REHABILITATION INTERVENTIONS AND HEALTH-RELATED QUALITY OF LIFE AFTER MYOCARDIAL INFARCTION

by

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Submitted to the Undergraduate Faculty of

School of Health and Rehabilitation Sciences in partial fulfillment

of the requirements for the degree of
Bachelor of Philosophy

University of Pittsburgh

2009

UNIVERSITY OF PITTSBURGH

SCHOOL OF HEALTH AND REHABILITATION SCIENCES

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Myocardial infarction (MI) is a widespread occurrence, with approximately 610,000 new and 325,000 recurrent MIs experienced every year in the United States. While 84% of these victims will survive the attack, many will suffer poor outcomes as a result. These outcomes include increased risk for another MI, sudden death, heart failure, and stroke; chest pain; depression; and poor quality of life. The American Heart Association recommends that all MI patients participate in a cardiac rehabilitation program (CRP) to help reduce mortality and morbidity, control risk factors, and improve quality of life. CRPs are interventions that start soon after an MI and consist of a variety of components, including exercise programs, education, counseling, and stress management.

Health-related quality of life (HRQoL) is a measure of how persons believe their general health status and any illnesses affect their physical, social, and mental functioning. HRQoL is an important patient outcome and should be considered when evaluating the effectiveness of any rehabilitation intervention. MI survivors have been shown to have a decreased HRQoL immediately after the MI and for up to 4 years thereafter. It is clear that any CRP should be designed to help return patients' HRQoL to its pre-MI level. While many studies have looked at how CRPs influence HRQoL after an MI, a systematic review has not been found that

specifically considers this outcome. The purpose of this study was to conduct a comprehensive review of how CRPs affect HRQoL following an MI, and which CRP designs are effective at improving HRQoL.

A comprehensive literature search yielded 13 articles that studied HRQoL differences before and after a CRP following an MI. These studies were analyzed by CRP length; time between MI and CRP start; CRP components, type, and intensity; and effect on HRQoL. Findings indicated that CRPs do seem to positively influence HRQoL following an MI, regardless of design and components, possibly excluding inpatient CRPs and those that use only a few counseling sessions. Limitations included many non-controlled studies, heterogeneity of designs, and a bias towards younger, male participants.

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PREFACE

I would like to acknowledge and sincerely thank my mentor, Ketki D. Raina, PhD, OTR/L, for her immense help and support throughout the past two years. I would also like to thank the members of my thesis committee, Denise Chisholm, PhD, OTR/L, Margo B. Holm, PhD, OTR/L, and Jon C. Rittenberger, MD, MS for their generous assistance in the completion of my thesis.

1.0 BACKGROUND

1.1 MYOCARDIAL INFARCTION

Approximately every 34 seconds an American will experience a myocardial infarction (MI; Lloyd-Jones et al., 2009). Myocardial infarction occurs when blood flow to a part of the heart muscle is interrupted. This interruption is caused by a partial or complete blockage of one or more of the coronary arteries that supply blood to the muscle. If blood flow to the heart is not restored within a few minutes, the muscle cells are permanently injured and die. This can lead to disability and death for the person experiencing the MI (American Heart Association, 2003). It is estimated that 610,000 new and 325,000 recurrent MIs are experienced every year (Lloyd-Jones et al., 2009). Nine worldwide risk factors have been identified that, if modified, could result in a 90% reduction in the risk of a first-time MI. These risk factors are: (a) cigarette smoking, (b) abnormal blood lipid levels, (c) hypertension, (d) diabetes, (e) abdominal obesity, (f) lack of physical activity, (g) low fruit and vegetable consumption, (h) high alcohol consumption, and (i) psychosocial index (Lloyd-Jones et al., 2009). The average age of a first MI is 64.5 years for men and 70.3 years for women. While 84% of MI victims survive the attack, many survivors experience poor outcomes (Lloyd-Jones et al. 2009).

1.2 MYOCARDIAL INFARCTION OUTCOMES

An estimated 15 years of life are lost because of an MI, and MI survivors have a sudden death rate that is 4 to 6 times that of the general population (Lloyd-Jones et al., 2009). The risk for another MI, sudden death, angina pectoris, heart failure, and stroke is substantial. Depending on gender and clinical outcome, MI survivors have a 1.5 to 15 times higher chance of illness and death when compared to the general population (Lloyd-Jones et al., 2009). Brown et al. (1999) found that 56% of MI patients still experience some form of chest pain 4 years after an MI. Return to work after an MI is questionable and fairly slow, with between 50% to 89% of MI survivors who were previously employed returning to work after the MI and 56% to 79% returning within the first year (Froelicher, Kee, Newton, Lindskog, & Livingston, 1994). Emotionally, MI survivors experience anxiety, depression, fatigue, and irritability after an MI (Trzcieniecka-Green & Steptoe, 1994) and this poor emotional functioning persists for at least 3 years (Plevier et al., 2001).

1.3 CARDIAC REHABILITATION

Because MI survivors experience such poor outcomes, the American Heart Association issued a scientific statement in 2005 recommending that all patients who experience an MI should participate in a cardiac rehabilitation program (CRP; Leon et al., 2005). Cardiac rehabilitation has been defined as the "sum of activity and interventions required to ensure the best possible physical, mental, and social conditions so that patients with chronic or post-acute cardiovascular disease may, by their own efforts, preserve or resume their proper place in society and lead an

active life" (World Health Organization, 1992, p. 5). CRPs are secondary prevention programs designed to help MI survivors prolong life, modify risk factors, improve physical functioning and quality of life, promote general well-being, and aide patients in returning to their normal lives (Choo, Burke, & Hong, 2007; Höfer et al., 2006; Oldridge et al., 1991). CRPs typically consist of any combination of an assortment of components including exercise programs; psychological counseling; stress management programs; relaxation training; and education and counseling about topics including MIs, risk factor management, smoking cessation, nutrition, and medications.

CRPs can vary widely in their structure, from length of time between MI and program start (days to months) to program length (weeks to months), intensity (days and hours per week), and components (exercise, counseling, education). They can be inpatient or outpatient, and outpatient CRPs can be hospital-based or home-based. In the United Kingdom (UK), CRPs are divided into four distinct phases. Phase I occurs during hospitalization, phase II is after discharge, phase III takes place in an outpatient setting, and phase IV is long-term maintenance in the community (Arnold, Sewell, & Singh, 2007). Another classification system for CRPs that is used elsewhere in Europe and Asia consists of three phases: phase I, the acute stage; phase II, the subacute or recovery stage; and phase III, the maintenance stage (Izawa et al., 2004). Similarly, in the United States (US), a three-phase system is used: phase I is inpatient, phase II is outpatient, and phase III is community-based (Huntley, 2002). Due to advanced medical interventions and financial issues, phase I inpatient CRPs are becoming shorter and phase II outpatient CRPs more popular (Yoshika et al., 1999).

CRPs can be delivered by a variety of people, including nurses, physicians, physical therapists, occupational therapists, psychologists, and exercise physiologists. They can also be

self-guided by the patient, such as through the use of the *Heart Manual*, a "step-by-step guide… using a structured programme of exercise, stress management, and education" (Dalal et al., 2007, p. 204) that is supported by a nurse facilitator and used widely in the UK.

1.4 CARDIAC REHABILITATION PROGRAM OUTCOMES

Regardless of the broad variation in CRPs, they have been shown to be widely effective in improving patient outcomes following an MI. CRPs reduce total and cardiovascular mortality, decrease recurrent MIs, reduce pain symptoms, and improve exercise capacity (Williams et al., 2006). They also increase smoking cessation, improve blood lipid levels and blood pressure, and help patients lose weight. Along with physical health outcomes, CRPs help patients socially and psychologically as well. Patients show improvements in anxiety, depression, and psychological well-being, and experience social benefits (Wenger et al., 1995).

Despite the obvious benefits of participating in a CRP, the percentage of MI survivors that do so is unfortunately low. In the US, only 35% of MI survivors participate in an outpatient CRP (Centers for Disease Control, 2008). This may be because of high costs, lack of access, patient anxiety, time and travel issues, lack of physician referral, and lack of knowledge about benefits of participating. Higher levels of education and a higher income are predictors of participation in a CRP. Women have a lower rate of participation than men, with approximately 27% participating, compared to 39% of men (Centers for Disease Control, 2008). This disparity may be because women tend to be older and have more comorbidities, are referred by physicians less often, have less self-efficacy and lower tolerance levels toward exercising, which is

perceived as a primary emphasis of CRPs, and have higher rates of musculoskeletal conditions, which may cause challenges when exercising (Davidson et al., 2008).

1.5 HEALTH-RELATED QUALITY OF LIFE

Health-related quality of life (HRQoL) is defined as "the functional effect of an illness and its consequent therapy upon a patient, as perceived by the patient" (Schipper, Clinch, & Olweny, 1996). A high HRQoL indicates that a patient perceives him or herself as having high physical, mental, and social functioning despite any diseases or illnesses, while a low HRQoL indicates the patient sees him or herself as being low-functioning because of a disease or illness. HRQoL is affected by disease and medical treatment, and is modified by impairments, stress, and perceptions (Oldridge et al., 1998). Because of the current shift from a medical model of health to a bio-psycho-social model, HRQoL is considered an important outcome of medical treatments that must be considered along with other medical measures (Höfer et al., 2006).

