PHYSICAL ACTIVITY, EXERCISE AND CANCER

ORIGINAL ARTICLE

Personalized exercise intervention improves strength, balance and attitude towards exercise in breast cancer survivor

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ABSTRACT

This case report details the implementation of a personalized fitness program in an untrained, sedentary breast cancer survivor. Initial assessment included participant information collection, medical history review, and physical measurements. Resting heart rate, blood pressure, body composition, strength, flexibility, and balance were evaluated pre- and post-program. The training program focused on lower body strength, core strength, and posterior back muscle development, to target deficits observed during pre-assessment and through consultation with the participant. Training sessions focused on resistance exercise, gradually progressing from basic to complex movements according to the observed capabilities of the participant. Following the exercise intervention, marked improvements in grip strength and balance were seen, with grip strength improving 14.7% and 47.6% in the right and left hand, respectively. Right leg balance measured improved from 23 to 39 seconds and from 9 to 65 seconds in the left leg. Anecdotally, the participant's commitment to consistently attending exercise sessions notably improved throughout the course of the program. The protocol's tailored progression facilitated improved physical capabilities, confidence, and emotional well-being in the participant. The rapport established between the participant and the practitioner during the intervention played a pivotal role in the participant's adherence and success. This case report emphasizes the significance of a personalized, structured exercise program in untrained individuals, but particularly for individuals who have struggled with physical limitations and self-efficacy following diagnosis, treatment, and recovery from breast cancer.

Keywords: Exercise intervention, Self-efficacy, Cancer-related fatigue, Undergraduate practicum, Brest cancer.

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INTRODUCTION

Cancer is the second leading cause of death in the United States, and it is predicted that by 2030 there will be 22.1 million individuals living with a history of cancer (Miller et al., 2019). Even though surviving an initial cancer diagnosis is more likely with advancements in treatment options, survivors are put at an increased risk of developing comorbidities such as cardiovascular disease, obesity, and type 2 diabetes at a rate that is 18.5 times greater than the general population (Hooning et al., 2007). Cancer survivors have a 3.6 times greater risk of dying from cardiovascular disease when compared to individuals who have not had cancer (Yadav et al., 2021). Many of these long-term health risks may be attributed to the side effects of common cancer treatments such as surgery, chemotherapy, and radiation (Campbell et al, 2019). Exercise has been shown to be beneficial for managing symptoms of cancer treatment, evidenced by reduced severity of treatment side effects observed in exercised individuals as compared to a control group (Sprod et al., 2012). Interestingly, Sprod et al. (2012) also noted a direct correlation between age and symptom relief was also noted, with older patients experiencing greater symptom relief with exercise intervention.

In addition to the confounding health issues cancer patients face while undergoing treatment, the aftereffects of cancer interventions can continue to contribute to comorbidities even when in remission. It is known that chemotherapy has been linked to weight gain and it is common for breast cancer survivors to become obese or gain weight after cancer treatment (Makari-Judson et al., 2024; Yadav et al., 2021). Thus, the benefits of structured exercise could help mitigate the risk or effect of these comorbidities as well as increasing the patient’s quality of life (Gerritsen and Vincent, 2015). Since cancer survivors are more likely to be sedentary, as it has been reported that only 20-30% of cancer survivors are physically active, the risk of weight gain and associated comorbidities is increased (Pinto and Ciccolo, 2011). For many breast cancer survivors, sedentary behaviour was more common when a combination of chemotherapy and surgery was implemented as opposed to surgery alone (Phillips et al., 2016). Considering the known health effects of being sedentary along with the physical strain of many recommended cancer treatments, it would be beneficial for patients undergoing cancer and related treatments to pursue regular physical activity. Fortunately, it has been determined that not only is exercise training safe during and after cancer treatments, but it is known to improve overall physical function, quality of life, and attenuate cancer related fatigue (Courneya, 2003; Kim, Kang, and Park, 2009; Patel and Bhise, 2017).

