Section: Miscellaneous

Review Article

SYSTEMIC EFFECT OF STRESS: - PHYSIOLOGICAL AND PATHOLOGICAL CHANGES: A DETAILED REVIEW

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Received *: 19/06/2025*
Received in revised form *: 04/08/2025*
Accepted *: 23/08/2025*

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DOI: 10.70034/ijmedph.2025.3.612

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2025; 15 (3); 3341-3348

ABSTRACT

This panoramic review study explores the intricate consequences of stress on various body systems under one umbrella. Stress is a normal human response that triggers physical and mental reactions, as well as a series of functional responses and adjustments. The activation of the autonomic nervous system and the hypothalamic-pituitary-adrenal axis are prominent features of stress, affecting the function of other body organs and disrupting the standard homeostatic mechanisms. Stress enhances the secretion of stress hormones, promoting the individual's adaptation. During stressful conditions, the sympathetic system (fight /flight response) overrides the parasympathetic system (vegetative functions). Exposure to chronic stress impairs various body organs, promoting psychological disturbances and metabolic dysregulation. and activates pathophysiological changes, affecting normal physiology. Hypersecretion of cortisol and associated hormones harms the brain and other organs. Chronic stress can aggravate pre-existing health problems and promote unhealthy habits, predisposing individuals to various diseases. In conclusion, this extensive review tried to elucidate the adverse effects of chronic stress on the endocrine, nervous, cardiovascular, digestive, respiratory, and reproductive systems and focused on structural, functional, and pathological changes. This also interprets the changes observed due to the long-term exposure to stress on sleep, pregnancy, and the development of diseases like diabetes, osteoporosis, skin diseases, and adverse health effects on the oral cavity. The present review article allows researchers to take advantage of almost all the effects of stress from a single source.

Keywords: Glucocorticosteroids, Hypothalamic-pituitary-adrenal axis, Hypothalamus, Stress, Sympathoadrenomedullary system.

INTRODUCTION

Stress is a normal human response to a problematic situation, resulting in physical and mental reactions. Daily duties, such as work or important matters in family life, including the diagnosis of new diseases, upcoming events, the loss of a loved one, or natural calamities, can trigger stress. Stress responses help our body to adapt to new conditions. Stress can be positive (eustress), allowing us to be active, energetic, and ready to avoid hazards, or negative (distress) when stressors persist without relaxation. Alternatively, stress may be neither positive nor negative, referred to as 'eustress' (having no actual impact on a person).

Stress can be defined as the inability to cope with an apparent danger to one's physical, psychological, emotional, and spiritual welfare, which leads to a series of functional activities and adjustments. The colossal potency and clinical utility of the concept of "stress" is that it refers to the organism's reactions to adverse effects. Stress can be classified into acute (short-term and adaptive state as a direct result of a specific situation or event) or chronic (prolonged, producing abnormal reactions), interfering with the body's actions. It is also classified into physiological

stress, due to physical stimuli, and psychological stress, due to mental stimuli.

During stress, the Autonomic Nervous System (ANS) regulates vegetative functions and stress reactions, and the "fight-or-flight response" helps the body to overcome traumatic or difficult conditions.[1] Exposure to chronic stress leads to harmful reactions in different body organs, predisposing to cardiovascular ailments, psychological disorders, and metabolic dysregulation.[2] The duration and severity of stress and stressful events may vary from person to person.

The current review study has proposed several goals; primarily, a brief description of the physiological pathways of the stress system [Figure 1], secondly, to consider the impact of chronic stress on alterations in functional aspects of different systems, [Figure 2], and specific physiological conditions, and finally to analyze the possible pathological changes [Figure 3] due to chronic stress.

