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Effectiveness of Cardiac Telerehabilitation in Improving Functional Capacity, Quality of Life, and Cardiovascular Outcomes in Patients After Acute Coronary Syndrome and/or Coronary Revascularization (PCI/CABG): A Systematic Review Comparing Telerehabilitation With Traditional Cardiac Rehabilitation

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

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Background: This systematic review evaluates the effectiveness of telerehabilitation via mobile applications compared with conventional cardiac rehabilitation in patients after acute coronary syndrome (ACS) and/or coronary revascularization, including percutaneous coronary intervention (PCI) and coronary artery bypass grafting (CABG). The analysis focuses on physical capacity, quality of life, psychological well-being, health behaviors, cardiovascular and anthropometric parameters, and biochemical outcomes.

Material/Methods: This systematic review was conducted in accordance with PRISMA and PICO guidelines. A total of 3674 records were identified through searches of PubMed, Scopus, and Web of Science, of which 12 randomized controlled trials involving 1911 participants were included. The studies evaluated telerehabilitation delivered via mobile or web-based platforms in patients after ACS and/or coronary revascularization (PCI/CABG), compared with structured center-based cardiac rehabilitation or usual care.

Results: Telerehabilitation was associated with greater improvements in exercise capacity, as measured by the 6-minute walk test and maximal oxygen uptake, adherence to physical activity and dietary recommendations, and selected quality of life and psychological outcomes compared with control conditions ($P<0.05$). In contrast, cardiovascular risk factors, including blood pressure, body mass index, waist-hip ratio, lipid profile, blood glucose level, and smoking cessation, improved in both groups, with no significant between-group differences ($P>0.05$). The magnitude of observed effects varied depending on the type of comparator.

Conclusions: Telerehabilitation appears to be a comparable alternative to traditional cardiac rehabilitation in patients after ACS and/or coronary revascularization (PCI/CABG), with potential benefits in adherence and selected patient-reported outcomes. However, the findings should be interpreted with caution due to heterogeneity in comparator interventions.

Keywords: **Cardiac Rehabilitation • Cardiovascular Diseases • Coronary Angiography • Coronary Artery Disease • Telerehabilitation**

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Introduction

Cardiovascular disease is one of the leading causes of death worldwide. It is estimated that 17.8 million people die from it annually worldwide, representing 330 million years of life lost and 35.6 million years of life with disability [1]. In the context of exacerbation of these diseases, a key role is played by acute coronary syndrome (ACS), which is characterized by a sudden reduction in blood flow to the heart [2]. The most severe clinical conditions within ACS include unstable angina pectoris and myocardial infarction, including ST-segment–elevation myocardial infarction and non–ST-segment–elevation myocardial infarction [3]. Myocardial infarction is one of the most dangerous and life-threatening incidents in the course of coronary heart disease, constituting the most severe clinical picture of this pathology [4]. An effective and life-saving medical procedure in the treatment of myocardial infarction is coronary revascularization, the aim of which is to restore normal blood flow in the coronary vessels [5]. The main methods of revascularization include percutaneous coronary intervention (PCI) and coronary artery bypass grafting (CABG) [6,7]. Comprehensive care after ACS and/or a revascularization procedure is essential to minimize the risk of complications and prevent further cardiovascular events [8]. It is estimated that the risk of death in the period of 1 to 5 years after myocardial infarction is 30% higher than in the general population [9]. A key element of effective secondary prevention is cardiac rehabilitation, which plays an important role in restoring full physical fitness of patients and improving their quality of life [10]. The rehabilitation program aims not only to improve physical fitness, but also to educate patients about a healthy lifestyle, which can have a significant effect on long-term prognosis [11]. Several studies [12-14] have demonstrated the cardioprotective effect of regular physical activity, reporting a 20% to 25% reduction in mortality [15]. However, patients' awareness of the need to follow therapeutic recommendations, including regular physical activity, taking medications, avoiding stimulants, following an appropriate diet, and reducing stress, remains at an insufficient level [16]. Limited access to cardiac rehabilitation, high treatment costs, and patients' tendency to abandon the rehabilitation program may lead to serious postoperative complications and increase the risk of further cardiovascular incidents [17]. Telerehabilitation is a modern method of supporting the rehabilitation process, which combines the convenience of treatment at the patient's home with professional supervision of specialists in a medical facility. Through the use of modern technologies such as mobile applications, online platforms, smart bands, and mobile devices, it is possible to monitor the patient's progress in real time [18]. This innovative form of rehabilitation is an excellent alternative for people who cannot regularly attend traditional rehabilitation sessions due to high transport costs. Thanks to telerehabilitation, the patient maintains access to professional medical care while enjoying the convenience of treatment at home, which contributes to improving the quality of life and the effectiveness of the rehabilitation process [19]. The European Society of Preventive Cardiology indicates that cardiac rehabilitation is one of the most effective methods of therapy and secondary prevention for patients with circulatory system diseases [20]. Cardiac rehabilitation after ACS includes 3 key phases: phase 1 (early) begins immediately after the cardiovascular incident, in a hospital setting, focusing on patient stabilization; phase 2 (outpatient) focuses on improving physical condition, patient education, and modifying risk factors and health behaviors; and phase 3 (long-term) aims to maintain the achieved physical condition and healthy habits throughout life [12,21,22]. Cardiopulmonary fitness is a key prognostic factor after cardiovascular events. Its improvement contributes to a 13% increase in survival rates [23]. Traditional cardiac rehabilitation in medical centers has received great recognition and shown effectiveness [24,25]. Telerehabilitation is becoming increasingly popular, as it enables supervised physical activity at home [26]. This modern form of rehabilitation has gained particular importance during the COVID-19 pandemic, when restrictions related to access to medical facilities prompted the search for alternative therapeutic solutions [27]. The use of telerehabilitation tools has a wide application in the care of cardiac patients, including providing advice on modifying health behaviors, remote monitoring of the patient's physical activity, and providing psychosocial support, which promotes comprehensive rehabilitation and improves the quality of life of patients [28]. Previous systematic reviews have confirmed the effectiveness of telerehabilitation in the treatment of circulatory system diseases. Most of them focused on patients with a wide range of cardiovascular disorders, such as coronary heart disease, myocardial infarction, coronary artery bypass grafting, chronic heart failure, or metabolic syndrome [29-33]. However, other reviews, although they indicated positive effects of telemedicine, were based mainly on studies using video calls and telephone conversations and not on modern applications and devices [34,35]. Unlike previous reviews, the present systematic review focuses on a more specific, although still clinically heterogeneous, group of patients after ACS and/or coronary revascularization, including PCI and CABG. Despite the existence of previous studies on this topic, the present analysis provides important information that is more precise and targeted to a specific group of patients, making it a valuable contribution to the field of cardiac rehabilitation. This systematic review was additionally updated with the latest scientific reports [36-41], allowing the consideration of current trends and innovations in the field of telerehabilitation.

The aim of this systematic review is to assess the effectiveness of telerehabilitation using mobile devices and apps, compared with conventional cardiac rehabilitation, in patients after ACS and/or coronary revascularization, including PCI or CABG. The analysis will focus on the following outcomes: improvement in physical capacity, quality of life, and psychological well-being; changes in health behaviors, such as adherence to rehabilitation, dietary, and risk factor recommendations; improvement in cardiovascular and anthropometric parameters, such as body mass index (BMI) and waist-hip ratio (WHR); and biochemical results, including cholesterol and glucose levels.

Material and Methods

Study Design

This document is a systematic review of randomized controlled trials (RCTs) and was developed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines, to ensure transparency, accuracy, and completeness of analysis.

Search Strategy and Evidence Acquisition

A systematic review was conducted according to PRISMA and Patients, Interventions, Comparisons, Outcomes (PICO) guidelines. PubMed, Web of Science, and Scopus databases were searched for relevant articles published in the English language between 2017 and 2025. The search was not limited by publication date. On January 3, 2026, PubMed, Scopus, and Web of Science databases were searched, and clinicaltrials.gov was additionally searched for relevant studies. The search was based on the following keywords: “telerehabilitation”, “telehealth”, “telemedicine” AND “cardiac rehabilitation”, “coronary artery disease”, “cardiovascular diseases”, “percutaneous coronary intervention”, “acute coronary syndrome” AND “VO_2max”, “6MWT”, “six-minute walk test”, “BMI”, “blood pressure”, “HADS”, “cholesterol”, “adherence”, “quality of life”. Queries were filtered by topic (human studies) and publication period (2017-2025). Results were managed using Mendeley Desktop. After duplicate records were removed, the titles and abstracts were reviewed a second time for compliance with the eligibility criteria. Full texts of selected studies were then retrieved and analyzed in detail for inclusion criteria, publication date, study design, methods used in the intervention (IG) and control (CG) groups, and clinical presentation (ACS and/or coronary revascularization PCI or CABG).

