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REVIEW

Home-based physical activity interventions for breast cancer patients receiving primary therapy: a systematic review

Steven S. Coughlin[1,2] · Lee S. Caplan[3] · Valerie Williams[4]

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Abstract

Purpose Breast cancer continues to be the leading cause of cancer in women in the US, so it is important to provide these women with good therapies. However, there are adverse effects to these therapies. Physical activity plays an important role in alleviating these adverse effects of breast cancer therapy. However, the effectiveness of home-based physical activity interventions such as walking programs has not been detailed by prior reviews.

Methods This article reviews articles published to date to examine whether home-based physical activity interventions are effective in improving physical activity and other outcomes among breast cancer patients who are undergoing primary therapy for the disease. The present review is based upon bibliographic searches in PubMed and CINAHL and relevant search terms. Articles published in English from 1980 through February 28, 2019 were identified. A total of 360 article citations were identified in PubMed and non-duplicates in CINAHL.

Results After screening the abstracts or full texts of these articles and reviewing the references of previous review articles, we found 15 studies that met the eligibility criteria. Four of the studies were pre/post-test trials, 10 were randomized controlled trials, and one study was an observational study.

Conclusion Results from studies published to date indicate that among women receiving primary breast cancer therapy, home-based physical activity programs have positive effects on physical functioning and symptoms such as fatigue. Among women receiving adjuvant chemotherapy or radiation therapy, home-based physical activity programs are effective in reducing symptoms and improving physical functioning. Additional studies are needed to clarify the impact of home-based physical therapy interventions on other outcomes including quality-of-life, bone mineral density, cognitive functioning, and chemotherapy-induced peripheral neuropathy.

Keywords Breast cancer · Physical activity · Women

As breast cancer continues to be the leading cause of cancer among women in the US, the need for effective treatments remains high [1]. However, with breast cancer treatment comes side effects. Breast cancer treatment causes fatigue, debilitation, reduced physical function and aerobic capacity, and impaired quality-of-life [2]. These negative sequelae have been observed across therapies, including adjuvant chemotherapy and radiation therapy. Other potential side effects of breast cancer treatment include lymphedema, reduced bone mineral density, decreased cognitive functioning, and chemotherapy-induced peripheral neuropathy [3–6].

Physical activity plays an important role in alleviating many of the adverse effects of breast cancer therapy [2, 7]. Clinic-based, supervised physical activity programs have been shown to improve physical performance and decrease fatigue in breast cancer patients [7]. Physical activity and exercise during breast cancer treatment have been shown to prevent or reduce muscle weakness and declines in cardiovascular function, functional ability, and quality-of-life [7]. Interventions including range of motion, aerobic exercise, strengthening and stretching improve upper limb function

✉ Steven S. Coughlin
scoughlin@augusta.edu

1 Department of Population Health Sciences, Medical College of Georgia, Augusta University, 1120 15th Street, Augusta, GA 30912, USA

2 Institute of Public and Preventive Health, Augusta, GA, USA

3 Department of Community Health and Preventive Medicine, Morehouse School of Medicine, Atlanta, GA, USA

4 Department of Physical Therapy, College of Allied Health Sciences, Augusta University, Augusta, GA, USA

by increasing shoulder mobility and decreasing pain and lymphedema after surgical lymph node removal [8, 9].

The effectiveness of home-based (non-supervised) physical activity interventions for breast cancer patients receiving primary therapy has not been detailed by prior reviews. Home-based physical activity provides breast cancer patients with more flexibility in performing physical activity and may be more affordable and accessible for some patients. This article reviews articles published to date to examine whether home-based physical activity interventions are effective in increasing physical activity and improving other outcomes among breast cancer patients who are undergoing primary therapy for the disease (adjuvant chemotherapy, radiation). The use of home based programs may be especially important for patients who have decreased access to care or prefer to exercise at home.

