Research Article

Systematic Review of Exercise Effects on Health Outcomes in Women with Breast Cancer

ChaeWeon Chung, PhD, RN,1 Seonheui Lee, MPH, PhD, RN,2,* ShinWoo Hwang, PhD, RN,3 EunHee Park, MSN, RN3
1 College of Nursing, Research Institute of Nursing Science, Seoul National University, Seoul, South Korea
2 Health Technology Assessment Division, National Evidence-based Healthcare Collaborating Agency, Seoul, South Korea
3 College of Nursing, Seoul National University, Seoul, South Korea

A R T I C L E  I N F O

Article history:
Received 3 May 2013
Received in revised form
15 July 2013
Accepted 16 July 2013

Keyword:
breast cancer
exercise
intervention
systematic review

S U M M A R Y

Purpose: Exercise is commonly recommended to women after breast cancer surgery, yet it is difficult for patients and health professionals to adopt safe and beneficial types and modes of exercise. Thus studies on exercise interventions targeting women with breast cancer treatment were systematically reviewed.

Methods: The review process and quality assessment of the studies followed the guideline of the National Evidence-based Healthcare Collaborating Agency. Relevant studies were obtained from electronic databases, and two trained reviewers independently analyzed the studies. Of the 902 articles sorted, 11 were selected. Then, quality assessment for each study was carried out with the Scottish Intercollegiate Guideline Network (SIGN) checklist.

Results: Seven different types of exercise interventions were identified from 3 quasi-experimental and 8 randomized controlled trial studies. The interventions varied in duration from several days to 13 weeks, and tended to show significant effects on psychological outcomes and upper body functions within a short-term period and were effective in alleviating lymphedema at a longer 1-year point. Supervised, professional intervention had significant effects on health indicators and a higher adherence rate.

Conclusion: Well-designed exercises are effective and beneficial for improving women’s physical, physiological, and psychological health outcomes after breast cancer treatment as well as to facilitate changes in exercise behaviors. The feasibility of applying intervention protocols, efficiency of interventions, and strengths of exercise protocols should be further examined.

Introduction

Breast cancer is the second most prevalent female cancer in Korea, involving 14.3% of female cancers (National Cancer Information Center [NCIC], 2013). Considering the increase in the incidence rate from 24.5 per 100,000 persons in 1999 to 45.4 in 2010 (NCIC, 2013), it can be assumed that more women are affected by breast cancer and undergoing treatment. Women with breast cancer face physical and psychological complications during treatment; lymphedema, in particular, can occur after the surgical removal or radiation treatment of lymph nodes.

Lymphedema is one of the chronic, debilitating complications that occur in approximately 20.7% to 32% (Armer & Stewart, 2010; Clark, Sitzia, & Harlow, 2005; Paskett, Naughton, McCoy, Case, & Abbott, 2007) of women with breast cancer. Norman et al. (2009) even found 42% of women experiencing lymphedema, among which 80% of the cases had occurred in the first 2 years after treatment. Above all, lymphedema after breast cancer treatment is accompanied by upper body symptoms such as pain, numbness, stiffness, and weakness as well as impairment of arm and shoulder function (Bosompra, Ashikaga, O’Brien, Nelson, & Skelly, 2002; Hayes et al., 2012), which eventually affects these women’s overall quality of life (Ahmed, Prizment, Lazovich, Schmitz, & Folsom, 2008; Armer & Stewart; Fu, Chen, Haber, Guth, & Axelrod, 2010).

Recently, various interventions have been implemented to manage lymphedema, including physiotherapy (Beurskens, van Uden, Strobbe, Oostendorp, & Wobbes, 2007; Torres Lacomba et al., 2010), weight lifting (Schmitz et al., 2010), breathing (Moseley, Piller, & Carati, 2005), exercise therapy (Courneya et al., 2000).
Generally, exercise is regarded as aiding with improvement in physical functioning. However, existing review studies limited their focus on interventions for upper-limb dysfunction (McNeely et al., 2010) or for women receiving adjuvant therapy (Markes et al., Brockow, & Resch, 2006). Even within these focus, evidence remains insufficient about its benefits and harms due to the limited numbers of trials and participants, rigor of research designs, clinical heterogeneity, and different modes of interventions and measurement (Bicego et al., 2006; Markes et al.; McNeely et al.).

Thus, we examined the effectiveness of exercise interventions in reducing the occurrence of lymphedema and upper body morbidity in women after breast cancer treatment. This was expected to provide evidence to inform the development of strategies for nursing education and clinical practice in the field of breast cancer care.

Methods

This study followed the guidance of the National Evidence-based Healthcare Collaborating Agency (Kim et al., 2011), which is commonly used as a basis for conducting systematic reviews.

