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Women's Participation in Stress Management Interventions for Chronic Heart Failure: A Meta-Analysis of Randomized Controlled Trials

Lori A. J. Scott-Sheldon, PhD[a,b,c], **Emily C. Gathright, PhD**[a,b], **Elena Salmoirago-Blother, MD, PhD**[a,d,e], **Wen-Chih Wu, MD**[d,e,f,g]

[a]Center for Behavioral and Preventive Medicine, The Miriam Hospital, Providence, RI

[b]Department of Psychiatry and Human Behavior, Alpert School of Medicine, Brown University, Providence, RI

[c]Department of Behavioral and Social Sciences, Brown University School of Public Health, Providence, RI

[d]Department of Medicine, Alpert School of Medicine, Brown University, Providence, RI

[e]Department of Epidemiology, Brown University School of Public Health, Providence, RI

[f]Chief of Cardiology, Providence VA Medical Center, Providence, RI

[g]Director of the Cardiovascular Wellness and Prevention Center at Lifespan, Providence, RI

Abstract

Stress management interventions (SMIs) can alleviate the psychosocial stress often experienced by women with heart failure. The purpose of this meta-analysis was to summarize women's participation rates, and predictors of participation, in SMIs for the management of psychosocial distress in women with chronic HF. Studies were retrieved from bibliographic databases, reference sections of relevant papers, and research registries. Included studies (a) evaluated a SMI approach for the management of chronic HF, (b) sampled chronic HF patients, and (c) used a randomized controlled trial (RCT) design. Independent coders extracted the relevant data. Thirty-five RCTs met inclusion criteria (N = 3,649; mean age = 63.5±7.0 years). All studies sampled both men and women; the mean proportion of women who participated in the trials was 38.8% (95% confidence interval [CI]=34.5–43.4; I^2 = 82.4, 95% CI=81.0–83.6). Women's participation rates were higher in studies sampling more HF patients with hypertension (B = 1.01, SE = 0.45, P = .046) but fewer HF patients prescribed beta blockers (B = −1.10, SE = 0.33, P = .006), $F(2,12)$ = 6.27, P = 0.014, adjusted R^2 = 61%. SMIs may offer women a complementary or integrative approach to standard treatment to help manage the psychological distress associated with HF. Future research

Contact: Lori A. J. Scott-Sheldon, PhD, The Miriam Hospital, Centers for Behavioral and Preventive Medicine, CORO West, Suite 309, 164 Summit Avenue, Providence, RI, USA 02906; lori_scott-sheldon@brown.edu.

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Availability of data and material. This data used in this meta-analytic review were extracted from published randomized controlled trials of stress management interventions for heart failure patients. The database used to conduct the analyses is available upon request to the first author.

Code availability. The commands used to conduct the meta-analysis are available in Stata 16.0.

should explore the potential benefits of offering stress management approaches to women as part of comprehensive HF care.

Keywords

chronic heart failure; women; stress management interventions; meta-analysis

INTRODUCTION

Heart failure (HF) is a chronic condition affecting 26 million adults globally (Ponikowski et al., 2014). The global prevalence of HF is increasing worldwide but most notably in Asia where HF prevalence is 1.2 to 6.7% of the population (Ponikowski et al., 2014). HF affects 6.2 million U.S. adults (2.2% of the population) and is expected to increase 46% by 2030 (Virani et al., 2020). The increasing prevalence can be attributed to improvements in survival following a HF diagnosis but long-term prognosis for HF patients remains poor with high rates of hospitalization, hospital readmissions, and mortality (Dharmarajan & Rich, 2017). The burden on the healthcare system is substantial, costing the U.S. healthcare system an estimated $11 billion in 2014 (Jackson et al., 2018).

The prevalence of HF is similar among men and women and increases with age, but the clinical presentation, prognosis, and etiology of HF varies by sex (Levinsson et al., 2018). Women with HF tend to be diagnosed at an older age, present with multiple comorbidities (e.g., obesity, hypertension, chronic kidney disease), and report worse symptoms than men (Dewan, Rorth, Jhund, et al., 2019; Dewan, Rorth, Raparelli, et al., 2019; Pepine et al., 2020). Women with HF are also more likely than men to report greater psychological distress (e.g., depression, anxiety), increased fatigue, and lower quality of life (Chobufo et al., 2020; Lesman-Leegte et al., 2009; Piepenburg et al., 2019). Cardiovascular death, especially sudden death, however, is lower in women compared to men (Dewan, Rorth, Raparelli, et al., 2019; Pepine et al., 2020). Consequently, women tend to live longer with HF but experience greater symptom burden (Dewan, Rorth, Jhund, et al., 2019; Dewan, Rorth, Raparelli, et al., 2019). Therefore, secondary prevention efforts are necessary to improve outcomes especially among women with HF.

