,^{13,14,22-26} as well as hospitalized patients in different stages of severity.^{6,7,9}

Breastfeeding is recommended for COVID-19-positive or suspected positive mothers (after taking appropriate precautions), since it is the best diet for infants.^{5,19-21} It is noted that the virus seems not to be detectable in breast milk,⁴³ although certain case reports have shown the opposite.⁴⁴⁻⁴⁶ In addition, breast milk provides antibodies and generally protects against infectious diseases⁴⁷ along with vaccines, which produce antibodies transferred to the baby.⁴⁸ It is noted that COVID-19 vaccination in pregnant and

breastfeeding women is safe and effective.⁴⁸ In this context, there is no contradiction for breastfeeding. Moreover, breast milk may help against malnutrition in children, which increases in the era of COVID-19.⁴⁹

"There is no diet to prevent coronavirus."^{11,25} However, since the host metabolic status influences the course of the disease, a healthy balanced diet should be followed.⁵⁰ Indeed, a healthy diet as promoted by international bodies^{13,14,22-26} ensures the provision of vitamins and minerals, such as vitamins A, C, D, E, and B complex, selenium, iron, zinc, copper, and omega-3 fatty acids, which play a role in the immune system often acting synergistically.^{34,51} Traditional foods, such as kelp, are also recommended to achieve a better nutritional status in China,²⁹ possibly because they include angiotensin-converting enzyme inhibitory peptides, fibers, omega-3 fatty acids, and other antioxidant and anti-inflammatory components.⁵² The antioxidant and antithrombotic effects of Mediterranean diet as a whole and its several individual components may act as a "weapon" against the cytokine storm of the disease⁵³ and the activation of newly defined key molecules of COVID-19 pathogenesis, such as platelet activating factor (PAF).^{54,55} Indeed, micronutrients, non-nutrients, and Mediterranean diet have been proposed to exert a potential protective role against COVID-19 through modulation of PAF actions and metabolism.⁵⁶

To optimize vitamin D, a few minutes of sunlight exposure should be considered along with vitamin D-rich and -enriched foods.¹¹ Although several lines of evidence indicate a role of vitamin D supplementation in acute respiratory tract infection,⁵⁷ and ongoing studies with COVID-19 patients have included vitamin D as an adjunct therapeutic line in their protocol,⁴¹ the supplementation with vitamin D is not officially recommended for COVID-19 prevention and/or treatment. A National Institute for Health and Care Excellence (NICE) rapid guideline on COVID-19 and vitamin D concluded that "there is no

evidence to support taking vitamin D supplements to specifically prevent or treat COVID-19.⁵⁸ BDA and NICE guidelines, however, state that if people are unable to go outside, a daily supplement containing 10 μg (400 IU) should be considered.^{11,58} Recently, a cross-sectional European study reported an inverse association between mean levels of vitamin D and the number of COVID-19 cases per million.⁵⁹ Moreover, low levels of vitamin D have been measured in hospitalized patients with COVID-19 (76% of patients).⁶⁰ Therapeutic doses of vitamin C (24 g/d intravenously for 7 days) were also tested in critically ill patients with COVID-19.⁶¹ The study found no differences in mortality, nor duration of mechanical ventilation, but reported improvements in oxygenation (ratio of arterial partial pressure of oxygen to fraction of inspired oxygen [$\text{PaO}_2/\text{FiO}_2$]).⁶¹ Official sources have alerted that there is no evidence at this time point to support intravenous high-dose vitamin C in the management of COVID-19.⁶²

Dietary changes during quarantine have been documented in most studies, but they were not all in line with guidelines. More particularly, an increased intake of fruits and vegetables was observed in China⁶³ and an increase in Mediterranean diet adherence was observed in young Italian subjects⁶⁴ and Spanish people of all ages.⁶⁵ In contrast, a deterioration in food quality was observed during quarantine, possibly due to mood changes and health concerns in France,⁶⁶ Italy (increase of comfort foods),⁶⁷ Australia,⁶⁸ United Arab Emirates,⁶⁹ China (youth subjects),⁷⁰ and in an international study including subjects from Europe, North Africa, Western Asia, and the United States.⁷¹ In adolescents from Spain, Italy, Brazil, Colombia, and Chile, a “mixed effect” of quarantine was observed, with increases in intake of legumes, vegetables, fruits, sweets, and fried foods and decreases in intake of fast foods.⁷² For the interpretation of the available data, other behaviors should be also recorded such as increased screen time, which is connected to the consump-

tion of refined foods during the COVID-19 pandemic.^{69,73} Physical activity status, although strongly recommended, was not achieved in all studies, with some showing increases in physical activity^{64,65} and others showing decreases.^{40,68,71,74}

