Mental health is a major public health concern. Depression is the most prevalent mental health problem among older adults. It is estimated that 15.7% of adults 50 or older have experienced depression at some time in their life and 7.7% reported that they currently experience depression (Centers for Disease Control and Prevention [CDC], 2015). Some individuals may have depressive symptoms due to environmental and personal circumstances without meeting the criteria of clinical depression (Ayuso-Mateos, Nuevo, Verdes, Naidoo, & Chatterji, 2010). However, depressive symptoms often precede clinical depression (Conn, 2010). Depression is under-recognized and under-diagnosed in older adults because the influence of somatic and psychiatric comorbidity. Older adults with depression tend to have more chronic pain, psychomotor retardation, and cognitive impairment or weight loss than younger adults with depression (Lavretsky et al., 2011). Distress and depression can cause physical, mental, and social functioning impairment (Ayuso-Mateos et al., 2010). Depression also affects quality of life and increases health care costs in the United States (CDC, 2013).

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Older adults often have multiple medical disorders. Depression is one of the most common comorbidities associated with chronic diseases. Medical conditions associated with depressive symptoms include neurological disorders (e.g., dementia, stroke, Parkinson’s disease) and endocrine disorders (e.g., hypothyroidism, Cushing’s disease, diabetes mellitus) (Unützer, 2002). In addition, the use of medications (e.g., corticosteroid, benzodiazepine, anti-hypertensive agents) can cause or worsen depression (Unützer, 2002; Volkers, Nuyen, Verhaak, & Schellevis, 2004). Hence, the presence of depression not only adversely affects the course but also complicates the treatment of chronic diseases (CDC, 2013). Depression can be treated by antidepressant drugs, electroconvulsive therapy, cognitive-behavioral therapy, cognitive bibliotherapy, problem-solving therapy, brief psychodynamic therapy, and life review/reminiscence therapy (Fiske, Wetherell, & Gatz, 2009). However, it is difficult to manage depression in older adults because of the costs, side effects, and interactions among medications. Older adults also have less ability or willingness to participate actively in treatments (Blake, Mo, Malik, & Thomas, 2009; McCaffrey, Liehr, Gregersen, & Nishioka, 2011). Consequently, nonpharmacological interventions are needed to avoid undesirable side effects. These interventions may be more acceptable to older adults as they have fewer social and financial impediments as alternative treatments for this age group.

**Physical activity** is defined as physical movement generated by skeletal muscles that results in energy expenditure, such as brisk walking, raking leaves, or taking the stairs (National Institute on Aging [NIA], 2016). **Exercise** is a subset of physical activity that is intended, planned, and repetitive physical movement to improve or maintain physical fitness, such as weight training, tai chi, or aerobics (Caspersen, Powell, & Christenson, 1985; NIA, 2016). However, the terms physical activity and exercise are often used interchangeably (Munsanti & Murley, 2016; NIA, 2016). Regular exercise improves static balance, dynamic balance, balance confidence, gait speed, cognitive functioning, and health-related quality of life in frail older adults (Eyigor, Karapoltat, Durmaz, Isiboglu, & Çakir, 2009; Konak, Kibar, & Ergin, 2016; Napoli et al., 2014; Yoon et al., 2013). In addition, exercise has been found to be an effective alternative intervention that is often recommended to prevent and treat depression in older adults (Knapen, Vancampfort, Moriën, & Marchal, 2015; Lavretsky et al., 2011).

The biochemical or physiological mechanism is one of the explanations for the antidepressant effects of exercise. Current literature suggests that major depression may be associated with the elevated levels of cytokines and an increased inflammatory state (Dantzer, O’Connor, Freund, Johnson, & Kelley, 2008; Dowlati et al., 2010; Howren, Lamkin, & Suls, 2009). A recent meta-analysis suggested that anti-inflammatory treatment can decrease depressive symptoms (Köhler et al., 2014). Exercise can bring similar antidepressant effects by increasing synthesis and release of endogenous opiates, endocannabinoids, brain neurotransmitters, and anti-inflammatory cytokines, as well as increasing cerebral blood flow and hypothalamic-pituitary-adrenal axis function (Conn, 2010; Matta Mello Portugal et al., 2013). Other hypothesized mechanisms to explain the positive relationship between exercise and mental health include self-esteem and mastery explanations, and the distraction hypothesis. Physical activity increases physical ability, which may enhance one’s self-estimation, resulting in higher levels of self-esteem and body perceptions. In addition, exercise can serve as a useful distraction from stressful feelings, which can lead to better psychological wellness (Daley, 2002).

