Original Research

Utilization of an Anti-Gravity Treadmill in a Physical Activity Program with Female Breast Cancer Survivors: A Pilot Study

CIARAN M. FAIRMAN†[1], KRISTINA L. KENDALL‡[2], BRANDONN S. HARRIS‡[2], KENNETH J. CRANDALL‡[3], and JIM MCMILLAN‡[2]

[1]The Ohio State University, Department of Kinesiology. [2] School of Health and Kinesiology, Georgia Southern University, [3]Western Kentucky University, School of Kinesiology, Recreation, & Sport

*Denotes undergraduate author, †Denotes graduate student author, ‡ Denotes professional author

ABSTRACT

International Journal of Exercise Science 9(1): 101- 109, 2016. Breast Cancer survivors can experience a myriad of physical and psychological benefits as a result of regular exercise. This study aimed to build on previous research using lower impact exercise programs by using an anti-gravity (Alter-G®) treadmill to administer cardiovascular training. The purpose of this study was to determine the effectiveness a physical activity program, including an Alter-G® treadmill, for improving physiological and psychosocial measures in female breast cancer survivors. A 14-week intervention using an AB-AB study design was employed. Six female breast cancer survivors were recruited to participate in the study. Participants attended three 60-minute sessions per week, consisting of a combination of muscular strength/endurance, and cardiovascular endurance exercises. Consistent with current literature and guidelines, exercise interventions were individualized and tailored to suit individuals. Data was collected and analyzed in 2013. Visual inspection of results found improvements in cardiovascular endurance and measures of body composition. Quality of life was maintained and in some cases, improved. Finally, no adverse effects were reported from the participants, and adherence to the program for those who completed the study was 97%. The results of this study suggest that the use of a physical activity program in combination with an Alter-G® treadmill may provide practical and meaningful improvements in measures of cardiovascular endurance and body composition.

KEY WORDS: Breast cancer, physical activity, alter-g

INTRODUCTION

An estimated 235,030 new breast cancer cases are expected to occur for the year in 2014 (3). Consequently, more women are living with the negative effects of cancer, either by the disease itself, or as a result of treatment (radiation, chemotherapy, hormonal therapy etc.). Some of the negative effects include cancer related fatigue (crf), pain, irregular sleeping patterns, increased risk for osteoporosis and decreased cardiovascular and pulmonary function (6, 13). Furthermore, survivors can experience emotional distress including lower quality of life (QOL) and symptoms of anxiety and depression.

An increasing number of studies have emerged promoting exercise and physical activity (PA) as a means to attenuate the negative side effects and improve cancer-related QOL among survivors. Several studies have hypothesized, with relative success, that exercise can be used to prevent, attenuate, treat and rehabilitate the physiological and psychosocial challenges faced by survivors both during and post-treatment (4, 7, 9, 13, 14, 16).

Exercise programs traditionally utilize a treadmill, elliptical, or stationary bike to provide cardiovascular training. Recognizing the need for lower-impact exercises with survivors, particularly with their increased risk of falls and fractures following treatment (6), researchers have examined the use of water-based exercise programs to unweight participants (4, 7). These studies provide important implications that lower impact exercises may be a feasible alternative to load-bearing activities for breast cancer rehabilitation. This study utilized an anti-gravity (Alter-G®) treadmill to build on studies with lower-impact PA programs.

The antigravity treadmill (Alter-G ®) is a relatively new piece of equipment used in a range of settings from physical therapy to sports performance. This treadmill uses a chamber attached to a pair of modified shorts at waist-level. The chamber calibrates to match air pressure to the patient's body weight. After calibration, the treadmill can then increase air pressure inside the chamber to 'unweight' the participant to as low as 20% of their body weight. The Alter-G® treadmill builds on the premise set forth by the Aquaciser treadmill (Hudson Aquatic, Angola IN) by using pressure to unweight the participant; the advantage of the Alter-G® is that it allows the technician to modify the air pressure in the chamber, providing a range from 20-100% of the participants' body weight. This range allows participants the ability to start at a relatively low weight on their bones and joints, with the option to gradually increase the load throughout the duration of the program to eventually reach 100% body weight. Recent studies have supported its safety and efficacy in training lower body injuries and obese patients (14).

