

## Yoga and Meditation in Promoting Mental Health

**Maherra Desai\*, Munira Kapadia and Rajesh Parikh***Department of Psychiatry, Jaslok Hospital and Research Center, Mumbai, India***\*Corresponding Author:** Maherra Desai, Department of Psychiatry, Jaslok Hospital and Research Center, Mumbai, India.**Received:** August 01, 2019; **Published:** August 29, 2019**DOI:** 10.31080/ASNE.2019.02.0100**Abstract**

Mental health is much more than the mere absence of disease; it encompasses a complete state of well-being. Rapidly evolving social and technological influences - violent media visuals, global terrorism, dynamic economic situation, drug use, family mobility, and the disruption of family structures - result in physical and mental stress. Worldwide, over 450 million adults suffer mental illness each year. Yoga as well as transcendental meditation (TM) practice is found to independently mediate the adverse effects of psychosocial stress by reducing sympathetic activation and enhancing parasympathetic functioning - increased heart rate variability (HRV) and respiratory sinus arrhythmia (RSA); regulating metabolic parameters by reducing cortisol levels and increasing melatonin levels; and enhancing cognition as observed through fewer cognitive failures and greater gray matter volume (GMV) in various brain areas. The present review article aims to summarize the neurobiological benefits of yoga and meditation in facilitating mental and physical health, as well as in the management of mental disorders such as anxiety and depression. The added advantage of minimal cost, ease in learning and avoidance of pharmacological treatment side effects further enhances their application.

**Keywords:** Mental Health; Yoga; Neurobiology; Transcendental Meditation; Anxiety; Depression**Abbreviations**

TM: Transcendental Meditation; HRV: Heart Rate Variability; RSA: Respiratory Sinus Arrhythmia; GMV: Gray Matter Volume; WHO: World Health Organization; UN: United Nations; ANS: Autonomic Nervous System; NE: Norepinephrine; GABA:  $\Gamma$ -Aminobutyric Acid; 5-HT: 5-Hydroxytryptamine; HPA: Hypothalamic Pituitary Adrenal; PTSD: Post-Traumatic Stress Disorder; BDNF: Brain-Derived Neurotrophic Factor; EEG: Electroencephalogram; MSRT: Mind Sound Resonance Technique; GAD: Generalized Anxiety Disorder; RCMRG1C: Regional Cerebral Metabolic Rate Of Glucose Consumption

**Background**

Mental health has been defined by the World Health Organization as, 'a state of well-being in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution

to her or his community' [50]. Hence mental health is much more than the mere absence of disease. It encompasses a complete state of well-being. This state of well-being is increasingly challenged by rapidly evolving social and technological influences. Violent media visuals, global terrorism, dynamic economic situation, drug use, family mobility, and the disruption of family structures can result in physical and mental stress [34].

The effectiveness of yoga and meditation in the management of stress, anxiety and depression has been established by several studies [2,3,9,13,28,32]. This has culminated in the United Nations in 2014 declaring 21<sup>st</sup> of June as International Day of Yoga. In doing so, the U.N. declared, 'The International Day of Yoga aims to raise awareness worldwide of the many benefits of practicing yoga' [45]. The present article aims to summarize the benefits of yoga and meditation in facilitating mental health as well as in the management of mental disorders such as anxiety and depression.

## Introduction

Worldwide, over 450 million adults suffer mental illness each year, independent of their race, religion, gender, or socioeconomic status [50]. Within the United States, roughly 57 million people experience a mental illness in any given year, amounting to 26% of their population [27]. Of these, about 40 million individuals fall into the mild or moderate illness category, comprising mostly of depressive disorders, anxiety disorders, and substance-related disorders [27].

Prevalence data across 44 countries estimate that the lifetime prevalence of anxiety disorders ranges between 0.9% and 28.3% and past-year prevalence between 2.4% and 29.8% [4]. Variance is accounted for by factors such as gender, age, economic status, culture and conflict, and urban population [4]. Anxiety disorders are subdivided into panic disorder, obsessive-compulsive disorder, posttraumatic stress disorder, social anxiety disorder, phobias, and generalized anxiety disorder [10].

Anxiety disorders clinically manifest as physiological symptoms including chest pain, palpitations, tachycardia, insomnia and syncope; accompanied by an intense, unwarranted fear [12]. Underlying the neurobiology of anxiety disorders is an interconnected network with abnormalities in the prefrontal cortex, the limbic system and the autonomic nervous system (ANS). This is accompanied by changes in the neurotransmitters - specifically, norepinephrine (NE), serotonin, and  $\gamma$ -aminobutyric acid (GABA) [31]. The prefrontal cortex (occipital and medial prefrontal cortex) is linked to psychological symptoms of distortions in perception of the meaning of events and modifying behavioral response seen through excessive worry and fear and avoidance of stimuli. Enhanced activity of NE in the event of a stressor or threat, is linked to chronic symptoms of panic attacks, insomnia, startle, and autonomic hyperarousal [21].

