Review Article

Impact of Yoga beyond Physical Training on the Cardiovascular System: An Updated Review

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Abstract

Cardiovascular disease (CVD) poses a significant health challenge in both developing and developed nations, with unparalleled morbidity, mortality, and economic tolls. Primary prevention of CVD through lifestyle modifications has been emphasized to address this issue. Yoga, an ancient practice dating back thousands of years with roots in the Harappan and Mohenjo-Daro civilizations, offers a potential solution. Hatha yoga, which includes physical movements and breathing techniques, is the most commonly practiced form today. The health benefits of yoga have recently gained attention and are being researched globally. Yoga is beneficial in both primary and secondary prevention of diseases, particularly CVD and its risk factors.

This review aims to explore the physiology of yoga, recent studies on its effect on the prevention and control of CVD, and the clinical implications of these findings.

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Introduction

Cardiovascular disease (CVD) significantly impacts the general population, affecting around 7% of adults aged 20 or older.[1] In 2019, CVD accounted for a staggering 17.9 million deaths worldwide, representing 32% of all global deaths.[2] Globally, the estimated number of CVD cases is 523 million.[3] CVD is responsible for nearly a quarter of disability-adjusted life years lost due to non-communicable diseases.[4] Low-to middle-income countries bear a disproportionately high burden, accounting for over 80% of CVD deaths.[4] Moreover, CVD imposes a substantial economic burden, with annual expenditures in the United States estimated between $320 and $457 billion.[5,6] Thus, controlling and curbing the disease is crucial. Lifestyle modification is one of the simplest and most cost-effective methods for reducing CVD morbidity and mortality. This article explores the role of yoga in mitigating the CVD

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burden on society.

A Brief History of Yoga

Yoga has its roots in the ancient civilizations of Harappa and Mohenjo-Daro, dating back centuries.[7] Derived from the Sanskrit word "Yuj," meaning "to unite," yoga is believed to be a discipline that unites inner consciousness with universal consciousness, fostering a healthy body and mind.[8] Patanjali first described the principles of yoga authoritatively in his text Yoga Sutra.[9] While modern perceptions of yoga often focus on "asanas" (physical movements), its philosophy extends far beyond physicality. Yoga is based on 4 core principles.[9] First, the human body consists of multiple interrelated dimensions inseparable from one another, each affecting others in health and illness. Second, each individual is unique, necessitating a tailored approach to health and healing. Third, the practitioner is his or her own healer, emphasizing the importance of playing an active role in maintaining personal well-being. Lastly, a sound mind is essential for healing the body, acknowledging the interconnected nature of mental and physical health. Modern medicine echoes these principles, recognizing that a disease affecting 1 system can impact others if left unchecked. Similarly, healthcare often necessitates customized approaches and medication subsets for different patients. The role of lifestyle modifications in both primary and secondary disease prevention further highlights the significance of individuals taking charge of their health. Lastly, the psychosomatic nature of diseases and the role of stress, particularly in cardiovascular health, is widely recognized.

Hatha yoga, the most commonly practiced type, combines bodily movements (asanas) and breathing techniques (pranayama). Asanas involve maintaining various body postures and positions for extended periods, while pranayama focuses on consciously regulating breathing patterns and promoting mental awareness.[8] Yukhtara, another aspect of yoga, advocates for healthy dietary habits, which are integral in managing various medical conditions.[8]

Physiology of Yoga

The primary mechanism through which yoga confers its benefits is believed to be stress reduction.[10] Yoga modulates stress through various pathways, primarily by impacting the sympathetic nervous system and the hypothalamic-pituitary axis.[10] Yoga downregulates both axes,[11] resulting in decreased levels of salivary cortisol, serum glucose, and 24-hour urine catecholamines.[12–15] These effects are beneficial, as cortisol increases blood glucose levels and sodium retention via the renin-angiotensin pathway and causes dyslipidemia. Catecholamines (norepinephrine and epinephrine) induce vasoconstriction, increased heart rate, and cardiac workload. By inhibiting these processes, yoga exerts a protective influence on the cardiovascular system. Additionally, yoga has been shown to enhance nitric oxide levels and positively impact endothelial function,[16] promoting vasodilation and further stress reduction.

