



Psychological and Cardiovascular Effects of Meditation and Yoga

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Abstract

Through the continuous scientific exploration into the deep realms of consciousness, researchers have discovered precious *gems* of knowledge, commonly referred to as meditation and yoga. Such “techniques” have been used for millennia as a means by which to optimize awareness, enhance compassion and empathy, and bring joy to one’s life. In the present chapter, the author briefly reviews some of the most recent and compelling studies addressing the psychological and cardiovascular effects of meditation and yoga. Special emphasis is given to mindfulness-based interventions and the traditional Indian spiritual practice of yoga. Overall, the results indicate that meditation and yoga are efficient strategies

to downregulate psychophysiological arousal, facilitate handling of undesired thoughts, optimize one’s ability to deal with negative emotions, and reduce cardiovascular risk. Nevertheless, it is worth noting that the brain mechanisms that underlie the effects of meditation and yoga on psychological and cardiovascular responses are hitherto under-researched. Future studies are still necessary to further understanding of the long-term effects of meditation and yoga on emotion regulation, psychosocial skills, and cardiovascular health (e.g., blood pressure reduction and prevention of cardiovascular disease).

Keywords

Cardiovascular system · Mindfulness · Mental health · Relaxation techniques

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Introduction

Tenzin Gyatso, the spiritual leader of the Gelug school of Tibetan Buddhism and the fourteenth and current Dalai Lama, once said that “calm mind brings inner strength and self-confidence, so that’s very important for good health.” Indeed, a conspicuous relationship has been frequently reported among one’s state of relaxation, psychological skills, and physical health [1–3]. Compelling evidence indicates that a state of tranquility can induce a series of psychological and physical benefits, such as stress reduction, pain relief, and even longevity [4, 5]. There is, however, a chain of psychophysiological events that underpin the benefits of calmness on physical reactions [6, 7]. In the present chapter, the author will explore the effects of meditation and yoga as valuable techniques to downregulate psychophysiological arousal, facilitate handling of undesired thoughts, optimize one’s ability to deal with negative emotions, and reduce cardiovascular risk. The putative brain mechanisms that underlie the effects of meditation and yoga on psychological and cardiovascular responses will also be briefly discussed herein.

Although meditation and yoga might differ substantially in terms of applicability and methodology, the primary purpose of these techniques is to enhance awareness [8, 9]. In fact, meditation and yoga are utterly entangled. For example, breathing meditation techniques are commonly used during the practice of yoga as a means by which to enhance self-awareness and facilitate the control of certain movement patterns. One of the most impactful and immediate effects of meditation and yoga is the downregulation of psychophysiological arousal [10, 11]. The state of calmness induced during meditative practices naturally facilitates the reappraisal of negative thoughts and emotions, leading to a series of physiological adjustments that are beneficial to one’s health [12, 13].

The psychological mechanisms and reactions associated with meditative practices are highly complex in nature. Recent evidence suggests that through the continuous reallocation of attention toward the present moment, one’s ability to

interpret negative thoughts and emotions is optimized [14, 15]. However, it is noteworthy that meditative practices do not involve solely the control of attention. For example, movements and mantras are commonly used as a means to facilitate the connection between brain and body, ameliorate the detrimental effects of anxiety, and improve one’s quality of life [16]. These techniques serve primarily to partially inhibit processing of task-unrelated thoughts. In some cases, such disruptive thoughts are not exclusively blocked, but instead, they are processed with greater acceptance [17, 18]. This sequence of interpretative mechanisms is key to inducing a state of tranquility that may have residual effects and pervade during other activities of daily life [19, 20].

The effects of meditative practices, such as mindfulness-based interventions and yoga, have been extensively investigated by the scientific community [21, 22]. Although numerous randomized controlled trials have been conducted in this field, the overall quality of most studies has been deemed as “fair” (for details, see Goyal et al. [21]). Therefore, readers are advised to be extremely cautious while interpreting the findings that are readily available in the literature. The present author decided to report in this chapter only a limited number of recent and compelling studies in this field of scientific enquiry. These studies were selected on the basis of relevance, availability, and replicability. It is also important to emphasize that various forms of meditation and yoga differ considerably in terms of techniques and principles. In the present chapter, the author will not describe how exactly these methods differ from one another (for a detailed description, see e. g., [16, 23, 24]).