Methods

The present review is based upon bibliographic searches in PubMed and CINAHL and relevant search terms. Articles published in English from 1980 through February 28, 2019 were identified using the following MeSH search terms and Boolean algebra commands: (home based AND physical activity AND breast cancer) OR (walking intervention AND breast cancer). One of us (S.S.C.) performed the bibliographic review The searches were not limited to words appearing in the title of an article nor to studies in a particular country or geographic region of the world. The references of review articles were also reviewed [7]. Information obtained from bibliographic searches (title and topic of article, information in abstract, study design, and key words) was used to determine whether to retain each article identified in this way. Only studies written in English that examined the impact of breast cancer survivorship care plans on health outcomes were eligible for inclusion. Studies focusing on breast cancer survivors who had completed primary therapy were ineligible.

Results

A total of 360 article citations were identified in PubMed and non-duplicates in CINAHL. After screening the abstracts or full texts of these articles and reviewing the references of previous review articles, we were left with 15 studies that met the eligibility criteria. The major reason for exclusion was that the article was outside the scope of this review (Fig. 1). Twenty studies (5.6%) were excluded because they focused on breast cancer survivors rather than patients undergoing primary therapy for breast cancer. Four of the eligible studies were pre/post-test trials, 10 were randomized controlled trials, and one study was an observational study. The types of interventions included walking (8 studies), a combination or aerobic and resistance training (4 studies), a combination walking and upper extremity range of motion (1 study), and allowing the subjects to choose their activity (2 studies). A summary of the articles included in this review is provided in Table 1.

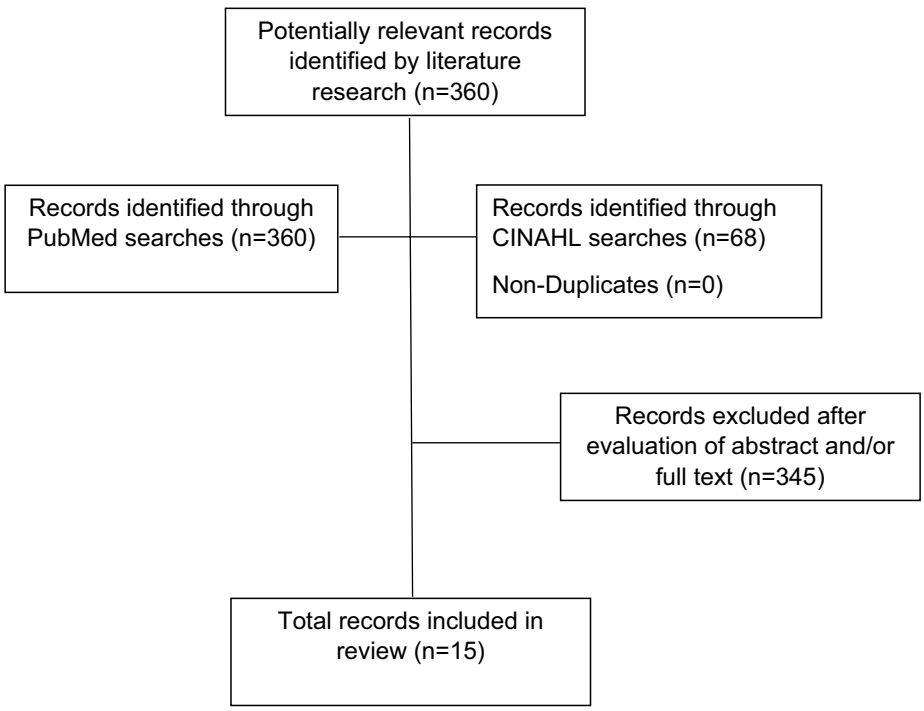

Fig. 1 Flowchart of record selection process

Table 1 Studies of home-based physical activity interventions for breast cancer patients receiving primary therapy