Review questions

Our key study question was devised on the basis of the acronym PICO (patient, intervention, comparator, and outcome), meeting the following criteria: (a) patients: postoperative breast cancer patients, (b) intervention: exercise, (c) comparator: other intervention without exercise, or no intervention, and (d) outcome: outcomes related to lymphedema and upper arm morbidity. The main research question was thus, What are effective exercise interventions for postoperative lymphedema and upper arm morbidity in women with breast cancer?

Search strategy

Selection of relevant databases and search terms

The articles were retrieved from the Ovid-MEDLINE and Ovid-EMBASE international databases using a systematic search method. Consultation with experts in the field of systematic review was received regarding the search method. The search was not limited by date of publication.

The following key words were used for the search. Terms related to the patient included breast neoplasm, breast cancer, breast tumor, breast carcinoma, breast adenocarcinoma, and breast sarcoma. We included studies if the participants were postoperative patients with breast cancer, regardless of the type of operation. However, we did not initially include studies that included participants with other types of cancer mixed into the same sample, since we could not distinguish the effectiveness of exercise intervention for breast cancer patients only.

For terms related to the treatment, we searched using mastectomy, lymph node excision, lymph node dissection, and sentinel lymph node biopsy. Terms related to the intervention included rehabilitation, physical therapy techniques, musculoskeletal manipulation, sports, physical activity, walking, jogging, cycling, bicycling, dance, aerobic, weight, training, muscle, endurance, resistance, strength, stretching, movement, and motion.

The search was not limited to studies on types of exercise because the purpose of our systematic review was to explore the effectiveness of all outcomes related to lymphedema prevention and upper arm morbidity. Moreover, the intervention could be either exercise alone or include other types of interventions with the exercise, for example, education, massage, or physiotherapy. We included randomized controlled trials (RCTs), as well as non-randomized studies.

Criteria for selecting studies

Two research assistants working independently screened all potential studies for inclusion according to the eligibility criteria. First, duplicate articles were excluded. They examined the title and abstract to select adequate studies. If necessary, the full text of the studies was read, and those that met the criteria were included. If they could not reach agreement by discussion, a research team discussed to resolve the disagreement and made the final decision. The causes of exclusion were documented.

Studies were eligible for inclusion if they (a) included women who were diagnosed with breast cancer; (b) revealed that the women had undergone any type of surgical procedure; (c) reported any type of exercise intervention; and (d) were published in a journal or a book in English or Korean.

The criteria of exclusion were as follows: If the studies were (a) animal studies, (b) not original articles (e.g., using secondary data, literature review), (c) written in neither Korean nor English, (d) unpublished grey articles, (e) case studies, (f) not dealing with postoperative patients with breast cancer, (g) not evaluating the effectiveness of exercise intervention in postoperative patients with breast cancer, (h) not comparing the effectiveness of exercise intervention with a control, and (i) not reporting relevant health outcomes.

Quality assessment of selected studies

The quality of evidence was assessed using the SIGN methodology checklist developed by the Scottish Intercollegiate Guideline Network (2008), which was translated into Korean by Kim et al. (2011). The Korean version of SIGN methodology checklist contains 10 items to evaluate internal validity, which refers to the clarity and appropriateness of the research questions, randomization of assignment as well as in analysis, usage of a concealment method, double blindness, homogeneity of the control group and the treatment group at the initial time point along with the treatment given to the two groups being the only difference between them, reliable and valid measurement, proper data analysis providing a p value and confidence interval, the attrition rate, and a comparison of all studies if multisite trials.

The SIGN methodology checklist yields scores for each of the 10 items and an overall assessment of the study quality (Table 1). Each study was rated by one of the three grades of (−), (+), or (+++) to indicate how well the study tried to minimize bias. Two research assistants independently screened the literature for quality. Then, disagreements in rating signs were resolved by consensus.

Data extraction strategy

A standard data extraction protocol designed for assessing the study format of randomized clinical trials was utilized. Two reviewers independently considered the full text and extracted all descriptions of the study methods, the interventions they received, and the relevant outcomes.

Results

A total of 902 abstracts were identified by data collection; these were published as early as in 1988. Initially, 127 articles were excluded because they included study participants who were nonpostoperative patients. Of these, 506 were screened out
because they did not meet the intervention criteria. The others were not incorporated in the review for being a duplicated article, review article, grey article, or case study. In the end, 11 studies meeting the inclusion criteria were selected (Figure 1).

Table 2 presents a summary of the selected studies, most of which were published from 2005 through 2011. Out of the 11 studies, 3 were conducted in Korea and all of them were done with a quasi-experimental design, while 8 studies applied a randomized controlled trial design. Regarding their regional distribution, the 11 studies were carried out in Republic of Korea (n = 3), Spain (n = 2), the United States (n = 2), Canada (n = 1), Israel (n = 1), the Netherlands (n = 1) and the United Kingdom (n = 1).