1.6 HEALTH-RELATED QUALITY OF LIFE INSTRUMENTS

HRQoL instruments fall under two separate categories: generic and disease-specific. Generic HRQOL instruments are ones that aim to be applicable across many diseases, interventions, and cultures, and can be used to assess differences between groups. There are two types of generic instruments: those that provide a singular value, or utility measure, for HRQoL, such as the Quality of Well-Being scale (QWB; Patrick & Deyo, 1989), and those that produce a

health profile of many different aspects of HRQoL, such as the SF-36 Health Survey questionnaire (SF-36; Izawa et al., 2004). Disease-specific instruments, such as the Quality of Life After Myocardial Infarction questionnaire (QLMI; Gardner et al., 2003), are designed to assess the HRQoL of patients with one particular disease or illness. They are used to evaluate differences in HRQoL over time. Using generic instruments to assess HRQoL in patients with a specific disease may offer low content validity because of the lack of questions that pertain exclusively to the condition, but they generally have higher reliability and generalizability. Disease-specific instruments, on the other hand, offer fairly high content validity, but lower reliability and generalizability across conditions or treatments (Patrick & Deyo, 1989). Table 1 describes validated generic and disease-specific HRQoL instruments and their characteristics.

1.7 MYOCARDIAL INFARCTION AND HEALTH-RELATED QUALITY OF LIFE

HRQoL is reduced after an MI, and continues to be lower than the general population for many years. Brink, Grankvist, Karlson, & Hallberg (2005) reported significantly lower levels in both the physical and mental component summaries of the SF-36 5 months after an MI as compared to normative data. A year after the MI, women had significantly lower scores in four domains (physical functioning, role-physical, social functioning, and role-emotional) and men in three domains (physical functioning, role-physical, and vitality). Brown et al. (1999) reported that four years after an MI, survivors aged under 65 years had significantly lower scores in all eight domains of the SF-36, especially in the physical domains.

It should be noted that HRQoL does sometimes appear to spontaneously regenerate after an MI without any interventions, as in Brink et al. (2005), where women showed significantly

Table 1. Health-Related Quality of Life Instruments

Name of Instrument	Type	Number of Items	Dimensions/Subscales	Scoring
Dartmouth COOP scale	Generic, Health Profile	9	Physical, Emotional, Daily Activities, Social Activities, Social Support, Pain, Overall Health	5 point ordinal scale for each dimension, 1=favorable, 5=unfavorable
EQ-5D	Generic, Health Profile	6	Mobility, Self-Care, Usual Activities, Pain/Discomfort, Anxiety/Depression, Health Status	3 levels for each dimension, 1=better, 3=worse + visual analogue scale of health status, 0-100, 0=worse, 100=best
MacNew	Specific, Profile	27	Physical Limitations, Emotional Function, Social Function	7 point ordinal scale for each item, 1=poor, 7=high
PGWB	Generic, Utility Measure	18	Anxiety, Depressed Mood, Positive Well-Being, Self-Control, General Health, Vitality	Items have 6 point scale, total score, 0-110 0-60=severe distress 61-72=moderate distress 73-110=positive well-being
QLMI	Specific, Profile	25	Limitations, Emotions, Overall Score	7 point ordinal scale for each item, 1=poor, 7=high
QLI – Cardiac Version III	Specific, Profile	72	Health and Functioning, Social and Economic, Psychological and Spiritual, Family	36 items measure level of satisfaction, 36 items measure level of importance, combined for 0-30 score for overall total and each subscale
QWB	Generic, Utility Measure	4	Symptoms, Mobility, Physical Activity, Social Activity	Interviewer administered, items scored & weighted to get score between 0 and 1 0=death, 1.0=asymptomatic optimal functioning
SF-36	Generic, Health Profile	36	*Physical*: Physical Functioning, Role-Physical, Bodily Pain, General Health, *Mental*: Vitality, Social Functioning, Role-Emotional, Mental Health	Each subscale score ranges from 0 to 100, 0=poorest level of functioning, 100=highest level of functioning 8 subscales, 2 component summaries, and total score generated

Table 1 (continued).

Name of Instrument	Type	Number of Items	Dimensions/Subscales	Scoring
SIP	Generic, Health Profile	136	*Physical*: Ambulation, Mobility, Body Care and Movement *Psychosocial*: Sleep and Rest, Emotional Behavior, Home Management, Social Interaction, Alertness Behavior, Communication, Work, Recreation and Pastimes, and Eating	Each item has yes/no answer Overall, domain, and category scores calculated based on acquired percentage Higher score=more impact Lower score=less impact

Note. Dartmouth COOP scale = Dartmouth COOP Functional Health Assessment Charts (Nelson, Wasson, Johnson, & Hays, n.d.), EQ-5D = EuroQol-5D questionnaire (EuroQol Group, n.d.), MacNew = MacNew Quality of Life After Myocardial Infarction questionnaire (Höfer, 2006), PGWB = Psychological General Well-Being Index (Grossi et al., 2006; Institute of Medicine, 1995), QLMI = Quality of Life After Acute Myocardial Infarction questionnaire (Gardner et al., 2003), QLI-Cardiac Version III = Quality of Life Index – Cardiac Version III (Choo et al., 2006), QWB = Quality of Well-Being scale (Oldridge et al., 1991), SF-36 = SF-36 Health Survey questionnaire (Izawa et al., 2004), SIP = Sickness Impact Profile questionnaire (Suzuki et al., 2005).

increased scores in the mental component summary and men in the physical component summary from 5 months to 1 year after an MI. Moreover, Oldridge et al. (1991) demonstrated that the control, non-CRP group showed significant time effects in all domains of the QLMI and in the QWB scale from baseline at 6 weeks after MI to 1 year post-MI.

In spite of this apparent natural restoration of HRQoL following an MI, it is important to recognize that it is a slow and incomplete process, as MI survivors still demonstrate significantly lower HRQoL levels when compared to the general population until at least 4 years after their MI (Brown et al., 1999). Thus, the goals of cardiac rehabilitation should not only be to improve the patient physically and medically, but also to expedite the process of regaining reduced HRQoL levels. CRPs should be designed to maximize this improvement of HRQoL so patients can return to their pre-MI health status levels.

Many studies have been conducted that look at HRQoL after MI with participation in a CRP, but these studies are very different in terms of methodology, HRQoL instruments, inclusion criteria, statistical analysis, and CRP design. Because of this heterogeneity, a critical review is limited, but a comprehensive evaluation of this body of literature is needed to understand how HRQoL is influenced by CRPs after an MI. Although there are many systematic reviews and meta-analyses that look at cardiac rehabilitation outcomes (Wenger et al., 1995; Williams et al., 2006), most include patients with other cardiac conditions, including chronic heart failure, coronary artery disease, and various cardiac surgeries. These reviews also generally focus on medical outcomes, such as mortality, exercise tolerance, blood pressure, and cholesterol levels. While two reviews included quality of life outcomes, both used all heart disease patients and only briefly touched on quality of life (Ades & Coello, 2000; Taylor, 2004). The purpose of this study was to use the current literature to develop a clearer understanding of how HRQoL is

affected by CRPs following an MI and whether CRP design modifies this influence. With many more MI victims surviving and attempting to regain their place in society, helping survivors to return to their pre-MI HRQoL levels is an important and essential part of cardiac rehabilitation.

2.0 METHODS

A comprehensive review of the literature was conducted using Medline (1950 – present), CINAHL (1981 – present), and PsycInfo (1967 – present) databases, including articles available by February, 2009. A combination of key search terms was used, including "myocardial infarction," "cardiac rehabilitation," "rehabilitation," "health-related quality of life," "quality of life," and "assessment outcomes." A manual search of reference lists of retrieved articles and relevant review articles was also completed. Approximately 350 abstracts were reviewed for inclusion. Articles not in English or unpublished were excluded. Approximately five articles not in English may have met the study criteria. Full-length texts were retrieved if the abstract indicated the article may meet inclusion criteria. Thirty-five articles were assessed and 13 articles met all inclusion criteria. Twenty-two articles were excluded because of reasons listed in Figure 1, which illustrates the search process in more detail. Inclusion criteria were:

1. Either only MI patients were included in the study, or if other cardiac conditions were included, MI patient results were presented separately.
2. A validated method of measuring HRQoL was used, as shown in Table 1, including both generic and disease-specific instruments.
3. The CRP was defined in terms of start point, length, components, and setting, and was consistent across all participants in the intervention group.

