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ORIGINAL ARTICLE

Motivation for Different Types and Doses of Exercise During Breast Cancer Chemotherapy: a Randomized Controlled Trial

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Abstract

Background Exercise is beneficial for breast cancer patients during chemotherapy, but their motivation to perform different types and doses of exercise is unknown.

Purpose The purpose of this study was to examine the anticipated and experienced motivation of breast cancer patients before and after three different exercise programs during chemotherapy.

Methods Breast cancer patients initiating chemotherapy ($N = 301$) were randomized to a standard dose of 25–30 min of aerobic exercise, a higher dose of 50–60 min of aerobic exercise, or a combined dose of 50–60 min of aerobic and resistance exercise. Patient preference and motivational outcomes from the theory of planned behavior (i.e., perceived benefit, enjoyment, support, difficulty, and motivation) were assessed before and after the interventions.

Results At pre-randomization, breast cancer patients were significantly ($p < 0.001$) more likely to prefer the combined program (80.1 %); however, after the interventions there was a significant ($p < 0.001$) increase in the number of patients preferring the high volume program and having no preference. At pre-randomization, breast cancer patients anticipated more favorable motivational outcomes for the combined program and less favorable motivational outcomes for the high volume program (all $p < 0.001$). After the interventions, the motivational outcomes experienced exceeded the anticipated motivational outcomes significantly more in the high volume group than the standard or combined groups.

Conclusions Anticipated motivational outcomes for different types and doses of exercise during chemotherapy varied considerably at pre-randomization, but the motivational outcomes experienced after the three interventions were similar. Clinicians can recommend any of the three exercise interventions to breast cancer patients knowing that positive motivational outcomes will result.

Clinicaltrials.gov identifier: NCT00249015.

Keywords Cancer survivors · Motivation · Patient preference · Physical activity · Theory of planned behavior

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Introduction

Exercise during chemotherapy for early-stage breast cancer improves health-related fitness and quality of life outcomes [1], chemotherapy completion rate [2, 3], and possibly even disease-free survival [4]. Moreover, higher doses of exercise may provide additional benefits. In the Combined Aerobic and Resistance Exercise (CARE) Trial, we randomized 301 breast

cancer patients initiating chemotherapy to thrice weekly supervised exercise consisting of either 25–30 min of aerobic exercise (standard program), 50–60 min of aerobic exercise (high volume program), or 50–60 min of combined aerobic and resistance exercise (combined program). In the primary paper [5], we reported several positive effects of the higher dose interventions compared to the standard program for physical functioning, endocrine symptoms, bodily pain, and health-related fitness. In subgroup analyses, these effects were more pronounced for patients who were healthy weight, aerobically fitter, and pre-menopausal/younger [6]. Moreover, the higher dose interventions were more effective than the standard program for managing sleep quality, especially in patients who had no comorbidities, were already meeting exercise guidelines, or were aerobically fitter [7]. Finally, the higher dose interventions were more effective than the standard program for managing depressive symptoms in patients with depressive symptoms at baseline or not receiving taxane-based chemotherapies [8].

Overall, the CARE Trial demonstrated that higher dose exercise interventions during breast cancer chemotherapy have small additional benefits compared to a standard program in unselected patients; however, a more pronounced benefit for the higher dose programs was observed in selected subgroups. These subgroups were generally characterized by patients with better physical functioning at baseline (e.g., younger, no comorbidities, healthy weight, aerobically fit, already exercising) or receiving less intensive treatments (e.g., lumpectomy, non-taxane-based chemotherapies). These subgroup effects suggest that matching patients to specific exercise interventions may optimize outcomes. One strategy for matching patients to exercise interventions is to understand their preference and motivation for the different interventions [9–11]. Such information may allow clinicians to identify which patients may be most motivated to perform which exercise interventions. Moreover, understanding the effects of different exercise interventions on motivational outcomes may be an important factor to consider when making an exercise recommendation [12].

The primary purpose of the present study was to examine the anticipated and experienced motivation for each of the three exercise interventions tested in the CARE Trial. More specifically, we wanted to identify (a) which exercise interventions were initially most motivating, (b) which each exercise interventions met or exceeded initial motivational expectations, and (c) which clinical, demographic, and behavioral variables moderated the anticipated and/or experienced motivational outcomes. Our investigation was guided by the theory of planned behavior [13]. The theory of planned behavior is a social cognitive model of human behavior that proposes that intention is the primary determinant of behavior. Intention is conceptualized as having two components: a behavioral choice or goal (i.e., what one intends to do) and intention strength (i.e., how motivated one is to do it). In the present study, we conceptualized patient preference as the behavioral choice component (i.e., what one would intend to do if given the choice). We also assessed motivation as an indicator of the strength of the behavioral intention. Moreover, intention is influenced by perceived behavioral control (expected difficulty of the behavior), instrumental attitude (expected benefits from the behavior), affective attitude (expected enjoyment of the behavior), and subjective norm (expected support for the behavior).

Based on our clinical observations during the CARE Trial, we hypothesized that breast cancer patients would be initially most motivated to perform the combined exercise program. Moreover, based on previous subgroup effects in the CARE Trial, we hypothesized that women who were younger, healthy weight, aerobically fitter, and previous exercisers would be initially more motivated to perform the higher dose exercise interventions than women who were older, obese, aerobically less fit, and previous non-exercisers. Examination of which exercise programs met or exceeded initial motivational expectations as well as potential moderators of meeting or exceeding motivational expectations were considered exploratory.

