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Postoperative rehabilitation management self-efficacy and its relationship with symptoms in the patients with lung cancer: A latent profile analysis

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ABSTRACT

Objective: To identify the potential subgroups of postoperative rehabilitation management self-efficacy in patients with lung cancer and explore the association between these subgroups and symptom burden.
Methods: This cross-sectional study enrolled 231 lung cancer patients who underwent surgery between May and August 2023. Latent profile analysis, univariate analysis, and disordered multinomial logistic regression were performed to explore postoperative rehabilitation management self-efficacy profiles and identify interindividual variability. ANOVA, LSD, and Tamhane's T2 method were used for multiple comparisons between symptom burden and self-efficacy subgroups.
Results: The three subgroups of postoperative rehabilitation management self-efficacy identified included low level group (17.7%), medium level group (63.2%), and high level group (19.0%). Patients with junior high school education were more likely to be classified as medium level groups, and patients with higher levels of social support and better resilience were more likely to be classified as medium and high level groups. Symptom severity and symptom interference of lung cancer patients after surgery varied considerably among the three classes. In the lung cancer module, the high level group had fewer symptoms than the medium level group ($P < 0.05$).
Conclusions: Postoperative rehabilitation management self-efficacy has different classification features among patients with lung cancer. Educational background, resilience, and social support were the influencing factors of postoperative rehabilitation management self-efficacy. Lung cancer patients with higher self-efficacy in post-operative rehabilitation management showed fewer symptom burdens. Medical staff should actively pay attention to patients with low self-efficacy and provide precise interventions for patients with different subgroups.

Introduction

Lung cancer is one of the most common cancers worldwide, with an estimated 2.2 million new cases and 1.8 million deaths.[1] Surgical resection is the main treatment. The disease itself and surgical treatment may bring some physical discomfort and treatment side effects. Many lung cancer patients after surgery experienced a high symptom burden, such as pain, fatigue, anxiety, and depression, which restrict them from pulmonary exercises, daily activities and reduce their quality of life.[2,3] In order to promote the rapid recovery of patients after surgery, post-operative rehabilitation management is proposed to reduce symptom burden, and improve respiratory function and quality of life,[3] which has become a focus of clinical research in recent years. However, due to the inconsistency of pulmonary rehabilitation training standards and assessment tools, psychological burden of patients and other factors, postoperative pulmonary rehabilitation management has limited clinical application.[4,5]

Postoperative rehabilitation management self-efficacy is defined as patients' confidence in actively responding to rehabilitation activities (such as acquiring and applying information and developing skills), which can influence the goals that patients set, their determination to maintain progress and achieve these goals, and their resilience when setbacks arise.[3,6] Accordingly, Feifei Huang developed the Self-Efficacy Scale for Postoperative Rehabilitation Management of Lung Cancer (SESPRM-LC) and found that lung cancer patients had an overall medium level of postoperative rehabilitation management self-efficacy.[3]

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According to literature reports, patients with higher self-efficacy in postoperative rehabilitation management tended to have better adherence to rehabilitation activities and coping abilities, fewer symptoms of anxiety and depression, and better quality of life.[7] Positive coping style, subjective well-being, social support, and psychological growth could effectively enhance postoperative rehabilitation self-efficacy.[8] Apart from the studies mentioned above, there were no other relevant studies describing postoperative rehabilitation management self-efficacy in lung cancer patients yet, and more studies focused on general self-efficacy or self-efficacy of some single aspects such as exercise and fatigue management,[9,10] using tools such as The General Self-Efficacy Scale (GSES), Strategies Used by People to Promote Health (SUPPH), and Brief version of Cancer Behavior Inventory-B (CBI-B). As mentioned earlier, lung cancer patients have many symptom burdens that affect their rehabilitation and quality of life after surgery. Some studies have pointed out that self-efficacy is also closely related to symptom burden,[2,11] but the relationship between self-efficacy and symptom burden in postoperative rehabilitation management of lung cancer patients remains to be verified.

