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Editorials

Mediterranean diet as a nutritional approach for COVID-19



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The 2019 coronavirus (COVID-19) disease pandemic, caused by the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), is associated with various clinical, mental, and psychological complications, and has challenged healthcare and social systems at a national and international level [1–3].

We and others have shown that obesity, central fat distribution, and adiposity-associated chronic diseases, e.g., diabetes mellitus and cardiometabolic disorders may lead to poor COVID-19 outcomes [4–6]. Common underlying pathophysiological features such as chronic inflammation, immune dysregulation, oxidative stress, increased cytokine production, endothelial dysfunction, increased number of angiotensin-converting enzyme 2 (ACE2)-expressing adipocytes and the possible role of adipose tissue as a viral reservoir, are among the factors that predispose to worse COVID-19 outcomes [4,6–8].

Obesity is in turn closely associated with lower socioeconomic status and lifestyle habits, with poor diet being one of the most significant contributing factors, building upon a given genetic background.

Disparities in nutrition, closely related to ethnicity, race, socioeconomic status, and other social determinants of health, may result in a suboptimal diet that is associated with several cardiometabolic conditions linked to COVID-19 infection and its prognosis [9]. Following an unhealthy diet has unfavorable implications in terms of inflammation and oxidative stress, and thus may influence the final outcome by affecting the immune system and energy homeostasis. Thus, it would be of paramount importance to adopt healthy eating habits during the COVID-19 outbreak and to maintain balanced dietary practices, as outlined in the recent nutritional advice published by the World Health Organization [10], as well as professional associations, societies, and governments [7].

Current evidence and expert opinion encourage the consumption of fresh and unprocessed plant foods such as vegetables, fruits and whole grain products. Moreover, they highlight the importance of vitamins and minerals such as zinc, vitamin C, D, A and the maintenance of adequate hydration, while they suggest a moderate consumption of fat, preferring unsaturated fats, and avoiding sugar and salt intake.

The Mediterranean diet, one of the healthiest dietary patterns worldwide, reputed for its demonstrated preventive effect of cardiovascular diseases and type-2 diabetes in several trials [11–13] is characterized by the inclusion of mainly plant-derived nutritional components, namely fruits, vegetables, legumes, nuts, and olive oil, all of which are significant sources of bioactive polyphenols. Polyphenols, particularly flavonoids and their metabolites, demonstrate pleiotropic health-promoting effects, especially in cardiovascular and metabolic disorders, due to their antioxidant, anti-inflammatory, and anti-thrombotic properties [14,15]. These properties become even more critical in view of the exaggerated inflammatory and pro-thrombotic milieu associated with COVID-19 severe illness [16,17]. Polyphenols alleviate the immune response, increase antioxidant defenses, improve vascular reactivity, and decrease tissue inflammation and cell infiltration, thus promoting metabolic and cardiovascular health; these beneficial effects appear to be exerted through preventing the activation of the Nuclear factor- κ B (NF- κ B) signaling pathway and nicotinamide adenine dinucleotide phosphate (NADPH) oxidase and by reducing the levels of pro-inflammatory cytokines such as interleukin-6 and tumor necrosis factor- α [18,19]. Ellagic acid, a particularly bioactive phenolic compound found in some fruits and nuts, also acts via interaction with microbiota and epigenetic regulation [18].

Consumption of nuts and dried fruits such as raisins, which are integral part of the Mediterranean diet, promotes cardiometabolic health through their rich composition in nutrients and bioactive phytochemicals, among which polyphenols play a central role as antioxidant and anti-inflammatory molecules [20]. Both nuts and dried fruits are easily storable and concentrated sources of nutrients; the latter are also portable alternatives to fresh fruits. In particular, Corinthian currants, derived from a specific type of black grape, are characterized by a low to moderate glycemic index [21] and an abundance in minerals, vitamins, fiber, flavonoids and phenolics [22,23]. Ongoing research on potential antimicrobial properties of several Mediterranean foods, such as raisins and olive products, should be considered in the context of current research efforts to elucidate any protective effects of flavonoids and other polyphenols against the coronavirus infection [24,25].

In summary, adherence to the Mediterranean diet has a favorable impact on cardiovascular diseases and other cardiometabolic disorders, such as diabetes that predispose to COVID-19 infection and related outcomes. The Mediterranean diet, having high antioxidant, anti-inflammatory, and potential antimicrobial and immunomodulatory properties, is a promising and relatively easy method to attenuate the severity of COVID-19 infection. Therefore, there is a critical and imminent need for more in vivo studies and well-designed clinical trials to explore the potentially beneficial effects of the Mediterranean diet and/or some of its key components, such as nuts, dried fruits and olive oil, in preventing COVID-19 infection and/or improving disease-related outcomes.

The COVID-19 pandemic has led to a profound change of food habits and dietary behaviors, both individually and globally. A large Italian

Abbreviations: ACE2, angiotensin-converting enzyme 2; COVID-19, 2019 coronavirus disease; NADPH, nicotinamide adenine dinucleotide phosphate; NF- κ B, nuclear factor- κ B; SARS-CoV-2, severe acute respiratory syndrome coronavirus-2.

population survey found that during the COVID-19 lockdown 35.8% of the studied subjects consumed less healthy foods, while 48.6% reported weight gain. Of note, greater adherence to the Mediterranean diet was observed in Central and Northern Italy, the epicenter of the pandemic, in which areas the BMI was also lower [26]. Elderly participants reported lower adherence to the Mediterranean diet compared to those aged 18–30 years old. Moreover, according to a Spanish study, female gender, middle age, and higher educational level were associated with higher adherence to the Mediterranean diet during home confinement [27]. Although it appears that relatively younger and more educated individuals increase their adherence to the Mediterranean diet in the middle of the pandemic the beneficial effects of this diet need to be formally and appropriately documented, and if positive as expected, findings need to be disseminated and become part of public health policy.

In conclusion, the Mediterranean diet may represent a potential strategic therapeutic approach to address both short- and long-term conditions associated with COVID-19 infection and severity and improve mortality and the overall well-being of affected populations. From a public health viewpoint, such efforts need to be combined with programs aiming to increase social awareness for obesity and the need to prevent and treat it as well as work required to eliminate health inequalities and to address the lack of access to healthy and nutritious food worldwide.

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Declaration of competing interest

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