Cardiac rehabilitation (CR) programs offer supervised exercise programs integrated with education and counseling to promote the secondary prevention of HF. Participation in CR is associated with decreased morbidity and mortality (Morris & Chen, 2019). Compared to men, women's participation in CR is associated with similar or greater improvements in mortality, cardiorespiratory fitness, psychological functions, and quality of life (Galati et al., 2018). Women, however, are less likely to be referred to CR and are also less likely to complete CR even when referred and enrolled relative to men (Colella et al., 2015; Oosenbrug et al., 2016).

Women are less likely to enroll in or complete CR due to multiple concerns, including concerns that aerobic exercise may place an undue strain on the heart, lack of motivation, and elevated depressive symptoms (Resurreccion et al., 2017). Stress management interventions (SMIs) provide stress management training with or without gentle physical exercise and stretching that may be an acceptable, complementary or integrative health (CIH) approach to help women not only manage the psychological distress but also the symptoms of, and treatment for, HF (Baum et al., 1995). Few exercise-based CR programs offer these additional interventions but prior reviews show the potential benefits of SMIs (e.g., cognitive-behavioral therapy, mindfulness, tai chi, yoga) as a CIH approach to CR to reduce psychological distress and increase quality of life among patients with cardiac disease (Blumenthal et al., 2016; Liu et al., 2018). Furthermore, emerging evidence shows that some SMIs such as tai chi and yoga can improve cardiorespiratory endurance among HF patients relative to controls (Gathright et al., 2020). Patient enrolled in CR who experience a reduction in psychosocial distress (e.g., depression) also had a lower mortality rate (Milani & Lavie, 2007; Milani et al., 2011).

Women represent 52% of patients living with HF but are often underrepresented in randomized controlled trials (RCTs) of recommended exercise-based CR for the management of chronic HF (Samayoa et al., 2014; Virani et al., 2020). SMIs can address the psychological and physical concerns that often prevent women from participating in CR but do women with HF participate in SMIs? To our knowledge, women's participation rates in SMIs for chronic HF has not been documented. Therefore, the purpose of this meta-analysis was to investigate women's participation rates in RCTs of SMIs for chronic HF and to assess possible predictors of women's participation (i.e., patient characteristics such as age, race, HF stage, comorbidities, and medications, geographical location, and type of SMI).

METHODS

The Preferred Reported Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were followed in the conduct and preparation of this meta-analysis (Moher et al., 2009). The PRISMA checklist can be found in the Electronic Supplemental Materials (Supplemental Table 1).

Eligibility Criteria

Published studies were included in the meta-analysis if the study (a) evaluated a SMI; (b) sampled chronic HF patients; and (c) used an RCT design. For this meta-analysis, SMIs were operationalized as interventions that included cognitive approaches (e.g., cognitive behavioral stress management, cognitive therapy, or coping skills interventions), relaxation techniques (e.g., mindfulness meditation, biofeedback, progressive muscle relaxation), and exercise-based practices (e.g., tai chi, yoga). Interventions that included aerobic exercise training were excluded because these interventions are provided as part of standard CR.

Information Sources and Search Strategy

Studies were identified using four information sources: (1) electronic bibliographic database (*PubMed*, *PsycINFO*, *Embase*, *ProQuest Dissertations & Theses Global*, *CINAHL*, *Cochrane Library*, *ERIC*, *Global Health*, *SocIndex*, and *Web of Science*) searches were conducted using a Boolean search string [((“complementary and alternative medicine”) OR (autogenic training) OR (biofeedback) OR (“cognitive restructuring”) OR (“cognitive behavioral stress management”) OR (“deep breathing”) OR (“emotional freedom technique”) OR (guided imagery) OR (“mindfulness-based stress reduction”) OR (mindfulness) OR (meditation) OR (“problem-solving training”) OR (“progressive muscle relaxation”) OR (“relaxation techniques”) OR (self-disclosure) OR (self-hypnosis) OR (tai chi) OR (“transcendental meditation”) OR (yoga) OR (“stress management”)) AND (“heart failure” OR (heart failure))] with no language or geographical restrictions applied; (2) reviewing reference sections of relevant manuscripts; (3) review of electronic tables of contents of related journals; and (4) electronic searches of online databases of funded research (e.g., *NIH RePORTER)* and clinical trials (ClinicalTrials.gov). Database searches were conducted in August 2017 and repeated annually with the last search conducted in April 2020 to ensure the inclusion of all records published through March 2020.

Study Selection

All records retrieved from the electronic bibliographic database searches were initially screened for inclusion based on title and abstract. The full-text manuscripts of potentially relevant records were retrieved and reviewed for inclusion by the study authors and verified by the PI (LAJSS). If the research was reported in multiple records, the records were linked in the database and represented as a single unit. The record reporting the most complete data was selected as the primary study, additional study records were considered relevant supplemental materials. Relevant research identified from reference sections, journals, and databases of funded research and clinical trials were cross-referenced with the electronic bibliographic database records and were added to the database as additional records as needed.

