

Correlates of Adherence to Supervised Exercise in Patients Awaiting Surgical Removal of Malignant Lung Lesions: Results of a Pilot Study

Carolyn J. Peddle, MA, Lee W. Jones, PhD, Neil D. Eves, PhD, Tony Reiman, PhD, Christopher M. Sellar, MSc, Timothy Winton, MD, and Kerry S. Courneya, PhD

Patients undergoing thoracic surgery for malignant lung lesions often present with less than optimal functional status (Handy et al., 2002; Kenny et al., 2008; Visser et al., 2006). Low cardiorespiratory fitness (VO_{2peak}) has been consistently associated with increased risk of surgical or postsurgical complications in individuals with malignant lung lesions (Beckles, Spiro, Colice, & Rudd, 2003a, 2003b; Dales, Dionne, Leech, Lunau, & Schweitzer, 1993; Win et al., 2006). For such patients, risk of perioperative and postoperative complications can be stratified by fitness level, such that individuals with VO_{2peak} less than 15 ml/kg per minute are at higher risk for complications (Beckles et al., 2003a, 2003b; Dales et al.; Win et al.). Research also has shown that after surgery, patients often experience further declines in function and quality of life (Brunelli et al., 2003, 2007; Kenny et al.). Therefore, interventions aimed at improving VO_{2peak} prior to surgery could have a number of benefits for such patients.

To begin investigating that question, a pilot study was conducted to examine the feasibility of exercise training for patients undergoing thoracic surgery for removal of malignant lung lesions. The study found that participants who adhered to at least 80% of the exercises experienced significant improvements in cardiorespiratory fitness, whereas those with less than 80% adherence did not (Jones et al., 2007). This article presents the medical, demographic, and social-cognitive correlates of exercise adherence in the trial.

Using a theoretical approach is important for developing evidence-based approaches to facilitating behavior change (Wood, 2008). To date, no research has investigated the social-cognitive correlates of exercise adherence in patients with lung cancer. Furthermore, evidence from previous studies in patients with other forms of cancer has shown that medical and demographic variables are associated with exercise adherence (Courneya

Purpose/Objectives: To examine the demographic, medical, and social-cognitive correlates of adherence to a pre-surgical exercise training intervention in patients awaiting surgery for suspected malignant lung lesions.

Design: Pilot study, single-group, prospective design with convenience sampling.

Setting: Exercise training was performed at a university research fitness center in western Canada.

Sample: 19 patients awaiting surgical resection of suspected malignant lung lesions.

Methods: At baseline, participants completed a questionnaire including the Theory of Planned Behavior variables of perceived behavioral control, attitude, and subjective norm, as well as medical and demographic information. Participants were asked to attend five supervised exercise sessions per week during surgical wait time ($\bar{X} = 8 \pm 2.4$ weeks).

Main Research Variables: Theory of Planned Behavior variables and exercise adherence.

Findings: Adherence to the exercise intervention was 73% (range = 0%–100%). Correlates of adherence were perceived behavioral control ($r = 0.63$; $p = 0.004$) and subjective norm ($r = 0.51$; $p = 0.014$). Participants with greater than 80% adherence reported significantly higher behavioral control than participants with less than 80% adherence (\bar{X} difference = 1.1; 95% confidence interval = 0.1–2.2; $p = 0.035$). Men had better adherence than women (\bar{X} difference = 24.9%; 95% confidence interval = 0.4–49.4; $p = 0.047$).

Conclusions: Perceived behavioral control and subjective norm were the strongest correlates of exercise adherence. Women could be at risk for poor exercise adherence prior to lung surgery.

Implications for Nursing: This information could be useful for clinicians in their attempts to improve adherence to exercise interventions in patients awaiting surgery for malignant lung lesions.

et al., 2004, 2008). Identifying salient exercise beliefs and correlates of exercise adherence for this patient population could help inform practitioners and future research

trials about the factors that influence exercise adherence in patients with lung cancer.

The purpose of this pilot study was to use the Theory of Planned Behavior (TPB) to investigate the social-cognitive correlates of exercise adherence. The associations between standard medical and demographic variables and exercise adherence also were examined. Finally, the most common salient behavioral and control beliefs about exercise were solicited from the patient group. The hypothesis was that the TPB variables would have medium to large correlations (i.e., $r = 0.3-0.5$) with exercise adherence.

Theoretical Framework

The TPB was adopted to identify and better understand the determinants of exercise adherence for the unique patient population (Ajzen, 1991) (see Figure 1). Ajzen's TPB is a social-cognitive theory of human behavior that postulates intention as the principle determinant of behavior. Three factors affect intention: perceived behavioral control (PBC), attitude, and subjective norm. PBC is a person's perceived confidence and control over performing a behavior and often is found to have a direct association with behavior, particularly in the presence of favorable intention. PBC is conceptualized as having two components. The first component, perceived controllability, refers to the control the individual has over performing the behavior. The second component, perceived self-efficacy, refers to the ease or difficulty of performing a behavior. Attitude refers to the positive or negative evaluation of performing the behavior. Attitude is divided into affective attitude and instrumental attitude. Affective attitude refers to emotions formed by the possibility of performing a behavior. In contrast, instrumental attitude refers to the more deliberate and thoughtful process of evaluating the potential benefits

of performing a behavior. Finally, subjective norm is the perceived social pressure to perform a given behavior. According to Ajzen (1991), PBC is derived from control beliefs (extent to which certain helpful or preventive factors could affect behavior). Attitudes are founded on behavioral beliefs (the perceived advantages and disadvantages of performing the behavior). Finally, subjective norm is derived from normative beliefs (beliefs that specific individuals might approve or disapprove of the behavior). Ajzen (1991) noted that salient beliefs may be unique to each population and, therefore, should be elicited when possible.