There has been an increase in systematic reviews that examine the effects of physical activity interventions on depressive symptoms. Most studies included older adults who live in nursing homes or assisted living facilities (Blake et al., 2009; Conn, 2010). However, a systematic review of exercise interventions on depressive symptoms in community-dwelling older adults in the United States is lacking. Hence, the aim of the current review was to assess the influence of exercise interventions on alleviating depressive symptoms in older adults who reside in a community setting in the United States.

**METHOD**

The search strategy for this systematic review was guided by research terms (i.e., keywords and/or subject heading when applicable) that included exercise, physical activity, depression, depressive symptoms, and older adults. An online search was performed of the electronic bibliographic databases CINAHL, PubMed, PsycINFO, and Medline (OVID). Manual reviews of reference
lists and internet searches (Google Scholar) were conducted to discover relevant articles for inclusion.

Research articles written in English, published from January 2006 to August 2015, that met the following inclusion criteria were reviewed: (a) studies conducted in the United States; (b) the study setting was a community (nursing homes and assisted living facilities were excluded); (c) studies that reported primary research; (d) studies that were either a randomized controlled trial (RCT) or a quasi-experimental design with intervention; (e) intervention(s) included exercise component/program, and depressive symptoms had to be measured before and after intervention regardless of the status of baseline clinical depression; and (f) mean age for participants was >60. Editorials, letters to the editor, case studies, opinions, study protocols, and dissertations were excluded.

Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines provided the direction for the current systematic review (Moher, Liberati, Tetzlaff, & Altman, 2009). Based on literature searches, 2,536 articles were identified initially and 1,545 remained after removing duplicates (Figure). The results of the search and selection process were managed using EndNote™ software. The authors independently performed the review process by title, abstract, and full-text screening. In each screening process, the results were compared, and any discrepancies were discussed by the authors. Of the 2,536 relevant articles identified, only 10 articles were included that assessed the effectiveness of exercise intervention on depressive symptoms among community-dwelling older adults. The included studies were assessed for methodological quality.

The Quality Assessment of Controlled Intervention Study (National Institutes of Health [NIH], 2014) was used to assess methodological quality and risk for bias. This tool contained 14 questions to assess the design, randomization, sample sizes, measurements, and statistical analyses for controlled intervention studies. The main purpose of the tool is to determine the potential bias that influences the internal validity in a study that would prevent it from reaching a summary judgment of high quality (NIH, 2014). The authors screened articles independently using this tool, and discussed the results to identify any fatal flaws in each study.

RESULTS
Study Characteristics
Based on the literature search, 10 studies that met the final inclusion criteria were included in the review (Table A, available in the online version of this article). By U.S. region, four studies were conducted in the SouthEast, three in the Northeast, two in the West, and one in the Midwest. Research designs for the included studies were RCTs ($n = 7$) and quasi-experimental designs ($n = 3$). Three studies were a pilot study. Few studies were developed and guided by a conceptual or theoretical framework (McCaffrey et al., 2011; Payne, Held, Thorpe, & Shaw, 2008; Resnick, Luisi, & Vogel, 2008). Exercise interventions were conducted in community settings that included homes (Payne et al., 2008; Pinto, Dunsiger, Farrell, Marcus, & Todaro, 2013), museums/
Participant Characteristics

Participants were recruited through the placement of advertisements, by press releases in local newspapers, and friend referrals, and visits to senior citizen meal sites, churches and church groups, senior community service organizations, independent living housing facilities, and community activity facilities. In total, the 10 articles comprised 827 participants with a mean sample size of 82.7 (range = 20 to 166 participants). Mean age of participants was 70.42 years (range = 63.6 to 79 years). One study targeted women with breast cancer (Payne et al., 2008), but all other studies included male and female participants (mean female participation = 56.6%). Four studies reported racial and ethnic information for the sample (Park et al., 2014; Payne et al., 2008; Pinto et al., 2013; Resnick et al., 2008). The majority of participants in the studies were White. Only one study (Resnick et al., 2008) included higher rates of ethnic minorities (92.8%; African American and Latino older adults). Although all studies measured baseline depression to assess the effectiveness of exercise intervention in reducing depressive symptoms, only two studies (Lavretsky et al., 2011; McCaffrey et al., 2011) screened or recruited participants with self-diagnosed or health care provider–diagnosed depression. Six studies targeted participants with specific health conditions, which included cancers (Kohut et al., 2006; Payne et al., 2008), osteoarthritis (Park et al., 2014), or cardiovascular disease (Pinto et al., 2013; Pope et al., 2011; Redwine et al., 2012).