Yoga also demonstrates immunomodulatory effects. Several studies have reported that yoga reduces the expression of classical inflammatory markers, including tumor necrosis factor-α, interleukin-1 β, C-reactive protein, and interferon-γ.[17] Since higher inflammatory markers are associated with increased stress, the reduction in these markers could be linked to the attenuation of stress and the hypothalamic-pituitary axis stimulation by yoga.[11]

The benefits of yoga are not solely confined to biological mechanisms; its psychological impact is also well-documented. Yoga has been shown to decrease perceived stress, potentially yielding long-term benefits, although definitive evidence is still lacking.[11] Furthermore, it improves mindfulness, self-compassion, and coping mechanisms while also decreasing stress.[11] Albeit these aspects have been individually established, their specific effects on cardiovascular health have yet to be quantitatively studied. In line with the World Health Organization's recognition of spiritual well-being as a health component, regular yoga practice has been associated with enhanced spirituality and improved mental health outcomes.[18] Figure 1 highlights the key physiological mechanisms by which yoga results leads to improvement of cardiovascular health.

Yoga: Controlling the Risk Factors of CVD

Controlling underlying risk factors is a critical component of primary prevention strategies for CVD. The seminal Framingham Heart Study identified modifiable risk factors, including high-density lipoprotein cholesterol (HDL-C), total cholesterol (TC), smoking, and systolic blood pressure (BP), which significantly contribute to CVD development. More recently, the obesity-metabolic syndrome epidemic has further compounded CVD risk.

A pre-post intervention single-arm study demonstrated that a yoga-based lifestyle modification could effectively reduce the Framingham Risk Score and 10-year estimated CVD risk in patients with low to moderate-risk scores.[19]

Hypertension

Hypertension, a significant disease in itself, is also a major contributor to coronary artery disease. Although the definition of hypertension may vary between guidelines, such as the American recommendation of a 130/80 mm Hg cutoff and the European standard of 140/90 mm Hg,[20] its role in the development of heart disease remains indisputable.

A recent multicentric study involving 121 participants in Nepal revealed that a 5-day yoga training course at health

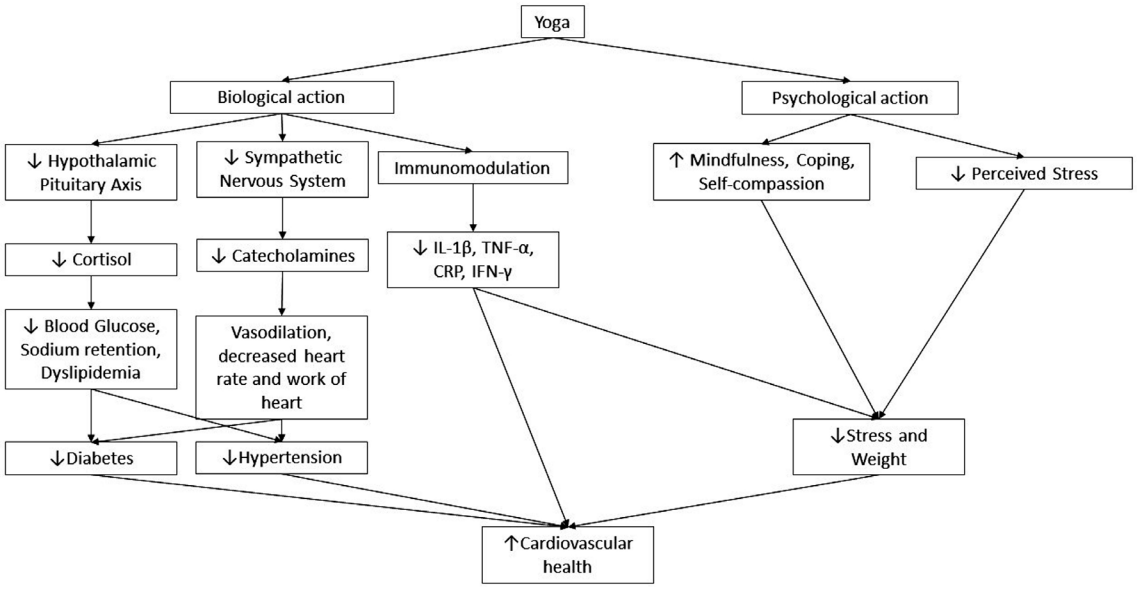

Figure 1. The image depicts the relationship between yoga and cardiovascular health.

