The Effect of the Anti-Inflammatory Diet for the Sequela of COVID-19(long COVID)

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Abstract. The novel coronavirus pneumonia epidemic has been gradually suppressed after three years of epidemic. However, due to the large number of infected people, the sequelae of COVID-19, namely long COVID-19, has become a new public health problem. The WHO defines long COVID as: symptoms still exist 3 months after the COVID-19 infection, and last for at least 2 months. There is no clear explanation for the occurrence mechanism of long-term COVID-19 in the current academic community. Still, the academic community widely recognizes that it has a large number of inflammatory clinical manifestations. The concept of an anti-inflammatory diet has gradually become known and respected. Since the WHO announced in May 2023 that the COVID-19 epidemic no longer constitutes an "international public health emergency", the attention paid to long COVID and its rehabilitation treatment has not been paid as much as to COVID-19 itself. For most infected people, its impact is to be longer than the direct impact of the virus. This review paper summarizes the current research on the symptoms of long COVID and the research results of an anti-inflammatory diet and evaluates the application potential of the sequelae of the COVID-19 virus from a nutritional perspective. Ultimately, the positive role of an anti-inflammatory diet in alleviating long-term COVID-19 will be evaluated, a more economical and convenient method of recovery will be recommended for the vast majority of patients affected by it, and reference and inspiration will be provided for future recovery from COVID-19 and infectious diseases.

Keywords: long COVID-19; anti-inflammatory diet; Jiangnan Diet; Dietetics; Rehab diet.

1. Introduction

The COVID-19 epidemic situation is one of the most serious public health events and the human experience is the largest and most impactful in the first 1/4 of the 21st century. After three years of hard work by medical personnel from various countries from the end of 2019 through 2023, humans finally tamed COVID-19, but after that humans also need to face a more long time effect——the sequelae of COVID-19. According to the data of WHO on 10 August 2023, in the time of the epidemic, there have been 769 million cases of infection, including more than 6.90 million deaths around the world [1].

In the post-pandemic era, the health impact of the sequelae of the novel coronavirus and its impact on other aspects is something that we must pay attention to as human beings. Such as the serious influenza A between the East Asian countries in recent months, which has some reason for the effect of the sequela of COVID-19 on the immunity system that made a higher data of death and infection than the years before [2,3]. At the same time, because of the effects of the COVID-19 pandemic and economic fluctuations, the cost of traditional modern medical treatment for the sequelae of COVID-19 may increase people's economic burden to a certain extent. Therefore, a more economical and effective way to deal with the sequelae of COVID-19 is for the general public to continue to do so. Purpose: This study will focus on existing research related to nutritional intervention and sequelae of COVID-19, and summarize the effects of active nutritional intervention of anti-inflammatory diet on the recovery of COVID-19 sequelae. It is hoped that it will provide help for future related research and clinical practice. Method: This study will be divided into four parts: Summarize the current research on the symptoms of sequelae of COVID-19; The composition of an anti-inflammatory diet and its representation in the Chinese diet; Evaluation of the potential for the application of long-term COVID from a nutritional perspective and Summary.

This study hopes to prove that the anti-inflammatory diet is a medically effective and economically more affordable intervention in improving the sequelae of COVID-19 through a review of related studies. It can reduce complications, improve the cure rate and mortality rate of the disease, and serve as an effective synergistic effect with other treatments; in terms of medical economic benefits, it can also reduce the waste of medical resources and reduce the medical expenses of the people, bringing better economic benefits to the healthcare system.

2. Summarize the Current Research on the Symptoms of Sequelae of COVID-19 (Long COVID)

In the first of, humans need to know what the sequela of COVID-19 is, then humans can talk about the way on the diet to overcome that. The coronavirus disease 2019 (COVID-19) is a kind of an acute infectious disease from the SARS-CoV-2 [4]. According to the definition by WHO, the long COVID takes 3 months to catch COVID, and at least persistent for 2 months, affects several systems of the body, and can't be explained by other kinds of medical diagnosis [5]. The characteristics in the clinic often are shortness of breath, rapid heart rate, fatigue, insomnia, and brain fog [4]. Although people don't know the concrete reason for the long COVID, some recent studies can show the effect of clinical presentation.

