

YOGA AND CARDIOVASCULAR HEALTH: INTEGRATING CLASSICAL INSIGHTS FROM THE PĀTAÑJALA YOGA SUTRAS WITH CONTEMPORARY SCIENTIFIC EVIDENCE: A NARRATIVE REVIEW

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ABSTRACT

Cardiovascular disease remains a major global cause of morbidity and mortality, driven substantially by modifiable behavioural, metabolic, haemodynamic, and psychosocial determinants. Yoga is increasingly investigated as an adjunctive strategy for cardiovascular prevention and rehabilitation; however, contemporary evidence has largely evaluated yoga as a composite mind–body or lifestyle intervention, with limited integration of its classical philosophical framework. This narrative review examines the relationship between the Pātañjala Yoga framework and contemporary cardiovascular science, with particular consideration of Yama, Niyama, *citta-vṛtti*, *citta-vikṣepa*, *kleśa*, Āsana, Prāṇāyāma, Pratyāhāra, Dhāraṇā, Dhyāna, and their potential cardiovascular correlates. Evidence from randomized controlled trials, systematic reviews, meta-analyses, physiological studies, and classical Sanskrit sources was synthesized across major biomedical and multidisciplinary databases. Contemporary findings indicate that structured yoga practice is associated with favourable effects on blood pressure, selected metabolic risk factors, heart rate variability, autonomic regulation, baroreflex sensitivity, endothelial function, exercise capacity, and quality of life, with emerging evidence in coronary artery disease, myocardial infarction, and heart failure. The classical framework provides a multidimensional model in which behavioural regulation, physical practice, respiratory modulation, and attentional processes may converge through interacting behavioural, psychophysiological, autonomic, vascular, and metabolic pathways. Nevertheless, substantial heterogeneity in yoga protocols, treatment dose, populations, outcome assessment, and methodological quality limits direct comparison and causal inference. Importantly, classical constructs should not be equated a priori with specific biomedical entities; their physiological interpretation requires empirical validation. Integrating Pātañjala Yoga with contemporary cardiovascular research therefore offers a scientifically testable interdisciplinary framework for investigating how a classical system of self-regulation may contribute to multidimensional cardiovascular health and rehabilitation.

KEYWORDS: Pātañjala Yoga; Yoga philosophy; Myocardial infarction; cardiovascular disease; Heart attack

INTRODUCTION

Cardiovascular diseases (CVDs) remain the leading cause of death globally, accounting for an estimated 19.8 million deaths in 2022 and approximately 32% of all deaths worldwide. The majority of these deaths are attributable to heart attack and stroke, while more than three-quarters occur in low- and middle-income countries.

[1] The cardiovascular burden is strongly influenced by modifiable behavioural and metabolic risk factors, including physical inactivity, unhealthy diet, tobacco use, obesity, hypertension, dyslipidaemia, and impaired glucose regulation. [1,2] Physical inactivity is of particular concern, with approximately 1.8 billion adults worldwide not meeting recommended levels of physical activity in 2022. [3] Consequently, contemporary cardiovascular prevention emphasizes sustained lifestyle modification, regular physical activity, healthy dietary practices, weight management, control of blood pressure and metabolic risk factors, and attention to psychosocial health. [4]

Psychological and behavioural factors are increasingly recognized as integral to cardiovascular health. The American Heart Association has highlighted associations between psychological health, well-being, and

