



Lifestyle under the light of nutrological and psychological aspects in the COVID-19 pandemic: a systematic review

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Abstract

Introduction: Due to the emergence of the new coronavirus (whose disease is COVID-19), in 2020 the WHO declared COVID-19 a global pandemic. Preventive measures can radically change individuals' daily habits, including lifestyle-related behaviors. Sedentary behavior, anxiety, and boredom caused by home confinement can influence motivation to eat and change lifestyle patterns. **Objective:** To carry out a systematic review on the impacts of COVID-19 on people's diet and lifestyle, as well as to point out the main dietary and lifestyle precautions during and after the new coronavirus pandemic, based on the results of clinical studies. **Methods:** The rules of the Systematic Review-PRISMA Platform were followed. The search was carried out from December 2021 to April 2022 in Scopus, PubMed, Science Direct, Scielo, and Google Scholar databases. The quality of the studies was based on the GRADE instrument and the risk of bias was analyzed according to the Cochrane instrument. **Results and Conclusion:** Were found 264 articles. A total of 116 articles were fully evaluated and 34 studies were developed in a systematic review. There is scientific evidence that foods/nutrients and natural substances from human physiology and biochemistry such as melatonin and coenzyme Q10 control immune system functions, and many metabolic or chronic diseases have been implicated in poor diet and lifestyle. The results of the pandemic indicate there have been a variety of lifestyle changes, physical inactivity, and psychological problems. Still, adults over 40 years old, with children, unemployed, and those living in a macroeconomic region were shown to be more exposed to unhealthy behaviors. Maintaining dietary intervention through telemedicine can reduce the negative impact of eating

habits and physical activity patterns.

Keywords: Lifestyle. Nutrition. Physical activity. Psychological aspects. COVID-19.

Introduction

Due to the emergence of the new coronavirus (whose disease is COVID-19), in 2020 the World Health Organization (WHO) declared COVID-19 a global pandemic, with exponentially growing numbers of infected [1]. In this scenario, preventive measures can radically change the daily habits of individuals, including lifestyle-related behaviors [2,3]. In this aspect, staying and working at home can affect diet, food choice and access to food and, thus, reduce the possibilities and limit the practice of physical activity [4,5]. Thus, physical inactivity and obesity have been described as a global public health problem [6-8].

In this sense, reduced physical activity and lower energy expenditure can negatively affect physical and mental health [9,10]. In addition, the pandemic situation is also associated with emotions such as fear, sadness and anxiety, which have been shown to reduce sleep quality [10-12]. Thus, the WHO developed guidelines to be adopted during home quarantine [13].

Furthermore, sedentary behavior, anxiety and boredom caused by home confinement can influence motivation to eat, change lifestyle patterns, reduce diet quality and promote excessive consumption of caloric foods [14,15]. A healthy diet, based on plant foods (vegetables and fruits), healthy fats, and foods low in fat and protein [12,16] along with adequate activity is a key strategy to support the immune system and curb seasonal and seasonal infections. viral infections in the population [17,18]. Despite this, there is limited evidence to assess the effect of lockdowns and

restrictions related to the COVID-19 pandemic on changes in dietary lifestyle behaviors [19,20]. Thus, changes in dietary lifestyle behaviors may differ depending on socio-demographic factors, body weight and changes in employment and family type during quarantine.

In this context, dietary supplementation with coenzyme Q10 (ubiquinone), melatonin, doses of vitamin C, vitamin D, minerals, short-chain fatty acids and omega-3 fatty acids, protein and carbohydrate content, Mediterranean diet and high-fiber diet can be beneficial in strengthening the immune response to fight SARS-CoV-2 infection and decrease inflammatory processes and the worsening of comorbidities such as hypertension, diabetes, obesity, chronic lung diseases, heart, liver and kidney diseases, tumors, clinically apparent immunodeficiencies, immunodeficiencies, such as the ability to secrete type I interferon early and pregnancy. Possible complications include acute respiratory distress syndrome, shock, disseminated coagulopathy, acute kidney injury, embolism, and secondary bacterial pneumonia [21].

Therefore, the present study aimed to carry out a systematic review on the impacts of COVID-19 on people's diet and lifestyle, as well as to point out the main dietary and lifestyle care during and after the new coronavirus pandemic, based on in the results of clinical studies.

Methods
Study Design

The rules of the Systematic Review-PRISMA Platform (Transparent reporting of systematic reviews and meta-analysis-HTTP://www.prisma-statement.org/) were followed [22].

