Meta-Analysis of the Effect of Cardiac Rehabilitation Interventions on Depression Outcomes in Adults 64 Years of Age and Older

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Heart disease is a major cause of hospitalization and is associated with greater impairment than arthritis, diabetes mellitus, or lung disease. Depression is prevalent and a serious co-morbidity in heart disease with negative consequences including higher levels of chronic physical illness, decreased psychological well-being, and increased health care costs. The objective of the study was to examine with meta-analysis the impact of community-based cardiac rehabilitation (CR) treatment on depression outcomes in older adults. Randomized controlled trials comparing patients (≥64 years old) receiving CR to cardiac controls were considered. Meta-analyses were based on 18 studies that met inclusion criteria, comprising 1,926 treatment participants and 1,901 controls. Effect sizes (ESs) ranged from −0.39 (in favor of control group) to 1.09 (in favor of treatment group). Mean weighted ES was 0.28, and 11 studies showed positive ESs. Meta-analysis suggests that most CR programs delivered in the home can significantly mitigate depression symptoms. Tailored interventions combined with psychosocial interventions are likely to be more effective in decreasing depression in older adults with heart disease than usual care. **© 2012 Elsevier Inc. All rights reserved.** **(Am J Cardiol 2012;110:1219–1224)**

Previous meta-analyses[1,2] have determined that community-based cardiac rehabilitation (CR) and psychosocial interventions for patients with heart failure (HF) and coronary artery disease (CAD) decrease mortality and improve health-related quality of life.[3–5] However, previous published studies have rarely focused on the geriatric population and many large trials including Montreal Heart Attack Readjustment Trial (M-HART) were undertaken in hospital settings, recruited men and/or patients <65 years old, or did not examine depression outcomes.[3,6–8] Thus, our aim was to review randomized trials that examined the impact of community-based CR interventions on depression in older patients (≥64 years old) using meta-analysis. Studies included telehealth care, medical management, exercise, counseling, nutrition, Tai Chi, breathing, and mindfulness interventions. Effect sizes (ESs) were estimated for reported depression outcomes. Studies employed trained interventionists, recruited older samples diagnosed with HF or CAD, compared ≥2 treatments, and measured depression. The significance of this analysis may demonstrate that CR interventions have the potential to improve psychological status for the increasing older population with cardiac disease.

Methods

We conducted a systematic electronic search of the PsycINFO, PubMed, ClinialTrial.gov, Central Register of Controlled Trials, and CINAHL databases. Relevant treatment trials were searched using the following keywords: depress*, elder*, geri*, heart disease or heart failure, old*, randomized, and trial. We reviewed studies of community-based CR interventions offered in the home or outpatient clinic setting for older adults diagnosed with heart disease. For this review, heart disease was defined as a primary diagnosis of HF or CAD based on the American Heart Association/American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR) 2010 scientific consensus statement on CR.[9] The search was limited to studies published from January 1998 through January 2012 and classified as randomized controlled trials investigating an effect of an intervention on depression outcomes. We limited the participants' mean age to ≥64 years because of high prevalence rates of heart disease and co-morbid depression in older populations. We also limited studies to participants of community-based interventions and thus excluded samples of institutionalized patients. We excluded case and qualitative reports and studies without comparison groups. Authors reviewed all abstracts and articles to ensure they met the inclusion criteria.

We considered community-based treatments as home or outpatient based. We defined in-home treatment as a health service that took place at a patient's residence. An outpatient intervention was defined as treatment that occurred in an outpatient CR clinic with similar components as in-home treatment. If an intervention involved >1 care setting, e.g., a disease management program held at an outpatient clinic with self-management activities at home, the study was classified as a combined home and outpatient intervention. Intervention components included some combination of heart health care management and/or education, counseling, exercise, or telehealth care. Usual care–control components typically were standard medical care that may have included a physician and/or specialist nursing care and heart education.

