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Effect of Aquatic Exercise on Fatigue, Fitness, Arm Edema, Levels of Distress, and Quality of Life among Breast Cancer Survivors

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Abstract

The purpose of this study was to evaluate the effect of a recreational therapy aquatic intervention on physical and psychosocial performance of breast cancer survivors. Eligible participants were assigned to either a water exercise group or a control group who received standard care treatment for breast cancer. The intervention group attended aquatic exercise sessions three times per week for eight weeks in a heated outdoor pool. Sessions lasted 50 minutes in duration. The aquatic exercise group significantly improved their endurance, body mass, level of distress, and total score for fatigue. No significant differences occurred in the control group. Social validity responses found that participants believed the exercise sessions improved physical fitness and that they desired to continue the program. Findings suggested that an aquatic exercise program may improve some physical and psychosocial measures among breast cancer survivors. The relatively small sample and quasi-experimental design limited capability of making greater generalizations.

Keywords: aquatic exercise, aquatic rehabilitation, physical outcomes, quality of life, recreational therapy, breast cancer survivors

Introduction

The World Health Organization (WHO) has identified breast cancer as the top cancer in women in the world (WHO, 2019). WHO estimated that worldwide over 2.1 million women had been diagnosed with breast cancer in 2018 with rates increasing globally. In the United States, breast cancer is the most common cancer among women except for skin cancers (American Cancer Society [ACS], 2018). About one in eight (12%) women in the United States will develop invasive breast cancer during their lifetime. In 2018 alone more than 3.1 million breast cancer survivors were living in the United States with an estimated 266,120 new cases of invasive breast cancer diagnosed (ACS, 2018). According to the WHO and the ACS, contemporary cancer treatments have improved survival rates of individuals with breast cancer. Unfortunately, these treatments often resulted in varied physiological and psychosocial issues that negatively impacted quality of life (ACS 2015; Mols, Vingerhoets, Coebergh, & van de Poll-Franse, 2009; Klein, Mercier, Abeilard, Puyraveau, Danzon, Dalstein et al, 2011). With a stable incidence of breast cancer and a growing number of survivors (ACS, 2018), efforts directed towards improving physical and psychosocial function are important.

Characteristics of Breast Cancer

Women with breast cancer face numerous physical and psychosocial challenges during and post cancer treatment. Medical treatments that include chemotherapy and radiation often have resulted in decreased physical fitness and physical activity performance as well as decreased self-esteem, mood alterations, stress, anxiety and depression (ACS, 2015). These symptoms were associated with reduced function including decreased physical activity. Increasingly, breast cancer care has been directed toward developing activity interventions to improve overall quality of life as well as longevity (Brown, Byers, Doyle, Courneya, Demark-Wahnefried, Kushi, et al., 2003; WHO, 2013).

The majority of breast cancer survivors encounter a variety of physical symptoms after finishing cancer treatment that may affect their quality of life. These symptoms include dizziness, insomnia, lymphedema, and discomfort at the incision site (Chung, 2008). Chung added that many survivors have to deal with decreased upper body mobility and strength, weight gain, and osteoporosis. Breast cancer survivors also have demonstrated various cancer-related symptoms such as reduced function, pain, and fatigue (Spector, Battaglini, Alsobrooks, Owen & Groff, 2012). Fatigue is the most common symptom among long-term cancer survivors (Bower et al, 2006). Fatigue is commonly associated with feelings of psychological distress and reduced quality of life (Galiano-Castillo, Ariza-García, Cantarero-Villanueva, Fernández-Lao, Díaz-Rodríguez, & Arroyo-Morales, 2014; Groenvold et al., 2007). Distress, which includes anxiety, depression, fatigue and fear of recurrence, commonly accompanies the diagnosis and treatment of breast cancer (Reddick, Nanda, Campbell, Ryman, & Gaston-Johanasson, 2005; Stanton, 2006; Waldrop, O'Connor, & Trabold, 2011). Physical symptoms as well as changes in mood state, characterized by fear and psychological distress, can influence the lives of individuals who survive breast cancer (Allen, 2002; Burnet & Robinson, 2000; Specter et al. 2012).

