

THE RELATIONSHIP BETWEEN STRESS AND THE HUMAN IMMUNE SYSTEM

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Abstract

This article scientifically analyzes the effect of stress on the human body, in particular on the functioning of the immune system. The article discusses psychological and physiological stress factors, their mechanisms of influence on the immune response through the hormonal system. Studies show that long-term or severe stress reduces the activity of immune cells, making the body vulnerable to infectious and chronic diseases. At the same time, it is proven that maintaining a positive psychological state, managing stress, and leading a healthy lifestyle are important factors in strengthening immunity.

Keywords: Stress, immune system, stress and immunity, psychological stress, physiological stress response, hormones, cortisol, adrenaline, immune response, the impact of stress on health, psychosomatics, stress management, neuroimmunology, homeostasis, lymphocytes, chronic stress, oxidative stress, psychoneuroimmunology, meditation, relaxation, stress reduction methods, physical activity.

Introduction

Stress is a psychological strain that occurs in difficult, difficult or complex conditions. The causes of stress are as follows: the type and content of the activity in which a person is engaged, the existing conditions, the organizational part of the activity and extreme factors, as well as the external environment demanding more than a person has. For example, increased demand in service activities is also a strong stressor. The causes of stress are explained in different ways from a scientific point of view. In particular, the most popular view is G. Selye's stress theory. According to him, all biological creatures in the world have an important mechanism - a device that ensures balance. Strong and prolonged exposure to internal and external stressors leads to a disruption of balance. The organism in this situation manifests its high level of defense - adaptation reaction. With the help of arousal, the organism tries to adapt to external influences. It is this influence that is considered a state of stress. If the influence does not disappear, stress intensifies, develops and leads to a number of changes in the organism. The concept of "stress diseases" is incorrect, it would be more correct to say "distress diseases", said G. Selye. G. Selye divided stress into 3 main stages:

Stage 1 - the stage of anxiety. ABP and body temperature decrease, capillaries fill with blood, blood sugar decreases, alkalosis is observed, functional changes occur in the gastrointestinal system.



Stage 2 - the stage of resistance. Alkalosis alternates with acidosis, hypoglycemia with hyperglycemia, arterial hypotension with hypertension, body temperature rises and the adrenal cortex swells, corticosteroids are released in large quantities.

Stage 3 - the stage of exhaustion. Dystrophic changes are observed in the heart muscle, ulcers appear in the gastrointestinal system, they are punctately blood-filled.

The persistence and duration of anxiety causes the following conditions in human behavior:

- appetite disturbance;
- insomnia;
- sluggishness in behavior.

Main Part

There are physiological, psychological, personal and medical signs of stress, any of which is always accompanied by emotional arousal. Experts distinguish the signs of a stress state as follows:

- physiological signs: increased heart rate and breathing, flushing or pallor of the skin of the face, sweating, increased adrenaline in the blood;
- psychological signs: changes in the dynamics of psychological functions, slowing down of thinking, difficulty in dividing attention, memory impairment, slowing down of the decision-making process;
- personal signs: complete loss of will, decreased self-control, stereotyped and sluggish behavior, fear, anxiety, causeless anxiety, loss of creative abilities;
- medical signs: increased neurosis, fainting, affect, headache, insomnia.

Stress was originally used as a physiological term, denoting a non-specific reaction of the organism to any unpleasant influences ("general adaptation syndrome") (G. Selye). Later, this word was used to explain the physiological, biochemical, psychological states and behavior of an individual in extreme situations.

Stress is used in the sense of relating to the subjective reaction of a person. In this case, it expresses a person's internal mental arousal and tension; this state is also interpreted in the sense of emotions, protective reactions and elimination of stressogenic influences (coping processes) that occur in a person. These processes can lead to the improvement and development of a functional system, as well as to the occurrence of mental tension.

Stress can be a physiological reaction of the organism to manifest demands or harmful influences. It is in this sense that G. Selye and W. Cannon used the term "stress". The task of the physiological reaction is precisely to "help mental processes and behavioral actions to eliminate the state of stress".

The study of the manifestation of stress, its impact on health and activity indicates that any person experiences this state several times during his life. As N.Kh. Rizvi put it, "... stress is everywhere, it is a shadow of life, someone likes it and uses it to achieve the desired result, while someone does not like it and his body reacts to stress in the right way". In addition, it is necessary to emphasize once again the ambiguity of the term stress due to the infinite number of life events and individual (specific) characteristics of a person.



There are several types of stress, including:

- acute stress
- episodic acute stress
- chronic stress

Acute Stress

Everyone has experienced acute stress. It is the body's rapid response to a new and challenging situation. It is the type of stress that can be experienced while escaping from an accident. Such episodes of acute stress usually do not cause any harm. They can even prove to be beneficial for a person under certain circumstances. Stressful situations provide the body and brain with practice in how to best respond to future stressful scenarios. It is important to know that severe acute stress is completely different. This stress, like a life-threatening situation, can lead to post-traumatic stress disorder or other mental health problems.

Episodic Acute Stress

Episodic acute stress is when episodes of acute stress occur frequently. This can occur if a person is frequently anxious and worried about things they think might happen soon. As with severe acute stress, episodic acute stress can also affect a person's physical and mental health.

