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A Preliminary Study on the Efficacy of a Community-Based Physical Activity Intervention on Physical Function-Related Risk Factors for Falls among Breast Cancer Survivors

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Abstract

Objective—The aim of this study was to examine the effects of a 6-week community-based physical activity (PA) intervention on physical function-related risk factors for falls among 56 breast cancer survivors (BCS) who had completed treatments.

Design—This was a single-group longitudinal study. The multimodal PA intervention included aerobic, strengthening and balance components. Physical function outcomes based on the 4-meter walk, chair stand, one-leg stance, tandem walk, and dynamic muscular endurance tests were assessed at 6-week pre-intervention (T1), baseline (T2), and post-intervention (T3). T1-T2 and T2-T3 were the control and intervention periods, respectively.

Results—All outcomes, except the tandem walk test, significantly improved after the intervention period ($p < 0.05$), with no change detected after the control period ($p > 0.05$). Based on the falls risk criterion in the one-leg stance test, the proportion at risk for falls was significantly lower after the intervention period ($p = 0.04$), but not after the control period.

Conclusions—A community-based multimodal PA intervention for BCS may be efficacious in improving physical function-related risk factors for falls, and lowering the proportion of BCS at risk for falls based on specific physical function-related falls criteria. Further larger trials are needed to confirm these preliminary findings.

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DISCLOSURE OF PREVIOUS PRESENTATIONS
The authors declare that no detail of the study has been presented in any form.

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The authors declare that they have no conflict of financial interest.

Keywords

breast neoplasms; exercise therapy; risk factors; accidental falls

Breast cancer is the most prevalent cancer (41%) among women cancer survivors.[1] Breast cancer survivors (BCS) often undergo treatments that result in muscle loss and neurological dysfunction, which put them at significantly higher risk for falls and fall-related injuries, including fractures.[2-4] BCS who receive chemotherapy and/or hormonal therapy have a significantly higher odds of falling (1.23; 95% CI: 1.01 – 1.51)[3] and also significantly higher rates of falls (75%) than cancer-free controls (45%).[4] Emerging evidence demonstrated a history of falls is an independent risk factor for fractures in BCS, resulting in a significantly higher risk for fractures (hazard ratio = 1.15; 95% CI: 1.05 – 1.25) than cancer-free controls.[2]

Current evidence suggests physical function-related risk factors for falls, including compromised functional mobility (slower walking speed and lower limb weakness), balance dysfunction, and reduced lower limb muscular endurance, are significant problems related to cancer treatment-related muscle loss and peripheral neuropathy among BCS.[5,6] More BCS reported difficulty in walking 1.4 miles than their individuals without cancer.[6] About 20% of BCS of all ages and 30% of older BCS aged 70 or above walk slower than 1 m/s,[7] which is a predictor of adverse health-related events such as multiple falls.[8] BCS who fall also tend to have significantly weaker lower limbs than non-fallers.[4] There is evidence of balance dysfunction among BCS who have received chemotherapy, with significant increase in postural instability as compared to healthy controls.[9] Balance among BCS who have a history of falls is also significantly poorer than those who have no falls history.[10] Lower limb muscular endurance of BCS, especially during treatment, is also poorer than population norms,[11] which is often closely associated with higher risk of falls.[12]

Few studies have examined the effects of exercise interventions on physical function-related risk factors for falls in BCS,[13,14] and the focus has been on balance, lower limb strength and endurance outcomes. Little is known about the exercise intervention effect on walking speed, which has a significant direct association ($\chi^2 = 0.78$, $p < 0.05$) and the strongest association with falls as compared to other physical function outcomes.[15] To date, the exercise trials also have examined primarily unimodal exercises, such as resistance and impact training,[13,14] which is contrary to the recommended multimodal approach for falls prevention.[16] Multimodal physical activity (PA) intervention that includes aerobic, strengthening, and balance training has demonstrated effectiveness in improving physical function-related risk factors for falls and reducing the risk of falls.[16] However, the efficacy of this multimodal PA intervention approach has not been investigated in BCS within a community-based setting (i.e. in a community institution such as a health center). The multimodal PA intervention could potentially reduce the risk of falls in BCS,[16] while a community-based approach could be a possible cost-effective and accessible strategy for program implementation in the future.[17]

We have previously completed an evaluation of a 6-week community-based multimodal PA intervention in BCS.[18] The preliminary findings suggested the intervention was efficacious

in improving PA level, fatigue, and quality of life, but the effects on physical function outcomes related to falls were not reported. The primary purpose of the current analysis was to examine the effect of the community-based PA intervention on physical function outcomes in BCS. Secondary purposes were to: 1) explore the effects of the community-based PA intervention on the proportion of BCS with increased risk of falls based on specific physical function-related falls, and; 2) estimate the effect size of the PA intervention on physical function outcomes in BCS.

METHODS

This preliminary study utilized a single-group longitudinal design. Assessments were administered at 6-weekly intervals at pre-intervention baseline (T1), immediate pre-intervention baseline (T2), and immediate post-intervention (T3). T1 to T2 and T2 to T3 were the 6-week control and intervention periods respectively. The study protocol was approved by the university's Human Research Ethics Board Committee.

Participants

Women diagnosed with stage 0 to III breast cancer who had completed their chemotherapy and/or radiation therapy treatments at least one month prior, and had physician clearance to participate in the PA intervention were recruited. Those with metastatic disease were excluded from the program. The participants were recruited through health care providers at the community Breast Health Centre and the regional cancer center, flyer distributions at outpatient breast cancer clinics, and a local cancer survivors' newsletter. All participants provided written informed consent.