Selection Process

This systematic review included only RCTs comparing cardiac telerehabilitation (digitally assisted) with traditional rehabilitation. Traditional rehabilitation was defined broadly and included structured center-based cardiac rehabilitation programs and usual care interventions, such as physical activity counseling, self-education, routine follow-up, and educational materials. This variability in control interventions was taken into account during the interpretation of the results. The studies were not limited by sample size or duration of follow-up. The most recent articles in English were selected. The inclusion and exclusion criteria for this systematic review were developed based on the PICO model, which provides a clear definition of the scope of the analysis and facilitates the selection of relevant studies (**Table 1**).

Study Risk of Bias Assessment

The Cochrane RevMan tool for RCTs was used to assess the risk of bias for each included study. The primary objective was to systematically assess the methodological quality of the studies and identify potential sources of bias that could affect the validity of the study results. Each study was assessed for risk of bias by selecting 1 of 3 options: low risk of bias, unclear risk of bias, and high risk of bias. The risk of bias assessment included the following areas: random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective reporting, and other sources of bias. To ensure the accuracy of the risk of bias assessment, each included study was assessed twice. Reviewers were trained in the Cochrane Risk of Bias tool and followed Cochrane guidelines to minimize subjective interpretation. Any discrepancies in the risk of bias assessment were carefully analyzed and reviewed several times. This approach was intended to ensure a consistent and reliable assessment process.

Of the 12 RCTs included, 10 studies described in detail the generation of random sequence [36-45]. The allocation concealment assessment allowed the selection of 4 studies with a low risk of bias assessment [37,39,40,43], which means that the assignment of participants to groups was appropriately concealed, minimizing the risk of selection bias. Only 1 study [37] was assessed as low risk of bias in the blinding of participants and personnel section, indicating complete blinding of both the participants and study personnel, which reduced the risk of performance bias. In 5 studies [38,40,41,44,46] the assessment was inconclusive (unclear risk of bias) because blinding concerned only 1 group, either participants or personnel, which can increase the risk of errors in the assessment of results. Six studies [37,39-41,43,45] were assessed as having low risk of bias in the blinding of outcome assessment section, meaning that the outcome assessors were blinded to the allocation of participants, minimizing the risk of detection bias. In 11 studies [26,38-47], the criteria for low risk of bias in terms of incomplete outcome data were met, indicating that outcome data were fully available, and missing data were appropriately accounted for, limiting the risk of attrition bias. Assessment of other sources of bias also indicated a low risk of bias in 11 studies [26,37-43, 45-47], suggesting that no major factors

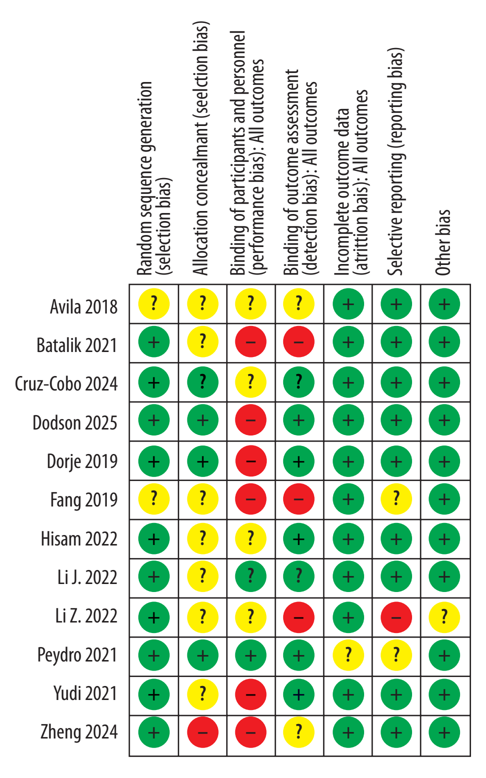
Table 1. Inclusion and exclusion criteria according to PICO.

PICO	Inclusion Criteria	Exclusion Criteria
Patients	– Age >18 years (both women and men) – medical diagnosis of coronary heart disease (CHD), including: • acute coronary syndrome (ACS): myocardial infarction (MI – ST-segment–elevation myocardial infarction and non–ST-segment–elevation myocardial infarction), unstable angina pectoris • previous coronary artery revascularization (PCI) or coronary artery bypass graft (CABG) – patients who have not previously participated in cardiac rehabilitation following a cardiovascular event	– Age <18 – Heart failure (NYHA III and IV) – Implantable cardioverter-defibrillator or other rhythm control device – Persons with serious comorbidities that may interfere with results (eg, advanced cancer)
Intervention	– Participants were provided with access to telerehabilitation or mHealth tools such as: mobile applications, websites, smart devices (bands, smartwatches, smartphones) – Monitoring of patients by medical personnel via telephone calls, text messages or video consultations or self-monitoring of activity and parameters using an application – Rehabilitation focused on at least one of the following health behaviors: physical activity, adherence to therapeutic recommendations, quitting smoking, healthy diet	– Rehabilitation exclusively in hospital or exclusively at home without telemonitoring
Comparison	Standard cardiac rehabilitation and medical care, carried out in: a stationary center, an outpatient form, a health education form with a brochure/guide and a dedicated exercise program. Including rehabilitation supervised by a specialist in cooperation with a cardiologist, dietitian and psychologist.	– Patients from the control group who received telerehabilitation components, ie, applications/smart devices
Outcomes	Exercise Capacity, hemodynamic parameters, and motor tests: Six-minute walking test (6MWT), VO_2max, daily physical activity levels (number of steps, accelerometer), motor tests, eg, Timed Get Up and Go test, 30-Second Chair Stand Test Health behavior and adherence regarding taking medications, following a recommended diet, physical activity, control of stimulants eg, smoking Biochemical parameters: laboratory results (lipid profile, LDL, HDL, triglycerides, blood glucose) Anthropometric parameters and body composition: body mass index, waist-hip ratio,% fat Quality of life and mental well-being: standardized questionnaires for assessing quality of life and mental state, anxiety and depression	– Qualitative research results, scientific articles containing only abstracts, book chapter reviews, discussion, and conference materials were excluded

were identified that could have influenced the study results. Nine studies [26,38-43,45,46] were assessed as having a low risk of bias in the selective reporting section because all of these studies reported the use of a registered study protocol, which ensured full transparency and reduced the risk of underreporting of results. A summary of the risk of bias results is presented in **Figure 1**.

Methods of Sensitivity Analyses

To assess the robustness of the findings and explore potential sources of heterogeneity, qualitative sensitivity analyses were conducted. These analyses examined the effects of (1) the type of comparator (usual care or low-intensity interventions vs structured, supervised cardiac rehabilitation), and (2) the characteristics of the study population (clearly defined ACS populations vs post-PCI populations with less clearly specified clinical status). Given the identified heterogeneity, these analyses should be interpreted as exploratory. First, studies were grouped according to the comparator. Trials by Dorje et al, Fang et al, Zheng et al, and Cruz-Cobo et al [36,40,43,47] used usual care or low-intensity interventions as the control condition, whereas studies by Peydro et al, Batalik et al, Avila et al, Yudi et al, Dodson et al, Li Z. et al, Li J. et al, and Hisam et al [37-39,41,42,44-46] compared telerehabilitation with structured, supervised cardiac rehabilitation programs. Second, studies were categorized according to patient population. Trials including clearly defined ACS populations (Dorje et al, Peydro et al, Batalik et al, Avila et al, Yudi et al, Dodson et al, Li Z. et al, Cruz-Cobo et al, and Hisam et al) [37,39-46] were compared with studies involving post-PCI populations with unclear clinical status (Fang et al, Zheng et al, and Li J. et al) [26,38,47].



	Random sequence generation (selection bias)	Allocation concealmant (seelction bias)	Binding of participants and personnel (performance bias): All outcomes	Binding of outcome assessment (detection bias): All outcomes	Incomplete outcome data (atrittion bais): All outcomes	Selective reporting (reporting bias)	Other bias
Avila 2018	?	?	?	?	+	+	+
Batalik 2021	+	?	−	−	+	+	+
Cruz-Cobo 2024	+	?	?	?	+	+	+
Dodson 2025	+	+	−	+	+	+	+
Dorje 2019	+	+	−	+	+	+	+
Fang 2019	?	?	−	−	+	?	+
Hisam 2022	+	?	?	+	+	+	+
Li J. 2022	+	?	?	?	+	+	+
Li Z. 2022	+	?	?	−	+	−	?
Peydro 2021	+	+	+	+	?	?	+
Yudi 2021	+	?	−	+	+	+	+
Zheng 2024	+	−	−	?	+	+	+

Figure 1. Risk of bias summary.

Overall, the findings of this review should be interpreted with caution due to heterogeneity in study populations and control interventions.

Results

Study Selection

The initial search of 3 electronic databases identified 3674 records, of which 1735 were duplicates and were removed. The titles and abstracts of 1939 records were then reviewed, excluding 1882 of these, 1344 because they were irrelevant and 538 because they did not meet the inclusion criteria. The remaining 57 records were subjected to a detailed full-text review to assess compliance with the eligibility criteria. Detailed review of the articles identified 10 articles that met the criteria. Additional screening of reference lists identified 2 additional studies that met the inclusion criteria. Ultimately, 12 RCTs were included in the review (**Figure 2**).