Chronic stress

If a person experiences high levels of stress over a long period of time, they have chronic stress. Long-term stress can have a negative impact on a person's health. It can contribute to:

- anxiety
- cardiovascular disease
- depression
- high blood pressure
- weakened immunity

Chronic stress can also lead to common ailments such as headaches, indigestion, and difficulty sleeping.

Psychological stress is one of the most pressing problems of our time. To understand the physiological mechanism of stress, it is important to note that the sympathetic nervous system and the endocrine system play a major role. In situations of danger or stress, the brain, particularly the hypothalamus, are activated and "command" the adrenal glands to produce catecholamine hormones (adrenaline and noradrenaline). These hormones increase the heart rate, increase blood pressure, tone muscles, and stimulate the immediate release of energy sources such as glucose. In short-term stressful situations, such reactions are important for saving human life. However, when stress becomes chronic or is constantly repeated, an excessive increase in adrenaline, cortisol, and other hormones in the body creates the basis for the development of various diseases. In particular, such negative consequences as problems with the cardiovascular system, decreased immunity, diabetes, obesity, gastrointestinal diseases, and even an increased risk of cancer are observed. Acute physiological adjustments noted during laboratory problem-solving or psychomotor tasks include: increased heart rate and blood pressure; changes in cardiac output and peripheral vascular resistance; increased muscle tension and electrodermal (sweat gland) activity; impaired respiratory rhythm; and changes in gastrointestinal activity and immune function. The best-studied neurohormonal reactions are



catecholamines (adrenaline and noradrenaline) and cortisol. Noradrenaline is the main transmitter released by the nerves of the sympathetic branch of the autonomic nervous system. Adrenaline is released from the adrenal medulla after stimulation of the sympathetic nervous system, while activation of the pituitary gland by higher brain centers leads to the release of cortisol from the adrenal cortex. These hormones support autonomic activation during stress and are responsible for other acute changes, such as stimulation of processes that control blood clotting and the release of stored energy from adipose tissue. It is likely that such responses can also be observed during occupational stress, but studies in which work conditions are simulated or people are tested in their usual work are required to demonstrate such effects.

The immune system is a network of biological processes that protect the body from disease. It recognizes and responds to a variety of pathogens, from viruses to parasitic worms, to cancer cells and even wood shavings, and distinguishes them from healthy body tissues. In most biological species, the immune system consists of two main subgroups. The innate immune system provides protection through pre-formed immune responses to a variety of situations and stimuli. The adaptive immune system responds to each subsequent stimulus by readily recognizing molecules it has encountered before. Both systems use molecules and cells to perform their functions. Stress also affects the functioning of the immune system. During times of stress, the immune system becomes significantly weakened, leaving it open to parasites and disease-causing microorganisms.

Psychoneuroimmunology (PNI) is a branch of medicine that studies the functional interactions of the human nervous system and psyche with various parts of the immune system.

The founders of this scientific direction are Robert Ader, David Felten, and Nicholas Cohen.

Psychoneuroimmunology is a multidisciplinary (interdisciplinary) science that is closely related to the following areas: psychology, neurology, immunology, physiology, pharmacology, molecular biology, psychiatry, infectious disease science, endocrinology, rheumatology, and neurochemistry.

The revolution in medical science that Robert Ader initiated was the result of an accidental discovery. This happened in the early 1970s, when he and Nicholas Cohen were studying the taste aversion response. The researchers gave rats a saccharin solution and simultaneously injected them with an immunosuppressive drug called cyclophosphamide. This drug causes gastrointestinal upset. During the experiment, as expected, the rats learned to abhor the sweet solution—that is, they began to conditionally refrain from consuming it. To complete the experimental protocol, Ader and Cohen forced the rats to drink the saccharin solution using a pipette. It was at this stage that an unexpected phenomenon occurred: Ader and Cohen found that some of the rats that had been forcibly given saccharin later died. Also, the level of aversion and mortality in the rats was directly proportional to the volume of the solution ingested. Ader explained this in a 2010 interview:

“The hypothesis that seemed logical to me was that we had not only conditioned the disgust reflex, but also conditioned the immunosuppressive effects of cyclophosphamide.”

In other words, the sweet taste of saccharin itself triggered an immune-suppressing response in the rats through the nervous system—just as if they had taken an overdose of the drug.

Ader and Cohen later confirmed this hypothesis in a controlled experiment. They showed that behavioral conditioning can suppress immune responses—specifically, immune responses



measured by antibody concentrations. In doing so, they scientifically demonstrated a direct link between the brain and the immune system.

Conclusion

Thus, stress management, a healthy lifestyle, physical activity, adequate sleep, and psychological stability are important factors in supporting the normal functioning of the immune system. By reducing stress factors, it is possible to strengthen not only mental but also physical health. While the physiological side of stress is associated with hormonal changes, increased heart rate, increased blood pressure, and metabolic activity, the psychological side is accompanied by emotional tension, anxiety, and depression. In cases of short-term (acute) stress, the body's defense mechanisms are activated and the immune response can be temporarily enhanced. However, in cases of long-term (chronic) stress, the constant high levels of cortisol and other stress hormones suppress the activity of lymphocytes, increase inflammatory processes, and as a result, the body becomes vulnerable to infectious and chronic diseases.

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