Breast Cancer and Exercise

Evidence has supported the objective of maintaining pre-diagnosis physical activity levels for better quality of life among breast cancer survivors (Voskuil, van Nes, Junggeburt, van de Velde, van Leeuwen, & de Haes, 2010). A number of authors emphasized that exercise programs for individuals recovering from breast cancer should be designed to improve fitness and quality of life (Cheema & Gaul, 2006; Smith, et al., 2009). Exercise has been shown to reduce the risk of cancer recurrence among cancer survivors (Warburton, Nicol, & Bredin, 2006). Exercise also can improve mood, reduce fatigue, and enhance social well-being among survivors (Bicego, Brown, Ruddick, Storey, Wong, & Harris, 2009; Moadel, Shah, Wylie-Rosett, Harris, Patel, Hall, & Sparano, 2007; Smith, Alfano, Reeve, Irwin, Bernstein, Baumgartner, et al., 2009; Spector, Battaglini, Alsobrooks, Owen, & Groff, 2012). Social well-being is important because it is linked to improved quality of life among breast cancer survivors (Galvao & Newton, 2005; Kwan, Ergas, Somkin, Quesenberry, Neugut, Hershman, et al., 2010; Mols, Vingerhoets, Coebergh, & van de Poll-Franse, 2009).

Multiple systematic reviews of physical activity interventions among cancer

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survivors exist. These meta-analyses have focused on varied outcomes including fitness, fatigue, and quality of life. For example, McNeely, et.al (2006) examined the literature pertaining to the effects of exercise on breast cancer patients and survivors. The authors included randomized control trials that examined the effects of exercise interventions for breast cancer patients or survivors on fitness, physical functioning, quality of life, and fatigue. Of the 136 studies identified, only 14 met all the inclusion criteria. Despite significant heterogeneity and small samples, the outcomes were positive. Analyses of physical functioning, physical well-being, and quality of life indicated large effect sizes (ES) of .84 resulting from exercise. Pooled results examining the effect of exercise on fatigue showed a moderate to large ES of .72.

In a follow-up study, Speck, Courneya, Masse, Duval, and Schmitz (2010) updated and extended their 2006 meta-analysis that examined the impact of community-based exercise on cancer survivors. Findings from 82 studies were reviewed and weighted mean effect sizes (WMES) were derived from 66 quality studies for 60 outcomes. The majority of interventions were 5 weeks with 40% of them lasting longer than 3 months in length. Breast cancer was the most common diagnosis (83%) among study participants. The findings showed a large effect size for physical activity interventions post-treatment on upper and lower body strength (WMES = .99 & .9, $p < .0001$). Moderate effects on fatigue and breast cancer specific concerns were also found (WMES = -.54 & .62; $p = .003$). A small to moderate effect was seen for aerobic fitness, muscular strength, quality of life, anxiety, and self-esteem. The authors found that there were health benefits from physical activity during and post cancer treatments in general. They concluded that while exercise was effective to improve quality of life, cardiorespiratory fitness, function, and fatigue in breast cancer survivors and patients, larger trials with better study quality and longitudinal studies were needed.

In a similar analytical effort, Duijts, Faber, Oldenburg, Beurden, and Aaronson (2011) conducted a meta-analysis of 66 studies to examine the effectiveness of behavioral techniques (42 studies) and exercise (17 studies) on psychosocial function and health-related quality of life (HRQoL) among breast cancer patients and survivors. Fifty-six studies were included. Eligible for inclusion were randomized control trials that addressed stated behavioral techniques (i.e., therapy, relaxation techniques, biofeedback, and counseling) and physical exercise. Statistically significant results were found for the effect of behavioral techniques on fatigue (ES=1.158), depression (ES=-.336), anxiety (ES = -.346), body image (ES = .280), and HRQoL (ES = .298). The authors concluded that while future research on the effect of physical exercise was needed, the preliminary results indicated that physical exercise and behavioral techniques improved psychosocial functioning of breast cancer survivors.

Less research has occurred on the effect of exercise on lymphedema. The occurrence of lymphedema varied widely and may have resulted from breast cancer surgery that included the removal of the auxiliary lymph node or follow up radiation. Common symptoms involved edema, discomfort, pain, tightness, heaviness, greater sensitivity to touch, lack of sensation in the affected arm, and a diminished overall function (Tidhar & Katz-Leurer, 2009). Tidar and Katz-Leurer reviewed literature that assessed the safety of various exercises and effects on arm volume for individuals with lymphedema. Overall, Tidar and Katz-Leuer found that research indicated that combined exercise and deep breathing might have a positive effect on edema whether the participants performed exercise with or without compression sleeves.