Effects of Meditative Practices on Psychological Health

A recent randomized controlled trial conducted by Galante and colleagues [25] investigated the effects of an 8-week mindfulness course adapted for university students on psychological distress during the examination period. The results of the

study mentioned above indicated that the meditation program was sufficiently potent to reduce distress scores, maintain well-being, and engender resilience to the accumulation of stress. It is also important to emphasize that this study was designed specifically to recreate a real-life scenario and assess the effectiveness of a mental health support service. Accordingly, the program of meditation assessed by Galante et al. [25] could be easily implemented during the most stressful periods of the academic year as a means to facilitate coping with extreme levels of stress and protect students, to a certain extent, against mental health complications that are recurrently reported.

May et al. [14] have also investigated the effects of meditation on affective responses, well-being, and the five facets of mindfulness (i.e., observing, describing, nonjudging, non-reacting, and acting with awareness) in first-year psychology students and community members. The authors designed a very elegant study using one of the most effective strategies to improve well-being and psychological functioning – holidays. An 8-week A-B-A-B experimental protocol was used to verify whether meditation would be equally efficient in alleviating stress and enhancing one's affective state when compared to holidays. The results of this study indicated that the practice of meditation was sufficient to improve well-being, induce positive affective responses, and made participants more mindful of their physical sensations, thoughts, and emotions. Interestingly, holidays appear to elicit similar effects on affective valence and the facets of mindfulness when compared to days of meditation. The findings reported by May and colleagues [14] are particularly exciting, given the practical implications associated with this study. Whenever the ideal scenario of holidays is not a possibility, a 15-min meditation routine should suffice.

Davis and Hayes have conducted a comprehensive review in 2011 [26], where the authors explored the effects of mindfulness-based interventions on a myriad of psychological constructs such as emotion regulation, response flexibility, reactivity, stress, and anxiety. Mindfulness meditation appears to be sufficiently potent to improve voluntary control of several mental processes and,

consequently, elicit feelings of tranquility and clarity. This chain of psychological processes might ultimately reduce anxiety and optimize the handling of negative thoughts and emotions. Davis and Hayes [26] have also reported that mindfulness-based therapies have the propensity to reduce depressive symptoms and are inversely associated with ruminative thinking. One of the most important aspects to consider during the practice of meditation is the element of non-judgment. As humans, we are naturally designed to provide quick judgments on every situation. Although this is an extremely relevant psychosocial skill, constant judgmental thoughts can lead to ruminative thoughts and may compromise one's ability to accept any given situation. As a result, individuals tend to overreact to certain events – a psychological reaction that can have a negative impact upon appreciation, gratitude, life satisfaction, and compassion. Accordingly, meditative practices that somehow involve elements of nonjudgment are worthwhile strategies to pursue.

The ancient practice of yoga has also been investigated widely by the scientific community [7, 10]. It is worth noting that meditation and yoga are entirely intertwined [9]. It can be considerably challenging to dissociate these terms as both techniques share a common objective [8]. For example, breathing meditation techniques are frequently used during yoga sessions as a means to enhance awareness and facilitate the control of complex movement patterns [27]. Some meditation techniques are also employed in order to ameliorate the detrimental effects of pain and improve resilience [28–31]. Yoga-related movements can also elicit some level of discomfort that is used to direct attention toward the present moment and create a scenario where external influences remain outside focal awareness [32]. This can be considered as a feedback strategy that allows individuals to focus on the movement that is being executed, partially block task-irrelevant thoughts, and improve voluntary control. On some occasions, individuals can also be advised to control their facial expressions given the fact that negative physical reactions might hamper their movements, facilitate the processing of task-unrelated thoughts, and initiate a cascade of

reactions that might ultimately increase one's perceived exertion and evoke negative emotional responses [32, 33].

