IJFANS INTERNATIONAL JOURNAL OF FOOD AND NUTRITIONAL SCIENCES
ISSN PRINT 2319 1775 Online 2320 7876
, UGC CARE Listed (Group -I) Journal Volume 11, Iss 02, 2022

Impact of Nutrition on Immune Function and Disease Resistance

Dr. Sujata V. Patil Associate Professor Department of Community Medicine ,Krishna Institute of Medical Sciences, Krishna Vishwa Vidyapeeth, Karad, Maharashtra, India. Email: sujapatil99@gmail.com

Dr. Jayant R. Pawar ,Assistant professor , Krishna Institute of Allied Sciences, Krishna Vishwa Vidyapeeth, Karad, Maharashtra, Email: jayantpawar26@gmail.com

Mrs. Swati A. Ingale Assistant Professor, Krishna Institute of Nursing Sciences, Krishna Vishwa Vidyapeeth, Karad, Maharashtra, Email:swatiparmesh777@gmail.com

Abstract: This abstract provides a concise overview of recent literature exploring the intricate relationship between nutrition, immune function, and factors influencing immunological responses. Reviews on diet and immune function, obesity's impact on immunity, and the role of specific micronutrients such as selenium and zinc underscore the critical importance of nutritional status in supporting optimal immune responses. Thymic regeneration, age-related changes in inflammatory markers, and inflammatory biomarkers in older adults contribute valuable insights into the dynamic nature of the immune system across the lifespan.Conceptual reviews on food as immunologic modulation and the role of the gut microbiota expand our understanding of novel approaches to immune health. Additionally, investigations into immunometabolic disorders and the microbiota-mediated inflammation in the intestine highlight the complex interplay between systemic health and immune function.The abstract also addresses factors influencing immune function, including sleep, exercise, stress, age, chronic diseases, and vaccination, providing a holistic perspective on the multifaceted elements impacting immunological resilience. While recognizing the challenges such as methodological variations and the intricate nature of immune responses, the abstract emphasizes the need for a multidisciplinary approach in comprehending and enhancing immune health.

Keywords: Nutrition, Immune Function, Diet, Obesity, Micronutrients, Selenium, Zinc, Thymic Regeneration, Aging, Inflammatory Biomarkers, Inflammatory Markers

I. Introduction

The immune system, a marvel of biological complexity, stands as the body's formidable defense against an array of pathogens seeking entry. Comprising an intricate network of cells, tissues, and organs, this multifaceted system orchestrates a dynamic response to combat bacteria, viruses,

ISSN PRINT 2319 1775 Online 2320 7876
, UGC CARE Listed (Group -I) Journal Volume 11, Iss 02, 2022

fungi, and other invaders, ensuring the body's survival and well-being. The symphony of immunity unfolds within the confines of various components, each contributing distinct capabilities to the collective effort of safeguarding against potential threats.At the forefront of this defense are white blood cells, or leukocytes, representing a diverse group with specialized functions. Lymphocytes, including T cells and B cells, form the cornerstone of adaptive immunity [1]. T cells, equipped for cell-mediated responses, actively seek and destroy infected or abnormal cells, while B cells produce antibodies—a critical element of humoral immunity—enabling the neutralization of pathogens and marking them for elimination by other immune cells. Complementing these lymphocytes are phagocytes, such as neutrophils, monocytes, eosinophils, and basophils. These cells function as the body's clean-up crew, engulfing and digesting foreign particles, pathogens, and cellular debris.Antibodies, also known as immunoglobulins, serve as molecular sentinels crafted by B cells. These proteins possess remarkable specificity, recognizing and binding to antigens—unique molecular markers present on the surface of pathogens. The complement system, a group of proteins working in concert with antibodies, enhances the immune response by promoting the clearance of microbes and damaged cells[2]. This collaborative effort unfolds in various compartments, from the bloodstream to the lymphatic system, creating a comprehensive defense network.

