REVIEW ARTICLE

A Review of Interventions to Improve Enrolment and Adherence to Cardiac Rehabilitation Among Patients Aged 65 Years or Above

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Abstract: *Purpose*: This review provides an overview and quality assessment of existing interventions, assessing the intervention types that are most effective at increasing enrolment and adherence to cardiac rehabilitation in older patients aged ≥65 years

Methods: The review of the literature was performed using electronic databases to search for randomised controlled trials that aimed to increase enrolment and/or adherence to cardiac rehabilitation in older patients aged ≥65 years. The main key words were cardiac rehabilitation, enrolment, adherence and older patients. Studies were included if; (1) the intervention targeted improving enrolment and/or adherence to at least one of the following components of the cardiac rehabilitation programme: exercise, education or maintaining lifestyle changes; (2) assess the effectiveness of an intervention on increasing enrolment and/or adherence to a cardiac rehabilitation programme or any of its components; (3) include measures for assessing enrolment and/or adherence to a cardiac rehabilitation programme or any of its components; (4) the study included patients with a mean age of ≥65 years who were deemed eligible to participate in a cardiac rehabilitation programme. Included studies could be published in any language and there were no date restrictions for included studies. Studies focusing on pharmaceutical adherence were not included for the purpose of this review.

Results: Seven studies were included, with four investigating enrolment (1944 participants) and three assessing adherence to intervention programmes (410 participants). Three studies (1919 participants) reported higher enrolment to cardiac rehabilitation in the intervention group. Two studies that reported increases in enrolment to cardiac rehabilitation were deemed to have an unclear or high risk of bias. All three studies (410 participants) reported better adherence to cardiac rehabilitation in the intervention group when compared to the control group. Two studies that reported better completion of cardiac rehabilitation were deemed to have an unclear or high risk of bias. No formal meta-analysis was conducted due to the observed multiple heterogeneity among outcome measures, the low number of included studies and variability in study designs.

Conclusion: This review found only weak evidence to suggest that interventions can increase enrolment or adherence to cardiac rehabilitation programmes for patients aged ≥65 years, therefore no practice recommendations could be made and further high-quality research is needed in this population group.

Keywords: Systematic review, cardiovascular disease, CVD, older patients, ≥65 years, cardiac rehabilitation, enrolment, attendance, adherence.

1. INTRODUCTION AND STATEMENT OF PURPOSE

Cardiovascular disease (CVD) is the leading cause of death worldwide in older people aged ≥65 years [1]. There were an estimated 136,506 deaths due to CVD in the UK in 2014 for patients aged ≥65 years [2]. Despite proven benefits of attending and adhering to cardiac rehabilitation (CR) by older patients [3-5], enrolment and adherence to CR in this demographic group remains suboptimal [3, 4, 6, 7].

CR has evolved to become a multidimensional treatment designed to promote and facilitate physical activity as well as education, diet and risk reduction for a broad range of patients and CVD conditions [4, 8]. CR provides many benefits that are unique for older patients and offers an invaluable opportunity to address and moderate many of the challenges pertinent for the large and growing population of older adults

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with CVD. Patients aged ≥65 years are generally among the least fit and active patient group [9] and physical deconditioning is accelerated once a CVD condition has been diagnosed [9]. Furthermore, the risk of co-morbidities and complications post-acute cardiac event and/or major surgery is increased with advancing age and CVD [6]. Disability rates following a myocardial infarction, heart failure or cardiac surgery can be between 45% and 75% in older patients [10, 11]. Regular attendance at CR by older patients has been proven to reduce all-cause and cardiovascular mortality [5, 12] and cardiac risk factors [4, 13]. CR promotes enhancing physical function and its components such as cardiorespiratory fitness, strength and balance [4]. An increased physical function is an important factor in determining positive health outcomes post CR [4, 12-15]. Increasing physical function also helps overcome age-related deconditioning and vulnerabilities such as disability, frailty, and falls [4]. Additionally, CR has proven to increase cognition, socialisation, and independence in older patients [4, 16]. The association between these psychosocial factors, depression and CHD is complex but the effect of psychological diseases such as depression has been associated with greater CVD morbidity, mortality and lower health-related quality of life [4, 16, 17]. Enrolling and adhering to CR results in improved outcomes post revascularisation, in addition to better lifestyle modification and medication adherence compared to those who do not attend and adhere to CR [18].

