

# A Systematic Review of Cardiac Rehabilitation Programs for Patient with Coronary Artery Bypass Grafts Surgery

Maha Subih<sup>1</sup>, Majdi Alhadidi<sup>2</sup>, Mohammad Alrahahleh<sup>3</sup>, Altarabsheh Salah Eldien<sup>3</sup>, and Zyad Alfawaer<sup>4</sup>

<sup>1</sup>Al-Zaytoonah Private University of Jordan Faculty of Nursing

<sup>2</sup>Al-Balqa' Applied University

<sup>3</sup>Queen Alia Heart Institute

<sup>4</sup>Jordan University of Science and Technology Faculty of Medicine

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## Abstract

**Background and objectives:** Cardiac rehabilitation program (CRP) is a multidisciplinary strategy to help cardiac patients override the complications associated with cardiac disease. Patients following Coronary Artery Bypass Graft (CABG) face a critical complication that may affect their health-related quality of life and physiological outcomes, and these programs provide a better and faster recovery from cardiac surgery within the first weeks after surgery. This study reviews the impact of cardiac rehabilitation programs on the specific outcomes among CABG patients. **Methods:** In this systematic review the PRISMA-2020 guideline was used. Assessment of quality of the chosen studies, using the “Consolidated Standards of Reporting Trial (CONSORT)” and Transparent Reporting of Evaluations with Nonrandomized Designs (TREND) checklist. Eligible studies were finally included in the literature review were 8 out of the 45 records identified, (from 2010-2021). **Results:** The cardiac rehabilitation program showed a consistent enhancement in health-related quality of life as a primary outcome and in the physiological variables as a secondary outcome. This study of a systematic review of experimental and non-experimental studies highlights the positive impact of this type of program on health-related quality of life and physiological variables of CABG patients. **Conclusion:** The results have significant implications in nursing research and practice, as the data offered can be used by the stakeholders and administrators of health institutions to improve their awareness of joining CRP in the routine care of CABG patients. **KEYWORDS:** cardiac rehabilitation programs, experimental study, health-related quality of life, physiological variables, systematic review.

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**Running head:** Review of Cardiac Rehabilitation Programs

Maha Subih<sup>1\*</sup>, Majdi Alhadidi<sup>2\*</sup>, Mohammad Alrahahleh<sup>3</sup>, Salah Eldien, Altarabsheh<sup>4</sup>, Zyad Alfawaer<sup>5</sup>.

\* Maha Subih and Majdi Alhadidi should be considered joint first author.

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## 1 INTRODUCTION

Cardiac rehabilitation program (CRP) is a comprehensive intervention that integrates individualized and monitored exercise with teaching information, both of which are important for patients after CABG and act in two steps: First, cardiac rehabilitation promotes quicker and healthier recovery from cardiac surgery in the first duration following the surgery, which is mostly significant for CABG patient, as an aging person with several diseases and limitations. Second, it provides better routines, and the necessary information to manage coronary artery diseases (CAD) in order to be successful in the long run.<sup>1</sup>Kabboul et al<sup>2</sup> indicated that the core components of cardiac rehabilitation are, first, exercise to improve cardiovascular wellness without exceeding safe points; second, instruction about coronary illness alongside direction on approaches to balance out or turn around coronary illness by improving danger factors, for example, decreasing/quitting smoking, lipid and hypertension (HTN) control, weight reduction/control, improved management of diabetes, and increased physical movement; and third, diet counselling and improved mental health. Assessing the health-related quality of life (HRQOL) of cardiovascular patients is essential to know the impact of cardiovascular and rehabilitation interventions in terms of physical, mental, and social aspects, which can be beneficial as an indicator of the efficiency of therapeutic and diagnostic.<sup>3</sup> Nawito et al<sup>4</sup> referred to the HRQOL as an overall assessment of total well-being that includes physical and social well-being. All aspects of life, including work, home, relationships, finance, and health, affect it.

There are limited systematic reviews of randomized control trials (RCT) and quasi-experimental studies that assess the effectiveness of CRPs for CABG patients. Hence, it is important to conduct such type of studies because it provides a comprehensive understanding of the importance of a CRP and how it improves the HRQOL and physiological outcomes of cardiac patients. Hence, the purpose of this study was to investigate the literature that search the effect of CRPs on HRQoL of CABG patients, and physiological outcomes.