Methods

The methods of this study have been presented elsewhere (Jones et al., 2007); therefore, a summary of the main methods with additional information on assessment of TPB variables is presented here. Inclusion criteria were (a) age of 18 years or older, (b) suspected stage I-IIIa lung cancer (with or without preoperative histologic confirmation), and (c) candidate for surgery with curative intent. Exclusion criteria were (a) uncontrolled cardiovascular disease or hypertension, (b) contraindications to exercise (based on a cardiorespiratory graded exercise test), and (c) not living within driving distance of the intervention site. The Human Research Ethics Board at the University of Alberta and the Alberta Cancer Board provided ethical approval for the trial. All patients gave informed consent prior to enrollment in the trial. Medical and demographic information was collected through self-report on the questionnaire and review of medical charts.

Design and Procedures

Participants were recruited for the trial through a University of Alberta surgical clinic and were enrolled in the trial between January 2004 and March 2005. Once

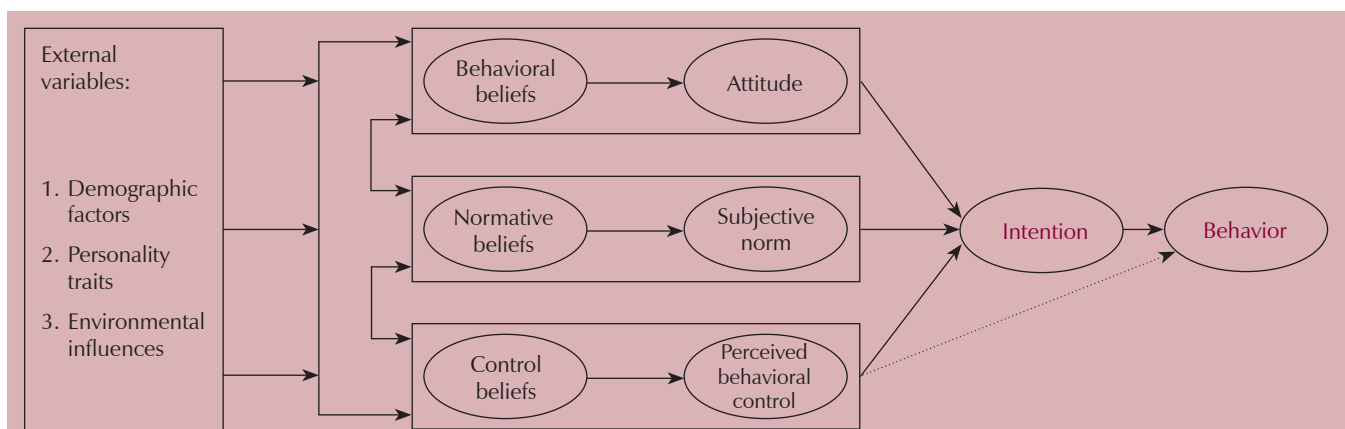


Figure 1. Theory of Planned Behavior

Note. From "The Theory of Planned Behavior," by I. Ajzen, 1991, *Organizational Behavior and Human Decision Processing*, 50, p. 182. Copyright 1991 by Elsevier. Adapted with permission.

enrolled, participants underwent a baseline assessment, including a cardiorespiratory exercise test and a questionnaire (assessing medical, demographic, and TPB constructs). After successful completion of baseline testing, participants began exercise training for the duration of their surgical wait time. All measures were taken at baseline, and participants were asked to respond to the questions in regard to the upcoming exercise program, which was anticipated to be approximately six weeks.

The exercise training took place at a university research facility and was supervised by trained exercise physiologists. Participants were asked to complete training on a cycle ergometer (Lifestyle Fitness 9500HR) five days per week for the duration of their surgical wait time. Details of the training program have been reported previously (Jones et al., 2007). Briefly, training intensities were individualized based on cardiopulmonary exercise test results. The training program was designed to include periods of long moderate-intensity training and interval training. Adherence to the exercise intervention was recorded as the number of sessions attended divided by the number of sessions expected for each participant.

Measures

Assessment of the TPB constructs was completed in accordance with Ajzen's established standardized guidelines (Ajzen, 1991, 2006). The items used were taken from previous research and were changed only to reflect the particular context. Reliability and validity of the standardized items have been established (Courneya et al., 2004; Courneya, Vallance, Jones, & Reiman, 2005; Jones et al., 2006; Karvinen et al., 2007). Each item was scored on a seven-point scale. For attitude and subjective norm, items were scored such that 1 was a negative response and 7 was a positive response. For PBC and self-efficacy, 1 was a positive response and 7 was a negative response. Scores for each TPB construct were created through averages of the respective items.

Perceived behavioral control and self-efficacy: Three items were used to assess PBC and perceived self-efficacy: "If you were really motivated . . .," followed by, (a) attending this six-week exercise program will be (1 [easy] to 7 [hard]), (b) how confident will you be to attend this six-week exercise program? (1 [not at all] to 7 [extremely]), and (c) how much control do you feel you have in attending this exercise program over the next six weeks (1 [very little] to 7 [complete]). The first two items are designed to measure self-efficacy and the third to measure PBC. Internal consistency for self-efficacy, as measured by Cronbach α , was 0.72. PBC and self-efficacy were scored separately.