Previous studies on postoperative rehabilitation management self-efficacy in patients with lung cancer have primarily utilized a variable-centered approach (e.g., regression, factor analysis) to estimate the overall level and provide evidence regarding how self-efficacy relates to various factors at a sample-wide average level. These methods first assume that the studied groups have the same characteristics, and the characteristics of the population can be inferred by sampling and analyzing the characteristics of the samples. However, evidence indicates the multidimensionality of self-efficacy.[12,13] The postoperative rehabilitation management self-efficacy scale contains multiple dimensions, and patients with the same total score may have different performances in different dimensions. But this point has not been discussed in previous studies. Latent profile analysis (LPA) is a people-centered analysis method that classifies individuals with similar characteristics into the same category, judges their potential characteristics by scale dimensions or item scores of different categories, and shows the proportion of each type of population in the whole. It is helpful to analyze the characteristics and influencing factors of different categories of people and implement precise interventions. Latent profile analysis has been widely used in psychological research of various cancer populations,[14] but there have been no latent profile studies on postoperative rehabilitation management self-efficacy in lung cancer patients.

Thus, this study aimed to (1) identify the latent profiles of lung cancer patients with different levels of postoperative rehabilitation self-efficacy; (2) explore the influencing factors between different latent profiles of patients; (3) analyze the relationship between different latent profiles and symptom burden of lung cancer patients.

Methods

Sample size

There are currently few simple formulas or calculators to estimate the required sample size in LPA. The required sample size is dependent on the number of profiles and the distance between the profiles, but this is unknown in advance.[15] Researchers can rely on previous studies, rules of thumb, and other methods to calculate the sample size for latent profile analysis.[15,16] In this study, according to the rule of thumb, the sample size should be at least 5–10 times the number of independent variables. This study preliminarily proposed 19 independent variables, which required at least 114–228 participants considering a non-response rate of 20%, and the actual sample size was 237 participants. All participants filled out the questionnaire completely, but 6 people filled out the questionnaire with too much homogeneity, which was regarded as an invalid questionnaire. The final sample included 231 patients, meeting the sample size requirements.

Participants and procedure

The convenience sampling method was used to select lung cancer patients who received surgical treatment in the thoracic surgery department of two tertiary hospitals in Changsha City from May to August 2023 as the study objects. Inclusion criteria were: (1) diagnosis of lung cancer and having undergone thoracoscopic segmentectomy or lobectomy; (2) within 24 hours after surgery; (3) age $\geq$ 18 years; (4) voluntary participation after informed consent. Exclusion criteria were: (1) cognitive or psychiatric problems; (2) severe hearing, visual, or speech impairments; (3) withdrawal from the study. On the day of the survey, we collected questionnaire data from patients who had surgery the previous day.

The investigators initially screened the subjects according to the patient information on the previous day's surgical schedule and determined whether they were participants according to the inclusion and exclusion criteria. Before the formal investigation, the researcher conducted a unified training for the data investigators, explaining the purpose of the study, the questionnaire structure and the scoring method. The investigators filled out the questionnaire once independently to familiarize themselves with all the entries, and the researcher provided a unified explanation for any questions that may arise when filling out the questionnaire. The data investigators explained the purpose and significance of the study to the recruited lung cancer patients according to the uniform instructions on the questionnaire, stating that the survey would not have any impact on them and they were free to choose whether to participate or withdraw at any time. The investigators briefly explained the contents and filling methods of the questionnaire, which included 99 items in five parts: demographic information, self-efficacy for postoperative rehabilitation management, resilience, social support, and symptom burden. All items except age will be answered by ticking boxes. It will take 20–30 minutes to complete the questionnaire. Then patients filled in the questionnaire themselves. When someone does not understand the problem, he/she could ask the researcher for an explanation. The researchers themselves did not interfere with the subjects' responses. The method of double check was used to input the data of the valid questionnaires to ensure accuracy.

