

The evolution of nutrition intervention during the COVID-19 pandemic

A evolução da intervenção nutricional durante a pandemia de COVID-19

Dixia Ramirez-Vega (<https://orcid.org/0000-0001-6002-570X>)¹
Monica Salinas-Cortes (<https://orcid.org/0000-0002-5414-622X>)^{2,3}
Melissa Melendez-Coral (<https://orcid.org/0000-0001-9606-6669>)¹
Geoffrey A. Cordell (<https://orcid.org/0000-0003-2536-3097>)⁴
Aida Rodriguez-Garcia (<https://orcid.org/0000-0002-0299-4753>)^{1,5}

Abstract COVID-19 has challenged health professionals in widely divergent areas, including innovation of practice, communication, multidisciplinary activities, broader use of technology, and adaptability. The role of the dietitian and other health professionals in dealing with the evolving crisis might be considered essential in treating patients. Given the limited access to various food options, nutrition screening and assessment deserves a high priority to complete a comprehensive nutrition evaluation, identify nutrition risks, prioritize care, and provide early nutrition intervention and support to all patients with or who have had, COVID-19 and are experiencing ongoing symptoms. Such an intervention would benefit the patients and the health system by reducing the length of hospital stay, ameliorating further complications, limiting hospital readmission, enhancing recovery, and assisting in the management of comorbidities and their metabolic alterations. This brief overview outlines the essential role of nutrition intervention and support as part of an integrated, multidisciplinary treatment program for the care of COVID-19 patients during the pandemic. Restrictive movements have changed consultative approaches, and the importance of Telenutrition for the effective communication of health status and recommendations.

Key words Nutrition intervention, COVID-19, Telenutrition, Malnutrition

Resumo A COVID-19 desafiou profissionais de saúde em diversas áreas, incluindo inovação da prática, comunicação, atividades multidisciplinares, uso amplo de tecnologia e adaptabilidade. O papel do nutricionista e de outros profissionais de saúde para lidar com a crise em expansão pode ser considerado essencial no tratamento de pacientes. Devido ao acesso limitado a várias opções de alimentos, a triagem e a avaliação nutricional devem ser priorizadas para a obtenção de uma avaliação nutricional abrangente, a fim de identificar riscos nutricionais, priorizar atendimento e possibilitar a intervenção nutricional precoce e o apoio a todos os pacientes com, ou que tiveram, COVID-19 e apresentem sintomas contínuos. Tal intervenção traria grande benefício aos pacientes e ao sistema de saúde, ao reduzir o tempo de internação, amenizar complicações posteriores, limitar a readmissão hospitalar, potencializar a recuperação e auxiliar no manejo das comorbidades e suas alterações metabólicas. Esta breve descrição elucida o papel essencial da intervenção nutricional e do apoio como parte de um programa de tratamento multidisciplinar para o cuidado de pacientes com COVID-19 durante a pandemia. Movimentos restritivos mudaram as abordagens consultivas e a importância da telenutrição para a comunicação eficaz do estado de saúde e das recomendações.

Palavras-chave Intervenção nutricional, COVID-19, Telenutrição, Desnutrição

¹ School of Nutrition, Tecnológico de Monterrey. Av. Morones Prieto 3000, Col. Sertoma. 64710 Monterrey NL Mexico. dixia.ramirez@tec.mx

² Steinhardt Department of Nutrition and Food Studies, New York University. New York NY USA.

³ Clinical Nutrition Department, Moses Division, Montefiore Medical Center. New York NY USA.

⁴ Natural Products Inc, USA and College of Pharmacy, University of Florida. Gainesville FL USA.

⁵ Facultad de Ciencias Biológicas, Instituto de Biotecnología, Universidad Autónoma de Nuevo León. San Nicolás de los Garza NL México.