Evidence Synthesis

A total of 12 studies met the inclusion criteria. The total number of patients included in this review was 1911 (1069 patients in the IG and 842 in the CG). The sample size of the included studies ranged from 56 to 400 participants. Eleven of the included studies were 2-arm RCTs [26,37-45,47], and 1 was a 3-arm RCT [46]. Studies published between 2018 and 2025 and conducted in the following countries were included: China (n=5), Spain (n=2), Czech Republic (n=1), Belgium (n=1), Australia (n=1), United States (n=1), and Pakistan (n=1). The type of technology used in the IGs in the studies was as follows: all included studies (n=12) used mobile or web applications to transmit current data on telerehabilitation, 2 of which used the mHealth platform [39,40]. Additionally, in 1 study the authors used a pedometer [43] and in another, a belt strop with sensor [47]. The duration of the rehabilitation programs ranged from 6 to 40 weeks. The endpoints in 3 studies [37,42,43] were assessed after 10 to 15 months, while in the remaining studies, they were assessed after various periods, from 2 to 24 weeks. Most studies included patients after ACS (myocardial infarction or unstable angina), while some included broader populations undergoing coronary revascularization (PCI/CABG), which may also include patients with stable coronary artery disease. Male patients predominated in all studies (58.5%-91%). The demographic and clinical characteristics of the included studies along with the analysis of the assessed parameters are presented in **Tables 2 and 3**. In some studies, "post-PCI" populations may include patients with stable coronary artery disease, as ACS status was not always clearly specified.

Comprehensive Effects and Outcomes: Exercise Capacity, Hemodynamic Parameters, and Motor Tests

For all assessed parameters, the IG consisted of participants in cardiac rehabilitation enriched with technologies in the form of applications and internet platforms coordinating the rehabilitation process. The CG included participants receiving either structured, supervised cardiac rehabilitation or usual care, or low-intensity interventions, depending on the study design.

The analyzed studies assessed physical capacity with the 6-minute walk test (6MWT), maximal oxygen uptake (VO_2max), and left ventricular ejection fraction **(**LVEF) [26,37-40,42,43-47]; hemodynamic parameters with systolic blood pressure (sBP), diastolic blood pressure (dBP), and resting heart rate (HR) [26,39,40,43,45-47]; and motor skills with the 30-second sit-to-stand test, sitting-rising test, handgrip strength, quadriceps strength and endurance, and Timed Up and Go (TUG) test [38,46].

Exercise Capacity and Hemodynamic Parameters

Most studies showed improvement in the 6MWT in both groups, but improvement was greater in the IG. Dorje et al [43] reported an increase in the IG from 489.2±99.4 m to 539.1±69.0 m

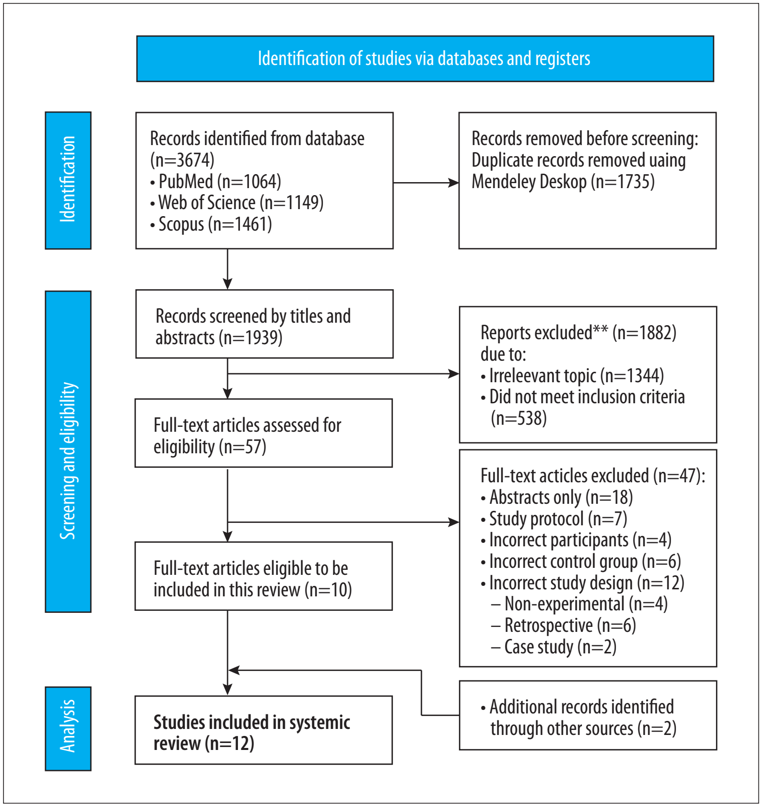


Figure 2. PRISMA flow diagram for data acquisition. Source: Page MJ, et al. BMJ 2021;372: n71. doi: 10.1136/bmj.n71. This work is licensed under CC BY 4.0: https://creativecommons.org/licenses/by/4.0/.

and in the CG from 485.0±93.5 m to 517.8±66.0 m, with a significant difference between groups at 6 months ($P=0.027$). Similar results were obtained at 6 weeks by Fang et al [47] and at 8 weeks by Yudi et al ($P<0.05$). [45]. Dodson et al [39] and Li Z. et al [44] found no significant differences after 1 and 3 months, but at 3 and 6 months, Li Z. et al noted a significantly higher 6MWT result in the IG (after 3 months, IG: 332.85±35.88 vs CG: 309.72±42.96 m; $P<0.05$) and (after 6 months, IG: 421.75±45.96 vs CG: 346.72±42.96 m; $P<0.05$). Li J et al [38] found that 6MWT performance increased significantly after 6 weeks in both the IG and CG (IG: 95% CI, 32.7-54.7; $P<0.01$; CG: 95% CI: 5.6-27.6; $P=0.003$), and the distance changes of the 6MWT in the IG were significantly better than those in the CG (IG: 43.7±39.2 vs CG: 16.6±39.1; $P=0.001$). Cruz-Cobo et al [4] reported that, after 6 months, the 6MWT result was significantly higher in the IG than in the CG (IG: 473.49±102.28 vs CG: 447.25±93.68; $P=0.04$). Peydro et al [37] reported a mean increase in VO$_2$max in the IG of 1.62 mL/kg/min ($P=0.004$), and in the CG of 0.6 mL/kg/min ($P=0.40$) at 10-month follow-up, without a significant difference between groups ($P=0.24$). Batalik et al [42] reported a significant mean improvement in VO$_2$max in both groups after 12 weeks (IG: 2.8 mL/kg/min vs CG: 2.5 mL/kg/min; both $P<0.01$) but without a significant difference between groups ($P=0.59$). After 15 months, the mean improvement in VO$_2$max was significantly higher in the IG group (IG: 25.5 mL/kg/min vs CG: 23.6 mL/kg/min; $P<0.05$). The greatest improvement was reported by Avila et al [46] in the IG home-based (26.7±6.55 vs 27.8±6.83; $P=0.03$) and IG center-based (25.4±7.32 vs 26.7±4.97; $P=0.04$) groups after 3 months.

It should be noted that the magnitude of observed differences may be influenced by the type and intensity of the comparator intervention across studies.

Motor Tests

Avila et al [46] found no significant differences between the IG and CG in grip strength, isometric quadriceps strength, or TUG test after 3 months (all $P>0.05$). Li J. et al [38] noted significant improvement after 6 weeks in the 30-second sit-to-stand test only in the IG ($P<0.01$). The repetition changes in the IG were significantly better than those in the CG (IG: 2.4±3.6 vs CG: 0.4±3.5; $P=0.007$). There was no significant change in hand grip strength test in either group ($P>0.05$).

Hemodynamic Parameters

After 2 to 3 months, 3 studies [43,45,46] showed no significant improvement in BP and HR between the IG and CG groups. Dorje et al [43] reported significantly lower sBP (-9.41 mmHg; $P=0.029$) and HR (-6.08 beats/min; $P=0.039$) in the IG group after 6 months. Cruz-Cobo et al [40] reported significantly lower mean sBP in the IG than in the CG at 3 months (128.96±15.87 vs 133.27±14.85 mmHg; $P=0.01$) and 6 months (130.00±21.90

Table 2. Characteristics of included studies.

