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The Role of Nutrition on the Immune Response

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ABSTRACT

The immune system reaction against infections and other foreign substances is known as the immune response. Nutrition is a critical component in the modulation of the immune system, hence the importance of a balanced diet. Better nutrition improves health, reinforces the immune system, contributes to longevity, and decreases the chance of non-communicable diseases. Thus, nutrition, health, and immune system are strongly connected. The aim of the present study is to evaluate current knowledge on the role of nutrition on the immune response. The article was conducted of two databases and were limited to the period from January 2018 to April 2023 with a combination of the following keywords: “role" and "nutrition" and "immune response. The results obtained were 17 articles found at the beginning of the search in both databases, and the 10 full text articles were selected for further review and discussion. The results of this study shows that immunonutrition plays a role in immune function. Nutrition such as vitamins A, B6, B12, C, D, E, and folate; and trace elements (zinc, iron, selenium, magnesium, and copper) play important and complementary roles in supporting both the innate and adaptive immune systems. The development and maintenance of our immune system are very intricately tied to our dietary pattern. Therefore, working on our food habits and improving our nutrition seem to be a pragmatic approach to strengthen our immune response. Multiple micronutrients play vital roles in supporting the immune response.

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1. INTRODUCTION

The immune system has a vital role such as protect your body from harmful substances, germs and cell changes that could make you ill. The main tasks of the body’s immune system are to fight disease-causing germs (pathogens) like bacteria, viruses, parasites or fungi, and to remove them from the body, recognize and neutralize harmful substances from the environment, and fight disease-causing changes in the body, such as cancer cells. Immunity refers to protection against infection. The immune systemic the collection of cells, tissues and molecules that functions to defend us against infectious microbes. The coordinated reaction of the immune system against infections (and other foreign substances) is known as the immune response.[1]

The immune response is the body's ability to stay safe by affording protection against harmful agents and involves lines of defense against most microbes as well as specialized and highly specific response to a particular offender. This immune response classifies as either innate which is non-specific and adaptive acquired which is highly specific. The innate response, often our first line of defense against anything foreign, defends the body against a pathogen in a similar fashion at all times. These natural mechanisms include the skin barrier, saliva, tears, various cytokines, complement proteins, lysozyme, bacterial flora, and numerous cells including neutrophils, basophils, eosinophils, monocytes,

macrophages, reticuloendothelial system, natural killer cells (NK cells), epithelial cells, endothelial cells, red blood cells, and platelets.[2]

The adaptive acquired immune response will utilize the ability of specific lymphocytes and their products (immunoglobulins, and cytokines) to generate a response against the invading microbes and its typical features are specificity as the triggering mechanism is a particular pathogen, immunogen or antigen, heterogeneity as signifies the production of millions of different effectors of the immune response (antibodies) against millions of intruders, memory such as the ability not only to recognize the pathogen on its second contact but to generate a faster and stronger response.[3],[4],[5]

Diet and nutrition are fundamental in maintaining the general and oral health of populations. Diet refers to the total amount of food consumed by individuals, whereas nutrition is the process of utilising food for growth, metabolism and repair of tissues. The relationship between diet and nutrition and health status can be affected by nutrient deficiency and vice versa. Dietary guidelines have been developed to provide evidence-based food and beverage recommendations for populations, aiming to promote a diet that meets the nutrient requirement, and to prevent diet-related diseases such as dental caries and obesity.[6]

Nutrition is a critical component in the modulation of the immune system, hence the importance of a balanced diet. Nutrition is essential for the lifelong development of human beings. Better nutrition improves health, reinforces the immune system, contributes to longevity, and decreases the chance of non-communicable diseases. Thus, nutrition, health, and immune system are strongly connected.[7] The aim of the present study is to evaluate current knowledge on the role of nutrition on the immune response.

2. METHOD

The research methods of this review was carried out by following several stages, namely determining the PICO analysis (Patient/ Population, Intervention, Comparison, Outcome) and searching for data sources. Research articles was conducted on Pubmed and Google Schoolar using a combination of the following keywords: “role” "nutrition" "immune response" and the articles published from January 2018 to May 2023. Figure 1 Research methodology.

