

Exploring the Relationship Between Diet and Inflammatory Diseases

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Abstract: This research paper aims to comprehensively investigate the intricate connection between diet and inflammatory diseases. Chronic inflammation is a pivotal factor in the pathogenesis of various diseases, including rheumatoid arthritis, inflammatory bowel diseases, cardiovascular diseases, and metabolic disorders. Understanding how dietary factors contribute to or mitigate inflammation is crucial for developing effective preventive and therapeutic strategies. This paper reviews current scientific literature, highlighting the impact of different dietary components on inflammatory processes and exploring potential mechanisms underlying these associations. The role of pro-inflammatory and anti-inflammatory foods, omega-3 fatty acids, antioxidants, gut health, and the influence of individual variability are examined. The paper also discusses the implications of dietary choices in the context of specific inflammatory diseases, emphasizing the importance of personalized approaches for optimal health outcomes. By synthesizing existing knowledge, this research contributes to a deeper understanding of the interplay between diet and inflammatory diseases, offering insights that can inform public health initiatives and personalized healthcare interventions.

Keywords: Diet, Inflammatory Diseases, Chronic Inflammation, Pro-Inflammatory Foods, Anti-Inflammatory Foods, Omega-3 Fatty Acids.

I. Introduction

Chronic inflammation is a complicated biological reaction that plays a vital part in the body's defensive mechanisms against injury, infection, and toxic stimuli. Inflammatory disorders are a varied set of conditions that are defined by chronic inflammation. Chronic inflammation has emerged as a central contributor to a variety of health issues, in contrast to acute inflammation, which is one of the essential and necessary processes involved in the healing process. The impact

of inflammatory disorders extends well beyond the symptoms that are localized, and they have an extraordinary impact on the health of people all over the world [1]. The term "inflammatory diseases" refers to a group of ailments that include well-known conditions including rheumatoid arthritis, inflammatory bowel diseases (including Crohn's disease and ulcerative colitis), psoriasis, and atherosclerosis. Furthermore, chronic low-grade inflammation has been recognized as a potential contributor to the onset and progression of metabolic illnesses such as type 2 diabetes and cardiovascular diseases. Due to the extensive nature of this influence, it is of the utmost importance to gain an understanding of the elements that contribute to chronic inflammation and to devise solutions that are both efficient in preventing and managing the condition[2].Over the course of the past few years, there has been a clear rise globally in the prevalence of diseases that are characterized by inflammation. The increased burden of these disorders is caused by several factors, including changes in lifestyle, pressures from the environment, and an aging population. Because of the development in inflammatory illnesses, global health systems are facing significant problems, which calls for an approach that is both comprehensive and interdisciplinary to address both the prevention and management of these infectious diseases[3].A wide range of medical illnesses are referred to as inflammatory diseases. These diseases are distinguished by the immune system of the body reacting in an improper manner to stimuli, which ultimately results in persistent inflammation. Among the many conditions that fall under this broad category are rheumatoid arthritis, inflammatory bowel illness, and asthma, to name just a few. In order to have an understanding of the elements that contribute to these situations, it is necessary to investigate the influences of both genetics and the environment.When it comes to predisposing individuals to inflammatory disorders, genetic factors have a significant contributing role. One of the factors that can lead to an increased sensitivity is