Author (year published)/ country	Study design	Population (P)		Assessed outcomes
		a) Number of patients (n) b) Medical diagnosis	c) Age (mean±SD) d) Male/female (n (%))	a) Exercise capacity, hemodynamic parameters, and motor tests b) Health behaviors and adherence c) Biochemical parameters d) Anthropometric and body composition parameters e) Quality of life and psychological well-being
Dorje et al (2019) China	Parallel-group, 2-arm RCT	a) n=312 b) ACS	c) Overall: 60.5±9.05; IG: 59.1±9.4 and CG: 61.9±8.7 d) M: n=254 (81%)/F: n=58 (19%); IGF: 28 (18%) and CGF: 30 (19%)/IGM: 128 (82%) and CGM: 126 (81%)	a) 6MWT, resting HR, sBP b) Adherence cardioprotective medications, smoking status, physical activity adherence (IPAQ), diet adherence c) Lipid profile (LDL, HDL, total, triglycerides) d) BMI, WHR e) Mental well-being (GAD 7-scale), quality of life (SF-12 mental health), PHQ-9
Peydro et al (2021) Spain	Two arm-RCT	a) n=59 b) ACS	c) Overall: 56.1±9.45; IG: 57.5±9.0 and CG: 54.7±9.9 d) M: n=54 (91.5%) and F: n=5 (8.5%); IGF: 4 (13%) and CGF: 1 (4%); IGM: 27 (87%) and CGM: 27 (96%)	a) VO$_2$max b) Medication adherence, dietary adherence (PREDIMED), physical activity adherence (IPAQ) smoking cessation c) Lipid profile d) Body composition assessment (Tanita BC-602 scale) e) Mental well-being (HADS), quality of life (EQ-5D-5L)
Batalik et al (2021) Czech Republic	Two-arm RCT	a) n=56 b) ACS + revascularization	c) Overall: 56.6±7.3; IG: 56.1±6.8 and CG: 57.1±7.9 d) M: n=36 (80%); F: n=20 (35.7%); IGF: 14 (45.2%) and CGF: 9 (32.1%); IGM: 17 (54.8%) and CGM: 19 (67.9%)	a) VO$_2$max d) BMI, waist circumflex e) Self-assessment of health status (HRQoL)
Avila et al (2018) Belgium	Three-arm RCT	a) n=90 b) ACS + revascularization	c) Overall: 61.2±7.6; IGHB: 58.6±13 and IGCB: 61.9±7.3 and CG: 61.7±7.7 d) M: n=80 (88.89%) F: n=10 (11.11%); IGHBF: 4 (13%) and IGCBF 3 (10%) and CGF 3 (10%); IGHBM: 26 (86.7%) and IGCBM: 27 (90%) and CGM: 27 (90%)	a) VO$_2$max, resting HR, sBP, dBP, sitting-rising test, handgrip strength (dynamometer), quadriceps maximal isometric knee extension strength and endurance b) Daily physical activity measured with the Sensewear Mini Armband (number of steps/per day, sedentary time, physical activity duration, active energy expenditure, moderate physical activity duration, vigorous physical activity) d) BMI, waist circumference, body fat (%) e) Health-related quality of life (HRQoL) and SF-36

Table 2 continued. Characteristics of included studies.

Author (year published)/ country	Study design	Population (P)		Assessed outcomes
		a) Number of patients (n) b) Medical diagnosis	c) Age (mean±SD) d) Male/female (n (%))	a) Exercise capacity, hemodynamic parameters, and motor tests b) Health behaviors and adherence c) Biochemical parameters d) Anthropometric and body composition parameters e) Quality of life and psychological well-being
Fang et al (2019) China	Two-arm RCT	a) n=80 b) After PCI (unclear ACS status)	c) Overall: 60.82±9.76; IG: 60.24±9.35 and CG: 61.4±10.16 d) Not reported	a) 6MWT, sBP, dBP b) Risk factors (Fagerstorm Test for Nicotine Dependence score) e) Quality of life (SF-36), anxiety and depression (Cardiac Depression Scale score)
Yudi et al (2021) Australia	Parallel-group 2-arm RCT	a) n=168 b) ACS	c) Overall: 56.2±10; IG: 56.8±9.9 and CG: 56.2±10.2 d) M: n=141 (84%); F: n=27 (16%)	a) 6MWT, BP b) Cardiac rehabilitation adherence, control of cardiac risk factors (smoking cessation) c) LDL cholesterol level e) Mental well-being (depression, anxiety), quality of life
Dodson et al (2025) USA	Two-arm RCT	a) n=400 b) ACS + revascular-ization	c) Overall: 71.0±25; IG: 71.0±26 and CG: 71.0±24 d) M: n=291 (72.8%); F: n=109 (27.2%); IGF: n =82 (27.5%) and CGF: n=27 (26.5%); IGM: n=216 (72.5%) and CGM: n=75 (73.5%)	a) 6MWT, BP b) SAQ-7 angina frequency score d) BMI e) SF-12, ADL, IADL, 8-Item Patient Health Questionnaire
Li Z et al (2022) China	Parallel-group 2-arm RCT	a) n=80 b) ACS + PCI	c) Overall: 55.5±8.6; IG: 55.4±8.9 and CG: 55.6±8.3 d) M: n=52 (65%)/F: n=28 (35%); IGF: 13 (32.5%) and CGF: 15 (37.5%); IGM: 27 (67.5%) and CGM: 25 (62.5%)	a) LVEF, 6MWT b) Medication and physical activity adherence c) LDL cholesterol level e) Satisfaction assessment, quality of life SF-12
Zheng et al (2024) China	Two-arm RCT	a) n=106 b) After PCI (unclear status)	c) Overall: 63.27±9.99; IG: 63.49±9.53 and CG: 63.04±10.44 d) M: n=62 (58.5%) and F: n=44 (41.5%); IGF: 21(39.6%) and CGF: 23 (43.4%)/IGM: 32 (60.4%) and CGM: 30 (56.6%)	a) LVEF, BP b) Risk factor compliance c) Lipid profile, blood glucose level e) Quality of life SF-12, anxiety and depression scale (HADS)

Table 2 continued. Characteristics of included studies.

Author (year published)/ country	Study design	Population (P)		Assessed outcomes
		a) Number of patients (n) b) Medical diagnosis	c) Age (mean±SD) d) Male/female (n (%))	a) Exercise capacity, hemodynamic parameters, and motor tests b) Health behaviors and adherence c) Biochemical parameters d) Anthropometric and body composition parameters e) Quality of life and psychological well-being
Li J et al (2022) China	Parallel-group 2-arm RCT	a) n=100 b) After PCI (unclear status)	c) Overall: 67±8.15; IG: 65.3±8.7 and CG: 67.7±7.6 d) M: n=74 (74%)/F: n=26 (26%); IGF: 15 (30%) and CGF: 11(22%)/IGM: 35 (70%) and CGM: 39 (78%)	a) 6MWT, 30-second sit-to-stand test, Timed Up and Go test (TUG test), hand grip strength b) Bandura's Exercise Self-Efficacy scale, Godin-Shephard Leisure Physical Activity Questionnaire c) Lipid profile
Cruz-Cobo (2024) Spain	Two-arm RCT	a) n=300 b) ACS + PCI	a) Overall: 62.53±8.66; IG: 61.13±8.69 and CG: 63.93±8.41 b) M: n=207 (69%); F: n=93 (31%); IGF: 47 (31.3%) and CGF: 46 (30.7%); IGM: 103 (68.7%) and CGM: 104 (69.3%)	a) 6MWT, sBP, dBP, resting HR b) Adherence: diet (adherence to the Mediterranean diet questionnaire), exercise level (MET/week and minute), sedentary time (IPAQ), smoking (Fagerström test and self-assessment), level of knowledge about cardiovascular risk factors and healthy lifestyle (a scale validated by the research team) c) Lipid profile, blood glucose level d) BMI, WHR
Hisam et al (2022) Pakistan	Two-arm RCT	a) n=160 b) ACS	a) Overall: 52.66±8.46; IG: 53.7±9.56 and CG: 51.64±7.13 b) M: n=126 (78.75%)/F: n=34 (21.25%); IGF: 29 (36.25%) and CGF: 5 (6.25%); IGM: 51 (63.75%) and CGM: 75 (93.75%)	e) SF-12, MacNew QLMI

Abbreviations: IG, intervention group; CG, control group; IGHB, intervention group home–based; IGCB, intervention group center-based; ACS, acute coronary syndrome; PCI, percutaneus coronary intervention; CABG, coronary artery bypass graft; CHD, coronary heart disease; MI, myocardial infraction; CAD, coronary artery disease; M, male; F, female; IGF, intervention group female; CGF, control group female; IGM, intervention group male, CGM, control group male; 6MWT, 6-minute walking test; WHR, waist-hip ratio; SD, standard deviation; IPAQ, International Physical Activity Questionnaire; PHQ-9, Patient Health Questionnaire,9; BP, blood pressure; RCT, randomized controlled trial; dBP, diastolic blood pressure; sBP, systolic blood pressure; HR, heart rate; IADL, instrumental activities of daily living; MacNew QLMI, MacNew Quality of Life after Myocardial Infarction questionnaire.

vs 135.78±16.73 mmHg; *P*=0.01). However, no significant differences were found in dBP between the groups. Mean HR was significantly lower in the IG than in the CG at 3 months (66.75±8.91 vs 71.93±9.86; *P*<0.001) but not at 6 months. Conversely, Zheng et al [26] reported greater improvement in BP in the CG than in the IG after 3 months (*P*=0.002). Li Z. et al [44] found that, after 6 months, more patients in the CG group had LVEF below 50% compared with patients in the IG group (*P*<0.05). Zheng et al [26] found no significant differences in LVEF between the groups after 3 months (IG: 57.53±6.74 vs 59.79±8.74 and CG: 57.11±9.01 vs 58.21±9.06; *P*=0.054).

