



Yi-Yun Lin, PhD, RN
Megan F. Liu, PhD, RN
Jann-Inn Tzeng, MD
Chia-Chin Lin, PhD, RN

Effects of Walking on Quality of Life Among Lung Cancer Patients

A Longitudinal Study

KEY WORDS

Longitudinal study
Lung cancer
Quality of life (QOL)
Walking

Background: Walking is typically the preferred form of physical activity among lung cancer patients. Physical activity can promote and maintain the health of such patients. **Objective:** We examined how walking affected the quality of life (QOL) of lung cancer patients, evaluating the factors that predicted changes in walking during a 6-months study. **Methods:** This study involved a longitudinal and correlational design, and the instruments comprised the Godin Leisure-Time Exercise Questionnaire, the Functional Assessment of Cancer Therapy–Lung Cancer, and social support and self-efficacy scales. **Results:** In total, 107 patients were evaluated for 6 months; the results indicated that the patients completed approximately 217 to 282 minutes of walking per week. The data demonstrated that the frequency of walking exercise decreased or stopped among 36% patients during the 6-month study. A generalized estimating equation analysis indicated significant differences between the Functional Assessment of Cancer Therapy–Lung Cancer scores and levels of physical and functional well-being among the lung cancer patients who did and did not engage in walking. Social support, self-efficacy, and patient treatment status can be used to predict the change in walking among lung cancer patients. **Conclusion:** Patient QOL can be improved by engaging in walking exercise for 6 months. Regarding lung cancer patients, social support and self-efficacy are the key factors in maintaining walking exercise. **Implications for Practice:** Integrating psychological strategies may be required to strengthen the positive effects of walking exercise on the QOL of lung cancer patients.

Author Affiliations: School of Nursing, Shu Zen College of Medicine and Management, Kaohsiung (Dr Y.-Y. Lin); Graduate Institute of Nursing (Dr Y.-Y. Lin), School of Gerontology Health Management (Dr Liu), and School of Nursing (Dr C.-C. Lin), College of Nursing, Taipei Medical University (Dr Tzeng), Taipei; and Department of Anesthesiology, Chi-Mei Medical Center, Yong Kang; and Department of Food Sciences and Technology, Chia Nan University of Pharmacy and Science, Jen-Te, Tainan City (Dr Tzeng), Taiwan.

Drs Tzeng and C.-C. Lin contributed equally to this work.

This study was supported by Chi Mei Medical Center (98CM-TMU-04). The authors have no conflicts of interest to disclose.

Correspondence: Chia-Chin Lin, PhD, RN, School of Nursing, College of Nursing, Taipei Medical University, 250 Wuxing St, Taipei 11031, Taiwan (clin@tmu.edu.tw).

Accepted for publication May 26, 2014.

DOI: 10.1097/NCC.0000000000000176

Lung cancer is the most prevalent type of cancer and the leading cause of cancer death in the world.¹ Lung cancer patients have reported a significantly lower quality of life (QOL) compared with patients who have other cancers.^{2,3} Quality of life is a multidimensional construct incorporating the physical, social, emotional, and functional aspects of well-being.⁴ It is a vital clinical end point in cancer populations, and particularly in lung cancer patients. Exercise is an element of wellness promotion that can enhance the QOL of cancer patients.⁵⁻⁹

Regular exercise can play a valuable role in improving the QOL among lung cancer patients.^{10,11} Coups et al¹² studied physical activity across the cancer trajectories of 175 early-stage lung cancer patients and determined that the active participants had a superior QOL compared with the sedentary participants. In addition, Solberg et al¹³ surveyed the association between physical activity level and QOL among long-term lung cancer survivors, discovering that the survivors who engaged in regular exercise attained a significantly higher QOL than did the sedentary survivors; thus, increased exercise was associated with an improved QOL. Similarly, Clark et al¹⁴ surveyed the motivational readiness for physical activity of 272 lung cancer survivors, indicating that high levels of motivational readiness for physical activity were associated with high levels of QOL. These results suggest that exercise can enhance QOL, warranting further research; however, no prospective studies have evaluated the longitudinal relationship between walking exercise and QOL among lung cancer patients.