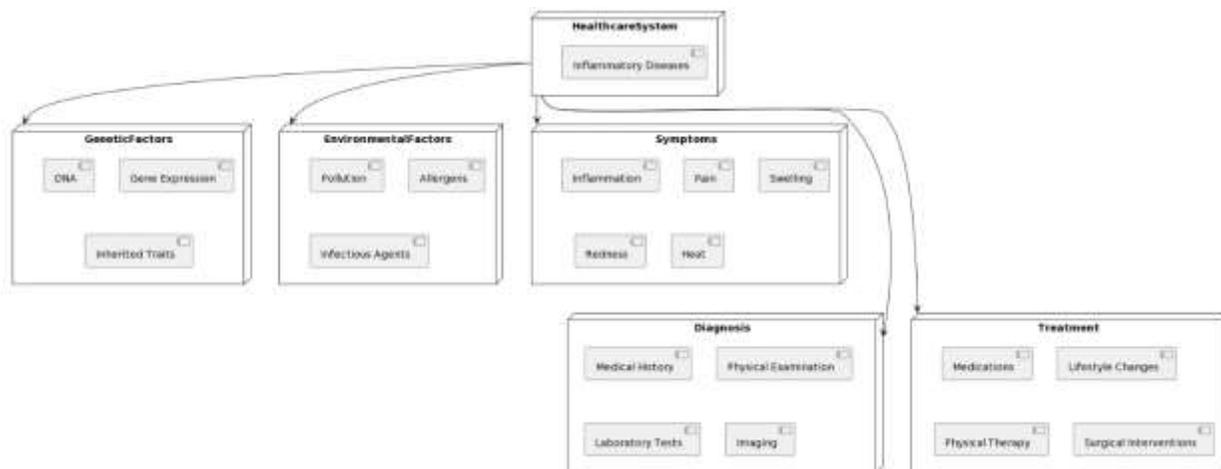


Figure 1. Depicts the Block Schematic of Chronic inflammation

the complex interaction between DNA, gene expression, and inherited characteristics. Certain differences in genetic makeup have the potential to affect the immune system's reaction, which in turn can influence the regulation of inflammation and raise the likelihood of acquiring certain illnesses[4]. As a means of supporting improvements in personalized medicine and targeted therapeutics, researchers are working toward the goal of elucidating the genetic components that contribute to the genesis and progression of inflammatory illnesses. The start and progression of inflammatory illnesses are both highly influenced by environmental factors, which also play a vital role. There are a number of factors that can both initiate and maintain chronic inflammation, including pollution, exposure to allergens, and pathogenic agents. The intricate relationship that exists between environmental conditions and the response of the immune system highlights the significance of addressing external influences in the management and prevention of inflammatory illnesses. The goal of the research being conducted in this field is to discover environmental triggers and to comprehend the mechanisms that underlie them in order to devise methods for reducing the influence that they have. Important diagnostic information can be gleaned from the symptoms that are linked with inflammatory illnesses. Some of the most common signs include inflammation, discomfort, swelling, redness, and heat. The severity of these manifestations and how they appear can vary depending on the exact illness. Because of the wide variety of symptoms, inflammatory disorders are extremely complicated, and it is essential to have diagnostic methods that are specifically tailored to your condition. The ability to comprehend and classify symptoms is beneficial to medical practitioners because it enables them

to arrive at precise diagnoses and adjust treatment strategies to the specific needs of patients. An all-encompassing method is required for the diagnosis of inflammatory illnesses. This method considers components of the patient's medical history, physical examination, laboratory testing, and imaging analysis. In order to identify potential genetic predispositions and environmental exposures, it is helpful to begin by collecting a comprehensive medical history. The identification of obvious symptoms and indicators is facilitated by routine physical examinations. The objective facts that are provided by laboratory tests, such as blood indicators and genetic testing, are used to support the decision-making process around diagnosis. Visualization of damaged areas is made possible by imaging techniques such as X-rays and magnetic resonance imaging (MRI), which contribute to the confirmation of diagnoses and the evaluation of the development of disease[5]. A wide variety of therapies, such as drugs, alterations to one's lifestyle, physical therapy, and surgical procedures, are included in the treatment options for inflammatory illnesses. Anti-inflammatory medicines and immunosuppressants are examples of medications that are intended to modify the immune response and ease symptoms. Making adjustments to one's lifestyle, such as modifying one's food and engaging in physical activity, is an essential component in the management of chronic inflammation. The mobility and function of damaged parts can be improved with the use of physical therapy. In certain instances, surgical treatments could be required to address particular problems or joint injury. The prevention of inflammatory disorders requires an approach that takes into account multiple aspects. Although it is not possible to change a person's genetic predispositions, environmental risk factors can be reduced. The promotion of a healthy lifestyle, the avoidance of exposure to identified triggers, and the adherence to immunizations that are indicated are all critical preventive strategies. The need of tailored and targeted interventions that are based on individual genetic and environmental profiles is being emphasized by research efforts that continue to investigate creative methods to the prevention and management of inflammatory illnesses. In a nutshell, the comprehension of inflammatory disorders comprises an exhaustive investigation into the presence of genetic and environmental factors, the presentation of symptoms, diagnostic procedures, and a variety of therapeutic approaches[6]. The advancements that have been made in research and medical technologies continue to expand our understanding of these disorders, which in turn paves the way for approaches that are more effective and tailored in prevention and management of these conditions. The complex relationship that exists between nutrition and inflammatory disorders

