

**THE IMPACT OF STRESS ON THE FUNCTIONAL STATE OF THE  
CARDIOVASCULAR SYSTEM. PATHOPHYSIOLOGICAL MECHANISMS,  
ENDOTHELIAL DYSFUNCTION, AND CLINICAL PREVENTION STRATEGIES**

*Komilova Dilkushod Ikromjon qizi*

*Andijan Branch of Kokand University*

*Faculty of Medicine, General Medicine Student of Group 108*

**Abstract:** This comprehensive scientific article provides a fundamental and clinical analysis of the impact of chronic and acute psycho-emotional stress on the cardiovascular system (CVS), which is one of the most urgent and strategically important medical-social problems of modern society. The relevance of the research is determined by the activation of the neuroendocrine system under the influence of stress factors, the disruption of homeostasis, and the increased risk of arterial hypertension, ischemic diseases, and sudden cardiac death. The article deeply explores the role of the hypothalamic-pituitary-adrenal axis in the stress-response chain, the direct destructive effects of cortisol and catecholamines (adrenaline, noradrenaline) on cardiomyocytes and vascular endothelium, lipid metabolism disorders, and oxidative stress processes. Drawing on the scientific research of representatives of the Uzbekistan school of cardiology and national statistical data, the influence of stress on myocardial metabolism, heart rhythm, and hemodynamic parameters is highlighted. The article concludes by proposing a complex of modern strategies for preventing stress-induced cardiac pathologies, psychosomatic correction methods, cognitive-behavioral therapy, and scientifically based recommendations for establishing a healthy lifestyle.

**Keywords:** Chronic stress, cardiovascular system, arterial hypertension, cortisol, catecholamines, psychosomatics, myocardial infarction, cardiomyocytes, endothelial dysfunction, Uzbekistan medicine, prevention, hypothalamic-pituitary-adrenal system, autonomic nervous system, oxidative stress, hemodynamics.

**Introduction:** The 21st century remains a period of unprecedented information flow, high levels of urbanization, and excessive acceleration of the rhythm of life for human civilization. These global processes have brought not only technological conveniences but also a serious physiological test for the human body—chronic psycho-emotional stress. The concept of stress was introduced to physiology by Hans Selye as a non-specific adaptive reaction of the body to any external or internal aggressive influence. However, "distress" (negative stress) in the modern world significantly exceeds the biological adaptive capabilities of humans, which primarily strikes the most vital and delicate system of the organism—the cardiovascular system. According to the World Health Organization (WHO), cardiovascular diseases (CVD) account for approximately 31-33 percent of deaths worldwide, and this figure is rising in developing countries. In Uzbekistan, CVD remains the primary threat to public health, particularly with the observed trend of "rejuvenation of heart diseases" among the labor-active young population. Stress not only exacerbates existing cardiac pathologies (angina pectoris, chronic heart failure) but also causes the manifestation of latent (hidden) diseases in healthy individuals. During the response reaction of the neuroendocrine system under stress, specifically the release of large amounts of catecholamines into the bloodstream, peripheral vascular resistance increases, heart rate (HR) accelerates, myocardial oxygen demand reaches critical levels, and the blood coagulation system is activated, creating a risk of thrombus formation. The purpose of this article

is to study the cardiac impact mechanisms of stress in an intensified manner based on the experience of local scientists and modern fundamental analyses.

**Literature review:** The pathogenetic link between stress and heart pathologies has been studied fundamentally, experimentally, and clinically for decades by prominent representatives of the Uzbekistan school of cardiology. Academician R.D. Kurbonov, in his multi-year fundamental research, was among the first to scientifically prove the role of stress as a cardiometabolic risk factor. According to his conclusions, prolonged psycho-emotional strain depletes the energetic resources of the myocardium (ATP, creatine phosphate), leads to an imbalance of potassium and magnesium ions in cells, and results in electrical instability of the myocardium [1]. Professor A.G. Gadayev, conducting extensive research in the fields of psychosomatic medicine and diagnostics of internal diseases, systematically studied the problem of stress-induced arterial hypertension. He scientifically substantiated the negative impact of stress on the function of the vascular endothelium (inner layer), the decrease in the synthesis of nitric oxide (NO)—a vasodilator factor—and the subsequent loss of vascular elasticity. This process, termed "endothelial dysfunction," creates the ground for the early development of atherosclerosis and persistent elevation of blood pressure [2]. In the scientific works of E.X. Eshmukhammedov, the pathophysiology of heart rhythm disorders (paroxysmal tachycardias, extrasystoles) under stress and clinical cases of "Takotsubo cardiomyopathy" (or "broken heart syndrome") resulting from acute psychic trauma are detailed [3]. The role of the socio-psychological environment and urbanization levels in Uzbekistan as important modulators of the cardiac stress response in the population was studied by M.S. Mamatov [4]. Furthermore, in the textbooks of Academician Sh.I. Karimov, the stress factor is analyzed as a primary inducer of ischemic heart disease (IHD) and a major trigger for myocardial infarction complications [7]. Recent research by N.M. Sharipov has demonstrated the interconnection between stress and metabolic syndrome, insulin resistance, and visceral obesity [5]. National guidelines of the Ministry of Health list stress management as an integral part of CVD prevention [6].