The QOL of cancer patients can be improved by implementing walking programs.^{15,16} Lin et al¹⁷ surveyed the exercise preferences of lung cancer patients, discovering that walking was the most preferred exercise. To date, research remains lacking regarding the relationship between walking exercise and the QOL of lung cancer patients. The effectiveness of exercise primarily depends on the adherence by cancer survivors. However, exercise adherence is a challenge after a cancer diagnosis. Knowledge regarding the factors that influence the changes in walking of cancer patients could enhance patient adherence to walking exercise. A review of relevant research indicated that this study is the first longitudinal study to examine how walking affects the QOL of lung cancer patients. We also explored the factors predicting changes in walking during a 6-month study of lung cancer patients, determining that patient QOL can be improved by incorporating walking programs into cancer care.

■ Materials and Methods

Study Population

This study involved a longitudinal, correlational design, and convenience sampling was conducted to collect data from survey questionnaires. The participants were recruited from the chest outpatient clinics of 2 teaching hospitals in Taiwan. The inclusion criteria were as follows: diagnosed with lung cancer by a primary physician, no evidence of recurrent or progressive disease, age 18 years or older, and able to communicate in Mandarin or Taiwanese. The initial sample comprised 109 lung cancer patients. Data for 2 of the original participants were removed because they refused to participate throughout the study period.

Instruments

DEMOGRAPHIC AND DISEASE CHARACTERISTICS

The demographic characteristics of patients were age, gender, education level, marital status, and comorbidities (ie, other chronic diseases, including hypertension, diabetes, and cardiovascular disease). The disease and treatment conditions captured the disease stage, treatment modalities, and current treatment status.

QUALITY OF LIFE

In this study, the QOL was measured using the Functional Assessment of Cancer Therapy–Lung Cancer (FACT-L), which comprised 34 questions.⁴ The evaluation involved a 5-point Likert scale that ranged from 0 (“not at all”) to 4 (“very much”), and a high score represented a correspondingly high QOL. The FACT-L is composed of the Functional Assessment of Cancer Therapy–General (27 items) and an additional lung cancer–specific subscale (7 items). The FACT-General comprises 4 subscales: physical well-being (PWB; 7 items), social well-being (7 items), emotional well-being (6 items), and functional well-being (FWB; 7 items). The reliability and validity of the FACT-L have been previously established.^{18,19}

WALKING PARTICIPATION

Walking exercise was measured using a modified version of the Godin Leisure-Time Exercise Questionnaire, which was developed by Godin and Shephard.²⁰ The exercise questionnaire indicated the average frequency of mild (leisurely walking), moderate (not exhausting), and strenuous (producing a rapid heartbeat) activity undertaken that lasted more than 15 minutes during the free time of the patients in a typical week. In addition, the scale was adapted to enable the participants to indicate the average number of minutes spent on walking exercise. The Godin Leisure-Time Exercise Questionnaire yielded test-retest reliabilities of 0.69 to 0.80 and 0.24 to 0.56 with VO₂max.^{20,21} Miller et al²² demonstrated a concurrent validity coefficient of 0.45 by using a Caltrac accelerometer.

SOCIAL SUPPORT

In this study, social support was measured based on the scale of “perceived social support specific to health-related exercise behaviors,” using 13 questions.²³ The evaluation involved a 5-point Likert scale, where 1 = “never,” 2 = “rarely,” 3 = “sometimes,” 4 = “usually,” and 5 = “always.” The scale of social support indicated how much exercise support the patients received from their family, friends, and medical staff members. Sallis et al²³ surveyed the level of support that friends and family members provided regarding patient physical activity, yielding a test-retest reliability of 0.55 to 0.79 in a 2-week period. The reliability and validity of this scale were previously established.²⁴

SELF-EFFICACY FOR EXERCISE

We used a self-efficacy questionnaire designed by Marcus et al²⁵ that comprised 5 questions, each scored from 1 point, indicating no self-confidence, to 5 points, indicating strong self-confidence.

This questionnaire has been used to evaluate how much self-confidence a patient requires to maintain his/her exercise habits during unfavorable situations. Williams et al²⁴ studied the predictable psychosocial factors concerning physical activity adjustment and maintenance in 205 healthy adults, determining that the scale exhibited favorable reliability and an internal consistency value of 0.86.

