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Abstract

Brown, K, Loprinzi, PD, Brosky, JA, and Topp, R. Prehabilitation influences exercise-related psychological constructs such as self-efficacy and outcome expectations to exercise. *J Strength Cond Res* 28(1): 201–209, 2014—Osteoarthritis (OA) is a clinical condition affecting more than 27 million Americans. There is no known cure for OA other than replacing the diseased joint with a joint prosthesis, a process called total knee arthroplasty (TKA). The TKA projections for the year 2016 are 1,046,000, and this number is predicted to increase by 600% to more than 3.4 million cases by 2030. The purpose of this study was to determine whether knee OA patients who engage in guided exercise (prehabilitation) before their TKA report higher levels of self-efficacy to exercise (SEE) and higher outcome expectations for exercise (OEE) than those who do not. Thirty-one participants were randomized into 2 groups (16 in prehabilitation group [PRE] and 15 in control group [CON]), all participants completed the protocol (22 women and 9 men). The PRE group participated in an exercise intervention (prehabilitation) 3 times per week for 8 weeks before TKA. One-way repeated measures analysis of variance was used to investigate the effects of group (PRE vs. CON), time (baseline T1, T2, T3, and T4), and the interaction of group and time on the dependent variables of SEE and OEE. This analysis indicated that SEE did not change over time ($p = 0.62$) or between the groups ($p = 0.86$). The analysis of the OEE indicated a significant time effect ($p = 0.008$). Post hoc analysis indicated that the CON group significantly declined between T2 and T4. The PRE group did not significantly change their OEE over the 4 data collection points of the study.

Introduction

Among adults with osteoarthritis (OA), participation in regular exercise has been shown to reduce the rate of functional decline ([20]). Exercise is considered to be a cornerstone of rehabilitation following total knee arthroplasty (TKA); however, there has been less attention placed on the role of exercise in preparation before an individual undergoing TKA, referred to as prehabilitation. Previous research using exercise as an intervention before TKA (i.e., prehabilitation) indicates that preoperative knee strength is a consistent predictor of preoperative ([6]) and postoperative functioning among TKA patients ([30]).

Although there is emerging empirical evidence that prehabilitation may positively influence postoperative outcomes, such as functional ability ([4,7,17,26]), it is unclear as to how a preoperative program combining both education and exercise will affect postoperative psychological parameters (e.g., their confidence to engage in exercise rehabilitation) related to recovery and rehabilitation ([5]). Unfortunately, efforts to help patients adopt an exercise program are often unsuccessful. It may be even harder to get the patient to adopt an exercise program, especially if those patients are experiencing pain, such as during the postoperative period.

For many older individuals, aging is associated with a loss of perceived control ([18]). This loss of control could be due in part to the lowering of one's confidence (i.e., self-efficacy) to participate in exercise programs without causing harm. Based on major tenents from the Social Cognitive Theory (SCT), one way to promote exercise behavior is to enhance exercise self-efficacy or an individual's confidence in their ability to overcome exercise-related barriers ([3]). Researchers have shown that exercise self-efficacy, a key construct of the SCT, is an important predictor of the adoption and maintenance of exercise behavior ([12]). To improve exercise activity in older adults, it is useful to consider self-efficacy expectations (desired results) to exercise, along with outcome expectations (expected benefits and costs of performing a behavior), that are key constructs of the SCT. Both self-efficacy expectations and outcome expectations toward exercise positively influence motivation to exercise and sustained exercise behavior ([24]).

Our previous work ([7]), along with those of others ([4,17,26]), has demonstrated that prehabilitation is effective in improving postoperative functional ability. However, at this point, we have a limited understanding as to how prehabilitation may influence exercise-related psychological constructs (e.g., self-efficacy or outcome expectations), which in turn may be mediating the relationship between prehabilitation and postoperative outcomes. As a result, future research is needed to examine the effects of prehabilitation on psychological constructs. If research shows that prehabilitation can positively influence these parameters, then this information will help us better understand possible underlying mechanisms through which prehabilitation may improve postoperative outcomes. This knowledge may in turn help in the development and implementation of effective prehabilitation programs.