Methods

Setting and Participants

The CARE Trial (Clinicaltrials.gov identifier: NCT00249015) has been described elsewhere [5]. Briefly, the CARE Trial was a multicenter Canadian trial with sites in Edmonton, Ottawa, and Vancouver. All procedures performed involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study. Eligibility criteria included English- or French-speaking non-pregnant women ≥18 years old with stage I–IIIc breast cancer initiating adjuvant chemotherapy. Women were excluded if they had incomplete axillary surgery, transabdominal rectus abdominus muscle reconstructive surgery, significant health problems, or were not approved by their oncologist. Eligible participants were identified by their treating oncologist prior to chemotherapy.

Randomization

After all baseline assessments, participants were stratified by center and chemotherapy regimen (any Herceptin versus no Herceptin/any taxane versus no Herceptin/no taxane) and randomly assigned in a 1:1:1 ratio to the standard, high volume, or combined group using a computer-generated program. The allocation sequence was generated in Edmonton and concealed from the project directors who assigned participants to groups.

Exercise Training Interventions

The exercise training interventions have been previously described.[5] Briefly, participants exercised for the duration of their chemotherapy beginning within 1–2 weeks of starting chemotherapy and ending within 3–4 weeks of completing chemotherapy. The standard group was asked to follow the aerobic exercise guidelines for cancer survivors [14, 15]. These guidelines recommend the equivalent of a minimum of 75 min/week of vigorous aerobic exercise spread over 3 days/week (i.e., 25–30 min/session). The high volume group were asked to follow double the minimum guidelines of 150 min/week of vigorous aerobic exercise per week (i.e., 50–60 min/session). The combined group were asked to complete the same minimum aerobic exercise guideline as the standard group, plus a strength training program for 3 days/week consisting of two sets of 10–12 repetitions of 9 different strength exercises at 60–75 % of their estimated 1 repetition maximum (i.e., about 50–60 min of combined exercise). Exercise sessions were supervised by qualified exercise trainers.

Measures

Data for the present report were contained in the pre-randomization questionnaire and the post-intervention questionnaire. The variables assessed were patient preference for group assignment (intention choice) and the theory of planned behavior constructs of motivation (intention strength), perceived behavioral control (perceived difficulty), instrumental attitude (perceived benefit), affective attitude (perceived enjoyment), and subjective norm (perceived support).

Patient Preference

At pre-randomization, participants were asked "Which exercise program would you prefer if you had the choice?" The four options were as follows: (a) the moderate amount of aerobic exercise, (b) the higher amount of aerobic exercise, (c) the CARE, and (d) no preference. After completing the intervention, participants were asked: "Looking back, now that the exercise program is over, what exercise program do you wish you had been assigned to?" Participants were once again provided with the same four response options.

Motivational Outcomes

At pre-randomization, motivational outcomes were assessed for each of the three exercise programs using a 5-point scale (1 = not at all, 2 = a little bit, 3 = somewhat, 4 = quite a bit, 5 = very much). All 301 patients were asked to rate all three exercise programs by anticipating what it would be like to do each of the three exercise programs during chemotherapy. The specific questions asked were "how beneficial would it be," "how enjoyable would it be," "how supportive family and friends would be," "how difficult would it be," and "how motivated would you be" to do each of the three exercise programs. At post-intervention, participants completed a retrospective evaluation of the experienced motivational outcomes for the specific exercise program to which they were randomly assigned. Participants were asked to think back and rate "how beneficial it was," "how enjoyable it was," "how supportive family and friends were," "how difficult it was," and "how motivated they were" to do the exercise program they did during chemotherapy.

Moderators of Motivational Outcomes

Potential moderators of pre-randomization and post-intervention motivational outcomes included pre-randomization patient preference (the high volume preference was dropped from this analysis because of the small sample size), age (<50 versus ≥50 years), marital status (married versus not married), menopausal status (pre-menopausal versus post-menopausal), meeting aerobic exercise guidelines at baseline (equivalent of <150 versus ≥150 min of exercise/week), meeting strength exercise guidelines at baseline (<two versus ≥two sessions/week), baseline aerobic fitness (<27.5 versus ≥27.5 ml/kg/min), body mass index (<25.0 versus 25.0–29.9 versus ≥30 kg/m^2), disease stage (stages I/IIa versus stages IIb/III), and type of surgery (lumpectomy versus mastectomy).

Statistical Analyses

Patient preference for group assignment was analyzed using chi-square tests. Since all participants rated their anticipated motivational outcomes for all three exercise programs at baseline (i.e., standard, high volume, and combined), the comparison of the pre-randomization motivational outcomes was analyzed using a one-way repeated measures multivariate analysis of variance (RM-MANOVA) with "exercise program" as the within-subjects factor and the five motivational outcomes as the dependent variables (i.e., benefit, enjoyment, support, difficulty, and motivation). To test whether these differences were influenced by moderators, the RM-MANOVA process was repeated with the addition of a selected moderator (e.g., age) serving as the between-subjects factor. Thus, separate two-way RM-MANOVAs were conducted individually for each moderator and were examined for significant interactions. Significant RM-MANOVAs were followed by RM-ANOVAs and post hoc pairwise comparisons for each of the five motivational outcomes.