Procedures

This study was reviewed and approved by the Institutional Review Board Committee of the study hospital in Taiwan. The study was initiated by enrolling lung cancer patients from the chest outpatient clinic. The patients agreed to provide data at the beginning of the study and at 2 follow-ups after 3-month intervals. During patient enrollment, we explained the study purpose and data collection methods, ensuring the participants that their right to receive appropriate medical care would not be affected regardless of whether they participated in the study; all participants provide their written consent. We instructed the patients on how to complete the questionnaire, and they required approximately 15 minutes to complete the basic personal information portion and structured questionnaire. Patients who could not complete the survey questionnaire (ie, illiterate participants) were assisted by a researcher who read each question and recorded the answers. During the study, the right of the patients to withdraw for any reason was fully respected.

Statistical Analysis

The SPSS software package version 17.0 (SPSS, Chicago, Illinois) was used to analyze the data. Descriptive statistics were used to present the demographic and disease-related characteristics and mean (SD) of the walking and QOL scores. A generalized estimating equation (GEE) was used to account for the dependence of repeated measurements. The GEE method extends the quasi-likelihood approach, which is increasingly used to analyze longitudinal data because it does not require the participants to undergo the same numbers of assessments.^{26–28} Therefore, the effects of walking exercise on QOL were analyzed using the GEE method, which was also used to control the baseline heterogeneity. Treatment status was added to the analytic models as a confounding variable. The GEE was also used to identify the predictors for changes in walking exercise during the 6-month study period.

■ Results

Demographic and Disease Characteristics

Table 1 lists the participant and disease-related characteristics. Of the 107 participants, 57 were men and 50 were women; the average age was 63.75 (SD, 10.38) years. Most patients (87.9%) were married. The disease and treatment information indicated that 47.7% of participants were at stage I, and 73.8% had undergone surgery. On average, the participants were diagnosed 43.91 (SD, 28.15) months previously.

Changes in QOL and Walking Over the 6-Month Study Period

Table 2 lists the changes in the QOL and cancer symptoms from the baseline to the 2 follow-up points. The QOL was measured using the FACT-L, which yielded a score range of 0 to 136, and mean scores of 114.19 (SD, 12.34), 113.30 (SD, 15.37), and 112.74 (SD, 17.76) at the baseline, 3-month, and 6-month follow-ups, respectively.

The results indicated that the patients exhibited average walking times of 282.29 (SD, 152.47), 248.23 (SD, 170.13), and 217.90 (SD, 180.16) minutes per week, at the baseline, 3-month, and 6-month follow-ups, respectively. Regarding the frequency of walking, the patients walked a mean number of 6.19 (SD, 1.57), 5.21 (SD, 2.67), and 4.55 (SD, 2.96) days per week at the 3 time points. Over 6 months, the data indicated that the frequency of walking decreased or stopped in 36% of patients, was maintained in 32% of patients, and increased in 10% of patients.

Table 1 • Descriptive Statistics Regarding the Demographic and Treatment Characteristics of Lung Cancer Patients (N = 107)

Variable	Mean (SD)	Range
Age, y	63.75 (10.38)	30–83
Education level, y	8.87 (5.30)	0–20
No. of comorbid conditions	0.91 (0.97)	0–5
Time since the diagnosis, mo	43.91 (21.06)	13–131
Variable	Frequency	%
Gender		
Male	57	53.3
Female	50	46.7
Marital status		
Never married	2	1.9
Married	94	87.9
Divorced	4	3.7
Widowed	7	6.5
Employment		
Employed	18	16.8
Unemployed or retired	89	83.2
Stage of cancer		
I	51	47.7
II	2	1.9
III	25	23.4
IV	25	23.4
Treatment ^a		
Operation	79	73.8
Radiotherapy	16	15
Chemotherapy	49	45.8
Targeted therapy	31	29
Current treatment status		
Completed	42	39.3
Receiving treatment	65	60.7

^aThe frequency added to more than 107 because certain patients had received multiple treatment modalities.