In regard to overall quality of the study, most of them were graded as (+ +) indicating the studies tried well to minimize bias except one (So et al., 2006) (Table 3).

The types of interventions varied with physiotherapy (n = 3) and multimodal exercise (n = 1), which combined physical therapy and physical training being the most frequently provided by physiotherapists and physicians. This was followed by interventions by comprehensive rehabilitation (n = 2) in 2 studies not involving physiotherapy, aerobic exercise (n = 2), weight lifting (n = 1), aqua lymphatic therapy (n = 1), and a dance/movement program (n = 1). The interventionists were mostly professionals in diverse practices, such as aerobic specialists, a clinical physical therapist, a registered dance/movement therapist, physiotherapists, a graduate student in dance, certified fitness professionals, and a group of experts (surgeon, oncology nurse, dietician, image consultant, physiast, exercise prescription manager, and registered fitness instructor).

Most of the control groups of each study were given usual care with education, self-exercise, or leaflets, while two studies applied a delay of intervention for the control group. One study (So et al., 2006) did not mention the control group treatment, and only one study of aerobic exercise involved two control groups with exercise-placebo and usual care (Daley et al., 2007).

The total initial sample size was as small as 30 (Beurskens et al., 2007), and the largest was 154, comprising 77 women in each group (Schmitz et al., 2010). Most of the studies comprised equal numbers of participants in the control and experimental groups but four studies had approximately double-sized experimental or control group assignment (34 vs. 74; 16 vs. 32; 20 vs. 10; 20 vs. 13).

The retention rates ranged from 70.5% through 100% with two studies reporting no attrition (Kilgour, Jones, & Keyserlingk, 2008; Na et al., 1999). These two studies also have relatively short intervention and follow-up periods: Kilgour et al. at 11 days and follow-up on day 14; Na et al. at 18 days and follow-up on day 48 (post-discharge 1 month). Although Tidhar and Katz-Leurer (2010) reported no attrition, they included one woman who discontinued intervention from the final analysis based on the intention-to-treat principle.

Characteristics of the study sample were as follows: 4 studies set age criteria mostly ranging from 18 to 65 years, while studies without age criteria resulted in having women aged 31 thru 81 years apply aqua lymphatic therapy and women aged 38 thru 82 years participate in a dance and movement program.

With regard to the inclusion criteria, most of the studies selected women who had undergone unilateral breast surgery with axillary lymph node dissection due to breast cancer except for one study (Sandel et al., 2005), which did not describe the inclusion criteria and resulted in including four women with breast surgery. Women who were on the day of surgery and up to within 1 to 5 years after breast cancer treatment were selected, depending on the interventions. The status of receiving chemotherapy or radiotherapy was not consistently applied among the studies.

An inquiry into the intervention time and follow up showed that four studies designed interventions to follow immediately after breast surgery (postop 3 days, within 1 week, postop 2 weeks). Duration of the intervention ranged from 11 days at the shortest (Kilgour et al., 2008) to 13 weeks at the longest (Schmitz et al., 2010). One study by Na et al. (1999) did not set a certain duration of intervention; rather they intervened from the first day of surgery until the day of discharge, which resulted in 18 days of intervention on average for the experimental group. Follow-up and posttests were mostly performed immediately after the interventions and up to 12 months at the longest (Schmitz et al.). Posttests were performed only once in 5 studies while 6 other studies tested the outcomes at multiple time points (Table 3).

The measured variables varied and were classified as physical, psychological, physiological, or behavioral outcomes, as shown in Table 2. Quality of life (QOL) was the most frequently measured psychological outcome, evaluated in 5 of the 11 studies reviewed. Among physical outcomes, the range of motion (ROM) or shoulder mobility (n = 7) and arm volume or arm circumference (n = 7) were found to be measured most frequently. Interestingly, Schmitz et al. (2010) determined the effects of a weight lifting intervention by lymphedema onset measured by arm swelling and clinician evaluation. Behavioral outcomes such as adherence (n = 3) to the given intervention and the stage of change for exercise were also examined; further physiological outcomes of salivary markers and caloric intake were also noted.

