Yoga Therapy's Effects on Stress and Related Variables: Research-Based Insights

By Sasima Pakulanon and Christine Le Scanff

Most yoga professionals know from experience—their own and that of the clients they serve—that the practices can profoundly enhance lives, improving stress management, emotional well-being, mental function, and more. As yoga researchers, we see these effects through an additional lens, one that's worth looking through to complement experiential understanding and deepen knowledge of why the practices work the way they do. Here, we outline the science behind yoga therapy's possibilities for increasing resilience to stress in a time when these skills are sorely needed. This article draws on a recent study we undertook with a small team to investigate some of these mechanisms of action.[1]

The Stress Response

Stress is a term with mostly negative connotations,[2] known to cause everything from emotional upheaval to suicidal thoughts.[3] In this physiological reaction of an organism, several defense mechanisms come into action to confront a situation perceived as threatening or requiring increased demand on the system.

A stressor is a stimulus that threatens homeostasis, and the stress response is the organism's attempt to re-establish the stability of homeostasis.[4,5] There are two sides to stress: In 1976, endocrinologist Hans Selye established the terms *distress* and *eustress* to distinguish between maladaptive and adaptive responses to stress.

The concept of allostasis focuses on adaptation mediators, which promote resilience to stressors; when they are overused or dysregulated, however, these same mediators can also contribute to pathophysiology. The physiological mediators, including hormones, cytokines, and cardiovascular regulation, play a crucial role in maintaining physiological variables in a stable state during the stress response.[6] These physiological mediators, specifically homeostatic mediators,[7] include behavioral alterations, as well as changes in the central nervous system, immunological function, hypothalamic-pituitary-adrenal (HPA) axis, and cardiovascular function.[6] As in the *panchamaya kosha* (five-sheath) model, in this biomedical view each system regulates the others, frequently reciprocally and sometimes indirectly, resulting in a nonlinear network of effects.[2] The stress-response system includes numerous

regulatory pathways: For example, anti-inflammatory cytokines, parasympathetic activity, and glucocorticoid pathways all decrease the production of inflammatory cytokines, whereas sympathetic activity increases inflammatory cytokine production. Parasympathetic activity itself, supporting the rest-and-digest functions, also reduces sympathetic activity (the fight-flee-or-freeze functions).[2]

Stress Biomarkers for Quantifying Effects

Physiological response is considered to be a reliable reflection of stress and has been used as an indicator of psychological and physiological stress in many studies. The stress response involves two primary systems: the autonomic nervous system (ANS) and the HPA axis.

Cortisol, a hormone generated by the HPA axis, is widely utilized as a stress biomarker.[8] Obtaining cortisol levels from saliva samples offers a noninvasive and stress-free alternative to blood plasma and serum and hence is a widely recognized source for steroid analysis.[8]

Another noninvasive measure, heart rate variability (HRV), is defined as the variability of the time between successive heartbeats. Studies in psychology and neuroscience show that HRV represents the dynamic interaction between the sympathetic (represented by LFnu) and parasympathetic (represented by HFnu) branches of the ANS, which is critical for maintaining homeostasis during physiological arousal.[9–11] (LFnu and HFnu, respectively, refer to the low- and high-frequency powers of HRV.)

Evidence for Yoga

According to a meta-analysis in 2019 in *Frontiers in Psychiatry* conducted by Breedvelt et al.,[12] interventions focusing on mindfulness, yoga, or meditation show beneficial effects on symptoms of anxiety, stress, and depression. Prior studies have confirmed that mindfulness training through meditation, which is of course a component of yoga,[13,14] also mediates the associations between the intervention and a reduction in depression symptoms.[14]

Furthermore, meditating for just 13 minutes each day for 8 weeks has been found to reduce anxiety and mood disturbance[15] while increasing positive affect[16] and thereby reducing unpleasant feelings. In addition, both short-term[17] and long-term[17,18] yoga sessions were found to reduce stress. A summary of yoga and mindfulness meditation (as part of yoga practice) on stress and related variables[19] is presented in Figure 1.

