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Review Article

Dietary intervention in enhancing immunity of cancer patients

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Abstract

The compromised function and environment of the immune system in individuals with cancer create a scenario in which the immune system fails to effectively identify and eliminate cancer cells. As a result, tumors can thrive and avoid detection by the immune system, leading to the progression of the disease. Gaining a comprehensive understanding of these immune-related challenges is essential for the development of effective cancer treatments, including immunotherapies, which aim to enhance the immune response against cancer. In addition to conventional treatments, dietary interventions have shown potential in supporting cancer patients by improving their immune function through nutritional support, influencing the gut microbiome, boosting the immune system, and other means. It is crucial to note that these dietary interventions should be tailored to each individual cancer patient, considering their specific requirements, preferences, and tolerances. This review seeks to underscore the significance of implementing well-adapted and appropriate dietary approaches to enhance the anticancer immunity of cancer patients.

Introduction

Poor immune function and immune environment are common characteristics of cancer patients [1-3]. Patients with cancer often possess compromised immune systems with less efficiency at recognizing and eliminating cancer cells. Such a situation can be attributed to various factors. For instance, Cancer cells can release certain substances that suppress the immune system, preventing it from mounting an effective response against the tumor. These substances may include cytokines, growth factors, and regulatory T cells, among others; Moreover, tumor Microenvironment: The tumor creates a unique environment that actively hampers the immune response. It recruits immune cells such as Myeloid-Derived Suppressor Cells (MDSCs) and Tumor-Associated Macrophages (TAMs) that suppress immune activity and promote tumor growth. In addition, T cells are a crucial component of the immune system responsible for recognizing and eliminating cancer cells. However, in cancer patients, T cells can become dysfunctional or exhausted. This means they lose their ability to effectively target and destroy cancer cells. Antigen-Presenting Cells (APCs) play a critical role in presenting tumor antigens to T cells, triggering an immune response. However, in cancer patients, the function of APCs can be impaired, leading to reduced activation of T cells and weakened immune response. Chronic inflammation can also contribute to the development and progression of cancer. Inflammatory cytokines and chemokines produced in response to the tumor can create an environment that promotes tumor growth and suppresses immune function. However, except for conventional cancer treatment, dietary intervention has been reported to contribute to rebuilding the immunology of cancer patients. Therefore, applying dietary intervention wisely for cancer patient is also important for increasing the clinical benefits of patients [4].

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Advantages of applying dietary intervention for regulating immunology in cancer patients

The relevance between compromised immune function and the advantages of dietary intervention lies in the potential of dietary modifications to improve the immune system's performance and bolster its ability to fight against cancer. Cancer patients often experience weakened immune function, which hampers their ability to effectively detect and eliminate cancer cells [5,6]. This compromised immune environment allows tumors to grow and evade immune surveillance, leading to disease progression. Therefore, finding ways to enhance the immune response against cancer becomes crucial in improving patient outcomes. Dietary interventions offer a promising avenue for supporting cancer patients by addressing their immune-related challenges. Proper nutrition plays a vital role in maintaining a strong immune system. Certain nutrients, such as vitamins, minerals, antioxidants, and phytochemicals, have been shown to have immune-boosting properties. By incorporating a well-modified and personalized diet, cancer patients can potentially enhance their immune function, promote the body's natural defenses, and optimize immune surveillance against cancer cells. Additionally, dietary interventions can influence the gut microbiome, which is increasingly recognized as a crucial factor in immune regulation. The gut microbiome consists of trillions of microorganisms that interact with the immune system. Certain dietary changes, such as increasing fiber intake or consuming probiotics, can positively impact the composition and diversity of the gut microbiome, thereby supporting a healthier immune response [7-9]. It's important to note that dietary interventions should be personalized to meet the specific needs, preferences, and tolerances of each cancer patient. An individualized approach takes into account factors such as the patient's nutritional requirements, potential interactions with ongoing treatments, and any dietary restrictions they may have. By tailoring dietary interventions, healthcare professionals can optimize the benefits and minimize potential risks, ultimately working towards improving the anti-cancer immunity of cancer patients [10-12]. Thus, the relevance between poor immune function in cancer patients and the advantages of dietary intervention lies in the potential of nutrition to enhance immune function, support immune surveillance against cancer cells, and positively influence the gut microbiome. By employing well-modified and personalized dietary approaches, cancer patients can potentially improve their immune response and contribute to better treatment outcomes [13,14].