Physiological Pathways of the Stress System

The hypothalamic-pituitary-adrenal (HPA) axis and the autonomic nervous system are the first two responders to stressful conditions.[3] The stress system is composed of the central (hypothalamus and the brainstem) and peripheral components (adrenocortical axis and efferent sympathetic adrenomedullary systems (SAM)), which are responsible for maintaining homeostasis by activation through a synchronized interplay between the systems as mentioned above.[3] Under stressful situations, components of the HPA axis, paraventricular nuclei (PVN) of the hypothalamus, anterior hypophysis, and adrenal gland secrete corticotropin-releasing hormone (CRH), arginine vasopressin (AVP), adrenocorticotropic hormone (ACTH), and cortisols (GC), respectively.[3,4] Acute stress elevates the amount of secretion of CRH, AVP, ACTH, and cortisol due to increased response of the HPA axis, which can be aggravated by angiotensin II and other inflammatory mediators, contrary to the normal pulsatile, circadian rhythmic secretion with a high peak in the early morning.[4]

During stressful conditions, the sympathetic nervous system (SNS) (adrenergic) activates and participates in the fight-or-flight reaction, which is crucial. The primary phase of the stress reaction is the sympathetic adrenomedullary system (SAM), with fast functional adjustments,[5] [Figure 1]. The secondary phase is considered sluggish (slow response) and activated by the hormonal mechanism (HPA axis) (long-lasting response) while, during non-stressful conditions, the responses of the parasympathetic nervous system (PNS) (acetylcholinergic) regulate the relaxation property of the body.[5] [Figure 1] Thus, the two components of ANS are essential in regulating visceral functions like the respiratory, cardiovascular, and metabolic systems, maintaining dynamic balance between the autonomic nervous system's two components (sympathetic and parasympathetic).[5] During stressful situations, long-term impairment in physiological pathways leads to psychological disturbances and metabolic dysregulation, which influences different organs and their functions.

Stress On Endocrine Function

Stress reactions are associated with the elevated secretion of several hormones, which promote the release of energy sources and help to adjust the person to their new situation. A major neuroendocrine action of stress is the stimulation of the hypothalamic-pituitary-adrenal axis, which secretes high levels of corticotropin-releasing factor (CRF), adrenocorticotropic hormone (ACTH), and glucocorticosteroids.[6] Along with these, the actions of catecholamines, growth hormone, and prolactin help the individual adapt to new conditions.[7] Glucocorticoids cause inhibition of the secretion of CRH and ACTH in the hypothalamus and pituitary gland, along with maintenance of homeostatic and vital functions.[6,7] Acute stress releases vasopressin along with the release of CRH and ACTH, which inhibits circulating gonadotropins and other sex hormones like luteinizing hormone (LH) and follicle-stimulating hormone (FSH), changing the pattern of the normal menstrual cycle.[7] Aldosterone, angiotensin II, and vasopressin are hormone triads that maintain homeostasis during stress.[8] Stress decreases the secretion of thyroid hormones and insulin, while a two- to tenfold increase in growth hormone (GH) and changes in prolactin levels occur, depending on the local regulatory environment.[7,8] Studies among MBBS students [Table 1:1] showed alterations in the hormone levels during academic stress.[9] Prolonged stressful responses can predispose to hormonal abnormalities like Graves' disease and gonadal dysfunction, and change the medical condition of many preexisting endocrine diseases like adrenal crisis and thyroid storm.[8,9] During the stress response, hormonal alterations allow the organism to overcome the situation by redirecting oxygen and nutrients to the CNS, CVS, and skeletal muscles associated with fight and flight responses.[6]

Stress and the Nervous System

The central nervous system (CNS), which controls our "fight or flight" reaction during stress, activates the HPA axis. There are four major statements explaining the stress–hippocampus link: 1) The existence of glucocorticoid receptor (GR) in the hippocampus, 2) High concentrations of stress hormones produces significant impairments in declarative memory function, 3) Shrinkage of the hippocampus due to long-term exposure of elevated levels of stress hormones, and 4) Stress and associated stress hormones can interrupt neuronal growth in the hippocampus.[10]

Research studies have shown that stress produces anatomical changes in various parts of the brain, which are closely correlated to multiple brain disorders, including nervousness, hopelessness, cognition, memory, and post-traumatic stress disorder (PTSD).[11] Neuroimaging studies of PTSD showed the various atrophic areas comprising the

hippocampus, anterior cingulate cortex (ACC), amygdala, and other brain parts.[11] The hippocampus expresses the highest stress response, which is known as the area for the overall function of memory and the translation of short-term memory to long-term memory, and also contains a high concentration of glucocorticosteroid receptors, and the amygdala assesses emotional aspects of memory.[12]