Exercise Activity in the Water

Exercise in the water is a viable medium for safe and effective improvements in levels of pain, mobility, fatigue, and mood state (Becker, 2009; Broach, 2016). Hydrodynamic principles facilitate a safe exercise venue for women who are breast cancer survivors. The properties of the water allow for movement that is difficult for many individuals on land. I discuss in the next three paragraphs several important properties of buoyancy, viscosity, and hydrostatic pressure that may impact aquatic exercise as well as mood effects that are important for meaningful water interventions for individuals who are breast cancer survivors.

First, water properties of buoyancy and viscosity allow for a progressive exercise program from assisted and resisted movements (Broach & Dattilo, 1996). Viscosity is the resistance that occurs between molecules of a liquid that affects the body as it moves through the water. The faster the body moves through the water the greater resistance is experienced, but that resistance drops to zero almost immediately when a movement stops (Poyhonen, Keskinen, Hautala, & Malkia, 2000). Buoyancy allows a reduction in joint compression forces during a client's water activity allowing for increased movement with less pain. The aquatic instructor can use buoyancy to assist or resist a movement for range of motion and strengthening activities.

Second, hydrostatic pressure provides a consistent compression gradient that can assist in decreasing edema and retuning lymph fluid into the vascular system (Ambroza & Richley-Geigle, 2010; Tidhar, Shimony, & Drouin, 2004). This pressure is equal around a body at a given depth while it increases with the depth of the water. Becker (2011) added that a person immersed to a depth of 48 inches is subjected to a force equal to 88.9mmHg (slightly greater than typical diastolic blood pressure) resulting in improved circulation and reduction in edema in the extremities.

Finally, research has indicated that aquatic immersion can result in mood changes associated with parasympathetic nervous system activity becoming more prevalent than sympathetic nervous system activity (Becker, 2011). Becker cited various studies that yielded findings specific to improved mood states and increases in plasma dopamine levels from warm water immersion or water exercise. Similarly, Becker stated that the literature strongly indicated both anxiety and depression were reduced after water- and land-based exercise. Becker contended that the important outcomes associated with mental health benefits of immersion needed further study; however, the effect produced appeared to have important implications for positive emotions from aquatic immersion.

Breast Cancer Recovery and Aquatic Exercise

Studies investigating the appropriate land-based exercise programs to improve health and quality of life in breast cancer survivors have been discussed in the literature. Some land-based physical activities are difficult or contraindicated for some individuals recovering from breast cancer because of the stress placed on their muscular or skeletal systems (Becker, 2011; Broach, 2016). Becker added that some individuals were unable to independently or fully perform some land-based physical activities because of limited range of motion, pain, and the effects of gravity-limiting movements. Water immersion decreases axial loading, and the effects of buoyancy allows movement difficult on land (Becker, 2011). Therefore, aquatic exercise (AE) is indicated for appropriate clients because, in a supervised program, they can participate with (a) less stress on skeletal or muscular system, (b) less energy expenditure, (c) improved performance, (d) less guarded actions associated with fear of falling, and (e) improved range of motion using buoyancy and warmth of the water (Broach, 2016). Also, AE as a complement to other therapies is a modality that is more conducive to independent participation in a challenging activity that may facilitate positive emotions and thus adherence to physical activity participation (Broach, Dattilo, & McKinney, 2007). Exercise in the water can be a safe and effective treatment for physical and psychosocial outcomes. While potential benefits of aquatics for individuals have been identified, only a few published studies have addressed aquatic interventions for individuals with breast cancer. I have described several of the randomized control trials in the next paragraphs.

Cantarero-Villanueva, Fernández-Lao, Caro-Morán, Morillas-Ruiz, Galiano-Castillo, Díaz-Rodríguez, et al. (2013a) investigated the effectiveness of an 8-week aquatic program on cancer-related fatigue as well as physical and psychological outcomes in breast cancer survivors. Using a randomized control trial, breast cancer survivors (N=68) were randomly assigned to either an experimental (aquatic exercise group in deep water pool) group or a control (usual care) group. The intervention group attended aquatic exercise 3 times per week for

8 weeks in a heated deep swimming pool for 60 minutes each session. Immediately after the program, the aquatic exercise group showed a large effect size in the total fatigue score of the Piper Fatigue Scale, trunk curl endurance, and leg strength, but no effects on vigor, confusion, and disturbance of mood. At the 6-month follow-up period, the aquatic exercise group maintained large to small effect sizes in fatigue scores, multiple sit-to-stand test, and trunk curl static endurance, but negligible effects for mood. Findings indicated that this aquatic exercise program conducted in deep water was effective for improving cancer-related fatigue and strength in breast cancer survivors.