To examine if the experienced motivational outcomes met or exceeded their anticipated motivational outcomes, and whether this varied by randomized group, we conducted a

two-way RM-MANOVA with "time" as the within-subjects factor and "randomized group" as the between-subjects factor. Separate RM-MANOVAs were conducted to test for any potential moderators by introducing one moderator variable at a time, as a second between-group factor, and examining for a three-way interaction. Significant RM-MANOVAs were followed by RM-ANOVAs and post hoc pairwise comparisons. Separate multiple regressions were used to test the associations among the theory of planned behavior variables at pre-randomization and post-intervention for each of the three exercise programs. Pearson correlations were used to examine the associations of pre-randomization and post-intervention motivation with exercise adherence.

Results

Participant flow through the trial has been reported elsewhere [5]. Briefly, we randomized 301 of 728 (41 %) eligible patients between April 2008 and September 2011. Overall adherence to the three exercise interventions was over 80 % with slightly higher adherence for the standard group [5]. Post-intervention follow-up data for patient preference and exercise motivation were obtained for 296 of 301 participants (98.3 %).

Patient Preference Pre-randomization and Post-intervention

At pre-randomization, breast cancer patients were significantly ($p<0.001$) more likely to prefer the combined program ($n=237$; 80.1 %) than the standard program ($n=28$; 9.5 %), high volume program ($n=6$; 2.0 %), or no preference ($n=25$; 8.4 %). At post-intervention, breast cancer patients were still significantly ($p<0.001$) more likely to prefer the combined program ($n=203$; 68.6 %) compared to the standard program ($n=16$; 5.4 %), high volume program ($n=21$; 7.1 %), or no preference ($n=56$; 18.9 %); however, patient preference changed significantly ($p<0.001$) after the intervention (Fig. 1). Specifically, there was an increase in the number of patients preferring the high volume program (+5.1 %) or having no preference (+10.5 %) and a decrease in the number of patients preferring the standard program (−4.1 %) or combined program (−11.5 %).

Pre-randomization Anticipated Motivational Outcomes

Pre-randomization anticipated motivational outcomes for each of the three exercise programs are presented in Table 1. The RM-MANOVA showed significant ($p<0.001$) differences among the three exercise programs. Follow-up RM-ANOVAs showed significant differences for all five motivational outcomes (all $p<0.001$). Post hoc tests generally showed that patients anticipated the most favorable motivational outcomes for the combined program and the least favorable for the high volume program.

Two variables moderated pre-randomization anticipated motivational outcomes for the three exercise programs: (a) baseline aerobic exercise guidelines (p for interaction =0.001) and (b) baseline aerobic fitness (p for interaction =0.005). The follow-up RM-ANOVAs for baseline aerobic exercise guidelines showed significant interactions for benefit (p for interaction <0.001; Fig. 2a), enjoyment (p for interaction <0.001; Fig. 2b), support (p for interaction =0.004; Fig. 2c), and motivation (p for interaction <0.001; Fig. 2d). Post hoc tests generally showed that patients meeting the aerobic exercise guidelines were initially more motivated to perform the high volume and combined programs, but not the standard program, compared to patients not meeting the aerobic exercise guidelines. The follow-up RM-ANOVAs for baseline aerobic fitness showed significant interactions for benefit (p for interaction =0.001; Fig. 3a), enjoyment (p for

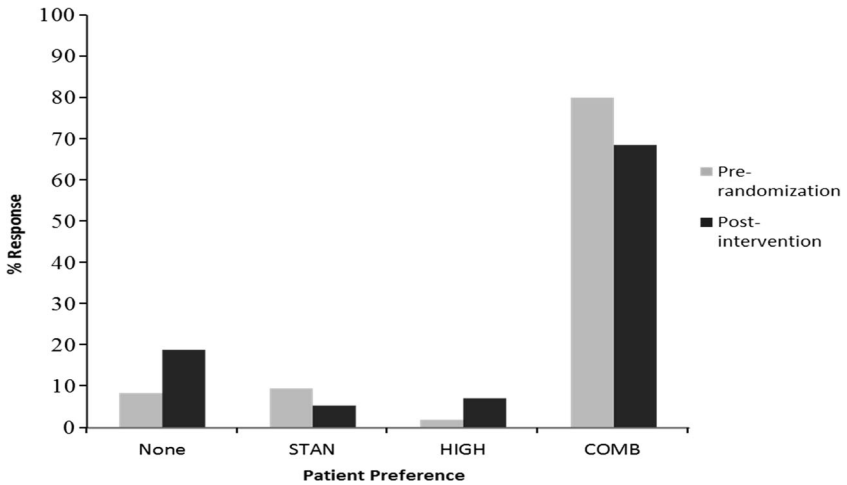

Fig. 1 Patient preference for randomized group assignment at pre-randomization and post-intervention. *STAN* standard, *HIGH* high volume, *COMB* combined

Table 1 Differences in anticipated motivational outcomes prior to randomization for the three exercise programs during breast cancer chemotherapy

Variable	STAN Program ($N=301$) M (SD)	HIGH Program ($N=301$) M (SD)	COMB Program ($N=301$) M (SD)	p value	post hoc
Anticipated benefit	4.0 (0.8)	3.8 (1.0)	4.5 (0.7)	<.001	COMB > STAN > HIGH
Anticipated enjoyment	3.8 (0.9)	3.4 (1.1)	4.0 (1.0)	<.001	COMB > STAN > HIGH
Anticipated support	4.5 (0.7)	4.3 (1.0)	4.5 (0.7)	<.001	STAN, COMB > STAN
Anticipated difficulty	2.5 (0.9)	3.4 (1.0)	3.0 (0.9)	<.001	HIGH > COMB > HIGH
Anticipated Motivation	4.2 (0.9)	3.8 (1.2)	4.4 (0.8)	<.001	COMB > STAN > HIGH

STAN standard volume aerobic exercise, *HIGH* high volume aerobic exercise, *COMB* combined aerobic and resistance exercise

interaction =0.002; Fig. 3b), and motivation (p for interaction =0.001; Fig. 3c). Post hoc tests generally showed that patients with higher aerobic fitness were initially more motivated to perform the high volume and combined programs, but not the standard program, compared to patients with lower aerobic fitness.