Despite these benefits, older patients are less likely to be referred, attend and complete their CR programmes [19-21]. It is estimated that only approximately 30-40% of total eligible cardiac patients are referred to CR [22-24]. Of those patients eligible for CR, only a small fraction of patients actually enrol and adhere to their CR programmes. Attendance can be as low as 21% within the older patients demographic compared to the mean attendance for all patient groups of approximately 40-45% of total eligible patients [2, 25, 26]. Low adherence to CR is common, with 40-50% of patients who participate failing to complete the full programme [26]. Studies suggest that only between 30-60% of patients continue to exercise for 6-12 months after completing their CR programme [18, 27, 28]. Older patients are estimated to be at the lower end of these adherence figure, particularly females are less likely to be encouraged to attend CR [29, 30]. The poor uptake and adherence to CR programmes among older patients is clearly of concern.

The rationale for conducting this review is that there are concerns that although patients aged ≥65 years or more have an increased risk of death and disability [1, 2, 5, 6, 9-11] from CVD, there is a lack of clarity as to what can be done to mitigate this. Whilst it is known that patients aged ≥65 years who attend and adhere to CR can lower their risk of a myocardial infarction by 31% and cardiac-associated death by 47% compared to those who do not attend [31], it is unclear which interventions can improve uptake and attendance rates. Although there have been previous studies that explored new interventions for enrolment and adherence to CR, they had focused primarily on younger patients or made no reference to specific age groups [32, 33]. This is despite the amount of research into the enrolment and adherence barriers reported for different population groups [20, 34-36] that has been undertaken and the consensus being that certain barriers affect various population groups differently [20, 34-35]. There is an urgent need to review evidence of all available interventions for increasing enrolment and adherence to CR among older patients.

Therefore, the purpose of this review is to assess the evidence of interventions that aimed to increase enrolment and/or adherence to cardiac CR programmes among patients aged ≥65 years.

2. METHODS

2.1. Review of the Literature

We reviewed the literature to identify interventions based on the Cochrane Review guidelines for systematic reviews [36].

In a pre-published protocol available online (http://www.crd.york.ac.uk/PROSPERO) [37] protocol registration number CRD42016042687, we reported that we aimed to conduct a systematic review to address two questions:

- Why do older patients above 65 years old have low uptake and adherence to cardiac rehabilitation programmes?

- Which types of interventions are most effective at increasing uptake and adherence to cardiac rehabilitation in this particular patient population group?

However, in the process of studying the literature it became clear that it is not feasible to tackle both questions in a single review. Consequently, this review has focused only on addressing the question of which types of interventions are most effective at increasing enrolment and adherence to cardiac rehabilitation in this particular patient population group.

2.2. Criteria for Inclusion/Exclusion of Studies

The inclusion/exclusion criteria followed the PICOS' (patient, intervention, control, outcomes, study design) convention as per Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [38].

2.3. Types of Participants

Included studies must have an approximate mean age of ≥65 years. Included studies could compromise patients diagnosed with any CVD condition/treatment, as long as participants had been deemed eligible for CR. For studies investigating enrolment, the study population comprised patients who were referred for CR. For studies focusing on increasing adherence, participants were those who had already enrolled to take part in a CR programme at the start of the study.

2.4. Types of Interventions and Controls

Any intervention with the aim of increasing patient enrolment or adherence to CR or any of its component parts could be included. Interventions could be targeted to: individuals, groups, partners, caregivers or other family members, or health professionals. Studies examining the effects of interventions to improve adherence to pharmacologic treatments exclusively were excluded. Studies assessing two or more

interventions to increase enrolment or adherence were included as long as the study included a usual care control arm.

2.5. Types of Outcome Measures

The primary outcome measures for this review were improvement in enrolment and/or adherence to at least one of the following components of CR: exercise, education or maintaining lifestyle changes. Enrolment was defined by the participant's uptake to CR after being deemed eligible to participate and being referred to a CR programme, for example, to attend an intake appointment or complete a minimum number of sessions. This review did not focus on improving referral to CR. Adherence was defined as the extent to which the participant's behaviour concurred with the advice given by healthcare professionals, for example to attend CR sessions or to undertake independent exercise. Adherence could be expressed as a dichotomous outcome (*e.g.* the participant did or did not concur with the advice given) or as a rate (*e.g.* percentage of sessions/weeks during the follow-up period in which the participant did the recommended amount of exercise). Measures of frequency and amount of exercise were used to assess adherence rates for as long as the studies reported results in this format. Measures of exercise capacity (*e.g.* strength, peak oxygen uptake) were deemed not to be suitable measures of adherence as they do not give an indication of the extent to which participants concurred with the advice given to them. Control groups were defined as patients who received usual care or not attending any formal CR.