References	Design	Primary intervention	Outcomes	Sample size	Results
Mock et al. [10]	6-week pre-/post-test trial of a home-based walking exercise program	Walking	Physical functioning, fatigue, emotional distress, and difficulty sleeping	46 breast cancer patients receiving radiation therapy	The exercise group scored significantly higher than the usual care group on physical functioning ($p = 0.003$), and reduced symptom intensity (fatigue, anxiety, and difficulty sleeping)
Mock et al. [11]	Randomized controlled trial of a home-based walking exercise program (exercise instruction, booklet)	Walking	Fatigue, emotional distress, physical functioning, and quality-of-life	52 breast cancer patients receiving adjuvant chemotherapy or radiation therapy	Women who exercised at least 90 min per week on 3 or more days reported significantly less fatigue ($p \leq 0.001$) and emotional distress, as well as higher functional ability ($p \leq 0.001$) and quality-of-life ($p = 0.02$) than women who were less active during treatment
Mock et al. [12]	Randomized controlled trial of a home-based walking exercise program	Walking	Fatigue	119 women with stage 0–III breast cancer receiving adjuvant chemotherapy or radiation therapy	The intention-to-treat analysis showed no group differences. When exercise participation was considered using the data analysis method of instrumental variables with principal stratification, a significant effect of exercise on fatigue was observed ($p = 0.03$)
Cadmus et al. [13]	6-month randomized controlled trial of a home-based exercise program	Subject selected physical activity	Happiness, depressive symptoms, anxiety, stress, self-esteem, quality-of-life, and self-reported and objective physical activity	50 breast cancer patients who had not yet begun or had only recently initiated adjuvant therapy (radiation or chemotherapy)	Exercise was not associated with improved psychosocial measures or quality-of-life
Mustian et al. [14]	3-month randomized controlled trial of a home-based aerobic and resistance training exercise program	Combina-tion aerobic and resistance training	Aerobic capacity, strength, muscle mass, fatigue, and quality-of-life	38 breast cancer patients receiving radiation therapy	Participants in the exercise intervention showed significantly higher quality-of-life ($p < 0.05$) and significantly lower fatigue ($p < 0.05$) than the controls
Swenson et al. [15]	6-week randomized controlled trial comparing a walking physical activity intervention with bisphosphonates	Walking	Adherence to the 10,000-step protocol	36 breast cancer patients receiving adjuvant chemotherapy who were randomized to the physical activity intervention arm	For the first 6 weeks, the mean total steps per participant was 280,571 (SD = 111,992), which is 67% of the prescribed steps. A significant linear increase occurred in steps per day after chemotherapy in a treatment cycle ($p < 0.0001$)

Table 1 (continued)

References	Design	Primary intervention	Outcomes	Sample size	Results
Ligibel et al. [16]	12-week pre-/post-test trial of a home-based aerobic physical activity intervention	Subject selected physical activity	Weekly exercise, cardiorespiratory fitness, quality-of-life, weight, body fat	Sedentary women with early stage breast cancer	In the 34 patients for whom baseline and week 12 measures were available, weekly exercise increased from 13 min to 116 min ($p < 0.001$). Cardiorespiratory fitness and quality-of-life improved significantly ($p < 0.003$ and $p = 0.001$, respectively). Participants also avoided weight gain and increases in body fat over the course of the study
Saarto et al. [4]	12-month randomized controlled trial of a home-based exercise program	Combination aerobic and resistance training	Bone mineral density at the lumbar spine and femoral neck, and physical performance (2-km walking test, figure-8 running test), physical activity	573 newly diagnosed breast cancer patients	Figure-8 running time improved significantly among the patients of the intervention group compared with the controls ($p < 0.001$). No significant group differences were observed in 2-km walking time or in physical activity. However, there was a linear relationship between increased physical activity and improved quality-of-life ($p = 0.006$), irrespective of the intervention. In premenopausal women, bone loss at the femoral neck was prevented by exercise, the mean BMD changes being −0.2% among the trainees versus −1.4% among the controls ($p = 0.01$). In postmenopausal women, no significant exercise-effect on BMD was found either at the lumbar spine (−1.6% vs. −2.1%) or femoral neck (−1.1% vs. −1.1%)
Vincent et al. [17]	12-week pre-/post-test trial of a home-based walking exercise program	Walking	Functional capacity (peak oxygen consumption), physical function (6-min walking test), and fatigue score	39 breast cancer patients, predominantly stage II	Peak oxygen consumption ($p = 0.008$) and 6-min walking test distance ($p = 0.04$) increased significantly. Fatigue score increased but not significantly

