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Yoga's impact on anxiety, depression, and stress-A narrative review

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Abstract
Major Depressive Disorder (MDD) is the second biggest component to the worldwide illness burden as well as one of the primary causes of disability, impacting over 340 million people. One major contributing element to MDD and a prevalent risk factor is chronic stress. One definition of stress is "perceived incapacity to cope." It has been demonstrated that stressful life events cause a series of physiological and psychological alterations affecting the immunological, endocrine, and neurological systems. Stressful can produce autonomic dysfunction, an imbalance in neurotransmitters, and an increase in a number of inflammatory cytokines and stress hormones. By lowering stress, yoga can lessen the symptoms of depression. Research has indicated that yoga has a part in preserving neurotransmitters, autonomic homeostasis, and inflammation. It influences the hypothalamic-pituitary-adrenal (HPA) system axis, the peripheral nervous system including GABA, limbic system activity, inflammatory and endocrine responses. Yoga along with antidepressants can help in reducing the depressive symptoms in patient with MDD. Yoga is an ideal complementary and alternative therapy for mental health disorders.

Keywords: Stress, yoga, depression

Introduction

Stress has been a long-standing practice and is a common, global human experience. "The nonspecific response of the body to any demand" is the general definition of stress. Beneficial stress, or eustress, is the kind of stress that is good for our health (e.g., getting into shape, doing well on examinations, receiving advancements in the job). The stress that is harmful to one's wellbeing is called distress, or unpleasant stress, and it frequently arises from a mismatch among one's demands and the resources available to meet those needs [1]. Each experiences stress in different amounts and for different lengths of time. Insufficient stress can have an impact on performance (meaning lesser motivation or boredom). Long-lasting stress sensations, nevertheless, can have negative effects, including fatigue, low self-esteem, and disturbed sleep [2]. Overstress can cause mental health problems like anxiety and depression as well as behavioural changes including higher drug and alcohol usage, eating disorders, and drinking. Additionally, it has a number of negative health effects, including muscular weakness, headaches, heart problems, and gastrointestinal difficulties [3]. The many coping mechanisms that a person may employ in a stressful situation are referred to as behavioural coping strategies [4]. Dealing is the process of addressing issues in order to release unpleasant feelings, which enables us to keep our emotions in check over the needs and conditions of the moment. It is evident that emotional strain can set off a depressive episode, particularly when the stressor's psychological effects outweigh the person's capacity for coping [5]. Yoga is one of the most beneficial coping strategies for reducing stress, through release of neurochemicals in the brain. Breathing exercises which could be as simple as a simple deep breath concentration to advanced breathing practices which makes one to perceive the effects of meditation, induces complete relaxation [6]. This review article focuses on the pathophysiological mechanism of stress and depression, and the role of yoga in reducing stress and depression.

Pathophysiology

It has been demonstrated that stressful life experiences cause a series of physiological and psychological changes, affecting the immunological, endocrine, and neurological systems [7]. Some of the well-known impacts of stress include stimulation of the hypothalamic-pituitary-adrenal (HPA) axis, activation of the Sympathetic Nervous System (SNS), and the start of an inflammatory response cascade [8]. Anxiety triggers the limbic system in upper cortical regions to transmit impulses to the hypothalamus. Corticotrophin Releasing Factor (CRF) is released when specific regions of the Para Ventricular Nucleus (PVN) are activated [9]. In the meantime, the bloodstream is filled with other neurotransmitters such as serotonin, acetylcholine (Ach), and norepinephrine (NE). Proopiomelanocortin (POMC) and arginine vasopressin (AVP) are produced by CRF acting on corticotrophs and PVN, respectively. Ultimately, POMC splits to yield alpha Melanocyte Stimulating Hormone (α-MSH) and Adreno Cortico Tropic Hormone (ACTH) [10]. In a complementary manner to CRF, AVP stimulates the excessive release of ACTH, which acts on the adrenal cortex to create glucocorticoids (GC) [11]. Simultaneously, SNS releases catecholamines (CC) into the bloodstream. As a result, GCs and CCs are the primary stress hormones that affect various aspects of brain function, such as neuronal development and endurance, hippocampal growth, metabolism, and immunity [11]. Although the neural mechanisms underlying the pathophysiology of stress-induced depression remain unclear, the symptoms of depression indicate frequent involvement of regions including the hippocampus, prefrontal lobe, amygdala, thalamus, corpus striatum, and cingulate cortex [12]. It has been demonstrated that long-term stress also sets off inflammatory reactions, which can impact your physical as well as mental wellness.