Data Extraction

Two raters independently coded study information, sample and intervention characteristics, and methodological features of the studies using a coding form with predefined codes. The quality of the studies was assessed using a 17-item methodological quality (MQ) rating form adapted from published checklists (Downs & Black, 1998; Fowkes & Fulton, 1991; Miller et al., 1995); the total possible score is 25 with higher values indicating stronger study quality. Coding discrepancies were reviewed, discussed, and resolved. The interrater reliability was high with 91% agreement between coders for the categorical variables (mean Cohen’s κ = 0.79) and the mean inter-class correlation coefficient for the continuous variables was 0.92 (median = 1.00).

Statistical Analyses

The proportion of women included in each sample (calculated based on the number of women who consented to participate in the study divided by the total number of participants in the sample) was used as the effect size (ES) estimate. Consistent with meta-analytic recommendations, the observed proportions were then converted to logits and used in the analyses (Lipsey & Wilson, 2001). The mean logit and the corresponding 95% confidence intervals (CIs) were calculated using a random-effects model with the between-study variance estimated using restricted maximum likelihood (Lipsey & Wilson, 2001). Results of the analyses (using logits) were converted back to proportions (and corresponding CIs) for ease of interpretation of study findings. The distribution of the ESs surrounding the mean logit ES was assessed using the homogeneity statistic, Q; a significant Q indicates a lack of homogeneity and an inference of heterogeneity. To assess heterogeneity, the I^2 index and its corresponding 95% CIs were calculated consistent with a random-effects model (Higgins & Thompson, 2002; Huedo-Medina et al., 2006).

To explain variability in the proportion of women included in the samples, moderator analyses were conducted using meta-regression (following random-effects assumptions with a Knapp-Hartung adjustment) with weights equivalent to the inverse of the variance for the mean logit ESs (Hedges, 1994; Lipsey & Wilson, 2001) These analyses examined *a priori* selected predictors of women's participation in SMIs. Patient characteristics (age, race, HF stage, comorbidities, medications), geographical location, and type of SMI (cognitive, relaxation, and exercise-based) were examined as potential moderators of women's participation. Meta-regression was also used to assess the impact of methodological quality on the proportion of women included in the samples.

Publication bias was assessed by visually inspecting the funnel plot and conducting statistical tests (i.e., Egger's regression test, Begg's rank correlation test) (Begg & Mazumdar, 1994; Egger et al., 1997; Sterne & Egger, 2001) Trim-and-fill methods were used to statistically detect and adjust for the possibility of missing studies (Duval & Tweedie, 2000) All statistical analyses were conducted in Stata 16 (LLC, 2020)

RESULTS

Study, Sample, and Intervention Characteristics

Comprehensive searches revealed 1,933 unique studies; 35 RCTs met inclusion criteria (see Figure 1 for details). Characteristics of the included RCTs are provided in Table 1. Studies were published between 1997 and 2019 with data collection occurring between 1992 and 2018 (mean lag time = 4.11 years, SD = 2.30; range = 1–9 years). The studies were conducted in the United States (43%), China (31%), Sweden (6%), Brazil (3%), Germany (3%), India (3%), Iran (3%), Philippines (3%), Taiwan (3%), and England (3%). Financial support was reported in 20 (57%) of the studies; 15 studies (43%) did not report receiving research funding.

The samples included a total of 3,649 patients who consented to participate in the studies and 3,402 participants were included in the studies' analyses. All studies recruited patients from clinical settings and included both women and men in the samples. The mean age of the participants was 63.5±7.0 years. In addition, 18 studies reported the age range of the study sample; ages ranged from 18 and 94 years with 67% of the study samples including participants ≥80 years of age. Race of the samples was fully or partially reported in most studies (26 out of 35); 69±36% (range = 6 to 100%) of participants were nonwhite. Less than half of the studies (17 out of 35) assessed baseline depressive symptoms using validated measures (e.g., Beck's Depression Inventory (Beck et al., 1996), Hamilton Depression Rating Scale (Hamilton, 1960), Hospital Anxiety and Depression Scale(Zigmond & Snaith, 1983)); three studies recruited patients with elevated depressive symptoms (Dekker et al., 2012; Freedland et al., 2015; Gary et al., 2010)

