



Neurophysiological and Psychological Benefits of Yoga: An Evidence-Based Narrative Review

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ABSTRACT:

Yoga, an ancient mind–body practice, has gained global recognition as an effective complementary therapy for enhancing physical, psychological, and neurophysiological well-being. Emerging evidence from neuroimaging, neurochemical and clinical studies highlights its role in modulating brain structure, function and connectivity. Regular yoga practice has been shown to increase grey matter volume in regions associated with attention, memory and emotional regulation, while also enhancing functional connectivity within default mode and fronto-parietal networks. Neurochemical findings suggest that yoga can upregulate γ -aminobutyric acid (GABA), serotonin and dopamine levels, contributing to improved mood and stress resilience. Psychologically, yoga interventions are associated with reductions in anxiety, depression and perceived stress, alongside improvements in emotional regulation, cognitive performance and overall quality of life. These benefits are mediated through mechanisms such as autonomic nervous system balance, hypothalamic–pituitary–adrenal (HPA) Axis modulation and enhanced mindfulness. This review synthesises current neurophysiological and psychological evidence underscoring yoga's potential as a cost-effective, holistic strategy for mental health promotion and neurocognitive enhancement.

Introduction

"Yoga, an ancient Indian discipline, harmoniously integrates physical postures (Asanas), breathing techniques (Pranayama), meditation (Dhyana), and ethical principles. Rooted in spiritual growth and self-realization, yoga has evolved into a globally recognized complementary approach to health. Beyond its well-documented physical benefits, recent research highlights yoga's profound impact on neurophysiological and psychological well-being, showcasing its potential to enhance brain function, emotional resilience, and overall mental health."

"Yoga's neurophysiological effectiveness stems from its ability to regulate the autonomic nervous system, balancing sympathetic and parasympathetic activity, and modulating the hypothalamic-pituitary-adrenal (HPA) axis. Regular practice increases vagal tone, reduces cortisol secretion, and improves homeostatic

regulation. Neuroimaging studies reveal structural and functional changes in key brain regions, including the hippocampus, amygdala, prefrontal cortex, and anterior cingulate cortex, associated with memory, attention, and emotional regulation.

Yoga influences neurochemical pathways, enhancing GABA, dopamine, serotonin, and brain-derived neurotrophic factor (BDNF), which play critical roles in mood regulation and cognitive processing. Psychologically, yoga supports mental well-being by reducing stress, anxiety, depression, and PTSD symptoms, cultivating mindfulness, emotional regulation, and self-awareness.

Clinical studies demonstrate improvements in cognitive functions, including attention, working memory, and executive functioning, particularly in at-risk populations. Yoga's therapeutic applications extend to psychiatric disorders, neurological



conditions, and chronic illnesses, highlighting its versatility.

However, standardizing yoga interventions remains a challenge due to variations in style, duration, frequency, and participant populations, contributing to outcome heterogeneity. Despite this, yoga's benefits in enhancing neurophysiological functioning and psychological health make it a valuable complementary therapy."

Neurophysiological benefits of yoga

Effects of yoga on brain structure and function –yoga induces both structural and functional changes in the brain that support cognitive and emotional well-being. Structurally, it has been shown to increase grey matter volume in the hippocampus, prefrontal cortex and insula, which enhances memory, attention and emotional regulation.⁵ Yoga also enhances hippocampal volume, offering protection against age-related decline and Alzheimer's disease⁶ and increases cortical thickness in regions associated with executive function and decision making.⁷ Functionally, yoga practice strengthens functional connectivity within the default mode network and attention networks, thereby improving focus and reducing mind wandering.⁸ It also regulates neurotransmitters by increasing levels of GABA, dopamine and serotonin, which contribute to reduced anxiety, improved mood and enhanced cognition.⁹ Moreover, yoga reduces amygdala reactivity, leading to better emotional regulation and lower stress responses¹⁰ while simultaneously boosting cognitive functions such as working memory, attention and executive function.¹¹