The purpose of this study was to determine the effectiveness a PA program, including an anti-gravity (Alter-G®), treadmill in improving physiological and psychosocial measures in female breast cancer survivors.

METHODS

Participants

Female breast cancer survivors [n=6, mean (SD) age: 51 (18) years, weight: 73.12(45.8) kg, height: 166.12(17.78) cm] were recruited via word of mouth, fliers, and cancer support-group meetings to participate in the study (Table 1). Participants were included in the study if they had completed treatment (radiation, chemotherapy, or hormonal therapy) at least 6 months prior to the intervention, and had received physician's clearance. One participant dropped out of the program due to an extended vacation taken towards the end of the study. The University's Institutional review board approved this study. The program began with a screening session, where physician release forms were reviewed; participants filled out informed consent forms and were given an overview of the study and the risks and benefits of participation.

Table 1. Subject characteristics (n=5)

	Characteristic	Mean (SD)
Age (yrs.)		51 (18)
Height (cm)		166.12 (17.78)
Weight (kg)		73.12 (45.8)
Cancer stage	0	0
	1	1
	2	4
	3	0
	4	0
Treatment	Radiation	2
	Chemotherapy	5
	Hormonal Thera	2
	Surgery	5

Protocol

A single-case research design (SCRD) (10) was employed. The design consisted of four phases over the course of 14 weeks: a baseline testing (A) phase to establish initial values for each variable (2 weeks), followed by an intervention phase (B)(5 weeks), a return to baseline (A)(2 weeks) and a final replication phase (B)(5 weeks). SCRD is unique in that is allows for repeated measurement of a variable, with each participant serving as their own control.

Baseline phases (2 weeks apiece) included flexibility and resistance training twice weekly, with testing (cardiovascular endurance, quality of life (QOL), and weight) on a third day. Intervention phases were similar to the baseline phases, with the addition of the Alter-G® to administer cardiovascular training two days per week, with the same testing protocol as baseline on a third day.

The Alter-G® treadmill was introduced during the intervention stages of the program. Participants began at a percentage of their bodyweight they felt comfortable (at least 50% of their body weight). Percentage of bodyweight was increased (~5% per week) as participants' progressed throughout the program. Aerobic exercise was performed for a minimum of 30 minutes each session.

Flexibility via modified sit-and-reach (S/R) was measured each session. Weight (kg), cardiovascular endurance via time on a modified Balke protocol, and QOL using Ferrans and Powers QUALITY OF LIFE INDEX© CANCER VERSION – III were measured once a week on the testing day.

The primary investigator was a certified professional with an extensive background working with cancer survivors. The investigator was able to modify, adapt and individualize exercise prescription as needed.

General standards of the exercise intervention included: Resting heart rate (RHR) and blood pressure (BP) were monitored prior to the beginning of each session. 60-minute sessions 2 days per week (a minimum of 24 hours rest was required between training days). A third day each week was used for testing. Warm-up, followed by bouts of aerobic, resistance, balance and flexibility training, followed with a cool down. RPE was used to monitor & adjust levels of intensity for both aerobic and resistance training. Participants began with 1-2 sets of 12-15 repetitions; gradually increasing to 3 sets of 8-12 repetitions.

Statistical Analyses

Visual inspection was used to analyse changes in magnitude (mean and level) and the rate of change (trend and latency) (10).

RESULTS

Visual analyses showed improvements in mean treadmill time between both the baseline and intervention, and return to baseline and final replication phase for all participants (Figures 1a. – 1e.). Visual analyses also found improvements in flexibility observed from baseline to intervention among all participants.