Participants' clinical characteristics were incompletely described in most studies. Thirty-three studies reported full or partial data on New York Heart Association Classification (NYHA) with 45% of the studies sampling patients classified as NYHA Class II or III. In the studies reporting NYHA Class of the study samples, 11±24% ($k = 30$) of patients were Class I, 46±28% ($k = 22$) were Class II, 30±21% ($k = 21$) were Class III, and 2±4% ($k = 30$) were Class IV. Twenty-one studies characterized patients' cardiac functioning using left ventricular ejection fraction (LVEF). The average LVEF was 33±8% (range = 22–46; $k = 13$); with 35±8% (range = 22–57; $k = 20$) and 34±11% (range = 21–72; $k = 20$) for the intervention and control groups, respectively. Comorbidities were common among patients, with 57±32% ($k = 20$) reporting hypertension, 31±10% ($k = 15$) reporting diabetes, and 32±9% ($k = 10$) reporting coronary heart disease. Nineteen studies provided full or partial information on patients' pharmacotherapy: 79±27% beta-blockers ($k = 18$), 66±24% angiotensin-converting enzyme inhibitors ($k = 18$), 69±27% diuretics ($k = 15$), 53±25% antiplatelets ($k = 6$), and 63±10% statins ($k = 6$).

SMIs included tai chi ($k = 9$), cognitive-behavioral therapy approaches ($k = 6$), biofeedback (4), yoga ($k = 3$), acupuncture ($k = 3$), self-management education/counseling ($k = 2$), mindfulness-based stress reduction ($k = 2$), mindfulness-based cognitive therapy ($k = 1$), progressive muscle relaxation therapy ($k = 1$), diaphragmatic breathing ($k = 1$), meditation ($k = 1$), relaxation, ($k = 1$), and transcendental meditation ($k = 1$). Control groups consisted of usual care ($k = 22$), health-related education/advice ($k = 10$), placebo ($k = 2$), and no treatment (assessment only, $k = 1$).

Prevalence and Predictors of Women's Participation in SMIs

The mean proportion of women who participated in the trials was 38.8% (95% CI=34.9–43.4; $I^2 = 82.4$, 95% CI=81.0–83.6; $k = 35$; Figure 2). Participation rates did not differ based on age, race, NYHA class, LVEF, comorbidities (i.e., diabetes), geographical location, or type of SMI (Table 2). The proportion of women participants was higher in studies sampling HF patients with hypertension ($p =.021$) and lower in studies sampling HF patients prescribed with beta-blockers ($p = .081$). A multiple meta-regression test showed that hypertension and beta-blockers predicted women's participation in RCTs of SMIs. The model was significant ($F[2, 12] = 6.27$, $p = .014$, I^2 residual = 62.5%) and accounted for 61% (adjusted R^2) of the between-study variance in the mean proportion of women who participated with limited variance remaining ($\tau^2 = .064$). Adjusting for multiple testing using the permutation test (20000 permutations) showed that the proportion of women participating in SMIs was associated with lower beta-blocker use (adjusted p-value = .007) but not hypertension (adjusted p-value = .079).

The methodological quality of the studies was moderate to high (mean = 70±9%; range = 52–88%); study quality was not associated with women's participation rate ($\beta = -1.34$, SE = 1.12, $p = .232$). Visual inspection of the funnel plot did not reveal any asymmetries that would indicate publication bias (see Supplemental Figure 1); statistical tests revealed discrepant results (Egger: bias coefficient = −2.23, $SE = 0.76$, $P =.003$; Begg: Δx-y = −131.00, $z = 1.85$, $P = 0.065$) but trim-and-fill methods indicated that no studies were omitted (estimated ES = 38.8%, 95% CI = 34.5–43.4%).

DISCUSSION

The current study shows that 38.8% of women participated in RCTs of SMIs which is substantially higher than the 19–30% of women who participated in meta-analyses of exercise-based CR for patients with HF (Lewinter et al., 2015; Taylor et al., 2019). Our findings suggest that offering stress management training may be an important consideration for women with HF. Psychosocial stress (e.g., depression, anxiety) has a profound impact on cardiovascular health,(Das & O'Keefe, 2008) and women with HF are more likely to experience higher levels of depressive symptoms, greater anxiety, and worse quality of life compared to men (Moser et al., 2010; Riedinger et al., 2001; Rutledge et al., 2006). While counseling to reduce stress is a recommended component for all patients enrolled in exercise-based CR, stress management training (e.g., cognitive-behavioral stress management, progressive muscle relaxation, meditation, yoga) is not routinely included as a component of traditional CR programs. CR may be an ideal setting to implement stress management training given the improved psychosocial and clinical benefits of enhanced CR + stress management training compared to standard exercise-based CR alone (Blumenthal et al., 2016).