Effect of yoga on neurotransmitter regulation

"Yoga profoundly impacts neurotransmitter regulation, influencing mood, stress response, cognition, and brain function. Regular practice. Increases GABA levels, promoting relaxation, reducing anxiety, and stabilizing mood. 2. Elevates serotonin (5-HT), improving mood, reducing depressive symptoms, and enhancing emotional stability. 3. Enhances dopamine release, supporting motivation, pleasure, attention, and positive behaviour. 4. Balances norepinephrine levels, reducing hyperarousal while maintaining alertness, improving stress resilience, focus, and cognitive performance. 5.

Stimulates endorphin release, producing analgesic and euphoric effects, contributing to enhanced well-being, pain relief, and stress reduction.

By modulating these neurotransmitters, yoga promotes a balanced and resilient brain, supporting overall mental health and well-being."

Effect of yoga on mental health :

Yoga is increasingly recognized as an evidence-based intervention to improve mental health. Its integrated practice of postures (Asanas), breathing techniques (Pranayama) and meditation (Dhyana) influences neurophysiological systems and psychological processes, resulting in significant benefits for mental well-being.

Yoga exerts wide-ranging psychological benefits by modulating neuroendocrine pathways and promoting emotional well-being. It helps in the reduction of stress and anxiety through regulation of the hypothalamic-pituitary adrenal (HPA) Axis, lowering cortisol levels, increasing parasympathetic activity and reducing sympathetic overdrive, thereby alleviating generalized stress responses.¹⁷ In the management of depression, yoga enhances serotonin and dopamine activity, improves emotional regulation and reduces rumination, with clinical studies demonstrating significant improvements when used as an adjunct therapy.¹⁸ By strengthening prefrontal amygdala pathways, yoga improves emotional regulation and resilience to stress, as evidenced by functional MRI studies showing reduced amygdala reactivity.¹⁹ Furthermore, yoga enhances cognitive functions such as attention, memory and executive control, especially in older adults, where it supports neuroplasticity and provides protection against cognitive decline and dementia.²⁰ In addition, yoga serves as an effective adjunct therapy in psychiatric disorders including PTSD, schizophrenia and substance use disorders, by reducing arousal levels and improving coping mechanisms.²¹ Beyond clinical outcomes, yoga also enhances quality of life and overall well-being, fostering self-awareness, mindfulness, positive mood and life satisfaction while cultivating a sense of meaning, purpose and psychosocial balance in both community and therapeutic settings.²²



Yoga asanas and their benefits:

Yogasana	Benefits	Neurophysiological effect	Reference
Tadasana (Mountain pose)	Improves posture, balance and body awareness	Activates proprioceptors, improves attention and focus	Villemure et al.,2015
Vrukshasana (Tree pose)	Strengthens legs, improves balance and concentration	Enhances vestibular function and cerebral coordination	Gothe & McAuley,2015
Trikonasana (Triangle pose)	Increases flexibility, reduces stress	Activates the parasympathetic system, mental relaxation	Woodyard,2011
Padmasana (Lotus pose)	calms mind, supports meditation	increases parasympathetic activity, alpha brain waves	Streeter et al.,2012
Sukhasana (Easy pose)	reduces anxiety, improves focus	stabilises the autonomic nervous system, and emotional balance	Desbordes et al.,2012
Vajrasana (Thunderbolt pose)	Aids digestion, promotes relaxation	Stimulates the vagus nerve, improves parasympathetic tone	Rocha et al.,2012
Paschimottanasana (Seated forward bend)	Relieves stress, stretches spine	Reduces sympathetic activity, lowers cortisol	Woodyard,2011
Bhujangasana (Bow pose)	Strengthens spine, reduces fatigue	Enhances oxygenation, mood improvement	Streeter et al., 2012
Dhanurasana (Bow pose)	Improves posture, relieves mild depression	Balances sympathetic and parasympathetic activity	Khalsa et al.,2016
Sarvangasana (Shoulder stand)	Boosts brain circulation, calms the mind	Increases cerebral blood flow, parasympathetic stimulation	Villemure et al.,2015
Shirshasana (Head stand)	Improves balance and concentration	Enhances cerebral circulation, cognitive function	Gothe &McAuley,2015
Shavasana (Corpse pose)	Deep relaxation, stress reduction	Lowers heart rate, reduces cortisol and increases alpha waves	Woodyard 2011
Pawanamuktasana (Wind-relieving pose)	Aids digestion, relaxes the spine	Stimulates parasympathetic activity, relieves tension	Rocha et al.,2012