## 2 METHODS

The review involved two stages: the first stage involved search in database, while the second stage included checking all the related studies found from the first stage to guarantee precision and constancy of the study. The guideline of “The Preferred Reporting Items for Systematic Review and Meta-Analysis protocols (PRISMA)” was applied<sup>5</sup> (See Supplementary File .1). This systematic review was registered in the PROSPERO under the number (CRD42021223297).

### 2.1 Search Strategy & Data Sources

The search used the next related terms: Population – CABG patients; Interventions –CRP; Comparators –

routine standard care or treatment, which is usually drugs and general instruction; Outcomes – HRQoL and physiological variables.

First, in this study, a comprehensive search of electronic databases was conducted including PubMed, EBSCO host, Springer Link, Science direct, google scholar, and Medline from the year 2010-2021. Our search keywords were; coronary artery bypass graft or CABG, health-related quality of life OR HRQOL, physiological outcomes, cardiac rehabilitation program OR CRP, cardiac rehabilitation intervention, randomized control trial OR RCT, Experimental/interventional, and Quasi-experimental. (See Supplementary File. 2: Electronic search strategy).

The search was limited to adult populations, English language, inpatients and outpatient settings, but we omitted articles that involved CABG patients who are mentally incompetent, such as delirium, confusion, or anxiety disorders; and patients with the uncontrolled glycemic condition and metabolic disturbances, uncontrolled HTN, neurological or muscular disorders, and uncontrolled cardiac arrhythmia (which can be detected from patients' files), as patients with these conditions have more complications and these conditions itself affect HRQOL. Summary of the studies' inclusion and exclusion criteria are in Table 1.

## 2.2 Data Extraction

The result of the literature search retrieved 793 studies for screening process. After duplicates were removed using EndNote 7 software, 358 records were retrieved for initial screening. The primary checking of the abstracts produced 45 studies addressing CABG patients. After examination of full-text articles, 8 eligible studies were finally included in the literature review, after excluding articles that concentrate on the effect of psychological interventions. The full text of articles was examined based on the title first for suitability, then the abstract of the studies was reviewed, then full text. Outcomes measured other than those stated in the inclusion criteria also excluded. Thus, eight studies were considered in the review. Figure. 1 presented the selection of studies based on The PRISMA 2020 flow diagram.<sup>5</sup>

## 2.3 Quality Assessment

Two reviewers (two cardiologist physicians) check studies' titles and abstracts to identify studies that possibly meet the inclusion criteria mentioned above. Then we obtained the full text of these studies and evaluated by two of the authors (two physicians). Any inconsistencies were solved through conversation with a third reviewer (MA).

In this study, Consolidated Standards of Reporting Trial (CONSORT)" checklist was used to perform data extraction<sup>6</sup>, to estimate the quality of the RCTs (See Supplementary File .2) and in order to evaluate the quality of the non RCTs Transparent Reporting of Evaluations with Nonrandomized Designs (TREND) checklist was used<sup>6</sup> (See Supplementary File .3). CONSORT checklist included 25 items to appraise RCT methodological quality and to identify the level of bias management in its analysis and design, while TREND had 22 items. A point was given to each study if there was a match of every single item; therefore, the CONSORT score for RCT' methodological quality extended from 0 (low quality) to 25 (high quality). On the other hand, TREND scores ranged from 1(low quality) to 22 (high quality).

The extracted data contained specific details about the populations, settings, study methods and interventions. Two authors (two physicians) extracted data individualistically and any incongruity or ambiguity was fixed through conversation with the third author (MS).

## 3 RESULTS

### 3.1 Qualitative Appraisal for Selected Papers

Summary of the reviewed studies illustrated in Table 2, it includes; authors names, year, setting, sample size, intervention, outcomes measures, and results of the articles reviewed. A total of 4 RCT and 4 quasi-experimental studies were involved for the final assessment.

Some of the selected studies focused on inpatients<sup>8-11</sup> and one study by Laustsen et al<sup>12</sup> on outpatients,

while some studies focused on in/outpatients.<sup>13-15</sup> All studies revealed a positive impact of CRP on HRQoL and physiological outcomes of CABG patients. This review was applied by the primary author (MS) and confirmed by the secondary authors (MR, and MH). Any differences were discussed and fixed by consensus.