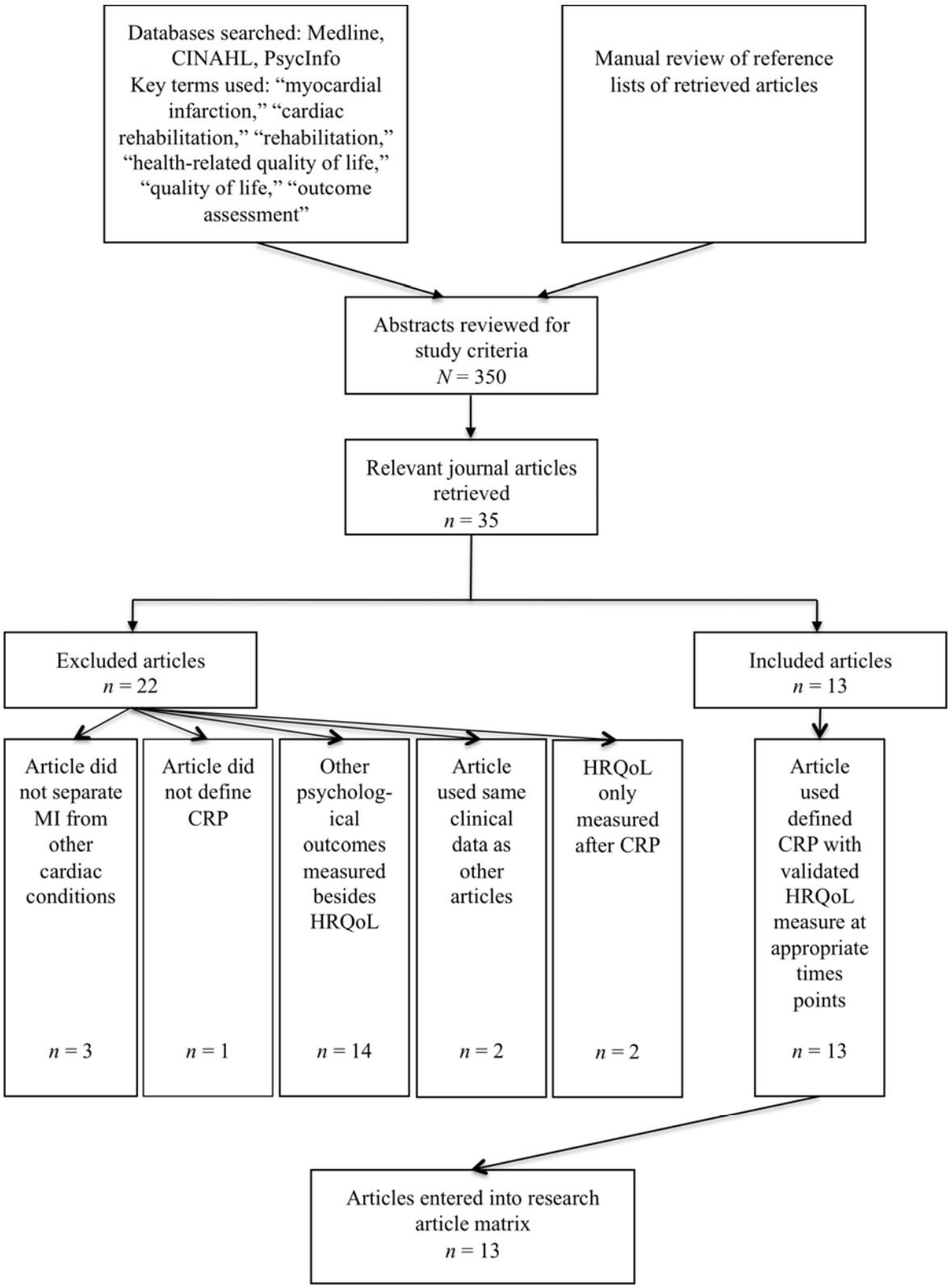

Figure 1. Flowchart Illustrating Literature Search for Articles
Note. *N* = number of articles, *n* = number of articles.

4. HRQoL was measured both before and after the CRP, and HRQoL was compared both across time and groups if appropriate.

5. Study participant characteristics, including age and gender, were recorded and documented in the article.

The 13 accepted articles were entered into a research article matrix, which can be found in the Appendix as Table 5. The studies were evaluated according to sample size, use of a control group, randomization, subject characteristics, and participant selection criteria. Based on these criteria, the studies were categorized by strength of evidence using a hierarchy developed by Moore, McQuay, & Gray (1995). This hierarchy is summarized in Table 2.

Table 2. Strength of Evidence Hierarchy

Type of Strength of Evidence	Study Type
I	Systematic review or meta-analysis of multiple randomized, controlled trials
II	Randomized, controlled trial with more than ten participants per group
III	Randomized, controlled trial with less than ten participants per group Controlled, nonrandomized trial Single or multiple groups with pre-post measures Comparison of two or more intervention groups
IV	Non-experimental studies from more than one center or research group
V	Descriptive studies

Each study was analyzed according to certain aspects of the intervention and how they affected HRQoL. These characteristics were (a) how soon after MI CRP was started, (b) how long the CRP lasted, (c) components of the CRP, (d) whether the CRP was inpatient or outpatient, (e) if outpatient, whether it was home-based or hospital-based, and (f) the intensity of

the CRP. The change in HRQoL, if any, was considered both immediately after the intervention and at future time points up to 14 months after the end of the CRP.

3.0 RESULTS

3.1 STUDY CHARACTERISTICS

Table 3 provides study characteristics for each article reviewed. Across all 13 studies, a total of 3,350 post-MI participants were included, with the range being between 23 and 1,367 participants. The average age was approximately 61 years, and 2,548 (76%) of the participants were male. Nine of the studies included only MI patients, and four included patients with other cardiac conditions who were not included in the participant total. The studies took place across a variety of countries, including North America, Europe, and Asia. European sites accounted for eight of the studies.

Six articles used non-controlled, non-randomized observational studies; two used controlled, non-randomized observational studies; four used randomized controlled trials; and one used a randomized non-controlled trial (see Table 3). Four of the studies were considered Level II evidence (Marchionni et al., 2003; Mayou et al., 2002; Oldridge et al., 1991; Trzcieniecka-Green & Steptoe, 1996), and the remaining nine were Level III. The most commonly used HRQoL outcome instrument was the MacNew Quality of Life After Myocardial Infarction questionnaire (MacNew), used in three studies (Arnold et al., 2007; Dalal et al., 2007; Höfer et al., 2006), and its predecessor, the Quality of Life After Acute Myocardial Infarction questionnaire, used in two studies (Gardner et al., 2003; Oldridge et al., 1991). Table 4 at the end

Table 3. Descriptions of Reviewed Studies

Article, Year	Design	Strength of Evidence Type	Number of Participants	Average Age of Participants	Number of Males (%)	Study Inclusion	HRQoL Instrument
Arnold, Sewell, & Singh, 2007	Retrospective observational	III	206	60.3	159 (77%)	MI patients who participated in CRP	MacNew
Choo, Burke, & Hong, 2007	Controlled quasi-experimental	III	60	55.5	50 (83%)	First time MI patients without cardiac history, age ≤ 75	QLI – Cardiac Version III
Dalal et al., 2007	Randomized non-controlled trial with preference arms	III	230	63.0	188 (82%)	Confirmed MI patients	MacNew
Gardner et al., 2003	Prospective observational	III	472 MI = 174	63.4 MI = 63.0	358 (76%) MI = 125 (72%)	MI, surgical revascularization, and PCI patients enrolled in CRP with ≥ 80% attendance	QLMI
Höfer et al., 2006	Prospective observational	III	487	60.9	315 (65%)	MI patients with or without PCI, CABG, or HVS who participated in CRP	MacNew, EQ-5D
Izawa et al., 2004	Controlled quasi-experimental	III	124	62.3	96 (77%)	MI patients who participated in CRP and completed exercise test	SF-36
Marchionni et al., 2003	Randomized controlled trial	II	270	69.0	183 (68%)	MI patients who participated in CRP	SIP
Mayou et al., 2002	Randomized controlled trial	II	114	58.1	89 (78%)	First or second MI patients able to participate in trial procedures	Dartmouth COOP scale

Table 3 (continued).

Article, Year	Design	Strength of Evidence Type	Number of Participants	Average Age of Participants	Number of Males (%)	Study Inclusion	HRQoL Instrument
Müller-Nordhorn et al., 2004	Prospective observational	III	2441 MI = 1367	60 MI = unknown	1904 (78%) MI = unknown	MI, CABG, and PTCA	SF-36
Oldridge et al., 1991	Randomized controlled trial	II	201	52.8	177 (88%)	MI patients with depression or anxiety able to exercise	QLMI, QWB
Suzuki et al., 2005	Prospective observational	III	44	58	37 (84%)	MI patients who participated in CRP	SIP
Trzcieniecka-Green & Steptoe, 1994	Prospective observational	III	51 MI = 23	59.7 MI = 59.7	45 (88%) MI = 19 (83%)	MI, CABG, or PCTA patients, age < 70	PGWB
Trzcieniecka-Green & Steptoe, 1996	Randomized controlled trial	II	100 MI = 50	60.2 MI = unknown	87 (87%) MI = unknown	MI or CABG patients, age < 70	PGWB

Note. HRQoL = health-related quality of life, MI = myocardial infarction, CRP = cardiac rehabilitation program, MacNew = MacNew Quality of Life After Myocardial Infarction questionnaire, QLI-Cardiac Version III = Quality of Life Index – Cardiac Version III, PCI = percutaneous coronary intervention, QLMI = Quality of Life After Acute Myocardial Infarction questionnaire, CABG = coronary artery bypass graft surgery, HVS = heart valve surgery, EQ-5D = EuroQol-5D questionnaire, SF-36 = SF-36 Health Survey questionnaire, SIP = Sickness Impact Profile questionnaire, Dartmouth COOP scale = Dartmouth COOP Functional Health Assessment Charts, PTCA = percutaneous transluminal coronary angioplasty, QWB = Quality of Well-Being scale, PGWB = Psychological General Well-Being Index.

of this section includes an overview of the 13 studies, including CRP characteristics, HRQoL instruments, measurement time points, and results. A more detailed description of each study is found in Table 5 of the Appendix.

3.2 HEALTH-RELATED QUALITY OF LIFE AND CARDIAC REHABILITATION PROGRAMS

Eleven of the studies showed significant improvement in HRQoL following participation in a CRP after MI and two did not (Mayou et al., 2002; Müller-Nordhorn et al., 2004). This confirms that HRQoL does improve after MI with participation in a CRP, although the next item to consider is whether the CRP causes the increase, or if it is due to natural spontaneous regeneration following an MI.

Six of the studies included a control, non-CRP group to look at whether CRPs significantly increased HRQoL after MI as compared to MI patients who did not attend a CRP. Four of the six studies (Choo et al., 2007; Izawa et al., 2004; Oldridge et al., 1991; Trzcieniecka-Green & Steptoe, 1996) showed a significant improvement in HRQoL only in the CRP groups. In Marchionni et al. (2003), both CRP groups and the control group showed a significant improvement after the CRP, except in the over 75 years of age cohort, which showed a significant improvement only in the two CRP groups. Mayou et al. (2002) showed a greater proportion of significantly improved HRQoL scores in the CRP group only at 3 months, not at 1 month or 1 year. These six studies provide evidence that CRPs do improve HRQoL immediately after an MI.