Introduction

Our regular lifestyle activities have changed dramatically since the development and rapid spread of the COVID-19 pandemic in January 2020. The need for establishing and maintaining a social distance and the “stay-at-home” orders have changed the common practices of everyone around the world, limiting physical activity and leading to states of boredom which have prompted an increased energy intake. If stress from the constant risk of infection is added to this overwhelming physical and psychological situation, where “comfort” foods rich in calories, sugars, and saturated fat are chosen to satiate, there is likely to be unintended weight gain, contributing to higher levels and incidence of obesity and cardiovascular diseases, and thus a potential increase in the risk of complications ensuing after COVID-19 infection and recovery¹.

Many efforts have been made to identify the presence of comorbidities in patients who are at the greatest risk of complications and death. Obesity, diabetes, and hypertension are substantial risk factors for severe COVID-19 infection and can lead to critical complications for other diseases and death, conditions that have been linked to poor nutrition^{2,3}.

Pellegrini et al. showed that during the pandemic, an average increase of 1.51 kg was reported in people with obesity during the first month of quarantine, new, unhealthy eating behaviors, and a reduction in physical activity¹. People who reported weight gain were those with a low education level, a low level of physical activity, boredom, loneliness, increased anxiety, depression, and consuming a high intake of unhealthy foods and snacks, such as carbohydrates and sweets¹.

It is established that weight gain can be part of a vicious cycle that eventually can contribute to an increased risk of severe infection. Therefore, both obesity and COVID 19 infection can be considered two significant public health challenges to be dealt with during the pandemic. Correcting eating habits and modifications in lifestyle are crucial elements to maintaining good health and nutritional status to assist the immune system in fighting to prevent and overcome this disease⁴.

Because of the COVID-19 pandemic and the implementation of social distancing measures in most countries, nutrition information communication styles and practices have changed significantly. It has been necessary to ensure remote access to continue nutrition education programs

and caring for patients with COVID-19. Patients of all ages require nutritional guidance and nutritional support, either because they suffer from comorbidities, such as diabetes, hypertension, or obesity, or because they contracted COVID-19 and are recovering⁵. COVID-19 patients with long hospitalization periods, or those with an extended duration of illness confined to their home, are in great need of nutritional counseling, in part because of muscle atrophy as a consequence of inactivity and extended bed rest, which is typically an average of 14 to 28 days⁵.

Telenutrition

Registered dietitians or registered nutritionists are healthcare providers with the credentials to provide medical nutrition therapy and nutrition education in the United States⁶. During the pandemic, nutritionists and most health care providers have to ensure appropriate channels of digital communication, such as TeleNutrition, with patients to continue to provide quality care that is safe and effective⁵.

During a telenutrition visit, anthropometric data cannot be used to assess patient nutritional status. However, tools and other resources can be used where the dietitian can instruct the patient on how to obtain that data and share the results. For example, patients can learn how to take their weight, height, measure waist, hip, neck, and calf circumferences with an anthropometric tape and scale; these measurements and their modulation can be helpful to identify nutritional risks⁶.

A barrier to effective telenutrition may be adequate access to a high-speed broadband service, which is essential for the patient and the health care provider. Unfortunately, some patients do not have these facilities readily accessible, including the elderly, rural residents, those with limited finances, and patients with lower levels of education⁶. Professional outreach is therefore critical to identify and address those needs.

One advantage of telehealth services is providing group visits with a multidisciplinary team to the individual patient or having a group of patients in the same video call for informational exchange purposes⁶. The equipment that telemedicine uses can be a specific telehealth application or a simple personal device, such as a smartphone or tablet. Some of the software that is frequently used include Zoom, Skype, Google Meet, or Facetime⁶. Telenutrition consultations can be a very useful tool for dietitians to continue with nutritional counseling in all locations with

either a single patient or with a group of patients. In the long term, these communication styles can be continued due to the practicality and the simplicity of encouraging patients to maintain their health and good nutritional status to fight against this virus and other acute and chronic clinical conditions. Therefore, it is a significant opportunity to establish and diversify digital patient education systems for the future.

Telehealth, including telenutrition, has been a powerful tool during this pandemic due to screening, monitoring, diagnosing, and treating, including writing e-prescriptions and providing follow-up care and rehabilitation. In addition, electronic devices, including computers, smartphones and tablets, which have easy-to-use apps, make telehealth far easier to manage and integrate into a daily regimen⁷.