Meta-analysis was performed to estimate ESs for mean

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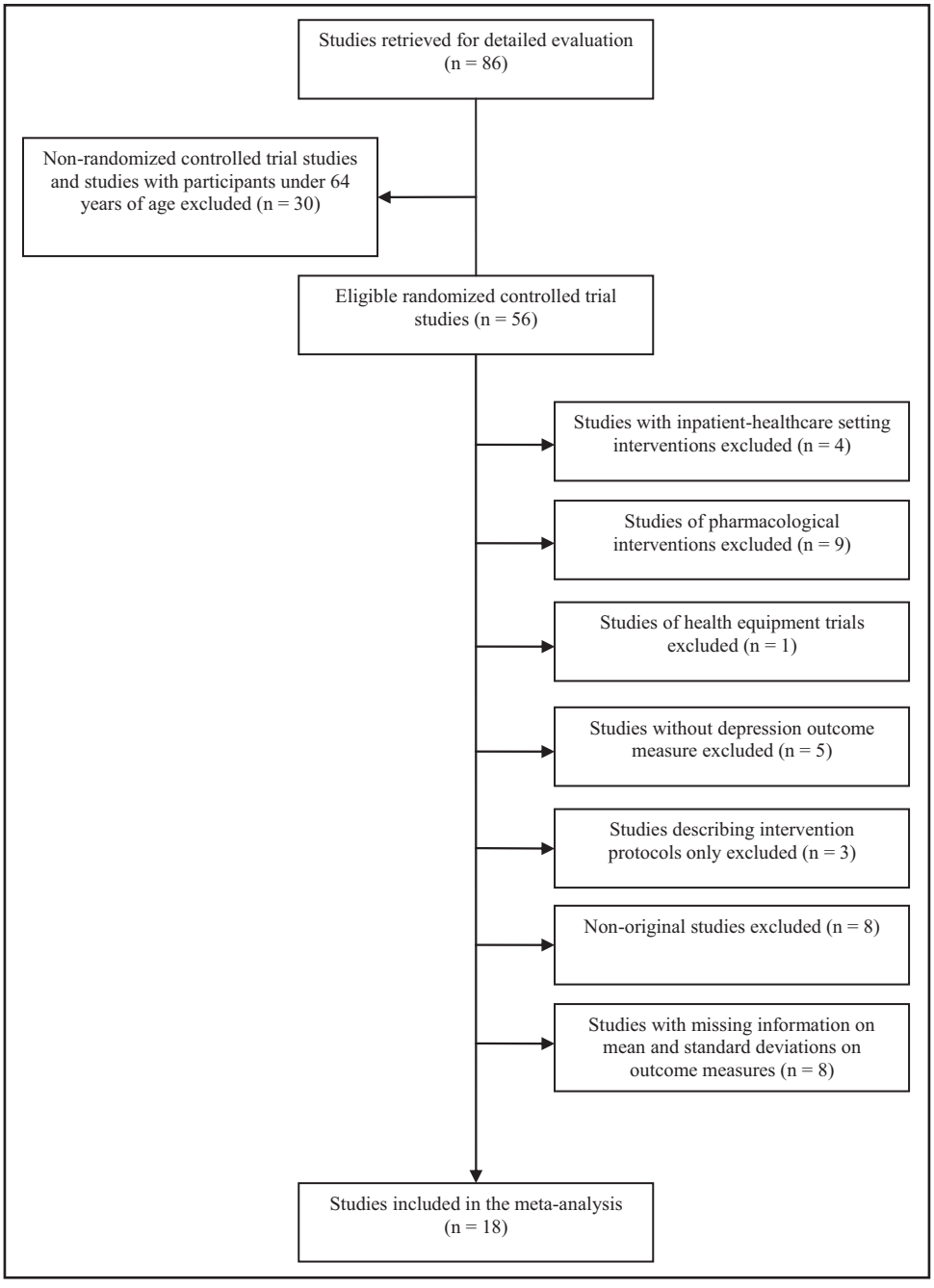