2.6. Types of Study Designs

Randomised controlled trials (RCT's) either at individual or cluster level or either parallel group, cross-over or quasi-randomised design were included. The inclusion of studies was restricted RCT's as it is well accepted that they are the gold standards for establishing efficacy in health-related interventions [39]. Systematic reviews and meta-analyses were identified as an additional source of studies.

2.7. Literature Search Strategy

A full logical audit trail for this study is available online (http://www.crd.york.ac.uk/PROSPERO) protocol registration number CRD42016042687. Electronic databases that were searched included; Cochrane Central Register for Controlled Trials (CENTRAL); CRD Database (NHS Centre for Reviews and Dissemination); EBSCO; EMBASE; Medline; PsycINFO; SPORTDiscus; US National Library of Medicine National Institutes of Health (PubMed) (all until May 2017); Google Scholar (until May 2017) and the reference lists of systematic reviews, meta-analyses and identified studies were also searched. There were no geographical or publication type restrictions. Included studies could be published in any language and there were no date restrictions for included studies. Studies could be published in any peer-reviewed journal, conference presentation or dissertation as long as they met the inclusion criteria and the information provided could be used for assessment. Search terms used for electronic databases included a combination of index terms for example 'cardiac rehabilitation; enrolment; adherence' and free text words such as 'intervention; trial'. Deciding on the search terms used was an iterative process, trialling search strings in the selected databases and sampling titles for proportional relevance, with sensitivity improving as scoping progressed. Considerations were given to alternative terms and spellings used so that all potential studies could be identified.

2.8. Selection of Studies

In order to be selected, abstracts had to clearly identify the study design, an appropriate population and relevant components of the intervention. Any obvious irrelevant references studies were excluded. Full-text reports of all the remaining trials were obtained and one author (SW) independently assessed them for eligibility based on the defined inclusion criteria and checked by a second author (BM). Disagreements were either resolved by discussion when possible or, when an agreement could not be reached, by consultation with an independent third party.

2.9. Data Extraction & Management

A data extraction form was designed based on EPOC recommendations [40]. Due to time constraints, a single author (SW) undertook data extraction regarding; inclusion criteria (study design: participants, type of intervention, comparisons and outcomes), risk of bias, and results with entries checked by a second author (BM).

2.10. Assessment of Risk of Bias

The assessment of bias in the included studies was assessed by a single author (SW) and verified by a second author (BM), using The Cochrane Collaboration's recommended tool [36], which is a domain-based critical evaluation of the following domains:

- Sequence generation
- Allocation concealment
- Blinding of outcome assessment
- Incomplete data outcome
- Selective outcome reporting

Because of the nature of the included interventions in previous reviews in this area [32, 33], blinding of treatment assignment was not deemed to be possible. Consequently, the blinding of outcome assessors was reported instead.

2.11. Data Synthesis

Based on the nature of interventions included in related studies in this area [32, 33] it was anticipated quantitative-synthesis would not be possible. The multiple heterogeneities observed among interventions and outcome measures meant it was inappropriate for a formal meta-analysis to be conducted. Instead, the heterogeneity among the included studies was assessed qualitatively by comparing their characteristics. Studies were grouped into those that assessed enrolment or adherence.

3. RESULTS

The first stage of the literature search returned 500,311 articles from all of the searched databases. Additional re-

cords (n=6) were identified through other sources. An updated search in March 2017 identified additional articles that were more recent (n=13). After accounting for 427,657 duplicates, 72,661 unique articles were identified on the basis of titles and abstracts. By applying stage 1 inclusion and exclusion criteria, 72,619 studies were then excluded after reviewing the titles and abstracts. The second stage of the literature search excluded a further 35 articles after full-text review. Only seven articles met the eligibility criteria and were included in the final analysis. Reasons for exclusion of articles at the second stage of the literature search are described on Table **1**. The process of study selection is summarised in Fig. (**1**) in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines [38].

Table 1.   Reasons for exclusion of articles at the second stage of the literature search.