Health Behaviors and Adherence

The assessment of therapeutic compliance was based on multiple tools. Physical activity was measured using the

Table 3. Characteristics of included studies, with comparison of the control group (CG) and the intervention group (IG).

Author (year published)	Intervention group (IG)		Control group (CG)	
	a) Number of patients (n) b) Duration (weeks) c) Frequency (per week) d) Study assessment endpoints	e) Intervention outline	a) Number of patients (n) b) Duration (weeks) c) Frequency (per week) d) Study assessment endpoints	e) Intervention outline
Dorje et al (2019)	a) n=156 b) 8 weeks intensive SMART-CR/SP program and 16 weeks gradual reduction of activity c) Not reported d) After 2, 6, and 12 months from intervention: lipid control, adherence and smoking status	e) Remote supervision of home cardiac rehabilitation and secondary prevention using a simplified version of the WeChat platform - SMART-Cardiac Rehabilitation/ Secondary Prevention, including: health education (online consultations), monitoring of physical activity (WeChat pedometer), blood pressure, heart rate, and lipid control (C-health XY-10)	a) n=156 b) 8 weeks c) After 2, 6, and 12 months from intervention: lipid control, adherence, and smoking status	e) Standard outpatient cardiology care (physical activity counseling)
Peydro et al (2021)	a) n=31 b) 40 weeks c) 7 times/week d) Lipid profile assessment after 4 and 10 months, the remaining after 10 months	e) Remotely monitored physical activity: adjusted walking pace to reach target heart rate measured by smartphone app and heart rate monitor (Polar H7) + daily exercise program supervised by mobile app. Training intensity 60%-80% of HR reserve	a) n=28 b) 8 weeks c) 2 times/per week d) Lipid profile assessment after 4 and 10 months, the remaining after 10 months	e) Routine cardio rehabilitation: aerobic cycling. Training intensity 60%-80% of HR reserve
Batalik et al (2021)	a) n=28 b) 12 weeks c) 3 times/week for 60 min d) after 3 months and after 15 months	e) Physical activity at home based on teleconsultations, using the wrist application (HR polar M430) and the Polarflow web application. Training intensity 70%-80% of HR reserve, monitored during activity using the Global position system. Additionally, health education (telephone consultations).	a) n=28 b) 12 weeks c) 3/per week for 60 min d) After 15 months	e) Traditional, supervised post-MI rehabilitation program. Intensity 70%-80% of HR reserve
Avila et al (2018)	a) Home-based n=30; center-based n=30 b) 12 weeks (phase II) and next 12 weeks continuation c) Home-based: 6-7 times/per week and center-based: 3 times/per week d) After 3 months	e) IGHB: individual home-based exercise program with telemonitoring. Minimum 150 min training/week (e-mails and phone calls, heart rate monitor - Garmin Forerunner 210 and Garmin online application) + health education in the field of adherence, training intensity 70%-80% of HR reserve; IGCB: center-based endurance training (150 min/per week) after standard 3-month cardiac rehabilitation. Load monitored by physiotherapist supervision (70%-80% of HR reserve)	a) n=30 b) 12 weeks (phase II) and 6 weeks of continuation c) Not reported d) After 3 months	e) After completing 3 months of traditional rehabilitation (phase II), patients received standard care, including advice on regular physical activity

Table 3 continued. Characteristics of included studies, with comparison of the control group (CG) and the intervention group (IG).

Author (year published)	Intervention group (IG)		Control group (CG)	
	a) Number of patients (n) b) Duration (weeks) c) Frequency (per week) d) Study assessment endpoints	e) Intervention outline	a) Number of patients (n) b) Duration (weeks) c) Frequency (per week) d) Study assessment endpoints	e) Intervention outline
Fang et al (2019)	a) n=40 b) 6 weeks c) 3 times/week d) 6 weeks	e) Home-based cardiac telerehabilitation program included self-education on CHD. Physical activity monitored using remote system (belt strap with sensor, mobile app, servers, web portal). Group performed outdoor walking/jogging exercise with real-time physiological monitoring along with CHD education materials	a) n=40 b) 6 weeks c) Not reported d) 6 weeks	e) Standard protocol (self-education regarding CHD and biweekly follow-up by assigned clinicians)
Yudi et al (2021)	a) n=83 b) 8 weeks c) 5 times/week d) After 8 weeks	e) Usual care traditional cardiac rehabilitation with an adjunctive smartphone-based cardiac rehabilitation program (S-CRP). Exercise rehabilitation and lifestyle education interventions	a) n=85 b) 8 weeks c) Not reported d) After 8 weeks	e) Usual care traditional inpatient cardiac rehabilitation including standard exercise rehabilitation (typical for phase II cardiac rehabilitation), promotion of self-care
Dodson et al (2025)	a) n=298 b) 12 weeks c) 5 times/week d) After 3 months	e) Traditional ambulatory cardiac rehabilitation programs in accordance with current standard of care and software mHealth-CR (Fitbit Inspire activity monitor and Omron HEM-9200T blood pressure cuff), physiotherapist advice, remote physiological monitoring, 150 min/week of moderate intensity exercise (effort 11-14/20 according to Borg) + education on cardiac risk factor management	a) n=102 b)12 weeks c) 5 times/week d) After 3 months	e) Traditional ambulatory cardiac rehabilitaion programs in accordance with current standard of care

Table 3 continued. Characteristics of included studies, with comparison of the control group (CG) and the intervention group (IG).

Author (year published)	Intervention group (IG)		Control group (CG)	
	a) Number of patients (n) b) Duration (weeks) c) Frequency (per week) d) Study assessment endpoints	e) Intervention outline	a) Number of patients (n) b) Duration (weeks) c) Frequency (per week) d) Study assessment endpoints	e) Intervention outline
Li Z et al (2022)	a) n=40 b) 24 weeks c) Not reported d) After 1,3, and 6 months	e) Conventional health education with a home exercise program booklet + home internet supervised exercise program (HOSEP). Patients were added into a WeChat virtual community and reminded every day, from 8 AM to 10 AM, by cardiac rehabilitation physical therapist, to complete the walking and sit-to-stand exercise as per their home exercise program	a) n=40 b) 24 weeks c) Not reported d) After 1,3, and 6 months	e) Traditional outpatient rehabilitation and telephone supervision once a week: questions and exercises, medications, well-being
Zheng et al (2024)	a) n=53 b) 12 weeks c) 3-5 times/week d) After 3 months	e) Health education, remote, home rehabilitation training (personalized exercise program and intelligent sports bracelet during training + mobile application)	a) n=53 b) 12 weeks c) Not reported d) After 3 months	e) Routine guidance on CHD risk factors, health guide (diet, physical activity)
Li J et al (2022)	a) n=50 b) 6 weeks c) 7 times/per week d) Questionnaires after 2 and 6 weeks, and motor tests after 6 weeks	e) Conventional health education and home exercise program, ie, walking for 30-60 min, and sit-to-stand exercises for 2-3 series every day. Load 60%-80% of HR reserve. Patients were added to the WeChat virtual community for rehabilitation reminders and online monitoring	a) n=50 b) 6 weeks c) Not reported d) Questionnaires after 2 and 6 weeks, and motor tests after 6 weeks	e) Conventional health education with a home exercise program booklet
Cruz-Cobo et al (2024)	a) n=150 b) 24 weeks c) 150 min/week d) After 3 and 6 months	e) Usual care + mHealth program with eMOTIVA mobile application; dietary education, cardiovascular prevention, risk factor control (cigarettes, stress, cholesterol, blood pressure, diabetes), educational online videos encouraging physical activity.	a) n=150 b) Not reported c) Not reported d) after 3 and 6 months	a) Usual care: education and cardiac rehabilitation
Hisam et al (2022)	a) n=80 b) 24 weeks c) Not reported d) After 12 weeks and 24 weeks	e) MCard, a medically supervised cardiac rehabilitation program, in addition to standard ACS care.	a) n=80 b) 24 weeks c) Not reported d) After 12 weeks and 24 weeks	e) Standard care and rehabilitation after ACS

Abbreviations: MI, myocardial infraction; ACS, acute coronary syndrome; CHD, coronary heart disease; HR, heart rate.

International Physical Activity Questionnaire (IPAQ), the Exercise Self-Efficacy Scale, and the Godin-Shephard Leisure Physical Activity Questionnaire. Dietary compliance was assessed using the PREDIMED (Prevención con Dieta Mediterránea) scale. Adherence to medical recommendations and treatment was evaluated using the medication compliance and walking compliance scales. The degree of nicotine dependence was analyzed based on the Fagerström Test for Nicotine Dependence score, and knowledge of cardiovascular risk factors was assessed based on specially developed questionnaires.