The most serious effect of long-term COVID is the harm to the respiratory system, the patients have severe manifestations of hypoxemia [6]. In the early of the epidemic, A study compared the normal lung CT and lung CT with COVID, they found the CT of COVID lungs were more rough than normal lungs, which have a ground-glass appearance, fine reticular appearance, and vascular thickening more prominent [6]. The early CT picture of double lungs with COVID-19 also has the characteristics of White Lung, the serious fibrosis of the lungs [7]. The COVID lung show in the clinic often are shortness of breath, sore throat, persistent cough, loss of smell, and other upper respiratory tract symptoms and in the end, difficulty breathing is the most common sight for people, there are about 23%~53% of patients still have dyspnea within 2 months after "recovery" [8,9].

The damage by COVID-19 in the circulatory system is myocardial injury and/or ischemia, abnormally elevated cardiac troponin levels [10]. And there have a study showed that the formation of blood clots by COVID-19 plays a role in worsening myocardial injury [11]. Then hypoxia and pulmonary microvascular injury may lead to right ventricular stress and cardiomyocyte necrosis, the latter of which may be achieved through local microvascular effects, endothelins, microthrombosis in exacerbation, and alteration of renin-angiotensin homeostasis [12]. With the development of the epidemic, people found various manifestations of cardiac dysfunction, manifesting as arrhythmias, acute coronary syndrome (ACS), heart failure, and myocarditis, occurring in more than 20% of cases among the new crown patients in the hospital [13].

In the before, scientists thought that COVID-19 could not go into the nervous system from the blood-brain barrier. However passing through the autopsied of the brain and the 3D microfluidic model of the human blood-brain barrier from the COVID-19 deceased, scientists found that have three important findings [14,15].

1)The COVID-19 S protein binds to the receptor ACE2, which is widely expressed in brain microvascular endothelial cells.

2)The S protein can directly damage the integrity of the blood-brain barrier to varying degrees.

3)The S protein can induce an inflammatory response in microvascular endothelial cells, thereby changing the function of the blood-brain barrier. Those findings support that COVID-19 can go into the brain and make some changes in the nervous system.

In the psychological aspect, COVID-19 also has some affections that cannot be ignored. Because of the affections from the body of the virus [16] or the social environment at that time, a lot of people appeared to have psychiatric problems. There is a long-term study to count data from the 402 COVID-19 patients who were discharged from hospital after recovery [17]. The rate of post-traumatic stress disorder (PTSD) was 28%, depression was 31%, anxiety was 42%, and insomnia was 40%.

3. The Composition of an Anti-Inflammatory Diet and its Representation in the Chinese Diet

Nutrition therapy is the first-line treatment, and nutrition is the foundation of all disease recovery and the cornerstone of the body's self-healing and anti-injury resistance. The clinical symptoms of COVID-19 have obvious inflammatory features, so the anti-inflammatory diet can become a kind of easy way to help humans overcome the effects of long COVID than other traditional medical treatment technologies, and representation in the Chinese diet the Jiangnan diet is recommended by scientific research report on dietary guidelines for residents [18].

The anti-inflammatory diet first be referred is by Dr. Barry Sears in 1995 year [19], which includes the Mediterranean diet (MD), Nordic diet, and anti-hypertension (DASH) diet, and the MD is the especial representation. The anti-inflammatory diet that not just a choice of a kind of anti-inflammatory food, it is a dietary pattern that emphasizes the combination of multiple nutrients and non-nutrients, which is characterized by eating more anti-inflammatory foods such as fresh fruits and vegetables, whole grains, fish, nuts and natural flavors under the premise of balanced nutrition, and reducing the intake of pro-inflammatory foods such as high sugar, high salt and high fat [20]. Dr.Han has a theory, Diet Theory for Family Nurses, based on Pathophysiology summarized as "non-nutrient synergistic nutrients assist in the prevention and treatment of chronic diseases through anti-inflammatory, antioxidant, and metabolic regulation" [21]. This theory encourages a balanced nutrition and antioxidant diet and reducing the intake of crude salt will be more conducive to enhancing the body's immune ability and alleviating the chronic inflammatory symptoms caused by the new coronavirus and its sequelae.