Study	Reason for Exclusion
Ali-Faisal *et al.* 2016	Mean age below 65 years.
Arrigo *et al.* 2008	Mean age below 65 years.
Ashe 1993	Mean age below 65 years.
Austin 2013	Not an RCT.
Beckie & Beckstead 2010	Mean age below 65 years.
Butler *et al.* 2009	No adequate measure of adherence to cardiac rehabilitation.
Carlson *et al.* 2000	Mean age below 65 years.
Cebrick Grossmann 2016	Mean age below 65 years.
Cossette *et al.* 2012	Mean age below 65 years.
Daltroy *et al.* 1985	Mean age below 65 years.
Danker *et al.* 2011	Non-random allocation to study group.
Froelicher *et al.* 2003	No intervention to increase adherence.
Gaalema *et al.* 2016	Mean age below 65 years.
Grace *et al.* 2016	Mean age below 65 years.
Hillebrand *et al.* 1995	Mean age below 65 years.
Hopper 1995	No adequate measure of adherence to cardiac rehabilitation.
Hughes *et al.* 2002	No adequate measure of adherence to cardiac rehabilitation.
Hughes *et al.* 2007	No adequate measure of adherence to cardiac rehabilitation.
Izawa *et al.* 2005	Mean age below 65 years.
Jolly *et al.* 1999	Mean age below 65 years.
Jolly *et al.* 2007	Mean age below 65 years.
Lounsbury *et al. 2015*	Not an RCT.
Lynggaard *et al.* 2017	Mean age below 65 years.
Macchi *et al.* 2009	No adequate measure of adherence to cardiac rehabilitation.
Mahler *et al.* 1999	No adequate measure of adherence to cardiac rehabilitation.
Meiller *et al.* 2012	Non-random allocation to study group.
Moore *et al.* 2006	Mean age below 65 years.
Oldridge & Jones 1983	Mean age below 65 years.
Pack *et al.* 2013	Mean age below 65 years.
Pack *et al.* 2013	Mean age below 65 years.
Parry *et al.* 2009	Mean age below 65 years.
Rejeski *et al.* 2002	Used same participant sample and outcome measures as Focht *et al.*, 2004.
Sniehotta *et al.* 2006	Mean age below 65 years.
Wolkanin-Bartnik *et al.* 2011	No adequate measure of adherence to cardiac rehabilitation.
Wyer *et al.* 2001	Mean age below 65 years.

RCT - Randomized controlled trial.
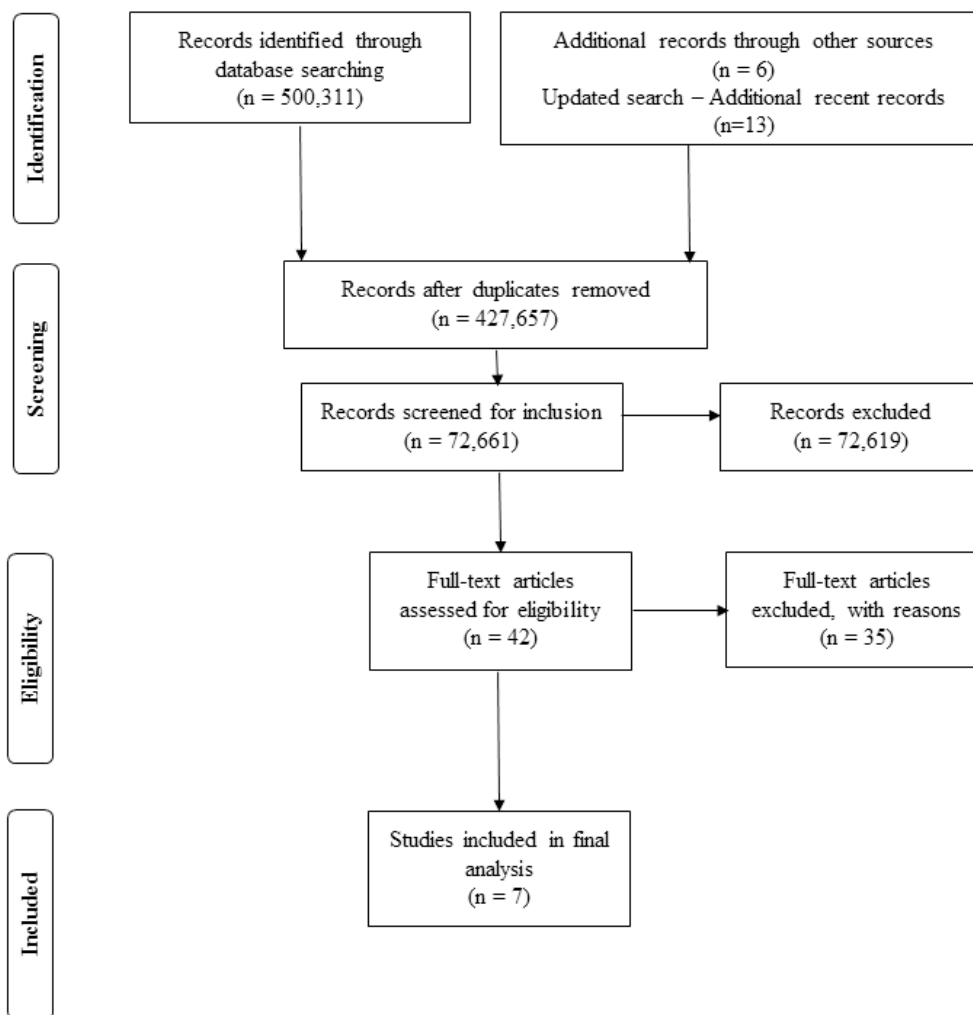
Fig. (1). Flow diagram of the study selection for this review based on PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines [38].