Intervention

The 6-week community-based multimodal PA intervention program conducted between September 2009 to August 2011 has been previously described.[18] The PA intervention followed the Canadian Physical Activity Guide to Healthy Active Living for Adults and Older Adults.[19-21] In brief, the intervention included six weekly 2.5-hour structured classes held at the Breast Health Centre in the community. The classes consisted of education sessions on self-management and supervised practical PA sessions on home-based exercises. The self-management component provided guidance on the principles of exercise planning and progression. The supervised practical PA sessions provided guided hands-on practice on exercises that would also be performed at home. The home-based exercises components included aerobic (a progressive walking program that had a target total weekly moderate intensity PA of 150 minutes, and gentle lower limb stretches were performed after each walking session), resistance (weekly target of two to three sessions of 1-3 sets of 8-12 repetitions in progressive strengthening exercises that target the major muscle groups of the trunk, upper and lower limb using weights or Therabands™, and were followed by one 2-repetition set of gentle upper and lower limb stretches with a maximum of 30-second hold), and balance (weekly target of two to three sessions of one 2-repetition set of progressive one-leg balance exercise with holds of up to one minute for each leg). The exercises were individualized and progressed accordingly based on the participants' PA levels, and their performance levels at T2 and during the class sessions. The classes were co-facilitated by a

certified exercise instructor, a registered dietitian, and a registered social worker. Physical therapists and lymphedema therapists were consulted as needed.

Outcome measurements

Sociodemographics and clinical characteristics, and physical activity levels were assessed at T1. Sociodemographic characteristics included age, ethnicity, education level, and employment status. Clinical characteristics included comorbidity, current stage of cancer, time since diagnosis and last treatment, types of cancer treatment completed, body mass index, and menopausal status. Comorbidity was assessed using the validated Charlson Comorbidity Index.[22-24] The index score ranges from 0 to 37, and is calculated based on 19 self-reported medical conditions that are weighted from 1 to 6.[25] PA levels were determined based on PA level in the previous six months, and participation in other concurrent exercise programs. Prior PA level was assessed using the validated Prochaska's stage of change questionnaire.[26-28] The questionnaire is based on self-reported PA behavior in the past six months in reference to the standard PA recommendation of 150 minutes per week of moderate-intensity PA.[29]

Physical function outcomes related to falls included functional mobility (walking speed and functional leg strength), balance (static and dynamic balance), and lower limb endurance (leg extension and leg curl) were assessed at T1, T2 and T3. Walking speed was assessed using the Short Physical Performance Battery 4-meter walk test[30] and required participants to walk at their usual pace. Two trials were performed, and the faster time (seconds) was recorded and converted to walking speed (m/s) for analysis. The 4-meter walk test has excellent test-retest reliability (intra-class correlation (ICC) = 0.80-0.89)[31], and good predictive validity for functional decline in older adults.[32] A walking speed of 1 m/s or less is predictive of multiple falls in older adults (RR = 1.8; 95%CI: 1.2 – 2.6).[8]

Functional leg strength was assessed using the chair stand test.[33] Starting in a sitting position in a standard height chair, participants were asked to perform 5 repetitions of sit-to-stand as fast as possible with arms across their chest. The test ended in standing position. The time in seconds was used for analysis. The chair stand test has excellent test-retest reliability (ICC = 0.89 – 96).[8,34] Chair stand test of 12 seconds or more is predictive of multiple falls (RR = 2.0; 95%CI: 1.3 – 3.0).[8]

Static balance was assessed using the one-leg stance test.[35] During the one-leg stance test, the dominant leg was tested first prior to the non-dominant one, with leg dominance based on participants' self-reported leg preference when standing on one leg. For the standard test level, the participants stood on one foot unsupported for up to 30 seconds first on their dominant leg. If the time was less than 30 seconds, the participants would not proceed to the next test level, and the time would be recorded. If participants were able to complete up to 30 seconds, the participants would take a one-minute rest, and proceed to the advanced level on the same side in which they would stand on their toes for up to 30 seconds. The time recorded would be the sum of the time of both levels. The above procedure was repeated on the non-dominant leg. Two trials on each side were performed, and the best time on each side was used for analysis. The one-leg stance test has excellent inter-rater reliability (gamma coefficient = 0.99 – 1.00),[35] and good predictive validity (RR = 11.6; 95%CI: 1.7 –

80) for falls in older adults.[36] A one-leg stance test of less than 30 seconds is predictive of falls in older adults.[36]

Dynamic balance was assessed using the tandem walk test.[37,38] Participants were instructed to walk forward heel-to-toe along a 20-foot line as quickly as they could without errors (i.e. not walking heel-to-toe or losing balance). The average time and number of errors of two trials were used for analysis, but the latter would be the key test outcome. This number of errors in the tandem walk test has demonstrated good test-retest ($r = 0.94$),[38] and excellent predictive validity.[37] Tandem walk test with more than two errors is predictive of multiple falls (OR = 2.93, 95% CI: 1.39 - 6.18).[37]

Lower limb muscular endurance was assessed using the Dynamic Muscular Endurance Test Battery for bilateral leg extension and leg curl.[39] The participants used a set weight on a Hoist VR-Combo V ROC leg extension / leg curl combo unit [a] that was based on their individual age and body weight, and had been modified for cancer survivors.[39] Each test was performed at a set rate of 12.5 repetitions per minute until they were not able to maintain at the preset rate.[39] If the participants were not able to perform one repetition with the expected individualized set weight, the weight was progressively reduced by 5-10 lbs until the participants could perform at least two repetitions at the preset rate. A one-minute rest was provided between trials. The product of the percentage of expected set weight used and the number of repetitions performed was recorded. This test battery does not have established cut-off scores for prediction of falls.