The purpose of this study was to determine whether knee OA patients who engage in guided exercise (prehabilitation) before TKA report higher levels of self-efficacy to exercise (SEE) and higher outcome expectations for exercise (OEE) than those who do not. We hypothesize that patients who complete an 8-week prehabilitation program before TKA will demonstrate higher perceptions of self-efficacy and outcome expectations than those not engaging in a prehabilitation program before and after their TKA. If prehabilitation impacts these psychological constructs, this will provide some evidence explaining the underlying mechanisms between prehabilitation, motivation to exercise, and sustained postoperative exercise behavior.

Methods

Experimental Approach to the Problem

This study was a randomized clinical trial approved by the University's institutional review board. Participants, after providing consent, were randomly assigned to an intervention or a control condition. Randomization occurred by participants selecting from shuffled unmarked envelopes containing a card assigning them to either a prehabilitation group (treatment) or a usual treatment group (control). Participants in the control condition received the usual care before and after their TKA. Usual care was defined as a 2- to 3-hour educational program administered approximately 2 weeks before the TKA. All participants completed measures of their SEE and OEE 8 weeks before their TKA survey (T1), 1 week (T2) before surgery, and again at 1 (T3) and 2 (T4) weeks after their TKA. These procedures resulted in 2 study groups (control and intervention) being measured 4 times (baseline T1, T2, T3, and T4) over the duration of the study.

Participants

Eligible community-residing individuals aged 40 years or older were initially identified by the staff attending a single orthopedic surgical clinic. All patients who initially met the inclusion criteria and were scheduled to have an elective TKA at least 8 weeks before their surgery were invited to participate in the study. The exclusion criteria can be seen in Table 1. Potential participants were excluded if they reported a history of uncontrolled angina, cardiomyopathy severe enough to compromise cardiac functioning, any other health problem that prohibited moderate exercise, or if they were currently taking nitrates, digitalis, or phenothiazines. These exclusion criteria are based on the American College of Sports Medicine's guidelines ([2]). Potential participants were also excluded if they reported involvement in an exercise program more than 1 time per week during the previous month. This method strived to ensure a sample that was as representative as possible of community-residing adults who were scheduled for unilateral TKA for treatment for knee OA ([9,16]). Only individuals who reported no contraindications to moderate intensity exercise, who were scheduled for a unilateral TKA, who were 40 years or older, and who stated they could make a commitment to the research protocol were included as participants for this study. Potential participants who were unable to read and write English or engage in a formal exercise program greater than once per week were excluded from the study. These exclusion/inclusion criteria resulted in 31 individuals being included in the study with 18 participants completing all 4 data collection points and being included in the sample for analysis. This sample included 11 women and 7 men (*n* = 9 PRE, *n*= 9 CON) who comprised the two study groups. A flow diagram of the allocation process is shown in Figure 1.

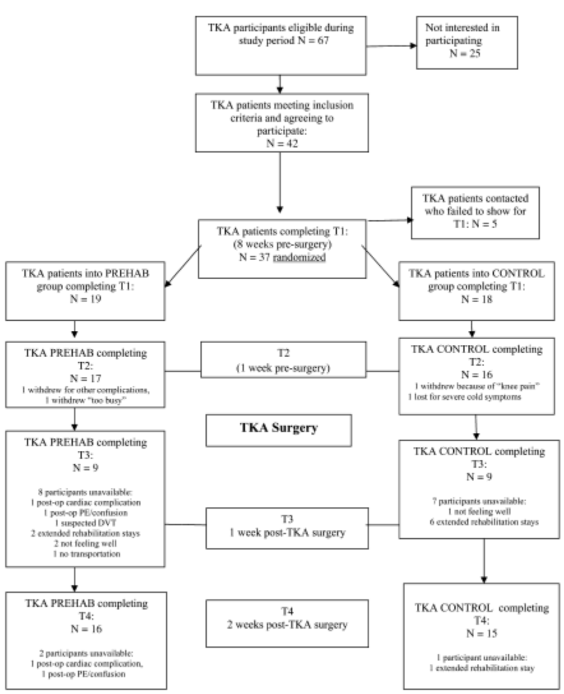
Table 1: Exclusion criteria: criteria to exclude subjects from starting or continuing in the exercise protocol (modified from ACSM, 2009).*

