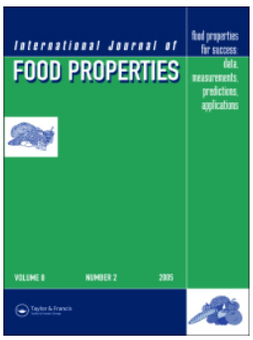

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COVID-19 and Fast Foods Consumption: a Review

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ABSTRACT

While all groups are affected by the COVID-19 pandemic, the aged people as well as those with underlying chronic medical conditions are at the greatest risk. The higher adherence to refined carbohydrate diets, sweats, and saturated fats contributes to the prevalence of obesity and type 2 diabetes; these disorders increase the risk for severe COVID-19 morbidity and mortality. Fast food consumption activates the intrinsic immune system and impairs adaptive immunity, leading to chronic inflammation and impaired host defence against viruses. Furthermore, inflammatory responses caused by COVID-19 may have long-term costs in survived individuals, leading to chronic disorders such as dementia and neurodegenerative disease through neuroinflammatory mechanisms that are related to an unhealthy diet. Therefore, now more than ever, wider access to healthy foods should be a main concern and individuals should be aware of healthy eating habits to reduce COVID-19 complications.

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INTRODUCTION

Coronavirus Disease 2019 (COVID-19) is an acute respiratory disease caused by a novel coronavirus (Severe Acute Respiratory Syndrome Coronavirus 2, SARS-CoV-2), that has reached pandemic grade.[1] While COVID-19 affects all groups, rigorous pathology and mortality are disproportionately highest in the elderly, underrepresented minorities, and/or in those with underlying comorbidities. Type 2 diabetes and obesity, as two prominent risk factors for severe forms of COVID-19, can explain the health difference observed in these individuals.[2] The high occurrence of these risk factors, worldwide, but especially in Iran and other developing countries is likely driven by increased consumption of the typical fast-food diets. They are consisting of high amounts of Saturated Fatty Acids (SFAs), refined carbohydrates, and sweets, and low levels of fibres, unsaturated fats, and antioxidants.[3,4] Here, we wanted to evaluate the evidence on unhealthy nutrition in viral infections, so this review mainly has focussed on fast foods.

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DIETARY HABITS: FAST FOODS

The fast foods can lead to chronic activation of the intrinsic immune system and an inhibition of the adaptive immune system.[5] Briefly, excessive SFA usage may induce a lipotoxic condition and activate the Toll-Like Receptor 4 (TLR-4) uttered on macrophages, dendritic cells, and neutrophils.[6] The activation of these biological stimulants produces proinflammatory mediators and other effectors of the intrinsic immune system.[7] In addition, the use of High–Fat Diet (HFD) in rats increased macrophage infiltration to lung tissues, specifically in the alveoli.[8] Recently, Siegers et al.[9] demonstrated that HFD increases influenza A virus-associated cardiovascular damage in mice.

This is particularly pertinent to COVID-19 patients agreed on the high rate of infection among lung alveolar epithelial cells and the taking part of lung tissue inflammation and alveolar damage in COVID-19 morbidity.[10] Moreover, fast food consumption and HFD inhibits T and B lymphocyte in the adaptive immune system, followed by an increase in oxidative stress markers.[11] Particularly, oxidative stress – induced by HFD – impairs T and B cell proliferation and maturation, and induces B cell apoptosis[12]; it has vital implication in host protection against viruses.

In an animal intervention, HFD exacerbated lung pathology due to influenza infection and impaired the adaptive immune response.[13] Therefore, high intake of fast foods practically impairs adaptive resistance whereas shifting into chronic inflammation and severely weaken host protection against viral morbidity.

Interleukin (IL)-1ß is an important mediator in immune responses of obese individuals.[14] Animal studies also reported the upregulation of this cytokine in the lungs [,15,16] as well as the activation of Nuclear Factor kappa B (NF-κB) and some proinflammatory markers.[17] Recent investigations have shown the effects of HFD feeding on lung inflammatory response, which was mediated by proinflammatory cytokines such as IL-1β, NF-κB, and IL-6.[18,19] Furthermore, researchers have found that neutralization of IL-1β at different stages of enteroviral infection prevents the development of chronic viral myocarditis by reducing inflammation.[20] Today, scientists are trying to introduce the chemical compounds that affect IL-1β signalling and reduce the inflammation in COVID-19[21]; therefore, from the nutritional aspect of view, individuals should decrease the consumption of HFD such as fast foods to suppress the expression of IL-1β and related proinflammatory process. This effort may be beneficial in COVID-19 pandemic.

