Patient Preference and Adherence

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ORIGINAL RESEARCH

Frailty, Illness Perception and Lung Functional Exercise Adherence in Lung Cancer Patients After Thoracoscopic Surgery

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Background: Lung cancer patients will have lung damage after surgery, need rehabilitation exercise. Common-sense model has shown the impact of patients' perception of illness on health behaviors. However, for patients with lung cancer after thoracoscopic surgery, there has been no relevant exploration of disease perception.

Objective: The purpose of this study was to investigate the clinical status of patients with lung cancer patients who have undergone thoracoscopic surgery, and to explore the correlation between frailty, disease perception, and lung functional exercise compliance.

Methods: The cross-sectional study included 218 patients with lung cancer after thoracoscopic surgery. We collected participants' frailty, disease perception, exercise adherence, and relevant clinical information. *T*-test, Chi-square, Linear regression, Pearson's correlation, and mediation analysis were used for statistical analysis of patient data.

Results: We analyzed the data by disease perception with high and low median scores and found significant differences in lymphatic dissection, stool within three days, pain, thoracic drainage tube placement time. Linear regression results show that, after controlling for confounding factors, frailty and disease perception were significantly associated with pulmonary function exercise compliance. The higher the frailty score, the worse the compliance, and the higher the disease perception negative score, the less exercise. Illness perception played a partially mediating role in the association between frailty and lung functional exercise adherence.

Conclusion: Frailty and disease perception have an impact on exercise adherence, therefore, we need to consider these factors in the intervention to improve exercise compliance after thoracoscopic surgery for lung cancer.

Keywords: frailty, illness perception, patient compliance, thoracoscopy, lung neoplasms

Introduction

Lung cancer is the world's highest morbidity and mortality disease.[1] The impact of the novel coronavirus epidemic,[2] some people have cough, dyspnea and other symptoms, which have caused attention to the examination.[3] As People's health awareness increases, they participated in physical examinations, and more lung cancer patients have been detected through detailed imaging examination.[4] Early stage lung cancer patients with small symptoms were also widely detected.[5] Early detection and early treatment are the main treatment methods for cancer patients to improve life expectancy.[6] Thoracoscopic surgery is a common method for the diagnosis and treatment of lung diseases.[7] This technique is characterized by short operation time, less trauma, and quick recovery,[8] but the decline in lung function and not dependent on recovery is worrying.[9] Although the length of hospitalization is short, the recovery of lung function needs to continue. Patients may not pay attention to postoperative exercise compliance (cough, get out of bed early, deep breathing, balloon blowing, and so on), resulting in increased complications such as atelectasis or discharge which may increase the readmission rate.[10,11] Compliance with lung function exercise plays an important role in postoperative recovery.[12]

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Disease perception is the core factor in the common-sense model of self-regulation. It is the cognitive and emotional representation of the patient's own disease, and these representations influence the patient's response to the disease.[13] This model recommends exploring the early stages of the disease and intervening.[14] The model also supports surgical recovery behavior, explaining that patients can implement health management plans by understanding changes in their disease.[15] A review has shown that disease perception was measured before and after intervention to evaluate the intervention effect of the self-regulating common-sense model on behavioral compliance.[16] The effect of disease perception on patient compliance with disease and interventions has been studied in other diseases. Disease perception was associated with medication compliance, glycemic control, and compliance with cardiac rehabilitation programs.[17–19] For lung cancer patients, the relationship between disease perception and exercise compliance still needs to be explored.

Frailty is related to age. Most of the research focuses on the elderly. However, according to the concept of frailty, the body becomes vulnerable to a variety of stressors, including hospitalization, surgery, and cancer and aging.[20–22] The incidence of frailty in lung cancer patients was 45%.[23] After surgery, it can be debilitating due to the loss of ability to carry out daily activities such as wound pain.[24] Frailty affects patients' health outcomes, and frailty affects patients' functional recovery and quality of life.[25] Studies have shown that frailty will affect the post-operative effects of cancer patients.[26] In terms of rehabilitation compliance, colorectal cancer postoperative rehabilitation compliance and abdominal surgery rehabilitation compliance are related to frailty.[27,28] In addition, studies have shown that faltering of hemodialysis patients can most affect the compliance.[29] However, what is the weak state of lung cancer patients after thoracoscopic surgery, and whether it affects the compliance, we need to explore.

Study Hypothesis

The common-sense of self-regulation model is grounded in illness perception, describing how patients make sense of changes in health threats and develop and assess management plans. In view of this theory, it is important to assess patients' perceptions and expectations for thoracoscopic postoperative rehabilitation, which will actively promote patients in their own healthcare, and provide adequate support during the transition to home.[15] The conceptual model considers broader mediating factors.[16] Previous studies have explored the relationship between drug belief as mediator and drug compliance, and the relationship between disease perception as mediator and psychological distress.[30,31] The model also provides a basis for us to explore the relationship between frailty, disease perception and lung function exercise compliance in lung cancer patients after thoracoscopic surgery. Based on the literature review and common-sense model, we will explore the mediating role of illness perception in the frailty of lung cancer patients after thoracoscopic surgery and lung function exercise adherence (Figure 1).

We propose the following hypothesis:

H1: Frailty has a positive effect on disease perception;

H2: Disease perception has negative effect on lung function exercise compliance;

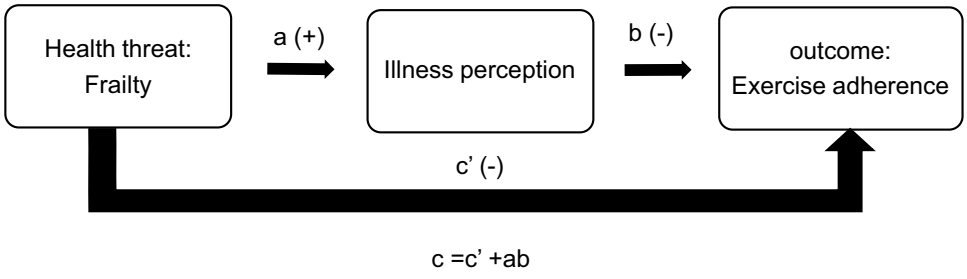

Figure 1 The Hypothetical model about explanatory factors used in mediation analysis.
Notes: In this hypothetical model: 1. The influence coefficient of influence of frailty X on disease perception M is a; 2. The influence coefficient of disease perception M on lung function exercise adherence Y is b; 3. The influence coefficient of frailty X on lung function exercise adherence Y is c'. Exploring the mediation model will involve two regression equations of the influence coefficient: 1.M = Constant 1+a × X 2.Y = Constant 2 +b × M +c' × X Therefore, 1. The indirect effect of frailty X on lung function exercise adherence Y through illness perception M is ab; 2. The direct influence of frailty X on lung function exercise adherence Y is c'; 3. The total effect of frailty X on lung function exercise adherence (Y) c=c'+ ab.

