

PSYCHO-BIOLOGICAL DETERMINANTS OF STRESS: NEUROENDOCRINE MECHANISMS, COGNITIVE ADAPTATION, AND PATHOGENESIS

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Abstract: This article examines the phenomenon of stress using a comprehensive approach in modern medicine and psychology. It highlights the functional interrelationship between biological (physiological) and psychological (emotional) components of stress. Special attention is given to the activity of the hypothalamic-pituitary-adrenal axis and the influence of cognitive appraisal processes on somatic health. The study systematically reviews scientific concepts ranging from Hans Selye's theory of the general adaptation syndrome to the cognitive-transactional model developed by Richard Lazarus. Neuroendocrine mechanisms of stress, including cortisol and catecholamine secretion, their role in cardiovascular pathology and oncogenesis, as well as the effects of occupational and examination stress on immune and genetic systems, are analyzed. Furthermore, the role of individual nervous system characteristics in determining stress resilience is discussed.

Keywords: Hans Selye's theory, hypothalamic-pituitary system, cortisol, catecholamines, occupational stress, examination stress, psychosomatics, cognitive appraisal.

Introduction

In recent decades, the increasing impact of stress factors on nearly all areas of human activity has positioned stress as a critical scientific problem at the intersection of medicine, biology, and psychology. In the mid-20th century, Hans Selye's stress theory conceptualized stress as a nonspecific adaptive response of the organism to intense stimuli. Contemporary research, however, indicates that a unified terminological approach to stress has not yet been established. Some authors consider stress primarily as a physiological reaction, while others view it as a psychological state or as a process related to external environmental demands. The biological function of stress is to mobilize the organism's adaptive capacities in the short term, whereas prolonged and uncontrolled stress contributes to the development of somatic diseases, including cardiovascular and oncological pathologies. The aim of this study is to synthesize existing literature into an integrated scientific model of stress, focusing on neuroendocrine mechanisms, adaptive stages, and psychophysiological consequences.

Materials and Methods

The study employs theoretical generalization and comparative analysis. Selected materials include fundamental and clinical research on the etiology, pathogenesis, and psychological aspects of stress. Functional links between biological stress markers (hormones and neurotransmitters) and psychological

indicators (anxiety levels, cognitive activity) were analyzed. The effects of stress on organismal homeostasis were evaluated using a systematic approach based on clinical and experimental data.

Results and Discussion

Neuroendocrine Regulation and Hormonal Cascade

The physiological basis of the stress response relies on complex interactions between the central nervous system and the endocrine system. Under stress, the hypothalamus activates, increasing the synthesis of corticotropin-releasing hormone (CRH). CRH stimulates the anterior pituitary to secrete adrenocorticotropic hormone (ACTH), which triggers cortisol and catecholamine release from the adrenal glands. This hormonal cascade forms the physiological foundation of the “fight or flight” response. Adrenaline elevates heart rate, dilates bronchi, and increases blood pressure, while cortisol activates gluconeogenesis to enhance energy supply. Chronic elevated cortisol, however, suppresses immune function, reducing resistance to infections and tumor cells.

Physiological Stages of Stress

According to Selye, the stress response develops in three main stages:

1. **Alarm stage** – characterized by rapid mobilization of resources.
 2. **Resistance stage** – hormonal regulation stabilizes, and adaptive mechanisms predominate.
 3. **Exhaustion stage** – depletion of adaptive resources and development of maladaptive processes.
- Pathophysiological Consequences

Prolonged stress induces structural and functional disturbances in the cardiovascular system. Stress increases lipid peroxidation, which damages cardiomyocyte membranes and contributes to pathological changes in cardiac muscle.

Psychological and Emotional Aspects

Stress as a psychological process is closely linked to an individual’s subjective appraisal of situations. According to Lazarus, the level of emotional stress depends on the cognitive assessment of controllability. Perceived lack of control reduces motivation and can intensify depressive reactions.

Individual Differences and Occupational Stress

Stress resilience depends on individual typological characteristics. Variations in autonomic nervous system tone influence individual stress responses. Occupational and academic stress in modern society can induce significant changes in both immune and genetic systems.

Conclusion

1. Stress is a systemic response encompassing the entire organism, regulated through neuroendocrine mechanisms.
2. Psychological factors modulate biological processes and play a critical role in the pathogenesis of psychosomatic diseases.
3. Stress affects the cellular and genetic level, activating DNA repair mechanisms.
4. Individualized approaches are essential for effective stress management.

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