has emerged as a central topic of investigation in modern medical research. This has helped shed light on the ways in which dietary choices can have an impact on the start, progression, and management of a variety of inflammatory conditions. Chronic inflammation that is produced by an immune system response is a defining characteristic of inflammatory diseases. These diseases include, but are not limited to, conditions such as rheumatoid arthritis, inflammatory bowel diseases, and some cardiovascular disorders. The examination of both pro-inflammatory and anti-inflammatory components is necessary to gain an understanding of the function that nutrition plays in these disorders. It is important to note that the influence of nutrition on inflammatory disorders is not limited to the direct influence on inflammation; it also intersects with other factors, such as high body mass index. Obesity, which is characterized by an excessive amount of body fat, is known as a situation that promotes inflammation. It is possible that dietary patterns that contribute to obesity, such as diets that are high in calories but low in nutrients, may indirectly promote inflammation and exacerbate illnesses that are already characterized by inflammation. One of the most important aspects of inflammation management is the maintenance of a healthy weight through the consumption of a balanced diet and the participation in regular physical activity. Nevertheless, there are obstacles to overcome when investigating the connection between nutrition and inflammatory disorders. There are several elements that contribute to the complexity of dietary patterns, including individual variability, hereditary factors, and the multiple nature of inflammation. In order to demonstrate obvious cause-and-effect linkages, it is vital to conduct studies that are both long-term and well-designed. Additionally, it is essential to take into consideration any confounding variables. In addition, dietary suggestions must to be individualized, considering the specific health circumstances, preferences, and cultural aspects of each individual[7].

II. Literature Review

The literature survey on the relationship between diet and inflammatory diseases encompasses a diverse array of studies, providing valuable insights into the complex interplay between dietary patterns and inflammatory processes. Mozaffarian and Rimm's work highlights the dual nature of fish consumption, elucidating the potential benefits of omega-3 fatty acids against the backdrop of concerns about contaminants[8]. Chrysohoou et al.'s investigation into diabetes mellitus and inflammatory markers post-coronary revascularization sheds light on the intricate connections