4. ENROLMENT

Four studies evaluated interventions to increase enrolment to CR, involving a total of 1944 patients [41-44]. Enrolment was defined by the included studies as attending CR at a certain time point, either intake appointment [41, 43, 44], or for 6 weeks' post hospital discharge [42]. Successful intervention types included; structured follow-up by a healthcare professional [44], in addition to being combined with an intermediate phase programme [42] and using multiple referral strategies [43]. Three studies reported statistically significant differences between the intervention and control groups [42-44]. Notably one study was considered satisfactory for low risk of bias [44].

Two studies were conducted in Canada [43, 44], with one study each in the United Kingdom [41] and the United States [42]. All of the included studies utilised a usual care group as the control. Four of the studies included participants with mixed CVD conditions [42-44], with one [41] examining patients diagnosed with a myocardial infarction exclusively. Two intervention groups included had majority male participants [41, 43] ranging from 68.8% to 84%. Only one mixed-

gender study had a majority of female participants [42]. One study was all female only intervention [43].

5. ADHERENCE

Three studies evaluated patient adherence to CR or one of its components [45-47]. 410 participants were involved in total. Adherence was defined as completing a number of sessions over the period of assessment for all three studies. All three studies utilised a parallel group randomised design with length of follow-up ranging from three to twelve months. Successful intervention types included; using a peer support group [45], also being combined with healthcare worker support [47] and application of GCMB theory training [46]. Two studies reported statistically significant differences between the intervention and control groups [45, 46]. Notably only one study had a satisfactory low level of bias [46]. All studies appear to be mixed gender. One study had majority male demographic [47], with one study having a majority of female participants [46]. However, one study [45] failed to report gender statistics for the participants. All three studies were conducted in the United States and utilised a usual care group as the control group.

6. QUALITY ASSESSMENT

In most cases, there was limited reporting of the methodology and outcomes data in the selected studies that met the inclusion criteria. This limited our ability to conduct an adequate critical evaluation of the following domains: sequence generation, allocation concealment, blinding, incomplete outcome data, selective outcome reporting, and other sources of bias. The risk of bias for all of the included studies was reported as high, low, or insufficient information available as summarised in Fig. (**2**) and Table **2** with further details provided on Table **3** and Table **4**. In summary, only three out of the seven trials [42, 44-46] undertook random sequence generation and only three trials [41, 44, 46] were clear about their allocation concealment measures. Only one study [43] adequately addressed detection bias. In addition, two trials [42, 45] had a low risk of attrition bias with five studies [40, 43-46] having a low risk of reporting bias. There were no other sources of bias in two studies [43, 46].

7. DISCUSSION

This study aimed to provide an overview of existing interventions and a quality assessment of the intervention types that are most effective at increasing enrolment and adherence

to CR in older patients aged ≥65 years. The results of this review point towards structured follow-up by a healthcare professional, in addition to being combined with an intermediate phase programme and using multiple referral strategies being relatively successful at increasing enrolment in older patients. Evidence suggests utilising a peer support group, also being combined with healthcare worker support and application of group-mediated cognitive behavioural (GCMB) theory training increases adherence to CR in this population [46].

