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R Vaisakh Bhasker
M.Sc. Student, Department of
Community Science, College of
Agriculture, Kerala
Agricultural University,
Vellanikkara, Thrissur, Kerala,
India

Dr. Aneena ER
Professor, Department of
Community Science, College of
Agriculture, Kerala
Agricultural University,
Vellanikkara, Thrissur, Kerala,
India

Dr. Seeja Thomachan Panjikkaran
Professor and Head,
Department of Community
Science, College of Agriculture,
Kerala Agricultural
University, Vellanikkara,
Thrissur, Kerala, India

Dr. Sharon CL
Associate Professor,
Department of Community
Science, College of Agriculture,
Kerala Agricultural
University, Vellanikkara,
Thrissur, Kerala, India

Dr. Suman KT
Professor, Department of
Community Science, College of
Agriculture, Kerala
Agricultural University,
Vellanikkara, Thrissur, Kerala,
India

Corresponding Author:
R Vaisakh Bhasker
M.Sc. Student, Department of
Community Science, College of
Agriculture, Kerala
Agricultural University,
Vellanikkara, Thrissur, Kerala,
India

Stress induced diseases - the silent epidemic

R Vaisakh Bhasker, Aneena ER, Seeja Thomachan Panjikkaran, Sharon CL and Suman KT

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Abstract

Stress is a universal physiological and psychological response to internal or external demands. While acute stress can be adaptive, chronic and uncontrolled stress has emerged as a silent epidemic globally, contributing significantly to major non-communicable diseases. This review investigates the physiological mechanisms underlying stress-induced disorders, with emphasis on neuroendocrine activation, hormonal imbalance, and systemic inflammatory pathways. Prolonged hypersecretion of cortisol and catecholamines alters metabolic, cardiovascular, immune, and neurological functioning, increasing the risk for anxiety, depression, hypertension, type 2 diabetes, myocardial infarction, gastrointestinal disorders, and autoimmune diseases. Preventive strategies including lifestyle modification, stress management therapy, physical activity, and nutritional interventions are discussed. Addressing chronic stress is essential to reduce global disease burden and improve quality of life.

Keywords: Stress, nutrients, stress induced disease, dietary management, eating disorders, physical activities

Introduction

Stress is defined as a state of threatened homeostasis, resulting from biological, psychological or social challenges. In modern society, rapid lifestyle changes, competitive environments, occupational pressures, and emotional instability have increased stress exposure across all age groups. While acute stress triggers adaptive survival responses, persistent stress negatively impacts health, leading to extensive physiological disruptions. According to global public health reports, stress contributes to nearly 80% of major diseases, yet remains under-recognized as a significant etiological factor. Based on a retrospective survey conducted among 1,479 Indian adults, the study revealed a strikingly high prevalence of stress within the population. According to the Perceived Stress Scale (PSS), 9.6% of the respondents experienced mild stress, while a large majority - 84.9% - reported moderate stress levels. Additionally, 5.5% of wagioidividuals were living with moderate to severe stress, emphasising a substantial psychological burden. The analysis also highlighted significant gender differences, with females reporting higher stress levels compared to males, suggesting the influence of social, emotional, and situational factors on stress perception.^[7] Long-term stress activates the hypothalamic-pituitary-adrenal (HPA) axis and sympathetic nervous system, resulting in elevated secretion of cortisol, epinephrine and norepinephrine. Sustained hormonal elevation induces systemic inflammation, oxidative stress, metabolic dysfunction and compromised immunity, gradually manifesting into chronic disorders. Hence, understanding stress pathways and consequences is critical for prevention and therapeutic strategies^[12].

Physiology of Stress Response

The stress response is regulated by two major pathways:

Sympathetic-Adrenal-Medullary (SAM) System

- Immediate fight-or-flight reaction
- Releases epinephrine & norepinephrine
- Increases heart rate, BP, respiration, and blood glucose

Hypothalamic-Pituitary-Adrenal (HPA) Axis

- Hypothalamus secretes CRH
- Pituitary releases ACTH
- The adrenal cortex produces cortisol
- Long-term activation causes metabolic, immune & neural dysfunction

Chronic cortisol elevation impairs hippocampal neuronal function, increases inflammatory cytokines, alters digestion, weakens immunity, and damages cardiovascular tissue ^[11].

Stress triggers powerful physiological responses. In the short term (acute stress), it increases heart rate, blood pressure, and blood glucose, boosts metabolism, and activates temporary anti-inflammatory mechanisms that sharpen focus and provide rapid energy for immediate action. However, when stress becomes long-term (chronic), continuously elevated cortisol leads to high blood pressure, insulin resistance, inflammation, and reduced sensitivity to stress hormones, increasing the risk of major diseases such as heart disease, stroke, diabetes, cancer, depression, and other mental health disorders ^[11].