Attitude: Seven items were used to assess affective (e.g., enjoyable/unenjoyable, boring/interesting, pleasant/unpleasant) and instrumental (e.g., useless/useful, harmful/beneficial, foolish/wise, bad/good) attitudes. The scales

were preceded by the statement, "Overall, I think that participating in this six-week exercise program will be . . ." Seven-point scales were used with the descriptors of extremely (1 and 7), quite (2 and 6), and slightly (3 and 5; 4 was not labeled). Internal consistency for affective and instrumental attitude, as measured by Cronbach α , were 0.69 and 0.72, respectively.

Subjective norm: To assess subjective norm, the study used three items on a seven-point Likert scale anchored with strongly agree and strongly disagree (1 and 7). The statement, "Most people who are important to me . . .," was followed by, (a) think I should do this six-week exercise program, (b) would encourage me to do this six-week exercise program, and (c) would approve of me doing this six-week exercise program. Internal consistency for the scale, as measured by Cronbach α , was 0.97.

Intention: One item assessed intention by asking participants to report the number of sessions they intended to complete on an open-ended scale that ranged from 0–30 (the highest possible score represents five days per week for six weeks).

Elicitation of behavioral beliefs was accomplished with open-ended written questions that asked participants to list the main advantages and disadvantages of exercising regularly over the following six weeks. Control beliefs asked about the main factors that would prevent or help regular exercise over the next six weeks.

Statistical Analysis

All analyses were conducted with SPSS® 15. Descriptive statistics for TPB variables, medical and demographic characteristics, and exercise adherence are presented as means. Pearson correlations were used to examine associations between the continuous demographic or medical variables (e.g., age) and TPB constructs as well as exercise adherence. The intercorrelations among TPB variables also were analyzed. Medium to large correlations were defined as $r = 0.3$ – 0.5 according to Cohen (1988). Independent samples t tests were conducted to compare the differences in adherence based on medical and demographic factors (i.e., male versus female, age younger than 65 years versus age of 65 years or older, nonsmoker versus current smoker, chronic obstructive pulmonary disease [COPD] versus no COPD, and body mass index [BMI] 20–25 versus more than 25). Differences in TPB variables based on the 80% adherence cut-point were analyzed with independent t tests. All tests were two tailed with significance set at $\alpha = 0.05$. No adjustment was made for multiple testing. Because of the nature of the pilot research and small sample size, associations were interpreted based on effects sizes in addition to p values. Meaningful associations were considered to be those with at least a medium effect size defined as $d = 0.5$ for between-group comparisons and $r = 0.3$ for correlations.

Results

Sample

Forty-three participants were screened for the study, and 35 (81%) were eligible. The main reason for ineligibility was geographic location (i.e., living too far away from the intervention site; $n = 6$). Of those eligible, 24 (69%) consented to participate. The main reason for nonconsent was lack of interest ($n = 6$). During the study, five participants (21%) became ineligible, mainly because of contraindications to surgery. Analyses were based on the 19 participants eligible for surgery.

The participants had a mean age of 64 years ($SD = 10$). Most were women (68%), married or common law (95%), not working (58%), and former smokers (53%). Almost half of the group had COPD (47%). Most participants were diagnosed with non-small cell lung cancer (67%) and ultimately received a lobectomy during thoracotomy (74%). The mean BMI of the group was 26.8 kg/m² at baseline. The length of wait for surgery and, consequently, training time varied from 4–13 weeks, with a mean of 8 weeks ($SD = 2.4$).

Theory of Planned Behavior Variables

Participants had relatively high levels of all TPB variables with means ranging from 5.9–6.4 on the 7-point scales. Correlations among the TPB variables were generally medium to large. Correlations between TPB variables and adherence are presented in Table 1.

Overall, adherence to the exercise intervention was 73% ($SD = 34%$, range = 0–100%). PBC had the strongest association with adherence ($r = 0.62$, $p = 0.004$), followed by subjective norm ($r = 0.51$, $p = 0.014$). Other nonsignificant but potentially meaningful associations with adherence were found for intention ($r = 0.35$, $p = 0.146$), self-efficacy ($r = 0.32$, $p = 0.179$), and affective attitudes ($r = 0.3$, $p = 0.279$).

Table 2 presents differences in TPB variables between those with greater than 80% versus less than 80% adherence. Participants with greater than 80% adherence had significantly higher levels of PBC (\bar{X} difference = 1.1; 95% confidence interval = 0.1–2.2; $p = 0.035$; $d = 0.95$). Differences for affective attitude (\bar{X} difference = 0.4; 95% confidence interval = –0.2–0.9; $p = 0.177$; $d = 0.69$) and intention (\bar{X} difference = 5.9; 95% confidence interval = –5.1–17; $p = 0.273$; $d = 0.55$) were not statistically significant but were meaningful (i.e., d values > 0.5).

In elicitation of behavioral beliefs, participants listed more advantages than disadvantages to exercise (see Table 3). The main advantages to exercising over the six-week period identified by participants were (a) increase fitness (47%), (b) improve mood and mental state (37%), (c) increase lung function (32%), (d) increase strength (32%), (e) weight loss (16%), and (f) help recovery from surgery (16%). The main disadvantages to exercising over the six-week period were (a) finding time (21%), (b) attending the fitness center program (16%), and (c) having sore muscles (11%). For elicitation of control beliefs, participants indicated that helpful factors were (a) a commitment to the program (16%), (b) the flexible hours of the fitness center (16%), (c) “coaching” (11%), (d) free parking (11%), and (e) a supportive family (11%). The preventive factors listed were (a) other medical conditions (21%), (b) family matters (16%), (c) transportation (16%), and (d) work commitments (11%).

