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The effect of life style on immune systems response to some diseases

Submitted to the Department of (Biology) in partial fulfillment of the requirements for the degree of **BSc. In Biology**

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CERTIFICATE

This research project has been written under my supervision and has been submitted for the award of the **BSc.** degree in **Biology** with my approval as a supervisor.

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DEDICATION

This effort I dedicate to **Allah** Almighty, my powerful foundation, my source of inspiration, wisdom, knowledge, and understanding. Throughout this project, he was the source of my energy.

Yusra Abubakr

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ABSTRACT

The immune system works in coordination with other structures in the body to prevent infections from occurring and to fight existing infections. The immune system plays a role in the formation and regulation of almost every disease and therefore has a very important place for human health. Researches show that the regulation of internal and external factors that can affect immunity can be effective in protecting against diseases and in the healing process. In this review, nutrition, exercise-sports, regular life, sleep, environmental factors, addictive substances, psychological state, previous illnesses, and genetic predispositions, affecting immunity are discussed. A diet composed by adequate and balanced intake of macro and micro nutrients ensures that the immune system works at the desired level. In addition to nutrition, moderate intensity regular exercise, regular life and quality sleep contribute to immunity by affecting various physiological mechanisms. On the other hand, external factors such as previous diseases, air pollution, radiation, various synthetic compounds and harmful habits such as stress, alcohol, cigarettes and drugs can disrupt the immune system by disrupting the cytokine balance. Although genetic factors are important in immunity, it seems that lifestyle which includes factors such as diet, daily activities, sleep patterns, habits, and moods is much more determinant for strong immunity.

Keywords: Immunity, nutrition, exercise, sleep, immune system, inflammation

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1. INTRODUCTION

The immune system is a complex network throughout the body that provides multiple lines of defense against illness. The immune system performs an important function by working as an orchestra with its cells, tissues, and molecules, preventing infections from occurring and fighting infections that settle. These defenses are generally divided into two main categories: innate immunity and adaptive immunity (Abbas, 2018). Lifestyle has a critical impact on the immune system. Health is a precious asset that individuals must actively nurture and protect. While genetics and environmental factors play essential roles in determining health outcomes, lifestyle choices also exert a profound influence. Lifestyle choices encompass a range of behaviors and habits, including diet, physical activity, sleep patterns, stress management, and substance use. These choices can either promote optimal health or contribute to the development of chronic diseases and other health-related issues (MacGillivray, 2014). A balanced and nutritious diet is fundamental to maintaining good health. Consuming a variety of foods rich in essential nutrients, such as fruits, vegetables, lean proteins, and whole grains, is associated with a lower risk of chronic diseases, including heart disease, diabetes, and certain cancers. Regular physical activity is another cornerstone of a healthy lifestyle. Engaging in exercise not only helps maintain a healthy weight but also has numerous other benefits, including improved cardiovascular health, enhanced mental well-being, and reduced risk of chronic conditions like osteoporosis and hypertension (Lynn, 2011). Conversely, a sedentary lifestyle can contribute to obesity and related health problems. Adequate and quality sleep is crucial for overall health and functioning. Sleep plays a vital role in physical and mental restoration, and a chronic lack of sleep can lead to a range of health issues, including increased stress, impaired cognitive function, and a higher risk of chronic diseases such as diabetes and cardiovascular disease. Chronic stress can have a

profound negative impact on health. Prolonged exposure to stress hormones can weaken the immune system, increase the risk of mental health disorders, and contribute to conditions like heart disease and hypertension. All of these play an important role in the immune system

The aims of this review is the idea of boosting immunity is enticing, but the ability to do so has proved elusive for several reasons. The immune system is precisely that a system, not a single entity. To function well, it requires balance and harmony. We summarized that researchers are exploring the effects of diet, exercise, age, psychological stress, sleep and other factors on the immune response, In the meantime, general healthy-living strategies make sense since they likely help immune function and they come with other proven health benefits.