Cantarero-Villanueva, Fernandez-Lao, Fernandes-de-las-Penas, Lopez-Barajas, Del-Moral, Avila, et al. (2013b) also conducted a study to investigate the impact of aquatic exercise on pressure pain threshold in breast cancer survivors with hormone therapy-associated arthralgia. Arthralgia is one of the most prevalent causes reducing adherence to hormone therapy in breast cancer patients. This single-blind, control trial included 40 women (ages 29-71 years) who were assigned alternately to either aquatic exercise in a chest-high pool or usual care while on the waiting list; control patients received aquatic therapy treatment later. The two-month aquatic intervention consisted of 24 sessions, three days per week for one hour each session. Participants experienced a decrease in pressure pain threshold measured in neck, hands, shoulders and legs, as measured by algometry pressure and waist circumference. Cancer-related fatigue and body mass index (BMI) did not show significant improvement. These data suggested that hydrotherapy in a chest-high pool might reduce the pain threshold and waist circumference in breast cancer survivors with hormone therapy-associated arthralgia.

Fernandez-Lao, Cantarero-Villanueva, Ariza-Garcia, Courtney, Fernández-de-las-Peñas, and Arroyo-Morales (2013) conducted a study to compare the effects of land versus water exercise programs on body composition and breast cancer specific quality of life. The examination included 98 participants who were assigned to a control, land exercise, or aquatic exercise group. Both exercise groups participated in an 8-week program of exercise. An ANCOVA revealed significant differences in body fat percentages and lean body mass with participants in the land exercise exhibiting a greater decrease in body fat percentage than those in water exercise. In addition, participants in the water exercise group experienced a significantly greater decrease of breast symptom ratings on the Breast Cancer Specific Qualify of life Questionnaire than those in the land exercise and control groups. The authors concluded that land exercise produced a greater decrease in body fat and an increase in lean body mass whereas water exercise was better for improving breast symptoms associated with quality of life.

In another study that examined the effects on pain, Canterero-Villanueva, Fernandez-Lao, Fernandes-de-las-Penas, Lopez-Barajas, Del-Moral, Avila, Isabel de la Llave-Rincon, and Arroyo-Morales (2012) conducted a randomized control study to examine the effects of an eight-week (3x/wk) water program on cervical and shoulder pain, pressure sensitivity, and trigger point presence in participants who had recovered from breast cancer. Sixty-six participants were assigned to a control or water exercise group. There was a significant between-group improvement (e.g., decrease) in shoulder and neck pain for the water exercise group. Some pain threshold differences in some of the other muscle and joint areas were examined but the findings were not consistent.

Tidhar and Katz-Leurer (2010) conducted a single-blind randomized trial to examine the effects of a specific aquatic therapy strategy (ALT) for individuals with lymphedema. Forty-eight women participated in the study. The control group was instructed to perform self-management treatment while the study group participated in aquatic therapy for three months. No episodes of arm infection or exacerbation in limb volume occurred during the study. ALT had a significant immediate effect on limb volume but no long-term effect. The adherence rate to ALT was significantly higher in the treatment group compared to the control group. Self-management and quality of life improved with the aquatic therapy strategy as well. Authors recommended that further studies were needed to address the effect of ALT on limb volume among women who do not adhere to self-management and in women who suffer from severe lymphedema.

Purpose and Rationale

Breast cancer is one of the most common cancers to occur in the United States. The majority of cancer patients encounter a number of physical and psychological difficulties after finishing cancer treatment including distress, fatigue, physical ability, and quality of life. Increasingly, cancer care has been directed toward developing interventions to improve overall quality of life as well as longevity (ASC, 2015; Brown et al., 2004) These symptoms are associated with reduced function including decreased physical activity. Physical exercise has been identified as a potential intervention to improve quality of life and health of women with breast cancer (Kendall, Mahue-Giangreco, Carpenter, Ganz, & Bernstein 2005; Duijts, Faber, Oldenburg, van Beurden, & Aaronson, 2010). While water exercise has been identified as beneficial for physical and psychological outcomes (Broach, 2016), and the potential benefits for individuals recovering from BC were discussed in a number of anecdotal manuscripts, only five studies were found that focused on aquatic interventions for individuals with cancer. Therefore, in light of the fact that the prevalence of breast cancer is expected to increase and despite improvements in surgical methods (ASC, 2015), there is a need for evaluating quality of life interventions for breast cancer survivors. Consequently, the purpose of this study was examine the effects of a recreational therapy AE intervention on strength, endurance, fatigue, quality of life, and arm edema of breast cancer survivors.