Measures

Descriptive measures

Data on demographic variables (i.e., sex, age, educational background, marital status, residence, monthly income per capita in family, smoking history, drinking history, treatment type, and comorbidity) were collected through a self-reported questionnaire.

Self-efficacy for postoperative rehabilitation management

SESPRM-LC was applied to measure postoperative self-efficacy in patients with lung cancer.[3] It contains 6 dimensions: rehabilitation information acquisition and application (5 items), coping with treatment side effects (3 items), symptom self-management (4 items), rehabilitation training and skills cultivating (5 items), daily life management (4 items) and emotional management (6 items). It uses a Likert 5-point scale, with “very little confidence” to “very confident” scoring from 1 to 5 respectively. The total score ranges from 27 to 135 points, and the higher the score, the better the self-efficacy of postoperative rehabilitation management of lung cancer patients. The Cronbach's alpha coefficient of the scale was 0.974 and ranged between 0.838 and 0.960 for the six dimensions.

Social support

The Social support rating scale (SSRS) was used to measure the social support level of patients,[17] with a total of 10 items. The sum of item scores is the total score, with higher scores indicating better social

support. The Cronbach's alpha of this scale in this study was 0.925.

Resilience

The psychological Resilience of the patients was measured by the Connor-Davidson Resilience Scale (CD-RISC).[18] CD-RISC, compiled by Connor and Davidson in 2003, comprised 25 items, each rated on a 5-point scale (0–4), with higher scores reflecting greater resilience. CD-RISC was tested in this study with a Cronbach's alpha coefficient of 0.963.

Symptom burden

The M.D. Anderson Symptom Inventory (MDASI) was compiled by Cleeland.[19] This study adopted the scale translated and validated.[20] The MDASI scale contained 13 symptom severity items and 6 interference items. Symptom severity was used to rank symptom severity of cancer patients in the past 24 hours, such as pain, fatigue, and nausea. The score ranges from 0 to 10, with 0 being "not present" and 10 being "as bad as interference you can imagine". Interference was used to assess the disturbance level of the above symptoms on the patient's daily self-care in 6 aspects such as walking and working. On a scale of 0–10, with 0 being "did not" and 10 being "interfered completely". A higher total score indicates greater distress. The Lung Cancer Module of the M.D. Anderson Symptom Inventory (MDASI-LC) was developed by Zhang,[21] which had 6 items including cough, expectoration, hemoptysis, chest tightness, constipation, and weight loss. The scoring method was the same as that of MDASI. The total Cronbach's alpha coefficient for all items was 0.958. For the symptom severity section and interference magnitude, Cronbach's α was 0.919 and 0.92 respectively, and for the Lung Cancer Module, it was 0.876.

Data analysis

SPSS 26.0 and Mplus 8.3 were used to analyze the data. First, the latent profile model was established using the average scores of 6 dimensions in SESPRM-LC. LPA has 3 types of fitting indicators: (1) Akaike information criterion (AIC), Bayesian information criterion (BIC), and samp-corrected Bayesian information criterion (aBIC). The smaller the values of the three indicators, the better the fitting degree of the model[22]; (2) Entropy represents the accuracy of classification, with the value ranging from 0 to 1. The higher entropy value indicates the higher accuracy of classification.[23] Generally, Entropy > 0.7 is required, and when Entropy ≥ 0.8, the accuracy of classification is above 90%; (3) Bootstrapped likelihood ratio test (BLRT), Lo-Mendell-Rubin likelihood ratio test (LMR-LRT) and Vuong-Lo-Mendell-Rubin likelihood ratio test (VLMR-LRT) are often used in model comparison, and a significant P value indicates that K model categories are better than K-1 model categories.[24] In addition, we took the interpretability of the profiles into great consideration and ensured that each profile consisted of no less than 5% of samples.[25]

Descriptive statistics (mean, standard deviation, frequency, and percentage) were used to describe the sample's characteristics. The distribution of each latent profile in demographic data was compared by ANOVA or Chi-square test. ANOVA was used to compare the scores of psychological resilience, social support, and symptom burden among potential categories of lung cancer patients. Due to a failed parallel line test, disordered multinomial logistic regression analysis was used to analyze the influencing factors of various categories of rehabilitation self-efficacy of patients with lung cancer after surgery. LSD and Tamhane's T2 method were used for multiple comparisons between symptom burden and self-efficacy latent profiles. A two-tailed $P < 0.05$ was considered statistically significant.