Medical and Demographic Variables

Table 4 displays levels of adherence based on medical and demographic factors. Gender was significantly associated with adherence, with men achieving a higher attendance than women (\bar{X} difference = 24.9%; 95% confidence interval = 0.4–49.4; $p = 0.047$; $d = 0.87$). Participants without COPD did not have statistically significantly higher adherence than those with COPD;

Table 1. Exercise Adherence and Theory of Planned Behavior Variables: Descriptive Statistics and Bivariate Correlations

Variable	1	2	3	4	5	6	\bar{X}	SD
1. Exercise adherence (%)							73	35
2. Instrumental attitude	–0.26						6.4	0.6
3. Affective attitude	0.3	0.44*					6	0.6
4. Subjective norm	0.51*	–0.1	0.32				6.6	0.7
5. Self-efficacy	0.32	0.5*	0.44	0.64**			5.9	1.1
6. Perceived behavioral control	0.63**	0.1*	0.36	0.59**	0.67**		6.3	1.1
7. Intention	0.35	0.1*	0.27	0.39	0.5*	0.78***	94.3	11.1

* $p = 0.05$ (two tailed); ** $p = 0.01$ (two tailed); *** $p = 0.001$ (two tailed)

Table 2. Difference in Theory of Planned Behavior According to Exercise Training

Variable	More Than 80% Adherence (N = 12)		Less Than 80% Adherence (N = 7)		\bar{X} Difference	95% Confidence Interval	t	Effect Size (d)	p
	\bar{X}	SD	\bar{X}	SD					
Instrumental attitude	6.49	0.7	6.5	0.4	0.2	-0.8-0.4	0.57	0.18	0.577
Affective attitude	6.1	0.1	5.7	0.8	0.4	-0.2-0.9	1.4	0.69	0.177
Subjective norm	6.8	0.4	6.4	1.1	0.4	-0.3-1.1	1.2	0.48	0.233
Self-efficacy	6.1	1	5.7	1.3	0.4	-0.8-1.5	0.68	0.34	0.508
Perceived behavioral control	6.8	0.6	5.6	1.5	1.1	0.01-2.2	2.3	0.95	0.035
Intention	96.5	11.5	90.6	10	5.9	-5.1-17	1.1	0.55	0.273

however, the difference was meaningful (\bar{X} difference = 22%; 95% confidence interval = -11.9-56.8; $p = 0.185$; $d = 0.65$). Nonsmokers also did not have statistically significantly higher adherence than current smokers; but, again, the difference was meaningful (\bar{X} difference = 18%; 95% confidence interval = -18.1-54.1; $p = 0.185$; $d = 0.49$). No other significant or meaningful associations were found between medical or demographic variables and adherence.

Given the wide range in length of the intervention (4.4-13 weeks), differences in adherence based on length of the intervention were examined. The correlation between weeks of the intervention and adherence was not significant or meaningful ($r = -0.19$; $p = 0.441$). Furthermore, participants with less than 80% adherence did not have a significantly different length of intervention than those with greater than 80% adherence (\bar{X} difference = 0.2 weeks; 95% confidence interval = -2.3-2.7; $p = 0.869$; $d = 0.08$).

Discussion

To the authors' knowledge, this was the first study to examine the correlates of exercise adherence in patients with lung cancer during preoperative exercise training. Mean adherence was good; however, differences were found in improvements in cardiorespiratory fitness based on those with greater than versus less than 80% adherence, suggesting that increasing adherence in future studies could improve outcomes. To date, little is known about the motivational, medical, demographic, or social-cognitive correlates of exercise behavior in this understudied population.

The TPB was used to examine the social-cognitive determinants of exercise adherence during the trial. Consistent with the hypothesis, TPB variables demonstrated medium to large correlations with exercise adherence. PBC was the most significant correlate of exercise ad-

herence. Additionally, participants with greater than 80% adherence reported significantly higher PBC than those with less than 80% adherence. Previous research in patients with cancer has shown PBC to be an independent correlate of exercise behavior and adherence (Courneya, Friedenreich, Sela, Quinney, & Rhodes, 2002; Courneya & Friedenreich, 1999). However, Ajzen (1991) postulated that intention is the most important predictor of behavior. Although intention had a moderate correlation with adherence in the current study, it was not the strongest correlate. Participants had agreed to take part in the exercise intervention, which likely provided participants with a uniform intention, allowing PBC to influence behavior (Conner & Sparks, 2005; Courneya et al., 2002). The results support that higher levels of PBC could be associated with better adherence and potentially better outcomes. The preliminary data suggest that future interventions should consider researching strategies to improve controllability and confidence in an attempt to maximize adherence and potentially improve outcomes.

Subjective norm also was a significant correlate of adherence. Although that result is not common, subjective norm has been identified as an important predictor of intention to exercise during and following treatment for breast cancer survivors (Courneya, Blanchard, & Laing, 2001; Courneya & Friedenreich, 1999). Furthermore, subjective norm was a significant predictor of exercise adherence in a group of predominantly female cancer survivors (Courneya et al., 2002). Perceived approval and support appear to be important factors in exercise behavior for patients with breast or lung cancer. However, the trend is not universal for female cancer survivors because research has shown that ovarian and endometrial cancer survivors do not form exercise intentions based on subjective norm (Karvinen et al., 2007; Stevinson et al., in press). The initial findings suggest that identification of salient normative referents for this

Table 3. Most Common Behavioral and Control Beliefs

Belief	n	%
Behavioral beliefs: advantages		
Increase fitness	9	47
Help mood or mental state	7	37
Increase lung function	6	32
Increase strength	6	32
Lose weight	3	16
Help with recovery from surgery	3	16
Prepare for surgery	2	11
Improve or maintain health	2	11
Get in the habit of exercising	2	11
Improve appetite	2	11
Improve energy	2	11
To feel good	2	11
Behavioral beliefs: disadvantages		
Finding time	4	21
Attending the fitness center program	3	16
Sore muscles	2	11
Control beliefs: helpful		
Made commitment to program	3	16
Flexible hours of the fitness center	3	16
Coaching	2	11
Free parking	2	11
Support of family	2	11
Control beliefs: barriers		
Other medical conditions	4	21
Family matters	3	16
Transportation	3	16
Work commitments	2	11

population could be beneficial for understanding subjective norm and perceptions of confidence and capability to exercise.