H3: Frailty has a negative effect on lung function exercise adherence.

That's why we wanted to do this study: (1) The clinical status of patients undergoing thoracoscopic surgery for lung cancer is few studies. (2) To explore the influencing factors of postoperative pulmonary function exercise compliance and whether disease perception is beneficial to the self-management of postoperative rehabilitation behavior. (3) Based on the self-regulation common-sense model, we need to explore whether the patients' disease cognition and emotion are affected by the debilitating state, and whether it will affect the rehabilitation exercise behavior.

Materials and Methods

Sample and Setting

A cross-sectional survey of patients undergoing cardiac and thoracic surgery in the affiliated Hospital of Jiangnan University in Wuxi, China, from October 2022 to April 2023. Patients who meet the following criteria are eligible for registration: (a) Everyone must be over the age of 18; (b) Thoracoscopic surgery was first performed to remove the tumor; (c) The imaging diagnosis was pulmonary nodules or intraoperative pathological puncture showed lung cancer; (d)Survey those who have no mental retardation, are good at speaking and understanding, and are willing to cooperate. These patients will be excluded: (a) The patient had metastatic tumor disease; (b) non-Lung cancer patients confirmed by postoperative pathology and diagnosis in accordance with the 2021 WHO Classification of Lung Tumors.[32]

The Ethics Committee of the Jiangnan University approved the present research, the Reference Number is JNU20221201IRB37.

Data Collection

All registered participants adopted the convenient sampling method. The investigators engaged in this study have been trained to score the correct content and scale, and to present the purpose and content of the scale to qualified patients in a consistent form. All patients signed a written consent form before taking part in the trial. In the form of individual interviews, distribute questionnaires, collect information, and collect and review in the field. In the process of collecting data, the patient will fill in the data, and then we will talk to the patient to better achieve the patients' authentic information. The recovered questionnaire was checked twice to ensure the correctness of all data entries. The time of assessment was after thoracoscopic surgery.

Study Variables and Instruments

Demographic and clinical questionnaires collected data including patient name, hospitalization number, age, sex, culture, BMI (body mass index), hypertension, diabetes, double nodules, time from diagnosis to surgery, cancer, location of surgery, lymphatic clearance, postoperative fever, postoperative stool, pain, sleep, preoperative time, postoperative time, the first day of drainage, total postoperative drainage, time to drain tube placement. Location of surgery, hypertension, diabetes, double nodules, location of surgery, lymphatic clearance were obtained through patient records and physician reports. Preoperative time, postoperative time, the first day of drainage, total postoperative drainage, time to drain tube placement were collated by looking at electronic medical records.

BMI was divided into three groups based on normal weight ($18.5 \leq BMI < 25\ kg/m^2$): <18.5, 18.5≤BMI <25, >25.[33] Time from diagnosis to surgery refers to how long after a diagnosis of lung disease is found to be treated, and it's divided into three periods, one month, one month to a year, and over a year. Classification of lung cancer is based on postoperative pathological results.[32] Postoperative fever and postoperative stool were asked whether the patient had the situation within three days after surgery. The pain was scored using the NRS pain scale.[34] The patient was given an analgesic pump for 1 day after surgery, if the patient was not allergic to the drug. Patients who report pain may use pain medication or painkillers. Regardless of whether the patient takes medication, the patient's feeling about pain is the standard. Sleep was assessed by whether patients reported good or bad sleep in the days after surgery, and by whether they used sleeping pills.

Frailty

Frailty was assessed by the Groningen frailty indicator (GFI). The GFI consists of 15 questions regarding the following domains of life: physical domain, cognitive domain, social domain, and psychological domain, generating a score ranging from 0 to 15. Frailty was defined as a GFI score ≥4. The Cronbach's α scale was 0.712 in lung cancer patients.[35]

Illness Perception (BIPQ)

The Chinese version of BIPQ was utilized to quantify illness perception. This scale consists of 8 items divided into three parts and 1 item analyzes the cause of the disease. (1) Items 1–5 (Consequences, Timeline, Personal control, Treatment control, Identity) make up dimension 1 for representation; (2)a second section for emotion consisting of item 6 and item 8 (Concern, Emotional response); (3)item 7 (Illness coherence) represents the knowledge of illness. The BIPQ assesses the cognitive dimensions (represented by items 1, 2, 3, 4, and 5), emotional dimensions (items 6 and 8), and comprehensibility (item 7) of illness perceptions in an objective manner. The Cronbach's α scale was 0.931 in lung cancer patients.

Each item has 10 scores, with 3 items being reverse-scored (items 3, 4, 7). We have inverted the data of these entries in the statistics, so the total score of this scale is 80 scores. Higher illness perception scores correspond to negative views regarding how a patient's illness impacts their health.[36]

Exercise Adherence

The Exercise Compliance Questionnaire is a 15-item questionnaire using a numeric scale (0–4, ranging from strong disagreement to strong agreement), with higher scores indicating greater adherence to exercise. The Cronbach's α scale was 0.86 in lung cancer patients.[37]

Statistical Analysis

In multifactor analysis, the sample size is usually calculated as 5–10 times of the influencing factors of the study variable lung functional exercise adherence, and 20% of the invalid sample size is considered.[38] According to Kendall's principles, the estimated sample size is 138–276 cases. We need to meet the structural equation model's minimum sample size of 200 cases by Boomsma A's research,[39] so we will collect more than 200 patients. All valid questionnaires were written by responders and reflected the reality of communicating with patients. Descriptive statistics for all variables were calculated using Statistical Package for the Social Sciences (SPSS) version 25.0 and PROCESS version.

