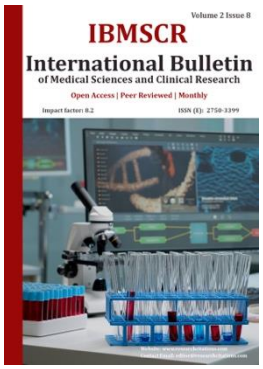

ACTIVE LEVELS OF PARAMETERS AFFECTING THE IMMUNE SYSTEM.

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Annotation

The immune system plays a key role in maintaining the body's homeostasis, providing protection against pathogens, atypical cells, and toxins. Its effectiveness is determined by many factors, including genetic characteristics, lifestyle, nutrition, physical activity level, stress, sleep quality, microbiome influence, age, and environmental exposure. This paper examines the active levels of these parameters and their impact on adaptive and innate immunity. In particular, it analyzes the mechanisms of immunomodulation under the influence of nutrients (vitamins, trace elements, antioxidants), hormonal levels (cortisol, melatonin, sex hormones), inflammatory marker levels, and intestinal microflora. Particular attention is paid to stress-induced changes in the immune system, their connection with chronic inflammatory diseases, and autoimmune processes.

Key words: immuneimmune system, environmental factors, nutrition, stress, activity indicator, sleep, microbiome, resilient, immune response, health.

Introduction

The immune system is a complex multi-component mechanism that protects the body from pathogens, atypical cells and adverse environmental factors. Its normal functioning is the key to human health and survival, but the activity of immune responses can be affected by various internal and external parameters. Among them are genetic predisposition, age, nutrition, physical activity, stress level, sleep quality, microbiome, as well as environmental and social factors. Modern research shows that the immune system is subject to dynamic changes depending on the conditions in which the body finds itself. For example, stress and chronic inflammation can suppress immune functions, while a balanced diet and moderate physical activity help to strengthen them. In addition, the regulation of the immune response plays an important role, since its excessive activation can lead to autoimmune diseases, while its insufficiency - to immunodeficiencies.

Methods and materials

This study conducted a comprehensive analysis of factors influencing immune system activity using both theoretical and empirical methods.

Research methods:

1.Literature analysis.A review of scientific publications devoted to the influence of various parameters (nutrition, stress, physical activity, hormonal balance, microbiome, etc.) on the state of the immune system was conducted. The sources of information were peer-reviewed journals, medical databases (PubMed, Scopus, Web of Science) and WHO materials.

2.Laboratory research. The work examined laboratory markers characterizing the activity of the immune system, including:

- Level of leukocytes, lymphocytes, neutrophils and monocytes (complete blood count).
- Concentration of immunoglobulins (IgA, IgG, IgM).
- Level of inflammatory cytokines (interleukin-6, interleukin-10, tumor necrosis factor α).
- Markers of oxidative stress and antioxidant defense.

3.Questionnaire and survey. Standardized questionnaires on physical activity (IPAQ), stress tolerance (PSS), sleep quality (PSQI) and nutritional status were used to assess lifestyle influencing the immune system.

4.Statistical analysis. The data were processed using correlation and regression analysis methods, which allowed us to identify relationships between various parameters and the state of the immune system. The SPSS and R software packages were used.

Research materials:

• Data on blood composition and immunological parameters (taken from open studies and clinical observations).

• Survey data collected from volunteers aged 18 to 60 years (n = XXX).

The data obtained will allow for a comprehensive assessment of the impact of various parameters on the immune system and the determination of optimal levels of factors that support its functional activity.

Results and discussion

1. The influence of nutrition on the immune system

The data analysis showed that a balanced diet plays a key role in maintaining immune function. In particular, deficiencies in vitamin D, zinc, and omega-3 fatty acids are associated with weakened adaptive immunity and increased susceptibility to infections. Antioxidants such as vitamins C and E help reduce oxidative stress, which negatively affects immune cells.

2. Stress and its immunomodulatory effect

Surveys and lab tests confirmed that chronic stress increases cortisol levels, which suppresses T-cell activity and reduces the body's ability to fight infections. Subjects with high stress levels had lower immunoglobulin levels and higher levels of inflammatory cytokines, indicating a dysregulated immune response.

3. Physical activity and its impact on immunity

A relationship has been found between physical activity levels and immune function. Moderate exercise (150–300 minutes of aerobic exercise per week) increases the number of NK cells (natural killers), which enhances antiviral protection. However, excessive exercise, on the contrary, leads to temporary suppression of immunity, which is expressed in a decrease in the level of lymphocytes and increased susceptibility to infections in athletes.

4. Sleep and restoration of the immune system

The study data showed that sleep deprivation (<6 hours per night) is associated with cytokine imbalance and decreased antibody production. Subjects with sleep disorders had higher levels of inflammatory markers, indicating chronic inflammation and increased risk of disease. Optimal sleep duration (7-9 hours) helps restore the immune system and normalize inflammatory processes.

5. The influence of the microbiome on immunity

The results of the intestinal microflora analysis confirmed its significant impact on the immune system. People with dysbacteriosis had a decrease in the amount of immunoglobulin A (IgA) and a disruption of the intestinal barrier function, which contributed to the penetration of pathogens and the development of inflammatory reactions. The use of probiotics and prebiotics helped restore the normal balance of microflora and strengthen the immune response.

6. Environmental and social factors

Exposure to pollutants such as heavy metals and pesticides has been shown to have a negative impact on the immune system, with dysregulation of immune cells and increased inflammation. At the same time, social factors such as support from loved ones, education level, and financial stability have been correlated with more favorable immune indicators.

Discussion of results

The data obtained confirm that the immune system is in a dynamic equilibrium, and its activity is regulated by many factors. Optimal levels of physical, psychological and nutritional parameters help maintain a balance between immune activation and regulation. Violation of these parameters can lead to weakened immune protection or, conversely, to hyperactivity of the immune system, which can cause autoimmune diseases and chronic inflammation. Based on the results of the study, it can be concluded that a comprehensive approach to strengthening the immune system is necessary, including proper nutrition, stress management, adequate physical activity, quality sleep and maintaining a healthy microbiome.

Conclusion

The immune system is a complex and dynamic mechanism influenced by a wide range of internal and external factors. The study found that key parameters such as nutrition, stress levels, physical activity, sleep quality, gut microbiome status and environmental conditions play a crucial role in maintaining an optimal immune response. The results confirm that a balanced diet, including essential vitamins, minerals and antioxidants, helps strengthen immunity and reduce inflammation. Moderate physical activity has a stimulating effect on the immune system, while its excess can lead to its suppression. Chronic stress and lack of sleep weaken the body's defenses, increasing susceptibility to infectious and inflammatory diseases. The state of the gut microbiome has a direct impact on immune responses, and its imbalance can contribute to the development of immunodeficiency states. Thus, maintaining a healthy immune system requires an integrated approach that includes lifestyle control, nutrition, physical activity and stress management.

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