At pre-randomization, the theory of planned behavior explained 47 % of the variance in anticipated motivation for the standard program ($p<0.001$) with independent contributions from enjoyment ($\beta=0.47$; $p<0.001$), support ($\beta=0.29$; $p<0.001$), and benefit ($\beta=0.10$; $p=0.069$), but not difficulty ($\beta=-0.03$; $p=0.54$). For the high volume program, the theory explained 62 % of the variance in motivation ($p<0.001$) with independent contributions from enjoyment ($\beta=0.42$; $p<0.001$), benefit ($\beta=0.26$; $p<0.001$), and support ($\beta=0.21$; $p<0.001$), but not difficulty ($\beta=-0.06$; $p=0.15$). For the combined program, the theory explained 54 % of the variance in motivation ($p<0.001$) with independent contributions from enjoyment ($\beta=0.34$; $p<0.001$), support ($\beta=0.28$; $p<0.001$), and benefit ($\beta=0.24$; $p<0.001$), but not difficulty ($\beta=-0.05$; $p=0.26$). Pre-randomization motivation was a significant correlate of exercise adherence in the combined exercise program ($r=0.23$; $p=0.019$), but not the standard ($r=0.02$; $p=0.84$) or high volume program ($r=0.13$; $p=0.21$).

Differences in Experienced Versus Anticipated Motivational Outcomes

Differences between the baseline anticipated motivational outcomes and the post-intervention experienced motivational outcomes across the three randomized exercise

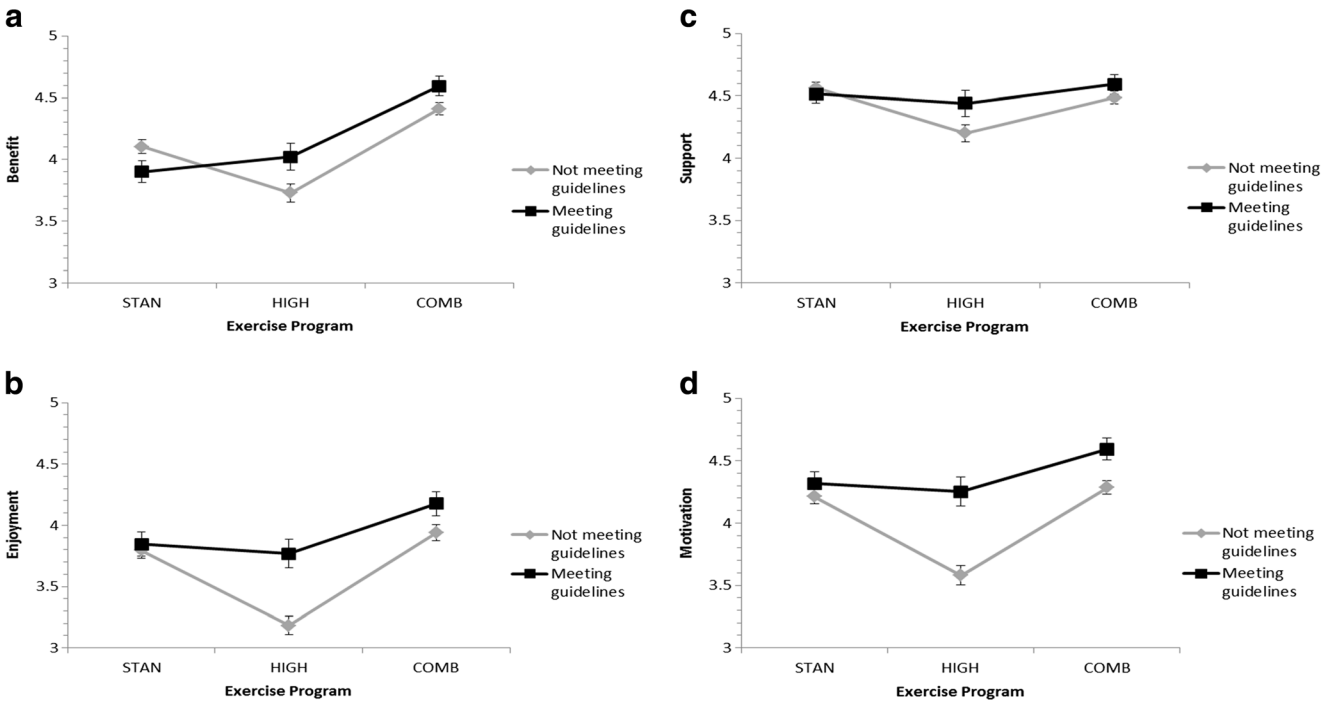

Fig. 2 Interaction of baseline aerobic exercise guidelines and exercise program on the motivational outcomes of perceived **a** benefit, **b** enjoyment, **c** support, and **d** motivation. *STAN* standard, *HIGH* high volume, *COMB* combined