1. Symptomatic CAD as evidence by uncontrollable angina or a diagnosed MI within the past 1 year.

2. Presence or history of cardiac dysrhythamias requiring therapy, including uncontrolled ventricular arrhythmia, - 6 PVC per minute, ventricular fibrillation, flutter, standstill, tachycardia, supraventricular tachycardia, idioventricular rhythms, atrial flutter or fibrillation, and second- or third-degree heart block.
3. Documented CHF as evidence of an S3 at rest or exercise, rales after exercise, or a documented medical history of CHF.
4. Severe aortic stenosis demonstrated by syncope and angina or severe left ventricular hypertrophy with S-T segment or T-wave changes on EKG.
5. Suspected or known dissecting aneurysm or history of ventricular aneurysm.
6. Acute myocarditis, pericarditis, subacute endocarditis, or acute rheumatic fever.
7. Systemic or pulmonary emboli within the past 3 months.
8. Acute thrombophlebitis or intracardiac thrombi.
9. A recent significant change in the resting EKG.
10. Uncontrolled hypertension (diastolic - 100, or systolic - 175 at rest)
11. Peripheral vascular disease severe enough to prevent moderate intensity walking for 30 minutes.
12. COPD severe enough to prevent moderate intensity exercise for 10 minutes.
13. A history of cerebrovascular disease, which has result in permanent mental or physical disability.
14. Other chronic disease, which contraindicates moderate-intensity exercise for 10 minutes, including but not limited to vascular disease, cancer, and severe renal or hepatic disease.
15. Any condition that requires the subject to take anti-anginal medications, lithium, tricyclic antidepressants, phenothiazides, and MAO inhibitors.
16. Younger than 40 years.
17. Unable to read and/or understand English.
18. Unable to agree to participate in the research protocol for 10 weeks.
19. Known or suspected latex allergy.

*CAD = coronary artery disease; MI = myocardial infarction; PVC = premature ventricular contractions; CHF = congestive heart failure; EKG = electrocardiogram; COPD = chronic obstructive pulmonary disease; MAO = monoamine oxidize inhibitors, are first generation antidepressants.

Figure 1: Flow diagram of participants through randomized intervention.



An a priori power analysis was performed to determine the sample size for adequate statistical power. The anticipated effect sizes for this study were conservatively estimated. The study used the intent to treat (ITT) ([8]) principle of retaining all participants randomized into the prehabilitation group regardless of their adherence with the prehabilitation intervention. Participants lost to follow-up would be replaced through oversampling to maintain a sufficient sample size to ensure adequate statistical power. The standard method of determining sample size between treatments with covariance correction for baseline scores within a repeated measures model used the following formula ([23]):

$$n = 2(Z\beta + Z\alpha)^2(1 - r^2)/(\mathrm{Mean}\ 1 - \mathrm{Mean}\ 2/SD)^2.$$

A conservative r^2 between pretest and posttest means was estimated to be 0.5 (level of correlation) for each variable being studied to estimate sample size. These sample size estimates are based on obtaining statistical power ($1 - \beta$) of 0.80 for the analysis of each dependent variable with an overall $\alpha = 0.05$. Under these assumptions, the sample needed in each group to complete the posttest to yield approximately 80% power is presented in Table 2. Therefore, it was estimated that by enrolling 40 subjects and using the ITT principle, anticipating a 25% dropout the proposed final sample of 30 subjects (*n* = 15 per study group) will have at least 80% power to detect a clinically significant effect of the treatments on the principle dependent variables.

Table 2: Sample size estimates for outcome variables were based on previous studies (16,32).

Variable	Baseline (Mean 6 SD)	Expected change (f)	Effect size (d)	Samplesizeneeded per group (*n*)
Self-efficacy	4.98 6 1.18	2.4 (48%)	4.14	3
Outcome expectations	4.29 6 0.39	0.35 (8%)	0.80	15

Intervention

The individuals in the prehabilitation group were introduced to an exercise program that was based on the constructs of the SCT. Table 3 dislays how the SCT concepts were applied within the exercise intervention program ([13]). These concepts included the appropriate skills, knowledge and adequate incentives to perform a given behavior, and confidence in one's ability to take action to overcome barriers needed for successful outcomes. The construct of self-efficacy was targeted by using strategies from the SCT that include: (a) setting incremental goals, (b) behavioral contracting (committing to a formal contract), (c) monitoring, and (d) reinforcement (feedback from self-monitoring or record keeping). Observational learning occurred as the participants learn through the experiences of credible others (professional trainers) rather than through their own experience. Finally, the use of reinforcements (using motivation) to change behavior was done by having the participants meet with the a member of the research team once a week to reinforce his or her good progress and help maintain his or her good exercise behavior.