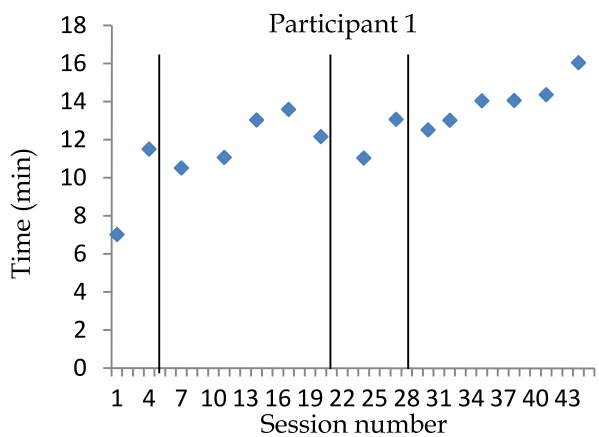

Figure 1a. Cardiovascular conditioning via the Balke Protocol.

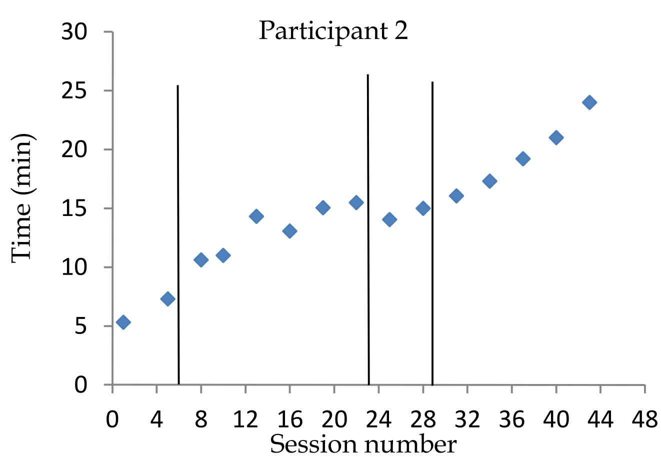

Figure 1b. Cardiovascular conditioning via the Balke Protocol.

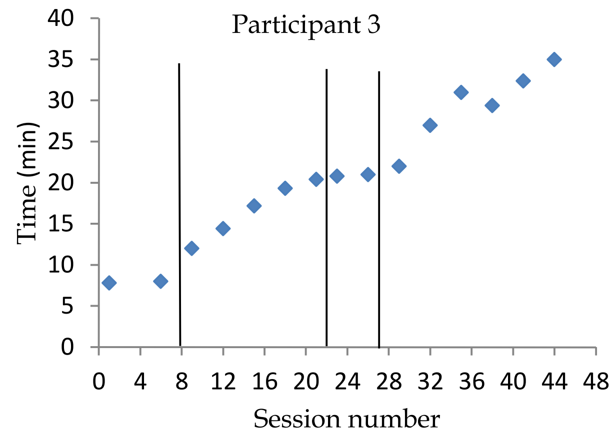

Figure 1c. Cardiovascular conditioning via the Balke Protocol.

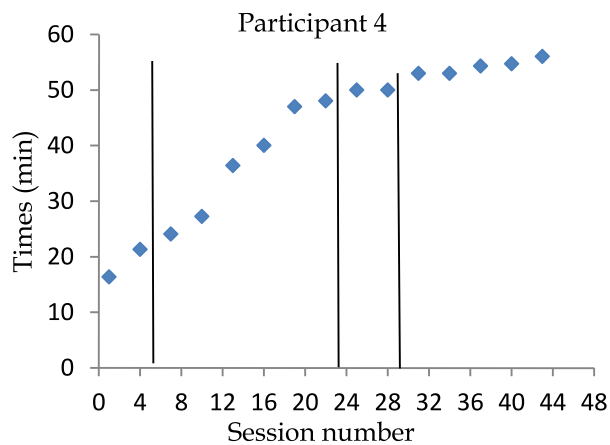

Figure 1d. Cardiovascular conditioning via the Balke Protocol.