cardiovascular health, suggesting that psychological states may influence cardiovascular risk through behavioural and biological pathways. [5] Within this context, mind–body approaches such as meditation, controlled breathing, and yoga have received increasing scientific attention as potential adjunctive strategies for cardiovascular risk reduction and health promotion. Contemporary evidence indicates that yoga may beneficially influence several cardiovascular risk factors, including blood pressure, body mass index, glycaemic measures, and lipid parameters, although the magnitude and consistency of these effects vary across populations and intervention protocols. [6] Importantly, yoga should not be viewed solely as a form of physical exercise. The classical framework of Pātañjala Yoga presents yoga as a multidimensional discipline extending beyond bodily postures. In *Yoga Sūtra* 1.2, yoga is defined as “*yogaś citta-vṛtti-nirodhaḥ*,” emphasizing regulation of the fluctuations of *citta*. The text further describes *abhyāsa* and *vairāgya* as important means for this regulation and subsequently presents the eight-limbed framework of *Yama*, *Niyama*, *Āsana*, *Prāṇāyāma*, *Pratyāhāra*, *Dhāraṇā*, *Dhyāna*, and *Samādhi*. [7] Thus, the Pātañjala framework encompasses ethical conduct, behavioural discipline, physical practice, regulation of breathing, sensory regulation, concentration, and meditation rather than physical postures alone. [7] This broader conceptualization is particularly relevant to cardiovascular science, where autonomic regulation, vascular function, metabolic health, physical activity, and psychological stress are recognized as interconnected determinants of cardiovascular health. Contemporary research has investigated yoga in relation to heart rate variability, autonomic function, blood pressure, endothelial function, arterial stiffness, and cardiometabolic risk, while proposed mechanisms include autonomic modulation, improved vascular function, and modulation of oxidative and stress-related pathways. [6,8,9] Therefore, an integrated examination of classical yogic principles and contemporary cardiovascular evidence may provide a more comprehensive framework for understanding the potential relevance of yoga to cardiovascular health. Such integration should remain critically grounded: classical concepts should not be assumed to be direct equivalents of modern biomedical constructs unless supported by empirical evidence. The present narrative review accordingly examines the classical principles of Pātañjala Yoga alongside contemporary scientific evidence concerning cardiovascular physiology and health, with particular attention to autonomic regulation, blood pressure, vascular function, cardiometabolic risk, and cardiac function.

METHODOLOGY

The present study was designed as a narrative review to integrate classical concepts of Pātañjala Yoga with contemporary scientific evidence related to cardiovascular health. Relevant literature was identified through PubMed, Scopus, Web of Science, Google Scholar, and the Cochrane Library. Additional literature relevant to Indian systems of knowledge and classical Yoga was identified through appropriate traditional-medicine and academic sources. For the classical component, primary Sanskrit sources of the *Pātañjala Yoga Sūtras* together with authoritative translations and established commentarial literature were considered to preserve the original conceptual context.

The literature search combined terms related to Yoga, Pātañjala Yoga, and cardiovascular health. Search terms included “Yoga,” “Yoga therapy,” “asana,” “pranayama,” “meditation,” “Patanjali,” “Pātañjala Yoga Sūtras,” “Yama,” “Niyama,” “Dharana,” “Dhyana,” “Samadhi,” and cardiovascular terms such as “blood pressure,” “hypertension,” “heart rate variability,” “autonomic function,” “coronary artery disease,” “myocardial infarction,” “heart failure,” and “ejection fraction.” Boolean methods were used to refine the search, along with additional searches for specific yogic practices and cardiovascular outcomes.

Original studies, randomized controlled trials, observational and physiological studies, systematic reviews, meta-analyses, and relevant narrative or mechanistic reviews were considered. Classical Sanskrit texts, authoritative translations, and established commentaries were used for interpreting Pātañjala Yoga concepts. Preference was given to human studies with clearly described interventions and relevant cardiovascular outcomes. The available evidence was synthesized around classical yogic principles, individual Yoga practices, and their reported cardiovascular effects, with particular focus on autonomic regulation, heart rate variability, blood pressure, vascular function, cardiometabolic risk, and cardiac function. Classical concepts were interpreted alongside contemporary scientific findings without assuming direct equivalence between traditional constructs and modern biomedical mechanisms.

Classical Foundations of Yoga in Pātañjala Yoga Sūtras

Concept and Definition of Yoga

The classical foundation of this review is primarily derived from the *Pātañjala Yoga Sūtras*, which provide a systematic philosophical and practical framework for Yoga. In contrast to the contemporary representation of Yoga largely as a form of physical exercise, Patañjali places the regulation of mental activity at the centre of the yogic discipline. The foundational statement, “*yogaś citta-vṛtti-nirodhaḥ*” (*Yoga Sūtra* 1.2), defines Yoga in terms of the regulation or cessation of the modifications of *citta*. [7,10] The commentarial tradition further explains *citta* as the psychomental field involved in processes such as cognition and perception, while *vṛtti* refers to its various modifications or functional states and *nirodha* to their restraint or regulation. [7,10] Patañjali subsequently identifies five forms of *citta-vṛtti*—*pramāṇa*, *viparyaya*, *vikalpa*, *nidrā*, and *smṛti* (*Yoga Sūtra* 1.5–1.6), thereby presenting mental regulation as a central component of yogic practice. [7,10]