centers, followed by 90 days of home-based yoga practice, led to significant reductions in BP.[21] Compared with the control group, yoga lowered systolic BP by 7.66 mm Hg and diastolic BP by 3.86 mm Hg. Additionally, a retrospective analysis of electronic health records of 10,037 hypertensive patients in the Western population demonstrated significant reductions in both systolic and diastolic BP in the 1,355 patients exposed to yoga compared to the 8,682 who were not (2.8 mm Hg and 1.5 mm Hg reductions in systolic and diastolic BP, respectively; $P<0.001$ for both). Patients who practiced yoga had 85% higher odds of achieving normal BP.[22]

The BP-reducing effects of yoga have been further validated in a randomized controlled trial (RCT) conducted by Chauhan et al.[23] In this study, hypertensive patients demonstrated significant reductions in both systolic and diastolic BP after a month of yoga practice, even in the absence of medications. Participants with mild hypertension, who were not taking antihypertensive drugs, were recruited for the intervention arm and practiced yoga for 1 hour each morning for 1 month. At the end of the study, there was a statistically significant reduction in both systolic (136.90±22.18 vs 133.00±21.38; $P=0.026$) and diastolic (84.70±6.50 vs 82.30±7.60; $P=0.002$) BP in the intervention group. Conversely, no significant changes in systolic (136.5±18.6 vs 136.4±18.3; $P=0.576$) or diastolic (84.10±9.70 vs 83.90±9.85; $P=0.081$) BP were observed in the control group, which consisted of healthy adults who did not participate in yoga.

Yoga demonstrated comparable results to aerobic exercises in the elderly Black population, according to a study examining its impact on BP management.[24] Moreover, a meta-analysis revealed that the benefits of yoga extended to pre-hypertensive individuals, as well. The American Health Association defines pre-hypertension as having systolic BP ranging from 120 mm Hg to 129 mm Hg and diastolic BP between 80 mm Hg and 89 mm Hg. This meta-analysis, which reviewed 5 studies, concluded that yoga led to a significant reduction in BP compared to non-yoga control groups.[25]

Interestingly, yoga's advantages also apply to pregnant women. An RCT demonstrated that practicing yoga reduced perceived stress levels in high-risk pregnancies.[26] Another RCT showed that introducing yoga at the 16th week of gestation for patients with a high risk of pregnancy-induced hypertension led to decreased hypertension incidence and improved feto-maternal outcomes.[27] A study comparing yoga and conventional exercises like walking found a lower incidence of pregnancy-induced hypertension, preeclampsia, and intrauterine growth retardation in pregnant women who practiced yoga.[28]

Despite the substantial evidence supporting yoga's positive impact on BP, some studies have reported contrasting results. An RCT conducted by Wolff et al[29] found that among 191 randomly selected hypertensive patients, twice-daily 15-minute yoga sessions failed to significantly reduce systolic, diastolic, or mean BP ($P>0.050$ for all). Nonetheless, the study did show that practicing yoga was associated with reduced anxiety and depression levels.

Similarly, an RCT by Papp et al[30] found no significant improvements in cardiovascular fitness, including BP responses, among patients practicing yoga.

In light of these mixed findings, further large-scale, multicenter studies are needed to confirm the effects of yoga on BP and cardiovascular health. Additionally, these studies should explore the specific duration and types of yoga movements that may yield the most significant clinical benefits.

Lipid Profile

The seminal Framingham Heart Study of 1961 established the causal relationship between dyslipidemia and CVD.[31] Since then, debates have arisen regarding the specific cholesterol targets, with current guidelines recommending a primary reduction of low-density lipoprotein cholesterol (LDL-C) and secondary goals including non-HDL-C, apolipoprotein B, and triglycerides (TGs).[32] These guidelines highlight the pivotal role of lifestyle modifications in achieving improved lipid profiles.