Descriptive analyses (frequencies, percentage, mean, and standard deviation) were used to characterize participants' baseline information, which were compared between low illness perception and high illness perception patients by the chi-square (χ^2) test or independent-samples *t*-test as appropriate. When the two sets of squares are different, the Mann–Whitney test is used. We analyzed the influencing factors of lung function exercise compliance. First, we used *t*-test, Mann–Whitney test, variance test, and Pearson's correlation, then conducted linear regression analysis of variables and collinearity analysis to see if the value was < 5. Durbin-Waston diagnosed the independence of the error term.[40] Pearson's correlation was adopted to test the coefficient correlation (r) among frailty, illness perception, exercise adherence. To further determine whether and to what illness perception mediated the association between frailty and exercise adherence, then a simple mediation model was conducted. Afterwards, the bootstrapping method with 5000 resamples was applied to test the mediating effect of frailty using the PROCESS macro in SPSS. We assessed the bias-corrected bootstrap confidence intervals (CI) of indirect effects, which were considered significant if the upper and lower bounds of the 95% CI did not straddle zero.

Results

Participant Demographics and Clinical Characteristics

A total of 242 eligible patients after thoracoscopic surgery were recruited to participate in the survey study, then eventually 218 patients were enrolled (Figure 2). Twenty-four patients were excluded because they did not have lung cancer. As shown in Table 1, the mean age of the participants was 60.27±0.881 years, 125 (57.3%) patients of whom

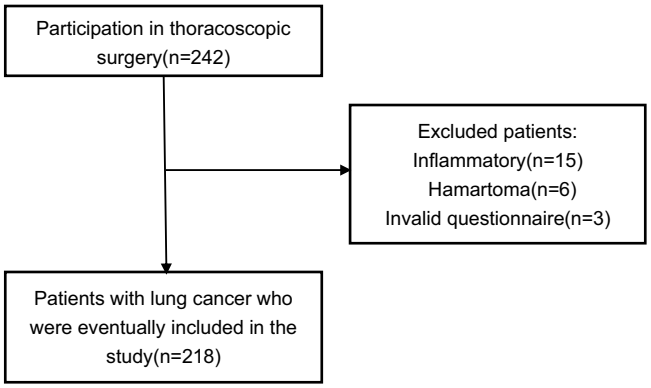

Figure 2 The enrollment of study samples.

were female. We classified low disease perception and high disease perception by a median score of 33.5. Furthermore, Lymphatic clearance (χ^2=7.390, p=0.007), Postoperative stool (χ^2=4.788, p=0.029), Pain (z=−2.648, p=0.008), frailty (z=−5.343, p<0.001), exercise adherence (z=−3.280, 0=0.001) showed a statistically significant association with high illness perception.

The mean lung functional exercise adherence of the participants was 36.93±12.053 scores. Age (r=−0.171, p=0.012), Cancer (t=10.482, p=0.033), Postoperative fever (t=4.305, p<0.001), Pain (r=−0.177, p=0.009), sleep (t=−3.24, p<0.001), postoperative time (r=−297, 0=0.001), the first day of drainage (r=−0.148, p=0.029), total postoperative drainage (r=−0.283, p<0.001), time to drain tube placement (r=−0.308, p<0.001), frailty(r=0.439, p<0.001), illness perception (r=−0.327, p<0.001) showed a statistically significant association with exercise adherence.

Descriptive Statistics for Illness Perception

According to the total BIPQ score for 34.784±12.084 in Table 2, patients expressed a relatively high degree of concern regarding their illness. The lowest mean score of illness perception is treatment control.

Linear Regression Model for Frailty and Illness Perception on Exercise Adherence

From the difference analysis and correlation analysis of exercise compliance, it is concluded that in addition to the target independent variables of frailty and disease perception, there are other independent variables interference, so we conducted a linear regression analysis (Table 3). According to the results of Model 3, the model has a good fit, and the adjusted R square is 0.232, which means that the influence degree of the independent variables involved in this regression analysis on the dependent variables reaches 23.2%, indicating that this regression model can better explore the influencing factors of lung cancer patients' postoperative functional exercise compliance. The linear regression model was significant (F=5.674, p < 0.001), indicating that at least one of the 11 independent variables could significantly affect the dependent variable lung function exercise compliance. Further, combined with the test of the regression coefficient of the independent variables, it can be concluded that postoperative fever significantly negatively affects the pulmonary function exercise compliance, with an influence coefficient of −5.188 (t=−2.686, p=0.008), indicating that fever may lead to poor exercise compliance. Frailty can significantly negatively affect compliance, and the influence coefficient is −1.084 (t=−3.239, p=0.001), that is, the higher the degree of frailty, the worse the exercise compliance. Disease perception can significantly negatively affect compliance, and the influence coefficient is −0.167 (t=−2.366, p=0.019), that is, the higher the disease perception, the more negative emotions, the worse the exercise compliance. In addition, pathological classification of cancer, postoperative time, the first day of drainage and total drainage volume, drainage tube placement time, sleep and pain status may not be influencing factors for compliance. According to the results analyzed in our investigation, these independent variables have no significant relationship with exercise compliance (p > 0.05).

Table 1 Baseline Characteristics of the Study

Variates		Mean ± SD/n(%)	Adherence (mean ± SD)	t/z/F/r	p	Low Illness Perception(n=109)	High Illness Perception(n=109)	z/χ^2	P
		218(100)	36.93±12.053			24.70±5.672	44.87±7.471	−12.763	<0.001
Age		60.27±13.008	36.93±12.053	−0.171*	0.012	60.86±13.675	59.67±12.339	−1.296	0.195
Sex				0.201	0.841			0.019	0.891
	Male	93(42.7)	36.40±1.315			46(42.2)	47(43.1)		
	Female	125(57.3)	37.33±1.037			63(57.8)	62(56.9)		
Culture				1.23	0.3			1.316	0.725
	Primary school and below	70(32.1)	35.34±1.372			36(33.0)	24(31.2)		
	Junior high school	80(36.7)	37.36±1.326			42(38.5)	38(34.9)		
	High school	34(15.6)	36.12±2.142			17(15.6)	17(15.6)		
	University and above	34(15.6)	40.00±2.242			14(12.8)	20(18.3)		
Money				−0.934	0.35			0.130	0.719
	Cash	8(3.7)	38.75±5.975			3(2.8)	5(4.6)		
	Health care	210(96.3)	36.68±0.820			106(97.2)	104(95.4)		
BMI				0.78	0.46			0.214	0.898
	<18.5	11(5.0)	33.18±13.068			5(4.6)	6(5.5)		
	18.5–25	139(63.8)	36.72±12.530			71(65.1)	68(62.4)		
	≥25	68(31.2)	37.93±10.874			33(30.3)	35(32.1)		
Hypertension				0.318	0.751			2.298	0.130
	No	129(59.2)	37.15±1.063			59(54.1)	70(64.2)		
	Yes	89(40.8)	36.62±1.282			50(45.9)	39(35.8)		
Diabetes				0.419	0.676			0.000	1.000
	No	196(89.9)	37.05±0.867			98(89.9)	98(89.9)		
	Yes	22(10.1)	35.91±2.438			11(10.1)	11(10.1)		
Double nodules				0.134	0.894			0.394	0.530
	No	164(75.2)	36.99±0.959			80(73.4)	84(77.1)		
	Yes	54(24.8)	36.74±1.557			29(26.6)	25(22.9)		
Time from diagnosis to surgery				2.623	0.075			1.368	0.504
	<1 month	68(31.2)	34.72±1.476			30(27.5)	38(34.9)		
	1 month-1 year	91(41.7)	36.86±1.287			48(44.0)	43(39.4)		
	>1 year	59(27.1)	39.59±1.459			31(28.4)	28(25.7)		