As described above, substantial evidence supports the physical benefits of exercise in cancer survivors, however there are other long-term holistic outcomes to consider such as self-efficacy, self-esteem, and psychosocial health. It is well known that exercise has a positive impact on psychosocial health in apparently healthy adults, but the effects may be even more profound in cancer survivors (Biddle, Fox, and Boutcher, 2000; Spence, McGannon, and Poon, 2005; Sweegers et al., 2018). Self-esteem and self-efficacy that have been lowered because of cancer diagnosis and/or treatment may in fact be deterrents to engaging in physical activity and could prevent individuals from attaining the physical benefits needed for long-term health outcomes (Rogers et al., 2006; Rogers et al., 2008). Furthermore, attitudes towards exercise, regardless of self-efficacy or self-esteem, may be improved through personalized program development (Marker et al, 2009; Sweegers et al., 2018). While traditional research in this area typically looks at larger groups of subjects, case study research in this area can provide an insight into the factors that affect an individual’s willingness to participate in exercise while suggesting tools for practitioners to utilize when working with participants with similar backgrounds and limitations. By treating “*patients*” and “*survivors*” as individuals, we may better encourage much needed participation in regular exercise. This case report details the implementation of a personalized exercise program for a 68-year-old female breast cancer survivor.

MATERIALS AND METHODS

Participant recruitment

As part of an undergraduate exercise science practicum class aimed to provide clinical experience for future practitioners, participants were recruited from the local community to participate in a student-led exercise program. Advertisements in local news outlets and social media were used to solicit potential participants. Eligibility included healthy adults with no current serious or unstable medical conditions. Once participants were identified, they were notified to report to the Exercise Science Laboratory for consultation and preliminary screening. The participants were then paired up with a student practitioner with whom they would exclusively work with for the duration of the 10-week study. This case report details the implementation of a personalized fitness program for one of the selected participants: a sedentary, 68-year-old female breast cancer survivor. The study was approved through the college's Institutional Review Board and carried out fully in accordance with all ethical standards.

Assessment methods

On the initial visit, the participant underwent a screening process which included completing an informed consent, PARQ, medical history, and consultation. Once it was confirmed that participant was eligible for the program and did not exhibit any limiting conditions, a pre-program fitness assessment was performed.

Baseline measurements included the resting cardiovascular measurements heart rate (HR, bpm) and blood pressure (BP, mm Hg), as well as anthropomorphic measurements to include height (cm), weight (kg), waist (cm) and hip (cm). Height and weight were used to calculate Body Mass Index (BMI, kg/m^2) and waist and hip measurements provided data to calculate waist-hip ratio (WHR). Baseline body composition was assessed using the 3-site skinfold method (triceps, suprailiac, and thigh; Lange skinfold callipers, Creative Health Products, Knoxville, TN). Body fat percentage was calculated using the Siri and Jackson-Pollock equations (Jackson, Pollock, and Ward, 1980; Siri, 1961).

Cardiovascular fitness was not initially assessed as it was not an aim of the program, however on post-assessment, the YMCA step test was performed to serve as a baseline moving forward (Golding, 2000). Heart rate was measured manually and used to calculate the estimated VO_2 max (Park, Park, and Lee, 2020; Santo & Golding, 2003).

Muscular fitness assessments included measurement of hand grip strength through hand dynamometry (BASELINE® Standard Hydraulic Hand Dynamometer, Fabrication Enterprises, White Plains, NY), while flexibility was assessed using goniometry at the shoulder, hip, and knee joints (Elite Medical Instruments, Fullerton, CA). Two trials of hand dynamometry were performed with each hand with the highest attempt recorded in kilograms. The range of motion (ROM) of each joint was measured bilaterally and recorded in degrees, with three trials performed on each side. Additionally, balance was assessed using the Stork Balance Test (Johnson and Nelson, 1979). Time elapsed while balancing on a single leg was recorded in seconds and performed on both right and left legs.

All assessment tools were translated into scores to be compared to respective normative values. Tests were repeated using the same techniques and in the same order following the 10-week exercise intervention protocol.

Training program

The participant was scheduled to attend two 60-minute training sessions per week, every Monday and Wednesday, for 10 weeks. The primary goal of the training program was to maximize the limited session time by focusing on areas that were determined through the fitness assessment to need improvement, or that were goals expressed by the participant. The program had an emphasis on lower body strength and mobility, core strength, and development of the posterior back musculature to improve posture and shoulder function. Sessions were focused on resistance exercise, as the participant planned to perform cardiovascular exercise at home to meet the minimum requirements of aerobic exercise.