The effects of the exercise intervention were profound in most of the studies; that is, multiple outcome variables of physical, psychological, physiological, and behavioral aspects were significantly

### Table 1 SIGN Checklist (N = 11)

<table>
<thead>
<tr>
<th>Items</th>
<th>Yes</th>
<th>No</th>
<th>Can not say</th>
<th>Does not apply</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The study addresses an appropriate &amp; clearly focused question.</td>
<td>11</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>2. The assignment of subjects to treatment groups is randomized.</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>3. An adequate concealment method is used.</td>
<td>7</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>4. Subjects &amp; investigators are kept “blind” about treatment allocation.</td>
<td>7</td>
<td>3</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>5. The treatment &amp; control groups are similar at the start of the trial.</td>
<td>10</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>6. The only difference between groups is the treatment under investigation.</td>
<td>11</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>7. All relevant outcomes are measured in a standard, valid &amp; reliable way.</td>
<td>11</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>8. What percentage of the individuals or clusters recruited into each treatment arm of the study dropped out before the study was completed?</td>
<td>5</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>9. All the subjects are analysed in the groups to which they were randomly allocated (often referred to as intention to treat analysis).</td>
<td>11</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10. Where the study is carried out at more than one site, results are comparable for all sites.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Note: SIGN = Scottish Intercollegiate Guideline Network.

* Excluded item in quasi-experimental study.
changed after the exercise interventions. Physiotherapy was found to be effective in improving outcomes such as the ROM, shoulder function, and pain regardless of the intervention dosages. However, its effect particularly on lymphedema was not found at 6 months of follow up (Beurskens et al., 2007; Na et al., 1999) but was evident at longer term follow up at 12 months (Torres Lacomba et al., 2010). This was consistent with the effects of multimodal exercise (composed of physical training and therapy) on cervical-shoulder ROM at 8-week post-intervention as well as weight lifting effects on lymphedema and strength found at the 12-month follow-up point. Meanwhile, 8 weeks of aerobic exercise was effective for most psychological and behavioral outcomes, even through 24 weeks after the intervention. However, no significant short- or long-term effects were shown for physical health indicators. Aqua lymphatic therapy also displayed similar results, given its effect on emotional and social QOL but not on physical QOL or limb volume after a 3-month intervention. Incidentally, dance and movement was neither effective for ROM or lymphedema, nor for health-related QOL; rather, it was only effective for breast cancer-specific QOL. Home-based rehabilitation improved some ROM movements but did not impact pain, lymphedema, or strength (Cho, Yoo, & Kim, 2006).