Cancer				10.482*	0.033			8.788	0.058
	Adenocarcinoma in situ	61(28.0)	35.90±1.556			23(21.1)	38(34.9)		
	Microinvasive adenocarcinoma	66(30.3)	40.68±1.557			41(37.6)	25(22.9)		
	Invasive adenocarcinoma	64(29.4)	35.88±1.409			30(27.5)	34(31.2)		
	Squamous cell carcinoma	23(10.6)	32.17±2.021			12(11.0)	11(10.1)		
	Mucinous adenocarcinoma	4(1.80)	35.00±7.036			3(2.8)	1(0.9)		
Location of surgery				3.537	0.618			7.121	0.208
	Left upper lung	50(22.9)	35.16±1.848			24(22.0)	26(23.9)		
	Left lower lung	35(16.1)	39.51±1.621			16(14.7)	19(17.4)		
	Right upper lung	71(32.6)	37.23±1.470			33(30.3)	38(34.9)		
	Right middle lung	7(3.2)	33.71±6.221			2(1.8)	5(4.6)		
	Right lower lung	44(20.2)	36.36±1.739			25(22.9)	19(17.4)		
	Other cases	11(5.0)	39.18±3.567			9(8.3)	2(1.8)		
Lymphatic clearance				1.838	0.067			7.390**	0.007
	No	118(54.1)	38.31±1.109			69(63.3)	49(45.0)		
	Yes	100(45.9)	35.31±1.192			40(36.7)	60(55.0)		
Postoperative fever				4.305**	<0.001			3.185	0.074
	No	169(77.5)	38.75±0.928			90(82.6)	79(72.5)		
	Yes	49(22.5)	30.65±1.394			19(17.4)	30(27.5)		
Postoperative stool				−1.526	0.127			4.788*	0.029
	No	94(43.1)	35.70±1.171			39(35.8)	55(50.5)		
	Yes	124(56.9)	37.86±1.125			70(64.2)	54(49.5)		
Pain		2.98±1.472	36.93±12.052	−0.177**	0.009	2.71±1.356	3.26±1.536	−2.648**	0.008
Sleep				−3.24**	0.001			3.233	0.072
	Good	131(60.1)	38.99±1.032			72(66.1)	59(54.1)		
	Bad	87(39.9)	33.83±1.265			37(33.9)	50(45.9)		
Preoperative time		3.57±2.857	36.93±12.054	−0.131	0.053	3.53±3.299	3.61±2.349	−1.029	0.304
Postoperative time		6.41±2.917	36.93±12.055	−0.297**	<0.001	6.00±2.357	6.83±3.347	−1.818	0.069
The first day of drainage		128.09±130.177	36.93±12.056	−0.148*	0.029	129.55±133.886	126.63±126.962	−0.086	0.931
Total postoperative drainage,		645.22±609.348	36.93±12.057	−0.283**	<0.001	611.32±549.044	679.13±665.041	−0.412	0.680

(*Continued*)

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Table 1 (Continued).

Variates		Mean ± SD/n(%)	Adherence (mean ± SD)	t/z/F/r	p	Low Illness Perception(n=109)	High Illness Perception(n=109)	z/χ^2	P
Time to drain tube placement,		4.89±2.762	36.93±12.058	−0.308**	<0.002	4.32±1.948	5.46±3.299	−2.624**	0.009
frailty				−4.58**	<0.001			17.929**	<0.001
	No	123(56.4)	40.36±0.976			77(70.6)	46(42.2)		
	Yes	95(43.6)	32.49±1.248			32(29.4)	63(57.8)		
frailty	frailty total	3.40±2.661	36.93±12.052	0.439**	<0.001	2.48±2.371	4.33±2.621	−5.343**	<0.001
	Health	1.58±1.924				1.09±1.681	2.07±2.031	−3.999**	<0.001
	Cognition	0.47±0.500				0.43±0.498	0.51±0.502	−1.218	0.223
	Society	0.4±0.799				0.32±0.744	0.49±0.846	−1.815	0.069
	Mental	0.95±0.790				0.64±0.752	1.27±0.702	−5.861**	<0.001
Illness perception		34.78±12.084	36.93±12.052	−0.327**	<0.001				
Exercise adherence		36.93±12.052				39.65±11.554	34.21±11.977	−3.280**	0.001

Notes: *p<0.05; **p<0.01.
Abbreviations: SD, standard deviation, BMI, body mass index.

Table 2 Descriptive Statistics for Illness Perception

	Mean	SD
Illness perception	34.784	12.084
Consequences	4.752	2.566
Timeline	4.528	2.491
Personal control	4.683	2.556
Treatment control	1.986	1.516
Identity	4.014	2.433
Concern	6.858	2.244
Illness coherence	3.583	2.317
Emotional response	4.528	2.362
Cognitive dimensions	19.917	8.813
Emotional dimensions	11.344	4.018
Illness comprehensibility	3.592	2.323

Abbreviation: SD, standard deviation.

Correlates of Illness Perception, Frailty, Exercise Adherence

To further examine the correlation, a Pearson's correlation coefficient was performed in Table 4. Frailty was positively correlated with illness perception ($r=0.439$, $p<0.01$). Illness perception ($r=-0.327$, $p<0.01$) was negatively correlated to exercise adherence. Frailty ($r=-0.398$, $p<0.01$) was also negatively connected to exercise adherence.