In a recent study, the population of T and B cell were considerably lowered in patients with severe COVID-19[22]; so, unhealthy diets may act as a negative trigger in SARS-CoV-2 infection. As known before, higher consumption of fast foods increases the risk of obesity.[23] It should be also highlighted that in patients with obesity the response to antiviral and antimicrobial drugs is poorer, and the response to the vaccine is reduced.[24]

Fast foods typically contain high amounts of industrially produced Trans Fatty Acids (TFAs). Diet rich in TFAs is associated with higher production of proinflammatory molecules, especially in individuals with diabetes.[25] As well, previous studies reported that higher intake of TFAs is associated with the risk of weight gain and abdominal obesity in all age groups. In addition, TFAs has been associated with increased asthma risk and lung inflammation.[26] Therefore, TFAs can indirectly worsen COVID-19 manifestations especially respiratory complications.

From another point of view, fast foods can act as a big source of toxic heavy metals in human, especially children.[27] Cadmium (Cd), Chromium (Cr), Nickel (Ni), and Lead (Pb) are nonessential and their bioaccumulation in tissues leads to intoxication and inflammation depending on their potential toxic effects.[28] For example, Pb exposure initiates Mitogen-Activated Protein Kinase (MAPK)-dependent inflammation by activating oxidative stress and miRNA-155 expression *in vitro* and *in vivo*.[29] Cd is also very toxic and its long-term exposure leads to lung damage.[30] Furthermore, oral feeding of Cd, Pb, Ni, and mercury increased encephalomyocarditis virus-induced mortality rates in mice.[31] There are no further researches to identify the possible relationships between heavy metals and coronaviruses infections, but the people should lower the intakes of these toxic metals through the elimination of fast foods from their dietary habits. The gut microbiome also plays an important role in disease progression. The gut microbiota composition also changes by both disease and diet. A recent animal pilot study showed that fast food diet

has a considerable impact on gut microbiome composition in as short a time frame as 4 days.[32] Mosquera et al.[33] also observed that chronic inflammation resulting from a change in the gut microbiome of engineered mice or antibiotic-treated mice reduces the immune response induced by polymeric nanovaccines. The inefficient immune response associates with changes in microbiota post-vaccination and can be resolved by a new immunomodulatory nanomaterial that stimulates immune cells.[34]

On the other hand, the role of the gut microbiome in lung diseases has been well expressed. It is also known that respiratory virus infections like SARS-CoV2 cause negative changes in the gut microbiome.[35] In a pilot study on 15 patients with COVID-19, Zuo et al.[36] found persistent alterations in the faecal microbiome during the time of hospitalization, compared with controls; faecal microbiota alterations were associated with faecal levels of SARS-CoV-2 and COVID-19 severity. With a better understanding of the gut microbiome, it is now identified that in addition to the intestinal flora itself, its metabolites such as Short–Chain Fatty Acids (SCFAs; mainly acetic acid, propionic acid, butyric acid, and valeric acid) are also involved in regulating vital activities of the human body. SCFAs modulate the activity of T cells and, therefore, they have an important link between flora and the immune system; they involve different molecular mechanisms and also play a role in viral infections.[37] In addition, several studies have demonstrated that SCFAs have a beneficial impact on animal allergic airway disease, [38] and human asthma[39] mainly through their anti-Tumor Necrosis Factor-alpha (TNF-α) properties.[40] Although the controversy still exists for the therapeutic use of SCFA.[40] Therefore, above, fast food consumption may worsen the clinical manifestation of COVID-19 through gut microbiota dysbiosis and proinflammation (Figure 1).

VITAMINS, MINERALS AND COVID-19

Epidemiological data report that various vitamin deficiencies may have increased susceptibility to complications and mortality due to COVID-19 infection.[41,42] From a practical point of view, fast food intake can decrease the bioavailability and serum levels of essential micronutrients. Moreover, diet quality is inversely associated with fast food intake; vitamin B1, selenium (Se), and vitamin B3 intake decrease in fast food