Method

Participants and Setting

The participants included 19 women (12 in the exercise group; 7 in the control group) whose ages ranged from 49-70 years old. To be eligible, the participants had a doctor's permission to participate, a diagnosis of breast cancer, received breast cancer treatment, and were at least 8 weeks post-surgery. They also no longer had an active cancer, had not participated in another AE prior to this study, and had no other medical condition precluding their participation as indicated by a health history questionnaire. Individuals were excluded if they were receiving radiation during the study period, had uncontrolled blood pressure, had very low white cell counts, or had any open wounds.

Participants were selected from a pool of volunteers in a mid-size city in the Southeast United States. They were recruited by email and written announcements from breast cancer survivor support groups, physicians, and the local chapter of the American Cancer Association. The study was conducted at the outdoor pool of a university recreation center. The pool maintained a water temperature of 86 to 88º F (30-31º C) during the program. All participants obtained physician's approval to participate and completed required registration forms. The required forms included: (a) Health History, (b) Recreation Center Application and Release, (c) Consent to be Photographed, and (d) Research Informed Consent.

Design

This study was a non-randomized control trial (i.e., convenience sample). Eligible participants who agreed to participate volunteered for one of the two groups based on availability. These groups included the water exercise group and the control group who received the usual care treatment for breast cancer. The individuals assigned to the control group who finished the period of eight weeks for this study were given free memberships to the University Recreation Center for eight weeks after the study and provided with aquatic exercise instruction by request.

The Intervention

The BC Aquatic Exercise program included exercises from Broach, Dattilo, and McKinney (2007), Aaronson and Essart (2007), and Ai Chi (Sova & Konno, 2003). The water exercise program was held at 11:00 a.m. three times per week over an eight week (24 sessions). Each 50-minute session included a seven-minute warm-up, seven minutes of upper extremity exercises, eight minutes of upper body exercises (optional barbells), eight minutes of lower extremity exercises, ten minutes of low intensity endurance and core stability exercises, and ten minutes cool down that included stretching and relaxation exercises (see Table 1). The primary investigator who is certified in Aquatic Therapy and Ai Chi trained and supervised the aquatic exercise instructor, an experienced Aquatic Exercise Association instructor, in the intervention process.

Table 1. Summary of BC Aquatic Exercises for Recovery

A. Walking warm-ups in chest deep water (wall or touching and instructor's hands may be needed as a starting point (approximately seven minutes)
   1. Ai Chi Posture and diaphragmatic breathing exercises (promotes drainage of lymphatic fluid). Inhale deeply and exhale fully and slowly.
   2. Walking forward (heel, ball, toe): Move arms in either a unilateral movement (e.g., crawl stroke) or a symmetrical movement (e.g., breaststroke).
   3. Walking backward (heels down): Reach arms behind then push the water forward during walking.
   4. Walking forward and backward with high knees: Move arms unilaterally or bilateral while walking.
   5. Slide stepping: Use hip abduction and adduction, crossing at the ankles for an increased sacra-iliac stretch. Use bilateral shoulder abduction to accompany hip abduction and shoulder adduction to accompany hip adduction.
   6. Hamstring heel slap: While walking forward touch hand to opposite heel.
   7. Crab Walking: Walking forward at a diagonal forward, backward, left to right, and right to left
   8. Grapevine: Walking laterally while crossing the outside foot over and then behind the inside foot

B. Upper body exercises (approximately seven minutes)
   1. Chin tucks: Perform neck flexion and extension to neutral.
   2. Ear to shoulders: Hold lateral flexion of the neck at range. Always rest at neutral briefly before flexing to the opposite side.
   3. Shoulder rolls: Roll shoulders forward and backwards slowly, and through full range of motion.
   4. Shoulder shrugs: Lift shoulders to earlobes, then relax.
   5. Cross over shoulder stretch
   6, Touch hands behind.
   7. Side bend Stretch
   8. Wrist rotations: Rotate hands around clockwise and counterclockwise with hands and fingers relaxed.
   9. Finger flexion and extension: Bend and straighten fingers as though playing the piano on the water.
   10. Finger to thumb touches: Touch thumbs to the tip of each finger.