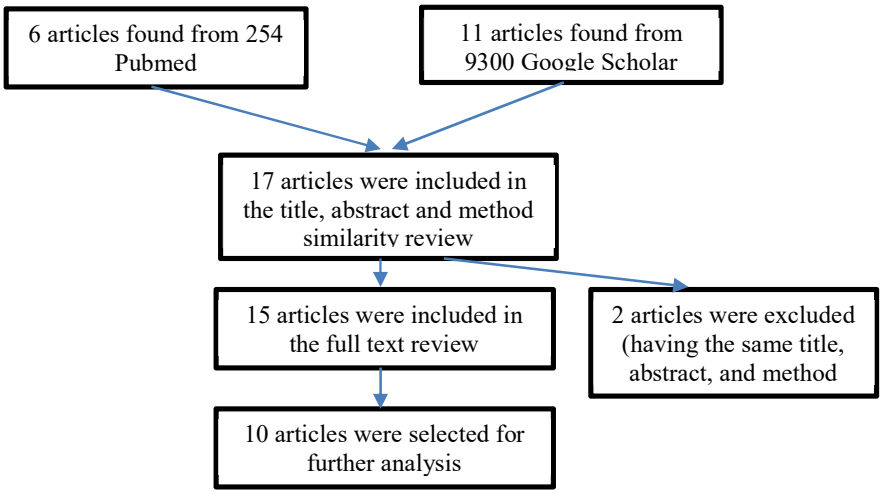

Figure 1 Research methodology

3. RESULTS AND DISCUSSION

Immunonutrition

Immunonutrition is multidisciplinary, involving definition of relationships between nutrition, immunity, infection, inflammation, and injury or damage. Immunonutrition plays a role in immune function, modulating gene expression in immune cells in neck and esophageal cancer patients treated by radiochemotherapy. This enhancement of immune function has also allowed patients to adapt to inflammation and oxidative stress caused by chemotherapy. Such a promising result highlights a

potential practical application of immunonutrition in treating disease. Foods are capable of influencing immune function.[8]

The role of nutrition on the immune system

Nutrition as a regulator of the early development of the immune system. Nutrition during the critical first 1000 days of life, from the moment a child is conceived, plays a vital role in the prenatal and postnatal development of the immune system. Mechanisms of nutritional modulation of the developing immune system. An important factor responsible for diet-mediated immune regulation is the modulation of the gut microbiome. Role of nutrition in the maintenance of immunity. A good nutritional regime helps lay the foundation for a healthy immune system and is also crucial for its maintenance. Functional foods for enhancing immunity.[9]

Nutrition plays in immune function is well established. Several vitamins, including vitamins A, B6, B12, C, D, E, and folate; and trace elements, including zinc, iron, selenium, magnesium, and copper, play important and complementary roles in supporting both the innate and adaptive immune systems. Deficiencies or suboptimal status in micronutrients negatively affect immune function and can decrease resistance to infections. Indeed, with the exceptions of vitamin E and magnesium, each of these micronutrients has been granted health claims in the European Union for contributing to the normal function of the immune system. Other nutrients such as omega-3 fatty acids also support an effective immune system, specifically by helping to resolve the inflammatory response.[10]

The roles that vitamins C and D play in immunity are particularly well elucidated. Vitamin C affects several aspects of immunity, including supporting epithelial barrier function, growth and function of both innate and adaptive immune cells, white blood cell migration to sites of infection, phagocytosis and microbial killing, and antibody production. Many immune cells have vitamin D receptors that affect their function after ligand binding, and as such vitamin D profoundly influences immunity. Vitamin D metabolites appear to regulate production of specific antimicrobial proteins that directly kill pathogens, and thus are likely to help reduce infection including in the lungs.[11]

The role micronutrients in supporting the immune response

Poor nutrition may not provide sufficient amounts of the nutrients needed by the immune system to function well. This would be associated with increased susceptibility to infection and inability to control the effects of being infected. Multiple micronutrients play vital roles in supporting the immune response. The roles of vitamins A, C and D and zinc, copper and iron are well explored, but B vitamins, vitamin E, vitamin K, selenium, magnesium and others all have roles. Deficiencies of several of these micronutrients impair many aspects of both innate and acquired immunity and increase susceptibility to infections. The immune impairments can be reversed by repletion and this reduces susceptibility to infection.[12],[13]

The role of nutrition in oral and periodontal health

Diet plays an important role in the typical oral dysbiosis of periodontal disease, as it provides nutritional substrates for microorganisms, can promote the creation of a microenvironment suitable for the multiplication and survival of certain periodontal pathogens bacteria, and can inhibit the growth of other microorganisms. Protein and simple carbohydrates, which on the one hand favor the establishment of a microenvironment with an acid pH and, on the other, favor inflammation. Periodontal health, inflammation, and promote eubiosis, could be obtained by mechanical removal of biofilm through non-surgical periodontal therapy, dietary control, and the associated intake of vitamin supplements and probiotics, prebiotics, or symbiotic agents.[14]