Table 3: Social Cognitive Theory concepts (14).

Concept	Definition	Application in study
Reciprocal determinism	Environmental factors influence individuals but individuals can also influence their environments and regulate his or her own behavior	Study participants are introduced to the physical therapy center and are influenced by its environment. Prehabilitation also influences their home environment.
Outcome expectations	Beliefs about the likelihood and value of the consequences of behavior choices	Changing expectations of physical outcomes due to sedentary subjects being introduced to exercise intervention.

Self-efficacy	Beliefs about personal ability to perform behaviors that bring desired outcomes	Subjects begin to believe in benefits of exercise as they see progress due to performing new behaviors
Collective efficacy	Beliefs about the ability of a group to perform concerted actions that bring about desired outcomes	By belonging to the prehabilitation group, the subjects believe that these concerted actions (Hawthorne effect) will bring about desired outcomes.
Observational learning	Learning to perform new behaviors by exposure to interpersonal displays of them	The subjects learn how to perform the new exercise behaviors from watching the trained professionals perform the movements.
Incentive motivation	The use of rewards to modify behavior	The subject receives praise (positive reinforcement) from the trainers for performing the exercises correctly. Subjects receive motivation to increase good behavior.
Facilitation	Providing tools, resources, or environmental changes that make new behaviors easier to perform	Subjects are given a prehabilitation intervention booklet with directions to perform each individual exercise. Therabands are provided. Trainers are provided. They are brought into the facility that changes their environment from normal settings.
Self-regulation	Controlling oneself through self-monitoring, goal-setting, feedback, and self-instruction	Subjects keep a logbook, set goals to increase strength, and follow prehabilitation intervention booklet.
Moral disengagement	Ways of thinking about harmful behaviors (e.g., poor exercise habits)	The subjects will be influenced by the progress they make from the exercise intervention and will have a change in the way they view harmful behaviors by increasing good exercise habits.

The prehabilitation treatment group was given a prehabilitation training booklet, which explained all 5 components of the prehabilitation training program, including warm-up, resistance exercises, flexibility exercises, step training, and a cool down. Components of this training program have been demonstrated to improve performance of functional tasks, knee pain, or the markers of rehabilitation among older adults ([31]). The prehabilitation training booklet was based on previous guidelines for older adult exercise programs ([28]).

One of the critical components of any exercise training program is the principle of specificity. This principle of training stipulates that the more closely the training mimics the evaluation method, the greater the improvement in the evaluation method as a result of the training ([11]).

Participants were requested to complete the prehabilitation training protocol 3 times per week, once per week under the supervision of the project staff at the University's Physical Therapy Clinic and 2 times per week without supervision at home. All 3 prescribed sessions included the same warm-up, resistance exercises, flexibility exercises, step training, and a cool down. This method of partially supervising the exercise intervention has previously resulted in acceptable adherence by older participants without making unreasonable demands on their time commitment to the supervised exercise sessions ([28,29,31]). Participants in this group were taught how to record each session of prehabilitation training in an exercise log.

A session of prehabilitation training included approximately 5 minutes of warming up, 15 minutes of resistance training exercises, 15 minutes of flexibility exercises, 10 minutes of step training, and 5 minutes of cool down exercises. The warm-up consisted of unweighted leg joint movements to increase blood flow to the muscles of the legs, trunk, and arms. Following the warm-up, participants completed 8 dynamic muscle strengthening exercises with elastic resistance, including squats, ankle dorsi/plantar, hamstring flexion, bicep curls, triceps extensions, chest press, and seated row. During the first training week, each participant performed 1 set of 10 repetitions of each strengthening exercise using an elastic band with sufficient resistance to produce "moderate" fatigue after the final repetition. Individual training progressed under the supervision of the researcher until weeks 7 and 8, during which each participant performed 1 or 2 sets of 10 repetitions of each exercise using an elastic band with sufficient resistance to produce "moderate" fatigue after the final repetition with a 2-minute rest between sets (approximately 20 minutes).