11. PNF UE D1/D2 positions
12. Climbing Rope: Raise both arms as high as possible and perform the reciprocal movement of climbing.
13. Pulling rope: With feet apart in a forward lunge and knees bent, reach forward and pull back, first with one arm, then the other, in a reciprocal fashion.
14. Breaststroke: Reach forward with both arms, abduct horizontally flexing elbows some then tuck and extend to original shoulder extension.
15. Jumping jacks: Simultaneously use abduction and adduction of the hips in conjunction with crossing arms with extended elbows downward and in front and then in back.
16. The punch: Push arms to full extension in a pushing motion and pull backward in an alternating motion. This is accomplished with palms up then with palms down

C. Upper body exercises with or without small floating barbells (approximately eight minutes). Only use equipment if ready

1. Chest stretch: Stretch both arms out in front of the body, just below the water surface. Hold barbells vertically with palms facing inward. Bend elbows backward to stretch the pectorals and return to original position.
2. Forward/backward circles: Hold barbells vertical with palms inward. Perform a circular motion with arms just below water level. Do exercise in both an inward and outward motion without raising the arms out of the water.
3. Bicep curls: Hold barbell with elbow extended and palm up. Bend elbow and pull barbell downward and back extending elbow to full range behind the body. Pull barbell with palm down from the rear position back to the original position.
4. Shoulder flexion/extension: Press barbells in a downward motion and return to surface with arms in front of the body. This exercise is also performed with elbows bent and palms down.
5. Shoulder abduction/adduction: Press downward with arms extended to each side. Also performed with elbow flexion.
6. Body rotation: Move the upper body as a unit from side to side with feet stationery and shoulder width apart. Emphasize not twisting the spine

D. Lower extremity exercises (approximately ten minutes)

1. Knee hugs: Pull knee into chest using arms. Use the wall or a volunteer for support.
2. Leg circles: Stand on the left leg with left leg closest to the pool wall. Make small inward/outward circles with right leg: Do not cross over middling. Reverse sides.

3. Hip abduction/adduction: Stand on left leg with left leg closest to the pool wall. Swing right leg out toward center of pool and then adduct, crossing in front of left leg. Reverse sides.
4. Hip and knee flexion and extension: Stand with back against the pool wall. The right knee is bent bringing the thigh parallel to water surface, straighten the knee and lower the leg. Repeat with the left leg.
5. Hamstring curl: Lift the left foot to left buttocks. Alternate with the right foot to the right buttocks.
6. The flamingo: Stand with the left side against the pool wall. Flex and externally rotate the right hip and knee with the right foot placed on the left knee. The right knee is rotated outward and back to parallel. Repeat exercise on other side.
7. Ankle rotations: Flex ankles and rotate the feet in a clockwise/counterclockwise direction in either a sitting or standing position.
8. Ankle flexion: Flex feet, hold the position for 5 seconds, then relax in either a sitting or standing position.
9. Pendulum: Stand with left side to pool wall holding wall with left hand for balance. Keep knees extended. Lift right leg forward to a comfortable height, then swing leg backward. Repeat with left leg while right side is to the wall.
10. Quick kicks: Flex foot and kick forward. Repeat kicking backwards

E. Aerobic Conditioning Exercises (60-80% MHR using the Borg Scale). Can be shallow or deep water (approximately ten minutes). Only use equipment when ready. Use buddy coaching with student to promote alignment
1. Jog with lateral arms
2. Jog with arm circles
3. Jog with figure 8 arms
4. Rocking horse while touching hands front and back
5. Cross country ski
6. March in Place
7 Jumping Jacks

F. Cool down (ten minutes)
1. Cool Down: Walking/Stretching

Procedural Reliability for the AE Program

The instructor followed at least 80% of the program curriculum each session. The instructor was allowed to vary the exercises to address potential participant boredom. The independent measure for procedural reliability was gathered every third exercise session (i.e., once per week). The observers timed the duration of each exercise sequence using a watch. Duration of occurrence using the gross method of agreement was calculated by comparing the number of seconds recorded during each event of the intervention including warm-up, upper extremity exercises, upper body exercises (optional barbells), lower extremity exercises, endurance and core stability exercises, and cool down. In addition, procedural reliability was assessed for the AT exercises by comparing the list of potential exercises in each exercise sequence to the actual performance of exercises. At least an 80% procedural reliability was maintained during the study.