Quality Assessment

Quality assessment for the selected 10 articles is summarized in Table B (available in the online version of this article) based on the quality assessment of Blake et al. (2009). No fatal flaws were found among the 10 included studies. All studies used randomization procedures except one (Redwine et al., 2012), but these procedures were not reported consistently. Park et al. (2014) intentionally excluded participants for randomization who had moderate to severe Alzheimer’s disease. Among the 10 articles, six studies reported the use of the concealment method (Lavretsky et al., 2011; McCaffrey et al., 2011; Park et al., 2014; Pinto et al., 2013; Pope et al., 2011; Resnick et al., 2008). Two studies kept participants’ treatment conditions blinded to laboratory personnel (Kohut et al., 2006) and those who rated the assessment (Lavretsky et al., 2011). Seven studies described groups that had similar characteristics at baseline, and two studies did not report group differences in baseline measures (Park et al., 2014; Payne et al., 2008). Eight of 10 studies reported high retention rates (>80%), and the attrition rates ranged from 4.1% to 38%. Only two studies (Lavretsky et al., 2011; Pinto et al., 2013) included the use of intention-to-treat analysis.

Interventions

Mode of Intervention. The mode of exercise interventions included walking (McCaffrey et al., 2011; Payne et al., 2008; Pinto et al., 2013; Pope et al., 2011), yoga (Bonura & Tenenbaum, 2014; Park et al., 2014), and tai chi (Lavretsky et al., 2011; Redwine et al., 2012). Two studies combined different exercise modalities in the program. One study allowed participants to choose an exercise modality at a prescribed intensity for aerobic exercises (e.g., treadmills, NuStep®, an arm ergometer, AirDyne® and other stationary bikes, a vertical climbing machine, cross trainers, and elliptical machines), strength/ flexibility/balance exercises (e.g., yoga, tai chi, flex band, free hand weights, stability balls), or resistance training exercises that used different weight machines (e.g., Cybex®, Nautilus®, and LifeFitness®) (Kohut et al., 2006). The other study implemented a combined physical activity (stretches, resistance, and aerobic exercise activities) and self-efficacy program, which enhanced intervention (Resnick et al., 2008).

Intensity and Duration. The training intensities in the reviewed studies varied. The frequencies of the exercise interventions were one to four times per week, and lasted 20 to 120 minutes per session. Duration of exercise programs ranged from 6 to 40 weeks. Three studies reported follow-up assessments posttest that varied from 1 to 12 months (Bonura & Tenenbaum, 2014; Park et al., 2014; Pinto et al., 2013). Participant retention rate was 62% to 95.9% across the 10 studies.

Outcome Measurements. Six studies used the Geriatric Depression Scale (GDS 5, 15, or 30) to measure depressive symptoms (Bonura & Tenenbaum, 2014; Kohut et al., 2006; McCaffrey et al., 2011; Park et al., 2014; Pope et al., 2011; Resnick et al., 2008). The other studies used the Hamilton Depression Rating Scale (Lavretsky et al., 2011), Center for Epidemiologic Studies–Depression Scale (Payne et al., 2008), Cardiac Depression Scale (Pinto et al., 2013), or Beck Depression Inventory (BDI; Redwine et al., 2012).

Effects of Exercise on Depressive Symptoms

Immediate Effects Post-Intervention. Two Groups With Two Exercise Interventions. In one study, older adults with coronary heart disease who were assigned to a high-calorie-expenditure exercise had higher levels of improvement in depressive symptoms compared with those in a low-calorie-expenditure exercise (standard cardiac rehabilitation) after 4 months of exercise (Pope et al., 2011). Kohut et al. (2006) reported that aerobic exercise had more positive effects on depressive symptoms than flexibility/ strength exercise after 10-month exercise three times per week and
45 minutes per session. They found that aerobic exercise significantly reduced the inflammatory mediators (e.g., serum C-reactive protein, interleukin [IL] -6, IL-18), which are related to antidepressant effects (Kohut et al., 2006).

Two Groups With One Exercise Intervention. These studies reported significant positive results for exercise intervention in clinical depression and depressive symptoms (Lavretsky et al., 2011; Park et al., 2014; Redwine et al., 2012). Two studies showed that participants in the exercise group had significant improvement in depressive symptoms compared with those who were in the control group that received a health education program (Lavretsky et al., 2011; Park et al., 2014). Redwine et al. (2012) found that a 12-week tai chi program reduced somatic symptoms significantly more than usual care, but not cognitive symptoms, as measured by the BDI with subcategorized scores of BDI-somatic and BDI-cognitive (Redwine et al., 2012). Resnick et al. (2008) found that participants who received a 12-week senior exercise, self-efficacy program that combined stretching, resistance, and aerobic exercise had significantly fewer depressive symptoms than those who received routine activities and nutrition courses. On the other hand, an intervention with 14-week, home-based, moderate walking exercise demonstrated a decrease in depressive symptoms over time; however, no significant group differences were found when this form of exercise was compared with usual care (Payne et al., 2008). Similarly, another study reported that a maintenance counseling intervention that was delivered by telephone to encourage participants to perform home-based walking or running with a pedometer and exercise logs did not show significant improvement in depressive symptoms compared to the contact control group who received phone calls to monitor general health problems after a 6-month intervention (Pinto et al., 2013).