Three of the controlled studies looked at HRQoL scores in both CRP and non-CRP groups at time points later than immediately after the CRP (Mayou et al., 2002; Marchionni et al., 2003; Oldridge et al., 1991). Mayou et al. did not show a significant difference in proportion of improved scores between the CRP and non-CRP groups at one year. In Marchionni et al. (2003), both the CRP groups and the control group showed a significant difference in HRQoL scores compared to the baseline at 8 and 14 months after baseline, except in the over 75 years of age cohort, which only showed the difference in both CRP groups. In Oldridge et al. (1991), the scores between the CRP and non-CRP groups were significantly different only immediately following the CRP, not at 4, 8, or 12 months after enrollment. These three studies indicate that HRQoL is only significantly improved in post-MI patients immediately following the CRP, but it is not particularly strong evidence. Nonetheless, in the rest of this section, HRQoL differences will only be considered immediately after the CRP, except where noted, due to the lack of evidence to demonstrate that CRPs cause a significant improvement in HRQoL at later time points than immediately after the CRP as compared to MI patients who did not attend a CRP.

3.3 LENGTH OF TIME BETWEEN MYOCARDIAL INFARCTION AND CARDIAC REHABILITATION PROGRAM INITIATION

Although no study has looked at the optimal time after the MI to start the CRP, 11 of the studies documented when they began their CRP (see Table 4). The average length of time between MI and CRP start was 4 to 5 weeks, with a range from immediately after the initial treatment for the MI (Höfer et al., 2006; Müller-Nordhorn et al., 2004) to 4 to 5 months after the MI (Trzcieniecka-Green & Steptoe, 1996), almost all with positive differences in HRQoL scores

from baseline. In Trzcieniecka-Green & Steptoe (1996), both the experimental group, who started the CRP 2 to 3 months post-MI, and the wait list control group, who chose to start the CRP 4 to 5 months post-MI, showed significantly improved HRQoL scores from baseline. This seems to demonstrate that length of time between MI and CRP start has very little, if any, effect on whether the CRP will improve HRQoL after an MI.

3.4 LENGTH OF CARDIAC REHABILTATION PROGRAM

Again, no study has specifically looked at whether the length of CRP affects HRQoL improvement, although 12 of the studies documented the length of their CRP (see Table 4). The average length was approximately 8 weeks, with a range from 3 to 12 weeks. All of the studies showed an improvement in HRQoL, except Müller-Nordhorn et al. (2004), whose CRP was the shortest of all the studies at 3 weeks. This would again seem to demonstrate that CRP length does not necessarily affect HRQoL improvements, although it is possible that a CRP that is less than 4 weeks may not be beneficial.

3.5 CARDIAC REHABILITATION PROGRAM COMPONENTS

The CRPs used in the 13 studies varied in terms of composition. Two of the studies (Arnold et al., 2007; Izawa et al., 2004) included only exercise programs in their CRPs, while two other studies (Trzcieniecka-Green & Steptoe, 1994; Trzcieniecka-Green & Steptoe, 1996) included only psychological counseling with relaxation training. The remainder of the studies, excluding

Mayou et al. (2002), used a combination of exercise, education, and/or counseling sessions, with mostly positive results. Mayou et al. (2002) used only two to four counseling sessions delivered by a cardiac nurse, with no difference in proportion of improved HRQoL scores at 1 month compared to the control group. Ten of the studies used exercise sessions as part of their CRP, with almost all of the studies' sessions including a warm-up, conditioning or endurance (typically walking or using a cycle ergometer), and cool down phases (see Appendix). Two studies (Höfer et al., 2006; Izawa et al. 2002) also used strength training and another (Marchionni et al., 2003) used stretching and flexibility sessions as well. The education and counseling components typically focused on MI and cardiac disease information, controlling risk factors, nutrition, medication, and smoking cessation. Psychological components were for helping the patient deal with their condition and to reduce stress. Thus, it seems that almost any combination of CRP components can produce improved HRQoL scores at the end of the CRP, except nurse-led counseling sessions with no other components.

3.6 TYPE OF CARDIAC REHABILITATION PROGRAM: INPATIENT VERSUS OUTPATIENT

Three of the studies (Höfer et al., 2006; Mayou et al., 2002; Müller-Nordhorn et al., 2004) used inpatient CRPs and the remaining 10 used outpatient. Of the three that used inpatient CRPs, HRQoL results were variable. Höfer et al. (2006) produced clear HRQoL improvements over baseline, while Mayou et al. (2002) only showed a greater proportion of significantly improved HRQoL scores over the control group at 3 months, not at 1 month. Müller-Nordhorn et al. (2004) showed no significant increase in HRQoL in MI patients, but MI patients actually showed a

significant decline in the "role-physical" subscale of the SF-36, indicating a lower HRQoL. Of the 10 studies that used outpatient CRPs, HRQoL was improved in all of them. This demonstrates some evidence that outpatient CRPs are more effective at improving HRQoL than inpatient ones, but this may simply be an effect of having a greater sample size of outpatient CRP studies, or greater healing time.

3.7 TYPE OF CARDIAC REHABILITATION PROGRAM: HOSPITAL-BASED VERSUS HOME-BASED

Two studies (Dalal et al., 2007; Marchionni et al., 2003) specifically looked at whether hospital-based and home-based CRPs produce differences in HRQoL improvement after MI. Dalal et al. (2007) included a hospital-based CRP with exercise, psychological counseling, and education sessions and a home-based group that used the *Heart Manual* with a nurse facilitator. At 9 to 10 months after enrollment, both groups showed significant improvements across all three domains of the MacNew, with no significant differences found between groups in the mean change in score. Marchionni et al. (2003) included a hospital-based group with exercise and counseling sessions, a home-based group that received an exercise prescription similar to that of the hospital-based group after four to eight instruction and counseling sessions, and a control group. HRQoL scores improved significantly from baseline across all groups and age cohorts, except the over 75 years of age cohort, which improved in only the two CRP groups. These two studies illustrate that outpatient hospital-based and home-based CRPs were equally effective in their ability to improve HRQoL.

3.8 CARDIAC REHABILITATION PROGRAM INTENSITY

One study considered whether CRP intensity affects HRQoL improvement after MI (Arnold et al., 2007). In this study, one group attended hospital-based exercise sessions once per week, while the other group attended them twice per week. After the CRP, both groups showed significant improvement across all three domains of the MacNew, with no significant differences found between the two groups. The remainder of the studies used a variety of different intensities, from one 2-hour session per week (Dalal et al., 2007) to five 1-hour exercise sessions and two counseling sessions per week (Marchionni et al., 2003). No clear relationship between intensity and HRQoL improvements was found, which suggests in agreement with the findings of Arnold et al. that intensity may not have an effect on HRQoL improvement following CRP.

Table 4. Overview of Reviewed Studies with Interventions and Results

Article, year	HRQoL Instrument	When CRP Started	How Long CRP Lasted	CRP Components	CRP Type	CRP Intensity	Measurement Time Points	Results
Arnold, Sewell, & Singh, 2007	MacNew	4-6 weeks post-hospital discharge	6 weeks	-Exercise sessions	Outpatient, hospital-based	Once weekly group: Once per week, 1 hour per session Twice weekly group: Twice per week, 1 hour per session	Baseline before CRP and following CRP	Both groups improved significantly across all 3 domains. No significant differences found between the improvements of both groups.
Choo, Burke, & Hong, 2007	QLI – Cardiac Version III	3 weeks post-MI	8 weeks	-Exercise sessions -1 education session -1 dietary counseling session	Outpatient, hospital-based	Three times per week, 1 hour per session	Baseline before CRP and following CRP	CRP group improved significantly in overall QLI, and health/functioning and psycho/spiritual subscales. Control group showed no significant changes in overall QLI or subscales.

Table 4 (continued).

Article, year	HRQoL Instrument	When CRP Started	How Long CRP Lasted	CRP Components	CRP Type	CRP Intensity	Measurement Time Points	Results
Dalal et al., 2007	MacNew	Hospital-based group: 4-6 weeks post-hospital discharge Home-based group: First week post-hospital discharge	Hospital-based group: 8-10 weeks. Home-based group: 6 weeks.	Both groups: -Counseling before discharge Hospital-based group: -Exercise sessions -Education sessions Home-based group: -Heart Manual, a self-paced guide using a program of exercise, stress management, and education	Hospital-based group: Outpatient, hospital-based Home-based group: Outpatient, home-based	Hospital-based group: Once per week, 2 hours per session Home-based group: Self-guided	Baseline at enrollment and 9-10 months after enrollment	Both randomized groups showed significant improvements across all 3 domains. No significant differences found between groups in the mean change in score. Both preference groups showed significant improvements across all 3 domains. No significant differences found between groups in the mean change in score. Outcomes between the randomized and preference groups were comparable.

Table 4 (continued).

Article, year	HRQoL Instrument	When CRP Started	How Long CRP Lasted	CRP Components	CRP Type	CRP Intensity	Measurement Time Points	Results
Gardner et al., 2003	QLMI	Not documented	12 weeks	-Exercise sessions -Education sessions	Outpatient, hospital-based	Three times per week, 1 hour per session	Baseline during first week of CRP and following CRP	MI group showed significant improvements across both domains and overall score.
Höfer et al., 2006	MacNew, EQ-5D	Immediately after initial treatment	4 weeks	-Exercise sessions -Physiotherapy sessions -Educations sessions -Psychological counseling -Stress management programs	Inpatient	Not documented	Baseline at admittance and at discharge	All 3 MacNew domains and overall score improved significantly. EQ-5D visual analogue scale showed significant improvement, while 3 of the 5 domains ("mobility," "usual activities," and "pain/discomfort") showed a significant improvement.

