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# Neuropsychological Impacts of Yogic Practices

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**ABSTRACT**

*Research in 21st century has prove that yogic and mindfulness-based practices have direct and indirect benefits to body in many ways. It also has been shown yoga triggers neurotransmitters that modulate psychological disorders such as aggressiveness, depression, anxiety and help to increase alertness and positive feelings. In this review, we have discussed the effect of yoga and meditation on human nervous system and the role of neurotransmitters. The mechanisms contributing to the therapeutic benefits of yoga include stress reduction, alteration of hypothalamopituitary adrenal axis, balancing the autonomic nervous system. This review includes the studies that describe the changes in the neurotransmitter and hormonal levels by yogic interventions to achieve improvements in the metabolic profile of yoga practitioner.*



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**Introduction :-** A healthy nervous system enables us to meet every event of life with calm and resilience. It keeps all the muscles, organs and tissues of the body working at full efficiency, gives sharper sensory perception and creates a sense of vitality and energy in our whole being. The nervous system is made up of large numbers of individual cells or neurons, each with a cell body and long projecting fibres that transmit rapid trains of nerve impulses or signals. Healthy life can be considered as a by-product of practicing yogic techniques since it has been observed that yoga practitioners are physically and mentally healthier and have better coping skills to stressors than the normal population. Yoga is mind-body technique which involves relaxation, meditation and a set of physical exercises performed in sync with breathing. Being holistic, it is the best means for achieving physical, mental, social and spiritual well being of the practitioners. This can be achieved by systematic and disciplined practice of ashtang (eight-limbed) yoga described by sage Patanjali.

**Cause of stress related psychological disorders :-** WHO estimated that globally over 450 million people suffer from mental disorders. This is likely to incrase to 15 percent by 2020. In India the burden of mental and behavioural disorders ranged from 9.5 to 102 per 1000 population (Reddy et. al, 2013). Uncontrolled chronic stress creates imbalance of the autonomic nervous system (ANS) by decreasing the activity of the parasympathetic nervous system (PNS), which controls body process during normal situation and increasing the activity of the sympathetic nervous system (SNS), which controls the body to deal with stressful situation. As detailed in Figure 1, Stress-related diseases occur because of an accessive stress response in the brain and in the endocrine (hormone) system in reaction to common, everyday sources of physical and psychological stress. The main components of the stress system are the corticotropin-releasing hormone and locus ceruleus- norepinephrine autonomic systems and their peripheral effectors, the hypothalamic pituitary adrenal axis (HPA), and the limbs of the autonomic system. Due to the continued excitation, the HPA axis is set in motion. The HPA axis regulates and helps to control many different bodily processes including one's reaction to stress, immune function, digestion and energy expenditure and storage. The axis is set in motion with release of corticotropin-releasing factor (CRF) from the hypothalamus. CRF then stimulates the anterior pituitary gland to release adrenocorticotropic hormone (ACTH), which subsequently stimulates the adrenal cortex to produce and release cortisol. Stimulation of the sympatetic nervous system causes release of epinephrin, norepinephrin. Excitation of renal sympathetic system stimulate Renin secretion and leads to formation of angiotensin I and II. Angiotensin II causes release of aldosterone, which acts by promoting sodium reabsorption in the renal tubules. Excess cortisol, Renin, epinephrin and norepinephrin secretion leads to a host of related metabolic disturbances and an increased risk for developing a variety of chronic conditions like obesity, heart disease, anxiety, alzhimer's disease, osteoporosis, diabetes, supressed libido, memory problems among other disorders (Chrousos, 2000, Dong et. al., 2015).