Ethical considerations

The study was conducted in accordance with the principles stated in the Declaration of Helsinki and was approved by the Ethics Committee of Xiangya Nursing school of Central South University (IRB No. E2022166). Informed consent was obtained from all study participants.

Results

Description of the sample

The mean age of lung cancer patients ($n = 231$) was 57.75 years old (SD = 9.90). More than half of the participants were female (59.3%), lived in the city (66.7%), and had no history of smoking (72.7%). Most of the patients were married (96.1%) and had been treated with surgery only (94.4%). The mean scores of SSRS and CD-RISC were 61.47 (SD = 10.85) and 64.14 (SD = 16.09) respectively. Other demographic characteristics are presented in Table 1.

Model fitting

Latent profile analysis was conducted based on the six dimensions of postoperative rehabilitation management self-efficacy of lung cancer patients. With one profile as the initial model, the number of sections in the model gradually increased, and 1–4 models were fitted. The VLMR-LRT, LMR-LRT, and BLRT of 2–4 profile models were statistically significant. As the number of profiles increased, the model's AIC, BIC and aBIC values gradually decreased and the Entropy values gradually became larger. When the number of profiles reaches four, the AIC, BIC, and aBIC values are minimum and Entropy values are maximum. However, the proportion of minimum profiles in the 4-class model is 2.2%, less than the required proportion (at least 5%) of samples in each profile

Table 1
Characteristics of lung cancer patients ($N = 231$).

Variables	Mean ± SD	*n* (%)
Age (years)	57.75 ± 9.90	
Sex		
Male		94 (40.7)
Female		137 (59.3)
Educational background		
Primary school and below		36 (15.6)
Junior high school		78 (33.8)
Senior high school		71 (30.7)
College and above		46 (19.9)
Marital status		
Married/living with a partner		222 (96.1)
Not married[a]		9 (3.9)
Residence		
City		154 (66.7)
Countryside		77 (33.3)
Monthly income per capita in family (yuan)		
≤ 2000		24 (10.4)
2001-3000		57 (24.7)
3001-4000		65 (28.1)
> 4000		85 (36.8)
Smoking history		
Yes		63 (27.3)
No		168 (72.7)
Drinking history		
Yes		56 (24.2)
No		175 (75.8)
Treatment type		
Surgery after chemoradiotherapy		13 (5.6)
Only surgery		218 (94.4)
Comorbidity		
Hypertension		47 (20.3)
Coronary heart disease		11 (4.8)
Diabetes		17 (7.4)
Others		6 (2.6)
No		150 (64.9)
Score of social support	61.47 ± 10.85	
Score of resilience	64.14 ± 16.09	

SD: Standard deviation.
[a] Not married = never married, separated or divorced, widowed.

by previous literature.[25] Therefore, considering the model fitting index and the practical significance of classification, this study selected models divided into three profiles as the best latent profile models for postoperative rehabilitation management self-efficacy of lung cancer patients (Table 2).

The three subgroups were labeled based on the level of each subdomain of SESPRM-LC. C1, labeled as "a low level of SESPRM-LC" (17.7%), showed an overall low level of SESPRM-LC, and the curve fluctuation is small. C2, labeled as "a moderate level of SESPRM-LC" (63.2%), showed a higher level of SESPRM-LC overall than C1. C3, labeled as "a high level of SESPRM-LC" (19.0%), showed the highest level of SESPRM-LC overall among the three latent profiles, and the curve fluctuated the most. The dimensions of "Rehabilitation information acquisition and application" and "Emotional management" scored highest (Fig. 1).