a. **Nutritional support:** Cancer and its treatments can place significant nutritional demands on the body. A well-balanced diet that includes adequate protein, vitamins, minerals, and antioxidants is essential for maintaining overall health and supporting the immune system [5-9,15].

b. **Immune system boost:** Certain foods and nutrients have been found to have immunomodulatory properties, meaning they can positively influence immune function. For example, fruits and vegetables rich in antioxidants, such as berries, leafy greens, and citrus fruits, may help reduce oxidative stress and inflammation, supporting immune health [10-12,16-19].

c. **Gut microbiome influence:** The gut microbiome plays a crucial role in immune regulation. A healthy gut microbiome can help enhance immune function and reduce inflammation. Consuming a diet rich in fiber, prebiotics (found in foods like onions, garlic, and bananas), and probiotics (found in fermented foods like yogurt and sauerkraut) can promote a diverse and balanced gut microbiome [20-25].

d. **Anti-inflammatory effects:** Chronic inflammation can promote cancer progression and weaken immune function. Several dietary components, such as omega-3 fatty acids found in fatty fish, walnuts, and flaxseeds, have anti-inflammatory properties that may help modulate immune responses and reduce inflammation [26-30].

e. **Weight management:** Obesity and excess body weight are associated with chronic inflammation and a higher risk of certain cancers. Maintaining a healthy weight through a balanced diet and regular exercise can help regulate immune function and reduce the risk of cancer development and progression [31-36].

f. **Individualized approach:** It's important to note that dietary interventions should be tailored to the individual needs and tolerances of each cancer patient. Factors such as the type and stage of cancer, treatment protocols, and existing health conditions should be considered when designing dietary plans [37-39].

g. While dietary interventions can complement conventional cancer treatments and potentially improve immune function, it's crucial to consult with healthcare professionals, such as oncologists and registered dietitians, to ensure that dietary recommendations align with the specific needs and goals of each cancer patient [40-42].

Selecting proper dietary intervention

Dietary interventions can potentially regulate immunology and support the immune system in cancer patients. Here, we summarized some dietary factors that may have a positive impact on immune function [14,43,44].

a. **Fruits and vegetables:** Consuming a variety of fruits and vegetables provides essential vitamins, minerals, and antioxidants that support immune health. Foods rich in vitamin C (such as citrus fruits, berries, and bell peppers) and vitamin A (found in carrots, sweet potatoes, and leafy greens) are particularly beneficial [45,46].

b. **Omega-3 fatty acids:** Found in fatty fish (like salmon and mackerel), walnuts, flaxseeds, and chia seeds, omega-3 fatty acids have anti-inflammatory properties

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that may help regulate immune responses and reduce inflammation [8,9].

c. **Fiber-Rich foods:** A diet high in fiber, obtained from whole grains, legumes, fruits, and vegetables, can support a healthy gut microbiome. The gut microbiome plays a crucial role in immune regulation, and a diverse and balanced microbiome is associated with better immune function [8,9].

d. **Probiotics and fermented foods:** Probiotics, which are live beneficial bacteria, can be found in foods like yogurt, kefir, sauerkraut, and kimchi. Consuming probiotics and fermented foods helps promote a healthy gut microbiome, which in turn supports immune health [24,45,46].

e. **Lean proteins:** Including lean proteins in the diet, such as poultry, fish, legumes, and tofu, provides essential amino acids for building and repairing immune cells. Protein is necessary for the production and function of immune cells and antibodies.

f. **Antioxidant-Rich foods:** Antioxidants found in foods like berries, dark chocolate, green tea, and spices (such as turmeric and ginger) help reduce oxidative stress and inflammation, supporting immune function [26].

g. **Hydration:** Staying hydrated is important for overall health, including immune function. Drinking an adequate amount of water and consuming fluids like herbal teas or homemade broths can help maintain proper hydration [31].

It's important to note that while certain dietary factors may have potential immunomodulatory effects, there is no one-size-fits-all approach. Dietary interventions should be personalized and consider individual factors such as cancer type, treatment plan, overall health, and any existing dietary restrictions or sensitivities.