2. Literature review

2.1 Nutrition

Human health as well as the prevention, management, and treatment of various diseases are significantly impacted by nutrition. There are evident connections between illness, diet, and immunity: Modifications to one factor impact the others. Over the past ten years, research on the interdependent effects of diet on immunological processes has been conducted, and the field of nutritional immunology has emerged as a fascinating area of study. Similar to other Like all other bodily systems, the immune system needs enough nutrition to function properly (MacGillivray, 2014). It is widely acknowledged that nutrition influences immune response, and clinical and epidemiological evidence indicates that nutritional deficits can change immunological response and raise infection risk. (Kubena, 1996). When it comes to the onset, progression, and control of non-

communicable diseases like allergies, cancer, diabetes, and cardiovascular disorders, nutrition is crucial. Nutrition is expected to influence illness risk and management as an immunomodulator, and such non-communicable diseases have well-defined immunopathological processes (Venter, 2020). Underdeveloped areas are more likely to have nutritional deficiencies, which raise the risk of morbidity and death from infectious diseases. It is necessary to address nutritional inadequacies in order for the immune system to function properly. When certain meals are consumed in the suggested quantities, research has shown that they can enhance immunological responses, including infection resistance (Black, 2014; Bailey, 2015).

2.1. 1 Nutritional Components:

Vitamin A:

Vitamin A plays a role in the innate and acquired immune functions. Vitamin A deficiency can impair barrier function, alter the immune response, and increase susceptibility to many infections (Calder, 2013). Intestinal barrier and mucus secretion, which may facilitate the entry of pathogens, have been shown to be impaired in mice with vitamin A deficiency (Ahmed, 1990). Vitamin A has an important place in the regulation of cells that control negative immune reactions. In vitamin A deficiency, the activity of natural killer cells may decrease and disrupt the response to the vaccine (Ross, 1996). Vitamin A deficiency is associated with increased morbidity and mortality for children. These rates have been reported to be associated with respiratory infections, diarrhea, and measles. In children with vitamin A deficiency, when supplements were given, an increase in the treatment of infectious diseases and a decrease in the morbidity rate was observed (Bailey,

2015). Vitamin A is found in animal tissues in the form of retinoids and in plant tissues in the form of carotenoid. Retinoic acid supports T cell movement to gut-associated lymphoid tissues (Iwata, 2004). Carotenoids are stored in tissues and multiply in plasma and can be converted to vitamin A. High doses of vitamin A have a strong teratogenic effect. The synthetic derivative of vitamin A, isotretinoin, is responsible for craniofacial defects together with a syndrome involving malformations of the central nervous system, heart, and thymus. Therefore, synthetic forms and excessive consumption are not recommended during pregnancy (Guillonneau, 1998).



Figure 1. Vitamin A

Vitamin D:

Vitamin D and its metabolites have many roles in the immune system, autoimmunity, and susceptibility to infections. Vitamin D is converted into its active form, 1,25-dihydroxy vitamin D3 in kidneys. Immune cells both respond to vitamin D and are involved in its production. For this reason, vitamin D can directly affect host defense by providing antimicrobial peptide synthesis from macrophages (Calder, 2013). People who are deficient in vitamin D have been found to be at increased risk of respiratory viral infections (Sabetta, 2010). It is

thought that vitamin D strengthens innate immunity, thus reducing transmission. Moreover, high vitamin D level is associated with a low interleukin 6 level, which is the main target in controlling the cytokine storm seen in COVID-19 (Meltzer, 2020).

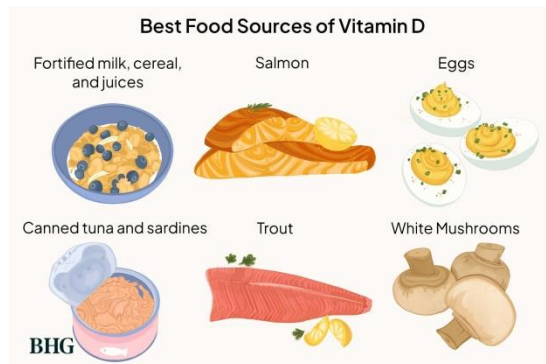


Figure 2. Vitamin D

Vitamin E:

Vitamin E is a fat-soluble antioxidant that can protect polyunsaturated fatty acids (PUFAs) in cell membranes from oxidation, reduce the production of reactive oxygen species (ROS) and reactive nitrogen species (RNS), and modulate signal transduction (Lee, 2018). It is a fat-soluble antioxidant that strengthens immune functions. It is found in the membrane of all nuclear cells, especially in the membrane of immune cells. Vitamin E consists of biologically active tocopherols and tocotrienols. Especially, α -tocopherol is frequently used in researches. Vitamin E can increase T cell function by directly affecting membrane integrity, signal transduction, or indirectly by reducing the production of suppressive factors such as prostaglandin E2 (PGE2) by macrophages (Maijo, 2014).