Acute stress stimulates particular types of nervous stimulation and produces surplus dopamine dissemination in the prefrontal and anterior cingulate cortices.[12] Furthermore, higher concentrations of glucocorticoids released during chronic stress disrupt memory formation and can impair learning, as glucocorticoids are modulators of these processes.[10]

The effect of hypercortisolism on the degeneration of different brain parts is associated with intellectual functions and declarative memory disorders[11], as shown in the Framingham Heart Study, which assessed the relationship of serum cortisol with intellectual activities and brain structural integrity during morning hours.[13] Exposure to increased glucocorticoids can cause the degeneration of the hippocampus, and reduced volume of the hippocampus is associated with neurophysiological changes such as weak vocal memory.[14] Elevated cortisol levels produced changes, especially in the corpus callosum and the posterior corona radiata.[13]

A study among businessmen [Table 1:2] revealed an association between mental stress and intellectual performance.[15]

Though stress produces adverse effects, it can temporarily improve brain function and memory under special conditions, such as unfamiliar, unexpected, and life-threatening aspects of compulsory stimulation.[16] Stress can affect the quality of memory by altering the way of learning, and can also improve memory.[14,16] Temporary upgrading of memory among exam participants, and knowledge acquisition during the exam period mold the synaptic connections for fruitful memory development and help to create strong memories [Table 1:3,4].[17,18] The persistent and unrestricted stimulation of the HPA axis and the ANS (as found in chronic stress) can lead to the progression of a sequence of pathological conditions ranging from sleeplessness and high blood pressure to tiredness and cardiovascular diseases.[19]

Stress and the Cardiovascular System

Both acute and chronic stress disturb the cardiovascular system, producing adverse effects on its functioning. Acute stress causes an increase in heart rate and force of contraction of the heart due to the secretion of stress hormones, and the body returns to its normal state after this fight-or-flight response.[20] Chronic stress contributes to increasing heart rate, blood pressure, and risk for hypertension, myocardial infarction, and stroke.[19,20]

Prolonged activation of the HPA axis by chronic stressors increases the risk for cardiometabolic and psychiatric disorders.[5] Consumption of high calories with fewer micronutrients and an inactive lifestyle predisposes people to obesity and metabolic syndromes, especially among stressed people, which can lead to adverse effects on the cardiovascular system.[21] Normal parasympathetic stimulation is altered by chronic, unexpected psychological stress, and increased sympathetic nervous system activity causes overreactions to cardiovascular activities such as tachycardia, hypertension, and reduced heart rate variability.[22] Stimulation of the sympathetic nervous system and renin-angiotensin system as a result of stress response causes increased levels of homocysteine and elevated cardiovascular activity, predisposing to various degrees of endothelial damage, leading to atherosclerosis.[22] Increased sympathetic nervous system activity in response to stress elevates cardiovascular function and releases catecholamines.[20,22] Sympathetic stimulation due to mental stress causes inflammation of blood vessels and promotes the development of atherosclerosis, plaque disruption, and increased risk of heart failure.[22]

Many research studies [Table 1:5,6] showed the impact of stress on the functioning of the cardiovascular system.[23,24] The INTERHEART Study, a case-control study from 52 countries, found that population-attributable risks (PAR) were about 32.5% for psychological factors.[2] Psychological stress predisposes to angina pectoris mediated by coronary vasoconstriction combined with tachycardia and high blood pressure, leading to acute myocardial ischemia.[2,22] Vascular complications of prolonged psychological stress lead to clinical conditions like stress-induced cardiomyopathy, stress-induced cardiac ischemia, and arrhythmias.[22]

Stress and Respiration: Stress and strong emotions can affect respiratory functions with respiratory symptoms, such as shortness of breath and rapid breathing, as the narrowing of the air passage from the nose to the lungs occurs during stress, and many external and internal stressors cause increased breathing or minute ventilation.[25] The human airway reactions to external and internal stressors are recognized as the preparatory phase for the 'fight or flight' response, and hyperpnea is considered a part of this response.[25] Research studies [Table 1:7,8] showed a negative effect on stress and pulmonary function tests.[26,27] Anxiety promotes dyspnoea, which aggravates suppressed symptoms of chronic obstructive pulmonary disease (COPD) and increases hospital admissions.[26,27]