Table 1 (continued)

References	Design	Primary intervention	Outcomes	Sample size	Results
Wonders et al. [6]	10-week pre-/post-test trial of a home-based physical activity intervention	Combination aerobic and resistance training	Symptoms of chemotherapy-induced peripheral neuropathy, fatigue	50 breast cancer patients receiving Docetaxel, Paclitaxel, or Vinorelbine	Prior to the exercise program, participants described their pain as unpleasant skin sensations, abnormally sensitive to touch, and coming on suddenly for no apparent reason. Following 10-weeks of exercise, participants reported less of these symptoms ($p=0.05$)
Van Waart et al. [18]	3-arm randomized controlled trial comparing a home-based low-intensity exercise program and a moderate- to high-intensity supervised exercise program with usual care	Walking	Cardiorespiratory fitness, physical functioning, symptoms (nausea, vomiting, fatigue)	230 breast cancer patients receiving adjuvant chemotherapy	Both exercise programs resulted in less decline in cardiorespiratory fitness ($p<0.001$), better physical functioning ($p<0.001$), less nausea and vomiting, and less pain compared with usual care
Cornette et al. [19]	27-week randomized controlled trial of a home-based physical activity program (endurance and resistance training)	Combina-tion aerobic and resistance training	The primary endpoint was cardiopulmonary function (maximal peak oxygen consumption). Secondary endpoints included a 6-min walking test, and assessment of muscular strength, fatigue, quality-of-life, physical activity level, and anxiety/depression	Breast cancer patients undergoing chemotherapy and radiation therapy	At 27 weeks, maximal peak oxygen consumption increased in the intervention group ($p=0.009$) and decreased in the control group ($p=0.046$). No significant differences were observed across groups in 6-min walking test, quadriceps strength, or quality-of-life
Donmez and Kapucu [3]	6-week randomized controlled trial of a home-based physical activity program	Walking and upper extremity range of motion	Upper extremity circumference and lymphedema-related symptom scores	52 breast cancer patients who were referred for surgery and who had undergone axillary lymph node dissection	The upper extremity circumference increased by about two times from the baseline, in the control group ($p<0.05$). Lymphedema-related symptom severity scores decreased significantly in the intervention group, compared to those at the baseline ($p<0.05$)

Table 1 (continued)

References	Design	Primary intervention	Outcomes	Sample size	Results
Nyrop et al. [20]	Observational study of adherence to a home-based walking exercise intervention	Walking	Fitbit steps per week and self-reported waling minutes	100 breast cancer patients receiving adjuvant chemotherapy	Mean walking steps were 3956 per day. Nineteen percent were fully adherent with the target of 6686 steps/day and an additional 24% were moderately adherent. Physical activity variables associated with greater Fitbit steps in unadjusted analysis were pre-chemotherapy history of vigorous physical activity ($p = 0.0091$) and higher self-reported walking minutes/week ($p < 0.001$)
Gokal et al. [5, 21]	12-week randomized controlled trial of a home-based walking physical activity intervention	Walking	Changes in subjective and objectively detected cognitive functioning, and self-reported changes in anxiety, depression, fatigue, self-esteem, mood and physical activity	50 breast cancer patients receiving adjuvant chemotherapy	Compared with the control group, the walking intervention had positive effects on perceived cognitive function but not on sustained attention, executive function, memory or visual spatial skills wen assessed objectively. The intervention had positive effects on fatigue ($p = 0.02$), self-esteem ($p < 0.001$), mood ($p = 0.03$), and levels of physical activity ($p = 0.0011$)

In a 6-week pre/post-test trial of a home-based walking exercise program, Mock et al. [10] found that the exercise group scored significantly higher than the usual care group on physical functioning ($p = 0.003$), and reduced intensity of symptoms. The latter included fatigue, anxiety, and difficulty sleeping.

