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A DETAILED REVIEW OF HOME-BASED EXERCISE AND YOGA-BASED EXERCISE OF CARDIAC REHABILITATION IN CABG PATIENTS

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ABSTRACT

Background: The treatment of coronary heart disease (CHD) has been recognised as incorporating exercise-based and yoga-based cardiac rehabilitation (CR). The critical element in the development of CR programs that are based on exercise and yoga is the assessment of the efficacy of contemporary alternative treatment methods.

Methods: MEDLINE, EMBASE, and the Cochrane Library were employed to identify previously published studies. This analysis encompassed English-language articles that evaluated the effectiveness of various forms of CR in patients with CHD. Abstracts and full-text articles were independently reviewed by the investigators, and data was extracted from the studies. In accordance with the categories delineated in previous Cochrane reviews, exercise, and yoga-based CR was categorised as center-based CR, home-based CR, tele-based CR, and combined CR for the purposes of this analysis. Recurrent cardiac artery bypass grafting, recurrent percutaneous coronary intervention (PCI), hospital readmissions, all-cause mortality, cardiovascular death, and recurrent fatal and/or nonfatal myocardial infarction were among the outcomes.

Results and Conclusions: The current body of evidence indicates that center-based CR is a viable option for patients with CHD. The efficacy of home and tele-based CR should be further investigated in subsequent studies, as they have the potential to save time, money, effort, and resources and may be preferred by patients.

KEYWORDS: *Coronary Heart Disease, Cardiac Rehabilitation, Hospital*

1. INTRODUCTION

It is well acknowledged that cardiac rehabilitation (CR) programs are crucial in the treatment of coronary heart disease (CHD). Cardiorespiratory rehabilitation (CR) programs are interdisciplinary medical interventions that include exercise and education to assist patients reach their maximum potential in terms of physical and functional health and to ward off future cardiac problems. Physical health may be improved and CR programs can help reduce mortality and morbidity significantly. That is why clinical recommendations strongly suggest these regimens [1]. Common places for CR to take place are hospitals and outpatient clinics. This kind of CR has been shown to be the most fundamental in earlier research. Despite the success of this method, its broad usage is sometimes hindered by a number of challenges, such as low referrals, low uptake, and poor adherence. Patients suffering from myocardial infarction (MI) have had the option of doing exercise regimens at home rather than undergoing conventional cardiac rehabilitation (CR) since the mid-1980s. The practice of doing coronary heart disease risk assessments at home has grown in popularity since the 1990s[2]. On the other hand, for patients dealing with more serious illnesses or consequences, doctors tend to choose CR programs conducted in medical centers rather than at home. It has been an effort by doctors to track these patients' vitals using handheld heart rate monitors since the mid-1980s, in an effort to guarantee that they are receiving safe and effective treatment. Some home-based modes have evolved over the last two decades to combine the convenience of home-based CR with the expert monitoring and support services offered by center-based CR, thanks to advancements in sensor technology, communication methods, and data analysis techniques [3]. The goal of this CR approach, which is called tele-based CR, is to increase patient engagement in CR programs while minimising the risk of improper activity. It is unclear, however, whether these contemporary modes are practical substitutes for center-based CR issues, as the results of prior research on the subject have been contradictory [4]. Due to the paucity of randomised controlled studies (RCTs) that assess the effectiveness of different treatments, we analysed the data to determine how well CR worked for patients who had undergone bypass surgery.

2. BACKGROUND AND OVERVIEW

2.1 History and Background of Cardiac Rehabilitation Post-CABG

“Four years after describing angina pectoris so magnificently, Heberden detailed a patient's recovery in 1772 after he spent thirty minutes a day labouring in the woods. In spite of some research showing the advantages of exercise, patients suffering from acute coronary events were frequently forced to limit their mobility, which resulted in significant deconditioning, a decrease in functional ability, an extended hospital stay, and an increase in mortality and morbidity. After Herrick described myocardial infarction in 1912, this wrong viewpoint was further reinforced. Acute coronary event patients were recommended to adhere to a 6-week bed rest regimen in the 1930s. The 1940s saw the introduction of chair treatment. As early as the 1950s, patients were cleared to walk for as little as three to five minutes each day four weeks after a coronary episode. The benefits of early ambulation in preventing bed rest problems and reducing associated risks were gradually acknowledged[5–10]. Proponents of early patient mobilisation, such as Levine and Lown, who were trailblazers in cardiac rehabilitation, faced fierce resistance. Although sceptics were at first resistant, the growing body of research supporting the advantages of early ambulation and physical exercise ultimately won them over. Bus drivers in London had a greater incidence of coronary incidents than ticket vendors, according to Morris' 1953 research. This was because, although drivers sat behind the wheel of the double-deckers, ticket salespeople were more active on each floor. The preparation of astronauts for space travel also shows the negative consequences of extended immobility [11].

Although it was a small study, the Dallas Bed Rest and Exercise Study published in 1968 by Saltin et al. offered strong evidence that exercise was beneficial and that bed rest was harmful. Cardiac rehabilitation programs are a multidisciplinary approach to helping cardiovascular patients recover and optimise their functional and mental status. These programs were developed in response to the physiologic basis of exercise benefits proposed by Braunwald, Sarnoff, Sonnenblick, Hellerstein, Naughton, and many others [12–13].

Most coronary professional groups have now advocated for this method as a crucial treatment tool in contemporary cardiology due to its shown advantages in reducing mortality and morbidity. Many young cardiologists were drawn to new technologies like echocardiography and coronary angiography, therefore the cardiology community did not fully support this field despite its early success. Because cardiologists were concerned with the short-term effects of newer, more potent medications like beta-blockers, calcium-blockers, and thrombolytics, cardiac rehabilitation was slow to become a common treatment technique [14–15].