Meaningful associations that were not statistically significant may be useful for generating hypotheses and planning future research. Such findings should be replicated in future research.

Affective attitude was moderately, though not significantly, correlated with adherence. Participants in the better adherence group also appeared to report stronger affective attitude than those in the low adherence group. Although the results were not statistically significant, the magnitudes of the associations are meaningful and warrant additional research with larger sample sizes. Making exercise training enjoyable could be a practical way to improve affective attitude and, consequently, influence behavior in this population. Elicitation of behavioral beliefs revealed that patients waiting for surgery listed many more advantages to exercise than disadvantages. Most behavioral beliefs were in line with those typically found in general healthy populations (e.g., improving fitness, finding time) (Canadian Fitness and Lifestyle Research Institute, 1996), whereas some were specific to the situation (i.e., preparing for surgery). The mix of general and specific beliefs is typical of cancer populations who tend to be interested in

the conventional benefits of exercise (i.e., increasing fitness and health) as well as how exercise could help them cope with cancer and its treatment (Courneya & Friedenreich, 1997). Interestingly, not all behavioral beliefs were accurate. Patients reported “increasing lung function” as a benefit of exercise. This is an important educational point because extensive evidence shows that exercise interventions do not change lung function (Nici et al., 2006). Although patients may notice improvements in perceptions of dyspnea, changes in objective measures of lung function are unlikely (Reardon et al., 1994). Discrepancies between salient and accurate benefits of exercise have been reported in the cancer literature (Courneya, Jones, Mackey, & Fairey, 2006). This is an important educational point for practitioners. Participants should have realistic expectations of the effects of exercise to avoid becoming discouraged, frustrated, or disappointed.

The salient control beliefs listed by participants were again a mix of those found in the general population and some specific to patients with lung cancer. Importantly, participants listed free parking and the flexible hours of the fitness center as helpful factors. This is an important consideration for future trials. The flexible hours were likely important because 37% of the group were working full-time or part-time, and flexible hours made participation in exercise more convenient. The exercise barriers were a mix of those expected from the general population and specific concerns, such as wanting to spend time with family or arranging transportation to the fitness center. Interestingly, the most salient preventive factor for the current group was other medical conditions. Other health concerns have been identified in clinical populations as an important barrier to activity (O’Shea, Taylor, & Paratz, 2007). Given the potential interference of other diseases with exercise and the fact that comorbidity was prevalent in the sample, the result is not unexpected. This also is an important point for education because it could help to highlight the benefits of exercise on comorbid disease. Incorporating flexibility into exercise programs is vital so that medical issues can be accommodated through prescription adjustment (e.g., breaks when necessary for patients who suffer from intermittent claudication).

In the current study, men had significantly higher adherence than women. Previous research in patients with cancer also has found that men have higher exercise adherence than women (Courneya et al., 2002). Cardiac rehabilitation literature offers further support of that finding: Women were shown to have significantly lower adherence than men in supervised (Daly et al., 2002) and home-based programs (Schuster, Wright, & Tomich, 1995). Some reasons that may explain the finding is that women tend to be less able to tolerate exercise than men and feel less efficacious than men in the ability to exercise (Schuster & Waldron, 1991). One strategy to combat that

Table 4. Differences in Exercise Adherence Based on Demographic and Medical Variables

Variable	r (p)	\bar{X}	SD	\bar{X} Difference	95% Confidence Interval	t	Effect Size (d)	p
Gender	0.34 (0.152)			24.9	0.4–49.4	2.2	0.87	0.047
Male (n = 6)		90.5	6.7					
Female (n = 13)		65.6	39.8					
Age (years)	0.04 (0.863)			7.7	–27.1–42.6	0.5	0.21	0.646
Younger than 65 (n = 11)		76.7	29					
65 or older (n = 8)		69	43.3					
Smoking status	0.16 (0.508)			18	–18.1–54.1	1	0.49	0.308
Never or former (n = 13)		79.2	34.4					
Current (n = 6)		61.2	39.6					
Chronic obstructive pulmonary disease	0.33 (0.185)			22.4	–11.9–56.8	1.4	0.65	0.185
No (n = 9)		83.3	25.7					
Yes (n = 9)		60.9	41.2					
Body mass index	0.28 (0.239)			5.1	–29.5–39.8	–0.3	–0.14	0.759
20–25 (n = 9)		70.8	35.7					
Higher than 25 (n = 10)		75.9	35.7					

could be emphasizing that the program is individualized to each participant's fitness level and that exercise will start out at a low level with gradual increases in intensity and duration. Strategies to improve self-efficacy such as forming realistic goals to providing mastery experiences, using appropriate positive modeling of other participants, and providing encouraging feedback could facilitate adherence for women (Burckhardt, 2005). More research is needed to fully identify the reasons women have lower exercise adherence than men and to develop appropriate intervention strategies aimed at improving adherence for women.