Data Collection

Pre- and post-intervention measures of fitness, arm edema, fatigue, distress level, and quality of life were administered. Cardiovascular fitness was assessed using the 12-minute walk test (Cooper, 1968). Body composition was assessed indirectly using height and weight to calculate BMI and directly using bioelectrical impedance to measure changes in body composition. Arm edema was assessed using an arm volumometer.

Fatigue was measured using the *Multimensional Fatigue Inventory Short Form* (MFISF) (Stein, Jacobsen, Blanchard, & Thors, 2004). The MFISF consists of 30 statements that comprise five subscales: general fatigue, physical fatigue, mental fatigue, reduced activity, and reduced motivation. Health-related quality of life was evaluated using the *HRQoL* scale developed by the Centers for Disease Control and Prevention. The instrument captures global perceptions of overall general health, measures of the number of days in the past 30 that physical and mental health was good; and that an individual felt pain, depression, anxiety, sleeplessness, and energy. Emotional Distresses as measured by intrusive and avoidant thoughts of cancer was evaluated using the *Impact of Event Scale* (IES). The IES (Horowitz, Wilner, & Alvarez, 1979) is a 15-item instrument that measures distress through the frequency of intrusive and avoidant thought patterns that an individual engaged in during the previous seven days.

Appropriateness of the procedures during the study were monitored at week 4 and at the end of the study using five open-ended questions. These questions reflected the participants' opinions regarding the importance of the program, least important part of the program, what could change, satisfaction, and comments (Table 2). To address the social importance of the effects a social validity questionnaire was administered to the AE program participants and the AE instructor. Those who completed the questionnaire rate statements from 0 to 3 to reflect perceptions of the impact of the AT program (Table 3).

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Table 2. Social Validity Questionnaire for Procedural Reliability

1. What do you feel is the most important part of the AE program?
2. What is the least important part of the AE program?
3. What do you think the instructor could do differently?
4. How satisfied are you with the AE program so far?
5. Do you have any additional comments or suggestions about the AE program?

Table 3. Pre- Post Social Validity Scale

1. How do you think AE will (has) affect(ed) <u>(Name)</u> physical ability?
2. How do you think AE will (has) affect(ed) (Name)stress level?
3. How do you think AE will (has) affect(ed) <u>(Name)</u> fatigue level?
4. What is your opinion of the value of AE?

Data Analysis

Descriptive analysis of the demographic characteristics that include age, type of surgery, and years post-surgery are presented in Table 4 using frequency distribution for the type of surgery (categorical variable) and mean for the continuous variables. The equality of the groups was examined using a t-test for mean and years post-surgery, based on unequal sample sizes with equal or unequal variance, which was determined using the Levene's test (continuous data) and the Fisher's Exact test (for the type of surgery). To test for the effect of the aquatic exercise, paired t-tests were performed for the MFISF, HRQoL, IES, and the physical measures. The differences from baseline to week eight were calculated for each participant. Results were considered statistically significant when the p value was <0.05. Data were analyzed using SPSS 20.

Results

The mean age was 63 (49 to 70 years old). There were no statistical differences in demographic parameters between the groups (See Table 4).

Table 4. Descriptive and Inferential Analyses of the Demographic Characteristics

Demographic Variable	Exercise (N-12)	Control (N-7)	p value
Age	63.08	62.85	.955*
Years since surgery (mean)	3.75	7.0	.375*
Type of surgery			
Lumpectomy	7	3	.650**
Mastectomy	5	4	

*As determined by independent sample t-tests
** As determined by Fisher's Exact test.