Stress and the Digestive System

The enteric nervous system (ENS) and CNS are bidirectionally linked by the sympathetic and parasympathetic pathways, forming the brain-gut axis (BGA).[28] Studies have shown that stress causes dysregulation of the brain-gut axis (BGA) and produces changes in the secretion of mucus, stomach acid, intestinal permeability, absorption of food, the functioning of ion channels, and inflammation of the gastrointestinal tract (GI).[29] Interaction between gut microbiota, the immune system, and the brain-gut axis plays a prominent role in the conversion of the

gastrointestinal tract's stress reactions, leading to various abnormalities in the gut.[29] Exposure to stress in the gastrointestinal tract causes the development of gastrointestinal disorders like gastroesophageal reflux disease (GERD), functional dyspepsia, peptic ulcer, inflammatory bowel diseases, and irritable bowel syndrome (IBS).[30]

Stress on the Reproductive System and Sexual Function

Chronic stress can cause impairment of the reproductive system.[7] Psychosocial stress decreases the secretion of gonadotrophic hormones (GnRH) along with the reduction in the secretion of luteinizing hormone (LH).[7] Many studies have demonstrated a strong correlation between stress and irregular menstrual cycles.[31,32] A higher risk for dysmenorrhoea was observed among those with high job stress and job insecurity.[32] Research findings (Table 1:9,10) showed a significant positive connection between premenstrual symptoms (PMS) and elevated stress scores.[31,32] Increased release of cortisol during stressful conditions enhances brain function and may slow or stop other non-essential body functions, and the production of gonadotrophins and estrogen was suppressed, affecting the woman's menstrual function.[8] Long-term stress is a supplementary risk factor for sterility and it decreases testosterone production while the increase in corticosterone levels impairs germ cells, which causes sterility problems in males.[33] Both acute and chronic stress can disrupt male productivity. Besides the increase in cortisol levels, chronic stress suppresses testosterone secretion, libido, and spermatogenesis in males.[33] In men, stress induces defects in sperm morphology, as well as reduced motility of sperm and sperm count, thus lowering reproductive potential in men.[34] A study to investigate the effect of stress on sexual function among 251 residents showed that personal burnout and job stress lead to male and female sexual problems.[35]

Stress and Muscle

Atrophy of skeletal muscle is associated with high serum glucocorticoid levels, which promote actions of prominent proteolytic enzymes.[36] A study conducted among undergraduate students revealed an inverse association between stress and recovery, and individuals with elevated stress require a longer time for recovery than subjects without prolonged stress.[37]

Stress and Obesity

Psychological stress predisposes to fat deposition in the visceral organs and correlates with alterations in dietary intake, weight gain, and fat accumulation. Exposure to long-term social stress promotes overweight and obesity through the high consumption of highly palatable, high-calorie foods, along with decreased physical activity.[38] A study among men and women exposed to prolonged social and environmental stress showed an increase in waist circumference and body mass index (BMI).[39] Food consumption is higher during stressful times, due to hormonal changes, and it is hard to eliminate stress-induced eating because eating is pleasurable, and it is noticed that obesity and stress have a bidirectional connection.[38,39] Long-term stress causes excess stimulation of the HPA axis, followed by overproduction of cortisol, resulting in increased fat storage, especially in the visceral region, beyond the contribution of undesirable metabolic outcomes, like Diabetes mellitus.[40]

Stress and Diabetes Mellitus

Psychological and physical stress promote an increased release of adrenal cortical and medullary hormones, which amplifies the need for insulin and insulin resistance and acts as a triggering factor for the beginning of type 1 Diabetes (T1D) and type 2 Diabetes (T2D).[40] Chronic stress increases cortisol production and reduces cellular uptake of glucose and consumption of glucose in skeletal muscle and white adipose tissue, producing hyperglycemia.[7,40] A decrease in insulin secretion during stress and insulin sensitivity are two predominant factors responsible for hyperglycemia secondary to increased glucocorticoid secretion.[7] Studies revealed the association between stress and diabetes.[41,42] Prolonged hypercortisolemia leads to visceral fat accumulation, reduced lean body mass, insulin resistance, glycogenolysis, and gluconeogenesis, and antagonizes the metabolic actions of insulin.[40,41] There exists a bidirectional association between diabetes and stress as diabetes worsens health due to a long-lasting illness that may be leading to stress, or stress itself could interrupt metabolic regulation, leading to or worsening diabetes.[43]

