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# Effect of Yoga in Cardiac Rehabilitation: A Review of RCT

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***Abstract:*** ***Importance-With the adoption of yoga-based cardiac rehabilitation, it is important to understand whether the programs are more effective compared to standard cardiac rehabilitation programs. Cardiovascular illness is one of the leading causes of death, with a higher possibility of reoccurrence. Therefore, yoga-CaRe would help in preventing mortality due to heart complications.***
***Objective-The review aim at finding whether yoga-based cardiac rehabilitation programs are more effective compared to standard cardiac rehabilitation programs. The review focuses on causes, diagnosis, therapy, and prevention of heart complications. The population includes patients who have been diagnosed with heart complications.***
***Evidence Review-The review used peer-reviewed journals obtained from different health databases, including PubMed, Cochrane, Medline, and CINAHL. The researcher searched relevant literature on the database using keywords from inception to 5/01/2022. A total of 327 articles were identified, with 314 articles excluded since they did not meet the criteria. For the studies to be included in the final review, they had to have a minimum of three months follow-up. Also, the studies ought to have investigated the impact of yoga-based cardiac rehabilitation in relation to physiological, psychological, and cardiovascular risk factors. However, articles published in languages other than English were excluded.***
***Findings-Whereas some studies found significant differences between yoga-CaRe and standard cardiac rehabilitation, others found no differences between the interventions. However, the findings indicate that yoga-CaRe programs were more superior compared to the standard cardiac rehabilitation.***
***Conclusions -Yoga cardiac rehabilitation improves cardiac health and patients' life quality.***
***Keywords: Yoga, Cardiac rehabilitation, Cardiovascular disease, Heart failure, heart disease.***

## I. INTRODUCTION

Heart illness is the leading cause of mortality globally. A report from the Centre for Disease Control and Prevention (CDC) (2018) indicates that in the US, heart disease accounts for one death for every four deaths. Heart illnesses comprise different types of heart conditions, with coronary artery disease considered the most prevalent. The risk of heart complications can significantly be reduced by changing one's lifestyle and, in some instances, using the medicine.

Approximately 126 million persons suffer from heart disease complications globally (Khan, Hashim & Mustafa et al., 2020). According to CDC 2018 report, a total of 30.3 million US adults were diagnosed with heart complications. Estimates from CDC further indicate that 647 000 Americans die from heart complications annually, making cardiovascular disease one of the leading causes of death. There are several cardiac complications, including cardiomyopathy, among others. Biological risk factors are the major causes of heart complications, including high blood pressure, hyperlipidemia, and excess weight. Psychological factors such as chronic stress and depression impact heart disease. Some of the medical guidelines include medication, surgical intervention in addition to lifestyle modification like physical exercise, healthy diet, and effective management of stress.

In recent years, yoga-based cardiac rehabilitation intervention has attracted significant interest in the health field. This research aims to investigate the effectiveness of yoga-based cardiac rehabilitation programs compared to standard rehabilitation programs. The review will cover studies that investigated yoga-CaRe programs that at least had a follow-up after three months.

## II. METHODS

The researcher conducted a literature search on health databases, including Cochrane, EBSCO, Scopus, CINAHL, and Medline databases from the start to 05/01/2022. The researcher used keywords to find relevant peer-reviewed articles. Different search terms like "yoga" and "cardiovascular disease" or "heart failure" or "heart disease" were used. Also, references and citation lists were hand searched for studies, with all peer-reviewed articles included.

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The inclusion criteria included studies that investigated the impact of the yoga-based cardiac rehabilitation of heart complication risk factors and its effect on heart rate variability, hypertension, BMI, lipid profiles, the levels of glucose, echocardiography, cardiac functions, quality of life in addition to levels of anxiety, stress, and depression. However, studies authored in languages other than English were excluded.

## III. RESULTS

The search yielded 327 unique studies. The researcher identified 13 studies that met eligibility criteria after reviewing the titles and abstracts. The identified studies investigated outcomes in patients that underwent additional yoga-based cardiac rehabilitation in comparison to those that used normal rehabilitation programs alone. Three hundred fourteen studies were not included following the screening of the titles and abstracts. Additional seven studies were excluded after full analysis. Only six studies met the criteria for the review. All articles were random controlled trials.