Finally, the results of the current study suggest that smokers and those with COPD could be at risk for poor adherence. Although the results were not statistically significant, when compared with their counterparts, those who were smokers and those with COPD were not able to achieve the threshold of 80% adherence that resulted in optimal cardiorespiratory benefits. Consideration of those results could be important for future research. Inverse associations between exercise adherence and smoking have been found in patients with breast cancer (Courneya et al., 2008) and older adult exercisers (Cooper, Resor, Stoeber, & Dubbert, 2007; Schutzer & Graves, 2004). However, little research suggests reasons for the inverse association. In the case of COPD, previous research has identified that the most common barriers to exercise reported by patients were progression of COPD and associated comorbid conditions (Nault et al., 2000). Patients with COPD often exhibit dyspnea, early-onset fatigue, muscle weakness, and poor aerobic capacity (Bernard et al., 1998; Jantarakupt & Porock, 2005; O'Donnell & Laveneziana, 2007; O'Donnell, Revill, & Webb, 2001). Any and all of the symptoms could have made exercise adherence difficult for participants with COPD. The reasons also could apply to smokers who

are known to have poor functional status and high rates of concomitant comorbidity (Arday et al., 2003). The findings are particularly important given the high rate of smoking and COPD in patients with lung cancer compared to other patient groups. Future research should consider replicating the findings and examining strategies to facilitate adherence for subgroups potentially at risk for exercise intervention nonadherence.

Study Limitations

The study has strengths and limitations to consider, most of which have been reported previously (Jones et al., 2007). One major limiting factor of the pilot study was the small sample size. Furthermore, the program had an average length of eight weeks before surgical intervention. Therefore, the results might not generalize to longer-term exercise or to adjuvant or postadjuvant settings. In this study, the participants agreed to take part in the exercise trial and were, therefore, a select group, which could limit the generalizability of the results. The study did not measure exercise history prior to enrollment, which could have influenced adherence.

Several important strengths warrant discussion. First, patients with lung cancer are an understudied population, and little is known about exercise behavior and adherence in such individuals. No study to date has examined the medical, demographic, and social cognitive correlates of exercise adherence in the population; thus, the findings from the current study are novel. Furthermore, the use of a theory to evaluate exercise adherence is important for progressing evidence-based research on behavior change. Finally, the intervention was a supervised, intense exercise program with good overall adherence and very promising improvements in cardiovascular fitness that have been replicated by others (Bobbio et al., 2008).

Implications for Nursing Practice and Research

The results presented here, although based on pilot data, provide important preliminary information for practitioners about a growing and understudied group of patients with cancer. Subgroups of patients had lower adherence, namely women. Those working with this patient population should be aware that subgroups could require strategies to facilitate exercise adherence. With a theoretical approach, PBC and subjective norm were the strongest correlates of adherence. This suggests that strategies aimed at improving controllability or confidence and approval or support from others could improve adherence. Through elicitation of behavioral and control beliefs, the study has identified potential intervention targets for practitioners. Professionals working with patients with lung cancer could use the beliefs outlined here to develop strategies that capitalize on the perceived benefits of exercise and overcome perceived barriers to maximize adherence.

Future research may build on the results so that adherence and, consequently, outcomes of exercise interventions can be improved. Studies should consider expanding on the preliminary results to investigate the reasons for poor adherence in the identified subgroups, particularly women. Strategies to facilitate adherence for such participants could be developed and tested. This could include further examination of behavioral beliefs to determine whether subgroups differ in behavioral beliefs (e.g., do women have different behavioral beliefs than males?). Future research should investigate strategies to foster the important social-cognitive correlates of adherence in this patient population. Specifically, interventions investigating strategies to improve controllability (PBC) could be beneficial. Furthermore, identifying salient normative referents could provide important information on ways to foster subjective norm. Gaining a better insight of participants who declined participation in the trial also would be interesting. Understanding of the behavioral beliefs of those who decline exercise could be used to improve

participation in exercise interventions and programs. The findings reported for salient control and behavioral beliefs can be used to test targeted interventions and to design TPB questionnaires that include belief-based items for patients with lung cancer.

Conclusion

The medical, demographic, and theoretical correlates of exercise adherence presented here increase the knowledge base of determinants of adherence in patients with lung cancer. The TPB proved to be useful for elucidating correlates of exercise adherence in the population and appears to be an appropriate theoretical model for future research. This preliminary pilot research could aid nurses in promoting exercise adherence in patients with lung cancer.

The authors gratefully acknowledge Tyson B. Kochan, BS, and Lisa A. Workman, MSc, for their assistance in data collection.

Carolyn J. Peddle, MA, is a graduate student in the Faculty of Physical Education and Recreation at the University of Alberta in Edmonton, Canada; Lee W. Jones, PhD, is an associate professor in the Department of Surgery at Duke University Medical Center in Durham, NC; and Neil D. Eves, PhD, is an assistant professor and member of the Faculty of Kinesiology at the University of Calgary, Tony Reiman, PhD, is an assistant professor in the Division of Medical Oncology, Christopher M. Sellar, MSc, is a graduate student and member of the Faculty of Physical Education and Recreation, Timothy Winton, MD, is an associate professor of surgery, and Kerry S. Courneya, PhD, is a professor and member of the Faculty of Physical Education and Recreation, all at the University of Alberta in Canada. Peddle and Sellar are supported by a full-time Health Research Studentship from the Alberta Heritage Foundation for Medical Research. Reiman is supported by the Alberta Heritage Foundation for Medical Research Clinical Investigator Award and was the principal investigator for the funding provided from the Alberta Cancer Board. Courneya is supported by the Canada Research Chairs Program and a Research Team Grant from the National Cancer Institute of Canada, with funds from the Canadian Cancer Society and the Sociobehavioral Cancer Research Network. Peddle can be reached at peddle@ualberta.ca, with copy to editor at ONFEditor@ons.org. (Submitted March 2008. Accepted for publication August 23, 2008.)