After completion of the resistance training exercises, within each session of prehabilitation, participants completed 6 flexibility exercises. Over the entire duration of the 8-week prehabilitation training program, the flexibility exercises included 2 repetitions of static stretching for 20 seconds for each flexibility exercise. The flexibility exercises emphasized knee extension/flexion, hip flexion/extension, trunk extension/flexion, and shoulder flexion/extension/rotation. After completion of the flexibility exercises, participants completed 3 step-training exercises. These step-training exercises included going up and down a single step forward and then sideways to the left and right. During the first week of the prehabilitation program, participants completed 8 repetitions of each of the step exercise using a 2- or 3-inch step. The number of repetitions and the height of the step of each of these step exercises were increased over the 8-week prehabilitation intervention. During the eighth week of the prehabilitation program, participants completed 20 repetitions of each of the step exercises using a 4- or 7-inch step. The cool-down consisted of 5 minutes of unweighted leg joint movements of the muscles of the legs, trunk, and arms. If the participant was unable to complete the initial level of training or was unable to progress at any week in the 8-week training schedule, an individualized training program was developed for him or her, consistent with that participant's ability level. This individualized prehabilitation training program strived to have the individual achieve the same level of training for all 5 components as prescribed in the prehabilitation exercise booklet. The number of repetitions and sets for all components of the prehabilitation program was recorded in the exercise log.

Measurements

Self-efficacy to exercise and OEE were measured by using the SEE scale ([19]) and the OEE scale, respectively ([27]). The 9-item SEE demonstrated reliability and validity ([14,22]). This instrument asked participants to indicate how confident (ranging from 0 [not very confident] to10 [very confident]) they were in their ability to exercise 3 times per week for 20 minutes if (sample items): the weather was bothering them; they felt pain when exercising; and they felt tired. An average of the items was calculated, with higher values indicating greater SEE.

The OEE scale, which has demonstrated evidence of reliability and validity ([27]), asks individuals to identify expected positive outcomes of engaging in exercise. Sample items from the 9-item OEE include: makes me feel better physically, makes my mood better in general, makes my muscles stronger, and gives me a sense of personal accomplishment. Item responses were based on a 5-point Likert scale ranging from 1 (strongly agree) to 5 (strongly disagree). The scale is scored by adding the responses to obtain the total score and dividing by the number of items.

Data Analysis

This study used the ITT ([8]) principle of retaining all subjects randomized into the prehabilitation group regardless of their adherence with the prehabilitation intervention. Repeated measures analysis of variance (RM-ANOVA) was used to determine the main effects of group (control vs. treatment), time (T1 vs. T2 vs. T3 vs. T4), and the interaction of group and time on the outcome variables. If significant main or interaction effects were detected with the RM-ANOVA, post hoc comparisons were conducted between the means using the Bonferroni ([1]) post hoc tests. These post hoc comparisons compensate to maintain the overall for Type 1 error at 0.05 ([21]).

Because of missing data during time 3 (T3), a secondary analysis was performed while excluding T3 data. This secondary analysis consisted of RM-ANOVAs being developed for each outcome variable while examining the effect of group (PRE vs. CON) and time over the remaining 3 data collection points (T1, T2, and T4). Although the attrition at T3 was higher than expected (50%), the attrition rate for T3 did not limit the results of the study. For all models, statistical significance was established as a p value < 0.05.

Results

Demographic characteristics of the sample are shown in Table 4. Comparisons between the 2 study groups indicated no differences.

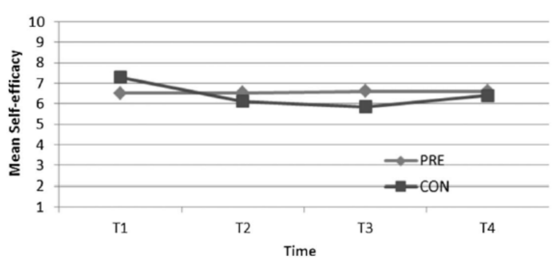
Table 4: Demographic characteristics of the subjects (N = 31).

Characteristic	*N*	%	PRE	CON	*p*
			16	15	
Age	31		60 (8.3)	67 (9.5)	0.46
BMI	31		38.8 (8.8)	34.6 (7.6)	0.38
Female	22	70	10 (45%)	12(56%)	0.33
Male	9	30	6 (38%)	3 (20%)	0.17
Ethnicity					
African American	3	1	2 (12.5%)	1 (7%)	0.52
Hispanic	1	3	0	1 (7%)	
White	27	87	14 (87.5%)	13 (87%)	
Current marital status					
Single	2	7	2	0	0.37
Married/committed relationship	25	8	12	13	
Divorced/widowed	4	13	2	2	
Knee affected			R-9, L-7	R-10, L-5	