A resurgence of interest in cardiac rehabilitation has occurred in recent years[16] due to a combination of factors, including a clearer picture of the aetiology of many cardiac diseases and the reality that, despite the enormous progress, cardiovascular disease is still the leading cause of death.

2.2 Effectiveness of CR on CABG patients: Summarizing Past Literature

The British Association for Cardiovascular Prevention and Rehabilitation recently defined cardiac rehabilitation (CR) as "the coordinated sum of activities required to influence favourably the underlying cause of cardiovascular disease, as well as to provide the best possible physical, mental, and social conditions, so that the patients may, by their own efforts, preserve or resume optimal functioning in their community and through improved health behaviour, slow or reverse progression of disease." This description aligns with the patient's goals of a speedy physical recovery after surgery, a return to work, and a lifetime of healthy lifestyle choices.[17] Individualised and supervised exercise, as well as education, are crucial components of CR's all-encompassing program for patients recovering after CABG. It has a two-stage approach: Long-term success in managing coronary artery disease requires healthy routines, tools, and knowledge. (1) CR promotes a faster and better recovery from heart surgery in the first weeks after the procedure. This is especially important for the typical CABG patient, an elderly individual with several comorbidities and limitations. (2) CR provides these resources. Both the typical kind of exercise in CR—moderate continuous—and aerobic interval training resulted in a peak Vo2 rise at the conclusion of the program, according to Moholdt and colleagues and others who have studied this topic. Regarding secondary prevention after an acute coronary syndrome (ACS), the GOSPEL trial demonstrated that CR enhanced the management of risk factors and the observance of lifestyle strategies aimed at secondary prevention. Good adherence to the healthy lifestyle and medication regime was demonstrated at 1 year in the Italian Survey on Cardiac Rehabilitation and Secondary Prevention After Cardiac Revascularisation (ICAROS Survey), which included only patients who had undergone myocardial revascularisation (approximately 70% after CABG) [18–20].

Specific recommendations on CR were developed and subsequently adopted by numerous national societies. These recommendations originated from the 2010 update of the American Association of Cardiovascular and Pulmonary Rehabilitation/American College of Cardiology Foundation/American Heart Association performance measures, the European Society of Cardiology's guidelines for cardiac rehabilitation, and for myocardial revascularisation from the American Heart Association and the European Society of Cardiology. Class I (level of evidence A) endorsement was given to CR following CABG in the 2011 American College of Cardiology Foundation/American Heart Association recommendations on CABG. The 2014 European Society of Cardiology Guidelines on Myocardial Revascularisation were more stringent in their classification of the recommendation for CR following CABG as class II [21-22], reflecting their review of the existing data.

3. APPLICATION TO PRACTICE INCORPORATION OF YOGA INTO CURRENT MEDICAL PRACTICE AND CARDIAC REHABILITATION

We found thirteen papers that compared traditional rehabilitation programs with those that included a yoga-based CR to see how well patients fared. After reviewing the titles and abstracts, 558 were deemed unsuitable. After further study, seven more were discarded, leaving just six for the evaluation. We did not omit any research due to their poor quality. You can find a summary of all six investigations in Table 1.

Table 1 Clinical Trials using Random Assignments Comparing Yoga-Based CR with the Gold Standard

"Study	Year	Location	Patient Type	Number of Patients (I: C)	Intervention	Control	Follow-Up	Outcome Measures	Results
Yadav et al	2015	India single centre	Stable CAD	80 (40:40)	60 minutes of yoga per day for three months with instruction	Conventional medical treatment	3 months	Heart rate, systolic blood pressure, diastolic blood pressure, and pulmonary function	Statistically significant enhancement in lung function Improvements in HR, SBP, and DBP, all with p<0.05
Christa et al	2019	India Multicentre	ACS - MI	79 (39:40)	complement to a 12-week yoga-based cardiac rehabilitation	Conventional medical treatment (not centered on physical activity)	Echocardiogram at 3 and 13 weeks	Cardiovascular resistance	The time-domain indices are the same. p=0.005 for high-frequency power (msω) With a total power of 0.10,
Prabhakaran et al	2020	India Multicentre	ACS	3959 (1970:1989)	A twelve-week Yoga-CaRe program	Improving upon current practices (site-specific; not all including physical activity)	Minimum 6 months; median 21.6 months	12-week EQ-5D-5L QOL for myocardial infarction survivors Self-reported return to pre-infarction activities	EQ-5D-5L p=0.002 and MACE p=0.41. No change from pre-infarct state (p=0.039)
Raghuram et al	2014	India Single centre	CABG	250 (129:121)	12-month yoga programme	12-month exercise-based CR	6 weeks, 6 months, 12 months	LVEF, body mass index, fasting blood sugar Profile of lipids Anxiety and depression scales from HADS, PSS, and PANAS	Significant enhancement of LVEF was seen across all groups. Those in the yoga group saw a significant improvement in 12-month LVEF (p=0.001) compared to those in the control group, going from 47% to 53% after 1 year, compared to 49% in the control group. People whose body mass index is more than 23 had a significantly different experience losing weight (p=0.038). Chest fat p=0.61. Triglycerides all-inclusive p=0.03. P=0.003 for total HDL Apparent total LDL p=0.75. The statistical tests for total VLDL (p=0.03), PSS (p=0.12), PANAS (p=0.02), HADS (p=0.42), and HADS (p=0.07) were also performed.
Sharma et al	2020	India Single centre	cardiac arrest (CAD) - LVSD treated medically	66 (33:33)	Adding yoga to cardiac rehabilitation for 12 weeks	Standard care (not exercise-based)	3 months	Vital signs (LVEF) Biochemical markers (total triglycerides, cholesterol, LDL, HDL) Quality of life (QOL) calculations: META and DASI Depression and anxiety: DVD HAM-A	Little change in LVEF (p=0.218) Biochemical parameters were not different. An increase in quality of life that is statistically significant (p<0.001) Depression and anxiety (p<0.001)
Tillin et al	2019	UK Multicentre	ACS	60 (25:35)	Include a minimum of 18 yoga courses in the regular curriculum Normative cardiac rehabilitation program in the United Kingdom's National Health Service (NHS)	Exercise-based CR	3 months	Vital signs, filling pressures (E/e'), 6MWT, blood pressure, heart rate, blood profile, and quality of life	E/e' p=0.4, 6MWT p=0.7, resting systolic blood pressure p=0.5, resting diastolic blood pressure p=0.6, resting heart rate p=0.8, international physical activity score p=0.8, EQ-5D health status p=1.0, EQ-5D self-rated thermometer p=0.6, and PSS p=0.11".