Stress and Skin Diseases

Psychological stress can affect the skin's health and predispose it to many skin diseases such as atopic dermatitis, psoriasis, etc. It produces many undesirable effects on the skin, which include weakened consistency of the stratum corneum, disturbance in penetration, change in the antimicrobial properties of the epidermis, slow healing of wounds, compromised epidermal natural defense, and cutaneous homeostasis.[44] This can lead to changes in immunity, favor the development of infections, and has the power to affect chronic inflammatory cutaneous diseases. A cross-sectional study conducted among 1435 medical students of King Saud University (KSU), found that highly stressed students had a higher prevalence of oily, waxy patches on the scalp, dry/sore rash, itchy skin, itchy rash on their hands, loss of hair, warts, and acne.[45] Exposure to psychological stress alters hormones of the HPA axis, beyond the discharge of stress mediators, including neuropeptides and cytokines. Stress impairs skin barrier function, and inflammatory skin diseases like psoriasis are exacerbated by stressful life events.[44,45] Significant associations between depression and skin diseases like dermatitis, psoriasis, eczema, alopecia areata, and urticaria have been shown in many studies.[45]

Stress and Osteoporosis

There exists a correlation between chronic psychological stress and bone loss and the risk of osteoporotic fractures. Bone mineral density (BMD) was lower among depressed individuals compared to non-depressed individuals.[46] Chronic stress stimulates the release of stress hormones, inhibiting osteoblastic function and causing bone loss, as there is a wide distribution of SNS in the periosteum, bone growth plate, and blood vessels supplying bone.[47] Increased secretion of cortisol and NE during chronic stress increases inflammatory cytokines, eventually leading to bone loss by suppressing bone development and increasing bone resorption.[46,47]

Stress and Oral Cavity

Chronic stress leads to the progressive development of oral disease by two divergent pathways: 1) Promoting individuals to follow unhealthy ways leading to oral disease. 2) Leads to the dysfunction of physiological systems and promotes the underlying mechanisms of disease progression.[48] A transitional rise in salivary cortisol was observed during stressful situations, along with increased quantity and activity of leukocytes predisposing to inflammation.[49] Chronic stress predisposes to oral ulcers, burning mouth syndrome (BMS), temporomandibular disorders (TMD), bruxism, and Lichen Planus.[49]

Stress During Pregnancy

The stress of the mother during the pregnancy period has a strong influence on the development of the fetus.[50] Stress may affect the functioning of the HPA axis of the fetus due to elevated levels of maternal cortisol increased actions of cortisol, and the development of the nervous system in the offspring.[50] Mothers' immune systems under stress are more susceptible to infection and illness, and their responses to challenges.[51] Beyond this, it also leads to behavioral changes such as improper diet, decreased exercise, and distracted sleep, predisposing to a stage of illness.[51] A large number of cortisol receptors can be seen in the neurons of the developing hippocampus, and impairments in cognition and memory can be observed among the children of stressed mothers.[52] Prenatal maternal stress leads to changes in frontotemporal cortical thickness, increased cortical gyrification index in the temporal region, and elevated depressive symptoms, mood disturbances, and neurobehavioural dysfunction.[51]

Stress and Sleep

Stress is considered an important risk factor for sleep disturbances, and disturbed sleep under acute/chronic stress may impair and alter the physiological and biochemical functions, producing adverse effects on health.[53] Elevated secretion of adrenocorticotropic hormone (ACTH) in the early morning is the determining factor controlling the end of sleep and maladaptive changes in the HPA axis, which are connected with sleep deprivation and sleep disorders, leading to neuroendocrine dysregulation.[54] The exposure to psychosocial stressors leads to sleep disorders like the onset of insomnia, reduction in the efficiency of sleep, and increased sleep fragmentation.[53,54]