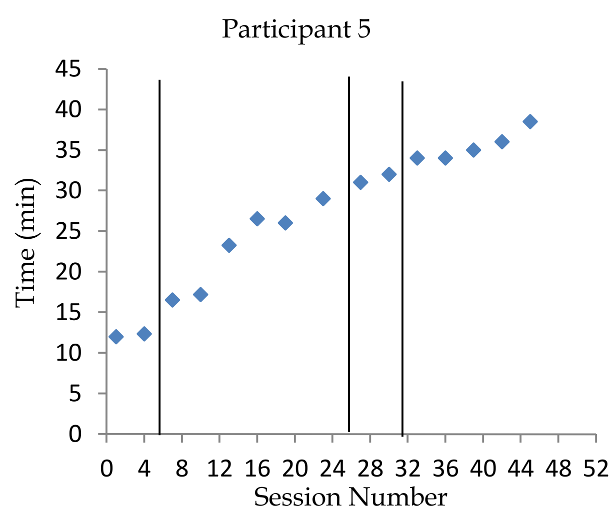

Figure 1e. Cardiovascular conditioning via the Balke Protocol.

There was a reduction in mean weight (figures 2a. - 2e.) for participants 1, 2, and 5 between the baseline phase and intervention phase, and between the return to baseline phase and final intervention phase. Participants 3 and 4 saw small increases in mean weight between the baseline and intervention phases, and a decrease in mean weight from the return to baseline and replication phase.