Three Groups With Two Exercise Interventions. One study found that participants in the chair yoga group had significant reductions in depressive symptoms compared to those in the chair exercise group or the no treatment group at posttest after 6-week programs (Bonura & Tenenbaum, 2014). On the other hand, one study showed that participants in the walking group, independent walking group, or art therapy group had significant decreases in clinical depression from pre- to posttest after the 6-week program, but there were no significant differences between groups (McCaffrey et al., 2011).

Sustainable Effects Post-Intervention. Results of the sustainable effects post-intervention were available in three studies (Bonura & Tenenbaum, 2014; Park et al., 2014; Pinto et al., 2013). The positive effect on depressive symptoms obtained during the 6- and 8-week chair yoga intervention was reported to be sustainable for at least 1 month after the program (Bonura & Tenenbaum, 2014; Park et al., 2014). Pinto et al. (2013) reported that although the maintenance counseling group did not exhibit significant improvement in depressive symptoms compared to the contact control group after a 6-month intervention, there were significant group differences after 12 months of intervention.

DISCUSSION

The current systematic review, which included seven RCTs and three quasi-experimental designs, provided an in-depth narrative synthesis and evaluation of exercise interventions on depressive symptoms in community-dwelling older adults. Based on the data reported in the 10 studies, six of eight studies had significant positive findings in depressive symptoms immediately after exercise intervention when compared with controls. In the remaining two studies with participants in two different groups who received different exercise interventions, only one study had significant reductions in depressive symptoms immediately after exercise intervention. As for the sustainable effects of the program, two studies measured the effects of exercise interventions at 1-month follow up and one study measured the effects at 6-month follow up. None of the studies measured the long-term (>12 months) effects of the program. These findings are congruent with two previous systematic reviews (Blake et al., 2009; Sjösten & Kivelä, 2006), which confirmed short-term positive effects of exercise interventions on clinical depression and depressive symptoms among older adults. Measuring long-term effectiveness of exercise interventions and developing strategies to maintain a sustainable effect after intervention constitutes an important target for future research. It is difficult to make a firm conclusion about the effectiveness of exercise intervention because the studies were varied in their mode of intervention, intensity and duration of exercise, measurement of depressive symptoms, and length of follow up. In addition, sample characteristics varied across the studies. Only two studies targeted older adults who had self-diagnosed or health care provider–diagnosed depression. Other studies targeted older adults who had specific health conditions, such as cancer, osteoarthritis, or cardiovascular disease.

The reviewed studies showed that exercise interventions not only decreased clinical depression in older adults, but interventions also alleviated the depressive symptoms of older adults with a diagnosis of cancer, osteoarthritis, coronary heart disease, and heart failure. The findings were supported by a meta-analysis that exercise is an effective approach to prevent and treat mental and physical health problems in patients with major depression (Knapen et al., 2015). Knapen et al. (2015) suggested that the positive effects of exercise are comparable to antidepressant medication and psychotherapy for patients with mild to moderate depression. Exercise is also a complementary therapy to traditional treatments for patients.
with severe depression (Knapen et al., 2015). The current findings were also supported by a previous meta-analysis that physical activity interventions reduced depressive symptoms, even in adults without clinical depression (Conn, 2010). Therefore, it is important to develop interventions aimed at increasing physical activity or exercise in older adults. Review of the immediate effects and sustainable effects of exercise intervention and group comparisons to prevent or alleviate depressive symptoms in older adults provides useful information for designing interventions.