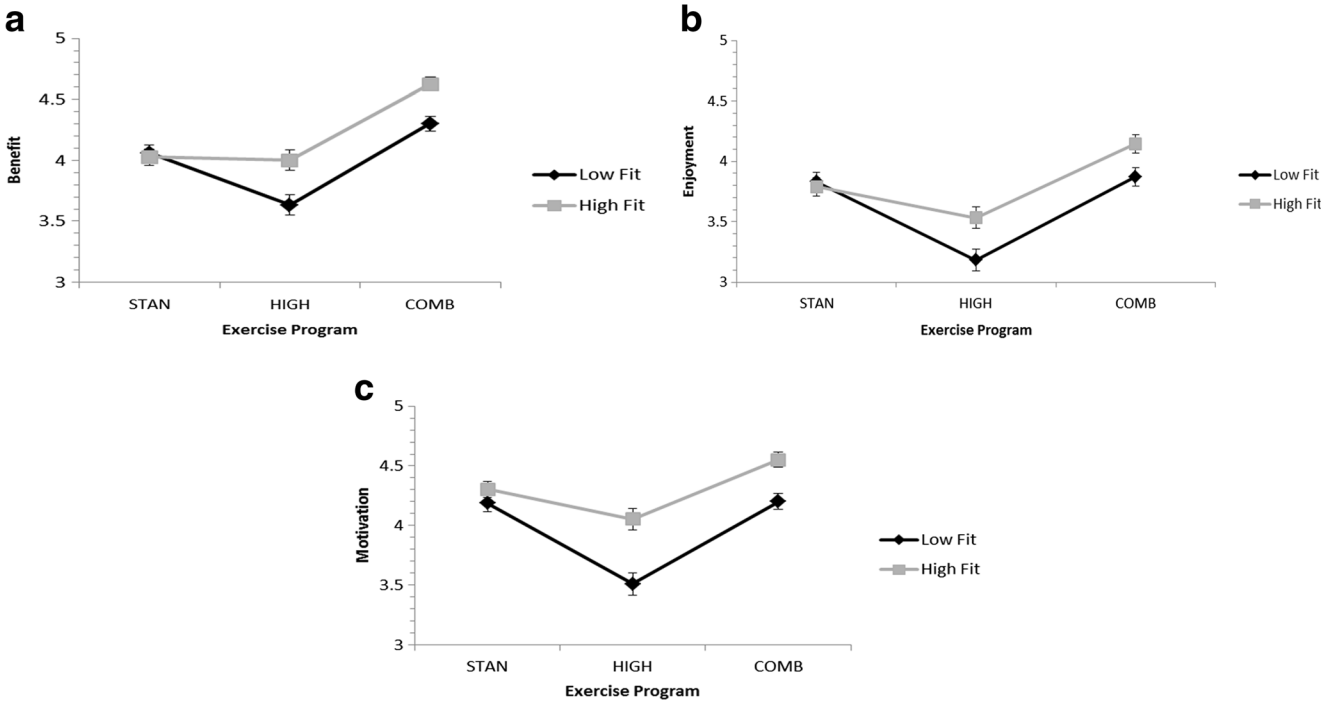

Fig. 3 Interaction of baseline aerobic fitness and exercise program on the motivational outcomes of perceived **a** benefit, **b** enjoyment, and **c** motivation. *STAN* standard, *HIGH* high volume, *COMB* combined

groups are presented in Table 2. The two-way RM-MANOVA demonstrated significant main effects for group ($p<0.001$) and time ($p<0.001$) as well as a time by group interaction ($p<0.001$). Follow-up RM-ANOVAs for the time main effect indicated that the experienced motivational outcomes were more favorable than the anticipated motivational outcomes for benefit ($p<0.001$), enjoyment ($p<0.001$), support ($p<0.001$), difficulty ($p<0.001$), and motivation ($p=0.002$). Based on standardized effect size d, many of these differences were moderate ($d>0.50$). Follow-up RM-ANOVAs for the time by group interaction indicated that the differences in how much the experienced motivational outcomes exceeded the anticipated motivational outcomes varied by randomized group assignment for benefit ($p=0.006$), enjoyment ($p=0.004$), difficulty ($p=0.001$), and motivation ($p=0.001$). Post hoc tests (Table 2) generally showed that patients randomized to the high volume group had their expectations exceeded much more than patients randomized to the combined and standard groups.

Pre-randomization patient preference was the only variable to moderate the differences between anticipated and experienced motivational outcomes for the three randomized exercise groups (p for interaction =0.003). Follow-up RM-ANOVAs indicated significant interactions for benefit (p for interaction =0.006; Fig. 4a), enjoyment (p for interaction =0.007; Fig. 4b), support (p for interaction =0.002; Fig. 4c), and motivation (p for interaction =0.002; Fig. 4d). Post hoc tests generally showed that the differences between anticipated and experienced motivational outcomes were significantly larger for patients randomly assigned to a non-preferred intervention.