Mock et al. [11] conducted a randomized controlled trial of a home-based walking exercise program (exercise instruction, booklet) among 52 breast cancer patients receiving adjuvant chemotherapy or radiation therapy. Women who exercised at least 90 min per week on 3 or more days reported significantly less fatigue ($p < 0.01$) and emotional distress, as well as higher functional ability ($p < 0.01$) and quality-of-life ($p = 0.02$) than women who were less active during treatment.

In a randomized controlled trial of a home-based walking exercise program, Mock et al. [12] found no group differences in an intention-to-treat analysis. However, when exercise participation was considered using the data analysis method of instrumental variables with principal stratification, a significant effect of exercise on fatigue was observed ($p = 0.03$).

Cadmus et al. [13] conducted a 6-month randomized controlled trial of a home-based exercise program among 50 breast cancer patients who had not yet begun or had only recently initiated adjuvant therapy (radiation or chemotherapy). Exercise was not associated with improved psychosocial measures (happiness, depressive symptoms, anxiety, stress, self-esteem) or quality-of-life.

Mustian et al. [14] conducted a three-month randomized controlled trial of a home-based aerobic and resistance training exercise program among 38 breast cancer patients receiving radiation therapy. Participants in the exercise intervention showed significantly higher quality-of-life ($p < 0.05$) and significantly lower fatigue ($p < 0.05$) than the controls.

Swenson et al. [15] conducted a 6-week randomized controlled trial comparing a walking physical activity intervention with bisphosphonates. They examined adherence to the 10,000-step protocol among 36 breast cancer patients receiving adjuvant chemotherapy who were randomized to the physical activity intervention arm. For the first 6 weeks, the mean total steps per participant was 280,571 (SD = 111,992), which is 67% of the prescribed steps. A significant linear increase occurred in steps per day after chemotherapy in a treatment cycle ($p < 0.0001$).

Ligibel et al. [16] conducted a 12-week pre/post-test trial of a telephone-based exercise intervention for women receiving adjuvant chemotherapy for early stage breast cancer. In the 34 patients for whom baseline and week 12 measures were available, weekly exercise increased from 13 to 116 min ($p < 0.001$). Cardiorespiratory fitness and quality-of-life improved significantly ($p < 0.003$ and $p = 0.001$, respectively). Participants also avoided weight gain and increases in body fat over the course of the study.

Saarto et al. [4] conducted a 12-month randomized controlled trial of a home-based exercise program among 573 newly diagnosed breast cancer patients. The outcomes of interest were bone mineral density (BMD) at the lumbar spine and femoral neck and physical performance (2-km walking test, figure-8 running test) and physical activity [4]. Figure-8 running time improved significantly among the patients of the intervention group compared with the controls ($p < 0.001$). No significant group differences were observed in 2-km walking time or in physical activity. However, there was a linear relationship between increased physical activity and improved quality-of-life ($p = 0.006$), irrespective of the intervention. In premenopausal women, bone loss at the femoral neck was prevented by exercise, the mean BMD changes being −0.2% among the trainees versus −1.4% among the controls ($p = 0.01$). In postmenopausal women, no significant exercise-effect on BMD was found either at the lumbar spine (−1.6% vs. −2.1%) or femoral neck (−1.1% vs. −1.1%).

Vincent et al. [17] conducted a 12-week pre/post-test trial of a home-based walking exercise program among 39 breast cancer patients. Peak oxygen consumption ($p = 0.008$) and 6-min walking test distance ($p = 0.04$) increased significantly. There was a statistically non-significant increase in fatigue score.

Wonders et al. [6] conducted a 10-week pre/post-test trial of a home-based physical activity intervention among 50 breast cancer patients receiving Docetaxel, Paclitaxel, or Vinorelbine. The outcomes of interest were symptoms of chemotherapy-induced peripheral neuropathy and fatigue. Prior to the exercise program, participants described their pain as unpleasant skin sensations, abnormally sensitive to touch, and coming on suddenly for no apparent reason. Following 10-weeks of exercise, participants reported less of these symptoms ($p = 0.05$).