**Discussion**

This systematic review aimed to explore effective exercise interventions to improve the health outcomes of women who had...
<table>
<thead>
<tr>
<th>Author/country (yr)</th>
<th>Design</th>
<th>Sample (n)</th>
<th>Inclusion/exclusion criteria</th>
<th>Experimental group</th>
<th>Control group</th>
<th>Outcomes measured</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aerobic exercise</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Daley et al. (2007) UK</td>
<td>RCT</td>
<td>Total: 108 → 96</td>
<td>- Treated for BC 12–36 months previously</td>
<td>8 weeks/</td>
<td>Supervised</td>
<td>Exercise-placebo (n = 36)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- EG: 34 → 33 → 31</td>
<td>- Not regularly active</td>
<td>Baseline,</td>
<td>aerobic</td>
<td>Usual care (n = 38)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- CG 1: 36 → 34</td>
<td>- No metastases &amp; inoperable or active locoregional disease</td>
<td>8 weeks,</td>
<td>exercise</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- CG 2: 38 → 33 → 31</td>
<td></td>
<td>24 weeks</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>88.9%</td>
<td></td>
<td>Baseline,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. So et al. (2006) Korea</td>
<td>Quasi-experimental</td>
<td>Total: 32 → 26</td>
<td>- 6 weeks after unilateral mastectomy</td>
<td>6 weeks/</td>
<td>Aerobic dance using a flex-band</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- EG: 19 → 15</td>
<td>- Planned RT after surgery</td>
<td>Baseline, 6 weeks</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- CG: 13 → 11</td>
<td>- Aged under 60 years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>81.3%</td>
<td>- Intact cognitive function- No regular exercise in previous 3 months - No systemic disease</td>
<td>3 months/</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- EG: 16 → 15</td>
<td>- Intact cognitive function- No regular exercise in previous 3 months - No systemic disease</td>
<td>3 months/</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- CG: 32 → 32</td>
<td></td>
<td>Baseline,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>97.9%</td>
<td></td>
<td>3 months</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Aqua lymphatic therapy</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Dance &amp; movement</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Sandel et al. (2005) USA</td>
<td>RCT</td>
<td>-Surgery within 5 years -With surgeon's approval</td>
<td>12 weeks/</td>
<td>Dance &amp; movement program</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Baseline,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(continued on next page)
<table>
<thead>
<tr>
<th>Author/country (yr)</th>
<th>Design</th>
<th>Sample (n)</th>
<th>Inclusion/exclusion criteria</th>
<th>Experimental group</th>
<th>Control group</th>
<th>Outcomes measured</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Intervention duration/Time for measures</td>
<td>Contents</td>
<td></td>
</tr>
<tr>
<td><strong>Physiotherapy</strong></td>
<td></td>
<td></td>
<td></td>
<td>Wait list crossover during weeks 14 through 25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Beurskens et al. (2007)</td>
<td>RCT</td>
<td>Total: 30 → 29</td>
<td>Two weeks after surgery with ALND</td>
<td>3 months/6 months</td>
<td>Standardized physiotherapy</td>
<td>Physical</td>
</tr>
<tr>
<td>Netherlands</td>
<td></td>
<td>- EG: 60 → 59</td>
<td>Aged over 18 year</td>
<td>Baseline, 3 months</td>
<td>Leaflet flyer with advice &amp; exercise</td>
<td>Psychological</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- CG: 60 → 57</td>
<td>Pain over score 1 on VAS</td>
<td>6 months</td>
<td></td>
<td>Physical ROM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>96.7%</td>
<td>Moderate shoulder disability (3 or more on a 5 point scale)</td>
<td>12 months</td>
<td>+ educational strategy</td>
<td>Arm circumference</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Excluded if</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Previous contralateral BC surgery</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Insufficient Dutch language</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Torres Lacomba et al. (2010)</td>
<td>RCT</td>
<td>Total: 120 → 116</td>
<td>Within 1 week after unilateral surgery with ALND</td>
<td>3 weeks/4 weeks after surgery,</td>
<td>Early physiotherapy (MID, scar tissue massage, stretching, progressive active, action-assisted shoulder exercise)</td>
<td>Physical</td>
</tr>
<tr>
<td>Spain</td>
<td></td>
<td>- EG: 60 → 59</td>
<td>Excluded if</td>
<td>6 months</td>
<td></td>
<td>Psychological</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- CG: 60 → 57</td>
<td>- Without ALND</td>
<td>12 months</td>
<td>+ educational strategy</td>
<td>Physical ROM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>96.7%</td>
<td>- Bilateral BC</td>
<td></td>
<td></td>
<td>Arm circumference</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Systemic disease</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Locoregional recurrence</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Any contraindication to</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>physiotherapy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Na et al. (1999)</td>
<td>Quasi-experimental</td>
<td>Total: 33 → 33</td>
<td>BC scheduled for mastectomy or modified radical mastectomy &amp; ALND</td>
<td>18 days/6 weeks</td>
<td>Early rehabilitation program + home exercise prescription</td>
<td>Physical</td>
</tr>
<tr>
<td>Korea</td>
<td></td>
<td>- EG: 20 → 20</td>
<td>Excluded if</td>
<td>Baseline at preop, postop 3 days,</td>
<td>Instruction for ROM &amp; postural exercise</td>
<td>Psychological</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- CG: 13 → 13</td>
<td>- Metastases</td>
<td>at discharge, postdischarge 1 month</td>
<td></td>
<td>Psychological problems</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100%</td>
<td>- Inability to stand for 3 min</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Multimodal exercise</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spain</td>
<td></td>
<td>- EG: 38 → 32</td>
<td>Finished co-adjuvant treatment</td>
<td>Baseline, 8 weeks</td>
<td>Physical therapy (stretching + massage)</td>
<td>Cancer-related fatigue</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- CG: 40 → 35</td>
<td>except hormone therapy</td>
<td>6 months</td>
<td>+ Multimedia instructional package with DVD after 8 weeks</td>
<td>Psychological</td>
</tr>
<tr>
<td></td>
<td></td>
<td>70.5%</td>
<td>Not having active cancer</td>
<td></td>
<td></td>
<td>Physical ROM</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Oncologist's referral for 4 or 5 physical findings</td>
<td></td>
<td></td>
<td>Arm circumference</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Excluded if</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Undergoing CT or RT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Chronic or orthopedic disease</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Uncontrolled hypertension</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Comprehensive rehabilitation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Korea</td>
<td></td>
<td>- EG: 34 → 28</td>
<td>Excluded if</td>
<td>Baseline, 10 weeks</td>
<td>+ Exercise (group &amp; home-based)</td>
<td>QOL</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- CG: 31 → 27</td>
<td>- Within 2 years after mastectomy</td>
<td></td>
<td>+ Peer support group activity</td>
<td>Psychological adjustment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>84.6%</td>
<td>- No recurrent or progressive disease</td>
<td></td>
<td></td>
<td>Physical ROM</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Completion of CT, RT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Without current hormone therapy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- No mental or systemic disease</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
- EG: Experimental group
- CG: Control group
- ALND: Axillary lymph node dissection
- VAS: Visual Analog Scale
- MLD: Manual Lymph Drainage
- MRT: Magnetic Resonance Imaging
- CT: Chemotherapy
- RT: Radiation Therapy
- QOL: Quality of Life
undergone breast cancer treatment. From a search of available databases, 11 studies were included for analysis. Among them, three were quasi-experimental studies and 8 were RCTs (Table 2). The overall quality was graded as (++) in 10 studies and one quasi-experimental study was evaluated as (+), which showed fairly good quality of the identified studies. Notably, 3 Korean studies were identified, given that the search criterion for language was English or Korean. The present review thus contributes English-language information to the research community on these studies heretofore known only to Korean researchers. Despite no cultural differences in intervention types and outcomes between the Korean and the Western studies, the 3 Korean studies all utilized a quasi-experimental design, which requires strengthening of research methods in the future.