Physical Activity

Several studies [37,40,43,45,46] found that IG participants showed higher levels of physical activity and adherence to cardiac rehabilitation than did CG participants. Dorje et al [43] reported significantly higher IPAQ scores in the IG at 2 months (*P*<0.0001) and 6 months (*P*<0.0001). Similar results were obtained by Peydro et al [37] (median increase in the IG: 1726 vs CG: 636 metabolic equivalent of tasks (METs) min/week; *P*=0.045). Also, Cruz-Cobo et al [40] found that the IG engaged in significantly more physical activity (min/week) than the CG at both 3 months (578.10±326.14 vs 443.46±278.11 min/week; *P*<0.001) and 6 months (614.51±332.26 vs 408.40±274.49 min/week; *P*<0.001). Regarding the intensity of physical activity (METs/week), the IG performed more intense activity than the CG at both 3 months (1991.74±1176.71 vs 1490.48±925.89 METs/week; *P*<0.001) and 6 months (2112.66±1196.67 vs 1372.60±944.62 METs/week; *P*<0.001). The CG had a significantly more sedentary lifestyle than the IG (mean number of hours seated: 9.34±2.13 vs 8.57±1.89; *P*=0.002 at 3 months, and mean 9.59±2.09 vs mean 8.38±1.88; *P*<0.001 at 6 months). Avila et al [46] found that after 3 months 97% of IG participants adhered to the recommended physical activity (150 min/week; *P*=0.73). At the same time, there was an increase in sedentary time in the center-based IG (1005 vs 1094 min/day; *P*=0.02) and a slight decrease in sedentary time in the home-based IG (1039 vs 1032 min/day; *P*=0.56). Yudi et al [45] found that, after 8 weeks, IG participants were significantly more likely to participate (IG: 87% vs CG: 51%; *P*<0.001) and adhere to the cardiac rehabilitation program (IG: 72% vs CG: 22%; *P*<0.001). Li J. et al [38] found that, in the IG group, 6 weeks after the intervention, the Exercise Self-Efficacy Scale scores were significantly improved (*P*=0.001), and the Godin-Shephard Leisure Physical Activity Questionnaire scores were significantly improved after 2 and 6 weeks (2 weeks: *P*<0.01; 6 weeks: *P*<0.01), without significant changes in the CG.

Health Behaviors

Dorje et al [43] reported better compliance with cardioprotective therapy in the IG compared with the CG after 2 months (*P*=0.0048), 6 months (*P*=0.011), and 12 months (*P*=0.011). Similar results were obtained by Li et al [44], showing higher compliance in the IG than in the CG after 6 months (medication: 37 vs 28; walking: 38 vs 20; *P*<0.05). Zheng et al [26] showed better control of BP (92.45% vs 67.92%), blood glucose levels (88.68% vs 66.04%) and low-density lipoprotein (LDL, 86.79% vs 56.60%) in the IG than in the CG (*P*<0.05). Cruz-Cobo et al [40] found the level of knowledge of cardiovascular risk factors was significantly higher in the IG than in the CG at both 3 months (IG: 116.14±4.23 vs CG: 111.02±6.94; *P*<0.001) and 6 months (IG: 117.85±3.83 vs CG: 111.00±7.11; *P*<0.001).

Diet and Smoking Cessation

Cruz-Cobo et al [40] reported a significantly higher PREDIMED score in the IG at 3 months (IG: 11.63±1.70 vs CG: 9.32±2.55; *P*<0.001) and 6 months (IG: 11.92±1.70 vs CG: 8.92±2.66; *P*<0.001). Peydro et al [37] showed that the percentage of patients who reported high adherence to the Mediterranean diet was significantly higher in the IG group (70% IG vs 32% CG; *P*=0.001). The PREDIMED score improved significantly in both the IG and CG groups, with no significant differences between the groups (*P*=0.35). Yudi et al [45] and Dorje et al [43] found that, in terms of smoking cessation, IG and CG did not differ statistically significantly after 2 and 6 months (*P*>0.05). Peydro et al [37] found that after 10 months, in both the IG and CG groups, 50% of participants with previous nicotine addiction successfully quit smoking. Cruz-Cobo et al [40] showed that regarding smoking cessation, although more participants quit smoking in the IG than in the CG, the difference was not significant (*P*>0.05). However, the scores for nicotine dependence at 3 months decreased significantly in the IG compared with the CG (IG: 2.30±2.27 vs CG: 4.14±2.96; *P*=0.03). Fang et al [47] observed a greater improvement in the Fagerström Test for Nicotine Dependence questionnaire scores in the IG than in the CG (*P*<0.05).

Biochemical Parameters

The analysis included lipid profile and blood glucose levels. Dorje et al [43] showed no significant differences in lipid levels between the IG and CG groups at 2 and 6 months of follow-up. At 12-month follow-up, both total cholesterol and LDL were significantly lower in the IG than in the CG (mean difference in total cholesterol -0.22 mmol/L; *P*=0.018 and LDL -0.20 mmol/L; *P*=0.016). Peydro et al [37] reported an increase in non–high-density lipoprotein (HDL) cholesterol by 7.3 mg/dL (*P*=0.021) and total cholesterol by 11.5 mg/dL (*P*=0.012) in the CG and in the IG by 2.1 mg/dL (*P*=0.08) and 6.5 mg/dL (*P*=0.141), respectively, with no significant differences between groups after 10 months (*P*>0.05). Similar results were obtained by Yudi et al [45] after 8 weeks, with no statistically significant difference between groups in LDL cholesterol results. Li Z. et al [44] found that LDL cholesterol in the IG group was 23.17±2.58 and in the CG 26.78±3.65 after 6 months

($P<0.05$). Zheng et al [26] reported no significant difference between the IG and CG groups after 3 months in terms of lipid profile and blood glucose levels ($P>0.05$). The results of Li J. et al [38] showed that LDL and HDL improved significantly after 6 weeks in both groups (IG: LDL 2.2±0.9 vs 1.8±0.6, HDL 1.1±0.3 vs 1.2±0.4 and CG: LDL 2.3±0.9 vs 1.8±0.7 and HDL 1.1±0.2 vs 1.2±0.4; all $P<0.01$), without significant differences between groups ($P>0.05$). Cruz-Cobo et al [40] found that the levels of lipid variables (HDL, LDL, and triglycerides) showed large decreases in both groups, with no significant differences between the groups. Blood sugar levels were significantly lower in the IG than in the CG at 6 months (101.10±18.57 mg/dL vs 115.44±39.46 mg/dL; $P=0.007$).

Anthropometric and Body Composition Parameters

The analysis included BMI, WHR, and percentage of body fat. Most studies [37,40,42,46] did not show significant differences between the IG and CG groups in any of the parameters ($P>0.05$). The results of Dorje et al [43] indicated no significant differences in BMI and WHR between the IG and CG groups after 2 and 6 months. Peydro et al [37] showed that after 4 months the mean BMI value in the IG group decreased by 2.24 kg ($P=0.042$) and by 0.64 kg ($P=0.495$) in the CG group. However, after 10 months, the mean BMI decreased in the IG group by 0.22 kg ($P>0.8$), and in the CG group by 1.29 kg ($P=0.099$). The differences between the groups were not statistically significant. Batalik et al [42] found that after 15 months BMI results did not improve significantly in the IG (27.9±3.6 vs 28.0±3.5; $P=0.81$) or in the CG (28.8±4.4 vs 28.3±3.5; $P=0.23$). Also waist circumflex (cm) in the IG group (102.1±10.7 vs 101.0±9.7; $P=0.14$) and CG (103.3±13.6 vs 102.2±12.7; $P=23$) did not improve significantly. Avila et al [46] found no significant improvement between the studied groups, with the values of BMI, body fat (%), and waist and hip circumference remaining stable (all $P>0.05$). Cruz-Cobo et al [40] found that BMI and WHR improved slightly in both groups, with no significant differences between the groups ($P>0.05$).

Quality of Life and Psychological Well-Being

The analysis included quality of life and psychological aspects of participants, including anxiety, depression, and general well-being, which were measured using various instruments, including the 12-Item Short Form Health Survey (SF-12), Hospital Anxiety and Depression Scale (HADS), Generalized Anxiety Disorder 7-item scale (GAD-7), 9-item Patient Health Questionnaire (PHQ-9), 5-level EuroQol 5-Dimension questionnaire (EQ-5D-5L), health-related quality of life (HRQoL), Activities of Daily Living (ADL), instrumental activities of daily living (IADL), 7-item Seattle Angina Questionnaire (SAQ-7), and MacNew Quality of Life after Myocardial Infarction questionnaire (MacNew QLMI). The results suggest that the intervention on quality of life and psychological well-being varied according to the follow-up duration and the assessment tool used.