The role of micronutrients against virus infection

Micronutrients, including several vitamins (vitamin A, B6, B12, folate, C, D, E) and trace elements (Zinc, Selenium, Copper, Magnesium), play important roles in supporting the immune system, and thus their deficiencies could increase the susceptibility of a host to infectious diseases. Adequate levels of micronutrients are essential to ensure an effective function of each component of the immune system. Regarding the innate immunity, micronutrients play fundamental roles in maintaining the

structural and functional integrity of the physical barriers, such as skin and mucus membranes. Micronutrients are also involved in supporting activity of antimicrobial proteins and chemotaxis of innate cells. Furthermore, several vitamins and minerals contribute to the phagocytic and killing activities of neutrophils and macrophages. Deficiencies of vitamins and select essential minerals also affect several aspects of the adaptive immunity, in particular the humoral response (antibody-mediated) and the cell-mediated immunity.[15]

The role of nutrition in immune function

Adequate and appropriate nutrition is required for all cells to function optimally and this includes the cells in the immune system. An "activated" immune system further increases the demand for energy during periods of infection, with greater basal energy expenditure during fever for example. Thus, optimal nutrition for the best immunological outcomes would be nutrition, which supports the functions of immune cells allowing them to initiate effective responses against pathogens but also to resolve the response rapidly when necessary and to avoid any underlying chronic inflammation. The immune system's demands for energy and nutrients can be met from exogenous sources i.e., the diet, or if dietary sources are inadequate, from endogenous sources such as body stores. Some micronutrients and dietary components have very specific roles in the development and maintenance of an effective immune system throughout the life course or in reducing chronic inflammation. For example, the amino acid arginine is essential for the generation of nitric oxide by macrophages, and the micronutrients vitamin A and zinc regulate cell division and so are essential for a successful proliferative response within the immune system.[16]

The evidence of the abovementioned studies has shown that diet plays an important role in the typical oral dysbiosis of periodontal disease, as it provides nutritional substrates for micro-organisms, can promote the creation of a microenvironment suitable for the multiplication and survival of certain periodontal pathogens bacteria, and can inhibit the growth of other micro-organisms. Among foods, with the greatest impact on periodontal disease, we find proteins and simple carbohydrates, which on the one hand favor the establishment of a microenvironment with an acid pH and, on the other, favor inflammation. In conclusion, to promote periodontal health, reduce inflammation, and promote eubiosis, we believe that multiple benefits are induced, in addition to mechanical removal of biofilm through non-surgical periodontal therapy, by dietary control and the associated intake of vitamin supplements and probiotics, prebiotics, or symbiotic agents.[17]

Nutrition for the immune system.

The diet gives fuels for the immune system to function. Building blocks for the generation of RNA and DNA and for the production of proteins (antibodies, cytokines, receptors, acute phase proteins) and new cells. Specific substrates for the production of immune-active metabolites (e.g. arginine as a substrate for nitric oxide). Regulators of immune cell metabolism (e.g vitamin A, zinc). Nutrients with specific antibacterial or anti-viral functions (e.g. vitamin D, zinc). Regulators that protect the host from oxidative and inflammatory stress (e.g. vitamin C, vitamin E, zinc, selenium, long-chain omega3 fatty acids and many plant polyphenols). Substrates for the intestinal microbiota which in turn modulates the immune system (see next section).[12]

This review focused on the potential effects of early life nutrition in epigenetic processes and its consequences on food allergy development. Nutritional factors, like environmental ones, can affect the development of the immune system and food oral tolerance in the early stages of life, through epigenetics. DNA methylation, histone modifications, and miRNAs are epigenetic mechanisms that can modify the risk of allergic diseases, such as food allergy. The first thousand days of life represent a "window of opportunity" to modify the risk of developing non-communicable diseases, such as allergic diseases, and nutritional factors represent an interesting target of intervention. This aspect is not easy to investigate, both from a qualitative and quantitative point of view, considering that there are many environmental factors that influence epigenetic programming in this period of life. Future studies in this area are desirable to better clarify epigenetic mechanisms elicited by nutritional factors in the risk of food allergy and to develop targeted intervention strategies for prevention and treatment.[18]

4. CONCLUSION

The development and maintenance of our immune system are very intricately tied to our dietary pattern. Therefore, working on our food habits and improving our nutrition seem to be a pragmatic approach to strengthen our immune response.

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