Statistical Analysis

Repeated one-way analysis of variance (ANOVA) and Cochran Q tests, followed by post-hoc Bonferroni pairwise comparisons, were used to examine the changes in physical function outcomes (continuous variables) and the proportion with increased risk of falls based on physical function outcomes (dichotomous variables) over time, respectively. The participants were characterized as having increased risk of falls based on each of the following criterion (except Dynamic Muscular Endurance Test that does not have a cut-off criterion): 4-meter walk test ≤ 1m/s,[8] chair stand test ≥ 12 s,[8] one-leg stance test < 30 s,[36] and tandem walk test > 2 errors.[37]

Effect sizes of the intervention for all participants were calculated by dividing the change between T2 and T3 by the standard deviation of each of the corresponding outcomes at T2. The interpretation of the effect size was based on Cohen's d – a small effect is between 0.2 to 0.49; medium effect is between 0.5 to 0.79; and large effect is equal or greater than 0.8.[40] All statistical analyses were performed using the IBM SPSS Statistics (version 21.0.0.1). [b]

RESULTS

Sixty-four BCS who met the inclusion and exclusion criteria were contacted, and 60 of them agreed to participate in the 6-week PA intervention program. The final analysis included 56

[a]**SUPPLIERS' LIST**
Hoist Fitness Systems, 9990 Empire St., #130, San Diego, CA 92126
[b]IBM SPSS Statistics Release 21.0.0.1, IBM Corporation, Armonk, NY 10504

participants because four dropped out during the program due to family death (1), lost of contact (1), and accidents unrelated to the program (2).

Participant characteristics are presented in Table 1. Most participants were younger than age 65, white and had an education beyond high school level. The majority of the participants had stage II breast cancer and had completed both chemotherapy and radiation therapy. Class attendance was excellent. Of the six class sessions, the average attendance was 5.1 ± 0.9 sessions (median: 5 sessions). Forty-three of the participants (76.8%) attended 5 or more sessions, 17.9% (10 participants) 4 sessions, and 5.3% (3 participants) 3 sessions.

Effects of PA Intervention on Physical Function Outcomes

All physical function outcomes improved significantly over time ($p < 0.05$) (Table 2). Post-hoc pairwise comparisons indicated the 4-m walk test (Figure 1a), chair stand test (Figure 1b), one-leg stance test on both the dominant and non-dominant sides (Figure 1c), and dynamic muscular endurance in both leg extension and leg curl (Figure 1f) improved during the intervention period (T2 to T3) (all $p < 0.05$), while these outcomes did not change during the control period (T1 to T2) (all $p > 0.05$) (Table 2). Tandem walk test time improved in both the control and intervention periods (all $p < 0.01$) (Table 2 and Figure 1d). There was no change in the number of errors in the tandem walk test during both periods (all $p > 0.05$), but there was a reduction in number of errors when comparing between T1 and T3 ($p = 0.05$) (Table 1 and Figure 1e).

Effect Size of Physical Function Outcomes

Most effect sizes for the physical function outcomes during the intervention period (T2 to T3) ranged from 0.29 to 0.42 (Table 2). The exceptions included the 4-m walk test, which had a large effect size of 0.74, and the number of errors in the tandem walk test, which had a minimal effect size of 0.07. The 95% confidence interval (CI) of the effect sizes were generally large (Table 2).

Effects of PA Intervention on the Proportion of BCS with Increased Risk of Falls

Overall, less than half of the participants had increased risk of falls based on physical function outcomes at both baseline time points (T1 and T2) (Table 3). The proportions of participants with increased risk were very small based on the 4-m walk test and chair stand test criteria in functional mobility (T1: 3.6% - 11.3%; T2: 0% to 8.9%), but were greater when based on the one-leg stance test (T1: 33.9% - 44.6%; T2: 33.9% to 41.1%) and tandem walk test (T1: 27.3%; T2: 25.0%) (Table 3).

The proportion of participants with increased risk of falls changed significantly only in the chair stand test ($p = 0.021$) and one-leg stance test ($p < 0.02$) (Table 3). Post-hoc Bonferroni pairwise comparisons revealed the proportion with increased risk of falls based on the chair stand test (0%) at T3 was significantly lower than at T1 (11.3%, Q[1] = -2.6, $p = 0.028$). Similarly, the proportion based on the one-leg stance test (non-dominant side) at T3 (33.9%) was also significantly lower than at T1 (44.6%, Q[1] = -2.8, $p = 0.014$). However, based on the one-leg stance test on the dominant side, the proportion with increased risk of falls at T3

(17.9%) was significantly lower than both T2 (33.9%, Q[1] = -2.5, $p = 0.04$) and T1 (33.9%, Q[1] = -2.8, $p = 0.014$).

DISCUSSION

This preliminary study suggested that a multimodal PA intervention had significant positive effects on physical function outcomes related to falls, specifically functional mobility (walking speed and functional lower limb strength), static balance, and lower limb muscular endurance. The intervention was also efficacious in lowering the proportion of BCS with increased risk of falls based on the static balance criterion. The improvements in physical function outcomes and the reduction in the proportion of BCS at risk for falls were unlikely consequences of learning effect or maturation because significant changes occurred only after the 6-week intervention period, and not after the 6-week pre-intervention control period.

This study is the first to demonstrate a brief community-based PA intervention that includes aerobic, strengthening, and balance components, could have beneficial effects on physical function and the potential to lower the risk for falls based on specific physical function-related falls criteria. The evidence adds to the current established benefits of PA for BCS in reducing fatigue and improving cardiovascular fitness.[41] This study also provided effect size estimates of the physical function outcomes, which ranged from small to medium. These estimates could be useful for future larger randomized control studies.