This stimulation of the ANS leads to panic like symptoms at a cardiovascular, (eg. tachycardia), muscular (eg. headache), gastrointestinal (eg. diarrhea) and respiratory level (eg. tachypnea). Anxiety disorders are characterized by an excessive response to moderate stimuli, slowed response to repeated stimuli and increase in sympathetic tone of the ANS [11]. Yoga is seen to be more effective than routine exercise with significant effects on the ANS functioning through improvements in deep-breathing ratio and maximum : minimum heart ratio [37].

The decrease in inhibitory signaling of GABA leading to anxiety is suggested by the effectiveness of benzodiazepine and receptor studies [30]. Acute stress, results in an increase in 5-hydroxytryptamine (5-HT) turnover in the prefrontal cortex, amygdala, hypothalamus and nucleus accumbens. Anxiety disorders, especially post-traumatic stress disorder (PTSD), leads to alterations in the hypothalamic-pituitary-adrenal (HPA) axis with an excessive and sustained increase in cortisol levels that could result in hypertension, osteoporosis, immunosuppression, insulin resistance, dyslipidemia, dyscoagulation, and, ultimately, atherosclerosis and cardiovascular disease [10,31].

Emotional regulation and empathy have been neurobiologically linked to reduction in sympathetic and increase in parasympathetic tone. Yoga is postulated to reduce stress and anxiety management by its downregulating effect on the HPA axis which has been linked to panic and post-traumatic stress disorder. The HPA axis - the body's stress response system - is activated during physical or psychological stress. Yoga reduces perceived stress, thereby reducing accompanied physiological arousal, including heart rate, blood pressure and easing respiration [7].

Mental health adversely impacts physical health [8]. Mood and anxiety disorders are often accompanied by physical symptoms of disturbed sleep, exhaustion, chronic headaches, indigestion, body aches, appetite changes and body weight fluctuations. A meta-analyses indicated that depression is most commonly linked to chronic fatigue and irregular sleep patterns, whereas anxiety is linked to stomach pains and irritable bowel syndrome [25]. A survey of 492 older adults found that perception of health was more strongly influenced by perception of stress and impairment rather than illness. Further, the resulting physical symptoms increase susceptibility to illness or prolong recovery duration [8].

The mainstay treatment for psychiatric disorders involves psychopharmacology. However, medications are linked to their accompanying side effects - antipsychotics may result in metabolic changes including weight gain, diabetes and dyslipidemias; antidepressants are linked to cardiovascular and sexual implications [49]. Furthermore, sometimes the therapeutic benefit is incomplete, necessitating complementary forms of illness management [40]. Research suggests that pharmacological treatment for anxiety by itself is not an effective and successful treatment of anxiety. Significantly reduced or completely ameliorated symptoms of anxiety are

possible through a combination of various techniques, including medication, psychotherapy, support groups, and complementary and alternative therapy options, such as yoga [10,12].

Although traditional therapeutic approaches to treating mental health challenges are the mainstay, evidence-based alternative therapies such as yoga and meditation are gaining credibility [9,32]. Besides, over the past few years there is an increasing awareness of the benefits of yoga and meditation in improving mental health and preventing cardiac and other physical diseases.

## Yoga

Yoga, founded in India around 3000 BC [35], comprises of a regimen of physical exercises (asana), breath control (pranayama), and meditation (dhyana) [18]. Yoga has been increasingly recognized as effective in improving health outcomes as well as in the prevention and management of diseases, including anxiety disorders [39].

The asanas, pranayama and dhyana have all been linked to the stimulation of the central nervous system resulting in the release of endorphins, monoamines, and brain-derived neurotrophic factor (BDNF) in the hippocampus [22]. Specifically dhyana, comprising of controlled breathing, relaxation and meditation techniques, has been linked most closely to ameliorating anxiety. Practicing Savitri pranayama—slow, rhythmic, and deep breathing, for 5 minutes can help achieve a state of deep psychosomatic relaxation in those trained in yoga practice. Practicing Shavasana reduces oxygen consumption [33].

Brown and Gerbarg have linked breathing and meditation to reduction in sympathetic and increase in parasympathetic nervous system activity; increased heart-rate variability (HRV) and respiratory sinus-arrhythmia (RSA); and improved EEG synchrony and coherence. Other research has found yoga meditation implicated in increasing the melatonin levels and decreasing cortisol levels. Let's take a closer look at these components [7].