Yoga has been proposed as a complementary form of therapy and treatment for patients with depression. One of the most exciting findings reported by Bridges and Sharma in 2017 [22] indicates that the practice of yoga is not only sufficient to reduce depression, but yoga can also be used to prevent an increase in depressive symptoms. Moreover, it has been demonstrated that the practice of yoga tends to lessen depressive symptoms and lower the levels of cortisol during early pregnancy and postpartum [34]. More recently, Maddux and colleagues [35] recruited 90 individuals reporting moderate-to-high stress in order to investigate the effects of yoga on psychological health. They have assigned participants to two different programs of yoga to explore the differences between 8- and 16-week interventions. The findings reported by Maddux et al. [35] indicated that a 16-week yoga intervention significantly reduced stress, anxiety, depression, and improved psychological health. Interestingly, an 8-week intervention was also beneficial in terms of lessening perceived stress when compared to both the control group and their baseline values. Additional 8 weeks of yoga intervention can certainly induce more pronounced effects on mental health, but the results of the aforementioned study indicate that even short-term interventions are highly positive in stressed individuals.

Effects of Meditative Practices on Cardiovascular Health

Meditation and yoga have also been proposed as efficient strategies to protect the organism against cardiovascular complications. Meditative practices are considerably effective to downregulate perceived activation, ameliorate anxiety, and reduce blood pressure in healthy individuals and clinical populations [36, 37]. The psychobiological mechanisms underlying the effects of meditation and yoga on cardiovascular health are largely unknown. However, compelling evidence indicates that meditative practices have the potential

to facilitate handling negative thoughts and emotions, induce a state of calmness and presence, and increase the activity of the vagal nerve [38, 39]. In a recent laboratory experiment conducted by Koerten and colleagues [12, 40], the authors investigated the effects of mindfulness, with a focus on nonjudgment, on recovery from stress in perfectionists. In the aforementioned experiment, the authors made use of heart rate variability analysis to further understand the impact of brief mindfulness meditation on cardiovascular responses. The results indicated that a brief mindfulness meditation training session with a focus on nonjudgment of experiences was sufficiently potent to increase heart rate variability and facilitate heart rate recovery from failure in perfectionists. Accordingly, it appears that some forms of meditation are sufficient to make individuals interpret failure with greater acceptance and optimize psychophysiological recovery.

It is logical to assume that some of the effects of meditation and yoga on cardiovascular health occur primarily through indirect pathways [32, 41]. For example, a state of calmness induced by the practice of meditation has the propensity to alleviate stress and, subsequently, decrease heart rate [42]. It is also possible that the continuous practice of meditation and yoga would have residual effects that may naturally make individuals more efficient to handle stressful situations (i.e., individuals become less reactive and defensive) [20, 43]. In such circumstances, meditative practices may function as *shields* to protect our bodies against extreme patterns of emotional reactivity, rumination, and anxiety-related thoughts. As a consequence of such psychological and psychosocial mechanisms, meditation and yoga may influence cardiovascular health to a certain degree [4, 5]. It is of supreme importance to emphasize that short-term interventions are generally sufficient to influence emotional and behavioral outcomes [44]. Conversely, anatomical and physiological changes usually require individuals to engage in meditative practices for long periods of time [45].

Gainey et al. [46] explored the effects of a Buddhism-based walking meditation program on glycemic control, arterial stiffness, stress

hormone, and vascular function in patients with type 2 diabetes mellitus. In the walking meditation condition, participants were asked to repeat the words “Budd” and “Dha” in their minds with each step in an attempt to practice mindfulness and switch attention toward the present moment. The program consisted of a 30-min exercise session performed at 50–70% of maximum heart rate, with a frequency of 3 times/week for a period of 12 weeks. The authors hypothesized that this form of meditation would facilitate attention allocation, induce a state of calmness, and improve endothelium-dependent vasodilation. The findings of this study indicated that glycated hemoglobin was significantly reduced in the group of participants who engaged in the walking meditation program. Moreover, a significant reduction in plasma cortisol was only identified in the walking meditation group. The authors speculated that a significant reduction in plasma cortisol could have influenced inflammatory processes, tension in the vascular wall, and sympathetic activity. Taken holistically, the results of Gainey and colleagues [46] indicate that simple instructions implemented during walking-related tasks to guide attention toward the present moment can lead to multifarious benefits for physical and mental health in patients with diabetes.