4. APPLICATION TO PRACTICE INCORPORATION OF HOME-BASED EXERCISE INTO CURRENT MEDICAL PRACTICE AND CARDIAC REHABILITATION

The effectiveness of exercise-based CR in patients undergone bypass surgery and CAD has been determined by systematic reviews that were illustrated below,

Table 2 Overview of participants, recruitment period, patient diagnosis, and medical therapy

"Reference, country	N	Mean age (years)	Male participants (%)	Recruitment period (years)	Maximum follow-up period	Patient diagnosis	Medication
Aronov *et al*, Russia	392	61.4	73.5	None specified	1 year	Angioplasty, myocardial revascularisation, acute myocardial infarction, etc.	Conventional medical treatment includes α-blockers, ACE inhibitors, nitrates, and other antithrombotic drugs. Some patients are on lipid-lowering medications.
Belardinelli *et al*, Italy	118	61	100	None Specified	33 months	CAD, ALMI included. Percutaneous coronary intervention (PCI) successfully treats one or two native epicardial coronary arteries but not all of them.	Aspirin, ticlopidine, calcium antagonists, and nitrates are prescribed in accordance with internationally recognised procedures. .
Briffa *et al*, Australia	113	47.5	89.5	None specified	1 year	Uncomplicated AMI or recovery from unstable angina. coronary angioplasty, thrombolytic medication, and percutaneous coronary intervention.	These medications include aspirin, β-blockers, angiotensin-converting enzyme inhibitors, calcium antagonists, long-acting nitrates, and diuretics.
Giallauria *et al*, Italy	61	58.5	78.5	None specified	6 months	AMI and undergone main or rescue PCI only	Statins, ACE inhibitors, β-blockers, ARBs, and aspirin
Hambrecht *et al*, Germany	101	56	87.3	1997–2001	1 year	Angina pectoris and percutaneous coronary intervention (PCI) diagnostic criteria for stable coronary artery disease. Those with acute myocardial infarction are not included.	They include ACE inhibitors, α-receptor antagonists, β-HMG-CoA reductase inhibitors, and acetylsalicyclic acid.
Higgins *et al*, Australia	105	60.8	81.3	1995–1997	51 weeks	Post-PCI patients exclusively. Zero acute myocardial infarction (AMI) during the first month prior to surgery.	Regarding medical treatment, the sole analysis pertains to lipid-lowering drugs.
Houle *et al*, Canada	65	51.5	100	2007–2008	12 months	Hospitalised patients with acute coronary syndrome (ACS) (unstable angina, non-ST-elevation myocardial infarction, or ST-elevation myocardial infarction). Coronary angioplasty, percutaneous coronary intervention, or no revascularisation...	In the normal care group, there is mention of medicines but no breakdown.
Kovoor e*t al*, Australia	142	51.5	100	None Specified	6 months	Just AMI. One exercise-treated patient had primary angioplasty as part of their thrombolytic therapy.	These include nitrates, aspirin, β-blockers, ACE inhibitors, calcium channel blockers, and medicines that decrease cholesterol.
Maddison *et al*, New Zealand	171	59	20	2010–2012	24 weeks	Heart disease diagnosis (angina, myocardial infarction, revascularisation, including angioplasty, stent, or coronary artery bypass grafting").	No description.
Maroto *et al*, Spain	180	76.9	57.5	(None specified) 2-year enrolment period	10 years	AMI only.	Discharge medication regimens used for secondary prevention were obviously inadequate by conventional standards, but they now conform to European and Spanish standards.
Munk *et al*, Norway	40	56.4	84.8	None specified	6 months	Both stable and unstable angina, exclusively after percutaneous coronary intervention (PCI). Those with acute myocardial infarction are not included.	Acetylsalicyclic acid, aspirin, beta-blockers, angiotensin-converting enzyme inhibitors, angiotensin-receptor blockers, statins, and amiloride.
Mutwalli *et al*, Saudi Arabia	49	69.7	100	2008–2010	6 months	Surgically repaired coronary artery bypass grafting. Whether individuals with acute myocardial infarction were included is uncertain.	No breakdown, only medication-focused guidance was given to the participants."

5. METHOD OF THE STUDY

All studies published up to this point have been meticulously searched in Scopus, CENTRAL (via the Cochrane Library), EMBASE (via Ovid SP), and MEDLINE (via Ovid SP) [23-50]. All aspects of the investigation, including the research plan, were documented and submitted to PROSPERO (ID CRD42016035472). Other papers were found by checking the references of related research and review articles. Randomised clinical trials (RCTs) comparing various forms of home-based exercise-based CRs to yoga-based exercise-based CRs with usual care as a component were included in this analysis. The patients had to be at least 18 years old and have coronary heart disease (CHD). In order to assess the effectiveness of various training times, studies were omitted if CR was conducted on all patients. We did not include in our meta-analysis any randomised controlled trials (RCTs) that assessed the efficacy of counselling techniques alone, as well as any abstracts from conferences, reviews (including systematic reviews), editorials, observational studies, animal experiments, or paediatric trials. The papers were evaluated using the aforementioned criteria for inclusion and exclusion. Furthermore, data on the total number of patients, participant characteristics, and primary outcomes of the eligible trials were gathered using a standardised data extraction form that also requested information about the first author, publication year, methodology, setting, and duration of follow-up. The authors read the whole article and extracted the data on their own.