 **Table 2 • Mean Quality of Life (QOL) and Walking Scores Over 6 Months Among Lung Cancer Patients**

Variable	Baseline (N = 107)		3 mo (n = 88)		6 mo (n = 79)	
	Mean (SD)	Range	Mean (SD)	Range	Mean (SD)	Range
QOL						
FACT-L ^a	114.19 (12.34)	76.67–135	113.30 (15.37)	61–136	112.74 (17.64)	64–136
FACT-G ^b	90.40 (10.66)	58.67–107	89.21 (13.02)	49–108	88.59 (14.99)	42.8–108
TOI ^c	68.62 (10.25)	36–84	68.88 (10.8)	29–84	67.96 (13.34)	24–84
PWB	23.77 (4.20)	10–28	23.88 (4.48)	10–28	23.76 (5.39)	5–28
SWB	23.47 (3.85)	4.67–28	22.55 (4.61)	5.83–28	22.85 (3.61)	13–28
EWB	22.10 (2.35)	13–24	21.88 (3.25)	8–24	21.93 (3.80)	4–24
FWB	21.06 (5.27)	3–28	20.91 (5.17)	6–28	20.05 (5.95)	4–28
LCS	23.79 (3.42)	12–28	24.10 (3.52)	12–28	24.15 (4.06)	12–28
Walking						
Time, h/wk	4.70 (2.54)	0.5–14	4.14 (2.84)	0–10.5	3.63 (3.00)	0–10.5
Frequency, d/wk	6.19 (1.57)	1–7	5.21 (2.67)	0–7	4.55 (2.96)	0–7

Abbreviations: EWB, emotional well-being; FACT-G, Functional Assessment of Cancer Therapy–General; FACT-L, Functional Assessment of Cancer Therapy–Lung Cancer; FWB, functional well-being; LCS, lung cancer–specific subscale; PWB, physical well-being; SWB, social well-being; TOI, trial outcome index.

^aFACT-L = PWB + SWB + EWB + FWB + LCS.

^bFACT-G = PWB + SWB + EWB + FWB.

^cTOI = PWB + FWB + LCS.

Effect of Walking on QOL

Table 3 shows how walking affected the QOL of lung cancer patients. The GEE results demonstrated a significant relationship (95% confidence interval [CI], 0.01–0.04; $P = .010$) between walking and QOL at the 6-month follow-up. The patients who engaged in walking exercise demonstrated a significantly higher overall QOL than did those who did not, and the overall QOL increased by 0.03 points per additional minute of walking time per week.

We also analyzed the relationships among QOL and walking, discovering a significant difference in PWB (95% CI, -3.19^{E-005} to 0.02; $P = .051$) and FWB (95% CI, 0.003–0.02; $P = .004$) at the 6-month follow-up.

Table 4 shows the results of the GEE analysis, indicating that social support (95% CI, 0.16–4.96; $P = .037$), self-efficacy (95% CI, 4.19–13.12; $P < .001$), and treatment status (95% CI, -147.67 to -15.97 ; $P = .015$) can be used to predict the changes in walking among lung cancer patients. The participants who were off treatment were more likely to participate in and maintain walking exercise than were those who were being actively treated. In addition, participants who exhibited high levels of social support and self-efficacy were more likely to participate in and maintain walking exercise than were those who exhibited low levels of social support and self-efficacy.

■ Discussion

Walking is a physical activity that lung cancer patients prefer. Physical activities enhance the health of cancer patients and improve their QOL; however, few studies have examined how walking affects the QOL of lung cancer patients. In this study, the walking habits of lung cancer patients were observed for 6 months. The results indicated that lung cancer patients who engaged in regular walking spent 30 to 40 min/d walking for at least 4 to 6 d/wk. Notably, walking is a physical activity in which patients can engage

in at any time. In a review of the physical activities undertaken by cancer survivors, Irwin²⁹ indicated that regular physical exercise was difficult for cancer patients. During the current 6-month observation period, approximately 40% of the lung cancer patients gradually reduced their walking frequency. Although walking is simple, additional studies must be conducted to determine how to reinforce and maintain the walking habits of patients.

During the 6-month observation period, the patient QOL was relatively stable; these results were similar to those of Sarna et al³⁰ regarding female cancer patients and Kenny et al³¹ regarding non–small cell lung cancer patients. Concerning the influence of walking on QOL, we determined that lung cancer patients who engaged in regular walking activities for 6 months exhibited an improved overall QOL. In addition, the PWB and FWB aspects of QOL improved. These results were similar to those of Newton et al¹⁶ regarding ovarian cancer patients who engaged in individualized walking exercise programs and Wang et al¹⁵ regarding patients with newly diagnosed breast cancer who engaged in walking exercise. However, Tang et al³² evaluated cancer patients engaging in home exercise, indicating that walking improved only the psychological dimension of QOL and did not enhance the physical dimension, possibly because of the varying intensity levels or durations of walking. Evidence has indicated that walking effectively enhances the QOL of lung cancer patients; therefore, health providers should recommend walking as a treatment that benefits lung cancer patients. However, the mechanisms underlying the effects of walking on improvements in the physical and function domains of QOL require further investigation.