It is also relevant to note that the findings in this particular topic vary considerably in terms of efficacy and effectiveness. For instance, a recent randomized controlled trial was conducted to investigate the effects of a yoga intervention plus usual care versus usual care alone following an acute coronary event [47]. The yoga intervention was designed and conducted by a certified yoga teacher and delivered twice a week for a period of 12 weeks alongside the usual care (i.e., physical activity, diet and weight management, and smoking cessation). A wide range of variables was measured, including exercise capacity, physical fitness, and vascular parameters. The authors reported that the addition of a structured 3-month yoga intervention to usual care was not sufficient to influence cardiovascular and neuroendocrine responses. However, it is important to emphasize that only 25 participants in the yoga + usual care group and 35 participants in the usual care group

completed the study. Therefore, the initially planned statistical power was not achieved (i.e., 33 participants in each group).

Effects of Meditation During Physical Activity

Meditation-based interventions have also been used during physical activity as a means by which to enhance one’s affective state and facilitate the control of working muscles [28, 48]. This combination of elements could potentially influence exercise behavior and alter interpretation of internal sensory cues during execution of movements. In a recent experiment conducted by Bigliassi and colleagues in 2020 [44], the authors investigated the effects of an audio-guided mindfulness single session on affective, perceptual, and psychophysiological responses during self-paced walking. Participants were asked to walk 200 m at a pace of their choosing, and a portable electroencephalography system was used to measure the brain’s electrical activity during the walking task. A second experimental condition (i.e., mindlessness meditation) was used to facilitate identification of extremely different patterns of attention allocation during the exercise session. The results of this study indicated that the mindfulness meditation intervention was sufficient to down-modulate perceived activation (i.e., participants felt more relaxed), make participants more aware of their physical sensations, thoughts, and emotions, and enhance their affective states. The psychophysiological data also indicated that the mindfulness intervention was sufficient to enhance interhemispheric connectivity between right frontal and left temporoparietal regions of the brain. The authors hypothesized that this pattern of communication could be indicative of enhanced awareness of affective and cognitive mental states.

Researchers have also theorized that some of the benefits of physical activity could be, to a certain extent, maximized with meditation [3]. Bigliassi and Bertuzzi [3] proposed that meditation-based interventions may have a facilitative effect on exercise behavior. The authors suggested the possibility of using meditation to promote

well-being, improve psychological functioning, and stimulate self-care and preservation. In such circumstances, meditation could potentially facilitate implementation of healthy behaviors (e.g., physical activity), increase exercise adherence, and counteract the detrimental effects of sedentariness. They also provided a series of specific recommendations for researchers and health professionals on how to use meditation prior to, during, and immediately after exercise sessions. For example, prior to commencing an exercise session, meditation can be used to regulate one's arousal state before the warm-up phase. This approach could be implemented as a means by which to reduce ruminative thinking and muscle tension. Accordingly, meditation-based interventions could be used in physical activity programs to maximize the exercise experience and optimize the handling of undesired thoughts that are naturally evoked during certain movement patterns. Sedentary individuals might also want to try meditation as a means to recreate an emotional backdrop against which healthy behaviors can be forged.

In a recent study conducted in my laboratory, I have also identified that meditation has the potential to ameliorate fatigue-related symptoms during exercise tasks performed at moderate intensity (study submitted for publication). The intervention was specially designed by a group of researchers to direct attention towards the present moment and change the way participants process internal sensory cues (example of instruction provided: "If you feel something, simply accept and embrace it. You don't have to control it but remember that it is your decision how this feeling will affect your performance"). Participants were asked to exercise for a total of 8 min at ventilatory threshold (i.e., an index of transition between aerobic and anaerobic metabolism). Throughout the exercise session, participants received instructions via earphones to focus on task-related factors. The experimental manipulation was sufficient to assuage overall exertion and limb discomfort to a greater degree than the other two conditions (i.e., control and counterproof conditions). The abovementioned study indicates that meditation-based interventions can be used to

influence perception of afferent feedback and interpretation of negative bodily sensations. Consequently, exercise-related tasks might be perceived as more enjoyable than under normal conditions.