In this analysis, exercise-based CR was defined as CR treatments that took place in the home, via telehealth, or as a combination of the two. The term "center-based CR" was used to describe CR that took place in a hospital or similar facility. Traditional follow-up procedures, such as frequent visits or phone calls, were used to classify home-based programs as those that took place outside of hospitals, in the community, or in patients' homes. CR that is conducted in patients' homes or other non-hospital settings and supervised by medical personnel using telehealth technology is referred to as tele-based CR. One option for CR was a combination of center-based and home-based services, while another was a combination of center-based and tele-based services. In this study, death from any cause was the main outcome. Recurrence of coronary artery bypass grafting (CABG) and readmission to the hospital over the course of the study were considered secondary objectives.When there was little chance of bias in the following areas: randomisation, outcome assessor blinding, partial outcome data, selective reporting, and no evidence of bias in any other areas, we said that there was little chance of bias overall. If there was at least one confusing possibility of bias in the areas of blinding, randomisation, missing outcome data, and selective reporting, but no other areas posed a significant risk, we said that the overall risk of bias was uncertain. If there was a high probability of bias in two or more of the following areas—randomization or outcome assessor blinding—or if the outcome data was inadequate or biased, then the total risk of bias was considered high. Utilising the random effects model via the metan package of Stata 13.0, we first conducted pairwise analyses to assess the accessible direct relative impacts of the competing therapies. For every set of comparisons, we calculated heterogeneity parameters in these studies. Prespecified subgroups comprised patients who were 70 years old or older, patients who had a diagnosis of acute myocardial infarction (AMI) and had bypass surgery, and the year in which the papers were published. From a cumulative ranking chance that an intervention was above a given ranking, with values ranging from 0 (absolutely the worst intervention) to 1 (absolutely the best), the surface under the cumulative ranking (SUCRA) was computed for each intervention. In order to establish the order of the competing treatment outcomes, the SUCRA was computed for the whole population and all subgroups. This allowed us to find the likelihood that a certain therapy would rank among the top treatments. We ran four sensitivity analyses on the main and secondary outcomes that were accessible: First, we only included studies that had a low overall bias risk. Second, we didn't include studies that had a high overall bias risk. Third, we didn't include the 1984 WHO research since it was the most heavily weighted in the analysis and might have influenced the results.

6. OVERALL STUDY OF CARDIAC REHABILITATION ON CABG PATIENTS

There were 13,675 articles that might be of interest based on the search results. Due to not meeting the criteria, 13,615 citations were eliminated. Following full-text screening, 60 randomised controlled trials (n=19,411) spanning the years 1981–2023, were included. The features of each research and its environment are shown in Table 3.

Table 3 Study Characteristics of the Included Trials

"Study	Method	Country	Length of follow-up (month)	Sample size	Intervention (center-based: 1; home-based: 2; tele-based: 3; c combined: 4; control: 0)
Aronov 2010[2]	Multicenter	Russia	12.0	392.0	1 vs. 0
Belardinelli 2001[23]	Single center	Italy	33.0	118.0	1 vs. 0
Bell 1998 [24]	Multicenter	Italy	12.0	252.0	1 vs. 2
Bengtsson 1983[26]	Single center	Sweden	14.0	171.0	1 vs. 0
Bertie 1992 [27]	Single center	UK	24.0	110.0	1 vs. 0
Bethell 1990 [25]	Single center	UK	60.0	229.0	1 vs. 0
Briffa 2005[28]	Multicenter	Australia	24.0	113.0	1 vs. 0
Carlsson 1998[29]	Single center	Sweden	12.0	235.0	1 vs. 4
Carson 1982[30]	Single center	UK	36.0	303.0	1 vs. 0
COACH pilot 2002[31]	Single center	Australia	6.0	245.0	3 vs. 0
COACH trial 2003[32]	Multicenter	Australia	6.0	792.0	3 vs. 0
Dalal 2007[33]	Single center	UK	9.0	104.0	1 vs. 2
DeBusk 1994[34]	Multicenter	USA	12.0	585.0	3 vs. 0
Dugmore 1999[35]	Single center	UK	60.0	124.0	1 vs. 0
Engblom 1996[4]	Single center	Finland	60.0	228.0	1 vs. 0
Erdman 1986[36]	Single center	Netherlands	60.0	80.0	1 vs. 2
Fletcher 1994[37]	Single center	USA	6.0	88.0	2 vs. 0
Fridlund 1991[38]	Single center	Sweden	60.0	178.0	1 vs. 0
Giallauria 2009[40]	Single center	Finland	60.0	61.0	1 vs. 0
Gordon 2002[39]	NR	USA	30.0	155.0	1 vs. 2
Haskell 1994[41]	Multicenter	USA	48.0	300.0	2 vs. 0
Heller 1993[42]	Multicenter	Australia	6.0	450.0	2 vs. 0
Higgins 2001[43]	Single center	Australia	51.0	105.0	2 vs. 0
Hofman-Bang 1999[44]	Single center	Sweden	24.0	87.0	1 vs. 0
Houle 2012[45]	Multicenter	Canada	12.0	65.0	2 vs. 0
Jolly 2007[46]	Multicenter	UK	24.0	525.0	1 vs. 2
Jones 1996[47]	Multicenter	UK	12.0	2328.0	1 vs. 0
Kallio 1979[48]	Multicenter	Finland	36.0	375.0	1 vs. 0
Kovoor 2006[49]	Multicenter	Australia	6.0	142.0	2 vs. 0
La Rovere	Single center	Italy	120.0	95.0	1 vs. 0