Except for Resnick et al. (2008), most studies recruited Caucasian individuals predominantly. Ethnic minorities were less likely to engage in physical activity and participate in community-based exercise programs (Resnick et al., 2008). In addition, they were less likely to receive a depression diagnosis and be treated compared to non-Hispanic White individuals (Akincigil et al., 2011). Racial and ethnic minorities may delay seeking help until the depressive symptoms become severe, or they may rely on informal, alternative, or medical service providers rather than mental health professionals (Givens, Houston, Van Voorhees, Ford, & Cooper, 2007; Sue, Cheng, Saad, & Chu, 2012). Reluctance of ethnic minorities to use mental health services may be the result of a cultural stigma that is associated with mental illness (Kandula, Kersey, & Lurie, 2004; Kramer, Kwong, Lee, & Chung, 2002). For example, stigma and shame often prevent Asian immigrants from seeking care, accepting treatment, or adhering to treatment (Conner et al., 2010; Kramer et al., 2002). There are limited studies on the attitudes and preferences of mental health treatment of ethnic minority groups. In future studies, it is important to include ethnic minorities or ethnically diverse communities to reinforce the positive effects of physical exercise on depressive symptoms. In addition, future exercise interventions targeted at ethnic minorities should address multiple barriers and need to be tailored to their unique needs and cultural preference. Tai chi is an example of a culturally sensitive exercise intervention, which is a form of mind–body exercise that involves a series of slow, focused movements with deep breathing and relaxation that are suitable for older adults (Chi, Jordan-Marsh, Guo, Xie, & Bai, 2013). Tai chi has shown great potential for improving psychological well-being in older adults with depression, anxiety, stress, and mood disturbance (Wang et al., 2010; Wang et al., 2014). Application of folk dancing that is specific to certain races/ethnicities as a form of intervention is another example of incorporating cultural preference for older adults from backgrounds that are diverse culturally and linguistically (Eyigor et al., 2009).

**IMPLICATIONS**

Exercise is an alternative intervention to prevent or alleviate depressive symptoms in older adults. However, older adults with depression were less active physically compared with older adults without depression (Wassink-Vossen et al., 2014). Older adults with depression had more functional limitations (somatic condition), lower overall levels of cognitive functioning and sense of mastery, and used more medications (Lavretsky et al., 2011; Wassink-Vossen et al., 2014). Hence, the design of exercise interventions for older adults with depression should take patient characteristics into account to strengthen the sense of mastery through psychotherapeutic interventions, and to modify interventions to accommodate functional limitations. Motivational strategies could be incorporated into exercise interventions to enhance older adults’ motivation and adherence to the program, such as using exergames (Chao, Scherer, Wu, Lucke, & Montgomery, 2013) and text messaging (Muller, Khoo, & Morris, 2016), or having peer support (Tomasino et al., 2017).

Care of older adults is complex and nuanced because they have multiple physical, social, and psychological conditions (Hooks & Roberts, 2007). Studies suggested that interprofessional approaches have effectively enhanced assessment, planning, and delivery of health care for older adults, such as fall prevention programs to reduce the risk of falls (Banez et al., 2008; Eckstrom et al., 2016) and geriatric care transitions to community from post-acute care facilities (Farris et al., 2017). Gerontological nurses can play a critical role in encouraging community-dwelling older adults to engage in physical activity to improve depressive symptoms. They can uniquely assess complex physical and mental health needs of older adults and plan and refer them to appropriate exercise interventions to cope with changes in their mental and physical abilities. In addition, gerontological nurses can partner with collaborative interdisciplinary teams to develop and implement senior exercise programs at homes or in the community, such as adult day care centers and community health centers.

As for ethnic minorities, community-based participatory research (CBPR) has been shown to be effective as a strategy for implementing interventions to improve health outcomes (Katigbak, Foley, Robert, & Hutchinson, 2016). CBPR is a collaborative, action-oriented research approach that involves community members’ knowledge of their communities and academic researchers’ research expertise (Katigbak et al., 2016). Researchers have used CBPR to promote physical activity among African American individuals (Coughlin & Smith, 2016) and improve management of hypertension among Filipino American individuals (Ursua et al., 2014). Hence, further studies may train community health workers to reach out to minority older adults and encourage them to participate in exercise programs. In addition, future exercise studies should include RCTs, a longitudinal study, and a culturally sensitive, adapted design.
LIMITATIONS

The limitations of the 10 included studies were their small sample sizes, various intervention modalities, and inconsistent measurements of outcome. In addition, most participants were Caucasian individuals. Therefore, the generalizability of current findings to minority populations is limited. For the purpose of the current study, the effectiveness of exercise intervention was determined solely by what was reported in each study. Different statistical analyses and varied sample sizes in each study may have influenced the significance of the exercise intervention on depression. In several studies, depression was measured with other psychosocial factors (e.g., perceived stress, social support, life satisfaction) and physical measurements (e.g., inflammatory markers, body weight, pain). However, for the analysis in the current review, the effectiveness of exercise on other outcomes was not addressed.

CONCLUSION

The findings of this systematic literature review suggest that exercise interventions have positive effects on depression and depressive symptoms among community-dwelling older adults in the United States. Future exercise studies with rigorous research designs are needed to establish longitudinal effects and target communities with more racially and culturally diverse populations. Motivational strategies supported by theories could also be used to enhance exercise behavior and adherence to an exercise program of older adults.