One study rated as high quality in RCT studies<sup>10,11</sup> was moderately high, and low moderate<sup>8,14</sup> while quasi-experimental studies found that Akbari and Celik<sup>9</sup> and Laustsen et al.<sup>12</sup> were moderately high and Pacaric et al.<sup>13</sup> and Spiroski et al.<sup>15</sup> were rated as low moderate quality. Table 3 and 4 show the methodological quality on the criteria listed in the CONSORT & TREND checklist.

### 3.2 Effect of CRP on HRQoL and physiological outcomes of CABG patients

This part presents the effect of CRPs on HRQoL (both domains; physical and mental) on CABG patients and on physiological aspects. All the reviewed studies revealed that the CRP had a positive effect on CABG patients' HRQoL, and physiological variables.

Nobari et al.<sup>10</sup> conducted a non-randomized controlled trial on 97 CABG patients, in which 49 were allocated to the healthy lifestyle empowerment program group (HLEPG), and the conventional education group (CEG) (n=48). In the follow up both groups exhibited a significant improvement in the HRQoL mean score but this increase was obviously better in the HLEPG, using the SF-12 tool. Zofaghari et al.<sup>11</sup> study consisted of 50 patients who underwent CABG surgery. The patients were randomly assigned to a control group (n = 25) and a Physiotherapy (PT) group (n = 25). The control group did not have any PT sessions, the PT group complete 16 sessions of PT. The QoL scores of the PT patients significantly improved after the intervention) in both the mental and physical components. Salavati et al.<sup>14</sup> conducted a randomized controlled clinical study in Hamadan/ Iran on 110 patients to compare the effects of CRPs versus normal care on the patients' HRQOL after CABG surgery, MacNew Heart Disease HRQOL questionnaire (27-item) was used to assess the patient's HRQOL, patients in the control group received routine education at hospital discharge, experimental patients group, in addition to the routine education had home-based CRP which included exercise programs (obligation walking and education). They found statistically significant improvement in the HRQOL of patients following CRP. Alexiev et al.<sup>8</sup> study measured the impact of an early comprehensive, individualized CRP soon after CABG and examined its effect on exercise capacity and HRQOL. It was a prospective study investigating two types of cardiac rehabilitation in 100 patients. Patients were assigned to two groups. The outcome indicated that a customized physiotherapy strategy designed to increase motion shortly after cardiac surgery is safe, achievable, and more practical than a usual program and improved patient HRQOL. Akbari and Celik<sup>9</sup> conducted a study that investigated the impact of discharge exercise and post-discharge CR on HRQOL after CABG surgery using the 36-item Short Form Survey. This quasi-experimental study was conducted on a convenience 100 patients undergoing CABG surgery. The intervention group was provided discharge training and post-discharge counseling. The control group received only the usual discharge and postoperative instructions. It was found that discharge training and post-discharge counseling are effective in improving postoperative HRQOL among patients who undergo CABG surgery. Laustsen et al.<sup>12</sup> conducted a follow-up study on 34 participants in Denmark. patients conduct exercise 60 minutes three times per week with moderate intensity of exercise for 20 minutes per session, HRQOL was assessed using (SF-36) questionnaire, and the results showed that there was a significant increase in mental and physical HRQOL. Pacaric et al.<sup>13</sup> in their prospective study conducted for 47 patients in Croatia, before surgery and one-month post-surgery, then one year after the rehabilitation program which took three weeks. Significant improvement in all quality-of-life domains were noted after rehabilitation. Spiroski et al.<sup>15</sup> studied 54 patients in Serbia after CABG surgery who contributed in a 3-week and 6-month outpatient. The inpatient interventions involved of daily walking for 45 minutes and cycling 7 times/week. The outpatient interventions involved of cycling 3 times/week and walking 5 times/week for 45 minutes. The study found a remarkable improvement in health-related factors such as HR, BP, BS, and lipid profile for patients after CRP.

### 3.3 CRP components

Cardiac rehabilitation guidelines provide different types of exercises include anaerobic training, resistance

training, and flexibility training with the intensity of exercise ranging from 40-85% resting heart rate (HR) for 20 – 60 minutes for up to three to five sessions per week for six to 12 weeks up to six months in most guidelines and using HR monitoring, blood pressure (BP) monitoring, symptoms monitoring and continuous Electrocardiogram (ECG) monitoring in the exercise training.<sup>16,17</sup> This could be found in the study by Nobari et al.<sup>10</sup> who used two CRP after CABG surgery. The HELP was applied in four 45–60-min training sessions, included face-to-face training and sharing experiences among patients. The information of the HELP was chosen based on the up-to-date scientific studies, with the assistance of psychologists, cardiologists, nutrition and religious experts. They included nutrition, physical activity, spiritual growth, interpersonal relations, health responsibility, and stress management. The selected contents were collected into an educational pamphlet and booklet. Monitoring using telephone was used in the 4<sup>th</sup> and 8<sup>th</sup> weeks post discharge to ensure patients would perform the program. The second group patients (CEG) received routine education at discharge. This strategy advice a 30-min daily walk, low salt diet, and medication compliance. The education was administered at the bedside and took between 5 and 10 min at discharge.