1) *Evidence Quality*: The evidence quality for every outcome in the disease category was reviewed based on GRADE recommendations, which included the quality of the methodology and confidence level in the findings across the studies. The quality was judged after considering the limitations, inconsistencies, imprecision, indirectness, and bias of the studies. The random controlled trials labelled their interventions "yoga" without indicating specific yoga styles. Two RCTs failed to state the levels of qualification of the Yoga instructors. In other studies, yoga was conducted by qualified yoga instructors. However, the level of bias was high in each study.
2) *Impact on cardiovascular risk factors:* The randomized control trials investigated different cardiovascular risks in trying to find whether the implementation of yoga care rehabilitation resulted in the improvement of physiological and biochemical variables. Raghuram et al. (2019) reported significant differences in the decrease of body mass index in clients subjected to yoga-based cardiac rehabilitation programs compared to those that were only subjected to normal exercise-based rehabilitation. Similarly, Yadav (2015) found a statistically significant decline in systolic and diastolic BP compared to those that only used pharmacological interventions. The et al. (2019) investigated cardiovascular risk factors, including blood pressure, heart rate, waist circumference, and ambulatory, and did not find significant differences between the yoga-CaRe group and the control group. Raghuram et al. (2019) did not find a statistically significant pattern associated with better glycemic regulation.
3) *Cardiac Function Improvement:* A Researchers investigated changes in heart functioning based on a clinical patient-reported measure of ejection and diastolic function. Sharma et al. (2020) found better cardiac function scores among the participants that were subjected to yoga-based programs at three months compared to the control group. Similarly, Prabhakaran (2020) reported a significant improvement in self-reported return to pre-infarct activities in patients under a yoga care rehabilitation program. Also, Christ et al. (2019) found that using yoga intervention resulted in improvement of parasympathetic activities in addition to general cardiac autonomic tone. Raghuram et al. (2014). reported improvement in patients with decreased systolic function after undergoing yoga-CaRe for a period of one year.
4) *Decrease in The Major Adverse Cardiovascular event (MACE):* Prabhakaran et al.'s (2020) study was the only RTC that investigated a decrease in MACE after the yoga-CaRe program. This program involved individualized yoga practice, breathing, meditating, and relaxation exercises instructed by a qualified yoga teacher. They investigated a total of 6737 patients over a period of 21.6 months and found that the rate of MACE occurrence was 6.7% on subjects under Yoga-CaRe compared to 7.4% for patients under standard care. Similarly, there were reduced cases of cardiovascular hospitalization among the patients subjected to Yoga-CaRe.
5) *Psychological Health Improvement:* Several studies found that yoga-CaRe positively impacted psychological health in relation to cardiovascular complications. Four randomized control trials investigated subjects' reported systems scores for mental wellbeing. Sharma et al. (2020) found a decrease in cardiac depression rate and anxiety. Similarly, Prabhakaran et al. (2020) found that patients under yoga-CaRe had better scores, 77 points, compared to 75.7 points for the control group. Also, Raghuram et al. (2014) found that the yoga group reported improvements in relation to depression, anxiety, and stress. Amaravathi et al. (2018) investigated the effectiveness of the yoga-CaRe program on patient quality of life and stress level following five years of coronary artery bypass graft (CABG). Results indicated significant improvements in mental health, perceived stress, and negative affect.
6) *Health Behaviors Improvement:* Prabhakaran et al.'s (2020) research investigated changes in health behaviors between the subjects. Results indicated a significant difference between the rate of adhering to medication and stopping smoking between the groups.