Figure 1. Selection process for including studies for meta-analysis.

differences in depression outcomes between the treatment and control groups. ES was calculated as the standardized mean difference (Hedges) between the treatment and control groups at the most current follow-up assessment with 95% confidence intervals (CIs).[10] Eighteen studies were included and meta-analysis was performed on each mental health outcome reported in the selected articles. Three studies were excluded from the meta-analysis because of missing information on depression outcome means and SDs for the treatment and control groups. Study data were analyzed using a standard ES calculation tool.[11]

Two reviewers independently screened abstracts and full articles and extracted data on treatment setting, sample size, sample mean age, gender, standardized depression measurements used, intervention format and duration, study location, and key findings for each study. The 2 reviewers independently noted methodologic details using a checklist including randomization, blinding of outcome assessment, and managing of attrition in the data analysis. The methodologic quality of these studies has been previously published.[12]

Figure 1 shows the various steps in the study inclusion and exclusion process. The search strategy initially yielded 86 articles. In the second review phase, 30 articles were excluded because of use of a nonrandomized design or the sample mean age was <64 years. In the next phase, another

Table 1
Description of studies included in meta-analysis

Study	Number*	Diagnosis	Country	Gender		Mean Age (years)	Intervention		Duration (months)	Depression Measurement Used	Other Measurements				Depression Outcomes
				Men	Women		HB	OP			WT	S	QoL	A	
1. Barrow et al[13] (2007)	65	HF	UK	+	+	69	+	+	4	SCL 90-R	+	+	+		T > UC
2. Gary et al[19] (2004)	32	HF	USA		+	68		+	3	GDS	+		+		T > UC
3. Gellis and Bruce[21] (2010)	36	HF	USA	+	+	76	+		1.5	BDI, HAM-D		+	+	+	T > UC
4. Gellis et al[20] (2012)	115	HF	USA	+	+	79	+		3	PHQ-9, CES-D		+	+	+	T > UC
5. Jolly et al[22] (2009)	169	HF	UK		+	68	+		6	SF-36 MH, HADS		+	+	+	T > UC
6. Riegel et al[24] (2006)	134	HF	US	+	+	72	+		6	PHQ-9			+		NS
7. Schwarz et al[26] (2008)	102	HF	USA	+	+	78	+		3	CES-D		+	+		NS
8. Tibaldi et al[28] (2009)	101	HF	Italy	+	+	81	+		<1	GDS		+			T > UC
9. Witham et al[29] (2005)	82	HF	UK	+	+	80	+	+	6	HADS	+		+	+	NS
10. Woodend et al[30] (2007)	249	HF	Canada	+	+	66	+		3	SF-36 MH		+	+		T > UC
11. Beckie et al[14] (2011)	252	CAD	USA		+	64	+		3	CES-D			+		T > UC
12. Campbell et al[15] (1998)	1,173	CAD	UK	+	+	66		+	6	HADS SF-36		+	+	+	NS
13. Chung et al[17] (2010)	62	CAD	Taiwan	+	+	71	+		1	BDI, PHQ-9					T > UC
14. Clark et al[16] (2000)	570	CAD	USA		+	72	+	+	1	CES-D		+	+		NS
15. Dougherty et al[18] (2004)	168	CAD	USA	+	+	64		+	2	CES-D		+	+		NS
16. Norris et al[23] (2009)	95	CAD	Canada	+	+	65	+		<1	CES-D					T > UC
17. Rollman et al[25] (2009)	302	CAD	USA	+	+	64	+		8	HAM-D, SF-36 MH		+	+		T > UC
18. Seki et al[27] (2003)	38	CAD	Japan	+		70		+	6	SDS		+	+	+	NS

A = anxiety; BDI = Beck Depression Inventory; CES-D = Center for Epidemiologic Studies Depression Scale; GDS = Geriatric Depression Scale; HADS = Hospital Anxiety and Depression Scale; SF-36 = Medical Outcomes Study Health Survey Short Form; HAM-D = Hamilton Rating Scale for Depression; HB = home based; OP = outpatient; QoL = quality of life; PHQ-9 = Patient Health Questionnaire-9; S = physical symptoms; SCL 90-R = Symptom Checklist Revised; SDS = Zung Self-Rated Depression Scale; SF-36 MH = Medical Outcomes Study Health Survey Mental Health Subscale; T = treatment group; UC = control group; UK = United Kingdom; USA = United States; WT = walk test.