Yoga has recently gained attention for its potential role in favorably regulating lipid levels. A study involving over 11,000 participants at high risk for diabetes showed that practicing yoga led to significant improvements in serum TC, TG, LDL-C, and HDL-C levels.[33] Notably, these changes were primarily observed in individuals with baseline irregularities in lipid levels, with minimal changes in those with normal lipid profiles.[33]

Another study comparing the effects of yoga and walking in overweight and obese individuals found that yoga significantly decreased LDL-C levels, while walking resulted in reduced TG levels.[34]

Yoga's role extends beyond primary prevention, as it has been shown to improve lipid profiles in individuals with type 2 diabetes. In a study involving patients with type 2 diabetes, practicing yoga for 6 months led to significant reductions in LDL-C, TC, and TG levels.[35] Another RCT conducted by Shantakumari et al36 demonstrated that daily 1-hour yoga sessions for 3 months resulted in significant decreases in TC (244.86±28.09 mg% to 219.56±32.02 mg%; P<0.010), TGs (151.88±43.08 mg% to 130.11±28.82 mg%; P<0.050), and LDL-C (144.74±28.45 mg% to 120.51±34.31 mg%) in patients with type 2 diabetes mellitus (DM) who were taking oral antihyperglycemic agents. Although not statistically significant, there was also an observed elevation in HDL-C (44.63±9.35 mg% to 47.15±8.17 mg%; P>0.050).

Furthermore, Hatha yoga has been found to be a safe therapeutic approach for significantly reducing TC, TG, and LDL-C levels in patients with end-stage renal disease.[37]

Weight Reduction: Tackling the Metabolic Syndrome

The concept of metabolic syndrome was first introduced in 1988, initially proposing that insulin resistance was central to a cluster of abnormalities that elevated cardiovascular risk.[38] This "Syndrome X" was later renamed "insulin resistance syndrome" and eventually became known as the "metabolic syndrome" we recognize today.[39] While the existence of "lean metabolic syndrome" remains controversial, the role of obesity and increased waist circumference in metabolic syndrome is well-established.

In a study conducted by Khan et al,[40] yoga was compared with aerobic exercise in 60 overweight or obese individuals. The results showed that yoga led to significant reductions in waist-to-hip ratio (0.809 vs 0.825; P<0.001), waist circumference (88.13 vs 83.25; P<0.001), and body mass index (BMI) (27.77±3.34 vs 28.97±3.51; P<0.001) compared to aerobic exercise. Moreover, another study demonstrated that incorporating yoga into a standardized behavioral weight-loss intervention program was effective for obese individuals, indicating that yoga might serve as a valuable component in multidisciplinary approaches to address obesity and metabolic health.[41]

Yoga may also be a valuable addition for individuals who have already experienced significant weight loss through dietary changes or exercise routines. Unick et al[42] demonstrated that adding yoga to the regimen of patients who had achieved substantial initial weight loss led to sustained weight loss compared with those who did not practice yoga. In their study, yoga contributed to significant weight reductions among those with initially high weight loss (9.0 vs 6.7 kg; 95% CI, 0.005 to 0.139; P<0.001). Furthermore, a systematic review found that these benefits of yoga also extended to adolescent and child populations.[43]

The benefits of yoga in weight loss transcend physical aspects, as demonstrated by a study showing that practicing yoga resulted in reduced stress eating, decreased appetite, and overall healthier eating habits.[44]

DM

According to the American Heart Association, individuals with type 2 DM are twice as likely to die from CVD than those without DM.[45] Moreover, CVD is the leading cause of death in diabetics, particularly in low- and middle-income countries.[46] The atherosclerotic cardiovascular disease (ASCVD) risk score, which includes DM as a risk factor, is used to calculate the 10-year ASCVD risk.[47]

Dysglycemia is a significant risk factor for CVD, with a continuous risk relationship in which a 1 mmol/L rise in fasting blood glucose levels corresponds to a 17% increase in cardiovascular risk.[48] In addition to dysglycemia, several comorbid conditions associated with diabetes, such as obesity, insulin resistance, dyslipidemias, and chronic kidney disease, further contribute to elevated CVD risk.[48]

Managing diabetes with medication alone can be challenging due to variations in lifestyle, dietary habits, and metabolism among individuals, which can impact the effectiveness and dosage of medications.[49] Lifestyle interventions, such as yoga, can provide an inexpensive and safe supplement to traditional diabetes management strategies.