The advent of smartwatches, which can integrate health, nutrition, and exercise functions, can also provide an essential adjuvant to managing aspects of exercise and sedentary activity and analyzing dietary profiles continuously⁸. Telehealth has become a promoter for the advancement of medical care in the future, recognizing that its use must be ensured in low and middle-income countries. Given the progress that this type of service provides, it is necessary to define the limits, the care protocols, the evaluation methods and assure long-term data privacy⁷. Although, in general terms, telemedicine provides important benefits regarding well-being, health promotion, disease prevention, and maintains the possibility of monitoring and caring for chronic diseases from a distance, it requires effective two-way communication, so personal phone calls and messaging applications are an important patient care option if patients do not have good access to digital resources⁹.

The rapid spread of COVID-19 has resulted in a dramatic acceleration in the use of virtual health care consultations, in the United States, from only 11% of patients using telemedicine before the pandemic to 46% of patients currently using these services. Before the pandemic, the characteristic use of this medical approach was focused on virtual emergency care, with profits of \$3 billion. After the pandemic, it is estimated that these services will increase revenue to \$250 billion for telemedicine resources¹⁰.

Accordingly, a literature review was conducted by Hincapie et al. regarding the use and acceleration of telemedicine due to the COVID-19 pandemic¹¹. In the United States, during March and April 2020, a massive migration to virtual

care was experienced, with a concomitant 80% decrease in face-to-face consultations. Another interesting fact is the increase from 50 to 1000 health teleconsultations per day. Furthermore, migration to these virtual services has now established itself in various medical specialties in countries such as Italy, the United States, and India at 60-95% of its usual level of practice¹².

Mexico seeks to promote the use of information and communication technologies (ICTs) to guarantee access to the people's right to health. So that patients with COVID-19, as well as those with various chronic diseases, are provided the same level of attentive care, the health sector has affirmed that this will reflect greater social equality, enhance poverty reduction, and provide increased competitiveness, thereby contributing to higher levels of growth and economic development¹³.

Locatel is a portal for online medical advice. It has been famous for 40 years in Mexico and has been used constantly in the care of COVID-19 patients. Before the declaration of the COVID-19 health emergency, Locatel received about 12,000 calls for traditional services. In the face of the contagion, about half of those calls are now exclusively related to the coronavirus, split between formal medical consultations and the provision of basic information^{12,13}.

However, the question here, and focusing on telenutrition, is in reality, how many patients stopped attending their nutritional consultation, and how many patients will continue to use this means of virtual consultation, especially in the area of nutrition? Therefore, it is important to use this opportunity to investigate and study enhancing this area of Telenutrition in Mexico, according to the resources available to the population.

Dietitians need to re-educate and change the way they provide nutritional care by removing the paradigm that the in-person visit might be focused on measuring weight and body composition. Telenutrition offers opportunities for education and promotion of healthy eating habits that can help patients improve their health practices outcomes similar to those resulting from face-to-face consultations. In addition, it is a practical resource to affirm and track implementation of the recommendations, engaging family members to assist in scheduling and other technical issues. Telenutrition can be successfully utilized to provide important nutritional care rapidly and effectively and become the norm for dietitians and a healthy and stimulating alliance with the patients.

The relationship between nutrition and the immune system

Nutrition has been recognized to play an essential role in helping to maintain and enhance the body's immunity. Certain nutrients have been particularly linked to helping with this while others can deplete it and, therefore, should be limited or avoided¹⁴. The complex interactions between available nutrients, the microbiota, and the immune system act as central regulators in maintaining homeostasis and limiting the impact of invading pathogens at mucosal sites¹⁵.

Excessive accumulation of saturated fatty acids (SFAs), a typical part of the Western diet, can act as pro-inflammatory signals in the brain¹⁶. Excessive SFA consumption can increase gut permeability, further promoting the leakage of endotoxin lipopolysaccharide (LPS) into the bloodstream, causing inflammation, a state known as metabolic endotoxemia¹⁷. Additionally, the excess consumption of refined carbohydrates and sugar leads to hyperglycemia, which has been causally linked to increases in circulating pro-inflammatory cytokines in human subjects with and without impaired glucose tolerance¹⁷.