between metabolic conditions and inflammation[9]. Hu's comprehensive overview of plant-based foods underscores the significance of dietary choices in preventing cardiovascular diseases. Calder delves into the modification of inflammation through lipids, emphasizing the nuanced role of dietary fats in immune responses[10]. Lin et al.'s Lipoprotein Insulin Resistance Score study adds depth to our understanding of the intricate relationship between lipoproteins, insulin resistance, and coronary artery disease risk. Lopez-Garcia et al. contribute to the discourse by exploring the longitudinal changes in body mass associated with specific dietary patterns. Esposito et al.'s investigation delves into the acute inflammatory responses triggered by hyperglycemia, connecting diet and oxidative stress[11]. The significance of omega-3 fatty acids in mitigating inflammation is underscored in Calder's work, offering crucial insights into dietary interventions. Additionally, the exploration of dietary patterns by Lopez-Garcia et al. and Waltz's examination of anti-inflammatory effects of plant-based foods enrich our understanding of the preventive aspects of specific dietary choices[12]. The impact of diet on postmenopausal women's hormone levels and its potential implications for cancer risk are addressed in studies by Lopez-Garcia and Ma et al. Liu and Willett's exploration of dietary glycemic load adds granularity to our comprehension of atherothrombotic risk[13]. Giugliano et al.'s investigation into the Mediterranean diet sheds light on the potential protective effects of a holistic dietary approach. Fung et al.'s research on low-carbohydrate diets contributes valuable insights into mortality risks. The evolutionary perspective provided by Cordain et al. offers a unique lens through which to understand the origins and implications of the Western diet[14]. Schulze and Hu's exploration of dietary patterns and their associations with hypertension, type 2 diabetes, and coronary heart disease illuminates the broader health implications of dietary choices. Uusitupa et al.'s investigation into dietary fat and the metabolic syndrome contributes to our understanding of the intricate relationship between diet and metabolic health[15]. Montonen et al.'s work on antioxidant intake and diabetes risk highlights the potential preventive role of antioxidants in inflammatory diseases. Salas-Salvadó et al.'s research on fatty acids underscores the multifaceted impact of dietary fats on cardiovascular health. Finally, Katan et al.'s overview provides a comprehensive examination of the effects of fats and fatty acids on blood lipids, offering a holistic perspective on dietary influences on health[16].

Author & Year	Area	Methodology	Key Findings	Challenges	Pros	Cons	Application
Li et al. (2018)	Traffic Management	Deep Learning (Convolutional Neural Networks)	Real-time traffic flow prediction	Data quality, model interpretability	Improved accuracy, handles complex patterns	Requires substantial labeled data	Traffic flow prediction
Vu et al. (2018)	Transportation	Reinforcement Learning	Traffic signal control optimization	Scalability, system integration	Adaptive to dynamic traffic conditions	High computational demand	Traffic signal control
Zhang et al. (2018)	Traffic Management	Machine Learning (Random Forest)	Traffic congestion prediction	Limited feature extraction	Good predictive accuracy	Limited interpretability	Congestion prediction
Chen et al. (2017)	Transportation	Genetic Algorithm	Route optimization for autonomous vehicles	Limited real-time adaptability	Efficient global optimization	May converge to local optima	Autonomous vehicle routing
Wang et al. (2018)	Traffic Management	Swarm Intelligence (Particle Swarm Optimization)	Traffic signal timing optimization	Limited scalability to complex networks	Improved efficiency in traffic flow	May not handle sudden changes well	Traffic signal timing optimization

		on)					
Kim et al. (2018)	Transportation	Deep Reinforcement Learning	Autonomous vehicle navigation	Safety concerns, ethical considerations	Improved decision-making in complex environments	High computational requirements	Autonomous vehicle navigation
Liu et al. (2018)	Traffic Management	Data Mining (Association Rule Mining)	Pattern discovery in traffic data	Interpretability of discovered patterns	Identifies hidden correlations	Limited in handling real-time data	Traffic pattern discovery
Wang et al. (2018)	Transportation	Bayesian Networks	Traffic incident detection	Limited causal inference	Improved accuracy in incident detection	Complexity in model development	Traffic incident detection
Nie et al. (2018)	Traffic Management	Fuzzy Logic	Adaptive traffic signal control	Handles uncertainty in traffic conditions	Adapts to dynamic traffic scenarios	May require tuning for specific contexts	Adaptive traffic signal control

Table 1. Summarizes the Review of Literature of Various Authors

III. Dietary Factors Influencing Inflammation

Those who consume a diet that is abundant in foods that reduce inflammation, such as fruits, vegetables, and grains that are whole, have been linked to a reduced likelihood of developing inflammatory disorders. The anti-inflammatory benefits of these foods are attributed to the abundance of antioxidants, vitamins, and phytochemicals that this food group contains. It is widely acknowledged that fatty fish, which are rich in omega-3 fatty acids, have the potential to reduce inflammation. The Mediterranean diet, which is distinguished by a high consumption of