Lower body strength

To address lower body strength, exercises commonly performed during each workout included squat variations, step up variations, hamstring curls, and knee extensions. Exercises progressed in complexity as the capabilities of the participant allowed. For example, in week one the client started with chair squats with only body weight as resistance. Once the participant was able to comfortably perform body weight chair squats, the next progression was to add external resistance using a medicine ball or dumbbells. Next, the time she was in contact with the chair was limited, then the chair was removed, and then finally the participant was able to perform body weight squats with external resistance and no chair for support.

Figure 1. Squat progression.

Balance and core

Another focus of the program was to improve balance. The primary exercise used to address balance deficits was the single leg step up. The participant performed step ups with the non-supporting leg held perpendicular to the spine. At the top of each repetition, the participant would hold this position for 1-2 seconds to emphasize postural control. Since core musculature is pivotally involved in balance and postural control, exercises that targeted the core were also a principal area of the exercise program. Two of the more commonly performed exercises were "*dead bugs*" and "*birddogs*". While performing these exercises, emphasis was placed on how efficient and controlled the movement appeared to be. Additional exercises targeting balance and core included "*farmer's carries*" and "*suitcase carries*".

Posture and shoulder function

Posture improvement and shoulder function were also targeted areas of the exercise program. The objective here was to strengthen the musculature of the back and shoulders through primary exercises such as overhead presses and rows, as well as band-resisted internal and external rotation. Push up variations were also included to balance out the pulling motions performed in addressing the back and posterior shoulder. Initially, the participant struggled with the push-up exercise, but was able to progress through staged variations, as described in Figure 2.

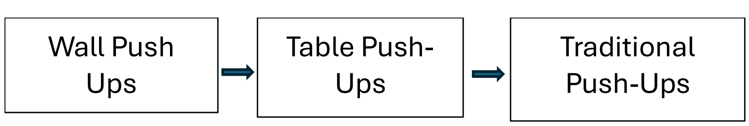

Figure 2. Push-up progression.

This progression started with wall pushups, and by week 5 the client had progressed to table pushups, followed by traditional pushups by week 9. The progression was always determined by the participant's performance and more resistance was added each week even if it was not noticeable to the client.

Overall, the two exercise sessions per week can be categorized as a full-body sessions that targeted all major muscle groups, with an emphasis on lower body strength, balance, posture, and shoulder mobility. Examples of three different exercise sessions are outlined below, with Sample workouts A and B performed in week 1, and sample workouts C and D performed in week 5.

Table 1. Sample workout A (week 1).

Exercise	Resistance	Volume (sets x reps)
Chair Squat	Body weight	3 x 8
Standing Hamstring Curls	Body weight	3 x 10 each leg
Side lying hip adduction	Body weight	3 x 8 each leg
Seated Chair March	Body weight	3 x 10
Wall Push-Up	Body weight	3 x 5
Bird Dog	Body weight	3 x 5 each side
External Rotation-Shoulder	Light band	3 x 8 each arm
Internal Rotation-Shoulder	Light band	3 x 8 each arm
Biceps Curls	2-5 lb dumbbells	3 x 10 each arm
Pull Aparts (Bands)	Medium band	3 x 10

Table 2. Sample workout B (week 1).

Exercise	Resistance	Volume (sets x reps)
Step Ups	10 lb dumbbells/6-inch box	3 x 6 each leg
Knee Extension	5 lbs	3 x 10 each leg
Overhead Press	3 lbs	2 x 7
Lat Pull Down	12.5 lbs	3 x 5-8
Glute Bridges	Body weight	4 x 5
Supermans	Body weight	3 x 5 each side
Triceps Kickback	3 lbs	3 x 10 each arm
Rows	Light band	3 x 12
Farmers Carries	10-12 lb dumbbells	3 x 15 yards
Calf Raises	6 lbs	3 x 10

Table 3. Sample workout C (Week 5).

Exercise	Resistance	Volume (sets x reps)
Squat	13 lb kettlebell	4 x 10
Standing Hamstring Curls	5 lbs	3 x 10 each leg
Side lying hip adduction	Body weight	3 x 10 each leg
Table Push-Up	Body weight	3 x 10-12
Bird Dog	Body weight	3 x 5-7 each side
External Rotation-Shoulder	Medium band	2 x 12 each arm
Rotation-Shoulder	Medium band	2 x 12 each arm
Biceps Curls	8 lb dumbbells	3 x 10 each arm
Pull Aparts (Bands)	Medium band	3 x 10
Dead Bugs	Body Weight	60 seconds

Table 4. Sample workout D (week 5).