Data Sources And Research Strategy

The search strategies for this systematic review were based on the keywords (MeSH Terms): “*Lifestyle. Nutrition. Physical activity. Psychological aspects. COVID-19*”. The search was carried out from December 2021 to April 2022 in Scopus, PubMed, Science Direct, Scielo, and Google Scholar databases. Also, a combination of keywords with the Booleans “OR”, “AND” and the “NOT” operator were used to target scientific articles of interest.

Study Quality And Risk Of Bias

The quality of the studies was based on the GRADE instrument [23] and the risk of bias was analyzed according to the Cochrane instrument [24].

Results and discussion
Findings Summary

It was found 264 articles. Initially, article duplication was excluded. After this process, the abstracts were evaluated and a new exclusion was performed, removing the articles that did not include the topic of this article. A total of 116 articles were fully evaluated and **34 studies were included** and developed in the systematic review. A total 38 studies did not meet the GRADE, and 44 studies were excluded due to risk of bias that could compromise the results (Figure 1).

Figure 1. Article selection (Systematic Review, N=34 clinical studies).

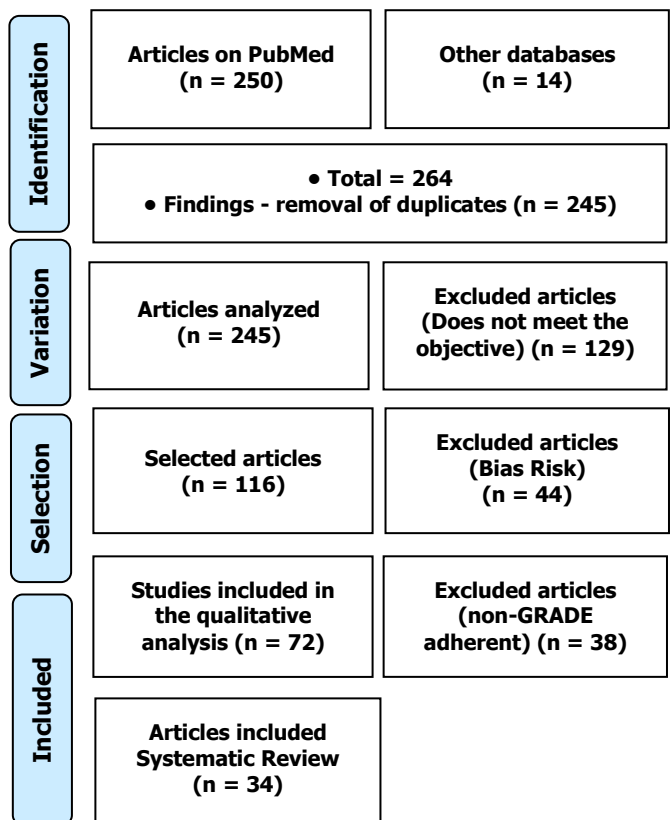
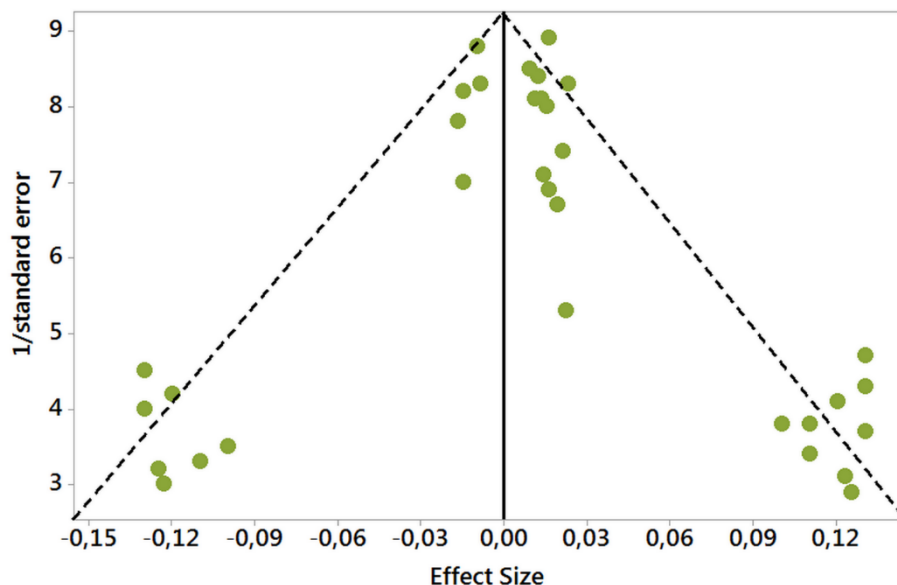


Figure 2 presents the results of the risk of bias in the studies using the Funnel Plot, through the calculation of the Effect Size (Cohen's Test). The sample size was determined indirectly by the inverse of the standard error (1/Standard Error). The number of clinical studies evaluated was n=34. The graph showed asymmetric behavior, suggesting a significant risk of bias in studies with small sample sizes, which are shown at the bottom of the graph.

