

## Impact of Acupressure on Stress Hormones and Physiological Markers

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### Abstract

Stress is a physiological and psychological response to internal or external challenges, characterized by activation of the hypothalamic–pituitary–adrenal (HPA) axis and the autonomic nervous system. Persistent stress can elevate circulating cortisol, increase catecholamine release, raise blood pressure and heart rate, and disrupt immune and metabolic function. While pharmacological and behavioral therapies are commonly used to manage stress-related conditions, complementary approaches such as acupressure have gained increasing attention for their potential regulatory effects on stress hormones and physiological parameters. Acupressure is a non-invasive technique involving the application of manual pressure to specific acupoints associated with neuromodulatory and autonomic regulation. This study examines the impact of acupressure on stress-related biomarkers, including cortisol, adrenocorticotropic hormone (ACTH), heart rate variability (HRV), blood pressure, and salivary alpha-amylase. Evidence from clinical and experimental studies suggests that acupressure may reduce cortisol levels, enhance parasympathetic nervous system activity, stabilize cardiovascular parameters, and promote overall physiological relaxation.

**Keywords:** Acupressure; Stress Hormones; Cortisol; Hypothalamic–Pituitary–Adrenal (HPA) Axis

### Introduction

Stress is a natural adaptive response that enables the body to cope with physical and psychological challenges. In acute situations, activation of stress pathways enhances alertness, mobilizes energy reserves, and prepares the body for action. However, when stress becomes chronic, prolonged activation of neuroendocrine systems can negatively affect cardiovascular, immune, metabolic, and psychological health. Persistent stress has been associated with hypertension, anxiety disorders, depression, impaired immunity, and metabolic dysfunction. The physiological stress response is primarily mediated by two major systems: the hypothalamic–pituitary–adrenal (HPA) axis and the autonomic nervous system. Activation of the HPA axis results in the release of corticotropin-releasing hormone (CRH), adrenocorticotropic hormone (ACTH), and ultimately cortisol from the adrenal cortex. Simultaneously, sympathetic nervous system activation increases catecholamine secretion, including adrenaline and noradrenaline, leading to elevated heart rate, blood pressure, and heightened physiological arousal. While these responses are protective in short-term stress, sustained activation can disrupt homeostasis. Measurement of stress-related biomarkers such as cortisol, salivary alpha-amylase, heart rate variability (HRV), and blood pressure provides objective indicators of neuroendocrine and autonomic function. Reduced HRV, elevated cortisol, and persistent sympathetic dominance are commonly observed in individuals experiencing chronic stress. Given the health risks associated with prolonged stress, there is growing interest in non-pharmacological interventions that can restore autonomic balance and

regulate hormonal responses. Acupressure, a non-invasive technique derived from traditional East Asian medicine, involves applying manual pressure to specific acupoints believed to influence systemic regulation. From a biomedical perspective, acupressure may modulate neural pathways, stimulate endorphin release, regulate the HPA axis, and enhance parasympathetic activity. The impact of acupressure on stress hormones and physiological markers is clinically relevant, particularly in settings where safe, accessible, and cost-effective interventions are needed. This study aims to examine the effects of acupressure on neuroendocrine function and objective physiological parameters associated with stress, while evaluating its potential role as a complementary strategy for stress management.

## **Role of the Autonomic Nervous System in Stress**

The autonomic nervous system (ANS) plays a central role in regulating the body's response to stress. It operates largely outside conscious control and maintains internal balance by coordinating cardiovascular, respiratory, gastrointestinal, and endocrine functions. The ANS consists of two primary divisions: the sympathetic nervous system and the parasympathetic nervous system. Stress alters the dynamic balance between these two systems.

### **1. Sympathetic Activation and the “Fight or Flight” Response**

During acute stress, the sympathetic nervous system becomes dominant. This activation prepares the body for immediate action by increasing heart rate, elevating blood pressure, dilating airways, and redirecting blood flow toward skeletal muscles. It also stimulates the adrenal medulla to release catecholamines such as adrenaline and noradrenaline.

These physiological changes enhance alertness and energy availability. While beneficial in short-term challenges, persistent sympathetic activation contributes to hypertension, anxiety, sleep disturbances, and cardiovascular strain.

### **2. Parasympathetic Regulation and Recovery**

The parasympathetic nervous system, primarily mediated by the vagus nerve, promotes rest, digestion, and recovery. It slows heart rate, lowers blood pressure, enhances gastrointestinal activity, and supports restorative processes.

Following a stressful event, parasympathetic activation helps restore physiological equilibrium. Effective stress adaptation depends on the body's ability to shift from sympathetic dominance to parasympathetic recovery.

### **3. Autonomic Imbalance in Chronic Stress**

Chronic stress often results in sustained sympathetic overactivity and reduced parasympathetic tone. This imbalance is associated with decreased heart rate variability (HRV), a measurable indicator of autonomic flexibility. Low HRV reflects diminished vagal modulation and has been linked to increased risk of cardiovascular disease, metabolic disorders, and mood disturbances.