Physiological Stress

Studies have looked at how yoga affects stress by measuring cortisol, blood pressure, heart rate, and HRV. Over the course of 10–12 weeks of yoga (with sessions lasting 60–120 minutes), improvements have been seen in how the heart and body handle stress.[17,20,21] Yoga has also been shown to help balance the body's automatic systems, especially in healthy women[17] and mental health workers.[21] One study found that practicing yoga for 35–40 minutes, six times over 3 months (or three menstrual cycles), lowered both heart rate and blood pressure.[20] Other research showed that regular yoga, lasting between 90 and 245 minutes per week for 5–24 weeks, helped to reduce cortisol levels.[22,23,24] Also, a combination of slow breathing and muscle movements in yoga was better at improving HRV and the LFnu:HFnu ratio than conscious breathing alone.[25]

In short, although the majority of research has found that yoga improves physiological stress, other studies have found inconsistent results regarding the efficacy of yoga training on stress related to the cardiovascular system and stress hormones.

Cognitive Function

Studies have found that yoga exercise increases cognitive functioning, particularly memory tasks. Rocha et al. (2012) found that short-term memory in easy tasks increased following 24 weeks of yoga instruction compared to physical activity in groups of healthy soldiers.[22] Gothe et al. (2016) also demonstrated that 8 weeks of yoga training enhanced memory tasks (i.e., partial recall,[1] 2-back accuracy test of working memory[2]) in older persons, indicating that yoga improves memory more than does simple stretching.[26,27] Purohit and Pradhan[28] discovered in 2016 that 12 weeks of yoga improves executive function tasks, including inhibition control, processing speed, and working memory.

"Effects of Yoga and Mindfulness Meditation on Stress-Related Variables: A Randomized Controlled Trial"

As mentioned above, our research team looked into the impact of yoga and mindfulness meditation on stress and other variables.[1] The study employed a randomized controlled design to investigate how an 8-week mindfulness meditation or yoga training program (45-minute sessions three times per week: one instructor-led session and two at-home sessions) reduced stress and related variables.

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LEARNING OBJECTIVES

1. Understand stress and related variables from a scientific perspective.
2. Describe the relevant research-based outcomes of yoga therapy as a mind-body practice.

1. "Partial recall" refers to a specific type of memory task or measure when an individual is asked to remember and recall some, but not all, of the information presented to them.

2. The 2-back accuracy test is a memory task in which participants are shown a sequence of items (e.g., letters or numbers) and must decide whether the current item matches the one shown two steps earlier; the measure tests how well people can remember and track recent information.