The results also indicated that self-efficacy, social support, and treatment status can predict the trends in walking activity among patients diagnosed with lung cancer. Pinto et al³³ examined the relationship between the QOL and exercise participation of patients diagnosed with breast cancer, reporting that a high level of social support was a predictive indicator of exercise involvement. Coups et al¹² identified significant correlations between participation in leisurely walking exercise with self-efficacy

Table 3 • Effects of Walking on Patient Quality of Life (QOL) According to a Generalized Estimating Equation Analysis

Variable	Estimate	Standard Error	95% Confidence Interval	P
FACT_L				
Intercept	112.70	2.72	107.37 to 118.04	<0.001
Time ^a				
6 mo	−4.94	2.76	−10.34 to 0.47	.074
3 mo	0.81	0.53	−0.23 to 1.85	.128
Walking, min	0.01	0.005	< 0.001 to 0.02	.045
Time × walking				
6 mo × walking	0.02	0.01	0.01 to 0.04	.010
3 mo × walking	−0.002	0.002	−0.01 to 0.002	.334
Sub-QOL				
PWB				
Time ^a				
6 mo	−1.72	1.38	−4.41 to 0.98	.212
3 mo	−0.45	1.05	−2.51 to 1.61	.671
Walking, min	0.001	0.002	−0.004 to 0.006	.626
Time × walking				
6 mo × walking	0.01	0.003	−3.17 ^{E-005} to 0.02	.051
3 mo × walking	0.003	0.003	−0.004 to 0.01	.353
SWB				
Time ^a				
6 mo	−1.11	1.09	−3.24 to 1.22	.307
3 mo	−1.46	1.17	−3.76 to 0.83	.211
Walking, min	0.002	0.003	−0.004 to 0.01	.591
Time × walking				
6 mo × walking	0.002	0.003	−0.004 to 0.01	.456
3 mo × walking	0.002	0.003	−0.01 to 0.39	.531
EWB				
Time ^a				
6 mo	−0.57	0.72	−1.99 to 0.84	.429
3 mo	0.62	0.70	−0.74 to 1.99	.371
Walking, min	0.002	0.001	−0.001 to 0.004	.210
Time × walking				
6 mo × walking	0.002	0.001	−0.002 to 0.01	.354
3 mo × walking	−0.003	0.002	−0.01 to 0.001	.121
FWB				
Time ^a				
6 mo	−3.81	1.38	−6.51 to 1.11	.006
3 mo	−0.81	1.23	−3.22 to 1.61	.514
Walking, min	<0.001	0.003	−0.01 to 0.01	.924
Time × walking				
6 mo × walking	0.01	0.004	0.003 to 0.02	.004
3 mo × walking	0.002	0.003	−0.01 to 0.01	.620
LCS				
Time ^a				
6 mo	−0.63	1.00	−2.59 to 1.34	.532
3 mo	0.41	0.96	−1.47 to 2.29	.669
Walking, min	0.002	0.002	−0.003 to 0.01	.435
Time × walking				
6 mo × walking	0.004	0.003	−0.002 to 0.01	.157
3 mo × walking	−0.001	0.003	−0.01 to 0.01	.795

Abbreviations: EWB, emotional well-being; FACT-L, Functional Assessment of Cancer Therapy–Lung Cancer; FWB, functional well-being; LCS, lung cancer–specific subscale; PWB, physical well-being; SWB, social well-being.