Conclusions

The results reported herein indicate that meditative practices have the potential to make individuals more conscious of their thoughts, emotions, and physical sensations, ameliorate anxiety, induce a state of calmness, facilitate handling of undesired thoughts, and optimize one's ability to deal with negative emotions. Although the effects of meditation and yoga on cardiovascular health are not well established, there is tentative evidence that such practices can be beneficial in terms of reducing blood pressure and increasing heart rate variability. The exact mechanisms underlying the effects of meditation and yoga on psychological and cardiovascular health are uncharted territories that require further scientific exploration. Researchers and health professionals are encouraged to explore the use of meditation and yoga as a means by which to downregulate psychophysiological arousal and promote self-control; especially, in clinical populations. For example, meditative practices can be used as valuable tools to alleviate stress, increase hope, and improve quality of life in mental health patients. In a world of electronic gadgets and social distance, meditation could bring us closer to ourselves and function as lens of positivity through which we see the world around us.

References

1. Ma X, Yue ZQ, Gong ZQ, Zhang H, Duan NY, Shi YT, Wei GX, Li YF. The effect of diaphragmatic breathing on attention, negative affect and stress in healthy adults. *Front Psychol.* 2017;8:e874.
2. Demarzo MMP, Montero-Marin J, Stein PK, Cebolla A, Provinciale JG, García-Campayo J. Mindfulness may both moderate and mediate the effect of physical fitness on cardiovascular responses to stress: a speculative hypothesis. *Front Physiol.* 2014;5:e105.