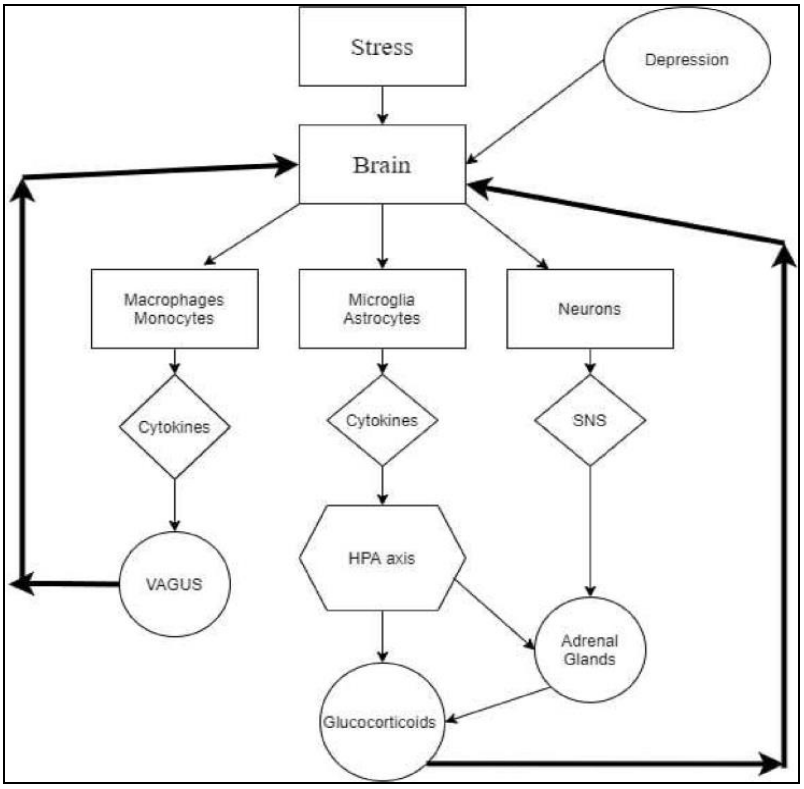

Fig 1: Pathophysiological mechanisms of stress

It is commonly recognised that the human body releases cytokines in reaction to stress, including interleukin-6 (IL-6), interleukin-1β (IL-1β), and tumour necrosis factor-alpha (TNF-α), which have been shown to cause symptoms of depression [14]. These inflammatory markers may impact several central nervous system (CNS) activities, leading to sleep disruption, cognitive impairment, and decreased monoamine levels, all of which compound the symptoms of depression [15]. Furthermore, it has been demonstrated that IL-1β regulates the expression of genes associated with serotonin transport, IL-6 inhibits hippocampal neurons neuronally, and TNF-α can trigger processes that catabolize tryptophan, the main building block for serotonin synthesis [16]. Further investigation in this area may uncover novel neural routes connecting the cytokines produced by stress with somatic and behavioral effects of depression. Increased glucocorticoid stages, of which cortisol is especially significant, are a significant downstream effect of major depressive disorder (MDD) and are found in most yet not every depressed persons [17]. Increased inflammatory cytokines can counteract the effects of cortisol by downregulating cortisol receptor activation, which is why excess levels of cortisol can prove more detrimental when combined with these cytokines [17]. Elevated cortisol levels have the potential to cause harm and degeneration of several cell types, such as hippocampus cells, by hindering the efficient control of glutamate within the cell [18]. Neurosteroids, such as GABA-A, DHEA, and allopregnanolone, are low in untreated depression patients; normal levels are restored with treatment and remission of depression. Stress seems to lower blood levels of BDNF, which you saw produced strong chemicals like glucocorticoids generated in the hippocampus by disrupting neurons in the hippocampus, according to experimental research. ADM therapy appears to prevent or reverse this decrease in BDNF levels [19].

Mechanism of Stress Management through Yoga

Yoga is helpful in managing mental illnesses like anxiety and depression that are brought on by stress. Regularly practicing yoga enhances overall health and encourages physiological improvements like lower blood pressure, blood sugar, and cortisol levels [20, 21]. The primary cause of depression, a psycho-physiological illness, is changes in the metabolism of monoamines (dopamine, serotonin, and adrenaline) [22]. Additionally, central neurotransmitters like gamma-aminobutyric acid (GABA) are crucial in the treatment of depression. Yoga assists in the treatment of depression via a variety of methods. Yoga is a mind-body therapy that has been shown to help with a wide range of psycho-somatic conditions. Yoga incorporates breathing exercises, meditation, physical postures, and moral precepts (yama and niyama) that support emotional cultivation and lessen internal conflict [23]. As per a recent analysis of yoga's effect on stress, a yoga intervention resulted in a significant reduction in stress [24]. Many molecular mechanisms, including those involving the Autonomic nervous system (ANS), the HPA axis, the peripheral nervous system (which includes GABA), limbic system activity, endocrine activities, and inflammatory reactions, have shown that yoga may help alleviate stress [25]. According to earlier research, yoga may have an impact on endothelial function, nitric oxide release, endogenous cannabinoids, opiates, and gene expression [26]. Heart rate variability (HRV), which stimulates the vagal nerve, and baroreflex sensitivity are two areas where yoga is said to have positive, fast impacts [27]. It additionally lessens the release of stress hormones. By reducing vagus nerve stimulation, it additionally lessens the activation and reactivity of the HPA axis and the sympathoadrenal system. This causes parasympathetic stimulation, which in turn causes a shift in activity from sympathetic to parasympathetic.