^aReference group: baselines data.

and social support among patients with non–small cell lung cancer. Based on the empirical results of these studies, efforts to improve support systems and patient self-efficacy should be considered in

addition to treatment status when planning walking exercise programs for patients with lung cancer. The importance of social support for walking tends to be underestimated because it is

Table 4 • Generalized Estimating Equation Analysis for Predicting Changes in Walking (N = 107)

Variable	Estimate	SE	95% Confidence Interval	P
Time ^a				
6 mo	−29.15	23.66	−75.52 to 17.22	.218
3 mo	−11.82	20.28	−51.58 to 27.93	.560
Treatment state ^b	−81.82	33.60	−147.67 to 15.97	.015
Disease stage ^c				
IV	73.40	46.15	−17.05 to 163.86	.112
III	26.70	33.78	−39.52 to 92.91	.429
II	−147.92	27.61	−202.04 to 93.80	< .001
Self-efficacy	8.65	2.28	4.19 to 13.12	< .001
Social support	2.56	1.23	0.16 to 4.96	.037
Age	1.12	1.33	−1.49 to 3.73	.399
Gender ^d	−2.51	29.26	−59.85 to 54.83	.932
Comorbid conditions	−18.02	12.08	−41.69 to 5.66	.136

^aReference group: baselines data.

^bReference group: off-treatment period.

^cReference group: stage I.

^dReference group: males.

considered an exercise that can be performed individually; however, social support and self-efficacy are key factors that motivate patients with lung cancer to maintain regular walking exercise, and improving these factors ultimately enhances the QOL of lung cancer patients.

Several limitations should be considered for this study. First, the reasons that the frequency of walking decreased among the patients may not be reflected by the closed questionnaire method used in this study. Qualitative interviews or a survey involving open-ended questions will be used in the future studies. Second, the generalizability of the study is limited to outpatient samples and cannot be extended to all patients with lung cancer. A larger and more homogeneous sample of lung cancer patients will be used in the future studies. Third, we did not assess the functional capacities of the patients (ie, pulmonary function) that could affect their walking. Finally, walking is a simple type of exercise, but the illness conditions of lung cancer patients may limit their willingness to exercise. Thus, the appropriate timing for implementing walking programs among lung cancer patients should be considered in the future.

This is the first longitudinal study to specifically investigate how walking affects the QOL of lung cancer patients in Taiwan. The results indicated that QOL can be improved by engaging in walking exercise for 6 months; furthermore, social support, self-efficacy, and treatment status can enhance the practice of walking exercise among lung cancer patients. These results should provide a valuable reference for healthcare providers, who should consider incorporating walking programs in their cancer treatment recommendations. Furthermore, integrating psychological strategies (ie, social support, self-efficacy) may be necessary to strengthen the effects of walking exercise to ensure QOL improvement among lung cancer patients.