In the first data search before applying all the exclusion criteria, hundreds of studies were noted to have focused on exercise for women after breast cancer surgery. Exercise with physical therapy has been known to be beneficial for shoulder ROM and shoulder function when implemented early after surgery (McNeely et al., 2010). This review also identified that any type of structured and supervised exercise could improve shoulder mobility, range of motion, or its function even in a relatively short-term period. Particularly, three exercise interventions guided by physiotherapy were initiated as early as from the day of surgery to 2 weeks after surgery (Beurskens et al., 2007; Na et al., 1999). These demonstrated the short-term effects on upper body functioning and long-term effects at 1 year on lymphedema. It shows that immediate intervention after breast surgery is applicable, though its long-term effect needs to be further examined to verify the significance and effectiveness to prevent lymphedema.

Multimodal exercise and comprehensive rehabilitation including physical therapy also had physical and psychological health effects. Compared to those exercise modalities, aerobic exercise and dance/movement are thought to be effective and more suitable in improving women’s psychological condition. As revealed in the reviewed studies, the psychological effects of exercise cannot be ignored; thus the short- and long-term benefits of exercise need to be explored further, along with its relationships with physical and behavioral health indicators. Then, depending on the women's potential health risks or the goal of care target after breast cancer treatment, more feasible interventions could be applied to improve those women's health conditions.

Meanwhile, unlike the consistent findings on the effects of exercise on upper limb functioning, there has been a long-standing debate on the safety and effects of exercise on lymphedema. According to the position statement of the National Lymphedema Network Medical Advisory Committee (2011), exercise is essential for effective lymphedema management in women after breast cancer treatment. From this review, 2 out of 7 studies that measured lymphedema at 1 year after the intervention did show the exercise effect while the remaining 5 studies failed to find effects by measuring it at less than the 6-month point. Typically, lymphedema has a tendency toward gradual onset occurring within 2 years postoperatively among 42% of women with lymphedema (Norman et al., 2009), or showing an incidence of 20.7% (Clark et al., 2005) and 32% (Paskett et al., 2007). Thus, a longer follow-up period is recommended to verify the effects of exercise on lymphedema in women after breast cancer treatment. In addition, the strategy of examining two indicators of lymphedema onset by measuring the arm volume and by a clinician’s diagnosis is thought to be meaningful. Previous research could have had limitations in following up the occurrence of lymphedema or intervention effects on the occurrence in study settings. Thus if more clinical data are collected, it could be more feasible to prescribe exercise aimed to prevent lymphedema onset according to the individuals risk factors.
### Table 3  Details of Exercise Interventions and Effectiveness