Digital Object Identifier: 10.1188/09.ONF.287-295

References

- Ajzen, I. (1991). The Theory of Planned Behavior. *Organizational Behavior and Human Decision Processing*, 50, 179–211.
- Ajzen, I. (2006, January). Constructing a TPB questionnaire: Conceptual and methodological considerations. Retrieved April 6, 2009, from <http://people.umass.edu/ajzen/tpb.html>
- Arday, D.R., Milton, M.H., Husten, C.G., Haffer, S.C., Wheless, S.C., Jones, S.M., et al. (2003). Smoking and functional status among Medicare managed care enrollees. *American Journal of Preventive Medicine*, 24(3), 234–241.
- Beckles, M.A., Spiro, S.G., Colice, G.L., & Rudd, R.M. (2003a). Initial evaluation of the patient with lung cancer: Symptoms, signs, laboratory tests, and paraneoplastic syndromes. *Chest*, 123(1, Suppl.), 97S–104S.
- Beckles, M.A., Spiro, S.G., Colice, G.L., & Rudd, R.M. (2003b). The physiologic evaluation of patients with lung cancer being considered for resectional surgery. *Chest*, 123(1, Suppl.), 105S–114S.
- Bernard, S., LeBlanc, P., Whittom, F., Carrier, G., Jobin, J., Belleau, R., et al. (1998). Peripheral muscle weakness in patients with chronic obstructive pulmonary disease. *American Journal of Respiratory and Critical Care Medicine*, 158(2), 629–634.
- Bobbio, A., Chetta, A., Ampollini, L., Primomo, G.L., Internullo, E., Carbognani, P., et al. (2008). Preoperative pulmonary rehabilitation in patients undergoing lung resection for non-small cell lung cancer. *European Journal of Cardiothoracic Surgery*, 33(1), 95–98.
- Brunelli, A., Monteverde, M., Borri, A., Salati, M., Al Refai, M., & Fianchini, A. (2003). Predicted versus observed maximum oxygen