This classical formulation is important when interpreting contemporary Yoga research because *citta* and *vr̥tti* cannot be considered direct equivalents of modern constructs such as the brain, cognition, or autonomic nervous system. Rather, they represent classical philosophical constructs that may provide a conceptual basis for investigating psychological and psychophysiological processes through modern scientific methods. [12,14]

Abhyāsa and Vairāgya

Patañjali identifies *abhyāsa* and *vairāgya* as fundamental means for regulating the fluctuations of *citta*. Yoga Sūtra 1.12 states, “*abhyāsa-vairāgyābhyām tan-nirodhaḥ*,” describing the regulation of mental modifications through sustained practice and non-attachment. [7,10] *Abhyāsa* is further defined as the effort toward mental stability and is said to become firmly established through prolonged, uninterrupted, and devoted practice (Yoga Sūtra 1.13–1.14). *Vairāgya* represents progressive freedom from attachment toward objects of experience. [7,10] The complementary relationship between these concepts has been examined in philosophical scholarship, where *abhyāsa* is interpreted as sustained practice and *vairāgya* as a process of dispassion or reduction of attachment, together contributing to the stabilization of consciousness. [11] From a contemporary perspective, this framework may offer a conceptual basis for discussing sustained engagement, self-regulation, and behavioural consistency in Yoga practice. However, these classical concepts should not be directly equated with modern constructs such as treatment adherence or behavioural compliance, as their philosophical scope is considerably broader. [11]

Kleśa and Psychological Disturbance

The Pātañjala system further explains sources of mental disturbance through the concept of *kleśa*. Yoga Sūtra 2.3 identifies five *kleśas*: *avidyā*, *asmitā*, *rāga*, *dveṣa*, and *abhiniveśa*. [7,10] Patañjali describes *avidyā* as the underlying field from which the other afflictions arise and subsequently explains *asmitā* as misidentification, *rāga* as attachment, *dveṣa* as aversion, and *abhiniveśa* as an instinctive clinging to life (Yoga Sūtra 2.4–2.9). [7,10] Within the classical framework, these concepts represent patterns of cognition, identification, attachment, aversion, and psychological reactivity. Contemporary interpretations of Pātañjala Yoga have considered such constructs within broader models of mental functioning and consciousness. [12,14] For cardiovascular research, however, the *kleśas* should not be regarded as direct equivalents of stress, anxiety, depression, or cardiovascular risk. Their potential relevance is better considered at a conceptual level in relation to mental reactivity, emotional regulation, and behavioural processes that may influence psychophysiological states.

The Aṣṭāṅga Framework of Pātañjala Yoga

The multidimensional nature of Pātañjala Yoga is explicitly expressed in Yoga Sūtra 2.29, which identifies eight components: *Yama*, *Niyama*, *Āsana*, *Prāṇāyāma*, *Pratyāhāra*, *Dhāraṇā*, *Dhyāna*, and *Samādhi*. [7,10] These components encompass ethical discipline, personal observance, physical posture, regulation of breathing, sensory withdrawal, concentration, meditation, and meditative absorption.

Yama and *Niyama* establish behavioural and personal disciplines, while *Āsana* is described as “*sthira-sukham āsanam*” (Yoga Sūtra 2.46), emphasizing steadiness and ease. [7,10] *Prāṇāyāma* is subsequently introduced as the regulation of inhalation and exhalation (Yoga Sūtra 2.49–2.53), providing a transition from physical stability toward regulation of breathing. [7,10]

The final four limbs—*Pratyāhāra*, *Dhāraṇā*, *Dhyāna*, and *Samādhi*—represent progressively internal dimensions of yogic practice. *Pratyāhāra* involves withdrawal of the senses from their objects (Yoga Sūtra 2.54–2.55), *Dhāraṇā* involves concentration on a particular locus (Yoga Sūtra 3.1), and *Dhyāna* describes the continued flow of cognition toward that object (Yoga Sūtra 3.2). *Samādhi* represents a further refinement of this process (Yoga Sūtra 3.3). [7,10] Contemporary experimental research has examined *Dhāraṇā* and *Dhyāna* separately and reported differences in autonomic, respiratory, electrophysiological, and attentional measures, although the evidence remains limited and heterogeneous. [13]

Modern studies frequently investigate selected components, particularly *Āsana*, *Prāṇāyāma*, and meditation rather than the complete eight-limbed system. [8,9] Recent research has also highlighted substantial variation in how Yoga interventions are defined and operationalized, with many studies focusing primarily on physical, breathing, and meditative components while giving comparatively less attention to *Yama* and *Niyama*. [15]

Taken together, the *Pātañjala Yoga Sūtras* present Yoga as an integrated discipline involving mental regulation, behavioural discipline, physical practice, breath regulation, sensory control, concentration, and meditation.