In Salavati et al.<sup>14</sup> study, the patients received usual education and home-based CRPs, which consist of: education about their disease, usual and unusual signs and symptoms and illness potential complications, drug treatment, lifestyle changes (stress management, nutrition counseling, smoking cessation, control blood pressure, and control weight,), workout programs (obligation walking and education). Also distributed a booklet about their disease (in hospital and at home based on the training). In between the visits a call by the nurses to answer any questions. Laustsen et al.<sup>12</sup> in their interventions included a 12-week telemonitored exercise-based cardiac rehabilitation program 2–6 weeks after hospital discharge, i.e., walking, biking, spinning, or fitness center. Physiotherapists gave separate weekly feedback on exercise training intensity, provided sessions on cardio-protective lifestyle in-hospital group-based education. Akbari and Celik<sup>9</sup> used a discharge training program and post-discharge counseling together with routine program. Educational booklet (that discusses CAD and care-related subjects such as complications of CABG, and self-care activities), encouraged to discuss their problems and ask their care-related questions. Then, care-related training in small three-person groups offered using teaching strategies such as question-and-answer, lecture, feedback-giving, demonstration, summarization and reinforcement. Applied in the meeting room or in patients' rooms. Sessions lasted 1-4 hours. Counseling via home visit and follow-up telephones provided at 2<sup>nd</sup> and 10<sup>th</sup> days and 6 weeks after discharge. Alexiev et al.<sup>8</sup> program was consisting of early ambulation, psychological counseling, pulmonary clearing techniques, breathing exercises, range of motion exercises, and risk factors management beside best medication treatment on the 4<sup>th</sup> day post discharge. Pacaric et al.<sup>13</sup> study used a cardiac rehabilitation intervention that focus on physiotherapy in which patients were taught coughing, exercises, deep breathing, and walking exercises to improve physical functioning. Patients showed improvement one year after rehabilitation in mental and physical health in comparison with pre-surgery status but no significant improvement was noticed one month after surgery and before the rehabilitation program. Spiroski et al.<sup>15</sup> used CRP consist that had two parts: an in and outpatient CRPs. The intervention involved information sessions, nutrition counseling, exercise training, smoking cessation, and psychosocial support. The inpatient intervention comprised of daily walking for 45 minutes and cycling 7 times/week. The outpatient intervention included cycling 3 times/week and walking 5 times/week for 45 minutes. All participants completed symptom-limited cardiopulmonary exercise testing (CPET) on a bicycle ergometer for 3 weeks, and for 6 months. Zolfaghari et al.<sup>11</sup> interventions were physiotherapy totally 15 min with 16 sessions (3 times a week for 1 month). The approaches of physiotherapy were individualized. It involved postural drainage, breathing exercise, positioning and cough exercise, chest tapotement, and thorax mobilization exercises. Hence, from previous studies we can conclude that there is no specific CRP fits all patients but the general components were the same. Also, whatever the physiological variables vary from one study to another all had the same results of improving.

#### 4 DISCUSSION

Cardiac rehabilitation programs for those patients could present a reasonably acceptable method to promote the smooth transition of patients to their new life post CABG. The impact of (CRP) on patient health outcomes, including adaptation in lifestyle and improved bio-physiological markers, has been well-documented