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### Table A

**Summary of Included Studies (n = 10)**

<table>
<thead>
<tr>
<th>Study Design/Setting</th>
<th>Sample</th>
<th>Intervention Group (IG)</th>
<th>Control Group (CG)</th>
<th>Program Delivery</th>
<th>Instrument</th>
<th>Main Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bonura &amp; Tenenbaum (2014)</td>
<td>N=106 → 98 (92.5% retention)</td>
<td>IG1: Chair yoga, a modified Hatha yoga 1) 5 minutes meditation 2) 30 minutes asana (yogic physical exercises) 3) 10 minutes pranayama (yogic breathing exercises) with mediation</td>
<td>No treatment</td>
<td>IG1 &amp; IG2: Class once/week, 45 minutes/session, for 6 weeks and 15-minute exercise instruction for at-home practice (handout)</td>
<td>GDS-30</td>
<td>After controlling compliance (covariate), chair yoga group significantly improved more than both chair exercise and control groups in depression at post-test and 1 month f/u (<strong>p &lt; 0.01</strong>)</td>
</tr>
<tr>
<td></td>
<td>Average Age: 77 (65-92)</td>
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<tr>
<td></td>
<td>2 community facilities for older adults, North Florida</td>
<td>IG2: Chair exercise, chair fitness sessions paralleled the physical movements selected for the chair yoga sessions</td>
<td></td>
<td>Attendance &amp; Compliance: mean attendance and home exercise engagement were significantly different</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>69.8% female</td>
<td>IG2: Chair exercise, chair fitness sessions paralleled the physical movements selected for the chair yoga sessions</td>
<td></td>
<td>Attendance &amp; Compliance: mean attendance and home exercise engagement were significantly different</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kohut et al. (2006)</td>
<td>N=109 → 87 (81.3% retention)</td>
<td>IG1: Cardiovascular exercise, treadmills, NuStep, an arm ergometer, AirDyne &amp; other stationary bikes, a vertical climbing machine, cross trainers, &amp; elliptical machines</td>
<td>N/A</td>
<td>IG1 &amp; IG2: 3 times/week, 45 minutes/session for 10 months</td>
<td>GDS-30</td>
<td>Both groups had significant reductions in depression (<strong>p = 0.017</strong>)</td>
</tr>
<tr>
<td></td>
<td>IG1: 55 → 40  IG2: 54 → 47</td>
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<tr>
<td></td>
<td>Average Age: 70.1 (64-87)</td>
<td>IG2: Strength/flexibility/Balance exercise, yoga, Tai chi, Flex band, free hand weights, stability balls; Resistance training exercise, weight machine</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>IG1: 70.3  IG2: 69.8</td>
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<tr>
<td></td>
<td>65% female</td>
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</tr>
</tbody>
</table>