This Western diet, which usually consists of a regular intake of processed foods high in saturated fats, sugar, and salt, as well as excessive caloric intake accompanied by sedentary lifestyles¹⁸, can create reactive oxygen species (ROS), which promote a pro-oxidant environment putting the body in need for protection through vitamins, enzymes and antioxidant foods^{4,18}.

Omega 3 (n-3 FAs) is known for its anti-inflammatory and antioxidant properties. Historically, the inclusion of omega-3 fatty acids, particularly docosahexaenoic acid (DHA) in the hominid diet likely contributed to the evolution of modern human immune and nervous systems. The recent depletion of n-3 FAs due to Western diet consumption deprives the brain and immune cells of nutrients essential for optimal functioning¹⁷. The consumption of omega 3 from fish and shellfish, such as salmon, mackerel, and tuna, can generate these antioxidant reactions through oxylipins, including resolvins and protectins^{4,18}. Calder, an expert in nutritional immunology, explains that the immune system works as a barrier in eliminating pathogens and forming a complex system between different types of cells and chemical mediators¹⁹. A recent review identified micronutrients that may have synergistic effects, including vitamin A, D, C, E, B6, and B12 and folate, copper, iron, zinc,

and selenium. However, much of the evidence focuses on vitamin C, D, and zinc¹⁴. While food alone cannot guarantee immunity against viruses such as SARS-CoV-2, a healthy diet inclusive of essential nutrients such as fruits, vegetables, amino acids, unsaturated fats, as well as adequate calorie intake and hydration, can be key factors to help the immune system stay strong to prevent infections¹⁹.

Nutrition intervention during COVID-19

The nutritional management of hospitalized COVID-19 patients has been challenging during the pandemic, starting with the need to use personal protective equipment (PPE) to restrict contagion spread. With limited PPE supply, many dietitians are not entering intensive care units (ICUs), or the isolation rooms of patients and therefore are not performing a nutrition-focused physical examination. Instead, dietitians are using other means to collect assessment data, such as ICU remote monitoring capabilities, calling the patient or family, and using telehealth involving various audio and visual platforms²⁰.

Malnutrition, understood as overnutrition, undernutrition, and sarcopenia, is a condition that existed long before the COVID-19 pandemic struck²¹. However, with this pandemic these problems were exacerbated, and are related to the high mortality rate in patients with COVID-19 vs. chronic diseases, such as obesity, systemic hypertension, diabetes mellitus, advanced age, and/or evidence of systemic inflammation (e.g., elevated C-reactive Protein (CRP), ferritin, and interleukin-6 (IL-6))²⁰. These conditions are highly linked to nutritional status and lifestyle. The majority of deaths have involved older, frail, and/or poly-morbid patients, groups which also have high rates of malnutrition in the range of 23-60%, based on multicenter studies reported^{20,21}.

In China, Yu *et al.* observed how COVID-19 patients have a higher risk of becoming malnourished, requiring more extended hospitalization periods. International organizations have agreed that all patients with COVID-19 infection should be screened to identify nutritional risk, in order to provide an early intervention and support²²⁻²⁴. However, due to the high risk of exposure to COVID-19 for health care providers, including dietitians, and the critical need to focus on life-saving interventions as the priority, nutritional assessment and intervention can be delayed or limited, thereby increasing the nutrition risk of the patient²⁵.

The risk of malnutrition during the period of the pandemic can be classified into four stages:

1. *Social conditions* – understanding the access and availability of food and its adequate preparation, according to the health status of each person, is an important first step. In the case of not having a supportive diet, it is a risk factor for a reduction in immune function, and an enhanced risk for the development of communicable diseases, fatigue, and other conditions which could present an even greater risk of infection by COVID-19, or may give rise to complications from the disease after infection²⁶.