This presence of risk of bias is justified by the deficiency in the number of clinical studies with a significant sample size and with methodologies

developed as randomized controlled studies.

Figure 2. The asymmetric Funnel Plot suggest a risk of bias between the small sample size studies that are shown at the bottom of the graph. N=34 clinical studies.



Major Approaches and Clinical Outcomes of Diet and Lifestyle in COVID-19 (n=34 Clinical Studies)

According to the literary findings, there is scientific evidence that foods/nutrients and natural substances from human physiology and biochemistry such as melatonin and coenzyme Q10 control immune system functions, and many metabolic or chronic diseases have been implicated in poor diet and lifestyle [25,26]. In this sense, the large difference in COVID-19 mortality rates between European countries suggests that diet

and lifestyle can play a vital role in maintaining essential homeostasis to fight the infection [11]. Thus, the consumption of fermented vegetables has been shown to reduce the severity of COVID-19, that is, for each g/day of consumption of fermented vegetables, the risk of mortality from COVID-19 was reduced by 35.4% [10].

Table 1 presents the main nutrients and organic substances and dietary lifestyle changes responsible for immune control and viral load reduction.

Table 1. Major nutrients and organic substances and dietary lifestyle changes.

<i>Nutrients</i>	<i>Functions</i>
Coenzyme Q10 (Ubiquinone)	Coenzyme Q10 is an integral component of the mitochondrial respiratory chain and a key component of mitochondrial ATP production. Modulated mitochondrial dynamics and metabolism with lower levels of Coenzyme Q10 in viral infections lead to the hypothesis that one of the main effects of the SARS-Cov-2 virus could be mitochondrial bioenergetic dysfunction with Coenzyme Q10 deficit leading to the reduction of its endogenous biosynthesis. The mechanism may be virus-induced oxidative stress [25,27].
Melatonin	Melatonin is known as an anti-inflammatory agent and immune modulator that may address the progressive pathophysiology of COVID-19. Thus, the use of melatonin can help reduce thrombosis, sepsis, and mortality. Furthermore, the combination of 3.0 mg oral melatonin tablets and standard care can substantially improve sleep quality and blood oxygen saturation in hospitalized patients. Clinical symptoms such as cough, dyspnea, and fatigue, as well as CRP level and lung involvement in patients receiving melatonin can improve significantly with lifestyle changes [26,28].
Vitamin C	Vitamin C acts as an antioxidant and cofactor for regulatory enzymes and acts on both the innate and adaptive immune systems [29]. Furthermore, vitamin C can attenuate the pro-inflammatory action and pro-coagulant mechanisms, improving vascular and