7) *Pathophysiology:* In cardiovascular disease, the heart organ fails to supply adequate blood for metabolic demands and heart-related elevation of systemic venous pressure, which may lead to cardiac congestion (Tillin et al., 2019). This can be attributed to abnormalities of systolic or diastolic functions. Heart complication with decreased ejection increases diastolic volume while decreasing ejection fractions. Similarly, Heart complication with preserved ejection fractions increases left ventricular end-diastolic pressure. Diastolic dysfunction is attributable to impaired ventricular relaxation, which increases ventricular stiffness and valvular illness. Also, acute myocardial results in diastolic dysfunction, causing heart complications. Heart complication with mid-range ejection fraction, in which the patients have LVEF that ranges from 41 to 49 percent. LV dysfunction results in decreased CO and increased pressure in the pulmonary venous. RV dysfunction increases pressure in systemic venous, which causes fluid extravasation and subsequent edema.
8) *Clinical presentation:* Heart complications happen when the organ muscles fail to blood sufficiently. This leads to blood backing up, resulting in the build-up of fluid in the lungs, causing breath shortness (Ranjita et al., 2016). Some heart conditions like narrowed arteries in the heart or high BP weakens the heart or makes it too stiff to fill and pump blood as required. Signs and symptoms of heart failure include shortness of breath, feeling tired, swollen limbs, irregular heart-beating, inability to perform exercises, coughing or wheezing continuously with pink or white mucus and stains of blood, swollen abdomen, weight gain, loss of appetite, and feeling nauseated always, challenges focusing or decreased alertness, chest pain due to heart failure.
9) *Assessment and diagnosis, Treatment and Prognosis:* The initial assessment of patients with suspected heart complications includes physical and history examination in addition to the assessment of lab results, chest x-ray, and electrocardiography (Hunt et al., 2009). Diagnosis of heart failure confirmed through echocardiography, displacement of cardiac apex, 3$^{rd}$ heart sounds as well as chest radiography indicating pulmonary venous congestions or interstitial edema. Systolic heart failure can be ruled out using a B-type natriuretic peptide. Physical and historical examination of the patient help in evaluating optional or reversible causes. Almost all patients suffering from heart issues report dyspnea on exertion. Similarly, the 3$^{rd}$ heart sound is a result of increase increasing left ventricular end-diastolic pressure and a decreasing left ventricular ejection fraction (LVEF) (Solomon, 2005). Laboratory testing aids in identifying potentially reversible causes of heart issues. Heart failure treatment interventions include lifestyle changes including losing weight, exercises, decreasing salt in the diet, and management of stress results in improved quality of life in addition to surgical interventions. Heart disease is a lethal condition with a mortality rate comparable to cancer. Anderson et al. found that the probability of dying within five years was 62% for men and 38% for women.

## IV. DISCUSSION

The Yoga-based cardiac rehabilitation consists of four phases comprising of 13 sessions (Guddeti et al., 2019). The first phase entails individualized sessions with the patients while still in the health setting. This phase is mostly education with the objective of providing information concerning the health conditions and their treatment, recovery processes, and advice concerning the lifestyle and daily activity. The second phase is the individualized session, where the client is introduced to the elements of yoga, including how to breathe, meditate and relax. In the third phase, the patient starts attending group sessions. The final phase includes maintaining a healthy lifestyle as well as self-practicing yoga.

Yoga-based cardiac rehabilitation involves fewer aerobic activities compared to standard exercise-based rehabilitations; still, yoga-CaRe preserves the key principles of cardiac rehabilitation. The controlled exercise programs contribute to the improvement of functional capacity, which promotes mental wellness and healthy behaviors that decrease the possibilities of heart complications. Studies have found yoga improves heart health by decreasing risk factors like hypertension, variability of heart rate, obesity, resistance to insulin, and hyperlipidemia (Cramer et al., 2014). Previous studies have found yoga as the most impactful lifestyle intervention on 10-year heart failure risk (16.7%) (Chu et al., 2016).

Studies found that yoga reduces levels of serum cortisol, catecholamine, and aldosterone. Activating these pathways has been associated with most cardiovascular illnesses, including high blood pressure and heart failure (Tillin et al., 2019). Additionally, yoga increases melatonin and y-aminobutyric acid, among other neurotransmitters (Prabhakaran et al., 2020). Also, it decreases stress markers while increasing levels of endorphins. Thus, yoga is vital in preventing the impact of stress in humans. Furthermore, practicing yoga regularly attenuates oxidative stresses while improving endothelial functioning by boosting the bioavailability of nitric oxide. Evidence indicates the role of inflammation in cardiovascular disease, with systemic inflammation contributing to a high rate of mortality. Yoga increases the levels of adiponectin while decreasing leptin resistance, which enhances anti-inflammatory and insulin-sensitizing impacts.