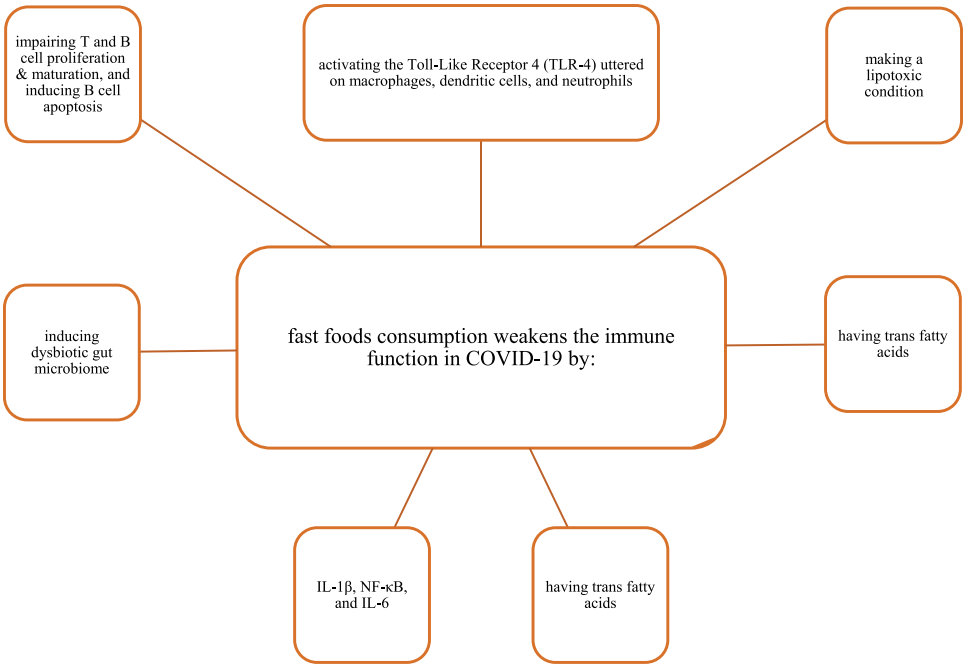

Figure 1. A summarized negative effects of fast foods and high-fat diet (HFD) on immune function.

consumers.[43] The impact of vitamin D has been much discussed recently because of its protective effects on acute respiratory tract infections.[42] Lower serum 25(OH) vitamin D concentrations have also been shown to associate with exposure to SARS-CoV-2 infection[44] and COVID-19 severity.[45,46] Muhairi et al.[47] reported that circulating 25(OH) D concentrations were inversely correlated with the consumption of fast food per week in the United Arab Emirates population.

Vitamin B status should also be assessed in COVID-19 patients. Vitamin B deficiency has the potential to suppress immune function (both the innate and adaptive immune responses).[48,49] High-doses of thiamine (B1) have been recommended for COVID-19 patients.[50] Furthermore, supplementation of niacin (B3) can help control the inflammatory process (generally caused by interleukin 6) in patients with COVID-19.[51] Another vitamin, folic acid, can be prescribed as an adjunct treatment for COVID-19 and respiratory disease in the early stages, [52] because tetrahydrofolic acid and 5-methyl tetrahydrofolic acid have strong and stable binding affinities against the SARS-CoV-2.[53] A recent paper reported that methylcobalamin (vitamin B12) has the potential to reduce organ damage in COVID-19.[54,55]

The current evidence has controversial comments regarding vitamin C supplementation in COVID-19 infection. A meta-analysis of 29 controlled trials with 11,306 participants could not detect any therapeutic effect of vitamin C (1 g/day) on upper respiratory tract infections.[56] In contrast, the administration of ~15 g/day of IV vitamin C for 4 days decreases mortality in sepsis-related Acute Respiratory Distress Syndrome.[57] In another study, 17 COVID-19 patients who received IV vitamin C (1 g every 8 h for 3 days) had a significant decrease in inflammatory markers, including ferritin and D-dimer, and a trend to decreasing FiO_2 requirements.[58] It might also help to reduce lung inflammation and lung injury in COVID-19.[59]

The essential trace element Se may be useful in severely diseased and Se-deficient COVID-19 patients.[60] Recently, Zhang et al.[61] showed an association between the reported cure rates for COVID-19 and selenium status. In summary, there is strong evidence that low Se status in both animals and humans can result in more severe forms of the disease.[62]

In practice, we suggest individuals to take these nutrients from the diet. We recommend that people consume high amounts of fiber, whole grains, fruits, and vegetables to boost immune function, especially those who survived from SARS-CoV-2. The therapeutic doses of nutrients may be beneficial as an adjunct therapy in COVID-19 infection.

CONCLUSION

Notably, it is necessary to consider the effect of lifestyle habits, for example diet, on the vulnerability to COVID-19 and recovery. Moreover, the large number of peoples that will survive from COVID-19 might be exposed to chronic medical circumstances that can be extra worsened by unhealthy diets. Finally, we recommend that individuals consume foods high in whole grains, fibres, unsaturated fats, and antioxidants to modulate gut microbiome and enhance immune function.

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None of the authors had a conflict of interest.

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Not applicable

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Authors' contributions

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