The evidence suggested that a multimodal PA intervention could have a clinically important impact on walking speed among BCS who have completed treatments. Besides having a significant post-intervention improvement and a medium effect size, the walking speed of the participants also improved by an average of 0.14m/s after intervention which is considered clinically important (minimal clinical important difference (MCID) = 0.10 - 0.17m/s).[42] The significant impact of the intervention on walking speed in BCS was expected, and corroborated the findings of previous multimodal PA intervention studies that focused on community-dwelling older adults.[43,44] The extent of improvement in walking speed could also potentially reduce the risk of falls. Evidence suggests walking speed has the strongest association with falls, when compared to other physical function outcomes such as the functional lower limb strength, static and dynamic balance measures.[15] The findings in the proportion with risk of falls based on walking speed did not demonstrate significant change after intervention. However, it could be limited by the small number of participants who had increased risk of falls based on the walking speed criterion. Future studies are needed to determine the association between changes in walking speed and risk of falls in the BCS population.

To date, no study has examined the effect of multimodal PA interventions on the risk of falls in BCS after they have completed treatments. Thus, the preliminary findings that this 6-week multimodal PA intervention could significantly reduce the proportion of BCS at risk for falls based on the static balance criterion was promising. This was notable considering that less than half of the BCS in the study were at risk for falls and the intervention was for a short duration. The preliminary findings of this study, together with the established evidence in

falls prevention among community-dwelling older adults,[16] suggested that multimodal PA interventions could potentially reduce the risk of falls in the BCS population. Furthermore, given that the PA intervention was delivered within a brief period of time in a community setting, this intervention approach could also potentially be cost-effective.[17]

It was noteworthy that even though walking speed, functional lower limb strength, and static balance significantly improved after intervention, only improvement in static balance corresponded to a significant reduction in the proportion of participants with increased risk of falls. This observation might be partly attributed to the much smaller proportions who were considered to be at risk for falls based on the walking speed and functional lower limb strength criteria as compared to static balance criterion. This suggested that static balance, relative to the other tested physical function outcome measures, might be a better clinical tool for monitoring changes in the risk of falls among BCS. Further studies are necessary to evaluate these speculations as records of falls before and after the intervention were not ascertained in this study.

Currently, there are few established physical function-related clinical outcome measures for balance in the BCS population.[45] Both one-leg stance[35,36] and tandem walk tests[37,38] are established measures for static and dynamic balance, respectively, in the general population. However, it was interesting to note that these measures had different outcomes in the BCS sample in this study. The one-leg stance test had minimal learning effect during the control period, while significant changes occurred post-intervention reflecting the task-specific training effect of the balance component of the PA intervention. On the other hand, both components of the tandem walk test (timing and the number of errors) demonstrated substantial learning effects over time after the control and intervention periods. Thus, the one-leg stance test for static balance may potentially have more clinical utility than the tandem walk test for dynamic balance in BCS.

Study Limitations

The interpretation of the findings should take into consideration the lack of established physical function outcomes in this population and the limitations of preliminary studies. The small sample size, under-representation of older BCS, and the lack of comparison control group were the key limitations. Furthermore, the results could not infer a reduction in falls as the records on falls were not obtained. Future larger trials that address these limitations will help determine the clinical impact of multimodal PA interventions on falls prevention, and will also provide a better understanding on the differential intervention effects between older and younger BCS.

CONCLUSIONS

This is the first study to date that demonstrates a 6-week community-based multimodal PA intervention may be an efficacious approach to improving physical function outcomes, including functional mobility, static balance, and lower limb muscular endurance. Despite a relatively small proportion of BCS in the study sample had increased risk of falls, the brief PA intervention appeared to lower the proportion at risk for falls based on specific physical function-related falls criterion in static balance.

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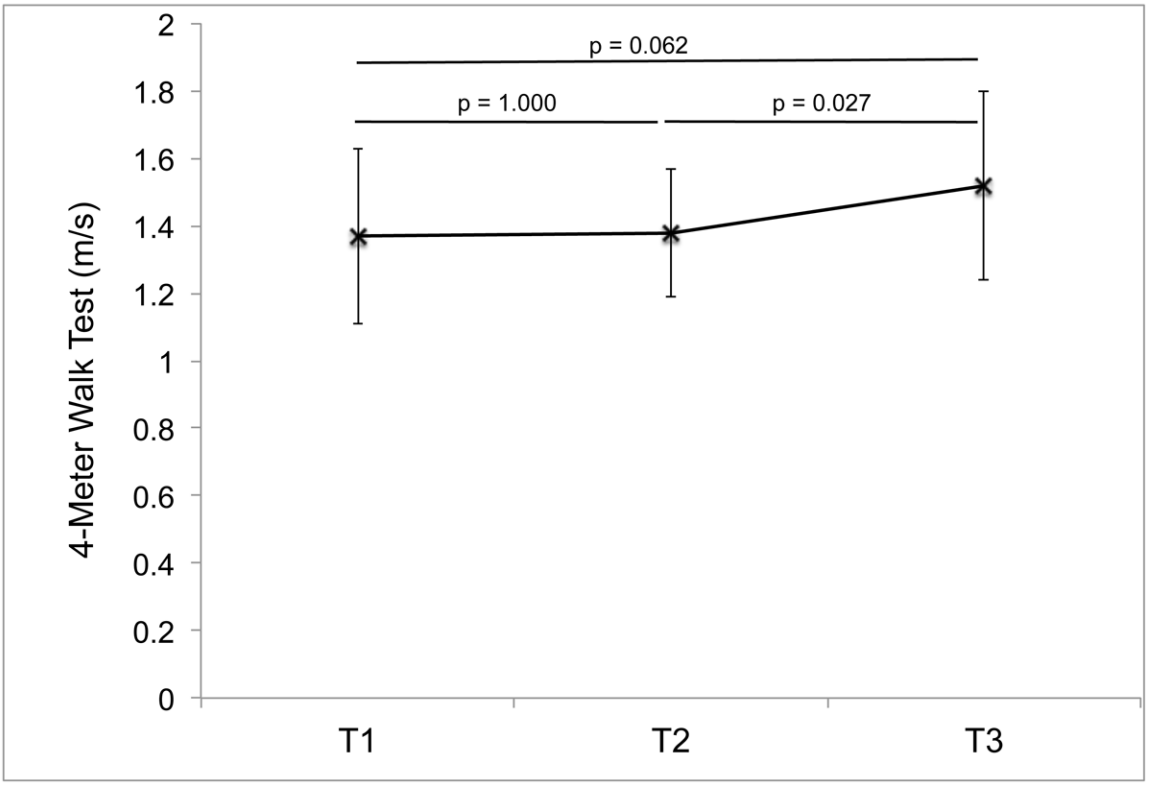