* Sample size reported.

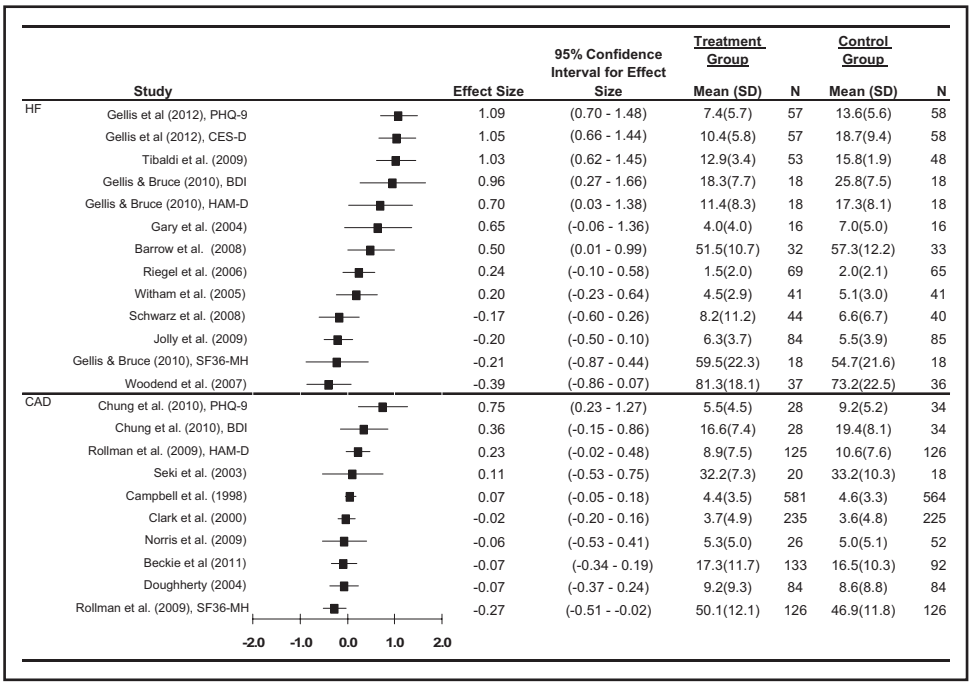

Figure 2. Estimates of effect sizes.

38 studies were excluded for the following reasons: (1) inpatient setting intervention (n = 4), (2) pharmacologic intervention (n = 9), (3) health equipment trial (n = 1), (4) depression measurement excluded (n = 5), (5) randomized study protocol description only (n = 3), (6) nonoriginal descriptive study (n = 8), and (7) studies with missing information on means and SDs (n = 8).

Results

Eighteen studies[13–30] of an elderly CR patient population were included in the analysis (Table 1). The review was comprised of 9 studies conducted in the United States, 4 studies in the United Kingdom, 2 studies in Canada, 1 study in Italy, 1 study in Japan, and 1 study in Taiwan. In Table 1, each study is assigned a reference number for ease of reading with uniformly extracted data and cited in the reference section. Overall, 3,827 patients were included: 1,926 assigned to the experimental condition and 1,901 to usual care. Overall mean age was 71 years (range 64 to 80). Sample sizes varied widely (range 32 to 570) with a mean sample size of 151.3 ± 197.2. Of the studies reviewed, 82% (n = 15) had a sample size of ≥50 participants, 4 reported[14,16,19,22] 100% women, and 1 study[27] had 100% men. Only 1 trial included >1,000 patients[15] and only 1 trial had >6-month follow-up.[22] However, previous meta-analyses included fewer and smaller trials and did not show a positive effect.