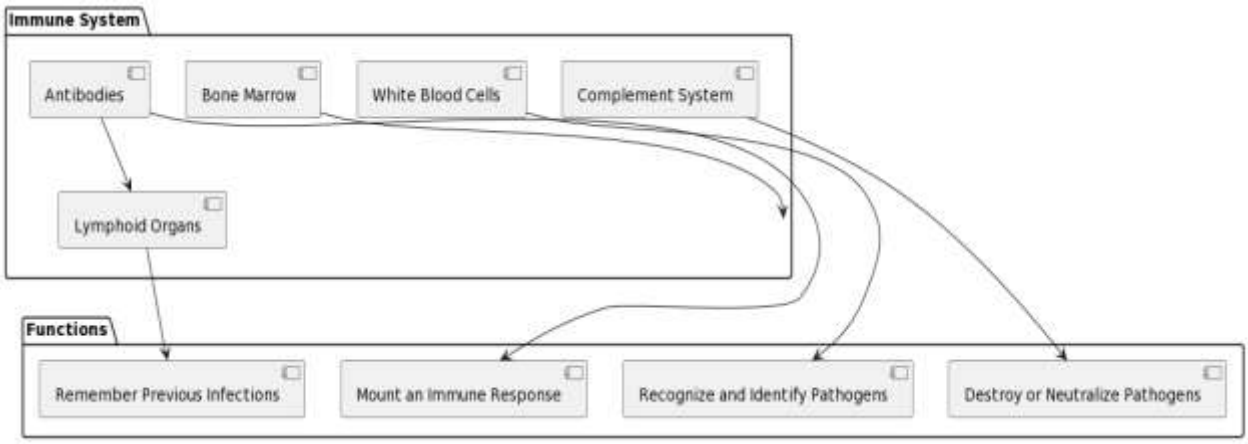

Figure 1. Depicts the Block diagram of Immune System and Disease Resistance

The bone marrow, acting as a hematopoietic factory, generates blood cells, including the diverse array of white blood cells pivotal for immune responses. Simultaneously, the thymus, a gland nestled in the upper chest, orchestrates the maturation and education of T cells, ensuring they acquire the ability to distinguish self from non-self. The spleen, a vital organ positioned between

ISSN PRINT 2319 1775 Online 2320 7876
, UGC CARE Listed (Group -I) Journal Volume 11, Iss 02, 2022

the ribs, serves as a blood filter and immune system command center, orchestrating responses to blood-borne pathogens and eliminating aged red blood cells.Beyond these internal bastions, the body's external barriers contribute significantly to immune resilience. The skin, a physical fortress, and mucous membranes act as primary obstacles, preventing pathogens from breaching the body's inner sanctum[3]. These barriers secrete substances with antimicrobial properties, bolstering their defense capabilities.In times of peril, the immune system unleashes an inflammatory response, a strategic reaction to tissue injury or infection. This orchestrated interplay involves the release of chemical signals, increased blood flow, and the recruitment of immune cells to the site of conflict. This inflammatory cascade serves as a double-edged sword—essential for eliminating threats but, when dysregulated, capable of causing collateral damage to healthy tissues.Integral to the immune system's efficacy is its remarkable ability to memorize past encounters with specific pathogens. This immunological memory forms the foundation of vaccinations, enabling the immune system to mount rapid and potent responses upon subsequent exposure to familiar foes. This adaptive quality underlines the immune system's sophistication, enhancing its capacity to protect the body in a dynamic and ever-changing microbial landscape[4].As the conductor of this symphony of defense, the immune system's performance is influenced by an array of factors. Nutrition emerges as a critical determinant, with adequate intake of essential nutrients ensuring the optimal function of immune cells. Sleep, a restorative balm, plays a crucial role in maintaining immune vitality. Regular exercise, a cornerstone of overall health, fortifies the immune system, promoting robust responses to potential threats. Conversely, chronic stress, a pervasive modern affliction, can undermine immune function, rendering the body more susceptible to infections.Age, an inevitable companion on life's journey, introduces nuanced changes to the immune landscape. The very young and the elderly may experience altered immune responses, emphasizing the need for tailored approaches to immune support across different life stages. Hygiene practices, a mundane yet pivotal aspect of daily life,[5] contribute significantly to disease prevention by impeding the spread of infections. Finally, vaccination, a triumph of medical science, stands as a testament to humanity's ability to harness the immune system's adaptive prowess for preventive purposes.