Self-efficacy for Exercise

Hypothesis 1 was evaluated using a RM-ANOVA, which included the within-factor time points (T1, T2, T3, and T4) and the between-group factor (PRE vs CON). The interaction of group and time was also evaluated. The dependent variable in this model was SEE. The time effect was nonsignificant, Wilks' Lamda = 0.89, $F(3,15)$ = 0.606, p = 0.62. The between-group comparisons were also nonsignificant, $F(1,17)$ = 0.034, p = 0.86. There was no significant interaction effect on SEE, Wilks' Lamda = 0.87, $F(3,15)$ = 0.784, p = 0.52. However, the observed power for the main effect of time test was only 0.62 for time and 0.52 for the interaction between time and group. Neither the PRE group nor the CON group had a significant change in their SEE over the 4 data collection points of the study as seen in Figure 2.

Figure 2: Self-efficacy expectation means for group × time 4 data points. Note: Higher scores indicate higher self-efficacy expectation.



A secondary analysis of SEE was performed because there were a high number of study participants (PRE 5, CON 6) who did not complete data collection at T3. To maximize statistical power, a secondary analysis of the SEE data was completed, excluding T3 data. There were several reasons for this loss of T3 data. Those reasons included (a) extended inpatient rehabilitation by 3 PRE and 4 CON subjects along with (b) medical complications like infections (1 PRE and 2 CON) and (c) cold symptoms causing one PRE to miss because of inability to leave their home. This resulted in a sample of 31 (n = 15 CON and n = 16 PRE) participants being evaluated.

This analysis examined the main effects of time (T1, T2, and T4) and group (PRE vs CON) and the group × time interaction. The effect of time remained nonsignificant for SEE, Wilks' Lamda = 0.97, $F(2,27) = 0.430$, $p = 0.655$. There was no significant interaction effect on SEE, Wilks' Lamda = 0.96, $F(2,27) = 0.537$, $p = 0.590$. The observed power for this test was 0.113 for time and 0.130 for time × group. The between-group comparison was also nonsignificant, $F(1,28) = 0.549$, $p = 0.465$.

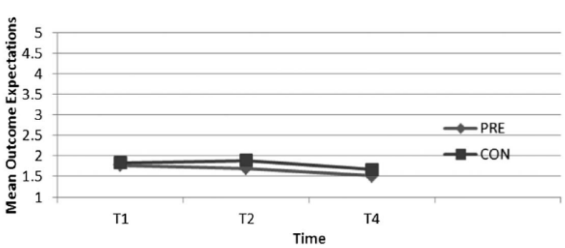
Outcome Expectations for Exercise

The evaluation of hypothesis 2 used a similar statistical model as above to determine significant differences in OEE within the sample over the duration of the study. There was a nonsignificant effect of time on OEE, Wilks' Lamda = 0.72, $F(3,15) = 2.06$, $p = 0.146$.

There was no significant interaction effect on OEE, Wilks' Lamda = 0.97, $F(3,15) = 0.142$, $p = 0.933$. The observed power for this test was 0.430 for time and 0.071 for time × group interaction. The between-groups comparison was nonsignificant, $F(1,17) = 0.187$, $p = 0.069$, although there was a trend toward significance. Whether significance will be reached when the sample size is increased is unclear but likely.

The secondary analysis of OEE excluding T3 indicted a similar pattern as the initial analysis; only this time there was a significant effect of time on OEE, Wilks' Lamda = 0.709, $F(2,27) = 5.75$, $p = 0.008$. There was no significant interaction effect on OEE, Wilks' Lamda = 0.986, $F(2,27) = 0.199$, $p = 0.821$. The observed power for this test was 0.828 for time and 0.078 for time × group interaction. Although time was significant, between-group comparison was not $F(1,28) = 0.604$, $p = 0.443$. Post hoc analysis, using the Bonferroni correction method indicated that the groups significantly declined between T2 and T4. Additional planned comparisons using T-tests (independent and paired samples) looked at between groups and within group changes over time. These tests indicated no significant differences. The PRE and CON groups did not significantly change their OEE over the 3 data collection points of the study as seen in Figure 3.

Figure 3: Outcome expectations for exercise for group × time 3 data points. Note: Lower scores indicate higher outcome expectations for exercise.