2. *Hospitalized patients* – during a hospital stay, the provision of adequate calorie and protein intake, as well as other essential nutrients, like fluids and micronutrients, has become a major challenge for health professionals caring for patients with COVID-19. Older patients may be at risk due to their pre-existing disease status and sarcopenia, which increases their chances of worsening a pre-existing malnutrition status and an increased risk of re-enforcing the syndrome. Other patients may also have feeding difficulties, chewing, or swallowing problems, physical disabilities, cognitive disturbances, psychosocial problems, or frailty. Medical, nursing, and nutrition staff have been overwhelmed for various reasons, including staff shortages, due to illness or self-isolation, the number of cases, the time spent communicating with families unable to visit loved ones, or putting on and removing PPE. In addition, the focus of medical teams lies primarily on the very urgent clinical challenges, mainly respiratory issues, rather than nutritional factors. Furthermore, staff members may be re-assigned to specialties where nutritional care is not a part of routine practice. These factors can result in suboptimal support for patients during mealtimes, as well as inadequate nutritional optimization²⁷.

3. *Critical care patients* – mortality rates in COVID-19 patients occur at a higher prevalence in ICU patients. The catabolic state due to the inflammation process and access to adequate nutrition, continues to be a challenge for clinical and medical dietitians, preserving muscle mass and its function, controlling altered laboratory data such as CRP, IL-6, ferritin, triglycerides, and blood glucose to mention some, and favoring a speedy recovery is achieved with the support of a correct nutritional intervention. Severe acute respiratory distress syndrome (ARDS) with refractory hypoxemia may require prone-positioning and/or

extracorporeal membrane oxygenation (ECMO). Circulatory failure and concomitant feeding may increase the risk of gut ischemia and feeding intolerance, multiple organ failure (MOF), and the need for early enteral nutrition (EN) to attenuate or mitigate gut-derived inflammation, and cytokine release syndrome, which alters nutrient utilization (especially lipids)^{26,28}. In particular, the positive outcomes of prone positioning among patients who develop severe ARDS secondary to the COVID-19 virus, has made this a common therapeutic intervention across the world, since patients have shown improved oxygenation and decreased mortality²⁹. Nutrition interventions while in a prone position were shown to be safe, and no difference was found in aspiration risk and/or tolerance compared to patients who are supine³⁰. However, even though this strategy has been practiced since the 1980's^{30,31}, most practitioners, including medical doctors (MDs) and dietitians, may not feel comfortable feeding a patient in this position. This has led to delays in meeting nutritional requirements or has resulted in the need for alternative nutrition support methods, such as parenteral nutrition. Continuing education resources need to be available for all healthcare providers involved in the provision of nutrition support to critical care patients in order to avoid the delay of adequate nutrition intervention during such a critical stage in their illness and recovery³².

4. *Malnutrition negatively affects clinical outcomes* – a large observational study found that disease complications, length of stay, and mortality were significantly worsened in hospitalized patients without treatment and at nutritional risk than in those hospitalized patients who were not at nutritional risk. Sarcopenia was reported to be associated with the impaired proliferation of peripheral mononuclear cells, an increased ratio of neutrophils to lymphocytes, and damaged homeostasis of natural killer lymphocytes, contributing to immune senescence³³. Sarcopenia is an underestimated condition in these cases, the amount and strength of muscle tissue offers the possibility of improving post-COVID-19 health conditions. Regarding the metabolic stress during severe infection, the skeletal muscle is catabolized to provide the immune system, liver, and gut with amino acids, especially glutamine. Patients with sarcopenia have a decreased availability of such protein mobilization and respond poorly to infection by SARS-CoV-2, because of the impaired immune potential and metabolic stress³⁴.