Water intake is emphasized by the vast majority of international bodies, ranging from 6 to 10 glasses per day,^{13,23} with a parallel limit in alcohol.^{23,27-29} Indeed, proper hydration status is necessary for the function of all organs and temperature control, which becomes critical in case of fever and disease.⁷⁵ Suboptimal hydration has additionally been hypothesized to increase mortality in patients with COVID-19.⁷⁶ During the COVID-19 lockdown, both decreases (binge or normal drinking patterns)^{65,71} and increases in alcohol consumption have been observed.^{77,78} An interesting case of methanol poisoning was documented in Iran, where hundreds of people died believing that drinking alcohol could cure and/or prevent the disease, which once more underlines the importance of scientific guidance during the pandemic.⁷⁹

As far as nutrition for high-risk groups is concerned, proper dietary habits and the prevention of malnutrition are highlighted.^{6,10} In patients with type 1 diabetes, worsening of glucose control was observed during quarantine, which was mainly due to the limited availability of glucose/insulin strips in this period, while diet noncompliance was also documented.⁸⁰ Overweight and obese subjects tended to increase snacking and gained weight, while underweight subjects tended to lose weight, indicating possible malnutrition.⁷⁷ However, it should be stressed that rapid weight loss for obese/overweight patients is contraindicated since muscle loss may have an adverse effect on recovery.³⁵

Malnutrition is common in free-living and hospitalized older adults.⁸¹ In addition, GI symptoms may accompany COVID-19,⁸² worsening dietary intake; thus, malnutrition is definitely an issue to be addressed. Moreover, malnutrition is connected with complications and worsened prognosis in

hospitalized patients⁸³ and has been found to be a predictor of mortality in influenza infections.⁸⁴ In patients with COVID-19, a high nutrition risk was related to worsened outcomes, higher mortality, higher procalcitonin values, and inflammatory markers.³³ In this context, hospital menu changes,⁸⁵ ONSs and early EN may prove beneficial.^{6,7} Early EN is generally associated with improved mortality and lower infection rates.⁸⁶ In all cases, individualization in the estimation of energy and protein requirements, as well as the route and way of nutrition delivery procedures, should take place.^{6,7,10} However, in clinical practice, patient weight and/or indirect calorimetry measurements may not be performed in order to minimize interaction with infected patients,⁸⁷ which may render nutrition assessment and nutrition care difficult. Indeed, patients' actual energy needs may differ from those estimated by equations due to hypermetabolism.⁸⁸ Moreover, patients tend to have nasogastric tubes for a longer time, rather than endoscopic gastrostomy placement, in order to minimize procedures in patients with COVID-19.⁸⁷

Specific dietetic advice by dietitians is useful, and telehealth can be used in order to assess and monitor patients remotely.³⁵ Moreover, the available data suggest that dietitians in the hospital setting may be discouraged from entering rooms of COVID-19 patients⁸⁷ but can contribute their knowledge through electronic health records.⁸⁷

It is noted that only a few high-quality review articles regarding official nutrition recommendations have been published.^{89,90} One focused on nutrition during quarantine but has not included clinically relevant information for hospitalized or seriously diseases patients.⁸⁹ Moreover, in the aforementioned review, recommendations from Australia, Brazil, Canada, Italy, Spain, and the United States were included while Asian countries were not referenced.⁸⁹ Other articles focused only on critically ill patients

in general^{90,91} or with a special focus on cachexia.⁹² The present work is of scientific interest to both public health professionals and health professionals working with hospitalized patients, and it includes a large spectrum of recommendations from scientific bodies (Europe, Canada, Australia, Asia, and international).

Several issues have not been addressed by international recommendations, such as diet-drug interactions, if clinically relevant. This subject may be of increasing importance to people under medical treatment who stay at home and do not have close medical monitoring.

In summary, there is a consensus regarding breastfeeding^{5,19-21} and healthy nutrition during quarantine.^{13,14,22-26} The risk of malnutrition should be assessed in high-risk groups and hospitalized patients.^{6,7,9} Early feeding should be provided with a priority on EN and/or ONSs covering energy and protein needs as well as recommended allowances of vitamins and minerals.^{6,7,9} Parenteral feeding should be provided if enteral feeding is contraindicated or if the caloric and/or protein goals are not achieved through the enteral route.

CONCLUSION

The present review presents the national and international official dietary recommendations during the COVID-19 pandemic. Although there is no diet to prevent coronavirus, the aim is to follow a healthy diet in order to boost the immune system. Health and nutrition professionals can make tailored nutrition plans taking into account nutritional risk and underlying diseases and in this way may reduce the deleterious effects of the COVID-19 pandemic. The present work can help and/or "guide" nutrition and health care professionals since it is a consolidated reference for practicing clinicians and other health professionals.

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