Individual Yogic Components and Cardiovascular Relevance

Yama and Niyama

Within the Pātañjala framework, *Yama* and *Niyama* constitute the behavioural and self-regulatory foundation of yoga, encompassing ethical restraint, personal discipline, contentment, self-observation, and regulation of conduct. Their potential relevance to cardiovascular health may be mediated through behavioural adherence, psychological regulation, and stress-related psychophysiological processes rather than through direct physiological effects. Contemporary theoretical models of yoga support interactions among cognitive, emotional, behavioural, and autonomic regulation, but do not establish cardiovascular effects attributable specifically to *Yama* or *Niyama*. [16] In a randomized trial, an ethics-oriented Aṣṭāṅga-yoga programme produced greater reductions in BMI and hip circumference than general Yoga in adults with abdominal obesity, with additional differences in quality-of-life measures; however, cardiovascular endpoints were not directly evaluated. [17] Thus, current evidence for *Yama* and *Niyama* remains indirect, and their independent contribution to blood pressure, autonomic function, vascular function, or cardiac performance requires component-specific investigation.

Āsana

Āsana represents the postural component of Yoga. Although Pātañjali characterizes *Āsana* primarily through stability and ease, contemporary research has predominantly examined it as a form of physical activity involving postural loading, stretching, muscle contraction, and controlled movement. [18,19] Acute cardiovascular responses vary according to posture and its physiological demands. In 22 healthy young adults, different Yoga postures produced significant changes in heart rate and systolic and diastolic blood pressure, with the magnitude and direction of response differing across postures. [19] Similarly, a study evaluating cardiovascular responses during Hatha-yoga practice showed that the haemodynamic response differed by posture, indicating that Yoga postures cannot be assumed to produce a uniform acute cardiovascular response. [18]

In 16 healthy women, a 90-minute Bikram Yoga session markedly increased heart rate and estimated myocardial oxygen demand. At the same time, diastolic blood pressure generally declined, indicating significant acute cardiovascular responses to exercise and heat. [20] Therefore, acute responses to *Āsana* should be distinguished from the potential chronic adaptations associated with regular practice.

Longer-term interventions provide evidence for possible improvements in cardiovascular risk factors. Randomized trials among individuals with elevated blood pressure have reported reductions in blood pressure following Iyengar or structured Yoga programmes. [21,22] A multicentre randomized trial involving 121 hypertensive participants reported significant between-group reductions of 7.66 mmHg in systolic and 3.86 mmHg in diastolic blood pressure after a three-month health-worker-led Yoga intervention. [22] Yoga has also been investigated in relation to vascular function. In elderly individuals with increased pulse pressure, a 12-week Yoga intervention produced greater improvements in arterial stiffness, blood pressure, endothelial function, and selected autonomic measures compared with brisk walking. [23] However, findings are not uniformly positive: a 12-week Hatha-yoga intervention did not significantly improve brachial flow-mediated dilation or carotid arterial compliance, despite reductions in total cholesterol and hba1c. [24] These findings indicate that cardiovascular effects of *Āsana* may depend on the specific protocol, intensity, duration, population, and comparator.

Prāṇāyāma

Prāṇāyāma is described in the Pātañjala Yoga Sūtras in relation to the regulation of breathing. Contemporary research indicates that controlled breathing can influence cardiovascular autonomic regulation through respiratory–cardiac interactions. In a crossover trial involving healthy adults, different components of pranayama produced significant increases in RMSSD, a time-domain measure of heart rate variability, indicating acute modulation of cardiac autonomic activity. [25] In patients with primary hypertension, three months of Sheetalī pranayama produced significant reductions in blood pressure together with improvements in time- and frequency-domain HRV parameters suggestive of greater parasympathetic influence. [26]