However, a number of shortcomings on intervention designs were identified right across the board. Only two studies [42, 47] recruited patients aged ≥65 years exclusively. It is also important to recognise other demographic factors that may have influenced results. Ethnicity, socio-economic status, gender and CVD condition in addition to age all affect enrolment or adherence to CR [34-36] so may have influenced outcomes. Included interventions were usually multifaceted, using a combination of many different techniques to increase enrolment or adherence, with a lack of studies employing a single intervention strategy making it difficult to identify what parts of the intervention were most effective. No studies were identified that targeted barriers such as
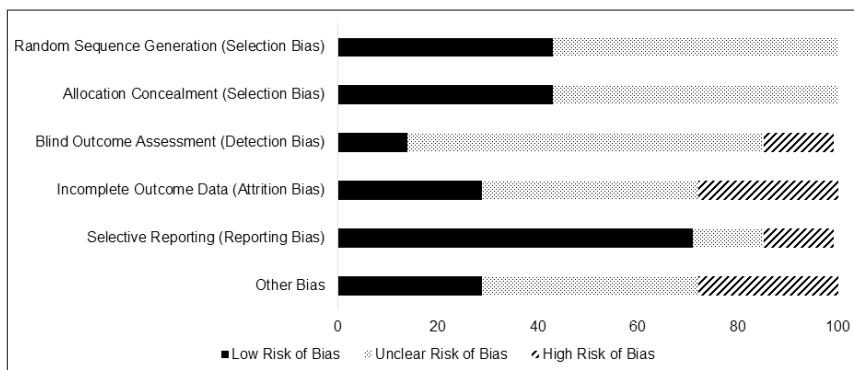
Fig. (2). Methodological quality summary: summary of authors' judgements about each methodological quality item for each included study presented as percentages of all included studies.

Table 2.   Assessment of methodological quality (qualitatively).

Study	Random Sequence Generation (Selection Bias)	Allocation Concealment (Selection Bias)	Blind Outcome Assessment (Detection Bias)	Incomplete Outcome Data (Attrition Bias)	Selective Reporting (Reporting Bias)	Other Bias
Carroll *et al.* 2007	?	?	?	-	+	+
Dolansky *et al.* 2011	+	?	?	-	-	?
Duncan & Pozehl 2003	?	?	?	?	+	-
Focht *et al. 2004*	+	+	?	+	+	?
Grace *et al.* 2011	?	?	?	+	?	?
McPaul *et al.* 2007	?	+	-	?	+	-
Price 2012	+	+	+	?	+	+

Summary of authors' assessment of methodological quality for each included study.
(+) - Plus signs indicates high methodological quality (low risk of bias).
(-) - Minus signs indicate low methodological quality (high risk of bias).
(?) - Question marks indicate unclear methodological quality (reported information about what happened in the study was insufficient).

Table 3.   Summary of studies examining enrolment to cardiac rehabilitation.