- consumption early after lung resection. *Annals of Thoracic Surgery*, 76(2), 376–380.
- Brunelli, A., Socci, L., Refai, M., Salati, M., Xiume, F., & Sabbatini, A. (2007). Quality of life before and after major lung resection for lung cancer: A prospective follow-up analysis. *Annals of Thoracic Surgery*, 84(2), 410–416.
- Burckhardt, C.S. (2005). Educating patients: Self-management approaches. *Disability and Rehabilitation*, 27(12), 703–709.
- Canadian Fitness and Lifestyle Research Institute. (1996, June). Barriers to physical activity. *Progress and Prevention*, 4. Retrieved April 6, 2009, from <http://www.cflri.ca/pdf/e/pip04.pdf>
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Philadelphia: Lawrence Erlbaum Associates.
- Conner, M., & Sparks, P. (2005). Theory of Planned Behaviour and health behaviour. In M. Conner & P. Norman (Eds.), *Predicting health behaviour* (pp. 170–222). Berkshire, England: Open University Press.
- Cooper, T.V., Resor, M.R., Stoeber, C.J., & Dubbert, P.M. (2007). Physical activity and physical activity adherence in the elderly based on smoking status. *Addictive Behaviors*, 32(10), 2268–2273.
- Courneya, K.S., Blanchard, C.M., & Laing, D.M. (2001). Exercise adherence in breast cancer survivors training for a dragon boat race competition: A preliminary investigation. *Psycho-Oncology*, 10(5), 444–452.
- Courneya, K.S., & Friedenreich, C.M. (1997). Determinants of exercise during colorectal cancer treatment: An application of the Theory of Planned Behavior. *Oncology Nursing Forum*, 24(10), 1715–1723.
- Courneya, K.S., & Friedenreich, C.M. (1999). Utility of the Theory of Planned Behavior for understanding exercise during breast cancer treatment. *Psycho-Oncology*, 8(2), 112–122.
- Courneya, K.S., Friedenreich, C.M., Quinney, H.A., Fields, A.L., Jones, L.W., & Fairey, A.S. (2004). Predictors of adherence and contamination in a randomized trial of exercise in colorectal cancer survivors. *Psycho-Oncology*, 13(12), 857–866.
- Courneya, K.S., Friedenreich, C.M., Sela, R.A., Quinney, H.A., & Rhodes, R.E. (2002). Correlates of adherence and contamination in a randomized controlled trial of exercise in cancer survivors: An application of the Theory of Planned Behavior and the Five Factor Model of Personality. *Annals of Behavioral Medicine*, 24(4), 257–268.
- Courneya, K.S., Jones, L.W., Mackey, J.R., & Fairey, A.S. (2006). Exercise beliefs of breast cancer survivors before and after participation in a randomized controlled trial. *International Journal of Behavioral Medicine*, 13(3), 259–264.
- Courneya, K.S., Segal, R.J., Gelmon, K., Reid, R.D., Mackey, J.R., Friedenreich, C.M., et al. (2008). Predictors of supervised exercise adherence during breast cancer chemotherapy. *Medicine and Science in Sports and Exercise*, 40(6), 1180–1187.
- Courneya, K.S., Vallance, J.K.H., Jones, L.W., & Reiman, T. (2005). Correlates of exercise intentions in non-Hodgkin's lymphoma survivors: An application of the Theory of Planned Behavior. *Journal of Sport and Exercise Psychology*, 27(3), 335–349.
- Dales, R.E., Dionne, G., Leech, J.A., Lunau, M., & Schweitzer, I. (1993). Preoperative prediction of pulmonary complications following thoracic surgery. *Chest*, 104(1), 155–159.
- Daly, J., Sindone, A.P., Thompson, D.R., Hancock, K., Chang, E., & Davidson, P. (2002). Barriers to participation in and adherence to cardiac rehabilitation programs: A critical literature review. *Progress in Cardiovascular Nursing*, 17(1), 8–17.
- Handy, J.R., Jr., Asaph, J.W., Skokan, L., Reed, C.E., Koh, S., Brooks, G., et al. (2002). What happens to patients undergoing lung cancer surgery? Outcomes and quality of life before and after surgery. *Chest*, 122(1), 21–30.
- Jantarakupt, P., & Porock, D. (2005). Dyspnea management in lung cancer: Applying the evidence from chronic obstructive pulmonary disease. *Oncology Nursing Forum*, 32(4), 785–797.
- Jones, L.W., Courneya, K.S., Vallance, J.K., Ladha, A.B., Mant, M.J., Belch, A.R., et al. (2006). Understanding the determinants of exercise intentions in multiple myeloma cancer survivors: An application of the Theory of Planned Behavior. *Cancer Nursing*, 29(3), 167–175.
- Jones, L.W., Peddle, C.J., Eves, N.D., Haykowsky, M.J., Courneya, K.S., Mackey, J.R., et al. (2007). Effects of presurgical exercise training on cardiorespiratory fitness among patients undergoing thoracic surgery for malignant lung lesions. *Cancer*, 110(3), 590–598.
- Karvinen, K.H., Courneya, K.S., Campbell, K.L., Pearcey, R.G., Dundas, G., Capstick, V., et al. (2007). Correlates of exercise motivation and behavior in a population-based sample of endometrial cancer survivors: An application of the Theory of Planned Behavior. *International Journal of Behavioral Nutrition and Physical Activity*, 4(4), 21.
- Kenny, P.M., King, M.T., Viney, R.C., Boyer, M.J., Pollicino, C.A., McLean, J.M., et al. (2008). Quality of life and survival in the two years after surgery for non-small cell lung cancer. *Journal of Clinical Oncology*, 26(2), 233–241.
- Nault, D., Dagenais, J., Perreault, V., Pepin, J., Labrecque, S., Seguin, M., et al. (2000). Qualitative evaluation of a disease specific self-management program, "Living well with COPD®." *European Respiratory Journal*, 16(317S).
- Nici, L., Donner, C., Wouters, E., Zuwallack, R., Ambrosino, N., Bourbeau, J., et al. (2006). American Thoracic Society/European Respiratory Society statement on pulmonary rehabilitation. *American Journal of Respiratory and Critical Care Medicine*, 173(12), 1390–1413.
- O'Donnell, D.E., & Laveneziana, P. (2007). Dyspnea and activity limitation in COPD: Mechanical factors. *COPD*, 4(3), 225–236.
- O'Donnell, D.E., Revill, S.M., & Webb, K.A. (2001). Dynamic hyperinflation and exercise intolerance in chronic obstructive pulmonary disease. *American Journal of Respiratory and Critical Care Medicine*, 164(5), 770–777.
- O'Shea, S.D., Taylor, N.F., & Paratz, J.D. (2007). But watch out for the weather: Factors affecting adherence to progressive resistance exercise for persons with COPD. *Journal of Cardiopulmonary Rehabilitation and Prevention*, 27(3), 166–174.
- Reardon, J., Awad, E., Normandin, E., Vale, F., Clark, B., & ZuWallack, R.L. (1994). The effect of comprehensive outpatient pulmonary rehabilitation on dyspnea. *Chest*, 105(4), 1046–1052.
- Schuster, P.M., & Waldron, J. (1991). Gender differences in cardiac rehabilitation patients. *Rehabilitation Nursing*, 16(5), 248–253.
- Schuster, P.M., Wright, C., & Tomich, P. (1995). Gender differences in the outcomes of participants in home programs compared to those in structured cardiac rehabilitation programs. *Rehabilitation Nursing*, 20(2), 93–101.
- Schutzer, K.A., & Graves, B.S. (2004). Barriers and motivations to exercise in older adults. *Preventive Medicine*, 39(5), 1056–1061.
- Stevinson, C., Tonkin, K., Capstick, V., Schepansky, A., Ladha, A.B., Vallance, J.K., et al. (In press). A population-based study of determinants of physical activity behavior and intentions in ovarian cancer survivors. *Journal of Physical Activity and Health*.
- Visser, M.R., van Lanschot, J.J., van der Velden, J., Kloek, J.J., Gouma, D.J., & Sprangers, M.A. (2006). Quality of life in newly diagnosed cancer patients waiting for surgery is seriously impaired. *Journal of Surgical Oncology*, 93(7), 571–577.
- Win, T., Tasker, A.D., Groves, A.M., White, C., Ritchie, A.J., Wells, F.C., et al. (2006). Ventilation-perfusion scintigraphy to predict postoperative pulmonary function in lung cancer patients undergoing pneumonectomy. *American Journal of Roentgenology*, 187(5), 1260–1265.
- Wood, M.E. (2008). Theoretical framework to study exercise motivation for breast cancer risk reduction. *Oncology Nursing Forum*, 35(1), 89–95.