Yoga impacts cardiovascular risk factors, including high blood pressures, heart rate, extreme weight, resistance to insulin in addition to the level of blood lipid in comparison to the standard care, both in healthy clients and patients considered significantly risky.

According to Raghuram et al. (2014), those subjected to yoga-CaRe reported a decline in systolic and diastolic blood pressure, decreased heart rate, and waist circumference. Additionally, the findings showed improvement in cholesterol levels. Chu et al. (2016) reported similar results in their systematic review and meta-analysis. Furthermore, yoga CaRe impacts health behavior, such as smoking cessation. Smoking habit ranks among risk factors that contribute to myocardial infarction (Prabhakaran, 2020). Yoga promotes healthy behavior by decreasing stress and behavioral urges related to smoking. Also, yoga promotes better moods, decreases negative affect and strong effects of withdrawal symptoms. Yoga further affects autonomic tone by increasing heart rate variability, increasing vagal output, which decreases sympathetic arousal.

## V. LIMITATION OF THE EVIDENCE

The studies reported different findings, which can be attributed to several limitations. While some studies found significant differences in cardiovascular risk factors, others did not. Also, the findings on biochemical risk factors between the groups were insignificant for three months follow-up studies. However, Raghuram et al.'s (2014) one-year study reported a decrease in triglycerides and cholesterol levels. With the exception of Tillin et al.'s (2019) study, other studies reported subjective improvement of heart functioning. Similarly, objective improvement of echocardiogram was evident only after one year of follow-up among patients with decreased functioning at the baseline. Results showed a 6 percent improvement in ejection fraction after one year of intervention. However, it is impossible to reproduce ejection fraction on echocardiography since it is not precise. As a result, most of the accreditation recommends giving ejection fraction as a range.

A study on MACE did not find statistically significant improvement associated with yoga. Of the research that explored psychological healthy, 50 percent of the reported improvement in clients subjected to yoga CaRe with metal analysis showing that inclusion of yoga resulted in improvement of perceived stress scores. The studies have varying findings, which can be attributed to the use of a heterogeneous population. Additionally, the inclusion criteria of the participants in the study differ significantly. Whereas some studies investigated subjects following elective coronary artery bypass, others researched the subjects after acute MI. Also, some investigated patients with only left ventricular systolic dysfunctions, while others investigated patients with normal functions only. Also, some of the research had more men compared to females' participants, while others investigated various ethnicities with varying baseline features. Also, some studies conducted their follow-up after three months, while others did their follow-up after one year. The majority of those that conducted follow-up after one year were likely to find conclusive findings compared to those that conducted follow after three months. The majority of the studies are small, which makes it challenging to draw a definite conclusion. Prabhakaran et al. was the largest study with 4000 participants. Still, this was inadequate and required inclusion of more MACE events after commencement of the study, which indicates how hard it is to meet sample requirements for significant results relating to yoga-CaRe Different results have been identified in these studies. However, it is challenging to determine the validity of the outcome due to the lack of standardized repetition. Also, the studies were conducted in different regions, which further impacted the generalizability of the findings. For instance, there are different baseline features between the findings in Raghuram et al.'s (2014) and Tillin et al.'s (2019) studies. The loss of follow-up for the yoga-Care participants was extremely high at 37.5% compared to the standard cardiac rehabilitation subjects at 12.5% in the only research conducted in the United Kingdom. According to the researchers, the participants did not want to proceed with the Yoga classes. This limitation might have impacted the results. Future research should focus on the impact of yoga-CaRE in different regions independently. This is because the socio-economic background might play a critical role in patients' participation in yoga-CaRe interventions.