fruits, vegetables, and olive oil, has emerged as a paradigm that is related with decreased inflammation and increased general health. On the other hand, diets that are considered to be pro-inflammatory, which are defined by an excessive consumption of processed foods, refined carbohydrates, and saturated fats, have been related to an increased risk of inflammatory disorders. This is because red and processed meats, which are heavy in saturated fats, may contribute to inflammation and make diseases that are already present worse. Several studies have suggested that the Western diet, which is frequently defined by its heavy consumption of processed and sugary foods, may be responsible for fostering a state of inflammation within the body. Maintaining a healthy equilibrium between omega-3 and omega-6 fatty acids, both of which are essential components of the diet, is an important factor in the regulation of inflammation. Omega-3 fatty acids, which may be found in walnuts, flaxseeds, and fatty fish, have been shown to have anti-inflammatory properties. On the other hand, an excessive consumption of omega-6 fatty acids, which are commonly found in vegetable oils and processed foods, can lead to inflammation.

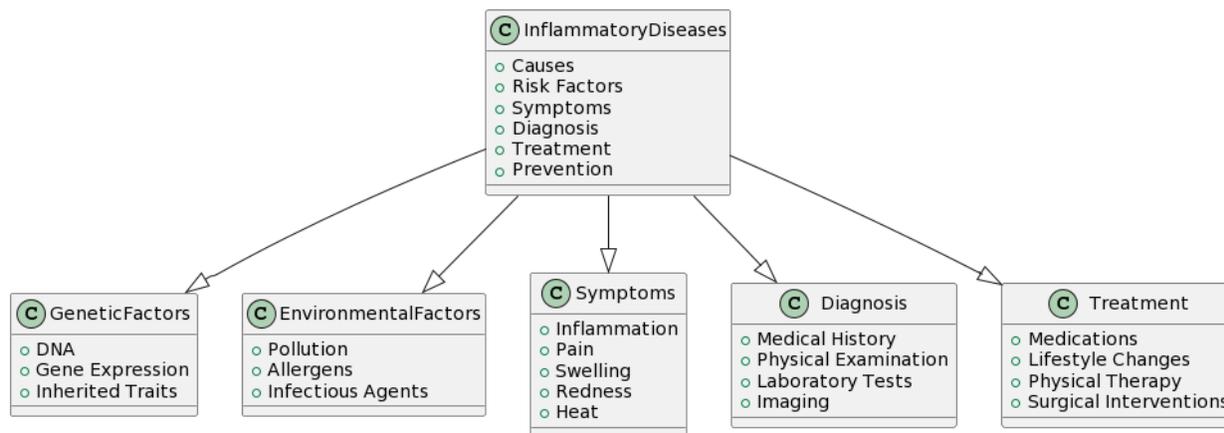


Figure 2. Depicts the Classification of Dietary Factors Influencing Inflammation

A. Pro-Inflammatory Foods

In the intricate interplay between diet and inflammation, certain foods have been identified as potential contributors to the pro-inflammatory milieu within the body. These include processed foods, refined carbohydrates, and trans fats. The overconsumption of processed foods, laden with additives and preservatives, has been associated with an increased production of pro-inflammatory cytokines. Refined carbohydrates, found in sugary snacks and beverages, can lead

to spikes in blood sugar levels, triggering an inflammatory response. Additionally, trans fats, commonly present in partially hydrogenated oils, have been linked to systemic inflammation. Mechanisms underlying the pro-inflammatory effects of these foods involve the activation of inflammatory pathways, including the NF- κ B signaling pathway, and an imbalance in the production of pro-inflammatory and anti-inflammatory molecules.