Low levels of heart-rate variability (HRV) and respiratory sinus arrhythmia (RSA) have been associated with anxiety, panic disorder, depression, irritable bowel syndrome, early Alzheimer's and obesity. The improved heart rate variability caused by yoga indicates an improved ability to deal with stress [20].

Enhanced brain functioning and problem solving abilities are linked to neurobiological changes in the form of increased EEG synchrony and coherence, seen after yoga practice [7]. Yoga meditation may also enhance executive brain functioning. Neuroplastic changes are seen in the brains of yoga meditation practitioners in the form of fewer cognitive failures and greater gray matter volume (GMV) in the frontal, limbic, temporal, occipital and cerebellar areas as compared to matched controls [39].

Yoga meditation results in increase in melatonin levels [42]. Increase in melatonin promotes sleep, stimulates the immune system (powerful antioxidant), and reduces blood pressure [29]. Tooley and colleagues observed higher plasma melatonin levels immediately after meditation in experienced meditators as compared to these levels in the same individuals without meditation [42]. Two possible mechanisms causing this effect were proposed. Firstly, meditation has been postulated to reduce blood flow to the liver, resulting in slower metabolization of melatonin. Secondly, yoga increases serotonin levels, which eventually gets converted to melatonin in the pineal gland. An Indian study by Harinath and colleagues also found increased plasma melatonin levels after 3 months of practicing hatha yoga and Omkar meditation. Additionally, they also reported improved cardiorespiratory performance and psychological profiles of healthy adults [24].

Yoga meditation is associated with decreased cortisol levels [3,46]. Higher levels of cortisol are positively correlated to negative affect and depression and physiological symptoms such hypertension and cardiovascular disease [6]. In a study on healthy elderly persons, Bowman and colleagues found a significant increase in vagal activity following nonaerobic form of yoga practice, but not following aerobic exercise [5]. Vagal or parasympathetic activity results in calming the body's stress response systems, and is linked with reduced cortisol levels [19].

Studies examining the beneficial effects of yoga based meditative therapies have demonstrated positive outcomes on anxiety [36]. Mind sound resonance technique (MSRT), involving mindful relaxation using mantra to generate resonance, induces deep physical and psychological relaxation. Pilot study of MSRT technique showed a reduction in state anxiety and enhanced psychomotor functioning in Generalized Anxiety Disorder (GAD) patients [14].

Meditation has been as effective as drugs like imipramine and chlordiazepoxide in the treatment of GAD. Additionally, it had the added advantage of not having problems of habit formation, withdrawal reactions, and concerns of overdosage, commonly linked with pharmacological treatments [47].

### Transcendental Meditation (TM)

TM, formulated by late Maharishi Mahesh Yogi, is a meditation technique based on the ancient Vedic traditions of India that focuses on developing a state of relaxed awareness by avoiding distracting thoughts [43].

TM practice is postulated to mediate the adverse effects of psychosocial stress by reducing sympathetic activation and enhancing parasympathetic functioning. Reduced sympathetic activation, measured by skin conductance levels, was seen in the first minute of meditation and continued at low levels throughout the TM practice [15,44].

Parasympathetic tone, measured by heart rate variability (HRV) and respiratory sinus arrhythmia (RSA), is also affected during TM practice. Research showed increased high frequency HRV in the first minute of meditation followed by high levels throughout the practice [44]; with it being higher during the transcending stage as compared to the other stages [23].

Additionally, TM practice has been linked to increased regional cerebral metabolic rate of glucose consumption (rCMRG1c) in the brain's frontal lobe and reduced rCMRG1c in the primary and secondary visual centers [26]. Subrahmanyam and colleagues linked reduced stress and improved health in practitioners of TM with changes in neurotransmitters [41].

Cumulative findings of a series of meta-analyses comparing studies of nearly 300 independent experimental samples on meditation and relaxation techniques suggest that TM has been postulated to be effective in the reduction of risk factors associated with coronary heart disease. This includes reduction in anxiety [17], blood pressure [38], sympathetic arousal [15,16], excessive alcohol consumption and in the enhancement of psychological health and maturity [1,34].

### Conclusion

The effectiveness of yoga and meditation on the reduction of stress and anxiety has been mentioned in various ancient texts and scriptures [35,48]. With recent research indicating the beneficial neurobiological effects of yoga and its role in mediating the neurotransmitter functioning in anxiety disorders, a renewed surge of acceptance and application of this once ancient Indian practice is being noted. The ease in learning, short regimes and minimal cost associated with yoga and meditation further enhances their application.

### Conflict of Interest

No conflicts of Interest.

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