Post-COVID repercussions and importance of nutrition care

At the beginning of the pandemic, there was a lot of uncertainty about SARS-CoV-2. Treatment guidelines were not available, and how the impact of this virus was going to affect communities around the world was a mystery. After over a year of global societies being hit hard by the COVID-19 virus, thanks to science and ongoing research, new therapies, and modifications to health care practices, there is now a much better understanding and degree of confidence in what therapies and medications will prevent the severity of illness, what can be done to decrease the risk of mortality, and what can help patients recover³⁵. The number of patients surviving hospital or ICU admissions has increased from early 2020 to late 2020, bringing some hope to patients, their families, and to healthcare professionals across the globe³⁵. Unfortunately, 35% of positive outpatients are still dealing with diverse complications from COVID-19 after more than 2-3 weeks post-infection, and consequently this situation continues to affect their physical, emotional, and mental health³⁶. This condition is now being referred to as long COVID, and it is considered that the virus, and the inflammation cascade that the virus triggers when someone gets infected, is responsible for these symptoms³⁶. Common symptoms experienced by these COVID-19 “long haulers”, who are individuals dealing with symptoms after 3-6 weeks, are severe deconditioning and fatigue, poor appetite, memory loss, and difficulty breathing³⁶. For example, loss of smell, taste, and anorexia are common symptoms that directly affect nutritional intake, and can lead to loss of weight and of lean body mass. When the complications of viral activity and inflammation are added to the abovementioned suboptimal nutrition intake and unintended weight loss, follow-up care, including adequate nutrition intervention, is an important form of adjuvant care post-infection.

In post-COVID-19 patients, a complete history of health and nutrition status is important for surveillance at home, as well as for patients who participate in rehabilitation programs. Medical nutrition therapy, oral nutrition supplements, medications, comorbidities, and lifestyle factors, including the ability to participate in physical activities, are some of the aspects that need to be considered after acute illness. Additionally, adequate sleep, managing stress, smoking behavior, and alcohol consumption are other key factors

that will help COVID-19 patients during their recovery. Different countries around the world have realized the importance of follow-up care after COVID-19 infection, and especially after an admission to a hospital. For example, in the United States and the UK, post-COVID-19 rehabilitation clinics have been designed specifically for post-COVID-19 infection care, and nutrition intervention is one of the key post-disease modalities. However, even within those countries, some patients are struggling to receive appropriate care due to accessibility³⁷. Developing countries have been experiencing a similar issue, mainly because their health care system is not easily accessible to the whole population, or it does not have the economic support from the government that could offer these services to their citizens, even prior to the pandemic. Patients tend to be discharged directly to their home, and there is no follow-up care. If patients do not receive the appropriate education and multidisciplinary intervention, including nutrition care, they will have a higher risk of further complications and hospital readmission³⁸.

Conclusions

A healthy and balanced diet, physical activity, and maintenance of a healthy weight help to strengthen our immune system and decrease the risk of comorbidities and severe infections, including COVID-19. Despite COVID-19 being a new virus, the above mentioned lifestyle attributes can also help prevent the risk of severe COVID-19 infections or complications, demonstrating how the expertise of a dietitian is vital in an integrated approach to treatment and recovery during and from disease and should be considered as important as other therapeutic interventions. During this pandemic, healthcare professionals of all disciplines, including dietitians and healthcare systems, have had to work together, evolve, change practices, be flexible, and adapt rapidly to new ways of practice to continue providing patient care. At the same time, it should not be forgotten that COVID-19 patients have also had to adapt to dramatic changes, and they will need continued support and guidance from a range of healthcare professionals, including dietitians. Telenutrition is an effective tool for dietitians and provides nutrition education and nutrition counseling, supporting public awareness of a healthy diet and patient recovery strategies while minimizing social contact to reduce the spread of the COVID-19.

This pandemic has prompted people of all ages to seek help from nutrition and other healthcare professionals to improve their nutritional status and achieve healthy lifestyles in order to maintain a stronger immune system to help fight infections like COVID-19. Dietitians and healthcare providers should take advantage of this opportunity to provide the appropriate evidenced-based nutrition therapy to prevent and treat those chronic diseases which can at the same time help decrease the risk of severe COVID-19

infection. The role of the dietitian and the nutrition team can be challenging, and it will differ greatly during the different stages of COVID-19 infection. However, regardless of the severity of the illness, or the stage in which each patient falls, in their recovery, dietitians should be considered part of the clinical core of professionals caring for COVID-19 patients. This will help patients to achieve optimal health so they can continue their journey in the fight against COVID-19 leading to the restoration of a healthier society.

Collaborations

All authors were involved in drafting the article or revising it critically for important intellectual content. All the authors approved the final version prior to submission.

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