While weight control and lipid control are essential components of diabetes management, yoga has also demonstrated independent benefits in treating diabetes. The exact mechanisms through which yoga exerts these benefits are still under investigation. A recent meta-analysis showed

that practicing yoga reduced oxidative stress in individuals with diabetes.[50] Furthermore, yoga positively influences autonomic balance, promoting β-cell proliferation.[49]

Yoga's effects on the autonomic nervous system may contribute to its benefits for individuals with diabetes. Rapid breathing exercises, such as kapalbhati, stimulate the sympathetic nervous system, while yoga-based relaxation techniques and certain asanas, like savasana, enhance parasympathetic activity.[49]

In an RCT conducted in India, researchers developed a "diabetic yoga protocol" consisting of a 60-minute routine that included various meditations, exercises, and asanas, such as Surya Namaskar and Kapalbhati. After a 3-month program, participants in the yoga group experienced significant improvements in post-prandial blood glucose levels, LDL-C, and waist circumference compared with those receiving usual care.[51]

Another RCT compared a community-based yoga program with usual care and found significant reductions in HbA1c levels (0.5%), LDL-C, and TC among participants in the yoga group.[52] Yoga has also shown potential benefits in preventing the onset of diabetes and reducing risk factors in high-risk populations who have not yet developed the disease. A multicenter RCT involving 3,380 participants in India (the NMB trial) demonstrated that a 3-month yoga-based intervention effectively decreased the progression to diabetes, particularly among younger participants (≤40 y).[53]

Smoking Cessation

Smoking is a significant risk factor for CVD, as demonstrated in the Framingham Heart Study. An RCT revealed that practicing yoga increased the odds of successfully quitting smoking by 37% compared to participating in general wellness classes.[54] These findings suggest that yoga may serve as an effective intervention for smoking cessation.

Another RCT reported the success of an integrated, spiritual program that included yoga, pranayama, music, and a healthy diet in helping individuals quit smoking and reduce BMI.[55] This holistic approach highlights the potential benefits of incorporating yoga into multifaceted wellness programs to address smoking cessation and overall health.

In a comparison of yoga and aerobic exercise, yoga was found to be equally effective in mitigating the negative effects of nicotine dependence while providing additional benefits in reducing cravings and enhancing inhibition control.[56] Table 1 summarizes the recent evidence surrounding the impact of yoga on various cardiovascular risk factors.

Table 1. A summary of recent studies conducted to determine the efficacy of yoga in controlling various cardiovascular risk factors