Women's participation in SMIs was higher in studies sampling women with hypertension and lower in studies enrolling participants using beta blockers. These findings are consistent with the large body of research showing significant sex-differences in the clinical presentation and treatment of HF. Comorbid cardiovascular-related conditions, except for hypertension, are less likely to be diagnosed in women with HF compared to men (Dewan, Rorth, Jhund, et al., 2019). Hypertension is more common among older adults (≥65 years of age) (Ahmad & Oparil, 2017), and women tend to develop HF at an older age, which may explain the sex differences in rates of hypertension among women and men with HF (Bozkurt & Khalaf, 2017). Consistent with these sex-disparities, our moderator analyses showed that samples with higher proportions of hypertensive patients significantly predicted higher rates of women's participation. In our analyses, age was not a significant predictor of women's participation, but this may have been a result of a restricted range of ages given that inclusion criteria reported in many of the individual studies restricted participation to patients within a specified age range. Similar to the differences in clinical presentation, women are undertreated relative to men with HF (Dewan, Rorth, Jhund, et al., 2019; Levinsson et al., 2018). Beta blocker therapy tends to be delayed or reduced in women with HF (Baumhakel et al., 2009) even though the efficacy of beta blockers is similar in both women and men.(Kotecha et al., 2016) Furthermore, most studies sampled HF patients with reduced ejection fraction (i.e., patients with LVEF ≤40%) for which beta-blockers are first-line pharmacological therapy. Understanding these sex differences in the clinical presentation and treatment of HF will be important in developing appropriate stress management approaches for women.

The proportion of women enrolled in RCTs of SMIs for HF in the current meta-analysis differ markedly from the proportion of women in the general population of HF patients (38.8% vs. 51.6%). Furthermore, none of the included studies targeted women or reported using strategies to increase women's participation in the trials. Women are often underrepresented in HF clinical trials (Tahhan et al., 2018), and receive suboptimal HF treatment compared with men (Dewan, Rorth, Jhund, et al., 2019). Future RCTs should enroll a representative sample of the HF population to more completely understand the benefits of SMIs for all HF patients. This could be accomplished by not only specifying inclusion criteria that required equal numbers of women to be enrolled in the trial but also by developing targeted recruitment strategies, educating physicians and other healthcare workers who may refer patients to these trials about the value of stress management, and offering flexible hours, days, and delivery methods for SMIs.

Limitations

There are several limitations of the current meta-analysis that must be considered when interpreting our findings. First, by specifying that the included studies be published RCTs of SMIs for HF, our findings may not be representative of all SMIs for HF. It is well-known that that studies with significant findings are more likely to be published than studies with non-significant findings (i.e., publication bias) and it is also possible that the samples included in published studies may be systematically different from that of unpublished studies. Only published RCTs of SMIs for HF were included as a measure to increase the quality of the included studies and to obtain more reliable results. Second, our findings indicated significant between-study heterogeneity among the 35 included studies with an I^2 of 82%. Meta-regression tests were conducted to identify possible sources of heterogeneity, but heterogeneity was only moderately reduced in the final model (I^2 = 63%) suggesting at least some between-study heterogeneity could not be explained by the selected moderators. Finally, our moderator tests were limited by the number or completeness of studies reporting on predictors of interest (e.g., race/ethnicity, HF status, comorbidities, medications). More complete reporting of patient demographic and health characteristics is needed for all RCTs of SMIs for HF.