At post-intervention, the theory of planned behavior explained 39 % of the variance in experienced motivation for the standard program ($p<0.001$) with independent contributions from enjoyment ($\beta=0.44$; $p<0.001$) and benefit ($\beta=0.23$; $p=0.064$), but not support ($\beta=-0.06$; $p=0.57$) or difficulty ($\beta=-0.09$; $p=0.32$). For the high volume program, the theory explained 47 % of the variance in motivation ($p<0.001$) with independent contributions from enjoyment ($\beta=0.35$; $p=0.001$), benefit ($\beta=0.20$; $p=0.068$), support ($\beta=0.18$; $p=0.042$), and difficulty ($\beta=-0.17$; $p=0.049$). For the combined program, the theory explained 45 % of the variance in motivation ($p<0.001$) with an independent contribution from benefit ($\beta=0.49$; $p<0.001$), but not enjoyment ($\beta=0.19$; $p=0.11$), support ($\beta=0.00$; $p=0.96$), or difficulty ($\beta=-0.13$; $p=0.10$). Exercise adherence was a significant correlate of almost all post-intervention motivational outcomes for all three exercise programs with limited variation among the three exercise groups. Across all three exercise programs, exercise adherence correlated with post-intervention motivation ($r=0.49$; $p<0.001$), benefit ($r=0.46$; $p<0.001$), enjoyment ($r=0.37$; $p<0.001$), difficulty ($r=-0.30$; $p<0.001$), and support ($r=0.22$; $p<0.001$).

Table 2 Differences in anticipated versus experienced motivational outcomes after each of the three exercise programs during breast cancer chemotherapy

Variable	STAN ($n = 95$) M (SD)	HIGH ($n = 99$) M (SD)	COMB ($n = 103$) M (SD)	Group × time effect p value	Post hoc tests
Anticipated benefit	4.0 (0.8)	3.9 (1.0)	4.4 (0.8)	.006	HIGH, STAN > COMB
Experienced benefit	4.7 (0.6)	4.6 (0.7)	4.8 (0.6)		
Difference	0.7 (1.0)	0.7 (1.2)	0.3 (0.7)		
[a]Effect size *d*	0.65	0.53	0.48		
Anticipated enjoyment	3.8 (0.8)	3.4 (1.2)	4.1 (1.0)	.004	HIGH > STAN, COMB
Experienced enjoyment	4.5 (0.8)	4.3 (0.9)	4.5 (0.8)		
Difference	0.6 (1.1)	0.9 (1.3)	0.4 (1.1)		
[a]Effect size *d*	0.68	0.61	0.34		
Anticipated support	4.6 (0.6)	4.4 (1.1)	4.5 (0.7)	.44	NA
Experienced support	4.8 (0.5)	4.7 (0.7)	4.8 (0.5)		
Difference	0.2 (0.8)	0.3 (1.1)	0.3 (0.7)		
[a]Effect size *d*	0.24	0.23	0.39		
Anticipated difficulty	2.5 (0.8)	3.5 (1.0)	2.9 (0.9)	.001	HIGH > STAN
Experienced difficulty	2.5 (1.0)	2.8 (1.0)	2.6 (1.0)		
Difference	0.0 (1.2)	−0.7 (1.2)	−0.3 (1.3)		
[a]Effect size *d*	0.00	0.60	0.25		
Anticipated motivation	4.3 (0.7)	3.8 (1.3)	4.4 (0.9)	.001	HIGH > STAN, COMB
Experienced motivation	4.3 (0.9)	4.4 (0.9)	4.5 (0.8)		
Difference	0.0 (1.1)	0.6 (1.2)	0.1 (1.0)		
[a]Effect size *d*	0.00	0.42	0.09		

STAN standard volume aerobic exercise, *HIGH* high volume aerobic exercise, *COMB* combined aerobic and resistance exercise

[a] Within subjects effect size d is adjusted for the degree of association between means [16]

Discussion

At pre-randomization, breast cancer patients had a strong preference for the combined program and a strong aversion for the high volume program during chemotherapy. In other words, adding resistance training to the standard aerobic exercise program made the exercise program initially more attractive whereas adding more aerobic exercise to the standard aerobic program made it initially less attractive. Moreover, patients reported they were initially more motivated to perform the combined program than the high volume or standard programs during chemotherapy because they anticipated it would be more beneficial, more enjoyable, more supported, and less difficult. To our knowledge, only one other breast cancer trial has assessed patient preference and motivation for different exercise programs. The Supervised Trial of Aerobic versus Resistance Training (START) [2], compared resistance training alone and aerobic exercise alone to usual care in 242 breast cancer patients receiving chemotherapy. At pre-randomization, 41 % of patients preferred resistance training, 36 % preferred aerobic exercise, and 23 % had no preference [10]. Interestingly, patients in START reported slightly more favorable motivational outcomes for aerobic exercise alone than resistance exercise alone at pre-randomization.

It is unclear why patients in the CARE Trial initially believed that the combined program would be more beneficial, enjoyable, supported, and less difficult to perform during chemotherapy than the standard or high volume programs. Prior to randomization, patients would have received education about the pending side effects of chemotherapy including fatigue, nausea, diarrhea, hot flashes, and peripheral neuropathy and may have taken these side effects into account when judging each of the three exercise interventions. Patients may have viewed the combined program as potentially more beneficial during chemotherapy because the exercise guidelines for cancer survivors recommend both strength and aerobic exercise [14, 15] and/or because it is intuitive that a combined exercise program should provide the benefits of both exercise modalities. Alternatively, patients may have been aware of the emerging data suggesting that strength exercise may improve chemotherapy completion rate [2] and help prevent lymphedema [17, 18], two very important outcomes to breast cancer patients. Finally, they may have viewed it as more beneficial because it is relatively easy for patients to perform aerobic