Author and Year	Parameter Studied	Study Type and Sample Size	Study Population	Intervention	Duration	Outcome
Dhungana et al 2021 [21]	BP	RCT 121	Hypertensive patients	Structured yoga training at the center along with home-based yoga	90 d	Reductions in both systolic and diastolic BP in the yoga arm by 7.66 and 3.86 mm of Hg, respectively (P<0.001)
Penrod et al 2022 [22] (Retrospective study)	BP	Case-control study 10,037	Hypertensive patients	At least 1 yoga session per week	At least 3 y	Significant reductions in both systolic and diastolic BP in the yoga arm by 2.8 and 1.5 mm of Hg, respectively (P <0.001)
Karthiga et al 2022 [27]	Gestational hypertension	RCT 234	Pregnant women at risk of gestational hypertension	Tadasana, Utkatasana, and other asanas as a part of yoga sessions, from 16 weeks of gestation, for 20 weeks	20 wk	Significant decreases in the risk of gestational hypertension (38.1% vs 6.6%; RR, 2.65; 95% CI, 1.42 to 4.95]
Nagarathna et al 2021 [33]	Diabetes and lipid profile	RCT 11,254	Adults at high risk for diabetes	Integrated and validated yoga lifestyle protocol	3 mon	Significant improvements in serum TC, LDL-C, and HDL-C (P<0.001 for all)
Telles et al 2014 [34]	BMI and lipid profile	RCT 68	Overweight or obese patients	90 minutes a day for 15 days of either supervised walking or yoga	15 d	Significant decreases in both groups in BMI and TC. Yoga decreased LDL-C (15.17 vs 14.22 mg/dL; P<0.05), while walking decreased TGs.
Sharma et al 2020 [35]	Anthropometric parameters and lipid profile	RCT 104	Adults with type 2 diabetes	40 minutes of yoga, at least 5 times per week	6 mon	Significant improvements in the atherogenic index of plasma (0.23 vs 0.06; P<0.001), lipid profile, and BMI (25.11 vs 28.02; P<0.001)
Khan et al 2022 [40]	Waist-hip ratio and BMI	RCT 60	Overweight or obese adults	45 minutes a day, 5 days a week	6 wk	Significant improvements in BMI, waist-hip ratio, and waist circumference (P=0.05 for all)

Continuation of Table 1.

Author and Year	Parameter Studied	Study Type and Sample Size	Study Population	Intervention	Duration	Outcome
Unick et al 2022 [42]	Weight reduction	RCT 60	Overweight or obese women	Twice weekly yoga (after a 3-month behavioral weight loss program)	3 mon	Yoga significantly reduced weight in those with initially high weight loss (9.0 vs 6.7 kg; 95% CI, 0.005 to 0.139; P<0.001).
Kaur et al 2021 [51]	Cardiovascular risk profile in diabetics	RCT 184	Individuals at high risk for diabetes	60 minutes daily of the diabetic yoga protocol comprising postures, breathing, meditation, and prayers	3 mon	Significant reductions in post-prandial glucose (P=0.035), LDL-C (P=0.014), and waist circumference (P=0.001)
Misra et al 2021 [52]	Diabetes mellitus	RCT 384	Type 2 diabetics	50 minutes daily for 2 weeks, followed by twice weekly	3 mon	Significant decreases in HbA1C (0.5%; P=0.02), TC (11.7 mg/dL; P<0.01), and LDL-C (3.2 mg/dL; P<0.01)
Nagarthna et al 2021 [53]	Diabetes mellitus	Cluster RCT 3380	Prediabetics	Yoga-based lifestyle modification protocol for 9 days, followed by daily practice at home	3 mon	Significant reductions in progression to diabetes [63.81; 95% CI, 56. 5 to 69.85; P<0.001]
Bock et al 2019 [54]	Smoking cessation	RCT 227	Adult smokers	Iyengar yoga	6 mon	Increases in the odds of abstaining from smoking (37% reduction; P <0.05)

RCT, Randomized controlled trial; BMI, Body mass index; TC, Total cholesterol; LDL-C, Low-density lipoprotein cholesterol

Role of Yoga in CVD

Ischemic Heart Disease (IHD)

IHD is a syndrome characterized by myocardial ischemia resulting from a demand-supply mismatch. The most common cause of this discrepancy is atherosclerosis and plaque ruptures, although other factors such as vasospasm or hypertrophied left ventricle can also contribute to ischemia. The presentation of IHD may be acute or chronic, with varying pathophysiology depending on the presentation. Yoga has been studied for its potential role in primary and secondary prevention of IHD.