Vitamin C:

Vitamin C is an essential vitamin (Carr, 2017). It is an important cofactor of many enzymes and regulates gene expression by interacting with transcription factors (Sorice, 2014). It contributes to immune defense by supporting various cellular functions of both innate and acquired immune systems. It protects against oxidative stress with its antioxidant feature (Carr, 2017). Anti-inflammatory, antiviral, and antibacterial properties are well known in the literature (Sorice, 2014). Plasma vitamin C concentrations decrease rapidly in cases of infection or stress. Vitamin C deficiency resulted in the impaired immune system and increased susceptibility to infections

Zinc:

Zinc is an essential mineral. Zinc deficiency can reduce immune cell proliferation, the activity of natural killer cells, cytokine production, and neutrophil function (Prasad, 2008; Wessel, 2017). Zinc is essential for hematopoiesis, cell maturation, cell differentiation, and progression of the cell cycle in the immune system. Cytokine production and production of reactive oxygen species also depend on zinc. Zinc deficiency also negatively affects the maturation and function of T and B cells. Insufficient zinc intake in dietary has also been associated with cancer. Therefore, zinc is vital for the correct functioning of the entire immune system (innate-acquired) (Baltacı, 2012; Wessel, 2017)

Iron:

Iron is a trace element that has an important place in cell differentiation and growth (Mohammed, 2017). Iron has multiple effects on the immune system. Oxidative burst, T cell proliferation, cytokine production, and bacterial killing are the effects of iron on the immune system. In iron deficiency, thymus atrophy may develop

(Calder, 2013). Iron deficiency impairs cellular immunity, especially from helper T cells (Elmadfa, 2019).



Figure 3.Iron

3. Obesity:

Increased incidence of obesity in children and adults is a common concern worldwide. Obesity and overfeeding are strongly associated with chronic inflammation. This obesity-associated inflammation is called metaflammation and the western-style diet is reported to be a risk factor for metaflammation. Western-style diet; it is characterized by a diet rich in sugar, trans and saturated fats, whereas poor in complex carbohydrates, fiber, micronutrients, polyphenols and omega-3 unsaturated fatty acids. The mechanisms underlying metaflammation caused by the western-style diet are still under investigation. A related mechanism is the increased ingress of lipopolysaccharide from microorganisms into the intestine due to increased intestinal permeability. With some mechanisms activated by lipopolysaccharides, inflammatory responses develop by immune cells (Childs,

2019). One of the diseases that obesity is sensitive to is influenza. Obesity is a risk factor in the development of influenza. It has been associated with long stay and high mortality rates in health care units. In addition to being sensitive to influenza, obese people are reported to be at higher risk for developing complications such as sepsis and pneumonia (Alwarawrah, 2018). Unlike the western-style diet, the Mediterranean diet, which includes a diet rich in vegetables, fruits, nuts, legumes, and fish, is defined as a healthy diet. A number of bioactive compounds found in fruits and vegetables have been reported to protect against chronic inflammatory diseases (Childs, 2019).

4. Exercise and Sport

It is known that exercise affects the immune system by causing changes in blood circulation, leukocytes, cytokines, red blood cells, and similar parameters. The immune response varies according to the duration and severity of the exercise and adaptation of an individual (Şenışık, 2015). Light and moderate regular exercise for up to 45 minutes have been found to reduce the risk of cardiovascular and metabolic disease by increasing the activity of natural killer cells, which act as protective agents in the body, dendritic cells, neutrophils and other leukocytes (Simson, 2020). Long-term intense exercise has been shown to suppress immunity by increasing the levels of cytokines. It has been reported that individuals with intense physical activity above the recommended time and intensity, such as high-performance athletes and military personnel, are more susceptible to infections (Simpson, 2020).