3. Bigliassi M, Bertuzzi R. Exploring the use of meditation as a valuable tool to counteract sedentariness. *Front Psychol.* 2020;11:e299.
4. Cramer H, Lauche R, Haller H, Steckhan N, Michalsen A, Dobos G. Effects of yoga on cardiovascular disease risk factors: a systematic review and meta-analysis. *Int J Cardiol.* 2014;173:170–83.
5. Levine G, Lange R, Bairey-Merz C, et al. Meditation and cardiovascular risk reduction: a scientific statement from the American Heart Association. *J Am Heart Assoc.* 2017;6:e002218.
6. Hölzel BK, Carmody J, Vangel M, Congleton C, Yerramsetti SM, Gard T, Lazar SW. Mindfulness practice leads to increases in regional brain gray matter density. *Psychiatry Res Neuroimaging.* 2011;191:36–43.
7. Luu K, Hall PA. Examining the acute effects of hatha yoga and mindfulness meditation on executive function and mood. *Mindfulness.* 2017;8:873–80.
8. de Bruin EI, Formsma AR, Frijstein G, Bögels SM. Mindful2work: effects of combined physical exercise, yoga, and mindfulness meditations for stress relieve in employees. A proof of concept study. *Mindfulness.* 2017;8:204–17.
9. Breedvelt JF, Amanvermez Y, Harrer M, Karyotaki E, Gilbody S, Bockting CLH, Cuijpers P, Ebert DD. The effects of meditation, yoga, and mindfulness on depression, anxiety, and stress in tertiary education students: a meta-analysis. *Front Psych.* 2019;10:e193.
10. Groessl EJ, Liu L, Chang DG, Wetherell JL, Bormann JE, Atkinson JH, Baxi S, Schmalzl L. Yoga for military veterans with chronic low back pain: a randomized clinical trial. *Am J Prev Med.* 2017;53:599–608.
11. Zeidan F, Johnson SK, Diamond BJ, David Z, Goolkasian P. Mindfulness meditation improves cognition: evidence of brief mental training. *Conscious Cogn.* 2010;19:597–605.
12. Koerten HR, Watford TS, Dubow EF, O'Brien WH. Cardiovascular effects of brief mindfulness meditation among perfectionists experiencing failure. *Psychophysiology.* 2020;57:e13517.
13. van der Zwan JE, de Vente W, Huizink AC, Bögels SM, de Bruin EI. Physical activity, mindfulness meditation, or heart rate variability biofeedback for stress reduction: a randomized controlled trial. *Appl Psychophysiol Biofeedback.* 2015;40:257–68.
14. May CJ, Ostafin BD, Snippe E. The relative impact of 15-minutes of meditation compared to a day of vacation in daily life: an exploratory analysis. *J Posit Psychol.* 2020;15:278–84.
15. Troy AS, Brunner A, Shallcross AJ, Friedman R, Jones MC. Cognitive reappraisal and acceptance: effects on emotion, physiology, and perceived cognitive costs. *Emotion.* 2018;18:58–74.
16. Matko K, Sedlmeier P. What is meditation? Proposing an empirically derived classification system. *Front Psychol.* 2019;10:e2276.
17. Hildebrandt LK, McCall C, Singer T. Differential effects of attention-, compassion-, and socio-cognitively based mental practices on self-reports of mindfulness and compassion. *Mindfulness.* 2017;8:1488–512.
18. Wersbe H, Lieb R, Meyer AH, Hofer P, Gloster AT. The link between stress, well-being, and psychological flexibility during an Acceptance and Commitment Therapy self-help intervention. *Int J Clin Health Psychol.* 2018;18:60–8.
19. Daubenmier J, Moran PJ, Kristeller J, et al. Effects of a mindfulness-based weight loss intervention in adults with obesity: a randomized clinical trial. *Obesity.* 2016;24:794–804.
20. Ruffault A, Czernichow S, Hagger MS, Ferrand M, Erichot N, Carette C, Boujut E, Flahault C. The effects of mindfulness training on weight-loss and health-related behaviours in adults with overweight and obesity: a systematic review and meta-analysis. *Obes Res Clin Pract.* 2017;11:90–111.
21. Goyal M, Singh S, Sibinga EMS, et al. Meditation programs for psychological stress and well-being: a systematic review and meta-analysis. *JAMA Intern Med.* 2014;174:357–68.
22. Bridges L, Sharma M. The efficacy of yoga as a form of treatment for depression. *J Evid Based Complement Altern Med.* 2017;22:1017–28.
23. Lindahl JR, Fisher NE, Cooper DJ, Rosen RK, Britton WB. The varieties of contemplative experience: a mixed-methods study of meditation-related challenges in Western Buddhists. *PLoS One.* 2017; <https://doi.org/10.1371/journal.pone.0176239>.
24. Davidson RJ, Kaszniak AW. Conceptual and methodological issues in research on mindfulness and meditation. *Am Psychol.* 2015;70:581–92.
25. Galante J, Dufour G, Vainre M, Wagner AP, Stochl J, Benton A, Lathia N, Howarth E, Jones PB. A mindfulness-based intervention to increase resilience to stress in university students (The Mindful Student Study): a pragmatic randomised controlled trial. *Lancet Public Health.* 2018;3:72–81.
26. Davis DM, Hayes JA. What are the benefits of mindfulness? A practice review of psychotherapy-related research. *Psychotherapy.* 2011;48:198–208.
27. Tellhed U, Daukantaitė D, Maddux RE, Svensson T, Melander O. Yogic breathing and mindfulness as stress coping mediate positive health outcomes of yoga. *Mindfulness.* 2019;10:2703–15.
28. Jay K, Brandt M, Jakobsen MD, Sundstrup E, Berthelsen KG, Schraefel M, Sjøgaard G, Andersen LL. Ten weeks of physical-cognitive-mindfulness training reduces fear-avoidance beliefs about work-related activity. *Medicine (Baltimore).* 2016;95:e3945.
29. Hilton L, Hempel S, Ewing BA, et al. Mindfulness meditation for chronic pain: systematic review and meta-analysis. *Ann Behav Med.* 2017;51:199–213.
30. Ramasubramanian S. Mindfulness, stress coping and everyday resilience among emerging youth in a university setting: a mixed methods approach. *Int J Adolesc Youth.* 2017;22:308–21.
31. Bilderbeck AC, Farias M, Brazil IA, Jakobowitz S, Wikholm C. Participation in a 10-week course of