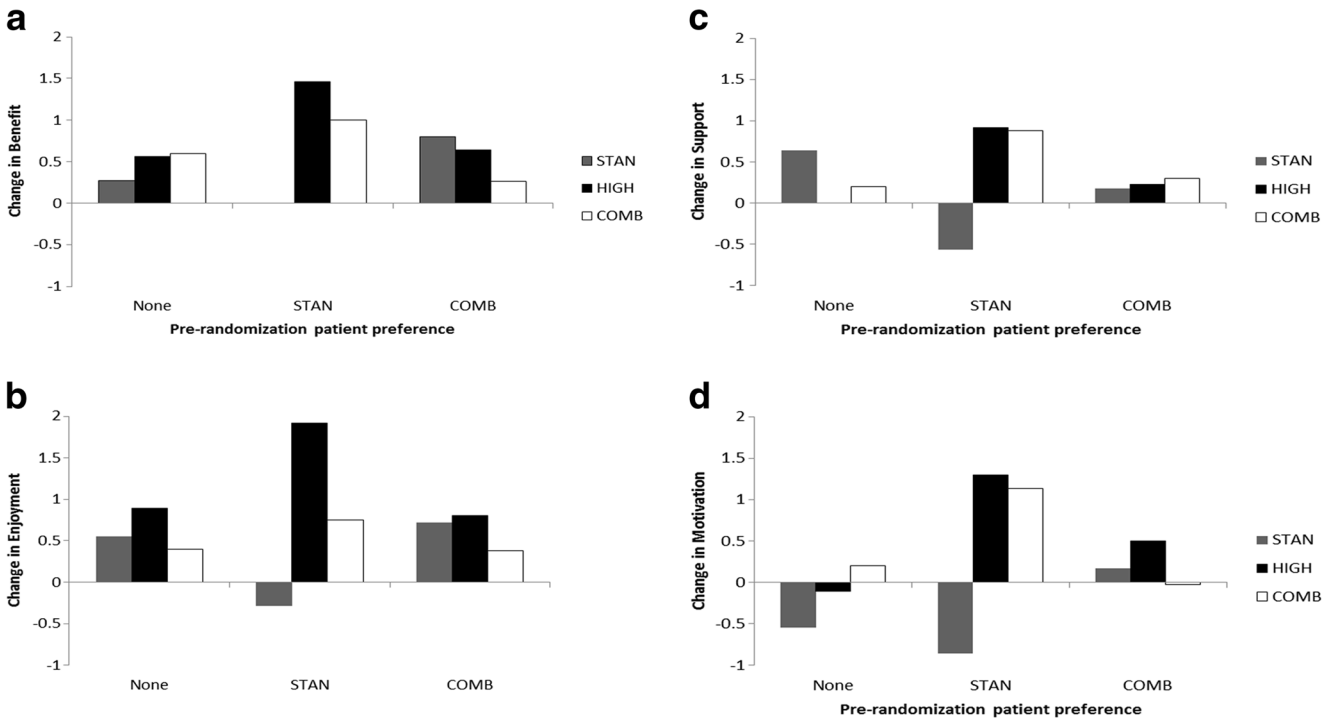

Fig. 4 Interaction of pre-randomization patient preference and randomized group assignment on changes in the motivational outcomes of perceived **a** benefit, **b** enjoyment, **c** support, and **d** motivation. *STAN* standard, *HIGH* high volume, *COMB* combined. *Note: Preference for HIGH was excluded due to the limited sample size

exercise on their own whereas gaining access to strength exercise equipment is likely more difficult.

Patients may have viewed the combined program as potentially more enjoyable because of a general preference people have for variety in activities [19, 20], which may reduce boredom, or because resistance training is more likely a novel activity that provides an opportunity to learn something new. Our data partially support this explanation as only 21 % of patients reported strength exercise at baseline compared to 30 % who reported aerobic exercise. Interestingly, breast cancer patients anticipated less support for the high volume program than the standard or combined programs. It is possible that the high volume program was perceived to be an overwhelming amount of aerobic exercise to be performed during chemotherapy and, therefore, they anticipated that their doctors and/or family would be less supportive of them doing such a difficult exercise program. Finally, patients may have viewed the combined program as potentially less difficult than the high volume program because it would induce less continuous stress on the cardiovascular system and less fatigue compared to 50–60 min of continuous aerobic exercise. Future studies of patient preference and motivation may assess the specific salient beliefs that underlie differences in the anticipated benefits, enjoyment, support, and difficulty of a particular exercise program during breast cancer chemotherapy to find out exactly why patients hold these varying motivational beliefs.

As hypothesized, baseline aerobic exercise and aerobic fitness moderated the anticipated motivational outcomes for the three exercise programs. Generally speaking, patients who were already exercising or fitter were initially more motivated to perform the high volume and combined programs, but not the standard program, compared to patients who were not exercising or less fit. These data suggest that patients are fairly adept at "self-selecting" into an exercise program that is likely feasible and beneficial for them. Indeed, data from the CARE Trial suggest that these self-selections would have been very prudent. For example, only fitter patients benefitted from the higher dose exercise interventions in terms of improved endocrine symptoms and taxane/neuropathy symptoms, whereas less fit patients showed no benefit [6]. Moreover, only fitter patients and those already exercising benefited from the higher dose exercise interventions in terms of sleep quality, whereas less fit and non-exercising patients showed no benefit [7].