Conclusion

The current study shows that 38.8% of women participated in RCTs of SMIs which is higher than the 19–30% reported in recent meta-analyses of exercise-based CR for patients with HF (Lewinter et al., 2015; Taylor et al., 2019). Future research should explore the potential benefits of offering stress management training to women as part of comprehensive HF care to minimize sex-related gaps in engagement in care.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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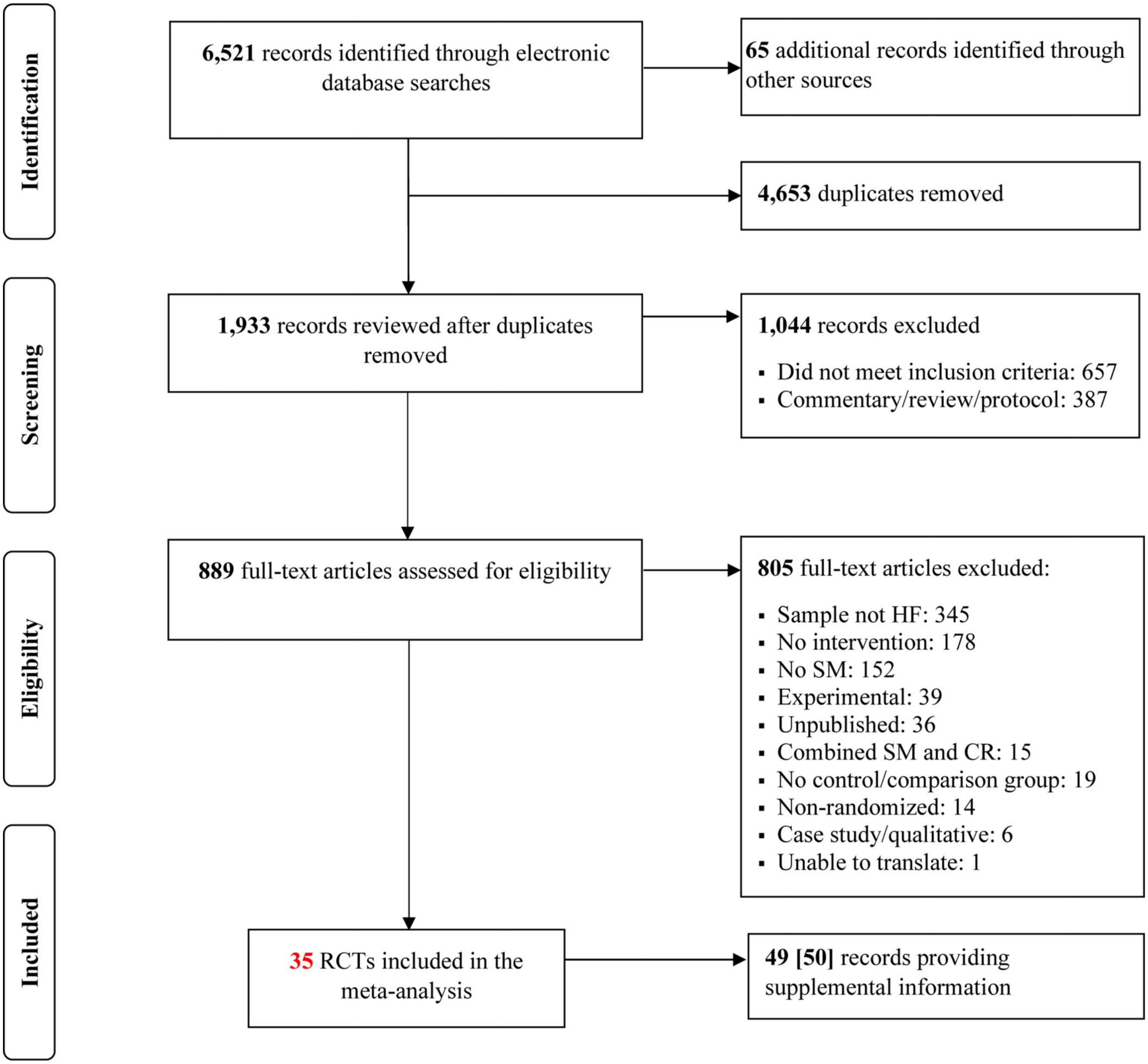

Figure 1.

Search and Selection Procedures. *Note*. A discrepancy in the total number of studies providing supplemental information is due to the inclusion of Pullen(Pullen et al., 2008) as both a primary study and a linked pilot study for Pullen.(Pullen et al., 2010) HF, heart failure; SM, stress management; CR, cardiac rehabilitation.