Slow breathing has also been linked to baroreflex regulation. In patients with essential hypertension, breathing at approximately six breaths per minute reduced systolic and diastolic blood pressure and significantly increased baroreflex sensitivity. [27] Among yoga practitioners, slow breathing has similarly been associated with greater parasympathetic activity and baroreflex sensitivity together with lower systolic blood-pressure variability compared with yoga-naïve participants. [28] Evidence for specific breathing techniques is also emerging: a meta-analysis of randomized controlled trials found significant reductions in systolic and diastolic blood pressure with alternate-nostril breathing, although substantial statistical heterogeneity was reported. [29] A randomized controlled trial involving 520 healthy adolescents practicing Bhramari pranayama for six months demonstrated significant improvement in time-domain HRV parameters toward a parasympathetic pattern. [30] a systematic review and meta-analysis of seven randomized trials involving 683 participants with hypertension reported significant reductions in heart rate and systolic blood pressure following pranayama, while effects on diastolic blood pressure and HRV were less consistent. [31]

Overall, the available evidence suggests that, among the classical components of Yoga, *Āsana* and, in particular, *Prāṇāyāma* have a more substantial contemporary cardiovascular evidence base. Nevertheless, heterogeneity in techniques, breathing frequency, intervention dose, duration, participant characteristics, and outcome assessment limits direct comparison across studies. [18,25,29,31]

Pratyāhāra, Dhāraṇā and Dhyāna

The latter limbs of Pātañjala Yoga progressively shift the emphasis from external practices toward regulation of sensory activity, attention, and consciousness. *Pratyāhāra* is described as the withdrawal of the senses from their respective objects (Yoga Sūtra 2.54–2.55), while *Dhāraṇā* refers to fixing the mind on a particular locus (3.1) and *Dhyāna* to the uninterrupted flow of attention toward that object (3.2). [10] From a contemporary psychophysiological perspective, these practices may be relevant to the regulation of attention, mental arousal, and autonomic activity. In a controlled physiological study involving 30 healthy participants, *Dhāraṇā* and *Dhyāna* were associated with distinct changes in autonomic and respiratory variables; during *Dhyāna*, heart rate and respiratory rate decreased, while high-frequency HRV and other indices associated with parasympathetic activity increased. [32] These findings provide preliminary physiological support for the possibility that specific meditative states described within the Yoga tradition can be accompanied by measurable autonomic changes. However, the available evidence remains limited by small samples, differences in meditation techniques, and variability in experimental designs. Contemporary evidence from meditation research also suggests possible reductions in psychological stress and blood pressure, although cardiovascular effects remain heterogeneous and the certainty of evidence varies across outcomes. [33]

Samādhi

Samādhi represents the most internally refined limb of Pātañjala Yoga and is described in Yoga Sūtra 3.3 as a state in which the object of meditation becomes predominant in consciousness. [10] Because *Samādhi* is a classical experiential and philosophical construct rather than a standardized biomedical intervention, it should not be directly equated with a specific cardiovascular or neurological biomarker. Nevertheless, preliminary contemporary research has attempted to characterize its physiological correlates. A recent electrophysiological investigation of an experienced yogi during approximately 30 minutes of *Samaadhi* reported marked reductions in respiratory amplitude together with distinctive cardiac, muscular, and EEG patterns. The investigators emphasized that these observations represent preliminary electrophysiological evidence and require replication using contemporary technologies and larger samples. [34] Therefore, within the context of cardiovascular science, *Samādhi* should presently be interpreted primarily as a classical concept with emerging physiological observations rather than as an established cardiovascular state or therapeutic intervention.

Contemporary scientific evidence on yoga and cardiovascular health

Contemporary evidence indicates that yoga favorably influences several established cardiovascular risk and functional parameters. In a meta-analysis of 64 randomized controlled trials (RCTs; n=16,797), yoga significantly reduced systolic blood pressure (−4.56 mmHg), diastolic blood pressure (−3.39 mmHg), BMI, HbA1c, LDL cholesterol, and other lipid parameters [6]. A subsequent systematic review and meta-analysis of 30 RCTs in individuals with prehypertension or hypertension similarly demonstrated reductions in systolic and diastolic blood pressure [35]. Reductions in resting heart rate and changes in HRV have also been reported, supporting an effect on cardiovascular autonomic regulation [36,37]. However, the direction and magnitude of HRV changes vary across studies according to intervention characteristics, respiratory pattern, baseline autonomic status, and methodological approach [38].