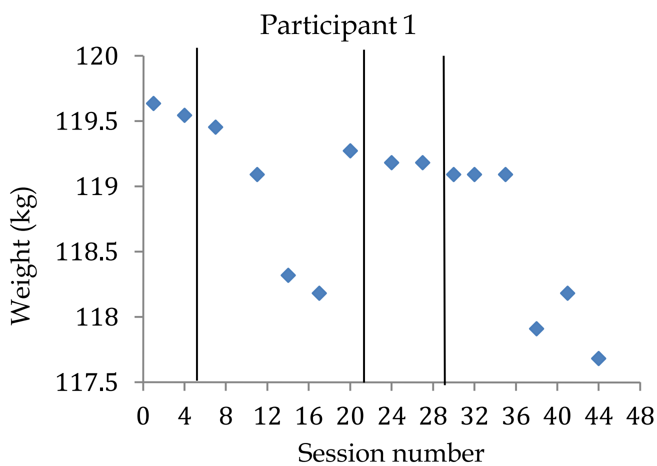

Figure 2a. Weight

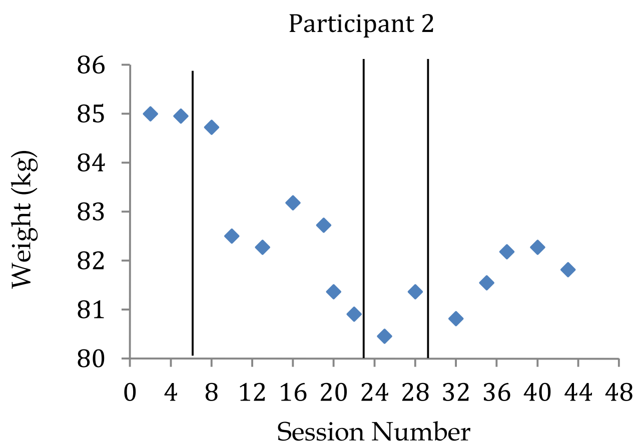

Figure 2b. Weight

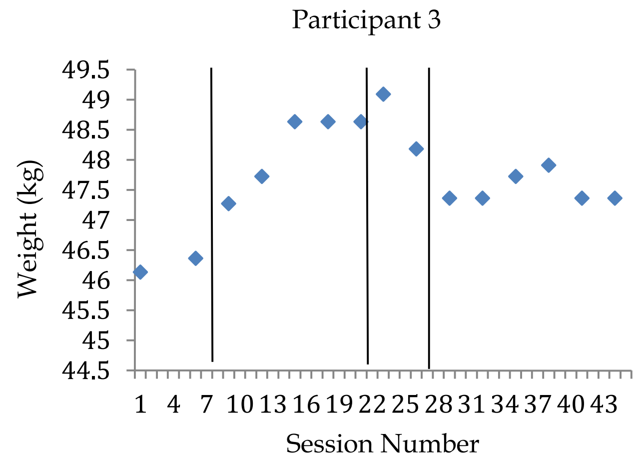

Figure 2c. Weight

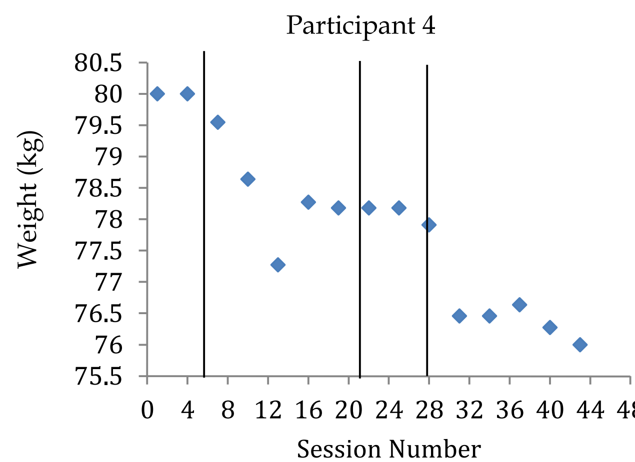

Figure 2d. Weight

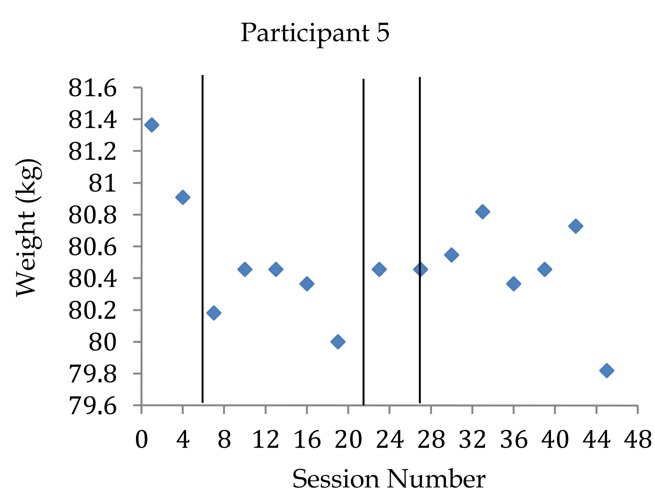

Figure 2e. Weight

There was a slight improvement in mean QOL (figures 3a. – 3e.) from baseline to intervention phase, and return to baseline and final replication phase for participant 1, 2, and 3. There was an improvement in mean QOL for participant 4 from the baseline phase to the first intervention phase, with a decrease from the return to baseline phase and final replication phase. Participant 5 showed a slight decrease in QOL from the first baseline phase to intervention phase, with an improvement in mean QOL throughout the subsequent phases.