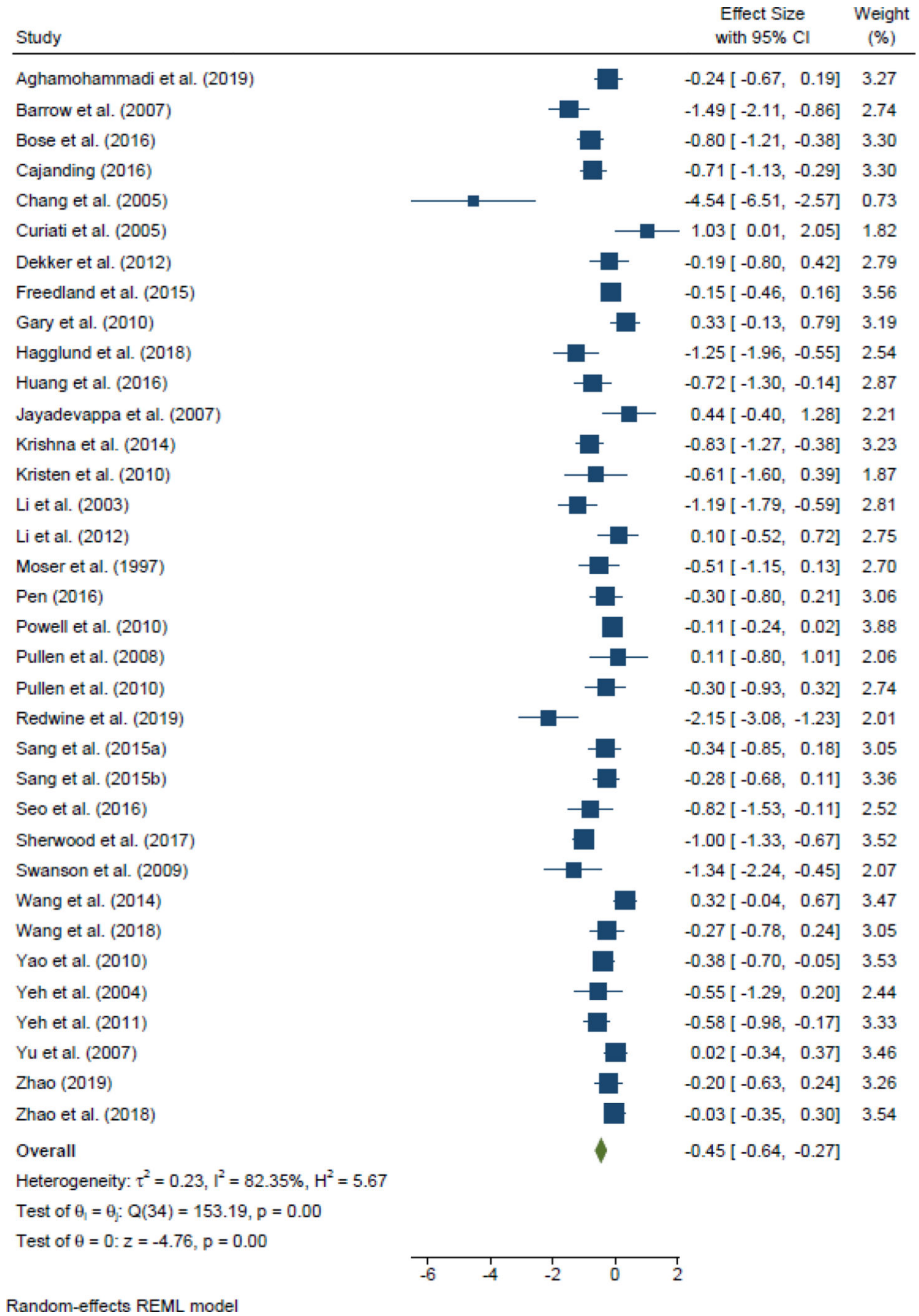

Figure 2.

Forest Plot of the Effect Sizes (and 95% Confidence Intervals) of Women's Participation Rates in SMIs. *Note*. Proportions were converted to logits and used in all analyses.

Table 1.

Study and Sample Characteristics of the 34 Randomized Controlled Trials Included in the Meta-Analysis.

Citation	Location	Data Year	N	% F	Age	% NW	% NYHA Class				LVEF I/C	% HTN	% Beta-Blockers	Intervention	Control
							I	II	III	IV					
Aghamohammadi (2019)	Iran	2019	90	44	69	NR	0	NR	NR	0	NR	NR	NR	SM	HE
Barrow (2007)	England	2004	69	18	68	NR	0	NR	NR	0	NR	0	NR	Tai Chi	UC
Bose (2016)	Sweden	2011	103	31	71	NR	0	84	16	0	NR	58	98	CET	UC
Cajanding (2016)	Philippines	2013	123	33	56	NR	12	43	40	5	NR	37	NR	CBT	UC
Chang (2005) *	USA	2000	63	1	67	16	0	51	49	0	31/30	NR	76	RR	UC
Curiati (2005)	Brazil	2000	19	74	75	NR	84	16	0	0	57/72	95	84	Meditation	HE
Dekker (2012)	USA	2009	42	45	66	10	0	19	74	7	41/38	88	86	CBT	UC
Freedland (2015)	USA	2010	158	46	56	37	NR	NR	42	0	40/38	72	92	CBT	HE
Gary (2010) *	USA	2004	36	58	66	28	0	43	57	0	NR	81	NR	CBT	UC
Hagglund (2018)	Sweden	2010	45	22	75	NR	0	NR	NR	0	NR	NR	NR	Tai Chi	UC
Huang (2016)	Taiwan	2008	60	33	60	100	NR	NR	NR	NR	49/41	NR	NR	BFAR	UC
Jayadevappa (2007)	USA	2003	31	61	64	100	0	NR	NR	0	27	NR	NR	TM	HE
Krishna (2014)	India	2011	130	30	50	NR	29	71	0	0	39/40	79	78	Yoga	UC
Kristen (2010)	Germany	2003	17	35	60	NR	0	82	18	0	29/31	NR	100	Acupuncture	Placebo
Li (2012)	China	2010	40	53	67	100	0	0	NR	NR	NR	NR	NR	Acupuncture	UC
Li (2003)	China	2010	40	53	67	100	0	0	NR	NR	NR	20	NR	Acupuncture	UC
Moser (1997)	USA	1992	43	38	55	NR	0	0	NR	NR	22/21	NR	NR	BFAR	AC
Pen (2016)	China	2013	61	43	67	100	0	NR	NR	0	32/33	NR	NR	Tai Chi	UC
Powell (2010)	USA	2001	902	47	64	40	0	68	32	0	NR	75	71	SMC	HE
Pullen (2008)	USA	2006	19	53	51	82	37	26	37	0	28/23	89	95	Yoga	UC
Pullen (2010)	USA	2008	40	43	54	98	28	40	33	0	31/27	95	97	Yoga	UC
Redwine (2019)	USA	2010	48	10	65	40	NR	NR	NR	NR	46	NR	NR	Tai Chi	UC
Sang (2015a)	China	2013	60	42	66	100	0	NR	NR	0	35/37	NR	NR	Tai Chi	UC
Sang (2015b)	China	2013	100	43	71	100	0	NR	NR	0	36/37	0	NR	Tai Chi	UC
Seo (2016)	USA	2011	73	31	66	0	0	51	46	3	35/39	NR	89	DBR	HE