Table 4 (continued).

Article, year	HRQoL Instrument	When CRP Started	How Long CRP Lasted	CRP Components	CRP Type	CRP Intensity	Measurement Time Points	Results
Izawa et al., 2004	SF-36	Both groups (Acute phase): Immediately post-MI CRP group (Recovery phase): 4 weeks post-MI	Both groups: 4 weeks CRP group: 8 weeks	Both groups: -Education sessions CRP group: -Exercise sessions	Both groups: Inpatient CRP group: Outpatient, hospital-based	Both groups: Not documented CRP group: Twice per week, 1 hour per session	Baseline before CRP (after acute, inpatient CRP) and following CRP	CRP group improved significantly across all 8 subscales. Non-CRP group improved significantly only in "bodily pain" subscale. Statistically significant interaction found in "physical functioning," "role-physical," "general health," and "vitality" subscales.

Table 4 (continued).

Article, year	HRQoL Instrument	When CRP Started	How Long CRP Lasted	CRP Components	CRP Type	CRP Intensity	Measurement Time Points	Results
Marchionni et al., 2003	SIP	4-6 weeks post-MI	Both groups: 8 weeks	Hospital-based group: -Exercise sessions -Counseling sessions Home-based group: -4-8 exercise instruction sessions -Exercise prescription -4-8 counseling sessions Non-CRP group: -1 education session	Hospital-based group: Outpatient, hospital-based Home-based group: Outpatient, home-based	Hospital-based group: -Exercise sessions five times per week, 30 minutes – 1 hour per session -Counseling sessions twice per week Home-based group: After instruction sessions, exercise prescription similar to hospital-based group	Baseline before CRP, following CRP, and 8 and 14 months after baseline	Hospital-based group score increased significantly compared to baseline across all time points and all 3 age groups. Home-based group score increased significantly compared to baseline across all time points and all 3 age groups. Non-CRP group score improved significantly compared to baseline across all time points in only 45-65 and 66-75 years of age cohorts, not significantly in >75 years cohort.

Table 4 (continued).

Article, year	HRQoL Instrument	When CRP Started	How Long CRP Lasted	CRP Components	CRP Type	CRP Intensity	Measurement Time Points	Results
Mayou et al., 2002	Dartmouth COOP scale	Not documented	Not documented	-Counseling sessions	Inpatient	2-4 counseling sessions in hospital, ~2 hours each	Baseline within 48 hours of admission and at 1 month, 3 months, and 1 year	At 3 months, the proportion whose score had significantly improved was significantly higher in the CRP group than the control group. Scores at 1 month and 1 year were comparable between groups.
Müller-Nordhorn et al., 2004	SF-36	Immediately post-MI	~3 weeks	-Exercise sessions -Education sessions - Psychological counseling	Inpatient	Exercise sessions 3-5 times per week, 15-25 minutes per session	Baseline at admission and 6 and 12 months later	MI patients showed significant decline in "role-physical" subscale. No other significant changes seen in MI patients.

Table 4 (continued).

Article, year	HRQoL Instrument	When CRP Started	How Long CRP Lasted	CRP Components	CRP Type	CRP Intensity	Measurement Time Points	Results
Oldridge et al., 1991 (Oldridge et al., 1998)[a]	QLMI, QWB	Within 6 weeks of MI	8 weeks	-Exercise sessions -Counseling sessions	Outpatient, hospital-based	-Exercise sessions twice per week, 50 minutes per session -Counseling sessions once per week, 1.5 hours per session	Baseline before CRP, following CRP, and 4, 8, and 12 months after entry	At 8 weeks, total QLMI score and emotions domain showed significant treatment effects over the non-CRP group. At 12 months, significant time effects were seen in both groups in total QLMI score, both domains, and QWB score. No significant difference seen between CRP and non-CRP groups at 12 months.

Table 4 (continued).

Article, year	HRQoL Instrument	When CRP Started	How Long CRP Lasted	CRP Components	CRP Type	CRP Intensity	Measurement Time Points	Results
Suzuki et al., 2005	SIP	~2 weeks after MI	12 weeks	-Exercise sessions (patients with angina or ischemic changes at low exercise level excluded) -Education sessions	Outpatient, hospital-based	-Exercise sessions 3-5 times per week, 50-80 minutes per session for 2 weeks -Home exercise prescription for 3-5 times per week, 30-60 minutes per session for 10 weeks -Education sessions three times per week	Baseline at beginning of CRP and following CRP	SIP total and "physical disorder" scores improved significantly after CRP.

Table 4 (continued).

Article, year	HRQoL Instrument	When CRP Started	How Long CRP Lasted	CRP Components	CRP Type	CRP Intensity	Measurement Time Points	Results
Trzcieniecka-Green & Steptoe, 1994	PGWB	2-3 months post-MI	12 weeks	-Psychological counseling sessions with focus on relaxation training	Outpatient	One session per week	Baseline before CRP, following CRP, and 6 months after CRP	PGWB scores across MI, CABG, and PCTA cohorts improved significantly following the CRP, but did not improve further at 6 months. No significant differences were found between PGWB scores for all diagnostic cohorts.

Table 4 (continued).

Article, year	HRQoL Instrument	When CRP Started	How Long CRP Lasted	CRP Components	CRP Type	CRP Intensity	Measurement Time Points	Results
Trzcieniecka-Green & Steptoe, 1996	PGWB	Experimental group: 2-3 months post-MI Waiting list control group: 4-5 months post-MI	10 weeks	-Psychological counseling sessions with focus on relaxation training	Outpatient	One session per week	Baseline before CRP, following CRP, and 6 months after CRP	Experimental group with both MI and CABG cohorts showed significantly improved PGWB scores following CRP, with a significant treatment by time interaction, but did not improve further at 6 months. Waiting list control group with both diagnostic cohorts showed significantly improved PGWB scores following CRP, but did not improve further at 6 months. Both diagnostic cohorts responded similarly to CRP, with no significant diagnostic cohort by time interactions. Control group showed no significant change at 10 weeks.

Table 4 (continued).

Note. HRQoL = health-related quality of life, MI = myocardial infarction, CRP = cardiac rehabilitation program, MacNew = MacNew Quality of Life After Myocardial Infarction questionnaire, QLI-Cardiac Version III = Quality of Life Index – Cardiac Version III, QLMI = Quality of Life After Acute Myocardial Infarction questionnaire, EQ-5D = EuroQol-5D questionnaire, SF-36 = SF-36 Health Survey questionnaire, SIP = Sickness Impact Profile questionnaire, Dartmouth COOP scale = Dartmouth COOP Functional Health Assessment Charts, QWB = Quality of Well-Being Questionnaire, PGWB = Psychological General Well-Being Index.
[a]Scoring for the QLMI changed after publication; Oldridge et al. (1998) used the same data with the current scoring system to assess HRQoL.

4.0 DISCUSSION

A systematic review of the literature examining changes in HRQoL in post-MI patients following participation in a CRP demonstrated that CRPs resulted in improved HRQoL immediately after the CRP in 11 of the 13 studies, but a long term impact of CRPs on increased HRQoL was not conclusively demonstrated. In terms of the design of the CRP, it seems that length of time between MI and starting the program, CRP length, components, setting, and intensity do not always impact improvements in HRQoL. Although it may be possible that outpatient CRPs are better for increasing HRQoL, this is only weakly supported by the evidence. Studies that specifically looked at outpatient hospital-based versus home-based CRPs and different intensities showed the same results across all groups, indicating that the specific CRP design may not necessarily be important.

This review revealed that merely participating in a CRP, regardless of design and components, helps increase HRQoL in at least the short term following MI. The studies reviewed used CRPs with a wide variety of designs, and all but two showed an improvement in HRQoL after the CRP. Of the two that did not show improvement (Mayou et al., 2002; Müller-Hordhorn et al., 2004), both were inpatient programs, and the study by Mayou et al. (2002) included no components except nurse-led counseling sessions. Although a significant improvement over non-CRP patients was not demonstrated at time points beyond 14 months, it is still important that the CRPs appear to help patients improve their HRQoL sooner rather than later. An MI can be a

devastating occurrence, but patients need to understand immediately after the event that it does not have to control their lives and their perceptions of themselves and their health.

Future research in this area is necessary for many reasons. First, more controlled studies of the effects of CRPs on HRQoL need to be conducted, especially including measures administered at different time points after the MI, up to at least 1 year. A clear demonstration that CRP patients do or do not show continued improvement as compared to non-CRP patients is also needed. Second, a comparison of inpatient CRPs versus outpatient CRPs needs to be conducted. If it can be shown that outpatient CRPs have the same or greater impact on the patient's HRQoL and other outcomes, lengthy inpatient CRPs may become unnecessary, reducing the cost of care and amount of time hospitalized. Third, more studies are needed to compare the all aspects of CRPs presented in this paper, including length of time between MI and CRP start, CRP length, and CRP components, to find the optimal design that both helps the patient as much as possible while limiting the amount of time and money required to reach these levels. Fourth, more research is needed with women and older adults in relation to CRP outcomes. Most outcome studies include younger male participants, which limits generalizing the results to both female and older CRP participants. While research in this area has increased in the past 5 years, more research is needed to have a true understanding of how to improve HRQoL following an MI for older and female patients.