### **4. Interaction with the HPA Axis**

The autonomic nervous system works in coordination with the hypothalamic–pituitary–adrenal (HPA) axis. Sympathetic activation can stimulate cortisol release, while elevated cortisol may further influence autonomic tone. This bidirectional relationship amplifies the physiological impact of prolonged stress exposure.

## 5. Implications for Therapeutic Interventions

Because autonomic imbalance plays a central role in stress-related disorders, interventions that enhance parasympathetic activity and reduce sympathetic dominance are clinically valuable. Techniques such as deep breathing, meditation, biofeedback, and acupuncture are believed to support autonomic regulation.

The autonomic nervous system is a key mediator of the stress response. Acute activation supports survival, but chronic imbalance can contribute to adverse health outcomes. Understanding this regulatory system provides a foundation for evaluating therapeutic approaches aimed at restoring physiological homeostasis.

## Consequences of Chronic Stress on Systemic Health

Chronic stress occurs when the body's stress response remains persistently activated over an extended period. Unlike acute stress, which is adaptive and short-lived, prolonged exposure to stress hormones and sustained autonomic arousal can disrupt homeostasis and negatively affect multiple organ systems. The cumulative physiological burden created by repeated stress activation is often referred to as allostatic load.

### 1. Cardiovascular System

Long-term sympathetic nervous system activation and elevated cortisol levels contribute to increased heart rate, vasoconstriction, and sustained hypertension. Over time, these changes may promote endothelial dysfunction, atherosclerosis, and increased risk of coronary artery disease, myocardial infarction, and stroke. Reduced heart rate variability, commonly observed in chronically stressed individuals, is also associated with heightened cardiovascular risk.

### 2. Neuropsychological Effects

Chronic stress significantly affects brain structure and function. Prolonged exposure to cortisol can impair hippocampal activity, influencing memory and learning. It is also associated with heightened amygdala reactivity, which may contribute to anxiety and mood disorders. Persistent stress has been linked to depression, sleep disturbances, cognitive fatigue, and reduced emotional regulation.

### 3. Immune System Suppression

Sustained cortisol elevation suppresses immune responses by reducing lymphocyte activity and inflammatory regulation. While acute stress may temporarily enhance immune readiness, chronic stress weakens immune defense mechanisms, increasing susceptibility to infections and delaying wound healing. It may also exacerbate autoimmune and inflammatory conditions.

### 4. Metabolic and Endocrine Effects

Chronic stress influences metabolic processes by altering glucose metabolism and promoting insulin resistance. Elevated cortisol can increase abdominal fat deposition and appetite, contributing to obesity and metabolic syndrome. Long-term endocrine disruption may increase the risk of type 2 diabetes and other metabolic disorders.

### 5. Gastrointestinal and Musculoskeletal Impact

Stress-related autonomic imbalance can disturb gastrointestinal motility and secretion, leading to symptoms such as indigestion, irritable bowel syndrome, and appetite changes. Muscle tension associated with prolonged stress may contribute to chronic pain conditions, including tension headaches and back pain.

## 6. Reproductive and Hormonal Disruption

In both men and women, chronic stress can interfere with reproductive hormone balance. It may lead to menstrual irregularities, reduced fertility, decreased libido, and hormonal dysregulation due to interactions between cortisol and gonadal hormones.

Chronic stress exerts widespread systemic effects through persistent activation of the autonomic nervous system and the hypothalamic–pituitary–adrenal axis. The resulting physiological imbalance can compromise cardiovascular, immune, metabolic, neurological, and reproductive health. These extensive consequences underscore the importance of interventions that restore autonomic balance and regulate stress hormones, including complementary approaches such as acupressure.

## Conclusion

Chronic stress is not merely a psychological experience but a systemic physiological condition that affects multiple organ systems through persistent activation of the autonomic nervous system and the hypothalamic–pituitary–adrenal axis. Sustained elevations in cortisol and sympathetic dominance contribute to cardiovascular strain, immune suppression, metabolic imbalance, cognitive disturbances, and emotional dysregulation. Over time, this cumulative burden increases vulnerability to chronic diseases and reduces overall quality of life. The growing recognition of stress-related health consequences highlights the importance of safe and accessible interventions that can restore physiological balance. Acupressure, as a non-invasive complementary approach, demonstrates potential in modulating stress hormones, enhancing parasympathetic activity, and improving objective physiological markers such as heart rate variability and blood pressure. Its simplicity, low cost, and minimal adverse effects make it suitable for diverse populations and clinical settings. While current evidence suggests beneficial effects on neuroendocrine and autonomic regulation, further well-designed randomized controlled trials are needed to establish standardized protocols, clarify long-term outcomes, and determine optimal frequency and duration of application. Acupressure represents a promising supportive strategy for mitigating the systemic impact of chronic stress and promoting holistic physiological well-being.

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