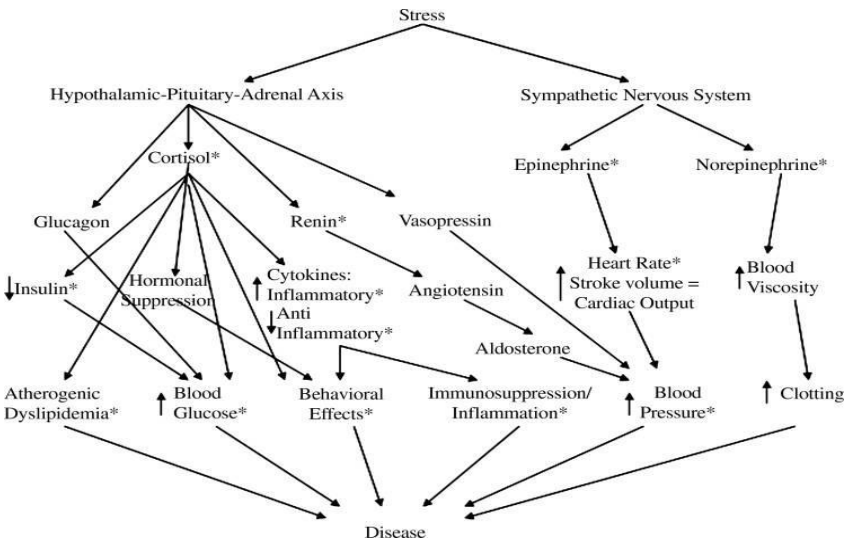


**Fig 1:** Impact of stress on the hypothalamic–pituitary–adrenal axis and the sympathetic nervous system. Yoga has been shown to have significant beneficial effects on these items (Ross and Thomas, 2010).

**Impact of yoga on Neurotransmitters and Hormonal Health**

**Increased production and release of serotonin :-** Serotonin is one such important neurotransmitter that regulates the psychological and physiological functions as well. Serotonin is a potent neurotransmitter required for proper transmission of signals within the neurons. This crucial chemical has a profound impact on our mood and social behavior, appetite and digestion, sexual desire and function, sleep, temperature regulation and contributes greatly to our overall state of well-being. It has been considered as the key factor in mood imbalances and also depression. Major proportion of this neurotransmitter is synthesized within the intestines while some portion is left to be produced in the brain. Yoga and Meditation helps the body release serotonin naturally (Kanchan et. al., 2016). Yoga asana can directly increase the firing rates of serotonin neurons, resulting in increased production and release of serotonin. In addition, there is an increase in the levels of tryptophan (precursor of serotonin) after yoga. Seretonin reduces grey matter density of amygdala and the right prefrontal cortex: brain regions responsible for initiating stress response. Meditation also increases activity in the happiness-producing regions of the brain: the left prefrontal cortex (Mandapaka et al., 2016).

**Improved GABA 'anti-anxiety' Neurotransmitter secretion :**- Best known as body's anti-anxiety neuro-chemical, GABA (gamma aminobutyric acid) is one of the major inhibitory neurotransmitters present in your brain. Deficiency of this chemical can create an array of problems, including anxiety, nervousness, phobias, restlessness, and insomnia. In anxiety the level of GABA reduces (Nemeroff, 2003). According to randomized controlled MRS (magnetic resonance study) conducted in 2010 year, it was observed that GABA level in brain significantly increases immediately after yoga. This is the first study to report positive correlation between thalamic GABA levels and improved mood or decreased anxiety and depression (Streeter et al., 2010). The strongest evidence in benefits of yoga through direct influence on the sympathetic and parasympathetic activity in autonomic nervous system is common evidence. It suggests the respiratory effect of pranayama, visualization and calming effect in dhyana as well as motor movement in asanas reduce sympathetic activation, increases level of GABA, regulate the hypothalamic-pituitary-adrenal (HPA) axis to improve outcome in mood disorders, stress, well-being provide an anxiolytic effect . It has been established that yoga intervention was linked with greater improvement in mood and anxiety and increased levels of GABA (Kanchan et al., 2016; Streeter et al., 2007) .

**Increased Endorphins levels :-** Endorphins are released with physical exertion. They are capable of lowering stress and causing pleasurable sensations and are highly effective in pain modulation and management. During yoga practice endorphins are released into the circulation from a brain region known as the pituitary gland. Once produced, Endorphins bind to specialized receptors located throughout the nervous system. Upon activation, these receptors block the transmission of pain sensation traveling to the brain and inhibit the release of chemicals responsible for inflammation and swelling (Anand and Verma, 2014).