References

- Jemal A, Bray F, Center MM, Ferlay J, Ward E, Forman D. Global cancer statistics. *CA Cancer J Clin*. 2011;61:69–90.
- Dagnelie PC, Pijls-Johannesma MC, Lambin P, Beijer S, De Ruyscher D, Kempen GI. Impact of fatigue on overall quality of life in lung and breast cancer patients selected for high-dose radiotherapy. *Ann Oncol*. 2007;18:940–944.
- Sugimura H, Yang P. Long-term survivorship in lung cancer: a review. *Chest*. 2006;129:1088–1097.
- Cella DF, Tulskey DS, Gray G, et al. The Functional Assessment of Cancer Therapy scale: development and validation of the general measure. *J Clin Oncol*. 1993;11:570–579.
- Hwang CL, Yu CJ, Shih JY, Yang PC, Wu YT. Effects of exercise training on exercise capacity in patients with non-small cell lung cancer receiving targeted therapy. *Support Care Cancer*. 2012;20:3169–3177.
- Stevinson C, Faught W, Steed H, et al. Associations between physical activity and quality of life in ovarian cancer survivors. *Gynecol Oncol*. 2007;106:244–250.
- Courneya KS, Karvinen KH, Campbell KL, et al. Associations among exercise, body weight, and quality of life in a population-based sample of endometrial cancer survivors. *Gynecol Oncol*. 2005;97:422–430.
- Peddle CJ, Au HJ, Courneya KS. Associations between exercise, quality of life, and fatigue in colorectal cancer survivors. *Dis Colon Rectum*. 2008;51:1242–1248.
- Vallance JK, Lavalley CM, Culos-Reed NS, Trudeau MG. Physical activity is associated with clinically important differences in health-related quality of life among rural and small-town breast cancer survivors. *Support Care Cancer*. 2012;20:1079–1087.
- Quist M, Rørth M, Langer S, et al. Safety and feasibility of a combined exercise intervention for inoperable lung cancer patients undergoing chemotherapy: a pilot study. *Lung Cancer*. 2012;75:203–208.
- Granger CL, McDonald CF, Berney S, Chao C, Denehy L. Exercise intervention to improve exercise capacity and health related quality of life for patients with non-small cell lung cancer: a systematic review. *Lung Cancer*. 2011;72:139–153.
- Coups EJ, Park BJ, Feinstein MB, et al. Physical activity among lung cancer survivors: changes across the cancer trajectory and associations with quality of life. *Cancer Epidemiol Biomarkers Prev*. 2009;18:664–672.
- Solberg Nes L, Liu H, Patten CA, et al. Physical activity level and quality of life in long term lung cancer survivors. *Lung Cancer*. 2012;77:611–616.
- Clark MM, Novotny PJ, Patten CA, et al. Motivational readiness for physical activity and quality of life in long-term lung cancer survivors. *Lung Cancer*. 2008;61:117–122.
- Wang YJ, Boehmke M, Wu YW, Dickerson SS, Fisher N. Effects of a 6-week walking program on Taiwanese women newly diagnosed with early-stage breast cancer. *Cancer Nurs*. 2011;34:E1–E13.
- Newton MJ, Hayes SC, Janda M, et al. Safety, feasibility and effects of an individualised walking intervention for women undergoing chemotherapy for ovarian cancer: a pilot study. *BMC Cancer*. 2011;11:389.
- Lin YY, Lai YF, Lu HI, Lai YL, Lin CC. Physical activity preferences among patients with lung cancer in Taiwan. *Cancer Nurs*. 2013;36:155–162.
- Butt Z, Webster K, Eisenstein AR, et al. Quality of life in lung cancer: the validity and cross-cultural applicability of the Functional Assessment of Cancer Therapy–Lung Scale. *Hematol Oncol Clin North Am*. 2005;19:389–420.
- Wan C, Zhang C, Cai L, et al. Psychometric properties of the Chinese version of the FACT-L for measuring quality of life in patients with lung cancer. *Lung Cancer*. 2007;56:415–421.
- Godin G, Shephard RJ. A simple method to assess exercise behavior in the community. *Can J Appl Sport Sci*. 1985;10:141–146.
- Jacobs DR Jr, Ainsworth BE, Hartman TJ, Leon AS. A simultaneous evaluation of 10 commonly used physical activity questionnaires. *Med Sci Sports Exerc*. 1993;25:81–91.
- Miller DJ, Freedson PS, Kline GM. Comparison of activity levels using the Caltrac accelerometer and five questionnaires. *Med Sci Sports Exerc*. 1994;26:376–382.
- Sallis JF, Grossman RM, Pinski RB, Patterson TL, Nader PR. The development of scales to measure social support for diet and exercise behaviors. *Prev Med*. 1987;16:825–836.

24. Williams DM, Lewis BA, Dunsiger S, et al. Comparing psychosocial predictors of physical activity adoption and maintenance. *Ann Behav Med*. 2008;36:186–194.
25. Marcus BH, Selby VC, Niaura RS, Rossi JS. Self-efficacy and the stages of exercise behavior change. *Res Q Exerc Sport*. 1992;63:60–66.
26. Liang KY, Zeger SL, Qaqish B. Multivariate regression analyses for categorical data. *J R Stat Soc*. 1992;54:3–40.
27. Liang KY, Zeger SL. Longitudinal data analysis using generalized linear models. *Biometrika*. 1986;73:13–22.
28. Zeger SL, Liang KY. Longitudinal data analysis for discrete and continuous outcomes. *Biometrics*. 1986;42:121–130.
29. Irwin ML. Physical activity interventions for cancer survivors. *Br J Sports Med*. 2009;43:32–38.
30. Sarna L, Cooley ME, Brown JK, et al. Women with lung cancer: quality of life after thoracotomy: a 6-month prospective study. *Cancer Nurs*. 2010; 33:85–92.
31. Kenny PM, King MT, Viney RC, et al. Quality of life and survival in the 2 years after surgery for non-small-cell lung cancer. *J Clin Oncol*. 2008; 26:233–241.
32. Tang MF, Liou TH, Lin CC. Improving sleep quality for cancer patients: benefits of a home-based exercise intervention. *Support Care Cancer*. 2010; 18:1329–1339.
33. Pinto BM, Trunzo JJ, Reiss P, Shiu SY. Exercise participation after diagnosis of breast cancer: trends and effects on mood and quality of life. *Psychooncology*. 2002;11:389–400.