- yoga improves behavioural control and decreases psychological distress in a prison population. *J Psychiatr Res.* 2013;47:1438–45.
32. Gard T, Noggle JJ, Park CL, Vago DR, Wilson A. Potential self-regulatory mechanisms of yoga for psychological health. *Front Hum Neurosci.* 2014;8:e770.
 33. Reicherts P, Gerdes ABM, Pauli P, Wieser MJ. On the mutual effects of pain and emotion: facial pain expressions enhance pain perception and vice versa are perceived as more arousing when feeling pain. *Pain.* 2013;154:793–800.
 34. Bershadsky S, Trumpfheller L, Kimble HB, Pipaloff D, Yim IS. The effect of prenatal hatha yoga on affect, cortisol and depressive symptoms. *Complement Ther Clin Pract.* 2014;20:106–13.
 35. Maddux RE, Daukantaitė D, Tellhed U. The effects of yoga on stress and psychological health among employees: an 8- and 16-week intervention study. *Anxiety Stress Coping.* 2018;31:121–34.
 36. Loucks EB, Nardi WR, Gutman R, et al. Mindfulness-based blood pressure reduction (MB-BP): stage 1 single-arm clinical trial. *PLoS One.* 2019;14:e0223095.
 37. Goldstein CM, Josephson R, Xie S, Hughes JW. Current perspectives on the use of meditation to reduce blood pressure. *Int J Hypertens.* 2012;2012:e578397.
 38. Peng CK, Henry IC, Mietus JE, Hausdorff JM, Khalsa G, Benson H, Goldberger AL. Heart rate dynamics during three forms of meditation. *Int J Cardiol.* 2004;95:19–27.
 39. Bornemann B, Kovacs P, Singer T. Voluntary upregulation of heart rate variability through biofeedback is improved by mental contemplative training. *Sci Rep.* 2019;9:e7860.
 40. Watford TS, O'Brien WH, Koerten HR, Bogusch LM, Moeller MT, Sonia Singh R, Sims TE. The mindful attention and awareness scale is associated with lower levels of high-frequency heart rate variability in a laboratory context. *Psychophysiology.* 2020;57:e13506.
 41. Malinowski P. Neural mechanisms of attentional control in mindfulness meditation. *Front Neurosci.* 2013;7:e8.
 42. Steinhubl SR, Wineinger NE, Patel S, et al. Cardiovascular and nervous system changes during meditation. *Front Hum Neurosci.* 2015;9:e145.
 43. Wielgosz J, Schuyler BS, Lutz A, Davidson RJ. Long-term mindfulness training is associated with reliable differences in resting respiration rate. *Sci Rep.* 2016;6:e27533.
 44. Bigliassi M, Galano BM, Lima-Silva AE, Bertuzzi R. Effects of mindfulness on psychological and psychophysiological responses during self-paced walking. *Psychophysiology.* 2020;57:e13529.
 45. Laneri D, Schuster V, Dietsche B, Jansen A, Ott U, Sommer J. Effects of long-term mindfulness meditation on Brain's white matter microstructure and its aging. *Front Aging Neurosci.* 2016;7:e254.
 46. Gainey A, Himathongkam T, Tanaka H, Suksom D. Effects of Buddhist walking meditation on glycemic control and vascular function in patients with type 2 diabetes. *Complement Ther Med.* 2016;26:92–7.
 47. Tillin T, Tuson C, Sowa B, et al. Yoga and Cardiovascular Health Trial (YACHT): a UK-based randomised mechanistic study of a yoga intervention plus usual care versus usual care alone following an acute coronary event. *BMJ Open.* 2019;9:e030119.
 48. Edwards MK, Loprinzi PD. Affective responses to acute bouts of aerobic exercise, mindfulness meditation, and combinations of exercise and meditation: a randomized controlled intervention. *Psychol Rep.* 2018; <https://doi.org/10.1177/0033294118755099>.