<table>
<thead>
<tr>
<th>Author (yr)</th>
<th>Intervention</th>
<th>Main/specific strategies</th>
<th>Effective</th>
<th>Not effective</th>
<th>Evaluation</th>
<th>Quality grade</th>
</tr>
</thead>
</table>
| 1. Daley et al. (2007) | Supervised aerobic exercise group (n = 34, EG) | - one-on-one session with an exercise specialist  
- 50 min/session, 3 times/week for 8 weeks  
- HR & RPE assessment every 2 min  
- moderate-intensity exercise (65–85% of age-adjusted HR & RPE of 12–13)  
- cognitive-behavioral techniques for exercise behavior change | At 8 weeks  
QOL: EG, CG1 > CG2  
Fatigue: CG1 > CG2  
Physical self-worth:  
EG, CG1 > CG2  
Aerobic fitness score:  
EG, CG1 > CG2 | Attractiveness of body  
Physical strength competence  
Percentage of body fat  
BMI | Significant, short-term, beneficial effects on QOL & psychological outcomes in previously inactive women | ++ |
| | Exercise-placebo group (n = 36, CG1) | - one-on-one session with the same exercise specialist  
- 50 min/session, 3 times/week for 8 weeks  
- light-intensity body conditioning/stretching  
- HR & RPE assessment every 5 min  
- no exercise counseling or behavioral change advice | At 8 weeks & 24 weeks  
Depression: EG, CG1 > CG2  
Physical conditioning competence:  
EG > CG1  
Increasing physical activity:  
EG, CG1 > CG2 | | |
| | Usual care group (n = 38, CG2) | - continued with their lives as usual | At 24 weeks  
Satisfaction with life: CG1 > CG2  
Stage of change for exercise:  
EG, CG1 > CG2 | | |
| 2. So et al. (2006) | Aerobic dance group (n = 19) | - group led by a graduate student in dance major  
- 40–50 min/session, 3 times/week for 6 weeks  
- gradual increase in the intensity (60–70% more)  
- using a flex-band | Body image  
Cardio-pulmonary function  
- THR  
- Periods till THR  
- VO2 max  
Shoulder ROM | | | + |
| | Control group (n = 13) | - no exercise | | | | |
| 3. Tidhar & Katz-Leurer (2010) | Aqua lymphatic therapy group (n = 16) | - group led by a clinical physical therapist  
- 1.2 m deep pool at 32–33°C  
- 45 min/session, once a week for 8 weeks  
- Self-management | Adherence  
Self-massage  
QOL  
Emotional, social  
Physical  
Limb volume | Need to address long-term effect of aqua lymphatic therapy on arm volume | ++ |
| | Control group (n = 32) | - Self-management | | | | |
| 4. Sandel et al. (2005) | Dance & movement group (n = 19) | - group led by a registered dance/movement therapist, a certified Lebed method instructor  
- Total 18 sessions for 12 weeks; 2 sessions/week for the initial 6 weeks & 1 session/week for an additional 6 weeks  
- 50 min or longer from warm-up to wrap-up  
- no program in weeks 13–25 | At 13 weeks  
QOL (Breast cancer-specific)  
At 26 weeks  
QOL (Breast cancer-specific) | Health-related QOL  
Shoulder ROM  
Arm circumference  
Body Image Scale | The only study including bilateral BC cases | ++ |
| | Wait list control group (n = 19) | - no program in weeks 1–12  
- involved the program in weeks 14–25 by the same instructor | | | | |
| **Physiotherapy** | | | | | | |
5. Beurskens et al. (2007)  
*Physiotherapy group (n = 15)*  
- individual physiotherapy in a private practice  
- 1–2 session/week for the first 3 weeks for 3 months, then once a fortnight or less, totaled 9 treatments  
- exercises for arm/shoulder coordination, muscular strength, lymphedema prevention, physical condition & massage  
- home exercises for 10 min/day  

*Control group (n = 15)*  
- leaflet flyer about arm/shoulder for the first week following surgery

6. Torres Lacomba et al. (2010)  
*Early physiotherapy group (n = 60)*  
- by a physiotherapist  
- 3 times/week for 3 weeks  
- care at home  

*Control group (n = 60)*  
- printed materials

7. Na et al. (1999)  
*Rehabilitation program group (n = 20)*  
- 40 min of physical therapy + 30 min of exercise, 4 times/day  
- 1st postop day: postural exercise, assisted ROM, arm use with light, functional activities  
- from postop day to discharge: physical modalities (PES, heat therapy, cold therapy) + ROM exercise if lymphedema; pneumatic compression for 30 min to 2 hrs/day, elevation, bandage, manual massage if pain; trigger point injection after drain remove, progressive-resistive exercise  
- at discharge: printed materials provided for self exercise  
- home exercise for 4 weeks  

*Control group (n = 10)*  
- self-exercise program and proper positioning by the physiatrist

**Multimodal exercise**  
8. Cantarevo-Villanueva et al. (2011)  
*The CUIDATE program group (n = 38)*  
- 24 hr of individual physical training (aerobic training) and 12 hr of physical therapy (stretching & massage)  
- 90 min/session, 3 times/week for 8 weeks  
- 1:3 or 1:4 ratio of therapists to patients  
- DVD instructional package after 8 weeks

*Usual care group (n = 40)*  
- recommended by the oncologist in relation to healthy lifestyle

**Comprehensive rehabilitation**  

---

**5. Beurskens et al. (2007)**  
- **At 3 months**  
  - QOL  
- **At 3 & 6 months**  
  - Functional shoulder impairment  
  - Pain  
  - Shoulder mobility  
  - Disability in daily life  

**At 3 months**  
- Arm volume  
- Grip strengths  

**Need for a long-term follow-up with a larger sample for a clearer effect on lymphedema occurrence.**

**6. Torres Lacomba et al. (2010)**  
- **At 12 months**  
  - Secondary lymphedema  
  - Arm volume ratio  

**Effective to prevent and reduce secondary lymphedema. Longer term effect needs to be studied.**

**7. Na et al. (1999)**  
- **At discharge**  
  - Upper arm circumference  
  - Postoperative complications  
  - Psychological problems  

**At post-discharge 1 month**  
- Shoulder internal rotation  
- Functional activities  

No comparison found for psychological problems

**8. Cantarevo-Villanueva et al. (2011)**  
- **At 8 weeks**  
  - Cancer-related fatigue  

**At 8 weeks**  
- Cervical ROM (2 out of 4)  
- Shoulder ROM (4 out of 6)  
- Physical activity  
- Salivary markers - cortisol, IgA, flow rate  