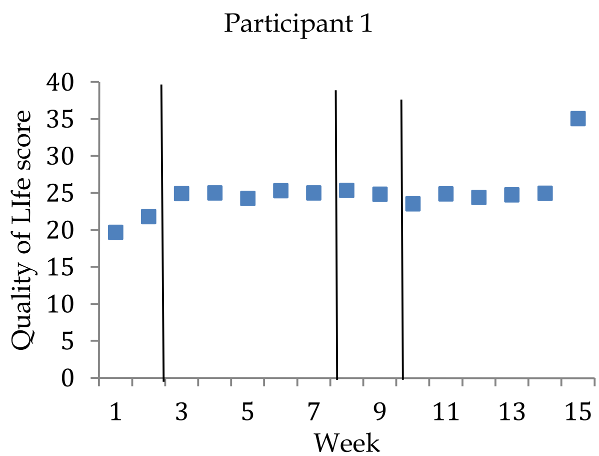

Figure 3a. Quality of Life

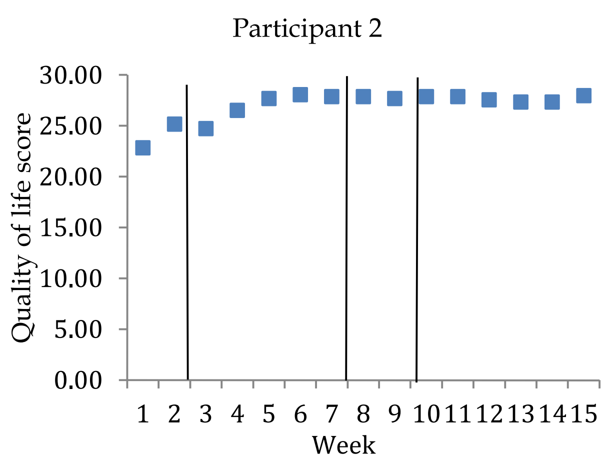

Figure 3b. Quality of Life

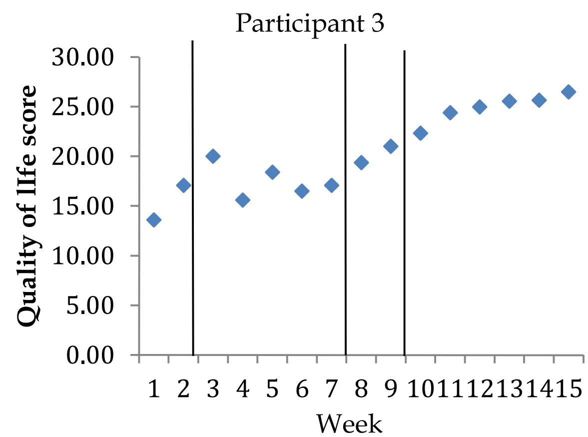

Figure 3c. Quality of Life

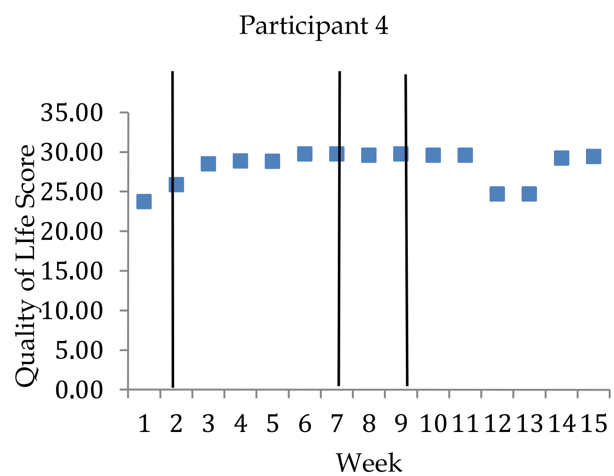

Figure 3d. Quality of Life

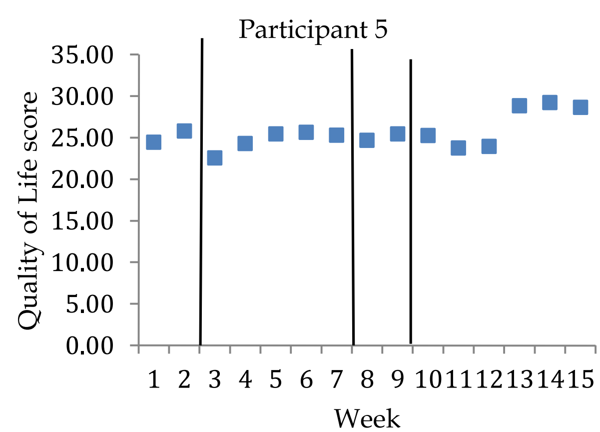

Figure 3e. Quality of Life

DISCUSSION

The purpose of this study was to determine if using a physical activity program, including an anti-gravity (Alter-G®) treadmill, would aid in improving physiological and psychosocial measures in female breast cancer survivors. It was hypothesized that using a PA program, including an Anti-gravity treadmill, would improve physiological and psychological measures in participants. Our analyses suggest that a 14-week exercise program utilizing an Alter-G® treadmill can at least maintain, and in some cases, improve physiological and psychosocial variables. All participants experienced improvements in treadmill times during both intervention phases. This is consistent with previous literature exercise demonstrating significant improvements in cardiovascular function in female breast cancer patients following exercise programs of varying length (2, 4, 6). This study is the first of its kind to examine the inclusion of an Alter-G® treadmill in a PA program directed at BCS. Low-impact activity may also reduce the risk of falls and fractures that may occur during traditional treadmill training among BCS who are at an increased risk following treatment7. While further research is needed to determine loading and progression protocols, our results suggest that the Alter-G® treadmill is a safe and well-tolerated alternative to regular treadmill training.