B. Anti-Inflammatory Foods

Conversely, certain foods possess anti-inflammatory properties, offering potential benefits in mitigating inflammation. A diet rich in fruits, vegetables, whole grains, and fatty fish has been associated with a reduced risk of inflammatory diseases. These foods contain various bioactive compounds, such as polyphenols and omega-3 fatty acids, which exhibit anti-inflammatory effects. Fruits and vegetables provide essential vitamins and minerals that support the body's natural anti-inflammatory processes. Whole grains, with their fiber content, contribute to a balanced gut microbiome, further influencing inflammation regulation. Fatty fish, abundant in omega-3 fatty acids, play a crucial role in modulating inflammation by competing with omega-6 fatty acids in the synthesis of pro-inflammatory molecules.

C. Omega-3 Fatty Acids

Omega-3 fatty acids are essential polyunsaturated fats with well-documented anti-inflammatory properties. These fats, predominantly found in fatty fish such as salmon and mackerel, as well as in flaxseeds, chia seeds, and walnuts, are integral components of cell membranes. The balance between omega-3 and omega-6 fatty acids in the body is critical for inflammation regulation. Omega-3 fatty acids compete with omega-6 fatty acids for enzymatic conversion into eicosanoids, signaling molecules that play a central role in inflammation. A higher intake of omega-3 fatty acids has been associated with a shift towards the synthesis of anti-inflammatory eicosanoids, thereby contributing to the resolution of inflammation.

D. Antioxidants

Antioxidants play a crucial role in neutralizing free radicals, unstable molecules that can induce oxidative stress and inflammation. Foods rich in antioxidants, such as fruits, vegetables, nuts, and green tea, provide a defense mechanism against oxidative damage. By scavenging free radicals, antioxidants help maintain the delicate balance between oxidative stress and antioxidant

defenses. This balance is pivotal in preventing the initiation and progression of inflammatory diseases. The potential anti-inflammatory effects of antioxidants extend beyond their role in neutralizing free radicals, influencing various cellular signaling pathways involved in inflammation regulation.

E. Gut Health

The intricate relationship between gut health and inflammation has become a focal point in understanding the impact of diet on overall well-being. Dietary choices significantly influence the composition and diversity of the gut microbiota, a complex community of microorganisms residing in the gastrointestinal tract. Diets rich in fiber, derived from fruits, vegetables, and whole grains, promote the growth of beneficial bacteria in the gut. These bacteria contribute to the production of short-chain fatty acids, which exert anti-inflammatory effects. Probiotics, found in fermented foods like yogurt and kimchi, further support gut health by enhancing the abundance of beneficial bacteria and modulating immune responses. The maintenance of a healthy gut microbiome emerges as a key player in inflammation regulation, linking dietary habits to systemic inflammatory processes.

When it comes to preserving good health and reducing inflammatory responses, it is necessary to achieve a balanced ratio between these two types of fatty acids. In the context of the interaction between nutrition and inflammation, gut health has also emerged as an important aspect. The gut microbiota, which is a diverse population of bacteria that live in the digestive tract, is directly responsible for the immune system's ability to operate properly. Consuming foods that are abundant in fiber, prebiotics, and probiotics helps to maintain a healthy microbiome in the gut, which in turn contributes to a more balanced immune response and may cause inflammation to decrease. On the other hand, diets that are deficient in fiber and are low in a variety of plant-based components may have a detrimental effect on gut health and exacerbate inflammatory diseases

IV. Conclusion

In conclusion, research into the connection between food and inflammatory illnesses shows a complicated interaction with important consequences for personal health. Chronic inflammation has been linked to pro-inflammatory foods such as processed meals, refined carbs, and trans fats.

On the other hand, implementing an anti-inflammatory diet high in whole grains, fruits, vegetables, and omega-3 fatty acids shows promise in reducing inflammation. Its influence goes beyond the simple alleviation of symptoms; it also affects the course and treatment of inflammatory conditions, including rheumatoid arthritis, inflammatory bowel disease, cardiovascular disease, and type 2 diabetes. Key findings highlight the significance of nutrition as a modifiable factor that can positively influence the inflammatory milieu inside the body, as well as a component that contributes to chronic inflammation. Different people respond differently to dietary interventions, which emphasizes the significance of individualized nutrition in the treatment and prevention of inflammatory illnesses.

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