Study	Number of Participants at Baseline	Cardiac Conditions at Timing of Intervention	Mean Age (years)	Gender (Male %)	Type of Intervention Group	Summary of Bias	Summary of Findings
Dolansky *et al.* 2011	Total = 40 IG = 17 CG = 21	MI. Undergone PCI/CABG/cardiac valve surgery.	Total = 77.1 (±6.8) IG = 77.6 (±6.9) CG = 76.5 (±6.7)	Total = 34.2 IG = 47.1 CG = 28.6	Cardiac TRUST programme. Nurses involved to help include the family in the education programme and the application of an additional exercise support programme.	High risk of attrition bias as 24% of participants had missing data and were excluded from analysis in addition to the 5% dropout rate. ITT not performed. Reporting bias deemed high as a secondary outcome was only reported in the intervention group. Allocation concealment and detection bias were unclear as they were not reported. Risk of attrition bias 2 patients excluded but no details on which group they were randomised into. Other sources of bias unclear due to differences between IG and CG group ethnicity and living arrangements.	Significant difference between groups noted (Chi-squared = 4.5; P < 0.05). 58.3% of patients attending outpatient CR in IG compared to 11.8% in CG.
Grace *et al.* 2011	LRO = 490 ARO = 551 CLAR = 471 CG = 297	Acute coronary syndrome. 2. Undergone PCI/CABG surgery. Diagnosis of HF/arrhythmia.	LRO = 66.7 (±11) ARO = 65.6 (±10.1) CLAR = 64.7 (±9.7) CG = 64 (±10.9)	LRO = 68.8 ARO = 78.4 CLAR = 79.4 CG = 70.4	LRO is comprised of a personal discussion with a health care professional (*e.g.* nurse/physiotherapist) and/or peer graduate (either bedside/telephone) post discharge. Automatic referral uses electronic patient records or standard discharge orders as a systematic prompt before hospital discharge. CLAR is when both methods are used.	Unclear risk of reporting and other bias as participant self-reported whether they were referred to CR, to which site, whether they attended a CR intake assessment, whether or not they participated in CR by providing an estimate of the percentage of prescribed sessions they attended. Unclear risk of detection bias as clinical staff aware of which groups patients were assigned. Selection bias was unclear as randomisation and concealment methods were not reported.	CLAR enrolment was 73.5%. ARO enrolment was 60%. LRO enrolment was 50.6% In comparison CG enrolment was 29%. Significant differences related to CR referral methods and CG (Wald statistics = 24.28, P=0.001; and 13.62, P=0.01, respectively). No significant differences between types of enrolment (P=0.34) and adherence (P=0.88).
McPaul *et al.* 2007	Total = 25 IG = 15 CG = 10	MI.	Total = 67.2	Total = 84	Home visit interview with an occupational therapist instead of a phone call.	High risk of detection bias as the study was not blinded. Unclear risk of randomisation was arranged by the researcher. ITT not performed so unclear risk of attrition bias. Other bias risks include the fact that no information was collected on major CVD risk factors in baseline measures.	Patients more likely to attend Phase III CR if received telephone call (CG) than home visit (IG). No statistics provided.
Price 2012	Total = 70 IG = 34 CG = 36	Undergone non-emergency PCI/CABG surgery.	Total = 67	Total = 0	Applied a nurse-delivered telephone coaching programme made between hospital discharge and cardiac rehabilitation intake appointment.	Unclear risk of attrition bias as ITT performed but patients were excluded from final analyses.	57.6% of patients in the IG attended their initial CR appointment compared to 33.3% of CG patients. Significant difference between IG and CG (P=0.048).

ITT - intention to treat analysis; IG - intervention group; CG - control group; LRO - liaison referral only; ARO - automatic referral only; CLAR - combined liaison & automatic referral; PCI - percutaneous coronary interventions; CABG - coronary artery bypass graft surgery; HF - heart failure CR - cardiac rehabilitation; CVD - cardiovascular disease; MI - myocardial infarction; TTM - transtheoretical model of behaviour change.

Table 4.　Summary of studies examining adherence to cardiac rehabilitation.

Study	Number of Participants at Baseline	Cardiac Conditions at Timing of Intervention	Mean Age (Years)	Gender (Male %)	Type of Intervention Group	Summary of Bias	Summary of Findings
Carroll *et al.* 2007	Total = 247 IG = 121 CG = 126	MI. Undertaken CABG surgery.	Total = 76.3 (±6.3) IG = 76.2 (±6.2) CG = 76.4 (±6.4)	Total = 66 IG = 69 CG = 63	A peer support group and healthcare professionals provided social support to patients.	Unclear selection bias and detection bias risk as randomisation, concealment and blinding methods not reported. High risk of attrition bias as no information on which groups dropouts were allocated to and no ITT performed.	Participation in CR was increased in the IG compared to CG over-time (Z =7.60, P<.0005). Adherence at 3, 6, and 12 months after the index hospital admission (Pearson Chi squared tests, P=0.05).
Duncan & Pozehl 2003	Total = 16 IG = 8 CG = 8	HF with an ejection fraction ≤40%.	Total = 66.4 IG = 69.4 CG = 63.3	N/A	CR staff advise patients on home exercise and application of an adher-ence facilitation.	Unclear selection bias and detection bias risk as randomisation, concealment and blinding methods not reported. Unclear attrition bias risk as 1 participant is unaccounted for. Other bias deemed high risk as differences in baseline participant details such as time diagnosed with heart failure, gender and age.	No significant differ-ences for adherence between IG and CG during Phase 1 super-vised exercise sessions (P>0.05). Adherence was signifi-cantly higher during unsupervised exercise sessions phase (P<0.01).
Focht *et al.* 2004	Total = 147 IG = 75 CG = 72	MI. HF (New York Heart Asso-ciation Type I or II). Undergone PCI/CABG/valve surgery. 2 or more major CVD risk factors.	Total = 64.8 (±6.94) IG = 64.9 (±7.41)	IG = 49.3 CG = 47.2	Applied GCMB theory [47] throughout first 3 months of CR.	Unclear risk of detection bias as blinding methods not reported. Other bias risks unclear as IG consisted of a group of older men and women who were overweight or obese.	IG attended 90.88% (SE=2.65) of sessions compared to 77.88% (SE=2.04) in the CG; P<0.05)