Dorje et al [43] found no significant differences in quality of life or anxiety and depression scores between groups, using the GAD-7, PHQ-9, and SF-12, after 2 and 6 months ($P>0.05$). Peydro et al [37] found that after 10 months, the improvement in HADS scores was greater in the IG group ($P=0.015$), with more marked improvement in anxiety ($P=0.006$) and depression ($P=0.02$). The EQ-5D-5L score increased only in the IG group, although the difference between groups was not statistically significant ($P=0.26$). The improvement in self-assessment was significant only in the IG group ($P=0.008$). The assessment of the quality of life by Batalik et al [42] using the HRQoL scale showed a significant improvement in both groups after 15 months (IG: by 60.1; $P=0.01$ vs CG: by 53.4; $P=0.01$). The IG result was significantly higher than the CG only in the "bodily pain" subscale (52.1±19.3 vs 60.1±23.1; $P=0.09$). Avila et al [46] reported no statistically significant improvement in health-related quality of life (HRQoL; P for interaction=0.57), including its physical quality of life (P for interaction=0.85) and mental (P for interaction=0.85) domains in either group. SF-36 scores also did not indicate improvement in either group ($P>0.05$). In the studies by Fang et al [47] and Yudi et al [45], significant improvements were noted in quality of life, depression, and anxiety after the intervention, particularly in the IG ($P<0.05$). In the study by Yudi et al [45] significant improvements were seen in the mental component summary and physical component summary scores of the SF-36, with better results in the IG (mental component summary scores: $P=0.04$; physical component summary scores: $P=0.0008$). Cardiac Depression Scale scores also indicated significantly greater improvement in the IG compared with the CG ($P=0.04$) [45]. The study by Dodson et al [39] assessed the SF-12 at 3 months after the intervention, showing a mean score of 46.3.2±1.0 in the IG and 48.2±1.1 in the CG ($P>0.05$). In contrast, the analysis of angina pectoris symptom severity and quality of life (SAQ-7) showed that the scores in the IG and CG groups were not significantly different after 3 months (mean [SD], 25.7% [0.8%] vs 20.9% [1.7%]; odds ratio [OR], 1.32; 95% CI, 0.72-2.39). In the case of the ADL and IADL, the IG and CG groups did not differ significantly (mean [SD], 9.7% [0.6%] vs 10.6% [1.1%]; OR, 0.92; 95% CI, 0.43-1.96). However, Li Z. et al [44] showed that after 6 months, satisfaction with rehabilitation was higher in the IG (92.5%) than in the CG (77.5%) ($P<0.05$). The SF-12 scores at 6 months were significantly better in the IG group than in the CG group (CG: 63.85±7.26 vs 77.35±9.21 and IG: 64.59±6.78 vs 89.46±9.33; $P<0.05$). Zheng et al [26] found that, at 3 months, the SF-12 scores in the IG were significantly higher than in the CG, both in the physical component summary (47.46±9.86 vs 43.28±8.21; $P<0.05$) and mental component summary (50.68±9.82 vs 48.26±9.69; $P<0.05$). Moreover, HADS scores were significantly lower in the IG group after 3 months (HADS anxiety subscale: 7.24±1.32 vs 9.26±1.89; *P*<0.05; HADS depression subscale: 7.79±0.81 vs 9.68±1.29; *P* < 0.05). Hisam et al [41] reported that the mean SF-12 physical component summary score significantly improved in the IG after 12 weeks (IG: 48.93 vs CG: 43.87; *P*<0.001) and 24 weeks (IG: 53.52 vs CG: 46.82; *P*<0.001). The mean SF-12 mental component summary scores also significantly improved in the IG group after 12 weeks (IG: 44.84 vs CG: 41.40; *P*<0.001) and 24 weeks (IG: 48.95 vs CG: 40.12; *P*<0.001). At 12- and 24-week follow-up, all MacNew QLMI domains (social, emotional, physical, and global) improved significantly (*P*<0.001) only in the IG.

Results of Sensitivity Analyses

To explore the effect of heterogeneity across studies, qualitative sensitivity analyses were performed based on comparator type and patient population. When studies were grouped according to comparator, trials using usual care or low-intensity interventions as controls (Dorje et al, Fang et al, Zheng et al, and Cruz-Cobo et al) tended to show more pronounced benefits of telerehabilitation, particularly in exercise capacity, adherence, and selected quality of life outcomes. In contrast, studies comparing telerehabilitation with structured, supervised cardiac rehabilitation (Peydro et al, Batalik et al, Avila et al, Yudi et al, Dodson et al, Li Z. et al, Li J. et al, and Hisam et al) demonstrated smaller between-group differences, with generally comparable outcomes, especially for physiological parameters. When grouped by patient population, studies including clearly defined ACS populations showed more consistent results, with improvements observed mainly in adherence and selected quality of life outcomes, while most clinical parameters remained comparable between groups. In contrast, studies involving post-PCI populations with less clearly specified clinical status showed more variable findings, potentially reflecting greater clinical heterogeneity. Overall, these analyses suggest that differences in comparator intensity and patient population may influence the magnitude and consistency of observed effects.

Discussion

This systematic review included 12 randomized controlled trials (n=1911) and was aimed to determine the effectiveness of using technologies such as web-based platforms, mobile applications, and smart devices to support cardiac rehabilitation in patients after ACS and/or coronary revascularization (PCI or CABG), compared with traditional cardiac rehabilitation or supervised cardiac training. The findings of this review should be interpreted in the context of a heterogeneous study population, including patients after ACS as well as those undergoing coronary revascularization (PCI/CABG), which may also involve individuals with stable coronary artery disease. As a result, the study population cannot be considered clinically homogeneous, and the findings should not be generalized exclusively to patients with ACS. In particular, differences in the intensity and structure of control interventions, ranging from usual care to fully supervised cardiac rehabilitation, may have influenced the magnitude of observed effects. Although there are published reviews comparing telerehabilitation with traditional rehabilitation in cardiac patients, they focused primarily on a broad spectrum of cardiovascular diseases, including coronary heart disease and heart failure [48-52]. The present review was limited to the analysis of randomized controlled trials that assessed patients only after ACS and/or coronary revascularization (PCI or CABG). The results of this review suggest that the addition of digital technologies to rehabilitation may provide benefits in selected health domains and appears to be generally comparable to traditional cardiac rehabilitation, a finding supported by 2 meta-analyses [48,53]. The fact that the studies selected for this review were published in recent years is evidence of the growing interest in telerehabilitation interventions as a resource aimed at improving the secondary prevention of ACS and/or coronary revascularization surgery. The sensitivity analyses suggest that the observed effects of telerehabilitation may be influenced by the type of comparator and characteristics of the study population. In particular, more pronounced benefits were observed in studies using usual care as a comparator, whereas comparisons with structured cardiac rehabilitation showed largely comparable outcomes. This indicates that differences in comparator intensity should be carefully considered when interpreting the results.

Physical Capacity and Hemodynamic Parameters

The 6MWT is a known predictor of cardiovascular events and a determinant of prognosis [54]. In the present review, compared with traditional cardiac rehabilitation, technology-based interventions often led to greater improvements in exercise capacity, as measured by the 6MWT and VO_2max, as well as in hemodynamic parameters, including BP, resting HR, and LVEF. In particular, patients participating in telerehabilitation achieved better results in the 6MWT, but significant improvements were only visible in the long-term evaluation (>6 months), while in shorter periods the results were comparable to those of traditional rehabilitation [40,43-45,47]. Our findings are consistent with those of the meta-analysis by Kavradim et al [55]. The observed improvements in functional capacity (eg, 6MWT), predominantly in long-term follow-up, may reflect the cumulative effects of sustained behavioral changes rather than immediate physiological responses. Telerehabilitation may facilitate long-term adherence to physical activity through continuous monitoring, feedback, and patient engagement, which over time can lead to gradual improvements in exercise tolerance. In contrast, short-term outcomes may not differ significantly between groups, as early improvements are often driven by structured exercise protocols common to telerehabilitation and traditional rehabilitation programs. Improvement in VO_2max was similar between groups in most studies [37,42,46], except for 1 analysis at 15 months, in which IG patients achieved significantly better results. This may suggest that patient monitoring, remote education, and real-time therapy adjustments improve long-term performance in patients after ACS and/or revascularization PCI/CABG. Also, the use of mHealth-based rehabilitation, when the patient self-monitors their activity level and health parameters, brings promising results and significant improvement in physical capacity [39,40]. The meta-analysis by Ettehad et al [56] showed that a 10-mm decrease in sBP reduced the risk of cardiovascular events by 20% and mortality by 13%. In our review, the results regarding hemodynamic parameters BP, resting HR, and LVEF were mixed. Some studies reported no significant differences between groups in the short-term assessment at 2 to 3 months [43,45,46], while others [40,43] showed significant reductions in sBP and resting HR in the telerehabilitation group after 3 to 6 months. Interestingly, 1 study [26] suggested greater BP improvement in patients undergoing traditional inpatient rehabilitation. Favorable results in terms of LVEF were obtained by Li Z. et al [44], who observed a smaller number of patients with LVEF of less than 50% in the IG group after 6 months. An earlier evaluation after 3 months [26] did not show significant differences between the groups. The meta-analysis of Akinosun et al [57] showed that digital interventions do not reduce sBP to a greater extent. The effects of telerehabilitation on physical capacity and hemodynamic parameters appear to be variable across studies. While some trials demonstrated improvements, others reported no significant differences or even slightly better outcomes in traditional rehabilitation groups. Therefore, the available evidence does not indicate a clear advantage of telerehabilitation over traditional rehabilitation in this domain. The telerehabilitation among patients after ACS and/or revascularization (PCI/CABG) may be an effective alternative to traditional rehabilitation in situations with limited access, such as during the COVID-19 pandemic and in cases of financial constraint and distant rehabilitation dates [58-60].