Most studies provided home-based interventions; 3 studies provided outpatient clinic-based interventions and 3 studies carried out combined interventions at the outpatient clinic and in the home. Telehealth care was the most common CR delivery model used followed by exercise strategies. Several trials used collaborative care approaches, whereas others included self-disease management and home-based deep breathing.

A subanalysis resulted in 10 studies reporting samples with a primary diagnosis of HF, whereas 8 studies recruited patients with CAD. Clinical characteristics of patients diagnosed with HF followed by those with CAD are reported.

Patients with HF (n = 1,086, 445 men, 540 experimental subjects, 546 controls) had a mean age of 73 years and a mean CR treatment duration of 3.7 months. Patients with HF were recruited if they met the New York Heart Association class III or IV symptom profile (left ventricular ejection fraction <40%). Thirty-seven percent reported a myocardial infarction in the previous year and 20% reported percutaneous coronary interventions before study enrollment. Most HF studies excluded patients with recent myocardial infarction (<3 months), significant aortic stenosis, sustained ventricular tachycardia, and uncontrolled atrial fibrillation. Common co-morbidities reported at enrollment included hypertension (65%), angina (63%), diabetes (55%), osteoarthritis (54%), and chronic obstructive pulmonary disease (30%). Researchers recruited a somewhat diverse older sample consisting of 73% Caucasians, 18% African-Americans, and 9% other. One study recruited a 100% sample of Hispanics.[24] Most study patients were married (53.9%) and reported lower rates of high school completion (38%).

Patients with CAD (n = 2,660, 1,081 men, 1,386 experimental subjects, 1,355 controls) were younger than HF samples with a mean age of 67 years and a mean CR treatment duration of 4.2 months. Similar to the HF studies, 37% of patients with CAD reported a myocardial infarction in the previous year. Twenty-nine percent of patients with CAD reported previous percutaneous coronary interventions. Researchers excluded those with atrial fibrillation, previous cardiac catheterization, and New York Heart Association class III and IV symptoms. Patient co-morbidities included high rates of hyperlipidemia (83%), hypertension

(76%), angina (50%), and diabetes (30%). Patients frequently reported a medication regimen of angiotensin-converting enzyme inhibitors (39%), β blockers (81%), lipid-lowering drugs (73%), and aspirin (84%). Two studies included 100% Asian patients (Japan, Taiwan) and other study samples recruited approximately 93% Caucasians, 4% African-Americans, and 3% Hispanics. Most patients (60%) reported high school completion.

Across studies, interventionists in the experimental group usually included some combination of trained cardiac nurses, social workers, exercise or physical therapists, and dietitians who followed a CR treatment protocol with cardiologists or primary care physicians as consultants. Study interventionists provided a range of outpatient, telehealth, or telephone-delivered services that included collaborative medical care, nutrition and health education, structured exercise, Tai Chi, motivational interviewing, and/or psychosocial interventions. Usual care providers included nurses, social workers, primary care physicians, and/or cardiologists who delivered standard cardiac care. They provided some combination of outpatient or in-home medical care, heart education, aerobic exercise, nutrition counseling, and/or telephone support.

Figure 2 presents ES estimates of the 15 studies and provides complete data (mean ± SD) to assess the overall impact of CR interventions on depression outcomes. Overall, 11 trials reported significant effects on improvement in depression scores. Of 4 exercise interventions, all but 1 study had positive ESs. One self-disease management intervention had negative effects on depression. The top 3 studies with the largest ESs had relatively small sample sizes ranging from 36 to 115. Average attrition rates of studies with positive ESs and negative ESs were 13.6% and 13%, respectively. Average standardized mean ES of the interventions was 0.18 (95% CI −0.64 to 0.29). ESs ranged from −0.39 (in favor of control group) to 1.09 (in favor of treatment group), and 11 studies showed overall positive ESs on depression outcomes.