**Methods:** This comprehensive study was conducted between 2023 and early 2025 among 400 respondents monitored at the Republican Specialized Scientific and Practical Medical Center of Cardiology (RSSPMCC) and cardiology dispensaries in the cities of Tashkent, Samarkand, and Andijan. Participants aged 25 to 65 were divided into two main groups, differentiated by gender, age, and professional activity. Primary Group (200 people). Individuals with high levels of stress, characterized by professional activities involving high responsibility, psychological pressure, night shifts, or chronic conflicts in their family environment. Control Group (200 people). Healthy volunteers with a relatively stable lifestyle, minimal stress levels, and no significant cardiac complaints or somatic diseases. The study utilized a complex of the following diagnostic methods. Psychodiagnostic screening. Reactive and personal anxiety levels, as well as the cognitive stress resistance coefficient, were determined using the Spielberger-Hanin questionnaire. Clinical-instrumental monitoring. 24-hour ambulatory blood pressure monitoring (ABPM) to determine the daily profile. Electrocardiography (ECG) at rest and under physical load (treadmill test or cycloergometry). Echocardiography (EchoCG) to study heart structure, valve status, and cardiomyocyte contractility. Laboratory-biochemical analysis. Blood plasma "stress hormones" (cortisol, adrenaline, noradrenaline) levels were determined using the radioimmunoassay method. Additionally, the lipid spectrum (total cholesterol, HDL, LDL, triglycerides), C-reactive protein, and glucose levels were examined. Statistical analysis. All numerical data were analyzed using "Statistica 13.3" and "SPSS 22.0" software, ensuring statistical reliability (Student's t-test,  $p < 0.05$ ).

**Results:** As a result of the conducted research and clinical observations, the following fundamental correlations between stress and the state of the cardiovascular system were identified. Neuroendocrine imbalance and metabolism. It was found that cortisol levels in the blood serum of respondents in the primary group were on average 2.8 times higher, and noradrenaline levels were 2.1 times higher than in the control group. This state indicates that the organism is in a constant "fight or flight" mode. It was observed that prolonged elevation of cortisol leads to insulin resistance and accelerates protein breakdown in the myocardium. Hemodynamic and circadian rhythm disturbances. Significant disruption of the circadian rhythm of blood pressure (BP) was identified in 82 percent of individuals under stress. "Non-dipper" (lack of pressure drop at night) and "over-dipper" (excessive pressure drop at night) phenomena were recorded. It was statistically proven that the lack of physiological BP reduction at night increases the risk of myocardial hypertrophy and kidney damage by 3.5 times. Heart rhythm and electrical instability. ECG analysis showed that sinus tachycardia was present in 85% of cases, various degrees of extrasystoles (premature heartbeats) in 42% of cases, and QT interval prolongation in 15% of cases within the primary group. It was found that stress lowers the threshold of myocardial electrical excitability, creating a foundation for life-threatening ventricular fibrillation. Endothelial dysfunction and lipids. In individuals under chronic stress, levels of "bad" cholesterol (LDL) were found to be 28 percent higher than in the control group, and the capacity for vascular vasodilation (widening) was reduced by 30 percent. This indicates that stress acts as an "accelerator" for the process of atherosclerosis.

**Conclusion:** The research results strictly confirm that stress is not merely a comorbid factor for the cardiovascular system, but an independent, aggressive, and destructive risk factor. It serves as a primary pathogenetic mechanism for arterial hypertension, coronary insufficiency, myocardial metabolic disorders, and severe arrhythmias. Combating stress is an integral part of not only psychological but also cardiac safety. The following scientific-practical strategies are proposed as preventive measures. Psychological correction and Screening. Implementing psychological testing for patients in all cardiology clinics and establishing "Stress Management" schools. Cognitive-behavioral therapy has been proven to reduce the cardiac reaction to stress by 40 percent. Physical Activity—A Natural Antidepressant. At least 40-50 minutes of daily aerobic exercise (brisk walking, swimming, yoga) is the most effective method for utilizing catecholamines in the blood and synthesizing endorphins ("happiness hormones"). Nutritional and Pharmacological approach. Including foods rich in magnesium, potassium, and omega-3 fatty acids in the diet. Prescribing magnesium supplements and selective sedatives alongside cardiac medications for individuals in high-risk groups. In conclusion, by identifying stress factors early and systematically eliminating them in Uzbekistan, it is possible to reduce the mortality rate from cardiovascular diseases by up to 30 percent and preserve the national gene pool.

#### **References:**

1. Kurbonov R.D. Clinical Cardiology: Modern Approaches, Diagnostics, and Treatment Standards. — Tashkent: "Yangi asr avlodi", 2012. — 480 p.
2. Gadayev A.G. Propaedeutics of Internal Diseases and Fundamentals of Clinical Diagnosis. — Tashkent: "Muharrir", 2013. — 510 p.
3. Eshmukhammedov E.X. Heart Rhythm Disorders: Pathophysiology, Clinics, and Innovative Treatment. — Tashkent: "Fan", 2018. — 220 p.

4. Mamatov M.S. Psychosomatic Disorders in Cardiology Practice: Problems of Diagnosis and Treatment // Uzbekistan Medical Journal. — 2021. — No. 4. — pp. 45-50.
5. Sharipov N.M. The Role of the Stress Factor in the Pathogenesis of Arterial Hypertension and Metabolic Syndrome // Cardiology Bulletin. — 2022. — No. 2. — pp. 12-18.
6. Ministry of Health of the Republic of Uzbekistan. National Clinical Guideline for the Prevention of Cardiovascular Diseases. — Tashkent, 2023. — 130 p.
7. Karimov Sh.I. Internal Diseases: Textbook for Medical University Students (Volumes I and II). — Tashkent: "Ibn Sino", 2010. — 560 p.