Health Behaviors and Adherence

The results regarding adherence in favor of telerehabilitation are promising. Several studies [37,40,43,45,46] showed that patients using interactive platforms were more likely to engage in regular exercises and adhere to rehabilitation recommendations. Moreover, digital technologies facilitated self-control and motivation, which translated into higher scores in questionnaires assessing the level of physical activity and satisfaction with participation in programs. Patients in the telerehabilitation group achieved significantly better results in the IPAQ questionnaire after 2 months from the beginning of the intervention, and this trend was maintained after 6 months [37,40,43]. Moreover, people participating in telerehabilitation more effectively followed the recommendations regarding cardioprotective pharmacotherapy, diet, and elimination of risk factors, such as hypertension, hyperglycemia, and elevated LDL level [26,40,43,44,47]. This effect was seen in both the short and long term (after 12 months). The only exception was smoking cessation, which had comparable results between groups [37,40,43,45]. This indicates the important role of technology in promoting healthy habits and long-term secondary prevention of cardiovascular diseases. This is clinically important, because according to scientific evidence, 1 year after myocardial infarction [61], patients who continue to smoke have poorer cardiovascular outcomes and higher mortality. Moreover, in secondary prevention of myocardial infarction, regular, moderate physical activity of 150 to 300 minutes per week [61] and following the Mediterranean diet are recommended to improve survival rates and reduce the risk of recurrent myocardial infarction [62]. The use of various types of technologies, such as mobile applications, smart bands, and the mHealth program, may effectively support patient education and promote adherence to recommendations after ACS and/or revascularization (PCI/CABG) by improving compliance with recommendations, motivating regular physical activity, and teaching proper habits that are maintained even many months after use [63,64]. The findings of the present review are consistent with those of other meta-analyses [57,65]. While telerehabilitation appears to improve adherence to several lifestyle behaviors, smoking cessation outcomes remain comparable between IG and CG groups. This may be explained by the complex and multifactorial nature of nicotine dependence, which often requires intensive behavioral support and pharmacological interventions. Digital tools alone may be insufficient to significantly influence smoking behavior, highlighting the need for more targeted and integrated approaches in this domain.

Biochemical and Anthropometric Parameters

Normal blood lipid levels are extremely important for secondary prevention of myocardial infarction. A meta-analysis by Gencer et al [66] including 21 492 patients showed that a 1 mmol/L reduction in LDL significantly reduces the risk of cardiac events by 26%. In the present review, analysis of biochemical parameters such as total cholesterol, LDL, HDL, and blood glucose levels in most studies [26,37,38,40,43,45] showed comparable improvement in both groups, regardless of the time of assessment (2-12 months). Similar observations were presented in the meta-analyses by Huang et al [67] and Al-Arkee et al [65]. Conversely, Xu et al [68] noted significant improvement only in HDL and total cholesterol values. In the present review, anthropometric parameters such as BMI, WHR, and body fat percentage also improved to a similar extent in the IG and CG groups, both in the short and long term [37,40,42,43,46]. Similarly, Akinosun et al [57] showed that BMI did not improve significantly after digital interventions. This suggests that the form of rehabilitation itself (telerehabilitation vs traditional) may not have a significant effect on these indicators, and other factors, such as individual patient engagement and comprehensiveness of the intervention, are crucial.

Quality of Life and Psychological Well-Being

The results regarding quality of life and psychological well-being indicate varied effects depending on the time of assessment and the measurement tool used. Most studies showed greater improvement in quality of life and psychological well-being in patients participating in telerehabilitation [26,37,41,42,44,45,47], while 4 analyses [37,39,43,46] indicated comparable results between groups. This may indicate that technologies supporting cardiac rehabilitation can have a positive effect on patients' well-being by increasing their sense of control over the treatment process, as well as improving interactions with medical staff. These findings suggest that telerehabilitation may positively influence patient-reported outcomes; however, the variability in measurement tools and follow-up duration limits the strength of these conclusions.

The observations in this systematic review are consistent with those of previous reviews or meta-analyses [48,69], suggesting that cardiac telerehabilitation may serve as an effective alternative to traditional rehabilitation, especially in situations where traditional rehabilitation is not possible due to various limitations, such as the COVID-19 pandemic and financial constraints. Moreover, telerehabilitation allows for the promotion of a healthy lifestyle on a larger scale, due to easier accessibility and lower treatment costs. The incorporation of digital tools into cardiac rehabilitation appears to be a promising strategy supporting traditional approaches. In the present review, the inclusion of usual care or low-intensity interventions as comparators may have led to an overestimation of the effectiveness of telerehabilitation. In addition, variability in patient populations, particularly in studies involving patients after PCI with less clearly defined clinical status, likely contributed to heterogeneity in the findings. Therefore, the results of this review should be interpreted with caution, as observed effects may partly reflect differences in comparator intensity and study populations rather than the true effect of the intervention. Importantly, the sensitivity analyses were exploratory in nature and indicate that the magnitude of observed benefits was greater in studies using usual care as a comparator, suggesting that comparator intensity may influence effect estimates. Overall, these analyses support the potential risk of overestimating intervention effects when lower-intensity control conditions are included. However, they should be considered supportive rather than definitive, as heterogeneity in study design and populations may have further contributed to variability in outcomes.

Limitations and Strengths of the Review

Despite the promising results of this review, some limitations should be considered. First, the methodological heterogeneity of the analyzed studies makes direct comparison difficult, as the duration of interventions and the follow-up periods of endpoints differed between studies. Furthermore, not all studies considered the long-term effects of digital technologies on rehabilitation outcomes, which limits the ability to fully assess their durability. An additional limitation is that only 1 of the included studies was fully blinded (participants and investigators), which could have influenced subjective assessments and increased the risk of observational bias. Another issue is the heterogeneity of assessment tools. Although quality of life was most often measured using the SF-12 and SF-36 questionnaires, and psychological well-being was mainly assessed using the HADS, individual studies also used different measurement tools. This can make direct comparison of results difficult and affect their consistency in the pooled analysis. The heterogeneity of control interventions, ranging from usual care to structured and supervised rehabilitation programs, may have influenced the observed effect sizes and potentially led to overestimation of the benefits of telerehabilitation in some studies. Another important limitation is the heterogeneity of the study population. Although most studies included patients after ACS, some included broader populations undergoing coronary revascularization, which may also involve patients with stable coronary artery disease. This limits the ability to draw conclusions specifically for ACS populations. Moreover, the predominance of studies from China may limit generalizability to other healthcare systems, as healthcare systems, access to cardiac rehabilitation, and the implementation of digital health interventions can differ substantially across regions. Additionally, cultural factors, patient engagement, and technology adoption can vary, potentially influencing the adherence to and overall effectiveness of telerehabilitation programs. Additionally, most included studies focused on surrogate or soft endpoints, such as exercise capacity, quality of life, and adherence, while data on hard clinical outcomes, such as mortality, recurrent cardiovascular events, or hospital readmissions, were limited. Although several studies reported similar endpoints, a meta-analysis was not performed, due to heterogeneity in outcome definitions, measurement units, and follow-up duration and the incomplete reporting of variance data in some studies.

The strengths of this review include the rigorous methodological approach, in line with PRISMA guidelines, and the use of clearly defined eligibility criteria based on the PICO framework. Only the most recent RCTs were included in the review, which increases its validity and credibility. In addition, despite the wide range of parameters analyzed, the endpoints assessed and the interventions used were largely consistent, allowing for more meaningful comparative analysis.

Conclusions

Telerehabilitation appears to be a comparable alternative to traditional cardiac rehabilitation in patients after ACS and/or coronary revascularization (PCI/CABG), with potential benefits particularly in adherence and selected patient-reported outcomes, while effects on physical capacity appear comparable to those of traditional rehabilitation.

Therefore, the overall clinical effect of telerehabilitation should be interpreted with caution. Further high-quality studies are needed, particularly to assess long-term effects and hard clinical outcomes.

Mobile applications and internet-based platforms appear to be promising and acceptable tools for supporting cardiac rehabilitation.

Department and Institution Where Work Was Done

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Declaration of Figures' Authenticity

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