Vascular outcomes provide further evidence of cardiovascular effects. In a systematic review of 18 studies including 1,043 participants, yoga improved endothelial function in 12 studies; a meta-analysis of controlled trials demonstrated a significant improvement in brachial flow-mediated dilatation (FMD). [40] Evidence for arterial stiffness is less consistent: a systematic review reported beneficial effects in some interventions, whereas other controlled studies found no significant change in pulse-wave velocity or arterial compliance. [41,42] In patients following myocardial infarction, a 12-week Yoga-based cardiac rehabilitation intervention also improved blood-pressure variability and baroreflex sensitivity compared with enhanced standard care, providing evidence of effects on short-term cardiovascular regulatory mechanisms. [39]

Metabolic outcomes are broadly concordant with these findings. Meta-analyses have demonstrated reductions in BMI and hba1c and favourable changes in total cholesterol, LDL cholesterol, triglycerides, and HDL cholesterol. [6,43,44] In established coronary heart disease, a meta-analysis of seven rcts involving 4,671 participants reported improvements in health-related quality of life, blood pressure, BMI, triglycerides, and HDL cholesterol, whereas effects on major cardiovascular events remained inconclusive. [45] Evidence in myocardial infarction is comparatively limited in this section because disease-specific Yoga-based rehabilitation has been addressed separately; the large Yoga-care trial nevertheless demonstrated improved self-rated health and functional recovery following acute MI. [46]

Heart-failure evidence remains smaller but clinically relevant. A systematic review of six randomized trials involving 296 patients reported improvements in selected functional and patient-reported outcomes. [47] A meta-analysis of 11 RCTs involving 552 participants found significant improvements in peak VO₂, exercise capacity, quality of life, 6-minute walk performance, and NT-proBNP, but not in pooled LVEF. [48] Individual randomized studies have nevertheless reported improvements in LVEF, NT-proBNP, myocardial performance, and quality of life following yoga added to standard medical therapy. [49,50] Overall, current evidence supports favourable effects of yoga on blood pressure, autonomic regulation, endothelial function, selected metabolic risk factors, exercise capacity, and patient-reported outcomes, while evidence for arterial stiffness, ventricular function, and hard cardiovascular outcomes remains heterogeneous or insufficient. [51]

Classical yogic constructs and contemporary cardiovascular correlates

The Pātañjala framework describes yoga as a progressive process involving behavioural discipline, postural practice, respiratory regulation, and attentional control. Yama and Niyama may be conceptually related to behavioural self-regulation and psychological adaptation; however, direct empirical evidence linking these individual constructs to cardiovascular outcomes remains limited. [16,17] Accordingly, their proposed relevance to cardiovascular health should be considered a conceptual association rather than an established causal pathway. Āsana has more readily measurable physiological correlates, including changes in heart rate, blood pressure, vascular function, and physical fitness. [18-24] Prāṇāyāma provides a more direct physiological interface through controlled respiratory modulation, with reported effects on HRV, baroreflex sensitivity, heart rate, and blood pressure. [25-31] Nevertheless, these findings are derived from heterogeneous interventions and populations, and the observed changes cannot be attributed to a single yogic component without component-specific trials.

Dhyāna has been associated with alterations in autonomic and respiratory variables, including reductions in heart and respiratory rates and changes in parasympathetic-associated HRV indices. [32,33] These findings support the presence of measurable physiological correlates during meditation but do not establish that Dhyāna directly modifies cardiovascular disease pathways. Overall, the available literature permits a functional correlation between selected yogic practices and cardiovascular physiological measures, but does not justify treating classical

constructs such as self-regulation, Prāṇāyāma, or Dhyāna as direct biomedical equivalents. Interpretation should therefore remain proportional to the level of empirical evidence, with particular caution regarding mechanistic inference and extrapolation from surrogate physiological outcomes to clinical cardiovascular endpoints.

Limitations and evidence gaps

The current evidence base is constrained by substantial heterogeneity in yoga interventions, including differences in practice components, intensity, session duration, frequency, treatment dose, instructor expertise, and comparator conditions. [15,44] Consequently, interventions labelled as “yoga” are not directly comparable, limiting pooled inference and reproducibility. Several studies, particularly those evaluating HRV and autonomic outcomes, have also been limited by small samples, short follow-up, incomplete intervention reporting, and methodological variation. [37,38] Differences in outcome definitions and measurement protocols further complicate interpretation, particularly for HRV indices, vascular measures, and echocardiographic parameters. An additional limitation concerns translation between classical yogic constructs and contemporary biomedical frameworks. Constructs such as prāṇa, citta, and dhyāna should not be equated a priori with specific physiological systems or biomarkers; proposed relationships should remain empirically testable hypotheses rather than established mechanisms. [10,14] As a narrative review, this synthesis is also subject to potential selection and interpretive bias and does not provide a formal quantitative estimate of treatment effects.