Of the 10 HF trials, 7 reported a statistically significant result on depression outcomes. Within the HF studies, a telehealth collaborative care intervention in a home health setting and a geriatric home hospitalization intervention showed the largest effects on depression outcomes (ES 1.09, 95% CI 0.70 to 1.48 for Patient Health Questionnaire (PHQ)-9; ES 1.03, 95% CI 0.62 to 1.45 for Geriatric Depression Scale), respectively, followed by another in-home collaborative long-term illness care model (ES 0.70, 95% CI 0.03 to 1.38 for Hamilton Rating Scale for Depression).

Six of 9 HF studies offered interventions in the home and reported a significant and substantial improvement in depression between the intervention and control groups at the end of follow-up. Of these, 4 trials used telehealth care interventions with mixed results. Costs of the intervention were not reported and variations existed between programs. Acceptability of the intervention to the patient was underreported. In comparison, results were evenly split on depression outcomes for the 8 CAD trials with 2 of those evaluating telehealth technology. Home-based deep breathing and mindfulness training had beneficial effects for patients with CAD.

An analysis of publication bias using funnel plots demonstrated an unlikely possibility of bias within studies showing a decrease in depression scores.

Discussion

Overall, the present meta-analysis suggests that community-based CR programs demonstrate a positive impact on depression outcomes ranging from small to large ESs. It also suggests that most in-home trials significantly mitigated depression symptoms. The impact of these interventions may be explained in part to the ability of trained interventionists to screen and detect early medical and mental health symptoms, provide education and behavioral health services, and request prompt consultation with physicians.

The trials reviewed had great variations in sample size, treatment protocol and procedures, intervention type, dosage, and outcomes. Telehealth interventions for congestive HF were identified as effective care models in decreasing depressive symptoms. Telehealth interventions appear to offer realistic and feasible options for delivering efficient and effective health care to chronically ill older adults. Telehealth innovations can be beneficial in conducting patient assessment, evidence-based psychological therapies, patient health education, and remote patient monitoring on a real-time basis with critical information communicated between patient and provider. Telehealth can extend the scope of medical resources, improve access to services, and minimize costs of delivering care to patients.

Overall, this meta-analysis suggests that tailored interventions with more specific content (e.g., nutrition, exercise, and/or psychosocial interventions) are likely to be more effective in decreasing depression in older adults with heart disease than usual care alone.

Explanations for studies with nonsignificant outcomes on depression may be attributed to weak study designs: (1) some interventions were too brief to observe changes in depression scores; (2) some patients may have been mildly or moderately depressed and thus a change in reported scores would be unlikely; and (3) some patients received CR care for a long period before enrollment in the study.

CR programs are nationally certified by the AACVPR, frequently use a case management model, and are known to have robust evidence of improved morbidity and mortality with CR participation.[31,32] Consensus statements in the field[9] have recommended CR programs as essential to comprehensive care for patients with CAD and HF. Programs should consist of a multifaceted and interprofessional approach with the goal of decreasing cardiovascular risk, increasing healthy behaviors and functioning, and promoting an active lifestyle using medical management, nutrition, psychosocial interventions, exercise, and behavioral activation. However, CR programs may be underused with low participation rates in the range of 10% to 20% of all eligible patients, which is likely exacerbated by a low referral rate of older adults, women, and minorities.[33,34]

The strengths of this meta-analytic review include the use of a broad search strategy and standardized inclusion and exclusion criteria. Results of our meta-analysis should be interpreted with caution. First, our search only examined studies that were published in English. Second, 3 compar-

ative randomized controlled trials were not included in the analysis because of unreported data. Third, the reviewed studies had various degrees of rigor in their trial designs.

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