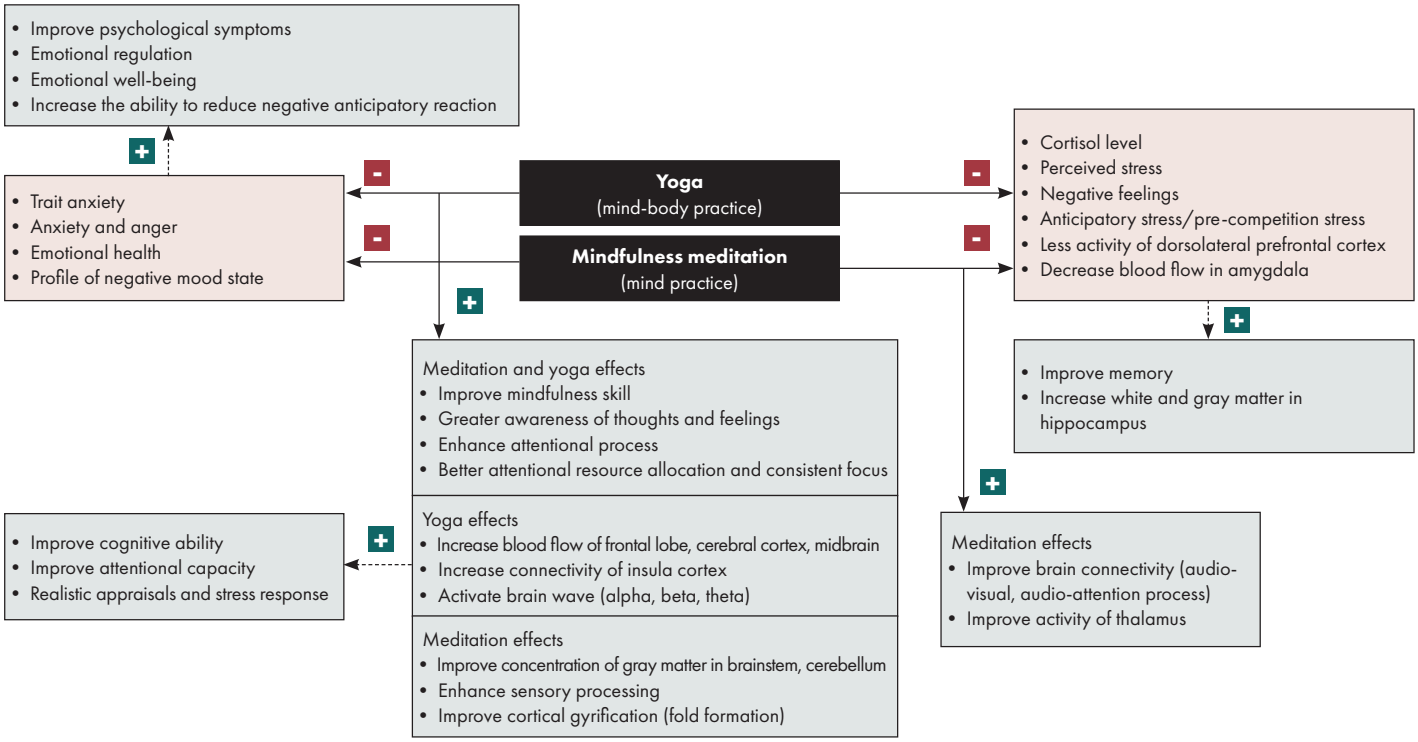

Figure 1. Effects of yoga and meditation on stress and related variables[19]

We randomly assigned 44 healthy people into three groups: (1) a control group (n = 15), (2) a yoga group (n = 13), and (3) a mindfulness group (n = 16). The results of the study revealed that only yoga training increased HF and decreased LF and resting heart rate. Yoga and mindfulness meditation were found to lower stress hormones, with higher levels of DHEA-S (dehydroepiandrosterone sulfate) and lower levels of cortisol after 8 weeks of practice. In addition, our study indicated that only mindfulness meditation alone improved mindfulness skills and increased concentration performance (which is part of cognitive functions). In summary, both yoga and mindfulness meditation were linked to a reduction in stress hormones; mindfulness meditation was associated with improved mindfulness and concentration performance, whereas yoga was associated with improved HRV.

The Mechanisms Behind Yoga's Effects on Stress

Yoga's hypothesized mechanism for affecting mood is HPA-axis modulation, which includes changes in DHEA-S and cortisol,[29] making it a sound coping technique. Furthermore, the practice improves present-moment awareness by teaching people to detect small distractions (feelings, ideas) while continuously returning attention to the meditation object, such as one's breath or specific areas of the body. This mechanism may strengthen attentional stability, allowing for improved affect control and increased focus on the task at hand. The holistic yoga practice that has been studied by Lau et al.[30] and others was mostly mindfulness-based and self-centered, and it appears to have moderated the stress response.[26,27]

The breath- and movement-based practice of yoga also activates the parasympathetic nervous system. Chin and Kales[25] suggested that regular breathing punctuated by alternate muscle contractions is one mechanism that contributes to enhanced parasympathetic tone. According to the polyvagal theory, this could be because combining breathing and movement patterns improves interoception, or knowledge of the internal state of the body's systems, which in turn improves autonomic regulation.

Meditation, as part of the practice of yoga, involves a deliberate focus of ideas to achieve an altered state of consciousness or so-called relaxed alertness and is associated with changes in perception, attention, and cognition.[14] Moreover, mindfulness is defined as the ability to tune in to and control one's own internal processes as well as responses to external stimuli. Mindfulness practice is closely related to the mental balancing model's components of cognition and attention. The mental balance model says that the aspects of attention and cognition are related to mindfulness,[31] which has been thought of as controlling one's attention and focusing on one's experience.[32] To cultivate mindful awareness, one must combine attention with a nonjudgmental orientation toward experiences,[33] as we practice in yoga therapy.

In Short: Why it Works

Research-based evidence highlights yoga as an effective mind-body practice for reducing stress, enhancing mood, and improving cognition. Stress disrupts homeostasis, activating the ANS and the HPA axis, with biomarkers such as cortisol and HRV reflecting physiological stress. Studies show that yoga, through breath control, meditation, and physical postures, lowers cortisol levels, improves cardiovascular function, and enhances parasympathetic activity. Additionally, yoga boosts cognitive function, particularly memory and attention, by fostering mindfulness and self-awareness. Our

own randomized controlled trial found that yoga reduced cortisol, increased HRV, and improved stress regulation, while mindfulness meditation enhanced concentration. Results like these suggest just why yoga therapy offers an effective holistic approach to stress management, emotional well-being, and cognitive enhancement. ●

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