Of note is the apparent difference between research and real life CRPs. Although many medical centers use multi-phase CRPs, studies tend to examine only one of the phases. Only one of the studies included in this review (Izawa et al., 2004) considered multiple phases, as it included participants that all went through an acute phase CRP, then compared a control group of these participants to a group that participated in a secondary recovery phase CRP. If the research

is to provide evidence for practice, then it must reflect the current standards of practice today. All of the CRP phases should be considered when designing a research study, as should the fact that many patients participate in both a shorter, inpatient CRP immediately after their MI and a longer, usually outpatient, recovery CRP after hospital discharge.

4.1 FUTURE IMPLICATIONS

Due to the overwhelming positive results of participating in a CRP after an MI, including a reduction in mortality, pain symptoms, and psychological problems, and better control of risk factors (Wenger et al., 1996; Williams et al., 2006), all post-MI patients should be referred to and encouraged to attend participate in a CRP. In view of the fact that merely participating in a CRP improves HRQoL, it may not be necessary to have a long, complex, or expensive CRP. In areas where money is an issue, designing a simple home-based CRP where the patient has a few instruction and counseling/education sessions and then is given an exercise prescription for home has been shown to be effective in helping patients improve decreased HRQoL. This would also be useful for patients who need to return to home or work as soon as possible and have limited time to attend outpatient sessions.

No matter the design of the CRP, it is important to have patients participate in one, especially women. The 35% of American post-MI patients who do participate in a CRP (Centers for Disease Control, 2008) is far too low. Physicians need to refer their patients and discuss the benefits with them, and health care facilities need to design programs that fit a range of patients' schedules and needs, especially female patients.

4.2 LIMITATIONS

This study had several limitations to consider, primarily pertaining to the heterogeneity of the articles reviewed. Only six of the 13 articles included a control group, and only five were randomized (see Table 3). The CRPs used in the studies varied widely in design, inclusion criteria, sample size, and HRQoL instruments used. Only published studies written in English were included, allowing room for publication bias. The high percentage (76%) of male participants used, while representing current CRP participation trends, limits generalizability to female MI patients. The average age of participants (61 years) was also lower than the average age of a first MI, resulting in a bias towards younger CRP attendees.

4.3 SUMMARY

Despite the limitations of this systematic review, a clear case can be made for the use of CRPs to improve HRQoL in MI patients. As we move from a medical model of health to a bio-psycho-social model, considering the patient's perceptions of their own health and functionality becomes very important in outcome studies. MI patients have been shown to have a reduced HRQoL immediately after the MI and for many years afterwards, and interventions that improve this outcome are important and necessary. This review looked at how CRPs affected HRQoL in post-MI patients and what, if any, aspects of the CRP design influenced this. While HRQoL has shown to improve compared to non-CRP participants immediately following the CRP, this improvement has not been demonstrated to continue over time (months or years). It seems that no one CRP aspect, with the exception of possibly an outpatient setting, affects the improvement

of HRQoL, although more studies need to be done. It is important to recognize that the evidence suggests that simply participating in a CRP helps patients increase their HRQoL, and all patients should be encouraged to attend a CRP not only for this benefit, but also for the many other clear advantages they offer. Women and older patients should especially be encouraged to participate in one, and CRPs should be better designed to include these important cohorts of the population.

APPENDIX

RESEARCH ARTICLE MATRIX

Table 5. Research Article Matrix

Arnold, H. J., Sewell, L., & Singh, S. J. (2007). A comparison of once- versus twice-weekly supervised phase III cardiac rehabilitation. *British Journal of Cardiology, 14*, 45-48.								
Purpose/ Hypothesis	Target population --- Specific sample (Incl/Excl)	Study design --- Level of evidence[a]	Interventions (by group)	Independent variable(s) --- Measurement time points	Dependent variable(s) (measures)	Sample size total (N) & by group (n)	Participant characteristics (by group)	Relevant outcomes by dependent variable
To determine if once- versus twice-weekly supervised outpatient rehabilitation programs produce comparable results in post-MI patients.	Post-MI patients who participated in a CRP across two hospitals.	Retrospective observational Type III	Once-weekly group: 1 hour-long exercise session per wk, for 6 wks, supervised with warm-up, conditioning phase, and cool down. Twice-weekly group: 1 hour-long exercise session, as described above, and 1 supervised walking class per wk. Both groups: Instructions to keep home training diary with 5 exercise sessions per wk.	Once- vs. twice-weekly groups Measures done before and after CRP	Cardio-respiratory exercise test: Incremental shuttle-walking test (ISWT) HRQoL: HAD scale, MacNew	N=206 Once-weekly group: n=85 Twice-weekly group: n=121	Once-weekly group: mean age=61.89 male/female= 65/20 Twice-weekly group: mean age=59.24 male/female= 94/27	ISWT: both groups showed significant increase in distance. HRQoL: -Both groups showed significant decrease in HAD anxiety scores. -Both groups significantly improved across all MacNew domains. -Improvements across all measures same between groups.

Table 5 (continued).

Choo, J., Burke, L. E., & Hong, K. P. (2007). Improved quality of life with cardiac rehabilitation for post-myocardial infarction patients in Korea. *European Journal of Cardiovascular Nursing, 6*, 166-171.								
Purpose/ Hypothesis	Target population ---------- Specific sample (Incl/Excl)	Study design ---------- Level of evidence	Interventions (by group)	Independent variable(s) ---------- Measurement time points	Dependent variable(s) (measures)	Sample size total (N) & by group (n)	Participant characteristics (by group)	Relevant outcomes by dependent variable
To determine the effects of a CRP on exercise capacity and HRQoL in post-MI patients in Korea. Hypotheses: Patients in CRP group would have greater improvements in exercise capacity and HRQoL than the control group.	Patients with first MI in Korean hospital. Inclusion: -First MI without CHD or CABG -≤75 years old -LVEF ≥ 35% -Without mobility limitation	Controlled, nonrandomized quasi-experimental Type III	CRP group: Hospital-based, exercise sessions 3x/wk, 1hr long, for 8 wks, with warm-up, conditioning phase, cool down, education sessions about MI, modifying risk factors, nutrition. Control group: Instructions to perform exercise at home.	CRP group vs. control group Measures done before and after CRP	Exercise capacity: peak oxygen consumption (VO2peak), anaerobic threshold (AT), maximal exercise duration (max EXD) HRQoL: QLI- Cardiac Version III	N=60 CRP group: n=31 Control group: n=29	CRP group: mean age=53.9 male/female= 27/4 Control group: mean age=57.2 male/female= 23/6	Exercise capacity: significant group x time interaction effects for VO2peak, AT, & max EXD improvements in CRP group as compared to control group. HRQoL: significant group x time interaction effects for overall QLI, health/functioning & psycho/spiritual subscales in the CRP group.

Table 5 (continued).

Dalal, H. M., Evans, P. H., Campbell, J. L., Taylor, R. S., Watt, A., Read, K. L. Q., et al. (2007). Home-based versus hospital-based rehabilitation after myocardial infarction: A randomized trial with preference arms – Cornwall Heart Attack Rehabilitation Management Study (CHARMS). *International Journal of Cardiology, 119,* 202-211.								
Purpose/ Hypothesis	Target population --- Specific sample (Incl/Excl)	Study design --- Level of evidence	Interventions (by group)	Independent variable(s) --- Measurement time points	Dependent variable(s) (measures)	Sample size total (N) & by group (n)	Participant characteristics (by group)	Relevant outcomes by dependent variable
To compare the effectiveness of home-based and hospital-based CRPs in post-MI patients.	Patients admitted to hospital with MI. *Inclusion*: confirmed MI, English-reading, registered in 1 of 2 primary care trusts. *Exclusion*: severe heart failure, unstable angina, uncontrolled arrhythmia, major psychiatric illness, comorbidity precluding treadmill use.	Randomized non-controlled trial with preference arms Type III	*Hospital-based group*: outpatient classes 1x/wk for 8-10 wks, with aerobic exercise and education about coronary heart disease, secondary prevention, & stress, began 4-6wks after discharge. management. *Home-based group*: Issued *Heart Manual*, with comparable components, to use over 6 wks, started 1 wk after discharge, follow up with nurse 5x.	(Randomized and preference) hospital-based groups vs. (randomized and preference) home-based groups Measures done before CRP and at 9-10 mos.	*Psychological well-being*: HAD scale *QoL*: MacNew Serum total cholesterol	N=230 Randomized hospital-based group: n=44 Preference hospital-based group: n=54 Randomized home-based group: n=60 Preference home-based group: n=72	Randomized hospital-based group: mean age=64.3 male/female= 35/9 Preference hospital-based group: mean age=62.8 male/female= 42/12 Randomized home-based group: mean age=60.6 male/female= 49/11 Preference home-based group: mean age=64.5 male/female= 62/10	*Psychological well-being*: No significant improvement in HAD scores. *QoL*: Improvements seen in all MacNew domains across all groups. *Cholesterol*: Significant reduction in cholesterol across all groups. -No differences in changes found across all measures and groups.

Table 5 (continued).

Gardner, J. K., McConnell, T. R., Klinger, T. A., Herman, C. P., Hauck, C. A., & Laubach, C. A. (2003). Quality of life and self-efficacy: Gender and diagnoses considerations for management during cardiac rehabilitation. *Journal of Cardiopulmonary Rehabilitation, 23,* 299-306.								
Purpose/ Hypothesis	Target population --- Specific sample (Incl/Excl)	Study design --- Level of evidence	Interventions (by group)	Independent variable(s) --- Measurement time points	Dependent variable(s) (measures)	Sample size total (N) & by group (n)	Participant characteristics (by group)	Relevant outcomes by dependent variable
Hypotheses: -Women will have lower QoL and self-efficacy scores than men but similar rates of improvements. -Patients underground surgical revascularization will have low QoL and self-efficacy scores at baseline but will show greater improvement in scores than MI & PCI groups.	Patients enrolled in a CRP who attended at least 80% of classes with surgical revascularization, MI, or PCI.	Prospective observational Type III	12wk CRP, 1hr sessions 3x/wk, with aerobic exercise, education about risk factors, nutrition, & medications.	Measures done before and after CRP	*HRQoL*: QLMI Self-efficacy: 7-item questionnaire Caloric expenditure	N=472 MI: n=174 Surgical revascular-ization: n=258 PCI: n=44 Men: n=358 Women: n=114	MI: mean age=63.0 male/female= 125/49 Surgical revascularization: mean age=63.9 male/female= 201/57 PCI: mean age=61.6 male/female= 33/11 Men: mean age=62.6 Women: mean age=65.8	*HRQoL*: QLMI scores increased significantly across all domains and groups. *Self-efficacy*: Scores improved significantly across all groups. *Caloric expenditure*: Improved significantly across all groups. -Women had lower HRQoL at baseline but similar at end.