II. Literature Survey

The exploration of the intricate relationship between diet and immune function emphasizes the significance of nutrients in supporting optimal immune responses. The review delves into the

ISSN PRINT 2319 1775 Online 2320 7876
, UGC CARE Listed (Group -I) Journal Volume 11, Iss 02, 2022

impact of dietary choices on the body's ability to defend against pathogens, providing valuable insights into the potential of dietary interventions for enhancing immune function[6].This work investigates the detrimental effects of obesity on the adaptive immune response to influenza virus, highlighting the intricate interplay between excess body weight, inflammation, and immune dysfunction. The review sheds light on the broader implications of obesity on respiratory health and susceptibility to infectious diseases.The complex relationship between selenium, melanoproteins, and viral infections is explored in this review. It investigates the multifaceted roles of selenium in the immune system and its impact on the body's ability to combat viral pathogens, providing insights into the potential therapeutic implications of selenium in viral infections[7].This literature review focuses on the pivotal role of zinc as a gatekeeper of immune function. It examines the influence of zinc on the development and regulation of immune cells, emphasizing its significance in maintaining a robust immune response. The review provides valuable insights into the potential therapeutic applications of zinc in modulating immune function.Thymic Regeneration and Immune System Renewal .This work explores the concept of thymic regeneration, offering a fresh perspective on rejuvenating an aging immune system[8]. It investigates the potential of teaching an old immune system new trick, emphasizing the role of thymic regeneration in enhancing immune function.his comprehensive review focuses on inflammatory biomarkers as predictors of hospitalization and death in community-dwelling older adults. It sheds light on the association between inflammatory markers and adverse health outcomes, providing valuable insights into the potential utility of these biomarkers in predicting health trajectories in the elderly[9]. Immune Function and Micronutrient Requirements Across the LifespanThis review provides a holistic exploration of immune function and micronutrient requirements across the lifespan. It emphasizes the dynamic nature of immune responses at different life stages and contributes to a comprehensive understanding of how nutritional interventions can support immune health from infancy to old age[10].The review delves into age-related increases in circulating inflammatory markers in men, independent of BMI, blood pressure, and lipid concentrations. It provides insights into the independent impact of aging on inflammatory processes, contributing to our understanding of age-related changes in immune function.This work explores the intricate connections between inflammation, metaflammation, and immunometabolic disorders[11]. It provides a conceptual framework for understanding how chronic inflammation contributes to the development of metabolic disorders, offering valuable

ISSN PRINT 2319 1775 Online 2320 7876
, UGC CARE Listed (Group -I) Journal Volume 11, Iss 02, 2022

insights into the bidirectional relationship between immune function and metabolic health.This review proposes a compelling perspective[12] on the potential of food as immunologic modulation. It explores the immunomodulatory properties of dietary interventions, providing a foundation for understanding how dietary choices can be strategically employed to modulate the immune system and promote overall health.The review delves into the intricate interplay between the microbiota, inflammation, and antimicrobial defense in the intestine. It elucidates the mechanisms through which the gut microbiota influences immune responses, contributing to our understanding of how microbial communities shape intestinal immune homeostasis. This comprehensive exploration focuses on the gut mycobiont's role in immunity and inflammatory disease. It highlights the dynamic interactions between fungi and the immune system in the gastrointestinal tract, offering insights into the potential impact of dysregulated microbiota on inflammatory diseases.This foundational review lays the groundwork for understanding the intricate relationship between nutrition and the immune system[13].

Area	**Author & Year**	**Methodology**	**Key Findings**	**Challenges**	**Pros**	**Cons**	**Application**
Diet and Immune Function	Childs, Calder, & Miles (2019)	Literature Review	Explored impact of diet on immune function.	Limited experimental data.	Comprehensive overview.	Potential bias in selected studies.	Insights into dietary interventions for immune enhancement.
Obesity and Immune Response to Influenza	Green & Beck (2017)	Review of Studies	Investigated impaired adaptive immune response	Variability in study designs.	Highlighted link between obesity, inflammation, and	Lack of uniformity in obesity classification.	Understanding obesity's impact on respiratory health and

Virus			in obesity.		immune dysfunction.		infection susceptibility.
Selenium, Selenoproteins, and Viral Infection	Guillin, Vindry, Ohlmann, &Chavatte (2019)	Literature Analysis	Explored roles of selenium in viral infections.	Limited clinical trials on selenium supplementation.	Provided insights into therapeutic implications of selenium.	Lack of standardized selenium dosage in studies.	Potential for selenium in managing viral infections.
Zinc as a Gatekeeper of Immune Function	Wessels, Maywald, & Rink (2017)	Integrative Review	Examined zinc's role in immune cell development.	Variability in zinc absorption among individuals.	Highlighted significance of zinc in maintaining robust immune response.	Limited consensus on optimal zinc dosage.	Potential therapeutic applications of zinc in immune modulation.
Thymic Regeneration and Immune System Renewal	Berzins et al. (2002)	Review of Thymic Regeneration Studies	Explored potential for thymic regeneration in aging immune systems.	Challenges in translating findings to clinical interventions.	Addressed rejuvenating aging immune systems.	Limited human studies on thymic regeneration.	Strategies for enhancing immune function in older individuals.
Inflammatory Biomarker	Salanitro et al.	Longitudinal Study	Investigated inflammat	Difficulty in establishi	Provided prognostic value of	Limited standardization of	Informing healthcare strategies

ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 11, Iss 02, 2022

s in Older Adults	(2012)	Analysis	ory biomarkers as predictors in older adults.	ng causation.	inflammatory biomarkers.	inflammatory marker assessments.	for older adults based on inflammatory markers.
Immune Function and Micronutrient Requirements Across the Lifespan	Maggini, Pierre, & Calder (2018)	Comprehensive Review	Explored changes in immune function and micronutrient needs over the lifespan.	Limited longitudinal studies on micronutrient requirements.	Provided insights into age-related immune changes.	Challenges in isolating specific effects of individual micronutrients.	Tailoring nutritional interventions to support immune health at different life stages.
Age-related Inflammatory Markers	Miles et al. (2008)	Cross-sectional Analysis	Investigated age-related increases in inflammatory markers independent of BMI.	Lack of uniformity in inflammatory marker measurements.	Highlighted independent impact of aging on inflammation.	Potential confounding factors in cross-sectional analysis.	Understanding age-related changes in inflammatory processes.
Inflammation, Metaflammation, and Immunom	Hotamisligil (2017)	Conceptual Review	Explored connections between inflammation,	Complexity in defining and measuring	Provided a framework for understanding the interplay	Limited clinical applicability of metaflammation	Informing research and therapeutic approache

ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 11, Iss 02, 2022

etabolic Disorders			metaflammation, and immunometabolic disorders.	metaflammation.	between inflammation and metabolic health.	concept.	s to immunometabolic disorders.
Food as Immunologic Modulation	Molendijk, van der Marel, &Maljaars (2019)	Conceptual Framework	Proposed the concept of a "Food Pharmacy" for immunologic modulation.	Challenges in standardizing and prescribing dietary interventions.	Emphasized the immunomodulatory potential of food.	Limited empirical evidence for the "Food Pharmacy" concept.	Exploring dietary strategies for targeted immunologic modulation.
Microbiota-Mediated Inflammation and Antimicrobial Defense	Caballero & Pamer (2015)	Review of Microbiota Studies	Investigated microbiota-mediated inflammation and antimicrobial defense in the intestine.	Variability in microbial composition across individuals.	Shed light on gut microbiota's influence on immune responses.	Challenges in deciphering causation vs. association in microbiota studies.	Understanding the role of the gut microbiota in intestinal immune homeostasis.
Gut Mycobiota in Immunity and	Li, Leonardi, & Iliev (2019)	Comprehensive Review	Explored the role of gut mycobiota in	Limited understanding of specific fungal	Provided insights into the dynamic interactions	Challenges in defining dysbiosis in the	Informing research on the impact of mycobiota

Inflammatory Disease			immunity and inflammatory disease.	species' functions.	between fungi and the immune system.	mycobiota.	on inflammatory diseases.
Nutrition and the Immune System: An Introduction	Chandra (1997)						

Table 1. Summarizes the Review of Literature of Various Authors

It offers a comprehensive introduction to the field, contributing to our understanding of how dietary choices influence the body's ability to mount effective immune responses. This systematic review investigates the efficacy of Vitamin C for preventing and treating pneumonia. It provides insights into the potential role of Vitamin C in respiratory health, contributing to the ongoing discourse on the use of nutritional interventions in respiratory infections.