2002[50]					
Lear 2003[51]	NR	Canada	12.0	302.0	3 vs. 0
Lewin 1992[52]	Single center	Scotland, UK	12.0	176.0	2 vs. 0
Maddison 2015[53]	Multicenter	New Zealand	6.0	171.0	2 vs. 0
Manchanda 2000 [54]	Single center	India	12.0	42.0	4 vs. 0
Maroto 2005[55]	Single center	Spain	120.0	180.0	1 vs. 0
Miller 1984[9]	NR	USA	6.0	198.0	1,4 vs. 0
Munk 2009 [56]	Single center	Norway	6.0	40.0	1 vs. 0
Mutwalli 2012	Single center	Kingdom of Saudi Arabia	6.0	49.0	2 vs. 0
Niebauer 1997[58]	NR	UK	3.0	113.0	2 vs. 0
Oerkild 2012[59]	Single center	Denmark	12.0	40.0	2 vs. 0
Oldridge 1991[60]	Multicenter	Canada	12.0	201.0	1 vs. 0
Ornish 1998[61]	Multicenter	USA	60.0	48.0	1 vs. 0
Reid 2012[62]	Multicenter	Canada	12.0	223.0	3 vs. 0
Roman 1983[63]	Single center	Chile	108.0	193.0	1 vs. 0
Schuler 1995[64]	Single center	Germany	72.0	113.0	2 vs. 0
Seki 2008 [65]	Single center	Japan	NR	39.0	4 vs. 0
Shaw 1981[66]	Multicenter	USA	60.0	651.0	1 vs. 0
Sivarajan 1982[67]	Single center	USA	6.0	258.0	1 vs. 0
Specchia 1996[68]	Single center	Italy	40.0	256.0	1 vs. 0
Stern 1983[69]	Multicenter	USA	36.0	106.0	1 vs. 0
Toobert 2000[70]	NR	USA	12.0	25.0	1 vs. 0
Vermeulen 1983[71]	NR	Netherlands	60.0	98.0	1 vs. 0
VHSG 2003[72]	Single center	Norway	60.0	197.0	1 vs. 0
Wang 2012[73]	Multicenter	China	6.0	160.0	2 vs. 0
West 2012[74]	Multicenter	UK	24.0	1813.0	1 vs. 0
WHO 1984[21]	Multicenter	European countries	36.0	3184.0	1 vs. 0
Wilhelmsen 1975[75]	Single center	Sweden	60.0	315.0	1 vs. 0
Young 2003[77]	Single center	Canada	12.0	146.0	2 vs. 0
Yu 2004[76]	Single center	China	24.0	269.0	4 vs. 0
Zwisler 2008[78]	Single center	Denmark	12.0	770.0	1 vs. 0"

Exercise type and intensity, session frequency and duration, and rehabilitation duration are the cornerstones of CR programs [50-60]. Although we go into great depth on each of these characteristics, data on them is only available from half of the studies. In terms of exercise type, eleven out of the thirty-seven studies looked at CR programs in centers that included both aerobic and strength training activities; the other trials solely looked at aerobic exercises. Individual CR programs included sessions that were 20 minutes to 2 hours long. Although the lengths of the three separate CR programs (center-based, 6.36 months; home-based, 6.13 months; telebased, 5.70 months; combined, 8.00 months) were not statistically different from one another, the combined CR programs were noticeably longer.

We provide the total risk of bias for the included RCTs. Thirteen trials (21.7%) were determined to have a low risk of bias regarding allocation concealment, while twenty-five (41.7%) trials were found to have a low risk of random sequence generation. Just fifteen studies (or 25.0% of the total) used blinding to evaluate outcomes; seven trials (11.7%) did not, and the other trials did not provide any information about blinding. Out of the trials that published results, twenty-six (43.3%) had incomplete data. Eighty percent of studies had similar between-group baseline characteristics. Twenty-four studies (or 40.0%) used intention-to-treat analysis. In addition to exercise-based rehabilitation, twenty-seven studies (45.0%) examined other therapies, such as counselling.

The analysis showed that center-based CR was the only one that notably reduced all-cause mortality when compared to usual care (RR=0.76,95%CI 0.55-1.33; RR=0.97,95% CI 0.62-1.52; RR=0.50,95%CI0.20-1.27). All other forms of CR were not significantly different from usual care in terms of mortality. Additionally, when comparing various kinds of CR, no statistically significant differences were identified (RR=0.89, 95% CI 0.57-1.40; RR=0.78, 95% CI 0.49-1.27; RR=0.78, 95% CI 0.49 1.27) between center-based and home-based CR, tele-based CR, and combination CR. In closed loops that allowed for the measurement of network coherence, there was no inconsistency and no significant disparities between direct and indirect estimations. Findings were in line with the standard analysis, showing that center-based CR was associated with a reduced incidence of bypass operation mortality than usual care (center-based CR vs. usual care: RR=0.65, 95% CI 0.49-0.85, p=0.002). Imprecise estimations about the effectiveness of center-based, home-based, tele-based, and combination CR were found in patients with CHD".