Stress induced diseases

Stress is the body's natural response to demands, helping improve focus and energy in the short term by releasing hormones like adrenaline and cortisol. But when stress becomes chronic, the body remains in a constant state of high alert, disrupting normal functions. Over time, this leads to serious physical and mental health problems.

Stress and Diabetes Mellitus

Chronic stress plays a major role in the development and worsening of type 2 diabetes. Stress activates the HPA axis, increasing cortisol and adrenaline, which raise blood glucose. When these hormones remain elevated long-term, they cause insulin resistance and persistent hyperglycemia ^[9]. They had that chronic stress also increases inflammation and oxidative stress, damaging beta-cell function and insulin signaling. Unhealthy stress-related habits such as overeating, poor sleep, and inactivity further heighten diabetes risk. Effective stress management is therefore essential for preventing and controlling Type 2 diabetes.

Stress and obesity

Stress activates the HPA axis and increases cortisol, which raises appetite - especially for high-calorie, high-fat foods - and promotes fat storage. When cortisol remains elevated during chronic stress, it leads to increased abdominal visceral fat, reduced metabolic rate, insulin resistance, and a higher risk of obesity-related diseases. Stress also encourages overeating, preference for comfort foods, reduced nayathrough exercise, healthy eating, mindfulness, and adequate sleep is essential to prevent obesity and metabolic disorder ^[6].

Stress and gastrointestinal diseases

Stress strongly affects digestive function, leading to symptoms such as bloating, constipation, diarrhea, cramps, and acid reflux. Activation of the HPA axis and elevated cortisol and adrenaline alter gut motility, either slowing digestion (constipation, bloating) or speeding it up (diarrhea, cramps). Chronic stress also heightens gut sensitivity and disrupts the gut-brain connection, contributing to disorders like Irritable Bowel Syndrome (IBS). It further disturbs

healthy gut bacteria, weakens immunity, and increases the risk of inflammation and ulcers. These combined effects make digestive problems common among individuals experiencing prolonged stress ^[10].

Stress and hypertension

During stress, the sympathetic nervous system releases adrenaline and noradrenaline, increasing heart rate and cardiac output to support the body's immediate "fight-or-flight" response. While beneficial in the short-term, chronic stress triggers prolonged release of cortisol, which reduces nitric oxide production - essential for blood vessel relaxation. Reduced nitric oxide causes vasoconstriction and increased vascular resistance, raising blood pressure. Cortisol also thickens arterial walls and reduces elasticity, worsening hypertension. Over time, this significantly increases the risk of heart attack, stroke, heart failure, and kidney disease, especially when combined with unhealthy coping behaviours such as smoking, poor diet, and inactivity ^[5].

Stress and cardiovascular disorders

Stress is the body's natural response to challenges, but when it becomes chronic, the continuous release of cortisol, adrenaline, and noradrenaline places harmful strain on the cardiovascular system. These hormones increase heart rate and blood pressure, promote fat and cholesterol buildup in arteries, and reduce nitric oxide production - leading to vasoconstriction, arterial stiffness, and hypertension, a major silent risk factor for heart disease and stroke. Chronic stress also encourages unhealthy lifestyle behaviors such as overeating, smoking, inactivity, and poor sleep, which further damage heart health.

Atherosclerosis: Prolonged high cortisol levels increase circulating triglycerides and LDL cholesterol, promoting plaque formation inside arterial walls. These plaques narrow and harden arteries, restricting blood flow and increasing inflammation. Plaque rupture can trigger clots that cause heart attacks or strokes ^[8].

Myocardial Infarction: Persistent stress elevates blood pressure and accelerates atherosclerosis, which can lead to plaque rupture and blockage of coronary arteries. Elevated cortisol also increases platelet aggregation and thrombosis risk, greatly increasing the likelihood of myocardial infarction. Unhealthy coping behaviors amplify this danger ^[8].

Ischemic Stroke: Chronic stress-driven hypertension and plaque instability raise the risk of blood clots blocking brain arteries, cutting off blood supply and causing cell death, resulting in ischemic stroke.

Stress and cancer

Chronic stress is increasingly recognized as a major contributor to cancer development and progression. Long-term elevation of stress hormones such as cortisol, adrenaline, and noradrenaline weakens the immune system by reducing the activity of natural killer (NK) cells and cytotoxic T cells, allowing abnormal cells to escape detection and form tumors. Persistent stress also increases inflammation and oxidative stress, generating reactive oxygen species that damage DNA and cause mutations in tumor-suppressor genes and oncogenes, leading to uncontrolled cell growth. This combination of reduced immune surveillance and DNA damage creates a biological

environment that supports tumor survival and proliferation. Research by Andre supports the strong link between chronic stress, inflammation, and cancer progression, highlighting the need for stress-management interventions such as physical activity, proper nutrition, mindfulness, and psychological support to reduce cancer risk ^[1].