Van Waart et al. [18] conducted a three-arm randomized controlled trial comparing a home-based low-intensity exercise program and a moderate- to high-intensity supervised exercise program with usual care. Both exercise programs resulted in less decline in cardiorespiratory fitness ($p < 0.001$), better physical functioning ($p < 0.001$), less nausea and vomiting, and less pain compared with usual care.

Cornette et al. [19] conducted a 27-week randomized controlled trial of a home-based physical activity program (endurance and resistance training) in which the primary endpoint was cardiopulmonary function (maximal peak oxygen consumption). Secondary endpoints included a 6-min walking test and assessment of muscular strength, fatigue, quality-of-life, physical activity level, and anxiety/depression. At 27 weeks, maximal peak oxygen consumption increased in the intervention group ($p = 0.009$) and

decreased in the control group ($p = 0.046$). No significant differences were observed across groups in 6-min walking test, quadriceps strength, or quality-of-life.

Donmez et al. [3] conducted a 6-week randomized controlled trial of a home-based physical activity program among 52 breast cancer patients who were referred for surgery and who had undergone axillary lymph node dissection. The upper extremity circumference increased by about two times from the baseline in the control group ($p < 0.05$). Lymphedema-related symptom severity scores decreased significantly in the intervention group, compared to those at the baseline ($p < 0.05$).

Nyrop et al. [20] conducted an observational study of adherence to a home-based walking exercise intervention among 100 breast cancer patients receiving adjuvant chemotherapy. Mean walking steps were 3956 per day. Nineteen percent of the women were fully adherent with the target of 6686 steps/day, and an additional 24% were moderately adherent. In unadjusted analysis, physical activity variables associated with greater steps (measured using Fitbit wearable device) were pre-chemotherapy history of vigorous physical activity ($p = 0.0091$) and higher self-reported walking minutes/week ($p < 0.001$).

Gokal et al. [21] conducted a 12-week randomized controlled trial of a home-based walking physical activity intervention among 50 breast cancer patients receiving adjuvant chemotherapy. The outcomes of interest were changes in subjectively and objectively detected cognitive functioning, and self-reported changes in anxiety, depression, fatigue, self-esteem, mood, and physical activity. Compared with the control group, the walking intervention had positive effects on perceived cognitive function but not on sustained attention, executive function, memory or visual spatial skills when assessed objectively. The intervention had positive effects on fatigue ($p = 0.02$), self-esteem ($p < 0.001$), mood ($p = 0.03$), and levels of physical activity ($p = 0.0011$).

Furmaniak et al. [22] did a Cochrane Database Systematic Review as an updated version of the Cochrane review published in 2006 in which physical exercise for breast cancer patients during adjuvant treatment had a number of positive effects. These included improved physical fitness and slightly reduced fatigue. This review included 32 studies with 2626 randomized women.

Cramer et al. [23] did a Cochrane Database Systematic Review assessing the effects of yoga on health-related quality of life, mental health, and cancer-related symptoms in women with breast cancer who are either receiving active treatment or have already completed treatment. They found that yoga improved health-related quality of life, reduced fatigue, and reduced sleep disturbances in the short term. This review included 24 studies with 2166 participants.

Discussion

The results of this systematic review indicate that women receiving primary breast cancer therapy, various forms of physical activity and exercise have improved physical functioning and decreased fatigue [10–12, 14, 18]. Only two studies have showed improvements in functional capacity (peak oxygen consumption) and cardiorespiratory fitness [16, 17]. Additional metabolic findings include possible positive effects on bone mineral density and the avoidance of weight gain [4, 16].