The Jiangnan diet is a kind of healthy diet that includes an anti-inflammatory diet. It is represented by the diet in the middle and lower reaches of the Yangtze River in China. Compared with the common dietary pattern in the north, it is lighter and has the characteristics of diverse foods, rich vegetables, fruits, soy products, and abundant fish, shrimp, and aquatic products [22]. This model helps prevent nutrient deficiencies and obesity and also intervenes in the occurrence of related chronic diseases. At the end of 2022, Zhang Wenhong, director of the National Center for Infectious Diseases of China, emphasized his statement at the beginning of the COVID-19 outbreak in 2020 that "vitamins and vegetables are essential, and the diet needs to be diversified, but it must not be dominated by carbohydrates" [23]. Dr. Zhang emphasized the same concept at the beginning of the epidemic and on the eve of the post-epidemic era - balanced nutrition and a rich diet [24].

4. Evaluation of the Potential for the Application of Long COVID from a Nutritional Perspective

The impact of COVID-19 on the human body is long-term, and the elimination of COVID-19 in the human body does not mean that the inflammatory effects it brings will be eliminated quickly. To cope with the impact of COVID-19 on the body, dietary patterns, as adjustable lifestyle factors, play an important role in prevention, treatment, and recovery. Studies have shown that different dietary patterns have a significant impact on the risk of COVID-19 infection, disease severity, and recovery.

The MD is known for its rich antioxidants, anti-inflammatory components, and balanced nutritional composition, which can reduce the risk and severity of COVID-19 infection by enhancing immune function and reducing the increase of chronic inflammatory mediators [25]. There is a study has found that people who follow a MD have a lower risk of contracting COVID-19 and have milder symptoms. Polyphenols and omega-3 fatty acids can play a role by regulating immune responses and reducing inflammation [26]. Like the MD, the Jiangnan diet is mainly based on plant-based foods, including abundant fruits and vegetables, high-quality protein (such as fish and beans), whole grains, and low salt, sugar, and fat. These foods provide vitamins, minerals, antioxidants, dietary fiber, and unsaturated fatty acids, which help enhance immunity, reduce inflammation symptoms, promote tissue repair, reduce the risk of cardiovascular disease, and control blood pressure and blood sugar

[27]. In addition, the potential improvement effects of the Jiangnan diet on long COVID symptoms also include relieving fatigue, improving respiratory function, protecting brain health, and relieving psychological stress.

In contrast, the modern industrial diet characterized by high sugar, high fat, and processed foods is associated with obesity, metabolic syndrome,c, and chronic inflammation, which greatly increases the severity of the sequelae of COVID-19. There are some studies found that a high-sugar, high-fat diet is associated with higher rates of hospitalization and severe illness. Modern industrialized dietary patterns may increase the risk of COVID-19 by promoting chronic inflammation and weakening the immune response [28].

For people affected by long-term COVID, an anti-inflammatory diet, high-protein diet, and intestinal health management are more helpful to improve symptoms and promote recovery. They are rich in Omega-3 fatty acids, antioxidants, and phytochemicals, which can relieve long COVID symptoms by reducing inflammatory markers and improving immune function. A high-protein diet is also important for maintaining muscle mass and function. Adequate protein intake can help improve symptoms of fatigue and muscle weakness in long COVID patients. In addition, long COVID patients may also have an imbalance in the intestinal microbiota. A diet rich in probiotics and prebiotics can help restore intestinal health and immune function, and improve fatigue and digestive symptoms [29].

In summary, dietary patterns are of great significance in the prevention, treatment, and recovery of long COVID. For patients with long COVID, the MD, Jiangnan diet, and anti-inflammatory diet reduce the risk and severity of infection, while the modern industrialized dietary pattern has the potential to increase the risk.

5. Conclusion

Although the current academic research on the long-term effects of COVID-19 on the human body is still unclear, and whether new long COVID symptoms will appear in the future is still unknown, it is widely recognized that it has long-standing inflammatory symptoms. In response to this series of symptoms, this article conducts research from a nutritional perspective, exploring the role of the rich variety of ingredients, high-quality protein, and amino acids in the anti-inflammatory diet, and the low-salt, low-oil and low-sugar dietary concepts in alleviating the symptoms of long COVID, and proposes a more economical and effective way for the rehabilitation treatment of COVID-19 and the prevention and treatment of potential infectious diseases in the future, improving the immune capacity of the target population, and reducing unnecessary investment in related medical resources, making it more feasible. However, at the same time, due to the lack of relevant research, this paper's impact on the recovery of long COVID is more of an evaluation, and there is a lack of relevant clinical experiments. In summary, this paper hopes to provide a new perspective for future infectious diseases and epidemiological research from a unique perspective and promote the promotion of healthy diets and lifestyles.

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