Table 5 (continued).

Höfer, S., Kullich, W., Graninger, U., Brandt, D., Gaβner, A., Klicpera, M., et al. (2006). Cardiac rehabilitation in Austria: Short term quality of life improvements in patients with heart disease. *Middle European Journal of Medicine, 118,* 744-753.								
Purpose/ Hypothesis	Target population --- Specific sample (Incl/Excl)	Study design --- Level of evidence	Interventions (by group)	Independent variable(s) --- Measurement time points	Dependent variable(s) (measures)	Sample size total (N) & by group (n)	Participant characteristics (by group)	Relevant outcomes by dependent variable
To document the effectiveness of Austrian inpatient CRPs by demonstrating potential for improving HRQoL.	MI patients, with or without PCI, CABG, or HVS, referred to one of the six cardiac rehabilitation centers.	Prospective observational Type III	Inpatient CRP started after initial treatment & lasted ~4wks. CRP included physical training, individually dosed strength training, physiotherapy, patient education about risk factors, psychological counseling, training courses for relaxation techniques & stress management, & vocational guidance.	Measures done at beginning and end of CRP	*HRQoL*: MacNew & EQ-5D	N=487	Mean age=60.9 Male/female= 315/124/ 48 unknown	*HRQoL*: MacNew overall and all dimension scores significantly improved. -EQ-5D overall scores significantly improved, as did the "mobility," "usual activities," & "pain" subscales and the visual analogue scale.

Table 5 (continued).

Izawa, K., Hirano, Y., Yamada, S., Oka, K., Omiya, K., & Iijima, S. (2004). Improvement in physiological outcomes and health-related quality of life following cardiac rehabilitation in patients with acute myocardial infarction. *Circulation, 68,* 315-320.								
Purpose/ Hypothesis	Target population ---------- Specific sample (Incl/Excl)	Study design ---------- Level of evidence	Interventions (by group)	Independent variable(s) ---------- Measurement time points	Dependent variable(s) (measures)	Sample size total (N) & by group (n)	Participant characteristics (by group)	Relevant outcomes by dependent variable
To examine the effect of a CRP on physiological outcomes and HRQoL in MI patients. Hypothesis: Post-MI CRP patients would have improvements in physiological measurements and HRQoL in comparison to control patients.	MI patients admitted to hospital who participated in routine 4wk acute phase CRP & could complete exercise testing and agreed to participate in recovery phrase CRP.	Controlled quasi-experimental Type III	*Both groups*: 4wk acute phase CRP with education about risk factors and smoking cessation. *CRP group*: 8wk recovery phase CRP with supervised exercise sessions including warm-up, aerobic exercise, resistance training, & cool down, 2x/wk for 1hr. *Control group*: No intervention.	CRP group vs. control group Measures done at end of acute phase CRP (1mo after MI) and at 3mo after MI	*Exercise capacity*: cardiopulmonary exercise testing (CPX) Handgrip strength measurement Knee extension muscular strength measurement *HRQoL*: SF-36	N=124 CRP group: n=82 Control group: n=42	CRP group: mean age=62.2 male/female= 63/19 Control group: mean age=62.4 male/female= 33/9	*Exercise capacity*: Peak VO_2 significantly higher in CRP group at end. *Handgrip strength & knee extension strength*: significantly increased in CRP group *HRQoL*: Significant time x group interactions found in four subscales of SF-36.

Table 5 (continued).

Marchionni, N., Fattirolli, F., Fumagalli, S., Oldridge, N., Del Lungo, F., Morosi, L, et al. (2003). Improved exercise tolerance and quality of life with cardiac rehabilitation of older patients after myocardial infarction: Results of a randomized, controlled trial. *Circulation, 107,* 2201-2206.								
Purpose/ Hypothesis	Target population --- Specific sample (Incl/Excl)	Study design --- Level of evidence	Interventions (by group)	Independent variable(s) --- Measurement time points	Dependent variable(s) (measures)	Sample size total (N) & by group (n)	Participant characteristics (by group)	Relevant outcomes by dependent variable
To test the hypothesis that 2mo of a post-MI hospital-based or home-based CRP would improve exercise tolerance compared to a control group and that this improve-ment would be indepen-dent of age.	Inclusion: Patients >45 referred to CRP unit 4-6wks after MI. Exclusion: Severe cognitive impairment or physical disability, LVEF <35%, contraindica-tions to vigorous physical exercise, refusal, or living too far from CRP unit.	Randomized controlled trial Type II	*Hospital CRP group*: Exercise sessions with endurance training, 3x/wk for 30min, & stretching/flexibil ity sessions, 2x/wk for 1hr, counseling about risk factors 2x/wk. *Home CRP group*: 4-8 exercise instruction sessions with risk factor education & home exercise RX with PT home visits. *Non-CRP group*: 1 education session on risk management.	Hospital CRP group vs. Home CRP group vs. non-CRP group Middle-aged (45-65) vs. old (66-75) vs. very old (>75) Measures done before and after 2mo CRP, 6 & 12mo later.	*Total work capacity (TWC)*: symptom-limited exercise test on cycle ergometer *HRQoL*: SIP	N=270 Each CRP group: n=90 Each age group: n=90 Each CRP x age cell: n=30	No documented characteristics by CRP group. 45-65 group: mean age=57 male/female= 77/13 66-75 group: mean age=70 male/female= 60/30 >75 group: mean age=80 male/female= 54/36	*TWC*: Improved in the both CRP groups but not in non-CRP group, no significant differences b/w CRP groups. *HRQoL*: In middle-aged & old groups, SIP scores improved significantly over entire duration regardless of treatment, but in very old group, SIP scores improved significantly only with either treatment.

Table 5 (continued).

Mayou, R. A., Thompson, D. R., Clements, A., Davies, C. H., Goodwin, S. J., Normington, K., et al. (2002). Guideline-based early rehabilitation after myocardial infarction: A pragmatic randomised controlled trial. *Journal of Psychosomatic Research, 52*, 89-95.								
Purpose/ Hypothesis	Target population --- Specific sample (Incl/Excl)	Study design --- Level of evidence	Interventions (by group)	Independent variable(s) --- Measurement time points	Dependent variable(s) (measures)	Sample size total (N) & by group (n)	Participant characteristics (by group)	Relevant outcomes by dependent variable
To determine the effectiveness of an individualized educational CRP delivered by cardiac nurses in hospital compared to a control group for patients following MI.	First or secondary MI patients <70 admitted to the hospital. Exclusion: Those unable to participate in trial procedures including data gathering.	Randomized controlled trial Type II	*CRP group*: Patients seen 2-4x in hospital by cardiac nurse. Sessions covered return to activities & secondary prevention. Patients were telephoned to review progress & discuss problems. *Control group*: Usual care including advice from staff, access to standard booklets & a medical outpatient follow-up at 6wks.	CRP group vs. control group Measures done at enrollment (as soon as possible after diagnosis), 1mo, 3mo, and 1yr.	*Anxiety & depression*: HAD scale *HRQoL*: Dartmouth COOP scale	N=114 CRP group: n=56 Control group: n=58	CRP group: mean age= 57.91 male/female= 45/11 Control group: mean age= 58.33 male/female= 44/14	-At 1mo, no difference b/w groups in HAD or COOP scores. -At 3mo, CRP group had significantly better HAD scores than control group, and proportion whose COOP scores had improved was significantly higher in CRP group. -At 1 yr, no difference b/w groups.

Table 5 (continued).

Müller-Nordhorn, J., Kulig, M., Binting, S., Völler, H., Gohlke, H., Linde, K., et al. (2004). Change in quality of life in the year following cardiac rehabilitation. *Quality of Life Research*, 13, 399-410.								
Purpose/ Hypothesis	Target population --- Specific sample (Incl/Excl)	Study design --- Level of evidence	Interventions (by group)	Independent variable(s) --- Measurement time points	Dependent variable(s) (measures)	Sample size total (N) & by group (n)	Participant characteristics (by group)	Relevant outcomes by dependent variable
To assess change in HRQoL in large cohort of cardiac patients during CRP, and to determine predictors for change at time of admission.	Inclusion: MI, CABG, and PTCA as primary indication for admission. Exclusion: Refusal by the patient, language or intellectual barriers, and medical conditions leading to direct readmission to acute care.	Prospective observational Type III	Inpatient CRP following treatment & lasting ~3wks. CRP included exercise therapy (cycle ergometer, walking, gymnastics), health education (seminars on risk factors & lifestyle changes, individual dietary counseling), psychological support, and relaxation therapy.	Measures done at admission, 6 mo, and 12 mo.	*HRQoL*: SF-36	N=2441 MI group: n=1367 CABG group: n=928 PTCA group: n=146	Characteristics not documented by diagnostic category. All patients: mean age=60 male/female= 1904/537	-CABG group significantly improved in physical component summary (PCS) and mental component summary (MCS) scales. -PTCA group significantly improved in PCS scale. -MI group significantly declined in role-physical subscale and showed no change in other scales.