GDS-30: Geriatric Depression Scale; RCT: Randomized Controlled Trial
<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>N (baseline)</th>
<th>At randomization</th>
<th>N =</th>
<th>IG</th>
<th>CG</th>
<th>IG retention</th>
<th>CG retention</th>
<th>Average Age</th>
<th>Gender</th>
<th>Intervention</th>
<th>Treatment</th>
<th>Measure</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lavretsky et al. (2011)</td>
<td>RCT</td>
<td>N=112</td>
<td>At randomization</td>
<td>N=73→68</td>
<td>IG 36→33</td>
<td>CG 37→35</td>
<td>(93.2% retention)</td>
<td></td>
<td>Average Age: 70.6 IG: 69.1 CG: 72</td>
<td>Individuals with current episode of major depression 62% female</td>
<td>Tai chi Chih: 20 movements or Chi Gong exercises which incorporates meditation and physical activity</td>
<td>Health education program: education about depression, stress sleep &amp; health-related issues</td>
<td>Medication treatment: All received 10-20mg oral Escitalpram daily for 16 weeks</td>
<td>24-item HDRS Test at 7 points: 1) pretest 2) week 6 3) week 8 4) week 10 5) week 12 6) week 14 7) posttest</td>
</tr>
<tr>
<td>McCaffrey et al. (2011)</td>
<td>Mixed method Pilot study</td>
<td>N=48</td>
<td>IG1 14→13 IG2 18→13 CG 16→13</td>
<td>(81.3% retention)</td>
<td>Average Age: 74.3 IG1: 74.6 IG2: 73.9 CG: 74.3</td>
<td></td>
<td></td>
<td>Self-diagnosed (38.5%) or health care provider-diagnosed (61.5%) depression</td>
<td>IG1: Group walking and guided imagery group, walked together, and were prompted to reflect on thoughts about life and nature</td>
<td>Art therapy group led by certified art therapist, drawing a self-portrait and presenting their portrait to the entire group</td>
<td>IG1 &amp; IG2: Walking 1-2 hours, twice/week for 6 weeks</td>
<td>GDS-30 Test at 2 points: 1) pretest 2) posttest</td>
<td>All 3 groups had significant decreases in depression from pretest to posttest (p = 0.000). No significant differences were noted in depression between the groups over time (p = 0.09).</td>
<td></td>
</tr>
<tr>
<td>Park et al. (2014)</td>
<td>Quasi experimental</td>
<td>N = 34</td>
<td>IG 23→22 CG 11→7</td>
<td>(85.3% retention)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Sit ‘N’ Fit Chair Yoga led by 2 certified yoga instructors. Chair-based yoga sessions incorporating the 4 Health education, received general health education</td>
<td>IG &amp; CG: Program twice/week, 45 minutes/session for 8 weeks</td>
<td>GDS -15 Test at 4 points: 1) pretest 2) week 4</td>
<td>Chair yoga group showed a significantly greater decrease in depression (p = 0.007).</td>
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<td><strong>design</strong></td>
<td>Average Age: 79 (62-92)</td>
<td>aspects of regular yoga-physical postures, breathing, deep relaxation, &amp; meditation while using the support of a chair.</td>
<td>information and specific facts related to the effects of OA</td>
<td>3) week 8 4) 1-month f/u</td>
<td>Chair yoga group had significant greater improvement in depression over time than control group at fixed-effects model, but not the random-effects model. Positive effect on depression was sustainable for at least 1 month after the program.</td>
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<tr>
<td><strong>A senior center in Broward County, Florida</strong></td>
<td>Individuals having pain from osteoarthritis (OA) 76.5% Female 61.5% White</td>
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<tr>
<td><strong>Payne et al. (2008)</strong></td>
<td>N= 20→18 IG= 10→9 CG = 10→9 (90% retention)</td>
<td>Home-based moderate walking exercise, Educate how to use pedometer and logs to record the frequency and length of their walking activity.</td>
<td>Usual care, standard interaction with nurses, physicians, and staff</td>
<td>CES-D Test at 4 points: 1) pretest 2) week 2 3) week 12 4) week 14</td>
<td>No significant differences in severity of depressive symptoms between groups or over time Approximately 30% of study participants in each group reported some depressive symptoms on the CES-D</td>
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<td><strong>RCT Pilot test</strong></td>
<td>Average Age: 64.7 (56-78)</td>
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<tr>
<td><strong>A National Cancer Institute in southeastern US</strong></td>
<td>Older women with breast cancer receiving hormonal therapy 100% female 90% White</td>
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<tr>
<td><strong>Pinto et al. (2013)</strong></td>
<td>N = 130→96 IG = 64→44 CG = 66→52 (74.6% retention)</td>
<td>Maintenance counseling: 1) 6-month intervention: Received home logs to monitor exercise participation and a pedometer to wear during exercise activities that involved walking or running. Participants were mailed informational tip sheets on exercise and on cardiovascular health.</td>
<td>Contact control group: 1) Received phone calls about monitoring general health problems. 2) Received exercise tip-sheets after 12M test.</td>
<td>26-item cardiac depression scale Test at 3 points: 1) pretest 2) 6 Month 3) 12 Month</td>
<td>There was a significant between-group difference in mean cardiac depression at 12-month (p = .009).</td>
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<td><strong>Rhode Island &amp; Massachusetts</strong></td>
<td>Average Age: 63.6</td>
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<tr>
<td>Study</td>
<td>N</td>
<td>IG1</td>
<td>IG2</td>
<td>IG1 retention</td>
<td>IG2 retention</td>
<td>Average Age</td>
<td>Intervention Details</td>
<td>Outcome</td>
<td>Notes</td>
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<tr>
<td>Pope et al. (2011) RCT Vermont</td>
<td>74→71</td>
<td>38→36</td>
<td>36→35</td>
<td>95.9%</td>
<td>N/A</td>
<td>64.9 (44-84)</td>
<td>High-calorie-expenditure (IG1) exercise: 5-7 times/week, 45-60 minutes/session, 50-60% peak VO2; walking was the preferred exercise modality, Exercise expenditure goal &gt;3000-3500 kcal/week</td>
<td>GDS-15</td>
<td>There was no significant difference in depression score between the two groups after intervention (p = 0.053). Percent weight loss was associated with positive change in depression score.</td>
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<tr>
<td>Redwine et al. (2012) Quasi experimental design</td>
<td>28→24</td>
<td>16→12</td>
<td>12→12</td>
<td>85.7%</td>
<td>N/A</td>
<td>70.9 (56-81)</td>
<td>Tai Chi program led by Tai Chi instructor. Tai Chi Chuan Yang-style Short Form-first third (warm-up exercise &amp; Tai Chi movement)</td>
<td>BDI: total scores (BDI-t), BDI-somatic (BDI-s), BDI-cognitive (BDI-c)</td>
<td>After controlling age, gender, ejection fraction, and category of heart failure, Tai chi group had reduced BDI-s (p ≤ 0.017), but not BDI-c (p = 0.50)</td>
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<tr>
<td>Pilot study</td>
<td>California</td>
<td>Patients with Heart Failure (NYHA class II)</td>
<td>Participants were asked to practice at home for 10–20 minutes per day, on days they were not attending the tai chi classes.</td>
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<td>IG: 72.6</td>
<td>CG: 63.9</td>
<td>12.5% female</td>
<td>Test at 2 points: 1) pretest 2) posttest scores from pre- to post-intervention than CG</td>
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</table>