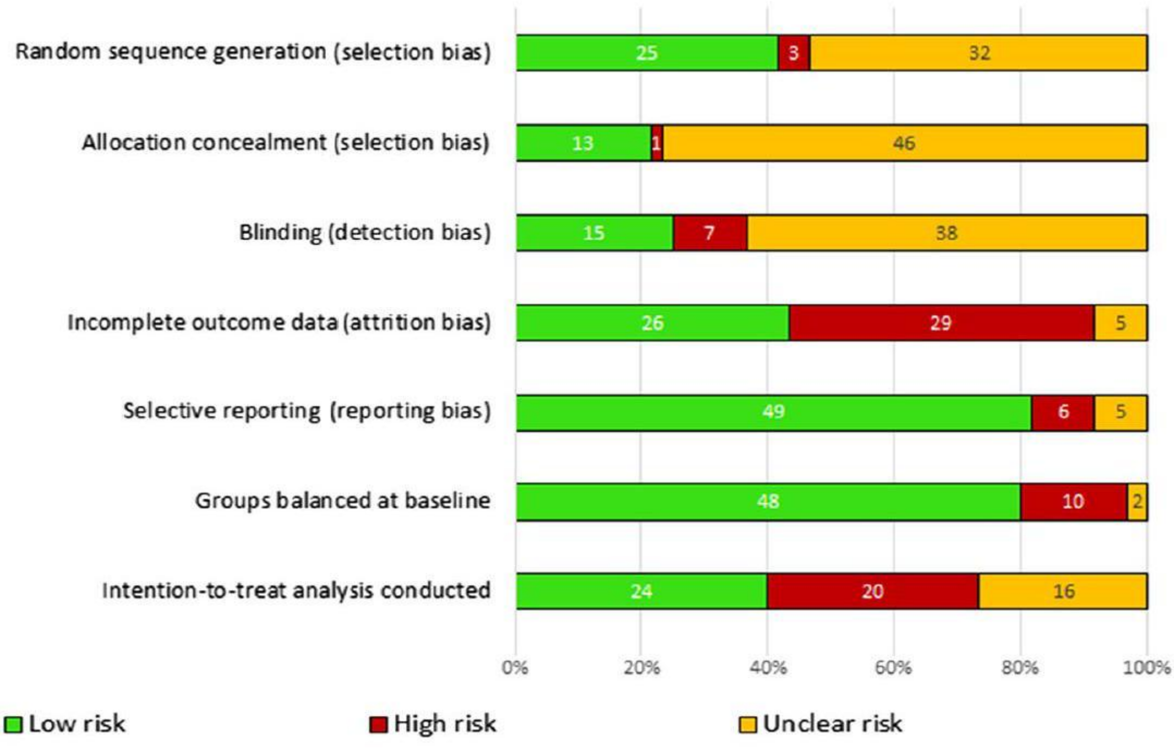

Figure 1 Risk of bias graph for the included studies.

Numbers (and percentages) of studies with low, high, or uncertain risk of bias for each factor are shown in Figure 1. Risk Ratio and 95% Confidence Intervals for the Network (Table 4) Review of relevant literature Examining the Column-Defining Treatment for Death from Bypass Surgery and Each of the Five Interventions for Overall Mortality (Upper Triangle) (Lower Triangle)

Table 4 Comparative performance analysis

	"Center-based	Home-based	Tele-based	Combined	Control
Center-based	NA	0.890(0.57 − 1.40)	0.780(0.490 − 1.270)	0.780(0.490 − 1.27)	0.760*(0.64 − 0.90)
Home-based	0.410(0.06 − 2.840)	NA	0.880(0.470 − 1.650)	0.880(0.470 − 1.65)	0.860(0.55 − 1.330)
Tele-based	1.340(0.560 − 3.230)	3.290(0.410 − 26.680)	NA	0.52(0.19 − 1.45)	0.970(0.620 − 1.520)
Combined	0.680(0.010 − 36.710)	1.660(0.020 − 138.060)	0.510(0.01 − 29.470)	NA	0.500(0.200 − 1.270)
Control	0.650*(0.490 − 0.850)	1.580(0.230 − 10.78)	0.480(0.21 − 1.110)	0.95(0.02 − 50.91)	NA"

"The relative risk is located in the cell that intersects the column-defining treatment and the row-defining treatment; while reading comparisons between treatments, do it from left to right. The row-defining therapy has a relative risk of less than 1 for all-cause mortality and the column-defining treatment has a relative risk of less than 1 for death after bypass surgery. * p=0.002.

Fatalities resulting from bypass surgery or cardiovascular causes; NA, not applicable

The risk of dying after bypass surgery was 0.41 (95% CI: 0.06-2.84), 1.34 (95% CI: 0.56-3.23), and 0.68 (95% CI: 0.01-36.71) when comparing center-based CR with home-based CR, tele-based CR, and combination CR. We found no differences between the CR programs and conventional treatment in terms of avoiding AMI, readmission, CABG, or rePCI. Plus, when compared to center-based CR, home-based, tele-based, and combination CR failed to decrease the risks of AMI, readmission, CABG, and rePCI.

We classified individuals according to publication time, counselling, age, or diagnosis of AMI to evaluate whether confounding variables impacted the effectiveness of exercise-based CR. The first subgroup analysis, which included patients categorised according to when the paper was published, confirmed that overall findings were similar across all patient groups (center-based CR vs. usual care: RR=0.71, 95%CI 0.58-0.89, p=0.001). However, there was no statistically significant difference in the claimed efficacies of other CRs according to publication time; this might have been due to insufficient statistical power. According to the results of the second and third subgroup analyses, there is a considerable age- and type-dependent difference in the effectiveness of various CRs. The effect of various CRs that are described may be heavily impacted by the kind of diagnosis. The effectiveness of CRs in patients with acute myocardial infarction (AMI) and those under the age of 60 was very similar to that in the whole patient population (RR=0.75, 95% CI 0.61-0.92, p=0.001 for AMI; RR=0.70, 95% CI 0.58-0.84, p=0.001 for patients under the age of 60). Possibly due to insufficient statistical power, CR effectiveness was not significantly different in other groups. Based on whether the comparison condition had counselling or not, the fourth subgroup meta-analysis found no significant impact (RR=0.73, 95% CI 0.55-0.96, p=0.024; RR=0.77, 95% CI 0.61-0.97, p=0.024). There were modest estimates of heterogeneity variance (tau value ≈0) in the common estimations. Our main analysis (center-based: RR=0.95, 95%CI 0.47-1.89) demonstrated more power than the sensitivity analysis that was limited to trials with low overall risk of bias, while it nevertheless produced similar findings. Furthermore, when we only included trials that were highly susceptible to multiple biases, we found that center-based CR differed significantly from standard care (center-based: RR=0.75, 95% CI 0.58-0.97). Consistent with the overall findings, the analysis that did not include the WHO 1984 report found a relative risk of 0.77 (95% CI 0.63 to 0.94).