Yoga shifts the balance from the sympathetic nervous system and the fight–or–flight reaction to the parasympathetic nervous system and the relaxation response. Yoga practice regulates the HPA axis and SNS, both of which could be the reasons for the reduction of stress hormones cortisol and catecholamines release and leads to the reduction of stress and induces relaxation [28].

1. Corticosteroids and catecholamines

Yoga acts on hypothalamus which inhibits the activity of the anterior pituitary gland and decreases the production of ACTH, this reduction in ACTH production affects the adrenal gland and reduces the synthesis of cortisol. Many studies have observed this decrease in cortisol levels after practicing yoga, whereas Cortisol activates phenyl ethanolamine-*N*-methyl transferase (PNMT). Decrease in cortisol production after yoga practices simultaneously decreases PNMT. This decrease in PNMT along with sympathetic inhibition also decreases catecholamine formation. Thus the decreased levels of corticosteroids and catecholamines together decreases the stress responses.

2. Dopamine

Practicing yoga increases the levels of dopamine in the human body. Another study confirmed that, 11C–raclopride binding in ventral striatum decreased by 7.9% while practicing yogic meditation which corresponds to a 65% increase in endogenous dopamine release. Increase in dopamine release concomitantly decreases the stress level.

3. Serotonin

The "serotonin hypothesis" denotes that the diminished activity of serotonin pathways leads to the pathophysiology of depression. Increasing serotonin activity in depressed individuals promotes positive shifts in automatic emotional responses. Yogic practices have been proved to increase the plasma levels of Serotonin. Regular yogic practices increase serotonin levels associated with reductions in monoamine oxidase levels, which is an enzyme that breaks down neurotransmitters and cortisol and thus reduces stress.

4. Melatoni

Melatonin is a regulatory circadian hormone which has a hypnotic and an antidepressive effect. Meditation has been shown to boost melatonin levels by decreasing its hepatic metabolism or increasing its production in the pineal gland. Thus, yoga reduces stress.

5. Noradrenaline

Yoga practices are proved to enhance noradrenalin and decreases the plasma levels of adrenalin which in turn reduces stress.

6. Inflammatory markers

Yoga reduces inflammatory markers such as NK cells, IL 6 and TNF-α and hs-CRP. According to previous study, yogic meditation reduces the activity of NF–B-related transcription of pro-inflammatory cytokines and decreases the transcription of innate antiviral response genes by Interferon Response Factors (IRF1), both of which are regarded important stresses.

7. BDNF

Yogic practices increases the levels of BDNF in the human body. Improvements in BDNF levels after yoga practise may be related to lower stress levels, as evidenced by lower cortisol levels, and improved HRV parameters.

8. Gene expression

Regular yogic practices have an effect at the molecular level and it modifies gene expression positively.

9. Sirtuins

There is a relationship between the Sirtuin1 gene (rs3758391) and depressive disorders, according to studies, and Sirt1 expression in the peripheral blood of depressed people is much lower than in healthy people. By activating SIRT1, The progress of depression-related phenotypes and aberrant dendritic architecture caused by persistent stress exposure will be prevented. According to previous reports, activating Sirt1 may improve mood function and have an antidepressant impact. Researchers have proved that the yoga and meditation-based lifestyle increases sirtuin-1 levels and hence serve the purpose of producing antidepressive effects and reducing stress [28].

10. Proposed psychological mechanism

Psychological mechanisms of the effects of yoga on stress and depressive symptoms has been proved to improve self - awareness, positive attitude towards stress, calmness and mindfulness [25]. Yoga slows the breath, helps to focus on the present and reassure relaxation, slow the breath and focus on the present. It improves self-confidence, attentiveness, relaxing sensations, well-being sensations, an optimistic outlook on life, achieves tranquility of the mind and lowers irritability. Patanjali's Yoga sutras is one of the traditional texts which mentions depression (*dhaurmanasya*) as one of the important distractions of the mind (*chitta vikshepa*) and is considered as an obstacles in the path of yoga. Sage Patanjali mentions many ways to overcome the mental distractions and first of which is one-pointedness (*eka tattwa abhyasa*) which is applied in both pranayama, concentration (*dharana*) and meditation.[28]

Individuals are advised to concentrate on their breathing patterns throughout the practice without any distractions. This mindfulness helps the practitioners to be aware of the present and won't be affected or disturbed by the past incidents. It is evident that deep yogic breathing has many functional benefits, which in turn regulates the imbalances in the ANS and thus alleviates stress by stimulating parasympathetic activity.

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