| Resnick et al. (2008) | N =166→103 | 1) Senior Exercise Self-efficacy Project (SESEP): a combined physical activity (stretching, resistance, and aerobic exercise activities) and efficacy-enhancing intervention by lay exercise trainers | 2) Written materials were modified for a low-literacy and bilingual Spanish/English population. |
| RCT, sites were randomized by geographic cluster | IG= 100→64 | Routine activities and nutrition courses | 3) The aerobic component of the intervention included culturally relevant dance activities. |
| 13 senior centers in New York City, New York | CG = 66→39 | IG & CG: Twice/week, 1-1.5 hour/session for 12 weeks | Test at 2 points: 1) pretest 2) posttest (2-4 weeks after intervention) |
| Average Age: 73 | Average Age: 73 | GDS-5 | SESEP group had significantly fewer depressive symptoms after intervention than CG (p = 0.02). |
| 81% Female | 12% Female | 92.8% African American & Latino | |

Note. BDI = Beck Depression Inventory; CES-D = Center for Epidemiological Studies–Depression Scale; GDS= Geriatric Depression Scale; HDRS: Hamilton Depression Rating Scale; SESEP: Senior Exercise Self-efficacy Project.
<table>
<thead>
<tr>
<th>Reference</th>
<th>Randomized Assignment</th>
<th>Concealment Method</th>
<th>Investigator Kept Blind</th>
<th>Groups Similar at Baseline</th>
<th>Drop-out Rate</th>
<th>Intention-to-treat Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bonura &amp; Tenenbaum (2014)</td>
<td>Yes</td>
<td>Not reported</td>
<td>Not reported</td>
<td>Yes</td>
<td>7.5%</td>
<td>Not reported</td>
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<tr>
<td>Kohut et al. (2006)</td>
<td>Yes</td>
<td>Not reported</td>
<td>Yes</td>
<td>There were significantly greater number of subjects in the one intervention group treated with daily aspirin than the other group</td>
<td>18.7%</td>
<td>Not reported</td>
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<tr>
<td>Lavretsky et al. (2011)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>6.8%</td>
<td>Yes</td>
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<tr>
<td>McCaffrey et al. (2011)</td>
<td>Yes</td>
<td>Yes</td>
<td>Not reported</td>
<td>Yes</td>
<td>18.7%</td>
<td>Not reported</td>
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<tr>
<td>Park et al. (2014)</td>
<td>Yes</td>
<td>Participant with moderate to severe AD were excluded for randomization</td>
<td>Yes</td>
<td>Not reported</td>
<td>Not reported</td>
<td>Participants with moderate and severe AD assigned to Intervention group</td>
</tr>
<tr>
<td>Payne et al. (2008)</td>
<td>Yes</td>
<td>Not reported</td>
<td>Not reported</td>
<td>Not reported</td>
<td>10%</td>
<td>Not reported</td>
</tr>
<tr>
<td>Pinto et al. (2013)</td>
<td>Yes</td>
<td>Yes</td>
<td>Not reported</td>
<td>Yes</td>
<td>25.4%</td>
<td>Yes</td>
</tr>
<tr>
<td>Pope et al. (2011)</td>
<td>Yes</td>
<td>Yes</td>
<td>Not reported</td>
<td>Yes</td>
<td>4.1%</td>
<td>Not reported</td>
</tr>
<tr>
<td>Redwine et al. (2012)</td>
<td>No</td>
<td>NA</td>
<td>NA</td>
<td>Yes</td>
<td>14.3%</td>
<td>NA</td>
</tr>
<tr>
<td>Resnick et al. (2008)</td>
<td>Yes</td>
<td>Yes</td>
<td>Not reported</td>
<td>Yes</td>
<td>38%</td>
<td>Not reported</td>
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</tbody>
</table>

*Note.* AD=Alzheimer disease; NA=not applicable.