Exercise	Resistance	Volume (sets x reps)
Step Ups	15 lb dumbbells/6-inch box	3 x 6 each leg
	13 lb kettlebell/9-inch box	1 x 6 each leg
Knee Extension	5 lbs with half foam roller	4 x 10 each leg
Overhead Press	13 lbs	3 x 6-10
Lat Pull Down	17.5-20 lbs	3 x 10
Glute Bridges	Body weight	4 x 12
Supermans	Body weight	3 x 5 each side
Rows	15-17.5	3 x 10
Farmers Carries	26 lbs	3 x 15 yards
Calf Raises	26 lbs	3 x 10

RESULTS

Participant information

The subject was a 68-year-old sedentary female with a history of breast cancer, self-reported to be in remission for approximately 10-years. Upon initial screening, the participant did not disclose any current serious health conditions and was not taking any medications. She expressed a lack of interest in exercise and has historically not been motivated to exercise. Her recent interest in starting an exercise program was the result of weight gain during her time in remission and her recognition of the need for exercise to improve her long-term health.

Physical assessment results

Resting heart rate, blood pressure, anthropomorphic (height, weight, BMI, circumference), as well as body composition were all within normal ranges prior to the exercise intervention (Table 5).

Table 5. Participant information and resting data.

Parameter	Pre-Program Value
Age (y)	68
Height (cm)	162.56
Weight (kg)	65.18
BMI (kg/m^2)	24.54
HR (bpm)	74
BP (mm/Hg)	125/70
WHR	0.84
Body Fat(%)	29.57

Following the exercise intervention, there were no significant changes in height, weight, BMI, body fat %, or resting cardiovascular measurements (HR, BP). Cardiovascular fitness testing resulted in a calculated VO_2max of 17.8 mL/kg/min, using a recovery heart rate of 130 bpm following the YMCA Step Test protocol. No comparison was made to pre-intervention testing as no cardiovascular assessment was initially performed. The post-intervention cardiovascular assessment result yielded a "*poor*" outcome for aerobic fitness (ACSM, 2022).

When comparing pre- and post-intervention hand dynamometry performance, a marked improvement was observed particularly in the left hand, increasing from 21kg to 31kg (47.6%). Right hand grip strength also improved, but to a lesser degree (from 34kg to 39kg, or 14.7%).

Table 6. Changes in grip strength and balance.

Parameter	Pre-Intervention Score	Post- Intervention Score
Right Hand Grip Strength (kg)	34	39
Left Hand Grip Strength (kg)	21	31
Right Leg Balance (s)	23	39
Left Leg Balance (s)	8.7	65

Another significant improvement was seen in balance performance. The initial performance of the Stork Test resulted in a poor classification for both the right and left legs with times observed being 8.71 seconds on the left leg and 23 seconds on the right leg. Following the exercise intervention, the left leg improved by 30.29 seconds to a score of 39 seconds and the right leg improved to 75 seconds, an increase of 52 seconds.

Program adherence

The participant completed 18 of 20 scheduled sessions, recording an adherence rate of 90%. One absence was a scheduled dental visit, while the other absence was due to a previously planned engagement.

DISCUSSION

The benefits of regular exercise cannot be overstated, especially when considering older individuals who have a medical history that increases their chances of future health risks. In the current case report, the participant had been comfortably sedentary for the majority of her adult life. However, in the months leading up to participation in the described exercise program, she began to recognize that in order to reduce her risk for future health conditions and also improve her quality of life, she would need to commit to regular activity. As a breast cancer survivor, she was aware of the evidence supporting the fact that cancer survivors who are physically active have a better quality of life, improved fitness and physical function, and less fatigue (Courneya and Freidenreich, 2007; Daley et al, 2007; Jankowski et al., 2008). This was despite some evidence that suggests that many breast cancer survivors do not believe that exercise can reduce long-term effects of cancer and related treatments (Hirschey et al., 2017). The participant had previously tried various modes of exercise including walking and water aerobics but without success. Thus, the challenge faced by the practitioner was to design an exercise program that would be tolerated by the participant enough to promote adherence and eventually facilitate the desired physical improvements.