ITT - intention to treat analysis; IG - intervention group; CG - control group; PCI - percutaneous coronary interventions; CABG - coronary artery bypass graft surgery; HF - heart failure; CR - cardiac rehabilitation; CVD - cardiovascular disease; MI - myocardial infarction; GCMB – group mediated cognitive behavioural physical activity program.

transport difficulties, family difficulties or inconvenient tim-ing which studies suggest were more likely to affect older patients than the general population [35, 36, 48]. Despite the fact that physician endorsement is a strong predictor of en-rolment to CR [34-36, 49, 50], particularly in older patients, [26] no studies included healthcare professionals as targets in the interventions. Furthermore, the majority of studies over-whelmingly focused on the exercise component of CR, par-ticularly those addressing adherence to CR with no studies providing separate data for the education or lifestyle compo-nents of CR. Disappointingly, no studies provided any cost-benefit analysis. There is clearly a paucity of high-quality studies specifically targeting enrolment or adherence to CR for this population group.

Only one study identified by this review focused exclu-sively on older heart failure patients [44]. Furthermore, the sample size was small (16 participants). Despite exercise training being acceptable as safe and beneficial to heart fail-ure patients with moderate heart failure [51], there is still a lack of interventions designed to increase enrolment or ad-herence to CR for this population. This could be explained by heart failure patient's unwillingness to exercise due to fear of putting excess strain on the cardiovascular system [51]. This fear is exasperated in older patients as they are more likely to feel that they are unable to influence their

recovery from illness [26]. Thus, future studies should be designed to address such barriers.

These findings are consistent with previous studies that have assessed enrolment and adherence in younger patients [32, 33]. The results suggest successful interventions to in-crease enrolment included regular nurse/therapist visits, early appointments after discharge, motivational letters, gender-specific CR, flexible hours of operation, automatic in-patient CR referral system, inpatient liaison, limiting/eliminating out-of-pocket expenses for patients and home-based CR [32, 33]. Few studies had a low risk of bias [33]. Interventions elicit-ing improvements in adherence with effective interventions including: daily self-monitoring of activity, action planning and adherence facilitation by CR staff, motivational and finan-cial incentives, introductory video and recommendation of 36 visits for all patients [32, 33]. However, the risk of bias in these studies was high [33]. They also found no studies pro-viding information about costs or resource implications.

CONCLUSION

There is a clear need and rationale for increasing enrol-ment and adherence to CR programmes in populations aged ≥65 years. Although studies have tested interventions that appear to be promising, there is a gap in evidence. This is

mainly because of a paucity of studies focusing on older patients. We therefore conclude that further high-quality research is needed to test interventions specifically designed for patients aged ≥65 years before any of them are recommended for routine clinical practice.

STUDY LIMITATIONS

Interventions for increasing enrolment and/or adherence vary across a diverse range of CR programmes. This is mainly due to the varied definition of CR and differences between programmes in different countries. With CR being provided at non-uniform settings with different demographics, there is a potential for results to be affected by factors associated with ethnicity and socio-economic status. Some included studies are relatively old and potentially based on outdated models of CR. Secondly, several of the identified studies had numerous weaknesses in study design, such as heterogeneity of intervention designs, multiple interventions, variability in description of primary and secondary endpoints and high risk of bias. Some of the authors whose study designs were uncertain were contacted by email for data clarification but unfortunately they did not respond, thus our review may be at risk of outcomes reporting bias. We included only studies reporting the outcomes of interest (enrolment or adherence to CR) which may have resulted in a biased sample. Our inability to conduct a meta-analysis is also a weakness for this study.

APPLICATION TO PRACTICE

Although most of the interventions reported relative increases in enrolment or adherence to CR, majority studies were poorly designed subsequently producing weak results. This renders the trial findings difficult to put into clinical practice. The lack of cost-benefit analysis is also frustrating, with costs of providing healthcare increasing worldwide, it would not be attractive for healthcare providers to adapt these strategies into clinical practice without this type of analysis. Although the concept of many of these interventions could work, more high-quality research is required before they could be recommended for routine clinical practice. Already recent studies [52] acknowledge the weaknesses of the current literature suggesting that future studies may incorporate better designs to avoid past mistakes.

CONSENT FOR PUBLICATION

Not applicable.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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