Mediation Analysis of Illness Perception on the Relationship Between Frailty and Exercise Adherence

As shown in Figure 3, the results of a simple mediation model testing, using Model 4, indicated that frailty inversely predicted exercise adherence ($\beta=-1.061$, $p<0.01$) and positively predicted illness perception ($\beta = 1.896$, $p<0.01$). After that, our results also revealed a significant indirect effect of illness perception on exercise adherence ($\beta= -0.338$, $p<0.01$). Bootstrap results for the mediation analysis that the confidence interval does not include zero, suggesting that illness perception only played a partial mediating role in the association between frailty and exercise adherence. The indirect effect accounted for 24.14% of the total effect (Table 5).

Discussion

In this study, the clinical status, frailty, disease perception, and postoperative lung functional exercise compliance of patients with thoracic lung cancer were investigated.

Most of the lung cancer patients we investigated who chose thoracoscopic surgery were middle-aged and elderly, and the average age were 60.2±0.881. For patients who can undergo surgery, some of them are asymptomatic patients before surgery, so postoperative symptoms and lifestyle changes may change patients' thoughts on the disease and treatment and cause psychological burden.[41,42] As our results show, there is a difference in the negative and positive perception of the disease in terms of physical frailty, chest tube placement, fever for three days after surgery, and no bowel movement. The average perceived disease score in our study of people with lung cancer was 34.78±0.818. A comparison of previous studies showed that stage 1 and stage 2 breast cancer had a disease perception score of 32 to 35 after surgery.[43] Therefore, our survey was of reference significance. In addition, item 9 of disease perception is an open answer to the cause of disease. Echoing the high-risk factors seen in lung cancer screening,[44,45] 69 person-time showed smoking, environmental fumes, dust. In the past two and a half years since the COVID-19 outbreak and vaccination, 45 cases believed that these have been blamed for lung deterioration. The reasons mentioned by other patients also need attention, bad living habits, drinking, staying up late, little exercise, irritable or stuffy mood, body constitution is not good. As the patient said, "there are no symptoms, and I don't smoke" and "The doctor said that the image is not good and needs treatment, so i had a choose for surgery". According to our survey, most patients want to know about disease in detail.

Table 3 Linear Regression Model for Frailty and Illness Perception on Exercise Adherence

	Model 1				Model 2				Model 3			
	B	**t**	**p**	**VIF**	**B**	**t**	**p**	**VIF**	**B**	**t**	**p**	**VIF**
Age	−0.023	−0.362	0.717	1.241	−0.122	−2.004*	0.046	1.162	−0.055	−0.872	0.384	1.303
Pain	−0.363	−0.65	0.516	1.284	−0.363	−0.641	0.522	1.29	−0.235	−0.424	0.672	1.297
Postoperative time	0.019	0.045	0.964	2.935	−0.121	−0.282	0.778	2.926	−0.024	−0.057	0.955	2.941
The first day of drainage	0.004	0.553	0.581	2.125	0.002	0.282	0.778	2.117	0.004	0.502	0.616	2.126
Total postoperative drainage	−0.002	−0.818	0.414	4.501	−0.002	−0.596	0.552	4.478	−0.002	−0.84	0.402	4.501
Time to drain tube placement	−0.12	−0.211	0.833	4.681	−0.201	−0.35	0.727	4.663	0.008	0.014	0.989	4.724
Adenocarcinoma in situ	0				0				0			
Microinvasive adenocarcinoma	1.695	0.864	0.389	1.552	1.019	0.507	0.613	1.592	0.954	0.486	0.628	1.592
Invasive adenocarcinoma	−0.648	−0.331	0.741	1.514	−0.596	−0.301	0.764	1.517	−1.037	−0.535	0.594	1.525
Squamous cell carcinoma	−3.112	−1.078	0.282	1.501	−2.173	−0.75	0.454	1.477	−3.393	−1.188	0.236	1.503
Mucinous adenocarcinoma	−1.022	−0.183	0.855	1.073	−1.465	−0.259	0.796	1.079	−2.134	−0.385	0.701	1.08
Postoperative fever(no)	0				0				0			
Postoperative fever(yes)	−5.264	−2.696**	0.008	1.269	−5.071	−2.568	0.011*	1.269	−5.188	−2.686**	0.008	1.269
Sleep(good)	0				0				0			
Sleep(bad)	−2.348	−1.395	0.164	1.297	−2.542	−1.495	0.136	1.293	−2.203	−1.323	0.187	1.298
Frailty	−1.398	−4.506**	<0.001	1.297					−1.084	−3.239**	0.001	1.541
Illness perception					−0.257	−3.894**	<0.001	1.184	−0.167	−2.366*	0.019	1.406
R^2	0.261				0.244				0.281			
Adjusted R^2	0.214				0.196				0.232			
F	5.554				5.068				5.674			
P	< 0.001				< 0.001				< 0.001			
Durbin-Watson	1.512				1.622				1.542			

Notes: *p<0.05, **p<0.01. Dependent variable: lung functional exercise adherence. Model 1: confounding variable (age, pain, cancer, postoperative fever, sleep, postoperative time, the first day of drainage, total postoperative drainage, time to drain tube placement)+frailty; Model 2: confounding variable+illness perception; Model 3: confounding variable+frailty+illness perception.

Table 4 Correlates of Illness Perception, Frailty, Exercise Adherence

	Illness Perception	Exercise Adherence	Frailty
Illness perception	1		
Exercise adherence	−0.327**	1	
Frailty	0.439**	−0.398**	1

Notes: ** p<0.01.

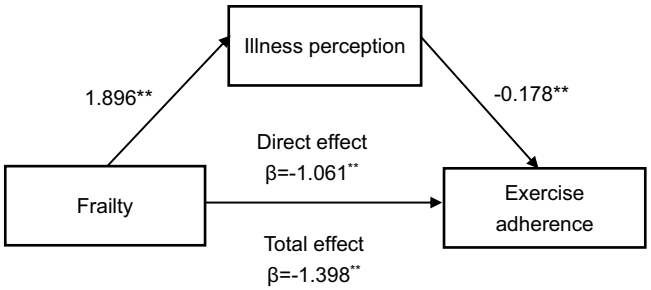

Figure 3 The established structural equation model for frailty and illness perception on exercise adherence.
Notes: **p<0.01. The structural model is checked with Model number 4 and number of bootstrap samples are 5000. Covariates: age, pain, cancer, postoperative fever, sleep, postoperative time, the first day of drainage, total postoperative drainage, time to drain tube placement.