Discussion

A dietary approach to enhance anti-cancer immunity is beneficial for cancer patients, especially those with compromised immunity from treatment [13,14,43,44,47,48]. Nutrient-rich diets provide essential vitamins, minerals, and antioxidants that support immune function, aiding in immune system restoration and strengthening. They also reduce infection risk and facilitate tissue repair, wound healing, and recovery from anti-cancer therapy. Certain dietary components can alleviate treatment side effects, such as ginger for nausea and high-fiber foods for constipation. Carefully planned diets help maintain healthy weight, preserve muscle mass, and provide energy and nutrients for healing. Antioxidant and anti-inflammatory properties of fruits, vegetables, and omega-3 fatty acids promote immune health. A healthy gut microbiome, facilitated by fiber, prebiotics, and probiotics, supports immune function and alleviates gastrointestinal issues [13,14,43,44,47,48]. Personalized dietary interventions consider the specific needs, preferences, and tolerances of each cancer patient [49,50].

Conclusion

Dietary intervention plays a crucial role in improving the health of cancer patients as well as other patient populations and sub-health populations. For cancer patients, dietary modifications can provide essential nutritional support, enhance immune function, and help combat the side effects of treatment. Adequate nutrition can support the body's ability to fight against cancer cells, promote tissue repair, and minimize treatment-related complications. Furthermore, dietary interventions tailored to individual needs can optimize the immune response, influence the gut microbiome, and reduce inflammation, all of which contribute to improved overall health outcomes. In addition to cancer patients, dietary interventions have proven beneficial for various patient groups and sub-health populations. For individuals with chronic conditions such as diabetes, cardiovascular diseases, or obesity, dietary modifications can help manage symptoms, regulate blood sugar and cholesterol levels, and support weight management. Moreover, specific dietary interventions, such as low-sodium diets for hypertension or gluten-free diets for individuals with celiac disease, are essential for addressing specific health concerns. In the context of sub-health populations, which encompass individuals experiencing fatigue, stress, or general well-being issues, dietary interventions can provide nutritional support, energy balance, and promote overall health. Overall, personalized dietary interventions, guided by healthcare professionals, have the potential to significantly improve the health and well-being of cancer patients, various patient populations, and sub-health populations by addressing specific nutritional needs, managing chronic conditions, and promoting optimal health outcomes.

A dietary approach aimed at improving anti-cancer immunity can be beneficial for cancer patients, particularly those whose immunity has been compromised by anti-cancer therapy. dietary strategy is helpful. Anti-cancer therapies, such as chemotherapy, radiation, and immunotherapy, can have side effects that weaken the immune system. A nutrient-rich diet can provide essential vitamins, minerals, and antioxidants that support immune function, helping to restore and strengthen the immune system in cancer patients. In addition, cancer patients undergoing treatment often have a higher susceptibility to infections due to compromised immunity. A balanced diet, rich in nutrients, can help improve the body's defense mechanisms and reduce the risk of infections.

Adequate nutrition is crucial for tissue repair, wound healing, and overall recovery. A well-rounded diet provides the necessary nutrients, such as proteins, vitamins, and minerals, which are vital for repairing damaged tissues and supporting the body's recovery processes after anti-cancer therapy. Moreover, some dietary components may help alleviate side effects associated with anti-cancer therapy. For example, consuming ginger or ginger-containing foods may help reduce chemotherapy-induced nausea, while consuming high-fiber foods can help manage constipation caused by certain medications.

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Cancer treatments can lead to weight loss, muscle wasting, and malnutrition. A carefully planned diet can help maintain a healthy weight, preserve muscle mass, and provide adequate energy and nutrients necessary for the body's functioning and healing. Some dietary components, such as fruits, vegetables, and omega-3 fatty acids, possess antioxidant and anti-inflammatory properties. These can help counteract oxidative stress, reduce inflammation, and promote overall immune health, which is particularly important for cancer patients. Finally, a healthy gut microbiome plays a crucial role in immune function. Consuming a diet rich in fiber, prebiotics, and probiotics can promote a diverse and balanced gut microbiome, supporting immune health and potentially mitigating treatment-related gastrointestinal issues. It's important to notice that dietary interventions should be personalized, taking into account the specific needs, preferences, and tolerances of each cancer patient.

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