Participants' improvements in flexibility are consistent with previous studies noting similar improvements in flexibility following exercise programs (11, 12) Improvements in flexibility may increase range of motion and improve physical functioning needed for activities of daily living (13).

Our results showed that all participants at least maintained if not experienced a favourable weight change. It is likely that more pronounced improvements in weight would be achieved with the addition of a dietary intervention (5). Our results also suggest that QOL can at least be maintained, if not improved in some cases. This is consistent with previous studies noting significant improvements in QOL in BCS following PA programs (14).

Cancer survivors often experience reduced bone mineral density following treatment, and are consequently at a greater risk for falls and injury (6) Furthermore, researchers have utilized aqua aerobics with cancer survivors with the premise that the buoyancy of water will reduce axial loading and allow participants to perform exercises they may not be able to on land (4,7). This study is the first of its kind to examine the inclusion of an Alter-G® treadmill in a PA program directed at breast cancer survivors. The treadmill is unique in its ability to modify the percentage of weight a participant works at, allowing for a progression from unloading exercise to loaded which may contribute to the gradual strengthening of bones, and bone ossification. Although not measured in this study, this mode of exercise progressing from low-impact to bodyweight training on the treadmill may serve to strengthen bone mineral density in survivors. This low-impact activity may also reduce the risk of falls and fractures that may occur during traditional treadmill training among breast cancer survivors who are at an increased risk following treatment. While further research is needed to determine loading protocols and progression, the results of this study suggest that the Alter-G® treadmill is a safe, well-tolerated and feasible alternative to regular treadmill training.

The nature of breast cancer rehabilitation is progressing to a more individualized method of exercise prescription. Researchers have proposed individual surveillance models to assess survivors' progress throughout the cancer continuum, and adjust exercise prescription accordingly (15,16) These models allow for physical limitations and impairments to be addressed consistently and exercise prescription to be modified accordingly. Utilization of an SCRD design, such as the one used in this study may be an effective way of monitoring patients. This is advantageous in a population where response to exercise may not represent that of an apparently healthy individual, and exercise prescription may vary accordingly. The simplicity of visual analysis provides practitioners a quick, straightforward method of analysing a participant's response to training. All testing used well-utilized field methods that could be easily replicated. Testing time was minimal with the exception for cardiovascular testing which was simultaneously used as an exercise session.

This study had several limitations. The small sample size makes it difficult to generalize to a larger population of survivors. However, the benefit of this type of study design allows for each participant to be his or her own control. This gives the unique advantage of being able to analyse individual results rather than as a group. Research of this nature highlights the individual response to exercise and supports the idea that variability in treatment received, duration of treatment, age, time since diagnosis, severity of disease, among others, may affect the response of breast cancer survivors to exercise.

The lengths of the baseline phases were two weeks apiece. Future studies may be strengthened by administering longer baseline phases between intervention phases to allow for a longer period of deconditioning. This in turn may make it easier to infer that it was the intervention that caused changes. This study took place in a small south eastern rural town and thus may not be generalizable to other geographical areas. The lack of laboratory tests may also be a limitation, particularly for methods of assessing cardiorespiratory fitness and body composition. Future studies may be strengthened by more robust methods of assessment such as gas exchange analysis to determine VO2max and Dual Energy X-ray absorptiometry to evaluate changes in fat mass and lean body mass.

Inclusion of an anti-gravity treadmill in a PA program may provide practical and meaningful improvements in physiological and psychosocial variables in female BCS.

REFERENCES

1. Binkley JM, Harris SR, Levangie PK, Pearl M, Guglielmino J, Kraus V, Rowden D. Patient perspectives on breast cancer treatment side effects and the prospective surveillance model for physical rehabilitation for women with breast cancer. Cancer 118(8 Suppl):2207–2216, 2012.

2. Burnham TR, Wilcox A. Effects of exercise on physiological and psychological variables in cancer survivors. Med Sci Sports Exerc 34(12): 1863–1867, 2002.