Table 5 Bootstrap Results for the Mediation Analysis

Variables	Effect Size	Standard Error	Bootstrap 95% CI		Rate
			Lower Limit	Upper Limit	
Frailty on exercise adherence (total effect)	−1.398**	0.309	−2.008	−0.788	
Frailty on exercise adherence (direct effect)	−1.061**	0.332	−1.716	−0.406	75.86%
Illness perception on exercise adherence (indirect effect)	−0.338**	0.148	−0.651	−0.064	24.14%

Notes: **p < 0.01. After controlling for age, pain, cancer, postoperative fever, sleep, postoperative time, the first day of drainage, total postoperative drainage, time to drain tube placement.

The high or low disease perception score affected patients' perceptions of the disease. The higher the score, the negative disease perception affected patients' psychological burden, which was associated with adverse outcomes, worse quality of life, and poor self-management behavior.[46,47] We found that the higher the negative score of disease perception, the worse the compliance. In our study, although surgery is considered of great help to the disease (perhaps patients strongly agree with the idea of early diagnosis and early treatment), patients still worry about the disease.[42] Patients' awareness of the disease and emotions also have an impact on compliance, such as pulmonary rehabilitation.[48] This is the same as the self-regulation common sense model, in which patients who are aware of the health threat of physical differences and cancer after surgery develop emotional responses and cognition to the threat, so that it affects behavior.[49,50] In our study, the frailty measurement after lung cancer surgery was 43%, and the previous study showed that lung cancer patients were 45%.[23] Therefore, we believe that the research results are valuable for reference. Frailty is not exclusive of the elderly, frailty and age related, but young middle-aged frailty is not rare.[51] The effect of surgery on patients can make patients who are still weak or patients who are not weak become weak patients,[21] therefore, the assessment of frailty after surgery can better understand a patient's state after experiencing many stressors. Previous studies have measured frailty in patients undergoing vascular surgery.[35] And studies have shown that the debilitating evaluation of patients with surgery and cancer is beneficial to explore the quality of life, survival rate and recovery effect of patients.[52] Our results show that frailty is negatively correlated with compliance, this indicates that the health status of the patients after surgery needs our attention.

We found that illness perception mediated the relationship between the frailty and lung functional exercise adherence of lung cancer after thoracoscopic surgery. The path analysis results showed that the indirect effect accounted for 20.91% of the total effect. Postoperative clinical symptoms and signs will cause patients to feel more frailty, thus affecting patients' perception of the disease. In addition, the common-sense model of self-regulation points out that negative cognition and emotion about the disease will choose negative behavior, that is not conducive to the recovery of the disease. Disease perception needs to adapt to different populations and scenarios, so we explored the situation of lung cancer after thoracoscopic surgery. Postoperative chest tube retention, fever, stool, other relevant patient care also need our attention. It's consistent with our research that some of the symptoms after surgery can affect our perception of the disease and also affect our recovery.[53,54] Reacquaint themselves with their bodies after treatment for operable lung cancer, and encourage the patient to rebuild his or her identity recognition, thus resume their daily lives.[55] As for the measurement of lung functional exercise compliance, our previous research evidence found that there was no uniform regulation of the number, content and time of exercise measures.[56,57] This made it difficult for us to investigate, and we used a scale that had been validated in domestic lung cancer patients,[37] After that, we hope to have relevant studies to quantify postoperative exercise and objective tools to measure.

The weakness of this study is that our design is cross-sectional, so longitudinal surveys or more variables over different time periods are needed to predict lung functional exercise compliance. We study a small sample of people, based on more comprehensive and extensive exploration of the self-regulation common sense model, we hope to have a larger sample size after that. We want to a multicenter survey, because it will make the research more universal and reliable.

Conclusion

In this study, a model of disease perception was used to explain the effects of patient clinical information, patient psychosomatic social cognition, frailty, and disease perception on exercise compliance in lung cancer patients after thoracoscopic surgery. The findings suggest that disease perception can be used as one aspect of improving postoperative compliance, and that clinical fever, physical recovery, caregivers, and psychology should also be considered as important components of intervention programs when formulating interventions.

Data Sharing Statement

The data used in this study are stored and managed by the corresponding author, Jiang Lei, to whom readers can direct any questions or need for data. The data are not publicly available due to the consideration of ethics, the researchers shall maintain the privacy of the participants and research data should be used only for academic articles.

Ethics Approval and Informed Consent

Approval was obtained from the medical ethics committee of Institutional Review Board of Jiangnan University, and the Reference Number is JNU20221201IRB37. The procedures used in this study adhere to the tenets of the Declaration of Helsinki. Participants gave written informed consent for the assessment.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; and agree to be accountable for all aspects of the work, and have agreed on the journal to which the article has been submitted.