For preliminary analysis, t-tests were used to compare the exercise findings for the control and exercise group. Significant differences existed in scores in the exercise group pre- and post-intervention for the 12-minute walk ($t = -4.93$, $p = .001$, pre-test $M = 587.426 \pm 79.02$, post-test $M = 607.22 \pm 70.22$), BMI $t = 3.844$, $p = .03$, pre-test $M = 30.15 \pm 7.77$, post-test $M = 29.4 \pm 7.73$), Impact of Event ($t = -1.82$, $p = .002$, pre-test $M = 20.16 \pm 12.7$, post-test $M = 13.50 \pm 13.05$), and the Multidimensional Fatigue Inventory ($t = -2.35$, $p = .038$, pre-test $M = 14.6 \pm 18.2$, post-test $M = 1.75 \pm 14.72$). No significant pre- to post-test differences existed among members of the control group. In addition, no significant differences existed in arm edema and healthy day scores for the either group.

Discussion

This small sample pilot study found pre- and post-intervention improvement in fitness, BMI, multidimensional fatigue, and levels of distress measures in breast cancer survivors who participated a water exercise program. Breast cancer survivors who received their usual care without water exercise showed no changes pre- to post-test interval.

Findings indicated no reductions in edema for either group. This finding was most likely because the majority of participants did not experience much arm edema. It is important to note for future research that one participant with lymphedema indicated physical irritation when using small floating barbells.

Limited research exists using aquatic exercise to compare findings. Our findings agree with previous studies that show that those who exercise have improved fitness levels more than those who did not participate in any exercise (Schwartz, 2000). Our results are similar to findings of researchers who examined the effects of water exercise on fatigue (Cantarero-Villanueva, et al, 2013a). Future studies should be conducted to help to reduce the gap in the literature about the effectiveness of specific aquatic exercise programs to reduce cancer related fatigue. The water exercise findings also indicated improved psychosocial measures that affected quality of life such as improved Impact of Event scores that reflect intrusive and avoidant thoughts of cancer and scores related to measures of mental and physical fatigue. These findings agree with findings from Fernandez-Lao et al. (2013) who found that water exercise resulted in improved scores on a quality of life symptoms scale over a land exercise group. The results support that aquatic exercise activity can be an effective intervention in the course of recovery. Fernandez-Lao also emphasized, however, that this improvement was not maintained during follow-up. One explanation for the improvements in quality of life may be related to the existence of an enjoyable and comfortable atmosphere of exercise and social interaction (Broach, Dattilo & McKinney, 2007).

Social validity questionnaires indicated that aquatic exercise participants perceived that AE had a positive effect of physical outcomes including fitness, tone, range of motion, fatigue, and quality of life. Perceived psychosocial benefits most noted by participants included increased overall well-being, improved confidence, being with other survivors in an enjoyable activity, and acquiring a physical activity habit. In addition, participants stated that they felt as though the most important outcomes included increased energy and social well-being. All participants expressed a desire to continue participation in aquatic exercise.

Exercise, in general, reduces the risk of cancer recurrence and death among cancer survivors, increases physical functioning among cancer survivors, and facilitates positive psychosocial benefits in cancer survivors during and after treatment (Speck, et al., 2010; Spector et al., 2012; Warburton, et al., 2006). As the quality of a breast cancer survivor's life is affected by physiological and psychosocial factors, we believe the improvement of physical health factors combined with the group engagement that occurs during aquatic exercise contributes to the enhancement of quality of life. Therefore, we believe that appropriate breast cancer survivors might benefit from a structured group aquatic exercise program from a qualified provider for a health enhancement and maintenance.

Limitations

A number of limitations may have influenced this study. First, this was a small sample quasi-experimental design with possible selection bias introduced by volunteers who were recruited or referred by their physicians. Participants were able to choose their participation in either the control or exercise group creating a convenience sample instead of a randomized sample. This restricted the ability to generalize the findings in addition to having other inherent threats to validity. While there were no differences in the demographic paramaters (age, years since surgery and types of surgery), the small sample and the use of t-tests rather than factorial ANOVA statistics (which could have identified possible between group interactions) may have limited reliability. Finally, there were no follow-up data, which could generate questions as to whether the benefit of the aquatic exercise program was maintained.

Conclusions

Overall, the body of literature pertaining to aquatic exercise and cancer is still in its infancy with limitations to most of the research. The preliminary evidence suggested improvements in physical and psychosocial measures were important to consider for outcomes related to aquatic exercise and future research. In addition, participants' social validity feedback and especially their desire to continue the program indicated that the participants perceived benefits in an aquatic exercise program. Future studies could include some of the same important physical as well as psychosocial measures that may be important for engagement in life activities, health, and quality of life.

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