<i>Vitamin D</i>	<p>pulmonary injury in sepsis [29]. A recent randomized trial evaluated patients with COVID-19 and suggested a beneficial effect of high doses of intravenous vitamin C on mortality [30].</p> <p>Vitamin D is well known for regulating gene transcription and the immune response. The active metabolite of vitamin D, 1,25-dihydroxyvitamin D (1,25-(OH)₂D₃) modulates the activity of nuclear factor (NF)-κB and then induces the production of many molecules amplifying the inflammatory response, such as IL-6, IL-1β, TNF-α, and IFN-α, stimulates the production, mobilization, and adhesion of inflammatory cells and influences the production of enzymes such as inducible nitric oxide synthase (iNOS), cyclooxygenase-2 and phospholipase A2 [31,32]. One study indicated that vitamin D improves the inflammatory response through multiple pathways and protects against respiratory infections and reduces the risk of influenza and COVID-19 [33].</p>
<i>Proteins</i>	<p>There is still no clinical evidence of high-protein diets in COVID-19. In a preclinical study, mice with protein malnutrition had a decreased expression of IFN-α, TNF-α, and iNOS in lung tissues, understanding their ability to fight infection [34]. Thus, adequate-protein intake to maintain physiological needs is essential in maintaining a healthy immune response to protect against SARS-CoV-2.</p>
<i>Carbohydrates</i>	<p>A high-carbohydrate diet is known to contribute to the prevalence of obesity, insulin resistance, and type 2 diabetes, which are risk factors in COVID-19 [35].</p>
<i>Mediterranean Diet</i>	<p>The Mediterranean diet is typically rich in vegetables, fruits, whole grains, beans, nuts, seeds, and olives. Weekly intake of fish, poultry, eggs, and dairy products should be moderate but limit red meat intake [36]. This diet may have protective effects against COVID-19. As shown by several surveys on dietary lifestyle changes during the pandemic [37-39].</p>
<i>Ketogenic diet</i>	<p>The ketogenic diet is a low-carb diet resulting in a metabolic state called ketosis. The ketogenic diet leads to weight loss, decreased blood sugar, and favorable changes in serum triglycerides [40]. Furthermore, the ketogenic diet has been proposed as a prophylactic diet for reducing viral loads [41], as well as having an anti-inflammatory action by modulating immune metabolism and preventing cytokine storm syndrome [42].</p>
<i>Minerals</i>	<p>As an example, magnesium was inversely correlated with levels of hs-CRP, IL-6, and TNF-α [43]. Common trace elements such as zinc, iron, copper, and selenium also act as cofactors for various enzymes involved in antioxidant reactions and have strategic immunomodulatory roles [44]. But scientific evidence of these minerals in COVID-19 is still lacking.</p>
<i>Short-chain fatty acids</i>	<p>Short-chain fatty acids are metabolic compounds fermented from dietary fiber by the intestinal microbiota. The increase in short-chain fatty acids has been associated with a higher intake of whole grains and exerts anti-inflammatory effects through the G protein-coupled receptor [45], modulating cytokine secretion in monocytes [46,47]. Omega-3 polyunsaturated fatty acids (PUFAs), especially eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) have been shown to exhibit anti-inflammatory effects in various diseases [48]. Lipid autacoids derived from arachidonic acid, including prostaglandins (PGs), thromboxane, and leukotrienes, are collectively termed eicosanoids and are critical mediators of inflammation, resolution, and tissue homeostasis. Infectious processes can activate inflammasome formation leading to an eicosanoid storm consisting of both pro-inflammatory and anti-inflammatory mediators. The SARS-CoV-2 infection leads to tissue damage, cellular debris release, endoplasmic reticulum stress, induction of inflammatory enzymes and thus triggering an eicosanoid storm, which then stimulates a cytokine storm [49]. Thus, PUFAs and omega-3s can improve the inflammatory state caused by viral infections, including COVID-19 [50].</p>
<i>Omega-3 fatty acids</i>	
<i>Fiber-rich diet</i>	<p>A high-fiber diet has beneficial effects on glucose metabolism, leading to lower blood glucose and higher insulin-sensitizing adipocytokine levels. It can also reduce the levels of pro-inflammatory cytokines such as IL-6, IL-18, and TNF-α [51,52].</p>

A cross-sectional observational study among adults in the UAE was carried out using an online questionnaire. A total of 1,012 subjects participated in the study. During the pandemic, 31% reported weight

gain and 72.2% drank less than eight glasses of water a day. In addition, participants' eating habits were distanced from the Mediterranean diet, with less healthy dietary lifestyles. In addition, 38.5% did not practice

physical activity and 36.2% spent more than five hours a day on screens for entertainment. Still, most participants reported physical exhaustion, emotional exhaustion, irritability, and tension during the pandemic compared to before the pandemic, as well as sleep disturbances, which were prevalent in 60.8% of participants. Therefore, the results of the pandemic indicate that there were a variety of lifestyle changes, physical inactivity, and psychological problems among adults in the UAE [53].

Yet another observational cross-sectional online research study identified patterns of dietary changes during the COVID-19 pandemic and their associations with socio-demographic data, body mass index (BMI), and lifestyle changes in Polish adults. A total of 43% of respondents decreased physical activity, 49% increased screen time and 34% increased food consumption. Among the three patterns of food change, two opposing patterns were found, healthy (28% participants) and unhealthy (19% participants). Also, participants residing in a macroeconomic region decreased adherence to healthy eating. Therefore, adults over 40, with children, unemployed, and those living in a macroeconomic region are more exposed to unhealthy behaviors [54].