in the literature.<sup>18</sup>

This review assessed the impact of CRP on CABG patients in terms of improving the HRQoL and their physiological outcomes. Most of the literature involved in this review mentioned the content for their CRP content (different dimensions of health-promoting behaviors (HPBs) such as dietary counseling, smoking cessation. . . , physiotherapy, breathing exercises, psychological counseling, pharmacological treatment. Facts about their illness, clinical manifestations, and potential complications), and the ways of applying these types of CRP (face to face training, educational booklet and a pamphlet, lecture, demonstration, question-and-answer, reinforcement, feedback-giving, and summarization, follow-up telephone, and home visits). The most common outcomes measured were HRQOL and physiological variables which CRP displayed a positive effect on these outcomes. The number of sessions and duration varies from 4 sessions, 45-60 minutes<sup>10,14</sup> to 3 times training/week for 12 weeks<sup>12</sup>, to 60-220 min sessions<sup>9</sup>, to 16 sessions (15 minutes each) <sup>11</sup>, and 7 times/week for 3 weeks (inpatients) with 2 training sessions daily, 45 minutes, each, to 5 times/week for 6 months (outpatients).<sup>15</sup> One study by Akbari et al.<sup>9</sup> includes family caregivers in the CRP, by training them to help patients achieve self-care activities post-discharge. Multi health professionals can give rehabilitation interventions, some given by intensive care unit nurses, some were physiotherapists, some studies used dietitians, physicians, and others. Some studies reported some major limitations that may affect the generalizability or external validity, such as small sample<sup>8,11,13,15</sup>, in addition to selection problems of participants<sup>12</sup>, or using convenience sampling method; no randomization or random assignment.<sup>9</sup> Also, short follow-up period<sup>8-11</sup>, single-center of CRP /single geographic area.<sup>8,13</sup> Illiteracy of participants<sup>10</sup>, no control group, and muscle training was not telemonitored.<sup>12</sup> Finally, not enough data for economic evaluation.<sup>13</sup>

#### 4.1 Limitations

Some limitations were recognized in this study. First, different approaches of applying CRP were studied, which makes the variation between these findings difficult. Second, in this study, we assessed the quality of experimental studies and excluded the qualitative studies. So, this review calls for the need for an integrative systematic review to evaluate the feasibility of CRIs and their impacts on CABG patients.

## 5 CONCLUSION

This review aimed to explore the quality of studies that examined the impact of CRPs on HRQOL for CABG patients, and all of these studies agreed that the in and out-patient who participated in the CRI had a positive effect after CABG surgery in terms of HRQOL included the domains of HRQOL (sleep disturbance, social isolation, pain, energy level, emotional reaction, and physical abilities). On the other hand, CRI was differing from one study to another, not all of them contain all aspects that should focus on for CABG patients, or they were comprehensive. Also, the time that CRI tested its effect on HRQOL differs. Some were shortly after surgery and some were late months after surgery. This study recognized a gap in which majority of literature focused on the impact of CRPs for in-patients. Accordingly, more studies are needed that measure the impact of CRPs on out-patients after CABG surgery.

Moreover, the reviewed studies found that the combination interventions in CRP which include physical exercise, dietary intervention, and educational intervention had a remarkable effect on some specific health-related outcomes like (heart rate, cholesterol, triglyceride, and body mass index). The above information is asserting the importance of developing better strategies that help in the integration of CRPs into the usual treatment plans among CABG patients.

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#### Ethical approval

Ethics approval is not required for the study.

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### Conflict of interest

The authors declare that they have no competing interests.

### Data Availability Statement

The data that supports the findings of this study are available in the supplementary material of this article

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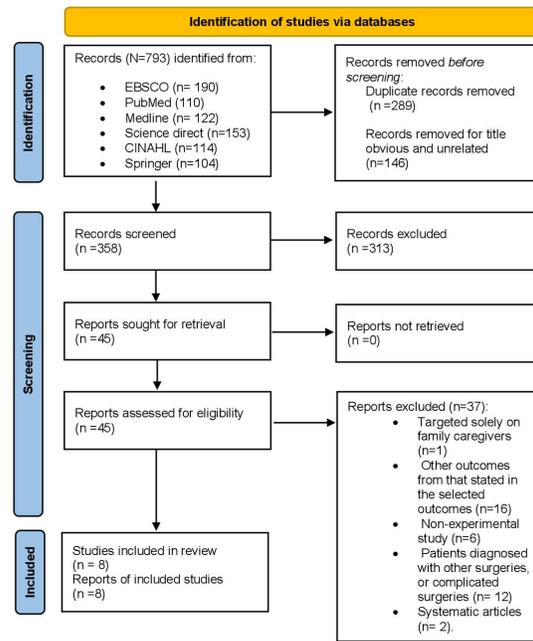


Figure 1: PRISMA 2020 flow diagram of study selection process (Page, McKenzie, Bossuyt, Boutron, Hoffmann, Mulrow, & et al, 2021).

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