7. LIMITATIONS OF THE STUDY

This study combines data from exercise-based CR and yoga (center-based CR) for the first time, and it is significant to the modern medical treatment of patients who have had bypass surgery. Even though we are relying on a prior Cochrane evaluation [70–80] rather than doing a de novo quality assessment of the papers included in this review, it is very improbable that our results would have been different based on that evaluation. Preliminary data about the participants is not available in this analysis. Still, most research found no significant difference in baseline characteristics between the control and intervention groups. Hospital admissions were the only outcome measure for which there was no indication of statistical heterogeneity across trials (P value 30%), however, there was a great deal of contextual and interventional variability. Research participants came from a broad variety of nations and clinical settings, and the therapies studied had a wide spectrum of quality. The exercise treatments that were given showed a lot of difference when compared to the ACPICR criteria and the BACPR's requirements. The experiment, which included the most participants (n=1813), has drawn criticism for its claimed exercise component. It was suggested that the lack of a clear outcome may have been caused by the exercise and yoga being underdiagnosed. Factors such as exercise intervention duration, modality, and intensity were not reported in a number of the other studies that made up this study. Eighty to ninetyYoga, regular exercise, and other forms of physical activity have a "dose-response" effect on heart health. A lower risk of death is linked to an increase in exercise capacity (VO2 peak). Patients undergoing exercise-based CR are unlikely to have any physiological benefit unless they exercise at the recommended dosage. There is a valid worry that many of the studies that were considered may not have given their subjects enough exercise. These days, with modern medical care, exercise regimens that include greater intensities may be more suitable and beneficial. Reported exercise faithfulness and adherence is a big cause for worry. There is no way to tell if people really complete their prescribed exercise and yoga, even though most of the studies here report the correct dosage. If these metrics are not reported, it is impossible to measure the exact amount of exercise and yoga that was obtained. How this plays out could greatly impact how effective the intervention is and how this analysis turns up. The interventional study reporting guidelines and checklists should enhance the quality of reports and trial interpretation going forward.

8. DISCUSSION

The effectiveness of existing CR techniques for patients with CHD has only been shown in one study. In particular, compared to patients getting standard care, cardiac patients receiving center-based CR had a significantly reduced risk of all-cause death and mortality after bypass operation. Due to the lack of statistical significance between center-based CR and usual care and home-based and tele-based CR, none of these approaches was shown to be better than the others. Also, there was no statistically significant difference between center-based CR and standard treatment in terms of the risk of AMI, reCABG, rePCI, and hospital readmissions. According to the results, there was also no statistically significant difference in the effectiveness of the various CR techniques [90]. The latest Cochrane analysis showed that exercise-based CR had significant positive benefits; the study comprised 14,486 individuals with CHD. Consistent with our results, exercise reduced the incidence of death after bypass surgery and hospital readmission while improving health-related quality of life. To identify the most beneficial methods for patients, we categorised exercise-based CR in our research. Patients benefited the most with exercise CR that was placed in a center setting. Currently, exercise-based CR mostly relies on center-based programs, including inpatient and outpatient, often held in controlled environments like hospitals, universities, or community centers. Several insurmountable obstacles are linked with center-based CR, such as transportation difficulties, restricted program availability, and unsuitable program scheduling [91-99].

Table 4 Analysis of Subgroup Networks Critical Review of Exercise-Based CR the Surface under the Cumulative Ranking Curve and Usual Yoga Care

	"Subgroup 1		**Subgroup 2**		**Subgroup 3**	
	RR (95% CI)	**SUCRA**	**RR (95% CI)**	**SUCRA**	**RR (95% CI)**	**SUCRA**
Row 1: publication year	1974-1990		1991-2000		2001-2014	
Usual care	1	7.400%	1	41.90%	1	25.10%
Center-based	0.710(0.580 − 0.890)	43.90%	0.74(0.46 − 1.18)	77.0%	0.880(0.54 − 1.430)	44.30%
Home-based	0.07(0.00 − 1.370)	87.60%	0.870	41.90%	0.820(0.43 − 1.57)	51.10%
Tele-based	-	-	1.200(0.51 − 2.83)	30.50%	0.860(0.44 − 1.680)	45.70%

Combined	0.250(0.010 − 5.150)	61.10%	0.780(0.13 − 4.74)	58.70%	0.460(0.14 − 1.50)	83.8%
Row 2: age (years)	Younger than 60 years		60 − 70 years		Older than 70 years	
Usual care	1	25.50%	1	38.00%	1	26.60%
Center-based	0.700(0.58 − 0.840)	74.60%	1.06(0.76 − 1.49)	29.20%	0.770(0.34 − 1.750)	73.40%
Home-based	0.840(0.450 − 1.540)	49.900%	1.140(0.44 − 2.990)	28.60%		
Tele-based	1.010(0.65 − 1.55)	27.80%	0.200(0.01 − 4.260)	82.50%		
Combined	0.420(0.040 − 4.620)	72.10%	0.570(0.21 − 1.520)	71.70%		
Row 3: AMI	Patients diagnosed with CHD undergo bypass surgery		Patients diagnosed with AMI			
Usual care	1	24.40%	1	32.60%		
Center-based	0.810(0.50 − 1.330)	55.20%	0.750(0.610 − 0.92)	69.90%		
Home-based	0.870(0.48 − 1.580)	47.40%	0.960(0.41 − 2.25)	41.70%		
Tele-based	0.910(0.55 − 1.490)	41.7%	1.21(0.48 − 3.03)	26.2%”		
Combined	0.550(0.210 − 1.450)	81.4%	0.260(0.01 − 5.310)	79.60%		
Row 4: counseling	Intervention included counseling		The intervention did not include counseling			
Usual care	1	11.00%	1	21.80%		
Center-based	0.730(0.55 − 0.960)	70.70%	0.770(0.61 − 0.970)	67.70%		
Home-based	0.660(0.250 − 1.770)	68.3%	0.910(0.550 − 1.480)	41.40%		
Tele-based			0.970(0.610 − 1.540)	32.20%		
Combined			0.510(0.20 − 1.270)	87.0%		