**Increased Oxytocin Hormone :-** Oxytocin plays a role in sexual reproduction, sexual arousal and is released by hypothalamus when we have an orgasm. Presence of oxytocin is important during and after childbirth, for bonding with the baby and milk production. It plays a role in development of pro-social behavior like trust, cooperation and social interaction. The social-occupational functioning of schizophrenic patients improved by increased oxytocin level through yoga. One of the mechanism by which yoga therapy can increase oxytocin synthesis is through stimulating Vagus Nerve. Stimulation of vagus nerve deactivates limbic areas which in turn could modulate the neural circuits involved in emotional processing (Jayaram et al., 2013).

**Increased Dopamine level :-** Commonly known to control brain's reward and pleasure centers, dopamine is a neurotransmitter that helps to regulate movement and emotions. Insufficient dopamine production results in Parkinson's disease or addiction. Any kind of rewards increases dopamine level in the brain Kinser et al., 2012). Brain Research found that Yoga Nidra- a guided meditation that produces deep relaxation increases level of dopamine in the brain by 65 % on an average (Kjaer et al., 2002).

**Discussion :-** Yoga influence the inflammatory processes involved in depression by influence on the vagus nerve thereby increasing the activity of peripheral nervous system and GABA system. Efferent vagal nerve fibers, via the neurotransmitter acetylcholine, exert anti-inflammatory actions. Studies suggest that yoga practices reduce stress-induced allostatic load in three stress reactive systems: the ANS, the HPA axis, and the GABAergic system (see Fig. 2). The yoga components of slow breathing, meditation, relaxation practices, mindfulness of sensations in the body, and physical postures may influence drive on brain pathways to the limbic and cortical areas involved in mood regulation and that influence parasympathetic outflow. Indeed, slow breathing practices found in yoga decrease blood pressure, presumably via enhanced efferent parasympathetic responsiveness. Thus, because inflammation is implicated as contributing to depressive symptoms, activation of the vagal anti-inflammatory pathway could be an important mechanism by which yoga practice could decrease symptoms of depression (Kinser et al., 2012). Yoga reverses the negative impact of stress on the immune system by increasing levels of immunoglobulin as well as natural killer cells. Yoga has been found to decrease markers of inflammation such as high sensitivity C-reactive protein as well as inflammatory cytokines such as interleukin-614 and lymphocyte-1B (Ross and Thomas, 2010). Yoga practices emphasize a shift toward interoceptive processing and the integration of self-regulatory processes across bodily systems (including cardiovascular, neuroendocrine, and musculoskeletal). It facilitates parasympathetic control, improved baroreceptor functioning, increased vagal tone, strengthening of the diaphragm, extinc- tion learning, and early forms of attentional orienting and engagement (Gard et al., 2014).

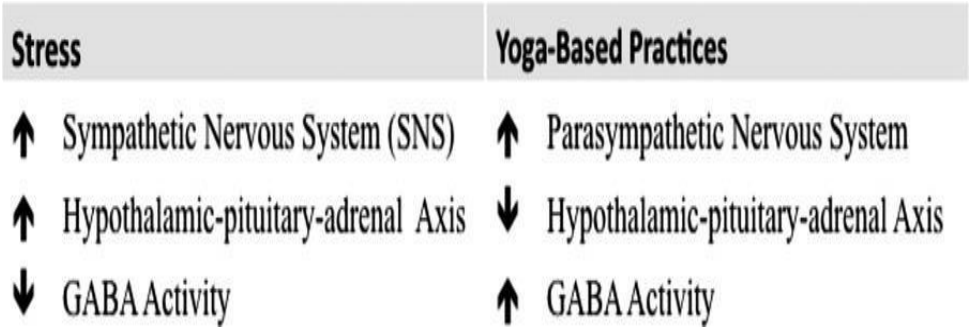


**Fig. 2:** Stress related imbalance corrected by yoga-based practices (Streeter et al., 2012)

Yoga asanas can be powerful practice for anxiety or depression. Yoga improves behavioural social interaction. Enhancing sleep quality to improve psychologic well-being, reducing social isolation, reinforce physical activity and self-care and healthier physical and psychological responses to stress; impairments in anxiety and depression. The breathing used in yoga, such as ujjayi, calm our stress response system and contributes to a state of calm (Kanchan et al., 2016). Yoga brings about better neuro-effector communication, improves strength of the body, increases the optimum functioning of all organ-systems, increases resistance against stress and diseases and brings tranquility, balance, positive attitude and equanimity in the practitioner which makes him lead a purposeful and healthier life.

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