Stress and eating disorders

Chronic stress plays a major role in the development and worsening of eating disorders by disrupting appetite regulation and emotional control. Prolonged elevation of cortisol, adrenaline, and noradrenaline interferes with hunger and satiety signals, increasing emotional distress and unhealthy eating behaviors.

Anorexia nervosa: Stress intensifies anxiety and body-image distortions, further suppressing appetite and reinforcing extreme food restriction, leading to severe malnutrition and life-threatening health damage.

Bulimia nervosa: Stress disrupts emotional regulation, triggering binge-eating episodes followed by purging behaviors. Guilt and shame worsen stress, creating a self-reinforcing cycle.

Binge-eating disorder: Stress increases cravings for high-calorie comfort foods, leading to uncontrolled overeating without purging. This cycle contributes to obesity, depression, and metabolic diseases.

Stress and fertility

Chronic stress has a significant impact on fertility in both men and women by disrupting hormonal balance and normal reproductive processes. Prolonged elevation of stress hormones such as cortisol interferes with the functioning of the HPA and HPO axes, reducing the body's ability to support healthy reproduction.

In men, chronic stress lowers sperm count, reduces sperm motility, and disrupts testosterone levels, leading to decreased libido and erectile dysfunction - factors that greatly reduce the chances of conception. In women, stress disrupts the menstrual cycle by interfering with ovulation, causes irregular or absent cycles, and reduces ovarian reserve. It also alters estrogen and progesterone levels, making implantation more difficult and increasing the risk of infertility and early pregnancy loss ^[3].

Overall, chronic stress creates a cycle where stress reduces fertility, and fertility challenges increase stress, reinforcing the problem. Effective stress management can restore hormonal balance and improve reproductive outcomes.

Stress management

Effective stress management requires a combination of healthy dietary habits and lifestyle modifications. A balanced diet rich in fruits, vegetables, whole grains, lean proteins, and healthy fats supports hormonal balance, boosts immunity, and reduces inflammation. Nutrients such as complex carbohydrates help increase serotonin levels, protein supports neurotransmitter production, and healthy fats aid brain function and cortisol regulation. Staying well-hydrated also helps maintain energy levels and reduce stress responses. Lifestyle changes play an equally important role. Regular physical activity releases endorphins that improve mood and reduce tension, while adequate sleep restores the body and lowers stress levels. Practices such as deep breathing, meditation, yoga, and mindfulness help calm the mind and reduce anxiety. Time management and strong

social support systems further improve emotional resilience. Avoiding harmful coping behaviors such as smoking, excessive alcohol, and caffeine is essential, as they worsen stress and negatively affect health.

Dietary management

Stress is the body's natural response to challenges, triggering physiological and psychological reactions. While short-term stress can enhance alertness, chronic stress can cause health issues like high blood pressure, weakened immunity, digestive problems, and mental health disorders. Effective stress management through dietary adjustments and lifestyle changes helps regulate stress hormones, improve resilience, and support overall well-being. This section focuses on how diet aids the body in coping with stress and maintaining mental and physical health.

Role of nutrients in Stress Management

Carbohydrates

Complex carbs (whole grains, oats, legumes, vegetables) provide slow, steady glucose, preventing hypoglycemia. Support serotonin production improves mood, relaxation, and sleep. Reduce cravings for unhealthy snacks, stabilizing energy and emotional balance ^[2].

Proteins

High-quality proteins (lean meat, eggs, dairy, soy, pulses, nuts) supply amino acids which is a precursors for neurotransmitters (dopamine, norepinephrine, serotonin). Stabilise blood sugar, prevent mood swings, and support brain structure and function.

Fats

Foods such as fish, flaxseed, chia seeds, walnuts and avocados are rich sources of omega-3 fatty acids, which play a significant role in reducing systemic inflammation and lowering circulating stress hormones. Omega-3 fats contribute to improved mood regulation, enhanced cognitive function, and sustained energy availability throughout the day. These fats also support the absorption of fat-soluble vitamins (A, D, E and K), which are essential for maintaining physiological stability and stress resilience. Thus, incorporating these lipid-rich foods into the diet offers both metabolic and psychological benefits relevant to stress management.