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Disclosure

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References

1. Cao W, Chen HD, Yu YW, et al. Changing profiles of cancer burden worldwide and in China: a secondary analysis of the global cancer statistics 2020. *Chin Med J*. 2021;134(7):783–791. doi:10.1097/CM9.0000000000001474
2. Van Haren RM, Delman AM, Turner KM, et al. Impact of the COVID-19 pandemic on lung cancer screening program and subsequent lung cancer. *J Am Coll Surg*. 2021;232(4):600–605. doi:10.1016/j.jamcollsurg.2020.12.002
3. Duma N, Santana-Davila R, Molina JR. Non-small cell lung cancer: epidemiology, screening, diagnosis, and treatment. *Mayo Clin Proc*. 2019;94(8):1623–1640. doi:10.1016/j.mayocp.2019.01.013
4. Aberle DR, Adams AM. National Lung Screening Trial Research T. Reduced lung-cancer mortality with low-dose computed tomographic screening. *N Engl J Med*. 2011;365(5):395–409. doi:10.1056/NEJMoa1102873
5. Wang YZ, Lv YB, Li GY, Zhang DQ, Gao Z, Gai QZ. Value of low-dose spiral CT combined with circulating miR-200b and miR-200c examinations for lung cancer screening in physical examination population. *Eur Rev Med Pharmacol Sci*. 2021;25(19):6123–6130. doi:10.26355/eurrev_202110_26890
6. Meza R, Jeon J, Toumazis I, et al. Evaluation of the benefits and harms of lung cancer screening with low-dose computed tomography: modeling study for the US preventive services task force. *JAMA*. 2021;325(10):988–997. doi:10.1001/jama.2021.1077
7. Yang SM, Hsu HH, Chen JS. Recent advances in surgical management of early lung cancer. *J Formos Med Assoc*. 2017;116(12):917–923. doi:10.1016/j.jfma.2017.07.009
8. Abbas AE. Surgical management of lung cancer: history, evolution, and modern advances. *Curr Oncol Rep*. 2018;20(12):98. doi:10.1007/s11912-018-0741-7
9. Uramoto H, Tanaka F. Recurrence after surgery in patients with NSCLC. *Transl Lung Cancer Res*. 2014;3(4):242–249. doi:10.3978/j.issn.2218-6751.2013.12.05
10. Agostini P, Lugg ST, Adams K, et al. Video-assisted thoracoscopic lobectomy: which patients require postoperative physiotherapy? *Physiotherapy*. 2020;106:87–93. doi:10.1016/j.physio.2019.01.001
11. Zhou W, Webster KE, Smith EL, et al. Physical activity in surgical lung cancer patients: a systematic review. *Support Care Cancer*. 2022;30(8):6473–6482. doi:10.1007/s00520-022-07018-1
12. van der Leeden M, Balland C, Geleijn E, et al. In-hospital mobilization, physical fitness, and physical functioning after lung cancer surgery. *Ann Thorac Surg*. 2019;107(6):1639–1646. doi:10.1016/j.athoracsur.2018.12.045
13. Richardson EM, Schuz N, Sanderson K, et al. Illness representations, coping, and illness outcomes in people with cancer: a systematic review and meta-analysis. *Psychooncology*. 2017;26(6):724–737. doi:10.1002/pon.4213
14. Hagger MS, Orbell S. The common sense model of illness self-regulation: a conceptual review and proposed extended model. *Health Psychol Rev*. 2022;16(3):347–377. doi:10.1080/17437199.2021.1878050
15. Gehring MB, Lerret S, Johnson J, et al. Patient expectations for recovery after elective surgery: a common-sense model approach. *J Behav Med*. 2020;43(2):185–197. doi:10.1007/s10865-019-00097-2
16. Jones CJ, Smith HE, Llewellyn CD. A systematic review of the effectiveness of interventions using the common sense self-regulatory model to improve adherence behaviours. *J Health Psychol*. 2016;21(11):2709–2724. doi:10.1177/1359105315583372
17. Kucukarslan SN. A review of published studies of patients' illness perceptions and medication adherence: lessons learned and future directions. *Res Social Adm Pharm*. 2012;8(5):371–382. doi:10.1016/j.sapharm.2011.09.002
18. Alyami M, Serlachius A, O'Donovan CE, van der Werf B, Broadbent E. A systematic review of illness perception interventions in type 2 diabetes: effects on glycaemic control and illness perceptions. *Diabet Med*. 2021;38(3):e14495. doi:10.1111/dme.14495
19. Flora PK, Anderson TJ, Brawley LR. Illness perceptions and adherence to exercise therapy in cardiac rehabilitation participants. *Rehabil Psychol*. 2015;60(2):179–186. doi:10.1037/a0039123
20. Dent E, Martin FC, Bergman H, Woo J, Romero-Ortuno R, Walston JD. Management of frailty: opportunities, challenges, and future directions. *Lancet*. 2019;394(10206):1376–1386. doi:10.1016/S0140-6736(19)31785-4
21. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly people. *Lancet*. 2013;381(9868):752–762. doi:10.1016/S0140-6736(12)62167-9
22. Gobbens RJ, Van assen MA, Luijkx KG, Schols JM. Testing an integral conceptual model of frailty. *J Adv Nurs*. 2012;68(9):2047–2060. doi:10.1111/j.1365-2648.2011.05896.x
23. Komici K, Bencivenga L, Navani N, et al. Frailty in patients with lung cancer: a systematic review and meta-analysis. *Chest*. 2022;162(2):485–497. doi:10.1016/j.chest.2022.02.027
24. Richards SJG, Frizelle FA, Geddes JA, Eglinton TW, Hampton MB. Frailty in surgical patients. *Int J Colorectal Dis*. 2018;33(12):1657–1666. doi:10.1007/s00384-018-3163-y
25. Ribeiro AR, Howlett SE, Fernandes A. Frailty-A promising concept to evaluate disease vulnerability. *Mech Ageing Dev*. 2020;187:111217. doi:10.1016/j.mad.2020.111217
26. Shaw JF, Mulpuru S, Kendzerska T, et al. Association between frailty and patient outcomes after cancer surgery: a population-based cohort study. *Br J Anaesth*. 2022;128(3):457–464. doi:10.1016/j.bja.2021.11.035
27. Fagard K, Wolthuis A, D'Hoore A, et al. A systematic review of the intervention components, adherence and outcomes of enhanced recovery programmes in older patients undergoing elective colorectal surgery. *BMC Geriatr*. 2019;19(1):157. doi:10.1186/s12877-019-1158-3
28. McComb A, Warkentin LM, McNeely ML, Khadaroo RG. Development of a reconditioning program for elderly abdominal surgery patients: the elder-friendly approaches to the surgical environment-BEdside reconditioning for functional improvements (EASE-BE FIT) pilot study. *World J Emerg Surg*. 2018;13(1):21. doi:10.1186/s13017-018-0180-7