Also, a cross-sectional observational study evaluated physical activity and physical inactivity in students during the COVID-19 pandemic. A total of 213 students participated in the study. The main dependent variables were physical activity and sitting time, measured using the International Physical Activity Questionnaire—Short Form (IPAQ-SF). The results showed that during confinement, both weekly physical activity and sitting time increased. Differences were observed in sex, year of study, BMI, alcohol consumption, tobacco use, symptoms of anxiety/depression, Mediterranean diet, life situation, and stage of change [55].

In this scenario, children and adolescents showed significantly altered lifestyle behavior globally, and physical activity and sedentary behavior can impact their health, due to school closures and home confinement during the COVID-19 pandemic. Reduced physical activity and prolonged physical inactivity are linked to negative physical and mental health outcomes, such as loss of muscular and cardiorespiratory fitness, weight gain, and decreased academic performance. Thus, the authors investigated this aspect in detail during the COVID-19 pandemic through an experimental longitudinal study among children and adolescents (6–17 years) in five schools in Shanghai, China. We analyzed data from 2,426 children and

adolescents (boys, 51.2%; girls, 48.8%). Overall, the median time spent in physical activity decreased dramatically, from 540 min/week (before the pandemic) to 105 min/week (during the pandemic). It is important to note that during the pandemic, the prevalence of physically inactive students has vastly increased from 21.3% to 65.6%. Screen time has increased considerably during the pandemic in total, averaging 30 hours per week. Therefore, governments, schools, healthcare professionals, and parents need to be aware of the serious situation and implement more effective interventions to minimize the negative impact of the COVID-19 pandemic, with improved lifestyle [56].

Furthermore, one study investigated the immediate impact of the COVID-19 pandemic on dietary habits and lifestyle changes among the Italian population aged ≥ 12 years. A total of 3,533 respondents were included in the study, aged between 12 and 86 years (76.1% women). The perception of weight gain was observed in 48.6% of the population; 3.3% of smokers decided to stop smoking; a slight increase in physical activity, especially for bodyweight training, was reported by 38.3% of respondents. The population group aged between 18 and 30 years resulted in greater adherence to the Mediterranean diet when compared to the young and elderly population. A full 15% of respondents bought more fruits and vegetables [57].

Besides, a cross-sectional observational study analyzed the impact of the COVID-19 lockdown on the eating behavior and lifestyle of the Iraqi population. The total number of participants was 2,137. The results showed that 12.0% (256) of the participants stated that their lifestyle had improved, while 50.9% (1,087) stated that their lifestyle had worsened. In particular, the frequency of physical activity was decreased and hours of sleep significantly increased during the lockdown. Regarding eating habits, it was observed that 29.3% and 14.3% felt that their appetite increased and decreased, respectively. Appetite change during block was significantly associated with age, sex, city, and BMI. Likewise, 32.4% reported weight gain. Therefore, the confinement of COVID-19 had a negative effect on lifestyle, mainly by reducing physical activity and changing dietary habits [58].

Finally, a randomized controlled clinical trial evaluated weight changes over a 3-month nationwide COVID-19 lockdown in a cohort of patients with Non-alcoholic fatty liver disease (NAFLD)-HIV in a dietary intervention study. through telemedicine. A total of 112 patients participated in this study. Of the 55 NAFLD identified, 27 were allocated to dietary intervention and 28 to general dietary recommendations, being followed

up before blockade for a mean period of 5.0 ± 1.5 months, in which the general dietary recommendations group showed a gain of 0.65 kg versus a loss of 1.5 kg in the intervention group. During blockade, 93.3% of patients in the general dietary recommendations group reported that "the diet got worse" vs. 6.7% in the intervention group and 35.3% vs. 15.7% reported increased appetite, respectively. Furthermore, greater weight gain was associated with changes in dietary patterns. Therefore, maintaining dietary intervention through telemedicine can reduce the negative impact of dietary habits and physical activity pattern, preventing a substantial increase in body weight [59].

Conclusion

There is scientific evidence that foods/nutrients and natural substances from human physiology and biochemistry such as melatonin and coenzyme Q10 control immune system functions, and many metabolic or chronic diseases have been implicated in poor diet and lifestyle. The results of the pandemic indicate there have been a variety of lifestyle changes, physical inactivity and psychological problems. Still, adults over 40 years old, with children, unemployed, and those living in a macroeconomic region were shown to be more exposed to unhealthy behaviors. Maintaining dietary intervention through telemedicine can reduce the negative impact of eating habits and physical activity pattern.

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Data sharing statement

No additional data are available.

Conflict of interest

The authors declare no conflict of interest.

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