Studies have also reported improvements in various cognitive and emotional outcomes, and quality of life [5, 10, 11, 14, 16, 19, 21]. There is only limited evidence that home-based walking programs protect against decline in cognitive functioning among breast cancer patients undergoing chemotherapy [21]. In the small randomized controlled trial conducted by Gokal et al. [21], the intervention had positive effects on perceived cognitive function but not on sustained attention, executive function, memory, or visual spatial skills, when assessed objectively using neuropsychological measures. Only one study investigating psychosocial outcomes and quality of life did not find significant improvements overall, however subjects with low social functioning at baseline did improve in this domain ($p < 0.05$) [13]. The authors of this study, Cadmus et al., report that the subjects included in their analyses had relatively high baseline quality of life parameters, which may explain why they did not find many significant outcomes.

In addition, home-based physical activity programs lead to improvements in other symptoms such as pain, nausea and vomiting, and altered unpleasant skin sensation [6, 18]. Physical activity programs have been shown to be effective in attenuating the symptoms of chemotherapy-induced peripheral neuropathy in studies of patients with cancer of the breast and other sites [6]. The biological mechanisms behind chemotherapy-induced peripheral neuropathy are not fully understood, and prophylactic and symptomatic treatments are largely ineffective. In the current review, the pre/post-test trial by Wonders et al. [6] showed that, following 10-weeks of home-based exercise, participants reported fewer symptoms of chemotherapy-induced peripheral neuropathy ($p = 0.05$).

In subjects who had undergone axillary lymph node dissection and participated in a post-surgical home based exercise program had improved limb circumferences and lymphedema symptoms [3]. Studies of breast cancer survivors suffering from lymphedema have shown that exercise training alleviates symptoms of lymphedema [2]. For example, in the Physical Activity and Lymphedema

(PAL) trial, Schmitz et al. [24] found that breast cancer survivors who engaged in a slow, progressive program of resistance exercise (weight lifting) not only strengthened their affected arms but also had a lower incidence and severity of lymphedema. In the current review, one study of a home-based physical activity program for breast cancer patients was identified [3]. Donmez et al. [3] found that lymphedema-related symptom severity scores decreased significantly in the intervention group, compared to those at the baseline ($p < 0.05$).

With respect to limitations, outcomes, intervention strategies, and tests varied among the studies. Caution is, therefore, required in comparing results across studies. In addition, our literature review may not have captured all relevant studies. A further issue is that, in most studies, physical activity was assessed using self-reported information.

Among women receiving adjuvant chemotherapy or radiation therapy, home-based physical activity programs are effective in reducing symptoms and improving physical functioning. Additional studies are needed to clarify the impact of home-based physical activity interventions on other outcomes including quality-of-life, bone mineral density, cognitive functioning, and chemotherapy-induced peripheral neuropathy.

Compliance with ethical standards

Conflict of interest The authors declare they have no conflicts of interest.

Ethical approval This article does not contain any studies with human participants performed by the authors.

Informed consent Not applicable.