At post-intervention, patients were still more likely to prefer the combined program; however, there was a significant increase in the number of patients preferring the high volume program or having no preference and a decrease in the number of patients preferring the standard or combined programs. Moreover, the extent to which the experienced motivational outcomes exceeded the anticipated motivational outcomes was meaningful and was greatest in the high volume program. The START Trial did not assess change in patient preference or motivation after the interventions [11], and so no data are available for comparison. Notably, the high volume program had the lowest anticipated motivational outcomes and, therefore, had the largest room for improvement. Nevertheless, a possible

explanation for why the high volume program exceeded its initial motivation was the general observation in the CARE Trial that the largest improvements in patient-reported outcomes occurred in the high volume group which, in some cases, were even larger than in the combined group [5]. It is also possible that the high volume intervention was simply more beneficial, enjoyable, supported, and less difficult during chemotherapy than patients had originally anticipated.

The only variable to moderate the extent to which the experienced motivational outcomes exceeded the anticipated motivational outcomes was pre-randomization patient preference. Generally speaking, patients' initial motivation for their randomly assigned intervention was exceeded much more if it was not their preferred intervention pre-randomization. These data suggest that breast cancer patients have a surprisingly positive motivational response when assigned to a non-preferred exercise program during chemotherapy. One possible explanation for this finding was their initially lower motivational evaluation of the exercise programs they did not prefer, thereby allowing them to be "pleasantly surprised" by their non-preferred exercise program.

The theory of planned behavior performed well in terms of explaining the anticipated and experienced motivation (i.e., intention strength) for each of the three exercise programs. The theory explained 39 to 62 % of the variance in motivation, consistent with previous research in cancer survivors [21–24]. Moreover, perceived enjoyment was the strongest independent correlate of motivation in almost every analyses whereas perceived difficulty played very little role in influencing motivation. The pre-eminence of enjoyment over difficulty is an uncommon finding in the exercise and cancer survivorship literature as most previous research has reported the reverse, although both constructs are almost always important [21–24]. This finding suggests that the anticipated (pre-randomization) or experienced (post-intervention) enjoyment of the exercise program may be the most powerful correlate of exercise motivation during breast cancer chemotherapy. Pre-randomization anticipated motivation, however, only predicted exercise adherence in the combined exercise program. The limited utility of motivational variables to predict exercise adherence in highly controlled, fully supervised, exercise efficacy trials is well-documented [25–27]. Conversely, exercise adherence during the exercise program was a powerful predictor of almost all experienced motivational outcomes suggesting that high adherence to a supervised exercise program is critical for a positive motivational response.

The strengths of our study include being the first prospective examination of breast cancer patients' preference and motivation for different types and doses of exercise during chemotherapy, the adoption of a validated theoretical model of motivation, the assessment of baseline anticipated motivational outcomes for all three exercise programs, the assessment of experienced patient preference and motivation after the interventions, the large sample size, and the trivial loss to follow-up. One limitation of our study was the limited variability in patient preference at pre-randomization which prevented us from examining the correlates of patient preference and also required us to exclude the high volume program preference from our moderator analysis of the motivational outcomes. A second limitation was the multiple statistical tests without correction that increases the chances of false positive findings. A third limitation is the highly select sample of motivated breast cancer patients that is unlikely to generalize to the 60 % of patients who declined participation in the study. Consequently, our data address the motivational evaluation and impact of three exercise programs in breast cancer patients who were initially motivated enough to volunteer for a supervised exercise trial. Our study does not provide insight into how to motivate patients who are otherwise unable or unwilling to join a supervised exercise program or how to motivate them to participate in a physical activity program on their own. Finally, although the randomized controlled trial design is a strength of our study, other approaches may be helpful in understanding motivation. For example, qualitative data may provide additional insight into the psychological mechanisms that might explain why the experienced motivational outcomes may have exceeded the anticipated motivational outcomes, and the importance of this finding for future behavior.

In summary, breast cancer patients had a strong initial preference and motivation for a combined aerobic and strength exercise program during chemotherapy compared to a standard or high volume aerobic exercise program because they anticipated it would be more beneficial, enjoyable, supported, and less difficult. Moreover, patients who were already exercising and aerobically fitter were initially more motivated to do the high dose exercise interventions than non-exercisers and lower fit patients. After the interventions, patients randomized to all three exercise programs reported a high level of experienced motivation because of a particularly positive motivational response to the high volume program. Moreover, patients had a particular positive motivational response when assigned to a non-preferred exercise intervention.

In terms of practical implications, clinicians and exercise specialists can use these data when recommending the type and dose of exercise to breast cancer patients initiating chemotherapy. In many cases, clinicians may recommend the patient's preference because patients are relatively adept at self-selecting an exercise intervention that is likely feasible and beneficial for them during chemotherapy. Nevertheless, in cases where there are good safety or efficacy reasons for not recommending the patient's preference, clinicians can be confident that patients will still have a positive motivational response to the recommended exercise program. Moreover, our data suggest that high adherence to a supervised exercise program strongly predicts a positive motivational response. Finally, motivation is not likely the only factor influencing breast cancer patients' ability and willingness to

exercise during chemotherapy. Environmental factors such as support from the cancer center, funding from health insurance companies, availability of exercise programs, and encouragement from health care providers may play an important role in helping breast cancer patients exercise during chemotherapy.

Compliance With Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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