Dietary fibre

Whole grains (e.g., oats, whole wheat), fruits and vegetables provide substantial amounts of dietary fibre that positively influence gut health. Improved gut microbiota activity enhances gut-brain axis communication, which in turn supports better mood stability. Fibre-rich foods help regulate blood glucose levels, thereby preventing sharp fluctuations that can contribute to irritability and stress-related mood swings. Their ability to prolong satiety further reduces stress-induced overeating. Fermentable fibres facilitate the production of short-chain fatty acids (SCFAs), which have demonstrated anti-inflammatory effects and contribute to a reduced physiological stress response ^[4].

Vitamins

mengmetabolism, and nerve health. Vitamin C: Antioxidant, regulates cortisol, reduces oxidative stress. Vitamin D: Supports serotonin synthesis, lowers depression risk,

enhances cognition. Vitamin A & E: Support brain cell communication and protect neurons from oxidative damage.

Minerals

Magnesium: Relaxes muscles, calms nervous system Zinc: Supports neuroplasticity, neurotransmitter balance, stress resilience. Calcium: Needed for neurotransmitter release and nerve signaling. Iron: Prevents fatigue and poor concentration by aiding oxygen transport. Selenium: Antioxidant, supports thyroid function, reduces inflammation^[4].

Bioactive Compounds

Polyphenols: Polyphenols, commonly present in tea, cocoa, and various berries, exhibit strong antioxidant activity and notable anti-inflammatory effects. They promote neurogenesis and contribute to better mood regulation and enhanced cognitive abilities.

Curcumin: Curcumin, a key bioactive compound derived from turmeric, shows potent anti-inflammatory properties and helps in lowering cortisol levels. It boosts neuroplasticity and strengthens overall resilience to stress.

Resveratrol: Resveratrol, occurring naturally in grapes, wine, berries, and peanuts, serves as a powerful antioxidant and assists in reducing cortisol. It improves cerebral blood circulation and offers protective benefits to neurons.

Flavonoids: Flavonoids, abundant in berries, citrus fruits, tea, cocoa, and apples, function as effective antioxidants and enhance vascular blood flow. They support neurotransmitter activity, encourage neurogenesis, and play a role in maintaining emotional balance.

Anthocyanins: Anthocyanins, concentrated in blueberries, cherries, grapes, and red cabbage, possess strong antioxidant and anti-inflammatory capabilities. They help boost memory, elevate mood, and support synaptic plasticity, which is crucial for learning.

Lutein: Lutein, naturally present in spinach, kale, broccoli, and egg yolk, helps shield the brain from oxidative damage. It supports cognitive performance, improves memory function, and contributes to stable emotional responses.

Lifestyle modifications

Adopting holistic lifestyle modifications is a powerful strategy for managing stress and building resilience. Regular exercise reduces stress hormones like cortisol and adrenaline, releases endorphins to improve mood, burns visceral fat to lower inflammation, and enhances insulin sensitivity to stabilize blood sugar and prevent mood swings. Yoga, meditation, and mindfulness activate the parasympathetic nervous system, lowering heart rate and blood pressure, while increasing serotonin and dopamine to improve focus, relaxation, and emotional balance. Adequate sleep restores hormonal balance, reduces inflammatory markers, resets the HPA axis, lowers cortisol, and prevents fatigue and anxiety. Limiting alcohol is crucial, as it increases cortisol, disrupts the HPA axis, damages gut integrity, and overburdens the liver, all of which worsen stress. Quitting smoking is essential because nicotine stimulates cortisol and adrenaline, creating cycles of

withdrawal stress, while tobacco chemicals increase inflammation and anxiety. Healthy food habits play a major role: avoiding high-sugar, high-salt, fried, and processed fatty meats prevents blood sugar spikes, systemic inflammation, and mood disturbances, while consuming whole grains, fruits, vegetables, nuts, seeds, lean proteins, and healthy fats stabilizes energy, supports neurotransmitter production, strengthens gut health, and enhances the body's resilience to stress. Together, these interconnected habits form a strong foundation for lasting mental and physical well-being.

Conclusion

Foods and effective stress management requires a holistic approach that combines balanced nutrition and purposeful lifestyle modifications. A diet rich in complex carbohydrates, high-quality proteins, essential vitamins, minerals, and bioactive compounds supports neurotransmitter production, stabilizes blood sugar, reduces inflammation, and protects brain function, enhancing mental and emotional resilience. Complementing this, regular exercise, yoga, meditation, adequate sleep, and the avoidance of alcohol, smoking, and unhealthy foods further regulate stress hormones, improve nervous system balance, and strengthen the body's capacity to cope with challenges. Together, these strategies create a synergistic framework that promotes long-term physical, mental, and emotional well-being, empowering individuals to manage stress effectively and maintain a healthier, more balanced life.

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