Table 1: A few research studies analysing the systemic effect of stress

Author & Year	Participants & Methods	Findings
1. Laila Y 2005	48 MBBS students, Levels of Plasma leptin, NPY, Nitrite, Nitrate, Adrenomedullin, Cortisol and ACTH were examined.	Academic stress leads to significant neurohormonal changes in the level of Leptin, NPY, nitrite, nitrate, adrenomedullin, and cortisol
2.Teixeira RR et al 2015	109 (75 males, 34 females). Lipp Inventory of Stress Symptoms for Adults, Stroop Color-Word Test, levels of Cortisol, and Salivary Alpha-Amylase were examined.	46.8% (34 males & 17 females) expressed significant symptoms of stress & 90.1% of them indicated chronic stress, elevating cortisol, affecting intellectual and ANS functions.
3. Vedhara K et al 2000.	60 PG students (36 male, 24 female). Assessment of self-reported levels of stress, salivary cortisol, short-term memory, selective and divided attention & auditory verbal working memory during non-exam and exam periods	An increase in perceived stress levels and a significant reduction in salivary cortisol were noticed during the exam period, compared to the non-exam period. Cortisol reduction was associated with enhanced short-term memory.
4. Brod G 2016	47 medical students(31 intervention, 16 control) Testing 3 months before the exam & immediately after the exam. fMRI face–diagnosis vs face–name pairs	Improvements in memory presentation were greater for face–diagnosis pairs (high knowledge-relevance) than for face–name pairs (low knowledge-relevance).. Knowledge accumulation develops the neural networks for successful memory formation, increasing functional connectivity between the anterior hippocampus and left middle temporal gyrus.
5.Vrijkotte TGM 2000	109 male white-collar workers (age, 47.26+5.3) Ambulatory blood pressure, heart rate, and heart rate variability	Work stress increases the heart rate reactivity, systolic blood pressure, and lowers vagal tone.
6. Satyjeet et al, 2020	117 patients with myocardial infarction and unstable angina enrolled as cases & 110 subjects enrolled as controls.	The risk of heart disease was higher among patients with different types of physiological stresses
7. Majeed F et al 2023	72 MBBS students (19- 22 yrs). Components of blood pressure, VC, FVC, FEV1/FVC, and PSS questionnaire	The occurrence of PSS at a level of 70% is higher among 1st MBBS students, especially among female participants. PSS is significantly higher in participants with low height, weight, and oxygen saturation, DBP, MABP, VC, FVC and FEV1.

8. Chaudhuri et al 2019	600 working females (300 subjects with PSS 20 or more, 300 subjects with PSS 13 or less) FVC, FEV1, FEV1: FVC % of 2 groups	Significant higher values of FVC and FEV1 among subjects with low PSS, no significant difference in FEV1/FVC% between the two groups
9.Nagma et al. 2015	100 students. BMI, questionnaire analysis, along with PSS and PBAC	There is a connection between high stress levels (PSS >20) and irregular menstrual cycles, while no relation between high stress levels (PSS >20) and hypo-menorrhea, menorrhagia, dysmenorrhoea, and duration of cycle
10.Fernandez et al., 2019	285 cases with PMS and 285 age-matched controls, 88 cases with PMDD and 176 corresponding age-matched controls. PSST questionnaire.	There is a strong relationship between psychological factors, including perceived stress, neuroticism, and coping strategies, and the occurrence of PMS/PMDD

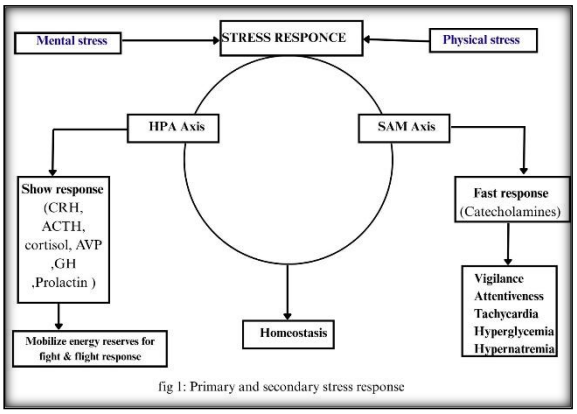
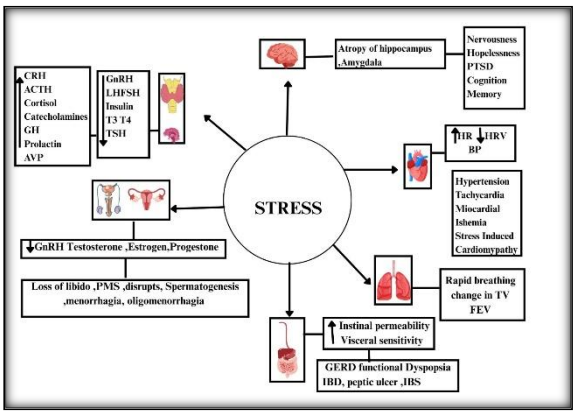