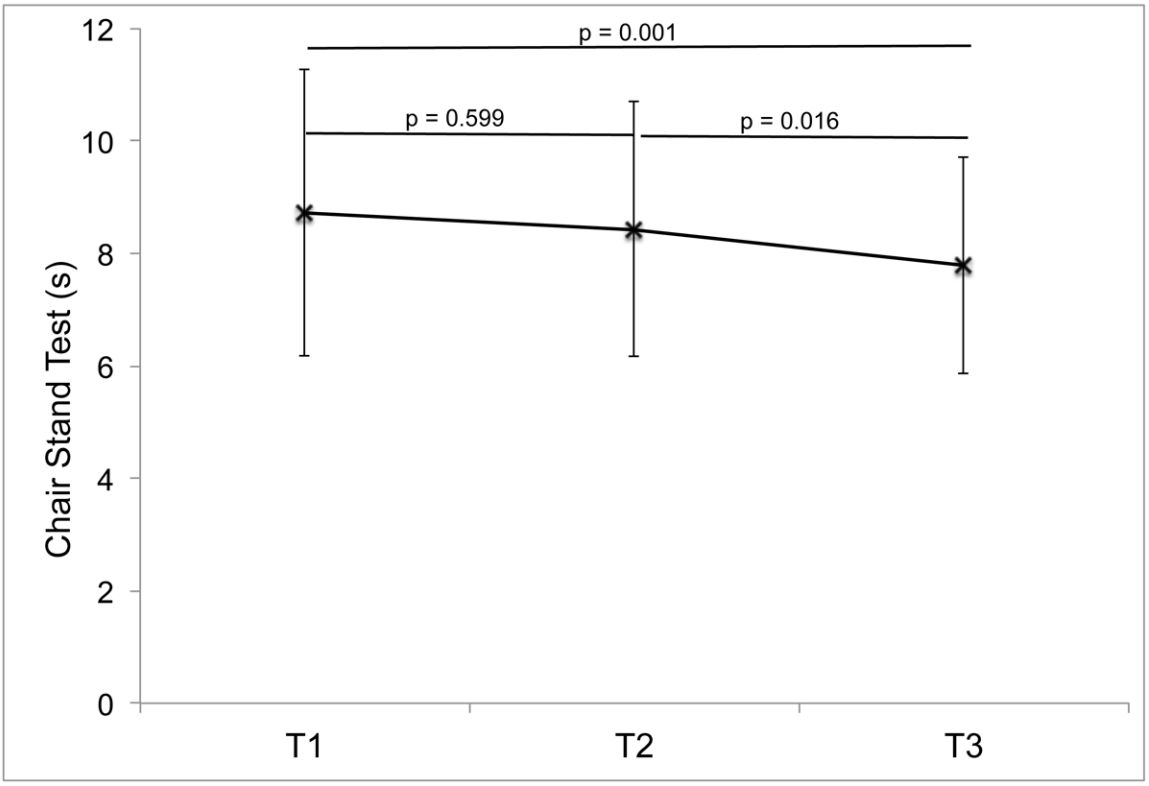

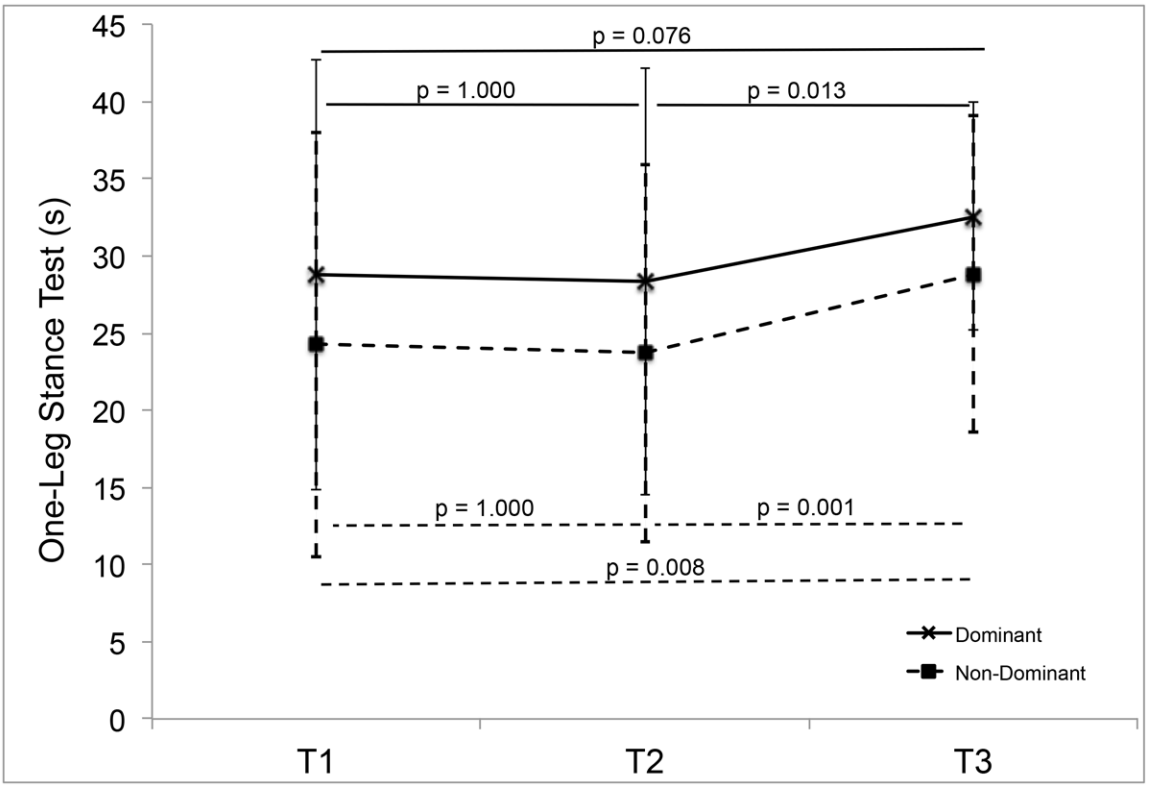

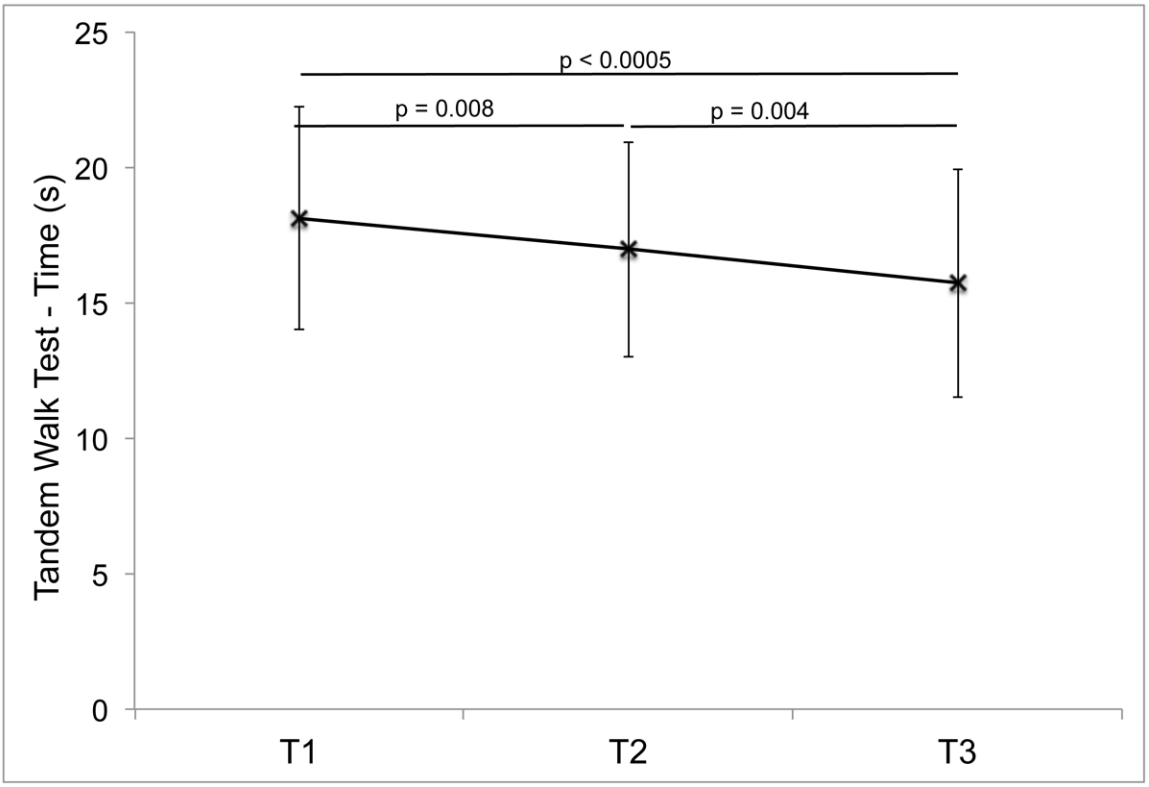

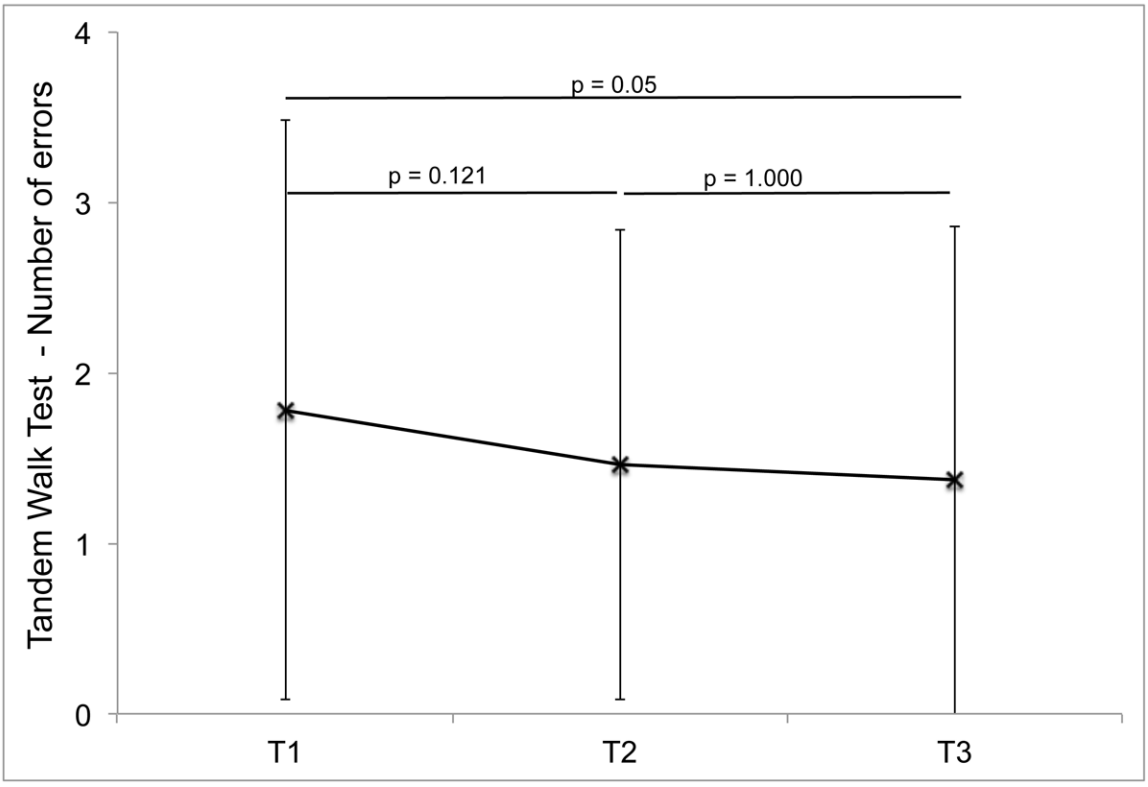

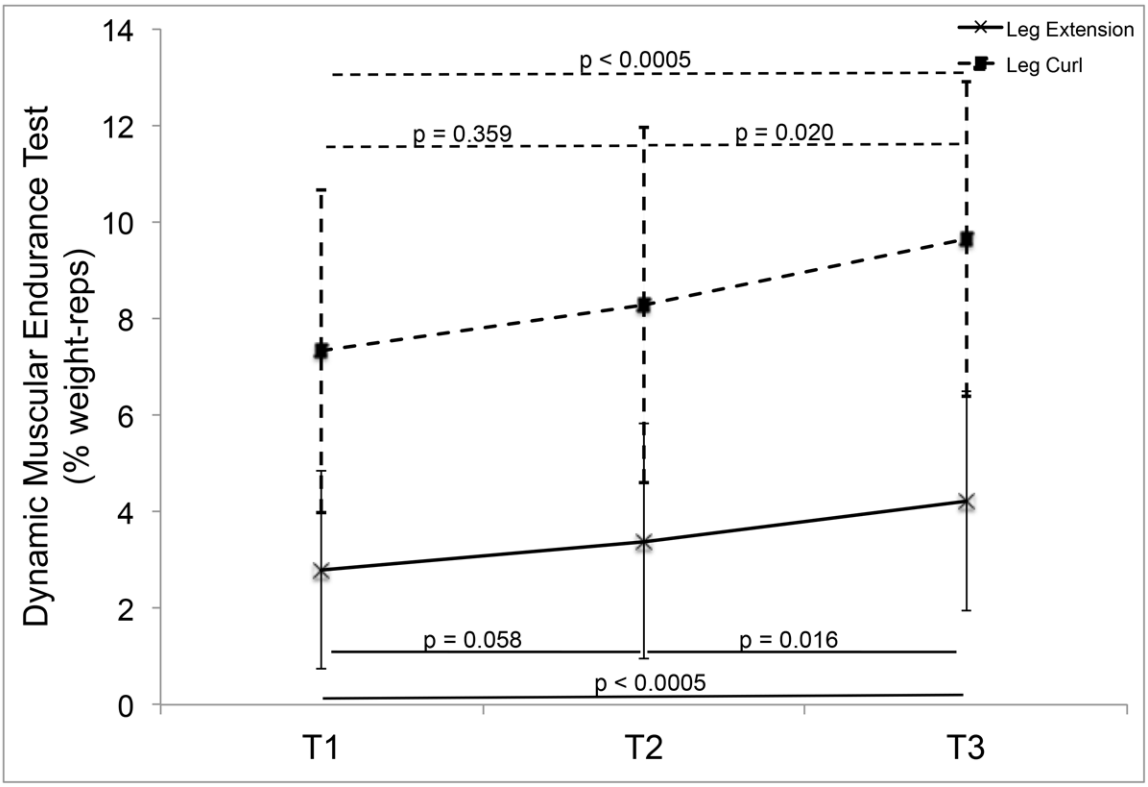

Figure 1. A – F. Post-Hoc Comparisons of Physical Function Outcome Changes over Time

(A) 4-meter walk test
(B) Chair stand test
(C) One-leg stance test - dominant & non-dominant sides
(D) Tandem walk test - Time
(E) Tandem walk test - Number of errors
(F) Dynamic muscular endurance test – Leg extension & leg curl
T1: 6-week pre-intervention baseline
T2: Immediate pre-intervention baseline
T3: Immediate post-intervention
Error bars represent standard deviations

TABLE 1

Characteristics of Participants (n = 56)