At the beginning of the program, the participant was hesitant to exercise and demonstrated frustration when confronted with physical challenge. When she had difficulty completing a task or exercise, she was disappointed that she was unable to meet her own expectations. However, by the end of the program the client was arriving approximately 20 minutes early to every session and had a noticeably better attitude. Her adherence rate was 90%, missing only 2 out of 20 sessions. One absence was due to a prior commitment and the other absence was due to a dental appointment. The positive change observed in her attitude towards exercise as well as in her self-efficacy can likely be attributed to the personalized support and rapport that was established with the practitioner. Prior research supports the link between personal fitness training and success in exercise programming (Wang et al., 2021). Providing a challenging but nurturing environment for the participant to succeed in was paramount to the physical changes that occurred.

The significant improvements in strength and balance that were observed, while not surprising given the participant's untrained status, are still important findings. One reason is that the participant who previously stated virtually no interest in exercise was able to adhere to a program that yielded these significant changes, signifying a pivotal change in attitudes towards exercise. Secondly, the physical changes observed are associated with the goals the participant expressed desire in achieving, strengthening self-efficacy while simultaneously improving the overall health profile.

In addition to the benefit of the increased grip strength and balance overall, another point of interest is that the imbalance between the right and left sides was reduced. Initially, the right hand grip strength was greater than the left, with scores of 34kg and 21kg, respectively- a deficit of approximately 61% when comparing right and left sides. Following the intervention, this deficit was reduced to 25%, with only an 8 kg difference between limbs as opposed to the initial 13 kg difference. While the grip strength in both limbs increased, a lag still exists. Perhaps with prolonged training, this imbalance could be corrected especially if prescribed movements include additional unilateral work.

The most substantial outcome of this intervention was the improvement of balance, particularly in the left limb. Interestingly, the score difference between limbs upon initial assessment was 62%, with post-assessment results yielding a similar difference of approximately 66%. However, in this case, the weaker left limb surpassed the initially stronger right limb with an increase in balance score of 56.3 seconds, as opposed to just 16 seconds in the right limb. From a programming perspective, it would benefit practitioners to be aware of overcompensations or overemphasis on training the weaker limbs due to the possibility of exacerbating existing imbalances or neglecting the initially stronger limbs. Still, improvement in balance performance at any capacity in older individuals is noteworthy, as it may indicate improved functional ability relating to independence and mobility.

A key component of the program's implementation was the personalized progression which was tailored to the participant's development. Due to the inexperience of the participant and expressed disinterest in exercise, the presentation of the exercises was vital, particularly when considering the order in which the exercises were introduced. Physically, the concern was inducing mechanical stress before the participant was adequately prepared to handle such stress, which could lead to injury. Mentally, it was important to allow the participant to feel a sense of achievement to build confidence and increase the likelihood of program continuation. Progressing by modifying the exercise and making it more challenging proved to be a better strategy for mastery of exercises as opposed to simply adding resistance to a more simplistic movement. Additionally, "*base*" exercises served as a foundation to teach new exercises without overwhelming the participant. Examples of this practice include the chair squat that progressed to a full bodyweight squat and the sitting chair march that progressed to a dead bug exercise. Again, this method of progression allowed the participant to not get overwhelmed or intimidated and was easier to teach how to improve over every session and not get too focused on any single day's performance. The participant was able to successfully complete each exercise, enabling her to feel more confident and mentally ready to perform more challenging resistance training movements. Over a period of several weeks, the participant became less self-conscious and more confident about exercise and getting out of her comfort zone. There was also a marked observed change in attitude towards exercise in general and the participant expressed a desire to continue to work out after she completed this program.

CONCLUSION

Upon completion of the program the participant saw improvement in performance categories that were related to her goals, particularly in strength and balance. Although only certain exercises were formally assessed, evaluation of progress during the weekly workout sessions confirmed that strength was increased in every exercise. It is best demonstrated in the amount of weight she was able to squat considering she was unable to perform a squat in the beginning of the program. The increase in the Stork Test timing shows that proprioception, core strength, and the ability to balance were improved. The participant mentioned that she was moving around better through her life and everyday tasks became easier to perform, and she had more confidence, reported to be in a better mood, and felt like she had more energy than before starting the program.

Improvements that were seen as a result of the program were equally in part due to the measured personalized progression and the one-on-one rapport that was established. The pace of the programming allowed her to build confidence and feel more comfortable attempting more challenging exercises. This one-on-one relationship is what could help previously untrained clients adhere to an exercise program, especially within the older population of breast cancer survivors.

AUTHOR CONTRIBUTIONS

Both authors made significant contributions to the study's design and implementation, as well as the interpretation of results, writing and editing.

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DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

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