29. Hornik B, Dulawa J. Frailty, quality of life, anxiety, and other factors affecting adherence to physical activity recommendations by hemodialysis patients. *Int J Environ Res Public Health*. 2019;16. doi:10.3390/ijerph16101827
30. Ruksakulpiwat S, Liu Z, Yue S, Fan Y. The association among medication beliefs, perception of illness and medication adherence in ischemic stroke patients: a cross-sectional study in China. *Patient Prefer Adherence*. 2020;14:235–247. doi:10.2147/ppa.S235107
31. Lee JY, Jang Y, Hyung W. Mediating effect of illness perception on psychological distress in patients with newly diagnosed gastric cancer: based on the common-sense model of self-regulation. *Cancer Nurs*. 2023;46(3):E138–e145. doi:10.1097/ncc.0000000000001103
32. Nicholson AG, Tsao MS, Beasley MB, et al. The 2021 WHO Classification of Lung Tumors: impact of Advances Since 2015. *J Thorac Oncol*. 2022;17(3):362–387. doi:10.1016/j.jtho.2021.11.003
33. Alifano M, Daffré E, Iannelli A, et al. The Reality of Lung Cancer Paradox: The Impact of Body Mass Index on Long-Term Survival of Resected Lung Cancer. A French Nationwide Analysis from the Epithor Database. *Cancers (Basel)*. 2021;13(18):4574. doi:10.3390/cancers13184574
34. Testori A, Giudici VM, Voulaz E, Alloisio M, Bottoni E. Robotic and video-assisted thoracic surgery for early-stage lung cancer: comparison of long-term pain at a single centre. *J Clin Med*. 2022;11(4). doi:10.3390/jcm11041108
35. Banning LBD, Visser L, Zeebregts CJ, Van Leeuwen BL, El Moumni M, Pol RA. Transition in frailty state among elderly patients after vascular surgery. *World J Surg*. 2020;44(10):3564–3572. doi:10.1007/s00268-020-05619-7
36. Tian X, Tang L, Yi LJ, Qin XP, Chen GH, Jimenez-Herrera MF. Mindfulness affects the level of psychological distress in patients with lung cancer via illness perception and perceived stress: a cross-sectional survey study. *Front Psychol*. 2022;13:857659. doi:10.3389/fpsyg.2022.857659
37. Li J, Davies M, Ye M, Li Y, Huang L, Li L. Impact of an animation education program on promoting compliance with active respiratory rehabilitation in postsurgical lung cancer patients: a randomized clinical trial. *Cancer Nurs*. 2021;44(2):106–115. doi:10.1097/NCC.0000000000000758
38. De Andrade Moral R, Díaz-Orueta U, Oltra-Cucarella J. Logistic versus linear regression-based reliable change index: a simulation study with implications for clinical studies with different sample sizes. *Psychol Assess*. 2022;34(8):731–741. doi:10.1037/pas0001138
39. van Lang ND, Boomsma A, Sytema S, et al. Structural equation analysis of a hypothesised symptom model in the autism spectrum. *J Child Psychol Psychiatry*. 2006;47(1):37–44. doi:10.1111/j.1469-7610.2005.01434.x
40. Chen Y, Schumann GJ-P. Spatial autocorrelation approaches to testing residuals from least squares regression. *PLoS One*. 2016;11(1):e0146865. doi:10.1371/journal.pone.0146865
41. Ugur O, Karadag E, Mert H, Sahin CK, Gurel T, Karakus HS. Examining the relationship between symptoms watched in lung cancer patients and illness perception. *J Pak Med Assoc*. 2022;72(4):634–638. doi:10.47391/JPMA.0179
42. Lehto RH. Identifying primary concerns in patients newly diagnosed with lung cancer. *Oncol Nurs Forum*. 2011;38(4):440–447. doi:10.1188/11.ONF.440-447
43. Liu Y, Liu W, Ma Y, et al. Research on body image cognition, social support and illness perception in breast cancer patients with different surgical methods. *Front Psychol*. 2022;13:931679. doi:10.3389/fpsyg.2022.931679
44. Bade BC, Dela Cruz CS. Lung cancer 2020: epidemiology, etiology, and prevention. *Clin Chest Med*. 2020;41(1):1–24. doi:10.1016/j.ccm.2019.10.001
45. Srinivasan M, Thangaraj SR, Arzoun H, Govindasamy Kulandaisamy LB, Mohammed L. The association of lung cancer and sarcoidosis: a systematic review. *Cureus*. 2022;14(1):e21169. doi:10.7759/cureus.21169
46. Osmialowska E, Stas J, Chabowski M, Jankowska-Polanska B. Illness perception and quality of life in patients with breast cancer. *Cancers*. 2022;14(5). doi:10.3390/cancers14051214
47. Liu Y, Wei M, Guo L, Guo Y, Zhu Y, He Y. Association between illness perception and health behaviour among stroke patients: the mediation effect of coping style. *J Adv Nurs*. 2021;77(5):2307–2318. doi:10.1111/jan.14761
48. Fischer M, Scharloo M, Abbink J, et al. The dynamics of illness perceptions: testing assumptions of Leventhal's common-sense model in a pulmonary rehabilitation setting. *Br J Health Psychol*. 2010;15(Pt 4):887–903. doi:10.1348/135910710X492693
49. Hagger MS, Koch S, Chatzisarantis NLD, Orbell S. The common sense model of self-regulation: meta-analysis and test of a process model. *Psychol Bull*. 2017;143(11):1117–1154. doi:10.1037/bul0000118
50. Cameron LD, Jago L. Emotion regulation interventions: a common-sense model approach. *Br J Health Psychol*. 2008;13(Pt 2):215–221. doi:10.1348/135910708X288800
51. Loecker C, Schmaderer M, Zimmerman L. Frailty in young and middle-aged adults: an integrative review. *J Frailty Aging*. 2021;10(4):327–333. doi:10.14283/jfa.2021.14
52. Vigore M, Granata N, Braga SS, et al. Cognitive impairment, frailty and rehabilitation outcome in older cardiorespiratory patients. DEC_FRAinRIAB: study protocol. *PLoS One*. 2022;17(8):e0272132. doi:10.1371/journal.pone.0272132
53. Li G, Zhang C, Wang C, Xiao L. Acupuncture against chronic postsurgical pain in non-small cell lung cancer patients: a protocol of randomized controlled trial. *Medicine*. 2021;100(40):e27461. doi:10.1097/MD.0000000000027461
54. Ding X, Zhang H, Liu H. Early ambulation and postoperative recovery of patients with lung cancer under thoracoscopic surgery-an observational study. *J Cardiothorac Surg*. 2023;18(1):136. doi:10.1186/s13019-023-02263-9
55. Missel M, Pedersen JH, Hendriksen C, Tewes M, Adamsen L. Regaining familiarity with own body after treatment for operable lung cancer - a qualitative longitudinal exploration. *Eur J Cancer Care*. 2016;25(6):1076–1090. doi:10.1111/ecc.12383
56. Hawley-Hague H, Horne M, Skelton DA, Todd C. Review of how we should define (and measure) adherence in studies examining older adults' participation in exercise classes. *BMJ Open*. 2016;6(6):e011560. doi:10.1136/bmjopen-2016-011560
57. Bakaa N, Chen LH, Carlesso L, Richardson J, Macedo L. Reporting of post-operative rehabilitation interventions for Total knee arthroplasty: a scoping review. *BMC Musculoskelet Disord*. 2021;22(1):602. doi:10.1186/s12891-021-04460-w