Relative risk as opposed to standard care is used to evaluate effects, with 95% confidence intervals shown in brackets. The cumulative ranking likelihood that an intervention was above a given rating was used to compute each intervention. The rankings ranged from 0 (absolutely the worst) to 1 (absolutely the best).”

9. CONCLUSION

According to previous meta-analyses, home-based CR programs have a positive impact on functional outcomes such as exercise capacity, quality of life, and systolic blood pressure. These programs also reduce the risks of mortality and cardiac events among patients with coronary heart disease. exactly 11,80 In terms of all-cause and bypass surgery-related mortality, however, our analysis indicated that home-based CR was not substantially different from standard treatment. Readmission to the hospital and revascularisation are more common with home-based CR compared to center-based CR, according to previous research. About 46.81 Neither center-based nor home-based CR differed in the incidence of rePCI, readmission, or revascularisation, according to our data. In order to improve patient uptake and adherence, it is widely believed that home-based programs should be made available. This will allow more patients to engage in exercise-based CR. Our results show that home-based CR programs do not last any longer than center-based programs, suggesting that researchers should test longer durations to see how patients respond and how well they stick to their treatment plans.

Also, only in center-based or combination CR was strength training coupled with aerobic training, according to our thorough exercise type study. Patients who want to do their CR exercises at home often only have access to written instructions, exercise records, and basic counting devices. These approaches aren't good enough to tell therapists if their patients did the exercises properly or whether they did enough repetitions of each exercise; they also can't provide enough feedback on the workouts' quality. While most recommendations advocate for home-based CR programs as an alternate rehabilitation strategy for preventing cardiovascular disease, our findings suggest that more research is required to support this claim.

There is debate about whether home-based CR is just as successful as center-based CR due to the absence of exercise instructions and monitoring. Clinicians have lately shown a growing interest in a novel kind of CR that relies on telecommunications and information technology; this form is called tele-based CR. With the use of sensor technologies, communication methods, and data analysis methodologies, **telebased CR aims to provide patients more feedback, education, and counselling. about ten CR and secondary prevention are making more and more use of tele-based strategies. Cardiovascular risk factors and health-related quality of life are both improved by tele-based CR, which also reduces the risks of adverse events and is cost-effective, according to previous systematic studies. Emerging research suggests that patients' exercise capacity has been boosted by advancements in tele-monitoring technology compared to standard center-based training, even if there is a dearth of long-term follow-up data for tele-based CR. When done correctly, tele-based CR has the potential to revolutionise the way outpatients get CR by allowing them to receive advice from physicians and undergo relevant clinical examinations remotely. $12.82 million In terms of training intensity, frequency, length, or kind, conventional CR programs still outperform their tele-based counterparts. Utilising telehealth technology, CR exercise intensity may be regulated remotely using physiological indicators, much as in a center-based program. Future research may find ways to extend the one-month to one-year length of tele-based CR programs,** which is comparable to the duration of conventional CR programs. In terms of health economics, CR that is conducted via telemedicine has the potential to be safer and more effective than CR that is conducted in a center, and it may also be less expensive. Due to the field's youth and quick evolution, tele-based CR's revolutionary technology has not yet established a solid foundation in patient care. And there's no evidence that this tech can keep patients interested in tele-based CR. We should consider seriously the findings of our analysis, which showed that the mortality of tele-based CR is equivalent to that of center-based CR and home-based CR, as data on direct comparisons of the mortality associated with tele-based CR and center-based CR are sparse. This study's findings suggest that tele-based CR should be given with care, especially as tele-technology is still in its early stages of development. Our research had numerous shortcomings with previous systematic reviews. For starters, evaluating CR via telemedicine or combined CR has been under-researched in randomised controlled trials (RCTs). That is why it is difficult to draw firm conclusions from comparisons including various CR initiatives. As a second point, the included research lacked adequate characterisation of their techniques. It seems that the outcomes of interest in this evaluation were unaffected by bias, however, a number of studies were determined to have significant risks of bias. Research has shown that CR can include more than simply fitness training and may even include interdisciplinary teams. The intervention groups often included counselling, a better diet, and intermittent oxygen treatment in addition to rehabilitative activity; however, the standard care groups did not, making it impossible to control for these differences. Furthermore, there was insufficient information on the quality of the randomisation or the achievement of allocation concealment in the majority of the trials. Thirdly, we confined our searches to papers and data published in English. Lastly, it's worth noting that CABG and PCI may temporarily lower mortality risk, therefore some of the secondary endpoint study findings might be questionable. Fifth, it is difficult to assess the added advantages of various therapies due to advancements in medical care post-MI. Last but not least, we failed to assess any variations between the CR programs with regard to cost-effectiveness, functional exercise capacity, or health-related quality of life.

Finally, this work summed together all the best data on a number of CR techniques. Based on the available data, individuals with CHD are best treated with center-based CR. It is important to do more research on the effectiveness of home-based and tele-based CR as these methods may help patients save time, energy, money, and resources.

Author Contributions

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Conflict of Interest

Supplementary Material

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