3. Breast CancerFacts & Figures 2013-2014. 2013:1–40. Available at: http://www.cancer.org/acs/groups/content/@research/documents/document/acspc-042725.pdf.

4. Cantarero- Villanueva I, Fernández -Lao C, Cuesta-Vargas AI, Del Moral-Avila R, Fernandez-de-las-Penas C, Arroyo-Morales M.The effectiveness of a deep water aquatic exercise program in cancer-related fatigue in breast cancer survivors: a randomized controlled trial. Arch Phys Med Rehab 94(2):221–230, 2013.

5. Cheema BS, Gaul CA. Full-body exercise training improves fitness and quality of life in survivors of breast cancer. J Strength Cond Res 20(1):14–21, 2006.

6. Chen Z, Maricic M, Pettinger M, Ritenbaugh C, Lopez AM, Barad DH, Gass M, Leboff MS, Bassford TL. Osteoporosis and rate of bone loss among postmenopausal survivors of breast cancer. Cancer 104(7):1520–1530, 2005.

7. Fernandez-Lao C, Cantarero-Villanueva I, Ariza-Garcia A, Courtney C, Fernandez-de-las-Penas C, Arroyo-Morales M.Water versus land-based multimodal exercise program effects on body composition in breast cancer survivors: a controlled clinical trial. Support Care Cancer 21(2):521–530, 2013.

8. Gilchrist LS, Galantino ML, Wampley M, Marchese VG, Ness KK. A framework for assessment in oncology rehabilitation. Phys Ther 89(3):286–306, 2009.

9. Hsieh CC, Sprod LK, Hydock DS, Carter SD, Hayward R, Schneider CM. Effects of a supervised exercise intervention on recovery from treatment regimens in breast cancer survivors. Oncol Nurs Forum 35(6):909–915, 2008.

10. Irwin ML, Alvarez-Reeves M, Cadmus L, Mierzejewski E, Mayne ST, Yu H, Chung GG, Jones B, Knobf MT, DiPietro L.Exercise improves body fat, lean mass, and bone mass in breast cancer survivors. Obesity 17(8):1534–1541, 2009.

11. Kazdin AE. Single-Case Research Designs: Methods for Clinical and Applied Settings. New York : Oxford University Press; 1982. Available at: http://www.worldcat.org/title/single-case-research-designs-methods-for-clinical-and-applied-settings/oclc/7976550

12. Mandelblatt JS, Luta G, Kwan ML, Makgoeng SB, Ergas IJ, Roh JM, Sternfeld B, Adams-Campbell LL, Kushi LH. Associations of physical activity with quality of life and functional ability in breast cancer patients during active adjuvant treatment: the Pathways Study. Breast Cancer Res Treat 129(2):521–529, 2011.

13. Pekmezi DW, Denmark-Wahnefried W. Updated evidence in support of diet and exercise interventions in cancer survivors. Acta Oncologica 50(2):167–178, 2011.

14. Simonson SRS, Jane M, Long, Elaine M, and Lester, Brooke E. Using the Alter-G Treadmill System with an Extremely Obese Female: A Case Study. Clin Kines 65(2):29-38, 2011.

15. Stathokostas L, Little RMD, Vandervoort AA, Paterson DH. Flexibility training and functional ability in older adults: a systematic review. J Aging Res 2012(8):306818–30, 2012.

16. Stout NL, Binkley JM, Schmitz KH, Andrews K, Hayes SC, Campbell KL, McNeely ML, Soballe PW, Berger AM, Cheville AL, Fabian C, Gerber LH, Harries SR, Johansson K, Pusic AL, Prosnitz RG, Smith RA.A prospective surveillance model for rehabilitation for women with breast cancer. Cancer 118(8 Suppl):2191–2200, 2012.

17. Winters-Stone KM[1], Dobek J, Bennett JA, Nail LM, Leo MC, Schwartz A.The effect of resistance training on muscle strength and physical function in older, postmenopausal breast cancer survivors: a randomized controlled trial. J Cancer Surviv 6(2):189–199, 2012.