In a study involving angiographically confirmed IHD patients, the intervention group was assigned a family-based yoga program. After 1 year, the yoga group showed significant disease regression on myocardial perfusion imaging, with a meaningful portion also exhibiting an arrest in disease progression on the imaging modality. They also had significantly reduced TC and LDL-C levels.[57]

Another study involving angiographically confirmed IHD patients randomized 42 participants to receive either yoga with diet and moderate aerobic exercise or risk factor control with diet. The yoga group showed significant regression in coronary lesions as assessed by angiography at 1 year, in addition to requiring fewer revascularization procedures.[58]

Yoga has also shown efficacy in cardiac rehabilitation programs. In a recent RCT, 3,959 post-myocardial infarction patients were assigned to either a yoga-based rehabilitation program or supplementary care with education. The yoga group reported improved subjective health on questionnaires and a faster return to usual activities. Nevertheless, the study lacked sufficient statistical power to demonstrate a significant difference in major adverse cardiovascular events between the groups.[59]

Another RCT randomized 250 post-coronary artery bypass graft patients to receive either yoga-based rehabilitation or standard care. The yoga group showed significant improvements in ejection fraction (EF) and reductions in blood glucose levels, LDL cholesterol, positive affect, and perceived stress.[60]

A meta-analysis of 6 RCTs recently concluded that incorporating yoga into cardiac rehabilitation programs improved quality of life, reduced the incidence of cardiovascular events, and assisted in managing risk factors.[61]

Despite the positive impact of yoga in IHD patients, a recent small sized RCT comprising of 80 participants found no benefit of yoga over routine care following acute coronary syndrome. They reported similar left ventricular filling pressure, functional class and 6-min walk distance. Further, there was no significant reduction in blood pressure, fasting blood glucose or lipid profiles. The results could be due to the small number of patients recruited (only twenty-five) or the infrequent yoga sessions regimen used in the study (only twice /week).[62]

Heart Failure (HF)

HF is a chronic and progressive condition in which the heart cannot pump sufficient blood to meet the body's needs.

HF has been categorized into 3 clinically distinct entities: heart failure with reduced ejection fraction (HFrEF) with an EF of less than 40%, heart failure with mildly reduced ejection fraction (HFmrEF) with an EF of 40% to 49%, and heart failure with preserved ejection fraction (HFpEF) with an EF of greater than 49%.[63,64] Although the management approaches for these categories differ, lifestyle modifications are a common treatment component for all of them.

A study involving 40 stable African American patients with HF found that practicing yoga improved endurance and quality of life and reduced inflammation.[65] Another study of 13 congestive HF patients demonstrated that yoga led to significant weight loss and reduced depression over 8 weeks.[66] Notably, this study was conducted within a lower socioeconomic population, emphasizing the potential benefits of yoga for individuals who may face financial barriers to medication adherence.

Research has shown that a 1-year exercise program can reverse myocardial stiffness in HFpEF patients.[67] While the specific effects of yoga on HFpEF have yet to be studied, an ongoing study is comparing different yoga breathing techniques and their potential benefits for HFpEF patients.[68]

Rhythm Disorders

Yoga has demonstrated potential benefits for individuals with rhythm disorders, such as atrial fibrillation (AF). The "YOGA My Heart" study revealed that practicing yoga improved symptoms and quality of life and reduced heart rate, arrhythmia burden, and anxiety in patients with symptomatic paroxysmal AF.[69]

An RCT further demonstrated that a yoga practice incorporating deep breathing and light movements could enhance quality of life and lower heart rates in patients with paroxysmal AF.[70]

It has been postulated that yoga, by alleviating symptoms in patients with AF and enhancing physical functioning, quality of life, and mental health, could potentially reduce the need for catheter ablation and its associated risks and side effects.[71] Table 2 summarizes the recent evidence surrounding the impact of yoga on various cardiovascular diseases including atherosclerosis, heart failure and cardiac arrythmias.

Limitations

When assessing the impact of yoga on CVD and associated risk factors, it is essential to consider the limitations present in the available research. The primary limitations include

a reliance on small observational studies and RCTs with limited high-quality RCTs or meta-analyses. In addition, inconsistencies among different studies regarding duration, type of movements, and timing of yoga interventions have led to a lack of clear consensus on which specific body movement or breathing practices are most beneficial for particular diseases.