**Effective at short-term and 6-month follow-up for decreasing fatigue**

**Comprehensive rehabilitation**  

---

(continued on next page)
<table>
<thead>
<tr>
<th>Author (yr)</th>
<th>Intervention</th>
<th>Outcomes</th>
<th>Evaluation</th>
<th>Quality grade</th>
</tr>
</thead>
</table>
- 3 times/week for 10 weeks  
- once/week, 90 min, education by a group of specialists followed by 60 min of group activity  
- 2 times/week, 90 min, exercises by physiatrist, an exercise prescription manager, a registered fitness instructor  
- home-based exercise of stretching | QOL  
Psychosocial adjustment  
Shoulder ROM *(4 out of 5 movements)* | Feasible and effective for early-stage breast cancer patients | ++ |

Control group *(n = 31)*  
- no group program

- a home exercise video  
- 11-day program  
  postop 3–9 days: 3 sets of ROM and flexibility exercises for 5–7 min/set  
  postop 10–14 days: 2 sets/day for 10–15 min/set  
- daily logbook | Shoulder ROM *(2 out of 3 movements)*  
Adherence rate  
8 women (40%) completed all sets | Pain  
Forearm circumference  
Shoulder strength  
Grip strength | The shortest intervention duration among those reviewed | ++ |

Usual care group *(n = 20)*  
- usual and standard information *(written & verbal)*

Weight lifting  
11. Schmitz et al. (2010) | Weight lifting group *(n = 77)*  
- small group at a fitness center led by certified fitness professionals  
- 90 min/session, 2 times/week for 13 weeks  
  3 sets  
  ×10 times of exercises with equipment  
- 9 months of unsupervised exercise | BCRL by arm swelling  
Strength (upper)  
Adherence (79% attendance rate) | BCRL as defined by clinician  
Strength (lower)  
Anthropometry (weight, BMI fat mass, lean mass)  
Dietary intake  
Physical activity | The first well-powered clinical trial to demonstrate no increased risk of lymphedema onset with weight lifting, with possible reduced likelihood of increased arm swelling among higher risk women with 5 or more nodes removed | ++ |

Control group *(n = 77)*  
- no exercise, keeping baseline level of exercise

Note: HR = heart rate; RPE = rating of perceived exertion; EG = experimental group; CG = control group; BC = breast cancer; QOL = quality of life; ROM = range of motion; THR = target heart rate; PES = percutaneous electrical stimulation; BCRL = breast cancer-related lymphedema; BMI = body mass index.
With regard to the intervention strategy, structured instruction and/or supervision seems to be more effective when compared to instruction via a pamphlet or no exercise instruction. This is thought to relate to the level of compliance with or adherence to the given intervention because home exercise driven by the participant herself with a video tape reached a 40% adherence rate even during only 11 days of intervention, which differed from the 79% adherence level through 13 weeks under a fitness professionals supervision. Furthermore, the longer effect of the latter intervention was significantly more effective with an 87% retention rate even after 1 year of follow up.

Lastly, evaluation of the efficiency of exercise interventions should also be determined. Most of the studies emphasized the outcome effects; however, reasonable dosage/input, manpower needed, anticipated outcomes, and measurement points should be future concerns in determining effective and efficient exercise interventions for women with breast cancer treatment.

Conclusion

An abundant number of exercise interventions have been conducted for women with breast cancer treatment. Thus, it was necessary to analyze any substantial effects of exercise, toward the eventual goal of identifying efficient and effective intervention modes for future patients. Exercise is effective and beneficial for improving women’s physical, physiological, and psychological health outcomes as well as women’s behavioral changes. Based on the outcomes, nursing education and practical guidelines for exercise should be expanded for women who have undergone breast cancer treatment. Exercise dosages, duration, the feasibility and efficiency of delivery of exercise, and target health outcomes based upon the strengths of each exercise should be refined in future RCTs. Utilizing multiple databases containing a larger number of languages would also expand the research communities knowledge of well-implemented RCTs.

Conflict of interest

All authors in this manuscript declare no potential conflicts of interest.

Acknowledgment

This research was supported by Basic Research Program through the National Research Foundation of Korea (NRF) from the Ministry of Education, Research, Science and Technology (No. 2011-0014609).

References


Cho, O. H., Yoo, Y. S., & Kim, N. C. (2006). Efficacy of comprehensive group reha-

bilitation for women with early breast cancer in South Korea. Nursing and Health Sciences, 8(3), 140–146.


administered, home-based exercise rehabilitation program for women following a modified radical mastectomy and axillary node dissection: a pre-


vivors. Cancer Epidemiology, Biomarkers and Prevention, 16(4), 775–782.