Figure 4. Exercise and Sport

5. Regular Life and Sleep

Sleep is an essential process for the individual to maintain body homeostasis. The immune system and sleep are indirectly related. Sleep has been found to positively affect the function of the immune system by causing changes on the hypothalamus-pituitary-adrenal axis and sympathetic nervous system. Sleep patterns, duration, and intensity of sleep have an effect on the body's defense system. As a result of impaired sleep patterns, it has been suggested that increased release of harmful cytokines such as C-reactive protein, IL-6, and tumor necrosis factor (TNF) may increase the risk of metabolic diseases (Nicholson, 2016).

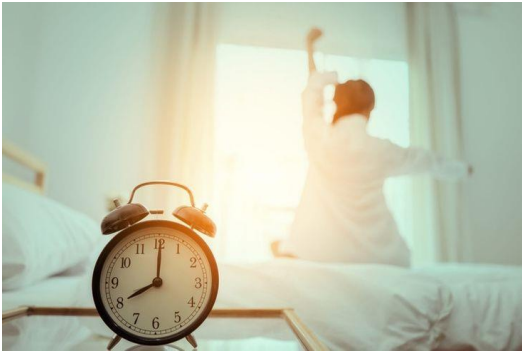


Figure 5. Regular Life and Sleep

6. Environmental Factors

It is known that the immune system is affected by various external factors. Air pollution affects autoimmunity. The risk of morbidity and mortality is higher in diabetic patients exposed to air pollution (Schraufnagel, 2019). Another external factor, endocrine disruptor pesticides, has been found to interact with various receptors, alter the intestinal microbiome, or induce oxidative stress through circadian disruption, leading to impairments in the immune system.

7. Smoking, Alcohol and Addictive Drugs

Harmful habits such as consuming alcohol, smoking, and drugs have been found to increase the susceptibility to infections by suppressing immune response and phagocytosis (Karavitis, 2011). Alcohol, drugs, and smoking can have detrimental effects on the immune system. alcohol consumption can weaken the immune system by impairing the function of immune cells, making it harder for the body to fight off infections and diseases. Drug abuse, especially with substances like opioids or methamphetamines, can also suppress the immune system, making individuals more vulnerable to infections and illnesses. Smoking, whether it's cigarettes or other forms of tobacco, is known to have a negative impact on the immune system. It damages the respiratory system, making it easier for infections to take hold, and reduces the effectiveness of immune responses (Barr, 2016).

8. Psychological State

Stress is indirectly effective in suppressing immunity. Stress is one of the environmental factors that cause neuron degeneration. Stress is when we feel overwhelmed or under pressure, and it can affect our immune system. When we're stressed, our body releases stress hormones that can suppress the immune system's response (Nocilaidis, 2015). This makes us more susceptible to infections and can slow down the healing process. Chronic stress can have a profound negative impact on health. Prolonged exposure to stress hormones can weaken the immune system, increase the risk of mental health disorders, and contribute to conditions like heart disease and hypertension. All of these play an important role in the immune system (Haloui, 2016).



Figure 6. Psychological State

9. Conclusion

The immune system is affected by many factors. Taking adequate macro and micronutrients with an adequate and balanced diet ensures that the immune system functions properly. As a result of researches, it has been shown that malnutrition and obesity caused by overnutrition suppress the immune system. In addition, it has been shown that some plants' leaves and seeds can support the immune system with the phytochemicals they contain. As a result of fasting in Ramadan, changes occur in the state of hunger and sleep patterns. These changes emerging with fasting have been shown to be effective in reorganizing the circadian rhythm associated with immunity and reducing inflammation-related cytokine levels. It has been demonstrated that moderate intensive regular exercise, regular life, and good quality of sleep indirectly support immunity by affecting various physiological mechanisms. On the other hand, it has been proven that past diseases, air pollution, radiation, various synthetic compounds, and similar external factors, stress, harmful habits such as alcohol consumption, smoking, and drug usage disrupt the immune system by compromising the cytokine balance. An important relationship has been found between genetic differences and immunity. Genetic variations and gender differences in individuals can lead to positive or negative changes in the immune response. When all the factors regulating the immune system are considered, improvement of internal and external factors, especially lifestyle, can ensure the proper functioning of the immune system and play an effective role in protection and treatment against diseases.

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