III. Role of Nutrition role immune function

Nutrition plays a crucial role in supporting immune function and enhancing disease resistance. The immune system is a complex network of cells and proteins that work together to defend the body against pathogens, such as bacteria, viruses, and other harmful microorganisms. Proper nutrition ensures that the immune system functions optimally, and deficiencies in key nutrients can compromise its ability to fight off infections. Here are some key ways in which nutrition impacts immune function and disease resistance:

ISSN PRINT 2319 1775 Online 2320 7876
, UGC CARE Listed (Group -I) Journal Volume 11, Iss 02, 2022

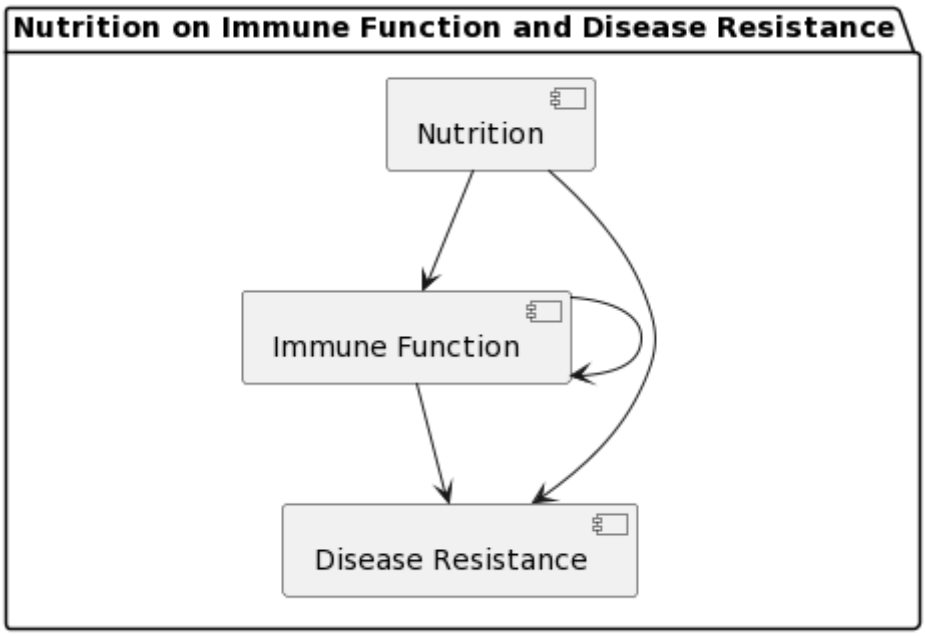

Figure 2. AutoimmuneSystems of Human Body

A. Macronutrients:

- Proteins: Essential for the production of antibodies, which are proteins that play a key role in immune response. Protein deficiency can impair the production of immune cells and antibodies.
- Carbohydrates: Provide energy for immune cells. Glucose is a primary energy source for immune cells such as T cells and macrophages.

B. Micronutrients:

- Vitamins and Minerals: Several vitamins and minerals are crucial for immune function. For example:
- Vitamin C: Supports the production and function of white blood cells (lymphocytes and phagocytes) and acts as an antioxidant.
- Vitamin D: Plays a role in regulating the immune system and can help reduce the risk of respiratory infections.
- Zinc: Essential for the development and function of immune cells and helps in wound healing.

ISSN PRINT 2319 1775 Online 2320 7876
, UGC CARE Listed (Group -I) Journal Volume 11, Iss 02, 2022

- Iron: Important for the proliferation of immune cells and oxygen transport, but excessive iron can be detrimental.

C. Antioxidants:

- Nutrients such as vitamins A, C, and E act as antioxidants, helping to neutralize harmful free radicals that can damage cells and weaken the immune system.

D. Probiotics:

- Healthy gut bacteria are crucial for a well-functioning immune system. Probiotics, found in foods like yogurt and fermented products, promote a balanced gut microbiome, supporting immune health.
- Water is essential for overall health and helps in the proper functioning of immune cells and the elimination of toxins.

E. Balanced Diet:

- A well-balanced diet that includes a variety of foods ensures a diverse range of nutrients, supporting overall health and immune function.
- Malnutrition, whether due to inadequate intake or nutrient deficiencies, can weaken the immune system, making individuals more susceptible to infections.

IV. Factors Affecting Immune System

The immune system is a complex and highly orchestrated network of cells, tissues, and organs that work together to protect the body from pathogens, such as bacteria, viruses, fungi, and parasites. Its primary function is to recognize and eliminate foreign invaders while distinguishing them from the body's own cells. The immune system plays a crucial role in maintaining the body's overall health and preventing infections. Here are key components and functions of the immune system:

A. White Blood Cells (Leukocytes)

- Lymphocytes (T cells and B cells): T cells are responsible for cell-mediated immunity, while B cells produce antibodies as part of the humoral immune response.
- Neutrophils, Monocytes, Eosinophils, and Basophils: Different types of phagocytes that engulf and digest pathogens and debris.