Neurochemical modulation: Yoga modulates neurotransmitters involved in mood and anxiety regulation. Magnetic resonance spectroscopy (MRS) studies show elevated GABA levels in yoga practitioners compared to controls (Streeter et al.,2010).²³ Increased serotonin and dopamine activity may underlie improved mood and motivation, while endorphin released contributes to analgesia and emotional well-being. (Streeter et al., 2012)

Autonomic nervous system regulation: yoga enhances parasympathetic activity through vagal stimulation, improving heart rate variability (HRV) and lowering sympathetic dominance (Streeter et al.,2012).⁹ Some randomized controlled trials (RCTs) report significant reductions in cortisol and inflammatory markers (eg, IL-6) following yoga interventions, though results remain inconsistent (Uebelacker et al.,2010).

Mechanisms linking neurophysiology and psychology²⁴

Yoga promotes psychological and neurophysiological well-being through multiple converging mechanisms. structural adaptations such as enhanced hippocampal and prefrontal regions, support memory, attention and emotional regulation, while neurotransmitter modulation increases the level of GABA, serotonin and dopamine, producing anxiolytic and antidepressant effects. Yoga also fosters autonomic balance by shifting activity toward parasympathetic dominance, thereby enhancing stress resilience and maintaining homeostasis. Through mindfulness training, it improves attention regulation, reduces maladaptive thought patterns and strengthens emotional resilience. In addition, yoga exerts anti-inflammatory effects by reducing pro-inflammatory cytokine activity, which contributes to improved mood regulation and overall mental health.

Discussion:

Yoga exerts profound neurophysiological and psychological benefits through interconnected mechanisms. It enhances neuroplasticity by increasing grey matter volume in the hippocampus and prefrontal cortex, regions essential for memory, learning and emotional regulation.^{25,26} at the neurochemical level, yoga promotes neurotransmitter regulation, elevating GABA levels to improve mood and reduce anxiety, while also modulating serotonin and dopamine to foster

positive affect.^{27,28} by influencing the autonomic nervous system yoga reduces sympathetic overactivity and enhances parasympathetic tone, thereby improving stress regulation and heart rate variability.^{29,30} This is complemented by significant stress hormone regulation, as evidenced by lowered cortisol levels, which reduce allostatic load and overall physiological stress burden.³⁰ Clinically, yoga has been shown in multiple meta-analyses to alleviate anxiety and depression, demonstrating efficacy in both clinical and non-clinical populations.^{31,32} Furthermore, yoga and meditation practices strengthen cognitive function, improving attention, working memory and executive processes.³³ Enhanced emotional regulation is another key benefit, with strengthened prefrontal–limbic connectivity supporting resilience and adaptive responses to stress.^{34,35} Finally, yoga significantly improves sleep quality, increasing sleep efficiency and reducing insomnia, particularly among older adults and individuals with sleep disturbances^{36,37}

Conclusion:

Yoga represents a holistic practice with robust neurophysiological and psychological benefits. Evidence supports its ability to reshape brain structure, enhance neurotransmitter activity and regulate autonomic function, while simultaneously reducing stress, anxiety and depression. these biological and psychological effects position yoga as a cost-effective and accessible adjunct in mental health care. Future longitudinal studies with standardized protocols are needed to confirm causal mechanisms and clinical applicability.

Conflicts of interest: No conflicts of interest among the authors

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