References

1. Cancer Facts and Figures (2019) Atlanta, GA: American Cancer Society 2019
2. Schwartz A, de Heer HD, Bea JW (2017) Initiating exercise interventions to promote wellness in cancer patients and survivors. Oncology (Williston Park) 31:711–717
3. Donmez AA, Kapucu S (2017) The effectiveness of a clinical and home-based physical activity program and simple lymphatic drainage in the prevention of breast cancer-related lymphedema: a prospective randomized controlled trial. Eur J Oncol Nurs 31:12–21
4. Saarto T, Sievanen H, Kellokumpu-Lehtinen P et al (2012) Effect of supervised and home exercise training on bone mineral density among breast cancer patients. A 12-month randomized controlled trial. Osteoporos Int 23:1601–1612
5. Gokal K, Munir F, Ahmed S et al (2018) Does walking protect against decline in cognitive functioning among breast cancer patients undergoing chemotherapy? Results from a small randomized controlled trial. PLoS ONE 11:e0206874
6. Wonders KY, Whisler G, Loy H et al (2013) Ten weeks of homebsed exercise attenuates symptoms of chemotherapy-induced peripheral neuropathy in breast cancer patients. Health Psychol Res 1:e28
7. Gebruers N, Camberlin M, Thenissen F et al (2019) The effect of training interventions on physical performance, quality of life, and fatigue in patients receiving breast cancer treatment: a systematic review. Support Care Cancer 27:109–122
8. Chan DN, Lui LY, So WK (2010) Effectiveness of exercise programmes on shoulder mobility and lymphedema after axillary lymph node dissection for breast cancer: systematic review. J Adv Nurs 66:255–267
9. De Groef A, Van Kempen M, Dieltjens E et al (2015) Effectiveness of postoperative physical therapy for upper-limb impairments after breast cancer treatment: a systematic review. Arch Phys Med Rehabil 96:1140–1153
10. Mock V, Dow KH, Meares CJ et al (1997) Effects of exercise on fatigue, physical functioning, and emotional distress during radiation therapy for breast cancer. Oncol Nurs Forum 24:991–1000
11. Mock V, Pickett M, Ropka ME et al (2001) Fatigue and quality of life outcomes of exercise during cancer treatment. Cancer Pract 9(3):119–127
12. Mock V, Frangakis C, Davidson NE et al (2005) Exercise manages fatigue during breast cancer treatment: a randomized controlled trial. Psycho-Oncol 14:464–467
13. Cadmus LA, Salovey P, Yu H et al (2009) Exercise and quality of life during and after treatment for breast cancer: results of two randomized controlled trials. Psychooncology 18:343–352
14. Mustian KM, Peppone L, Darling TV et al (2009) A 4-week home-based aerobic and resistance exercise program during radiation therapy: a pilot randomized clinical trial. J Support Oncol 7:158–167
15. Swenson KK, Nissen MJ, Henly SJ (2010) Physical activity in women receiving chemotherapy for breast cancer: adherence to a walking intervention. Oncol Nurs Forum 37:321–330
16. Ligibel JA, Partridge A, Giobbie-Hurder A et al (2010) Physical and psychological outcomes among women in a telephone-based exercise intervention during adjuvant therapy for early stage breast cancer. J Women's Health 19:1553–1559
17. Vincent F, Labourey J-L, Leobon S et al (2013) Effects of a home-based walking training program on cardiorespiratory fitness in breast cancer patients receiving adjuvant chemotherapy: a pilot study. Eur J Phys Rehabil Med 49:319–329
18. Van Waart H, Stuiver MM, van Harten WH et al (2015) Effect of low-intensity physical activity and moderate- to high-intensity physical exercise during adjuvant chemotherapy on physical fitness, fatigue, and chemotherapy completion rates: results of the PACES randomized clinical trial. J Clin Oncol 33:1918–1927
19. Cornette T, Vincent F, Mandigout S et al (2016) Effects of home-based exercise training on VO_2 in breast cancer patients under adjuvant or neoadjuvant chemotherapy (SAPA): a randomized controlled trial. Eur J Phys Rehabil Med 52:223–232
20. Nyrop KA, Deal AM, Choi SK et al (2018) Measuring and understanding adherence in a home-based exercise intervention during chemotherapy for early breast cancer. Breast Cancer Res Treat 168:43–55
21. Gokal K, Wallis D, Ahmed S et al (2016) Effects of a self-managed home-based walking intervention on psychological health outcomes for breast cancer patients receiving chemotherapy: a randomized controlled trial. Support Care Cancer 24:1139–1166

22. Furmaniak AC, Menig M, Markes MH (2016) Exercise for women receiving adjuvant therapy for breast cancer. Cochrane Database Syst Rev 21:9
23. Cramer H, Lauche R, Klose P et al (2017) Yoga for improving health-related quality of life, mental health and cancer-related symptoms in women diagnosed with breast cancer. Cochrane Database Syst Rev 3:1
24. Schmitz KH, Troxel AB, Cheville A et al (2009) Physical Activity and Lymphedema (the PAL trial): assessing the safety of progressive strength training in breast cancer survivors. Contemp Clin Trials 30:233–245