Future cardiovascular trials should therefore employ adequately powered, multicentre designs with standardized and reproducible yoga protocols, explicit reporting of individual Pātañjala components, treatment dose, adherence, and instructor characteristics. Integrated assessment of HRV, blood pressure, baroreflex sensitivity, endothelial function, arterial stiffness, metabolic markers, echocardiographic indices, and quality of life, together with longer follow-up and clinically relevant cardiovascular endpoints, would strengthen causal inference and facilitate translation into evidence-based cardiovascular rehabilitation.

CONCLUSION

Pātañjala Yoga represents a multidimensional framework in which ethical discipline, behavioural regulation, physical practice, respiratory control, and meditative processes are integrated within a progressive model of self-regulation. From a cardiovascular perspective, this framework provides a broader conceptual basis than exercise-based interpretations of yoga alone. Yama and Niyama may contribute to behavioural and psychological regulation, while Āsana provides a physical stimulus capable of influencing haemodynamic and functional adaptation. Prāṇāyāma introduces controlled respiratory modulation with measurable effects on autonomic cardiovascular regulation, and Dhyāna is associated with alterations in psychophysiological arousal and autonomic indices. [10,16,18-33]

Contemporary evidence indicates that yoga is associated with favourable changes across several cardiovascular domains, with the most consistent evidence observed for blood pressure and selected cardiometabolic risk factors. Randomized and meta-analytic evidence demonstrates reductions in systolic and diastolic blood pressure, BMI, glycaemic indices, and lipid parameters, while additional studies indicate potential improvements in HRV, baroreflex sensitivity, endothelial function, and exercise capacity. [6,35,37-45] These findings suggest that yoga may influence cardiovascular health through convergent behavioural, autonomic, vascular, and metabolic pathways rather than through a single physiological mechanism. The observed effects are particularly relevant in the context of cardiovascular prevention and rehabilitation, where modification of multiple risk determinants is clinically important.

Evidence from established cardiovascular disease further supports the potential role of yoga as an adjunctive intervention. In coronary heart disease, yoga-based interventions have demonstrated improvements in quality of life and selected cardiovascular risk factors, while Yoga-CaRe after acute myocardial infarction improved self-rated health and return to pre-infarct activities. [45,46] In heart failure, available trials suggest improvements in exercise capacity, quality of life, and NT-proBNP, although evidence for improvement in LVEF remains inconsistent. [47-51] Thus, current evidence supports the use of yoga primarily as a complementary component of comprehensive cardiovascular risk management and rehabilitation rather than as a substitute for guideline-directed medical or exercise-based care.

A central implication of this synthesis is that the cardiovascular relevance of yoga should be interpreted at both classical and biomedical levels without conflating the two. Concepts such as citta, prāṇa, Dhyāna, or self-regulation provide theoretically relevant constructs, but they should not be treated as direct equivalents of the autonomic nervous system, vagal activity, or other specific biological mechanisms in the absence of empirical validation. [10,14] Contemporary physiological findings may establish correlates of particular practices, but they do not, by themselves, demonstrate the mechanisms proposed within classical yoga philosophy. Similarly, improvements in surrogate outcomes such as HRV, blood pressure, FMD, or NT-proBNP should not be extrapolated automatically to reductions in cardiovascular morbidity or mortality.

Overall, the literature supports a scientifically plausible and clinically relevant association between structured yoga practice and multiple dimensions of cardiovascular health, particularly blood pressure regulation, autonomic function, vascular health, metabolic risk, functional capacity, and quality of life. However, substantial heterogeneity in intervention protocols, treatment dose, participant characteristics, outcome assessment, and methodological quality limits direct comparison and definitive causal inference. Future investigations should therefore move towards standardized, adequately powered, multicentre trials that explicitly define the yogic

components delivered and evaluate integrated physiological and clinical outcomes, including HRV, blood pressure, baroreflex sensitivity, endothelial function, arterial stiffness, metabolic biomarkers, echocardiographic measures, quality of life, and long-term cardiovascular events. Such an approach may enable Pātañjala Yoga to be evaluated not merely as a generic mind-body intervention, but as a theoretically coherent and empirically testable multidimensional model within contemporary cardiovascular science.

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