ISSN PRINT 2319 1775 Online 2320 7876
, UGC CARE Listed (Group -I) Journal Volume 11, Iss 02, 2022

B. Antibodies (Immunoglobulins)

- Proteins produced by B cells in response to the presence of specific antigens (foreign substances). Antibodies can neutralize pathogens and enhance their removal by other immune cells.

C. Complement System:

- A group of proteins that complement the action of antibodies. The complement system enhances the ability of immune cells to clear microbes and damaged cells.

D. Phagocytes

- Cells that engulf and digest foreign particles, including bacteria and dead or damaged cells. Examples include neutrophils and macrophages.

E. Lymphatic System

- A network of vessels, nodes, and organs that transports lymph (a fluid containing white blood cells) throughout the body. The lymphatic system plays a key role in immune surveillance.

F. Bone Marrow and Thymus

- Bone Marrow: Site of blood cell formation, including white blood cells.
- Thymus: Where T cells mature and develop immunocompetence.

G. Spleen

- An organ that filters blood, removing old or damaged red blood cells and serving as a site for immune responses to blood-borne pathogens.

H. Skin and Mucous Membranes

- Physical barriers that prevent pathogens from entering the body. Skin and mucous membranes secrete substances that inhibit the growth of microorganisms.

I. Inflammatory Response

- A coordinated reaction to tissue injury or infection, involving the release of chemical signals, increased blood flow, and recruitment of immune cells to the site of infection or damage.

J. Immune Memory

- The ability of the immune system to "remember" past encounters with specific pathogens, leading to a faster and more efficient response upon re-exposure. This forms the basis of immunization.

ISSN PRINT 2319 1775 Online 2320 7876
, UGC CARE Listed (Group -I) Journal Volume 11, Iss 02, 2022

Factors Affecting Immune Function	Description
Nutrition	Adequate intake of nutrients, including vitamins and minerals, is crucial for optimal immune function. Malnutrition or deficiencies can weaken the immune system.
Sleep	Sufficient and quality sleep is essential for immune health. Lack of sleep can impair immune function and increase susceptibility to infections.
Exercise	Regular physical activity supports a healthy immune system by promoting good circulation and the efficient movement of immune cells.
Stress	Chronic stress can suppress the immune system, making individuals more susceptible to illnesses.
Age	The immune system undergoes changes with age, and both the very young and the elderly may have altered immune responses.
Chronic Diseases	Conditions such as diabetes, autoimmune disorders, and HIV/AIDS can impact immune function.
Vaccination	Immunization helps train the immune system to recognize and fight specific pathogens, providing protection against infectious diseases.

Table 3. Factors Affecting the Immune System

V. Conclusion

In conclusion, the intricate interplay between nutrition and immune function underscores the significance of a well-balanced diet in supporting the body's defense mechanisms. The reviews on diet and immune function, obesity's impact on the immune response, selenium's role in viral infections, and zinc as a gatekeeper of immune function collectively emphasize the crucial role of specific nutrients in bolstering immunity. Thymic regeneration and the exploration of age-related changes in inflammatory markers contribute to our understanding of immune system dynamics across the lifespan.The reviews on inflammatory biomarkers in older adults, immunometabolic disorders, and the gut microbiota shed light on the broader context influencing immune function. They underscore the challenges of translating complex findings into clinical

interventions and highlight the need for standardized methodologies in research.Furthermore, the conceptual review on food as immunologic modulation introduces an intriguing perspective, emphasizing the potential of dietary interventions as a strategic approach to immune health. The exploration of gut microbiota in immunity and the impact of chronic diseases on immune function further enrich our comprehension of the multifaceted factors influencing immunological responses.The factors affecting immune function, such as sleep, exercise, stress, age, chronic diseases, and vaccination, collectively paint a comprehensive picture of the various elements influencing immune resilience. Recognizing the role of lifestyle, external stressors, and preventive measures like vaccination is crucial for promoting overall immune health.

References

[1] Childs, C.E., Calder, P.C., & Miles, E.A. (2019). Diet and Immune Function. Nutrients, 11(8).

[2] Green, W.D., & Beck, M.A. (2017). Obesity impairs the adaptive immune response to influenza virus. Annals of the American Thoracic Society, 14(Supplement 5), S406-9.