## VI. CONCLUSION

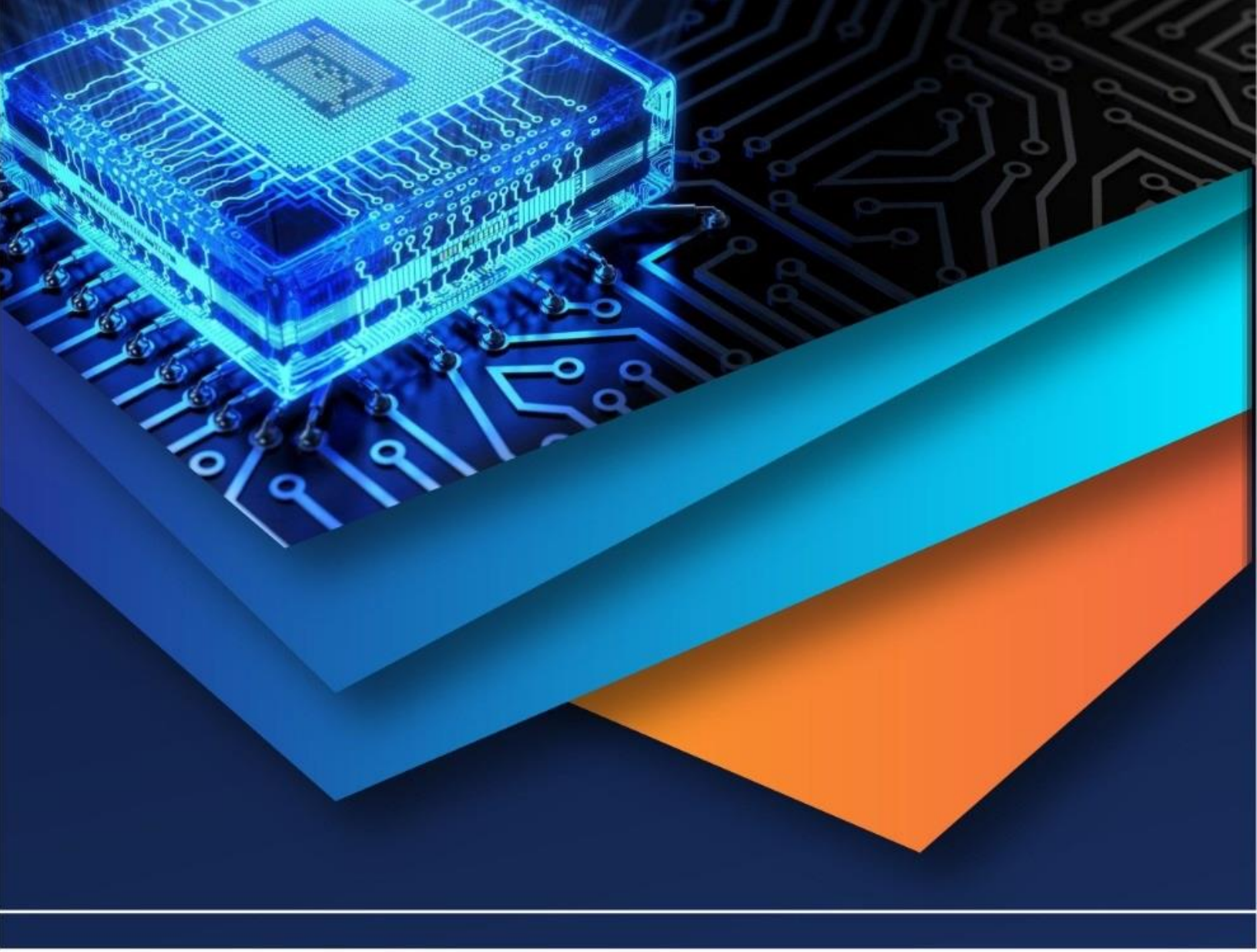
Overall, results indicate yoga-CaRe contributes to the improvement of heart health and patients' life quality. Furthermore, there was a pattern suggesting improvement of left ventricular systolic function for patients that hand impaired function. Evidence on the improvement of psychological Health, MACE, cardiac risk factors is not sufficient; however, the scores are superior compared to those subjected to standard cardiac rehabilitation. Patients subjected to yoga-CaRe indicated improvement of baseline in several domains.

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