	Mean ± SD (range) Frequency (%)
Age (years)	53.8 ± 9.6 (34 – 73)
≥ 65	8 (14.3%)
< 65	48 (85.7%)
Ethnicity	
Aboriginal	2 (3.6%)
Black	3 (5.4%)
Latina	1 (1.8%)
White	50 (89.3%)
Education Level	
High school or below	11 (19.6%)
Above high school	45 (80.4%)
Employment Status	
Currently working	19 (33.9%)
Homemaker	2 (3.6%)
On leave of absence	22 (39.3%)
Retired (not due to health)	10 (17.9%)
Disabled/retired (due to health)	3 (5.4%)
Clinical Characteristics	**Mean ± SD (range) Frequency (%)**
Comorbidity (score range: 0 - 37)	0.4 ± 0.7 (0 – 3)
Current Stage of Cancer	
Stage I	14 (25.0%)
Stage II	31 (55.4%)
Stage III	11 (19.6%)
Time Since Diagnosis (months)	22.9 ± 26.3 (6.0 – 141.0)
Cancer Treatment(s) Completed	
Chemotherapy or Radiation Therapy Only	18 (32.1%)
Both Chemotherapy and Radiation Therapy	38 (67.9%)
Last date of treatment (months)	9.1 ± 13.0 (1 – 76)
Body mass index (kg/m^2)	30.6 ± 6.3 (21.3 – 45.6)
Menopausal Status	
Premenopausal	17 (30.4%)
Perimenopausal	4 (7.1%)
Postmenopausal	33 (58.9%)

	Mean ± SD (range) Frequency (%)
Missing Data	2 (3.6%)
Physical Activity (PA) Level	**Frequency (%)**
Moderate PA ≥150 minutes/week in the past 6 months	
Yes, for more than 6 months	6 (10.7%)
Yes, for less than 6 months	16 (28.6%)
No	34 (60.7)
Participation in other concurrent exercise programs	
Yes	14 (25%)
No	42 (75%)

Table 2

Changes in Physical Function Outcomes over Time and their Effect Sizes (n = 56)

	T1	T2	T3			
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	**F**	**Overall *p***	***d* (95% CI)**
Functional Mobility						
Walking speed						
- 4-meter walk test (m/s)	1.37 ± 0.26	1.38 ± 0.19	1.52 ± 0.28 *	4.73	0.013	0.74 (0.14 – 0.96)
Functional lower limb strength						
- Chair stand test (s)	8.73 ± 2.55	8.43 ± 2.26	7.78 ± 1.92 *,++	8.66	<0.0005	0.29 (0.08 – 0.62)
Balance						
Static balance: One-leg stance test						
- Dominant (s)	28.78 ± 14.53	28.35 ± 14.30	32.57 ± 10.83 *	4.60	0.012	0.30 (0.18 – 0.73)
- Non-dominant (s)	24.27 ± 13.76	23.69 ± 12.21	28.82 ± 10.23 *,++	8.21	0.001	0.42 (0.25 – 0.81)
Dynamic balance: Tandem walk test						
- Time (s)	18.13 ± 4.11	16.97 ± 3.96 ++	15.73 ± 4.21 *,++	17.75	<0.0005	0.31 (0.18 – 0.73)
- Number of errors	1.78 ± 1.70	1.46 ± 1.38	1.37 ± 1.49 ++	3.93	0.023	0.07 (0 – 0.38)
Lower limb endurance						
Dynamic muscular endurance						
- Leg extension (% weight-reps)	2.79 ± 2.06	3.39 ± 2.45	4.23 ± 2.28 *,++	16.12	<0.0005	0.34 (0.17 – 0.97)
- Leg curl (% weight-reps)	7.32 ± 3.34	8.27 ± 3.68	9.64 ± 3.25 *,++	11.36	<0.0005	0.37 (0.15 – 0.95)

Time points: T1 (6-week pre-intervention baseline); T2 (immediate pre-intervention baseline); T3 (immediate post-intervention)

Post-hoc pairwise comparisons:

* Significant difference versus T2 ($p < 0.05$);

++ Significant difference versus T1 ($p < 0.05$)

d: Effect size calculated based on the change between T2 and T3 divided by standard deviation at T2 for each of the outcome

CI: Confidence interval

Table 3

Changes in Proportion with Increased Risk of Falls over Time

	T1	T2	T3	Q	Overall *p*
Functional Mobility					
Walking Speed: 4-meter walk test					
≤ 1 m/s (F)	2 (3.6%)	0 (0%)	0 (0%)	2.00	0.368
> 1m/s	54 (96.4%)	56 (100%)	56 (100%)		
Functional lower limb strength:					
Chair stand test					
≥ 12 s (F)	6 (11.3%)	5 (8.9%)	0 (0%) ++	7.75	0.021
< 12 s	47 (88.7%)	51 (91.1%)	56 (100%)		
Balance					
Static balance: One-leg stance test					
- Dominant					
< 30 s (F)	19 (33.9%)	19 (33.9%)	10 (17.9%) * ++	9.50	0.009
≥ 30 s	37 (66.1%)	37 (66.1%)	46 (82.1%)		
- Non-dominant					
< 30 s (F)	25 (44.6%)	23 (41.1%)	19 (33.9%) ++	8.17	0.017
≥ 30 s	31 (55.4%)	33 (58.9%)	37 (66.1%)		
Dynamic balance: Tandem walk test					
> 2 errors (F)	15 (27.3%)	14 (25.0%)	12 (21.8%)	1.17	0.558
≤ 2 errors	40 (72.7%)	42 (75.0%)	43 (78.2%)		

Time points: T1 (6-week pre-intervention baseline); T2 (immediate pre-intervention baseline); T3 (immediate post-intervention)

(F): Meeting physical function outcome-specific criteria for increased risk of falls
NT: not tested due to the presence of only one category across time

Post-hoc pairwise comparisons:

*Significant difference versus T2 ($p < 0.05$);

++Significant difference versus T1 ($p < 0.05$)