Discussion

The purpose of this study was to assess whether knee OA patients, scheduled for TKA, who participated in guided exercise before TKA had higher SEE and higher OEE than those who do not. The findings indicated no significant effect of the time, group, or group × time on self-efficacy, which is not in support of our hypothesis. However, it is interesting to observe in Figure 2 that the SEE of the PRE seemed to be consistently maintained over the study, and actually trended upward after their TKA at T3 and T4, but did not increase to a significant difference. This trend was not observed in the CON group; the SEE of the CON demonstrated a downward trend before and after their TKA and only trended upward at T3 to T4 after starting into their rehabilitation. These trends observed among the PRE and CON groups are similar to previous studies that have shown an increase in SEE in patients who participated in exercise ([10,25]). Other researchers have found that exercise interventions with knee OA patients after TKA resulted in improvements in these measures of self-efficacy ([15]). Although speculative, it is possible that with a larger sample size, this discernible trend for self-efficacy may have reached statistical significance but future investigations are needed to support this premise.

Regarding the variable OEE, our findings showed a significant time effect. The PRE and CON groups changed in their OEE between T2 and T4 (Figure 3). The CON group declined between T1 and T2 but improved at T4 as the PRE group maintained OEE scores at T2. The PRE group did not significantly change but steadily maintained their scores at T2 and improved their OEE scores from T1 to T4 over the course of the study. The PRE group had higher OEE scores than the CON group at T4, but the scores were not significantly different. Data presented in Figure 3 showed that the OEE of the PRE was maintained or trended upward while the OEE of the CON demonstrated lower scores than the PRE at T2 and T4.

Even though OEE scores of the PRE group did not increase significantly, they trended in the hypothesized direction of higher outcome expectations at T2, before their TKA, and remained higher than their baseline values after their TKA at T4. The CON groups' OEE scores decreased before their TKA and improved only slightly after their TKA. This increase of OEE at T4 for the CON group may be attributable to their participation in formal postoperative rehabilitation after their TKA, which may have positively influenced their expectations of the outcomes of their participation in exercise.

Outcome expectations, as described by the SCT, are beliefs that carrying out a specific behavior will lead to a desired outcome. This outcome expectation might be what the PRE group perceived to be the benefits of exercise (e.g., improving muscle strength, improved function, or feeling good in general). Through the exercise intervention, the PRE participants may have come to realize the value of the benefits of performing exercise and changing their behavior choices. As they may have realized and/or perceived results (e.g., better functioning and improved strength) because of the exercise program, they may have begun to change their outcome expectations. This interpretation of the findings supports the SCT with the PRE group having "past performance accomplishments, and a mastery of skills."

In summary, the outcomes of this study have revealed that preoperative exercise did not have an effect on SEE. The study did, however, demonstrate some evidence, although limited, that outcome expectations may be positively influenced through a prehabilitation exercise program. A limitation of this study is the relatively small sample size; therefore, future studies are encouraged to examine a larger group of participants to increase the statistical power of the analysis. Despite this limitation, major strengths of this study include using a randomized controlled trial design and examining the role that prehabilitation may have on psychological outcomes that, in turn, may be associated with postoperative exercise capacity and functional outcomes. It was not within the scope of the present study to examine the influence of prehabilitation-induced changes in psychological parameters (e.g., self-efficacy and outcome expectations) on postoperative outcomes, such as functional ability. Given that previous work demonstrates an influence of prehabilitation on postoperative functioning, along with the fact that the present study suggests that prehabilitation may influence outcome expectations, a logical next step would be to see if prehabilitation-induced changes in outcome expectations is linked with postoperative physical functioning. It would also be informative if future studies examined whether a preoperative exercise intervention could influence a patient's length of rehabilitation, lower cost of healthcare services, expedite return to work time, and improve overall quality of life. Additionally, future research assessing the participant's perceptions of the benefits of the prehabilitation exercises would be useful. Furthermore, additional research considering dispositional tendencies and perceptions of confidence in the physical therapist are warranted. Finally, research testing specific strategies to enhance self-perception of confidence and strategies to improve outcome expectations are needed.

Practical Applications

This study indicates that a prehabilitation exercise program performed by patients with knee OA before TKA may enhance their OEE after the surgery. Enhancing these perceptions is hypothesized to increase the likelihood that the patient will actively engage in their prescribed rehabilitation program and continue to exercise after formal rehabilitation.

Acknowledgment

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