Citation	Location	Data Year	N	% F	Age	% NW	% NYHA Class				LVEF I/C	% HTN	% Beta-Blockers	Intervention	Control
							I	II	III	IV					
Sherwood (2017)	USA	2009	199	27	58	0	0	NR	NR	0	32/28	74	97	CST	HE
Swanson (2009)	USA	2007	35	21	55	20	NR	NR	NR	0	30/29	7	100	Biofeedback	Placebo
Wang (2018)	China	2016	60	43	69	100	0	38	62	0	NR	NR	8	MBSR	UC
Wang (2014)	China	2009	142	58	62	NR	8	62	17	13	NR	59	NR	Biofeedback	UC
Yao (2010)	China	2008	150	41	52	100	0	100	0	0	31/30	16	48	Tai Chi	UC
Yeh (2011)	USA	2002	30	37	64	43	17	50	27	7	28/30	70	90	Tai Chi	HE
Yeh (2004)	USA	2005	100	36	67	14	20	63	17	0	24/22	67	86	Tai Chi	UC
Yu (2007)*	Hong Kong	2002	121	50	75	100	4	56	38	3	NR	68	22	PMRT	HE
Zhao (2019)	China	2017	86	45	61	100	0	46	37	17	41/43	NR	NR	MBCT	UC
Zhao (2018)	China	2015	148	49	70	100	NR	NR	NR	NR	NR	NR	NR	MBSR	HE

*Sample participating in a non-SMI was excluded: Chang et al. (2005) (Education, n = 32); Gary et al. (2010) (Exercise, n = 20; Exercise/CBT, n = 18); Yu et al. (2007) (Exercise Training, n = 32).

NW, nonwhite; NYHA, New York Heart Association; LVEF, left ventricular ejection fraction; I/C, intervention/control; HTN, hypertension; AC. Attention Control; BFAR, Biofeedback-Assisted Relaxation; CBT, Cognitive Behavioral Therapy; CET, Coping Effectiveness Training; CST, Coping Skills Training; DBR, Diaphragmatic Breathing Retraining; EDUC, Education; HE, Health Education; MBSR, Mindfulness-Based Stress Reduction; MBCT, Mindfulness-Based Cognitive Therapy; PMRT, Progression Muscle Relaxation Therapy; RR, Relaxation Response; SM, Self-Management; SMC, Self-Management Counseling; TM, Transcendental Meditation; UC, Usual Care; NR, Not Reported.

Table 2.

Predictors of Women's Participation in Randomized Controlled Trials of SMIs for Heart Failure*

	k	Coefficient	SE	*p*-value
Sample Characteristics				
Age, mean (SD)	35	.009	.017	.585
Nonwhite, %	26	.559	.363	.137
NYHA Class, %				
I	30	−.043	.530	.935
II	22	−.349	.504	.497
III	21	.884	.595	.154
IV	30	1.364	2.840	.635
LVEF, mean (SD)	22	.012	.018	.526
Medications, %				
Beta-blockers	18	−.905	.486	.081
ACE-inhibitors	18	−.557	.640	.397
Diuretics	15	−.078	.7567	.919
Statins	6	−2.821	1.595	.152
Antiplatelet	6	.059	.930	.952
Comorbidities, %				
Hypertension	20	.938	.372	.021
Diabetes	15	−.149	1.419	.918
CHD	10	−1.670	2.272	.483
Study Characteristics				
United States				
Yes	15	−.116	.234	.622
No (Ref)	20			
Type of SMI				
Cognitive	7	.273	.301	.371
Relaxation	16	.321	.259	.224
Exercise-based (Ref)	12			

k, number of studies; SE, standard error; NYHA, New York Heart Association; LVEF, left ventricular ejection fraction; ACE, angiotensin converting enzyme; CHD, coronary heart disease; SMI, stress management intervention; Ref, reference category.

*Unstandardized regression coefficients and the standard errors from each moderator test are presented. Continuous variables (age, non-white, NYHA class, LVEF, medications, and comorbidities) were mean centered; categorical variables were dummy coded (United States: 1 = yes, 0 = no; type of SMI: 1 = Cognitive, 2 = Relaxation, 3 = Exercise-Based). SMIs were categorized as cognitive (e.g., cognitive behavioral therapy, coping skills training), relaxation (e.g., mindfulness-based stress reduction, progressive muscle relaxation), or exercise-based (e.g., tai chi, yoga). Bold variables are significant at the $p<.10$ level.