Due to these limitations, our paper refrains from discussing disease-specific asanas and pranayama. Most prior studies demonstrating a positive impact of yoga on cardiovascular health have incorporated a regimen consisting of 30 to 60 minutes of daily yoga (either 1 or 2 sessions per day), encompassing various forms of pranayama balanced with light asanas suitable for individuals with or at risk of CVD.[72,73]

Conclusion

Numerous studies across various disease spectrums have demonstrated the benefits of yoga. In an era where there is a growing emphasis on lifestyle modifications and a need to reduce pill burden and polypharmacy, yoga offers a promising solution. However, it is essential to acknowledge that most studies supporting the benefits of yoga are small-scale, and only a few compare it directly with regular aerobic exercise.

Given the current evidence, it would be prudent to incorporate yoga into both primary and secondary prevention programs for individuals with diabetes, obesity, and CVD, including IHD, HF, and even AF.

Future research should be conducted on a larger scale, encompassing diverse ethnicities and socioeconomic backgrounds. Comparing yoga head-on with routine aerobic exercise in these studies could provide valuable insights into its potential superiority, as suggested by some existing research. If yoga proves to be more effective, it could potentially be included in major society recommendations.

Additionally, it would be worthwhile to investigate whether yoga can reduce pill burden and confer significant economic, physical, and mental health improvements for the millions of individuals affected by CVD. By exploring these possibilities, yoga may play an increasingly significant role in the management and prevention of chronic diseases.

Table 2. A summary of recent studies on the effect of yoga on cardiovascular disease

Author and Year	Parameter Studied	Study Type and Sample Size	Study Population	Intervention	Duration	Outcome
Manchanda et al 2000 [58]	Coronary atherosclerosis retardation	RCT 42	Angiographically proven CAD	Yoga, diet and risk factor control, and aerobic exercise	1 y	Significant reductions in angina episodes and body weight, Significant improvements in exercise capacity Significant regression in coronary lesions (20% vs 2%; P<0.001) Significant reductions in revascularization need (RR, 5.45; P<0.05)
Prabhakaran et al 2020 [59]	Cardiac rehabilitation after MI	RCT 3,959	Acute MI	Specialized yoga program ("Yoga-CaRe")	12 wk	Similar incidence of MACE (6.7% vs 7.5%; P=0.41), but better self-rated health (77 vs 75.7; P=0.002)
Raghuram et al 2014[60]	Cardiac rehabilitation after CABG	RCT 250	Patients scheduled for CABG	Monitored and home-based yoga practice	1 y	Significant improvements in ejection fraction (P=0.001) and lipid control (P=0.038) Significant reductions in BMI (P=0.008) and blood glucose (P=0.003)
Kubo et al 2011 [66]	Response to yoga in CHF	RCT 14	CHF	Twice-weekly yoga classes having meditation, yoga, breathing exercises, and relaxation	8 wk	Significant reductions in weight (-3.5 lb; P=0.01) and improvements in depression severity (P<0.05)
Lopes et al 2018 [68]	HF with preserved ejection fraction	RCT, In progress, expected 33	HF with preserved ejection fraction	Active yoga, compared with passive yoga and control	8 wk	In progress
Lakkireddy et al 2013 [69]	AF	Cohort study 52	Symptomatic paroxysmal AF	Twice-a-week, hourly sessions	3 mon	Significant reductions in symptomatic AF (3.8 vs 2.6; P<0.001), asymptomatic AF episodes (3.4 vs 2.9; P<0.001), and anxiety/depression (P<0.001)
Wahlstrom et al 2017 [70]	AF	RCT 80	Paroxysmal AF	Kundalini yoga	12 wk	Significant improvements in quality of life (P=0.02) and reductions in heart rate (P=0.024) and blood pressure (P=0.033)
Sen et al 2020 [71]	AF	538	AF	Half-an-hour alternate-day yoga sessions (Savasana, Anulom-Vilom, and Ujjayi)	16 wk	Significant reductions in symptomatic AF episodes (14.8 vs 8.2; P<0.005), non-symptomatic AF episodes (2.4 vs 1.3; P<0.005), and anxiety and depression (P<0.005)

CT, Randomized controlled trial; MACE, Major adverse cardiovascular events; CHF, Congestive heart failure; HF, Heart failure; MI, Myocardial infarction; CABG, Coronary artery bypass graft surgery; AF, Atrial fibrillation

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