fig 1: Primary and secondary stress response



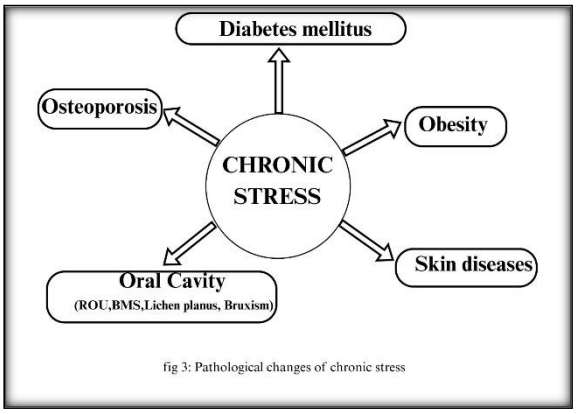


fig 3: Pathological changes of chronic stress

CONCLUSION

Analysis of reviews and research studies on the effects of stress revealed the advantages and disadvantages of stress. The benefits of stress comprise conserving homeostasis of cells, organs, and organisms, and boosting memory during some situations that lead to the existence of individuals. However, the detrimental effects of stress are more noticeable. The activation of the autonomic nervous system and hypothalamic-pituitary-adrenal (HPA) axis affects the functions of other body organs, and exposure to chronic stress leads to abnormal reactions in different body organs and promotes pathophysiological conditions, psychological disturbances, and metabolic dysregulation. Both acute and chronic stress primarily affect the endocrine system, increasing the secretion of major stress hormones (catecholamines and cortisol), CRH, and ACTH, which have a major role in the functioning of different systems. Along with these hormones, an increase was observed in the secretion of growth hormone and prolactin, while a decrease was observed in the secretion of thyroid hormones, insulin, and gonadotropins.

Chronic exposure of glucocorticoids to the brain causes atrophy of the hippocampus, impairing learning, cognition, and memory. Increased activity of the SNS causes accelerated heart rate, increased arterial blood pressure, reduced heart rate variability, and predisposes to cardiovascular diseases. Exposure to long-term stress causes dysregulation of the BGA, which affects permeability and secretion of the GIT, leading to intestinal diseases. Stress activates hyperventilation and changes in lung volumes and capacities. Elevated secretion of stress hormones suppresses secretion of gonadotrophins, estrogen, and testosterone, leading to dysmenorrhoea in females, and adverse effects on spermatogenesis in males, along with hypoactive sexual desire. Activation of the SNS predisposes to the deposition of fat in the visceral organs, promoting fat accumulation and weight gain, leading to obesity. Prolonged hypercortisolemia causes glycogenolysis, gluconeogenesis, and insulin resistance triggering the factors for the onset of type 1 (T1D) and type 2 Diabetes (T2D). Chronic stress predisposes to diseases of the oral cavity, dermatological problems, osteoporosis, and sleep disorders. Maternal stress during pregnancy weakens the immune system and impairs the cognitive and memory function of the fetus.

The present review study tried to highlight the various effects of stress under one umbrella and showed that chronic psychological stress alters physiological conditions and predisposes to pathological changes. It is essential to notice that disorders due to stress occur only if the stress is severe and prolonged. Many researchers are focusing

their studies on stress and trying to unravel changes due to chronic stress, such as anatomical, physiological, biochemical, and pathological effects, which is useful to the medical community in implementing pharmacological and non-pharmacological therapeutic interventions.

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