Table 5 (continued).

Oldridge, N., Guyatt, G., Jones, N., Crowe, J., Singer, J., Feeny, D., et al. (1991). Effects on quality of life with comprehensive rehabilitation after acute myocardial infarction. *American Journal of Cardiology, 67,* 1084-1089. **[b]*Also*: Oldridge, N., Gottlieb, M., Guyatt, G., Jones, N., Streiner, D., & Feeny, D. (1998). Predictors of health-related quality of life with cardiac rehabilitation after acute myocardial infarction. *Journal of Cardiopulmonary Rehabilitation, 18,* 95-103.**								
Purpose/ Hypothesis	Target population --- Specific sample (Incl/Excl)	Study design --- Level of evidence	Interventions (by group)	Independent variable(s) --- Measurement time points	Dependent variable(s) (measures)	Sample size total (N) & by group (n)	Participant characteristics (by group)	Relevant outcomes by dependent variable
To perform a randomized trial of an 8wk comprehen-sive CRP with post-MI patients who demonstrated moderate levels of depression or anxiety, using disease-specific and generic measures of HRQoL as primary outcomes measures.	Inclusion: Patients with diagnosis of MI who were depressed or anxious. Exclusion: Scoring <5 on short form of BDI or <43 on the SSAI or <42 on the STAI, residence > 30mi from the Center, inability to exercise, inability to complete forms due to cognitive or language problems.	Randomi -zed controlle d trial Type II	*CRP group*: Outpatient CRP ~6wks post-MI w/ eight 90min cognitive behavioral group counseling sessions w/ progressive relaxation training at end of session & exercise component w/ 8wks of 2x/wk 50min sessions w/ warm-up, conditioning, & cool down. *Control group*: Community care.	CRP group vs. control group Measures done at baseline, end of 8wk program, and 4, 8, & 12 mo after entry.	*HRQoL*: -QLMI -Time Trade-Off (TTO) scale -QWB *Exercise tolerance*: progressive symptom-limited cycle ergometer testing	N=201 CRP group: n=99 Control group: n=102	CRP group: mean age=52.9 male/female= 87/12 Control group: mean age=52.7 male/female= 90/12	*HRQoL*: -QLMI total and emotions domain CRP group scores increased significantly over control group at 8wks. -TTO and QWB scores showed no treatment effects. -No further treatment effects seen at 4, 8, or 12mo. *Exercise tolerance*: Increased significantly in CRP group over control group.

Table 5 (continued).

Suzuki, S., Takaki, H., Yasumura, Y., Sakuragi, S., Takagi, S., Tsutsumi, Y., et al. (2005). Assessment of quality of life with 5 different scales in patients participating in comprehensive cardiac rehabilitation after acute myocardial infarction. *Circulation, 69,* 1527-1534.								
Purpose/ Hypothesis	Target population --- Specific sample (Incl/Excl)	Study design --- Level of evidence	Interventions (by group)	Independent variable(s) --- Measurement time points	Dependent variable(s) (measures)	Sample size total (N) & by group (n)	Participant characteristics (by group)	Relevant outcomes by dependent variable
To use multiple QoL instruments to assess Japanese patients after MI, to determine the comparative features of the QoL scales, & to clarify the patient characteristics of those more likely to benefit from a CRP.	Patients diagnosed with AMI who participated in CRP with exercise training program.	Prospective observational Type III	*Both groups*: -Education classes 3x/wk on CAD, diet, smoking cessation, meds. -Individual counseling 2x. *Preserved PVO_2 group*: CRP w/ exercise sessions 3-5x/wk for 50-80 min. Supervised sessions for 2 wks, home exercise w/ 1-2 weekly supervised sessions for 10 wks. *Low PVO_2 group*: No exercise.	Measures done at beginning & end of 3-month CRP.	*Exercise capacity*: Symptom-limited CPX *QoL*: -Specific Activity Scale (SAS) -SIP -Ministry of Health & Welfare – Quality of Life (MHW-QOL) -State-Trait Anxiety Inventory (STAI) -Self-rating Depression Scale (SDS)	N=44 Preserved PVO_2 group: n=22 Low PVO_2 group: n=22	Preserved PVO_2 group: mean age=57 male/female= 20/2 Low PVO_2 group: mean age=59 male/female= 17/5	*Exercise capacity:* Both groups' PVO_2 significantly improved. *HRQoL*: -Preserved PVO_2 group: SIP total score, physical function-related QOL scores significantly improved. -Low PVO_2 group: SIP total score & both physical function-related & psychosocial aspect-related QOL scores significantly improved.

Table 5 (continued).

Trzcieniecka-Green, A., & Steptoe, A. (1994). Stress management in cardiac patients: A preliminary study of the predictors of improvement in quality of life. *Journal of Psychosomatic Research, 38,* 267-280.								
Purpose/ Hypothesis	Target population --- Specific sample (Incl/Excl)	Study design --- Level of evidence	Interventions (by group)	Independent variable(s) --- Measurement time points	Dependent variable(s) (measures)	Sample size total (N) & by group (n)	Participant characteristics (by group)	Relevant outcomes by dependent variable
To assess the effects on QoL of a relaxation-base stress management program, to compare the responses of MI and cardiac surgery patients, & to investigate predictors of outcome.	Inclusion: Patients <70 admitted to 2 hospitals for MI, CABG, or PCTA, with adequate command of English, & not suffering from serious psychiatric disorder or disability.	Prospective observational Type III	12wk CRP began 2-3mo after treatment, w/ relaxation program w/ 12 weekly sessions w/ psychologist. Included relaxation training, discussion of problems, info about effect of stress on health & coping responses, counseling about recovery process. Patients given relaxation cassette to play 2x/day at home.	Measures done before and after CRP & at 6mo.	*Emotional state*: HAD scale *QoL*: PGWB *Functional level*: Functional Status questionnaire (FSQ) *Social activity*: Social Support questionnaire (SSQ)	N=57 MI group: n=23 CABG group: n=22 PCTA group: n=6	MI group: mean age=59.7 male/female= 19/4 CABG group: mean age=59.0 male/female= 21/1 PCTA group: mean age=62.3 male/female= 5/1	-Significant improvements found in anxiety & depression of HAD scale, PGWB scores, 5 of the FSQ scales, and # of confidants on SSQ of all diagnostic groups. -Improvements maintained at 6mo.

Table 5 (continued).

Trzcieniecka-Green, A., & Steptoe, A. (1996). The effects of stress management on the quality of life of patients following acute myocardial infarction or coronary bypass surgery. *European Heart Journal, 17*, 1663-1670.								
Purpose/ Hypothesis	Target population --- Specific sample (Incl/Excl)	Study design --- Level of evidence	Interventions (by group)	Independent variable(s) --- Measurement time points	Dependent variable(s) (measures)	Sample size total (N) & by group (n)	Participant characteristics (by group)	Relevant outcomes by dependent variable
To determine whether the improvements in QoL resulting from this CRP were greater than those arising through the normal recovery process in the control group & whether similar responses would be observed in MI and CABG patients.	Patients <70 admitted to 2 hospitals for MI or CABG w/ adequate command of English, & not suffering from serious psychiatric disorder or disability.	Randomized controlled trial Type II	Patients recruited 2-3mo after treatment. *CRP group*: 10wk stress management program w/ 10 group-based weekly sessions w/ psychologist. Relaxation method developed based on autogenic training. Relaxation cassette given to play 2x/day at home. *Control group*: No intervention, but offered program after 10wks.	CRP group vs. control group Measures done before and after CRP & at 6mo. Participants in control group who did CRP were assessed after program & at 6mo.	*Emotional state*: HAD scale *QoL*: PGWB *Functional status*: FSQ	N=100 CRP group: n=50 Control group: n=50	CRP group: mean age=59.4 male/female= 43/7 MI=27 CABG=23 Control group: mean age=61.0 male/female= 44/6 MI=23 CABG=27	*CRP group*: Significant improvements in anxiety & depression of HAD scale, PGWB scores, & 6 FSQ scales. *Control group*: Change in 1 FSQ scale. -Significant improvements were seen in HAD anxiety & depression & PGWB in control group late treatment. -MI & CABG groups showed few differences.

Table 5 (continued).

Note. MI = myocardial infarction, CRP = cardiac rehabilitation program, HAD scale = Hospital Anxiety and Depression Scale, MacNew = MacNew Quality of Life After Myocardial Infarction questionnaire, HRQoL = health-related quality of life, CHD = coronary heart disease, CABG = coronary artery bypass graft surgery, LVEF = left ventricular ejection fraction, QLI-Cardiac Version III = Quality of Life Index – Cardiac Version III, QoL = quality of life, PCI = percutaneous coronary intervention, QLMI = Quality of Life After Acute Myocardial Infarction questionnaire, HVS = heart valve surgery, EQ-5D = EuroQol-5D questionnaire, SF-36 = SF-36 Health Survey questionnaire, SIP = Sickness Impact Profile questionnaire, Dartmouth COOP scale = Dartmouth COOP Functional Health Assessment Charts, PTCA = percutaneous transluminal coronary angioplasty, BDI = Beck Depression Inventory, SSAI = Spielberger State Anxiety Inventory, STAI = Spielberger Trait Anxiety Inventory, QWB = Quality of Well-Being scale QWB = Quality of Well-Being scale, PGWB = Psychological General Well-Being Index.
[a]Hierarchy of strength of evidence developed by Moore, McQuay, & Gray, 1995.
[b]Scoring for the QLMI changed after publication; Oldridge et al. (1998) used the same data with the current scoring system to assess HRQoL.

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