[3] Guillin, O.M., Vindry, C., Ohlmann, T., &Chavatte, L. (2019). Selenium, selenoproteins and viral infection. Nutrients, 11(9), 2101.

[4] Wssels, I., Maywald, M., & Rink, L. (2017). Zinc as a gatekeeper of immune function. Nutrients, 9(12), 1286.

[5] Berzins, S.P., Uldrich, A.P., Sutherland, J.S., Gill, J., Miller, J.F., Godfrey, D.I., & Boyd, R.L. (2002). Thymic regeneration: Teaching an old immune system new tricks. Trends Mol. Med., 8, 469–476. doi: 10.1016/S1471-4914(02)02415-2.

[6] Salanitro, A.H., Ritchie, C.S., Hovater, M., Roth, D.L., Sawyer, P., Locher, J.L., Bodner, E., Brown, C.J., & Allman, R.M. (2012). Inflammatory biomarkers as predictors of hospitalization and death in community-dwelling older adults. Arch. Gerontol. Geriatr., 54, 387–391. doi: 10.1016/j.archger.2012.01.006.

[7] Maggini, S., Pierre, A., & Calder, P.C. (2018). Immune Function and Micronutrient Requirements Change over the Life Course. Nutrients, 10, 1531. doi: 10.3390/nu10101531.

[8] Miles, E.A., Rees, D., Banerjee, T., Cazzola, R., Lewis, S., Wood, R., Oates, R., Tallant, A., Cestaro, B., Yaqoob, P., et al. (2008). Age-related increases in circulating

inflammatory markers in men are independent of BMI, blood pressure and blood lipid concentrations. Atherosclerosis, 196, 298–305. doi: 10.1016/j.atherosclerosis.2006.11.002.

[9] Hotamisligil, G.S. (2017). Inflammation, metaflammation and immunometabolic disorders. Nature, 542, 177–185. doi: 10.1038/nature21363.

[10] Molendijk, I., van der Marel, S., &Maljaars, P.W. (2019). Towards a Food Pharmacy: Immunologic Modulation through Diet. Nutrients, 11(6), 1239.

[11] Caballero, S., & Pamer, E.G. (2015). Microbiota-mediated inflammation and antimicrobial defense in the intestine. Annual review of immunology, 33, 227-56.

[12] Li, X.V., Leonardi, I., & Iliev, I.D. (2019). Gut mycobiota in immunity and inflammatory disease. Immunity, 50(6), 1365-79.

[13] Chandra, R.K. (1997). Nutrition and the immune system: an introduction. The American journal of clinical nutrition, 66(2), 460S-3S.

[14] Hemilä, H., &Louhiala, P. (2013). Vitamin C for preventing and treating pneumonia. Cochrane database of systematic reviews, (8).

[15] Dhabliya, M. D., & Dhabalia, M. R. (2014). Object Detection and Sorting using IoT. International Journal of New Practices in Management and Engineering, 3(04), 01-04.

[16] Verma, M. K., & Dhabliya, M. D. (2015). Design of Hand Motion Assist Robot for Rehabilitation Physiotherapy. International Journal of New Practices in Management and Engineering, 4(04), 07-11.

[17] Khetani, V., Nicholas, J., Bongirwar, A., & Yeole, A. (2014). Securing web accounts using graphical password authentication through watermarking. International Journal of Computer Trends and Technology, 9(6), 269-274.

[18] Bhattacharya, S., Rungta, D. S., & Kar, N. (2013). Intelligent Frequent Pattern Analysis in Web Mining. International Journal of Digital Application & Contemporary research, 2.

[19] Limkar, S., Kulkarni, S., Chinchmalatpure, P., Sharma, D., Desai, M., Angadi, S., & Jadhav, P. (2020). Classification and Prediction of Rice Crop Diseases Using CNN and PNN. Intelligent Data Engineering and Analytics: Frontiers in Intelligent Computing: Theory and Applications (FICTA 2020), Volume 2, 1177, 31.

ISSN PRINT 2319 1775 Online 2320 7876
, UGC CARE Listed (Group -I) Journal Volume 11, Iss 02, 2022

[20] Mahajan, R. A., & Mahajan, S. A. (2020, March). Development of scrum-tree-KNN algorithm for distributed agile development. In 2020 International Conference on Emerging Smart Computing and Informatics (ESCI) (pp. 17-21). IEEE.