Associated factors of latent profile membership

The results of univariate analysis showed that there were no statistically significant differences in age, sex, marital status, place of residence, history of smoking, history of drinking alcohol, treatment type, and comorbidity among different potential categories of patients ($P > 0.05$). There were statistically significant differences in educational background, per capita monthly family income, social support, and resilience scores ($P < 0.05$). The four statistically significant indicators in the univariate analysis were used as independent variables, and the three potential categories of SESPRM-LC of lung cancer patients were used as dependent variables. Multiple logistic regression analysis was performed with C1 "a low level of SESPRM-LC" as the reference group. The results showed that the three categories had statistically significant differences in educational background, social support, and resilience ($P < 0.05$). Compared with C1, Lung cancer patients with junior high school education (OR = 5.154, 95% CI = 1.343–19.773) were more likely to be classified as C2, and patients with higher levels of social support (C2: OR = 1.093, 95% CI = 1.035–1.155; C3: OR = 1.119, 95% CI = 1.036–1.210), better resilience (C2: OR = 1.103, 95% CI = 1.060–1.147; C3: OR = 1.257, 95% CI = 1.178–1.341) were more likely to be classified as C2 and C3 (Table 3).

Comparison of symptom burden among latent profiles

ANOVA results showed significant differences in symptom burden scores among different latent profiles of patients ($P < 0.05$). The post hoc tests using LSD or Tamhane's T2 method for multiple comparisons demonstrated that the scores of C1 and C2 groups were higher than those of C3 group in symptom burden total score, symptom severity, and symptom interference score. In lung cancer module, the scores of C2 group were higher than those of C3 group ($P < 0.05$) (Fig. 2).

Discussion

In our study, more women than men had lung cancer (59.3% vs 40.7%) and 72.7% of lung cancer patients had no smoking history. A global analysis of lung cancer published in 2022 showed that most countries had increasing trends in females but decreasing trends in males and in lung cancer incidence and mortality.[26] Lung cancer in individuals who have never smoked (LCINS) is estimated to be the fifth most common cause of cancer-related deaths worldwide, preferentially occurring in women and Asian populations.[27] Many studies have revealed that lung cancer seems to be sex-specific. Women are at higher risk of developing adenocarcinoma than men.[28,29] Due to sex differences at the molecular/genetic level, women are more sensitive to tobacco-specific carcinogens than men, which leads to a greater risk of tobacco-induced lung cancer in women.[30] In addition, factors such as cooking habits, diet, passive smoking, history of cancer and lung disease, and oral contraceptives also contribute to the increased incidence of lung cancer in non-smoking women. Culinary factors are considered to be a major risk factor for lung cancer in Asian non-smoking women.[31,32] Residents in this province like to eat oily and spicy food, mostly fried, which produces a lot of oil smoke. Prolonged exposure to such kitchen environments may increase the risk of lung cancer for women, but whether there is an actual correlation or other high-risk factors needs further research. In this study, most of the patients (94.4%) were treated with surgery only, and only 13 patients (5.6%) received preoperative chemoradiotherapy. Because of no statistical significance in the univariate analysis, the variable of treatment type was not included in subsequent regression analysis. Previous studies have pointed out that the frequency of chemoradiotherapy is one of the independent risk factors affecting the level of self-efficacy in lung cancer patients undergoing surgery,[33] but there is no correlation between the two in our study. The results of this study may result from a smaller proportion of patients receiving chemoradiotherapy.

Through latent profile analysis, this study identified three subgroups of postoperative rehabilitation management self-efficacy of lung cancer patients, low level group (C1), medium level group (C2), and high level group (C3). Educational background, social support, and resilience are the influencing factors of postoperative rehabilitation management self-efficacy. The high level group was less severe than the low and medium level groups in terms of symptom severity and symptom interference, and the high level group was less severe than medium level group in terms of lung cancer module.

The results showed that 17.7% of the patients belonged to the low level self-efficacy group, which was characterized by the overall low level of all dimensions, and there was little difference among all dimensions. Those with primary school and below, low levels of social support, and low levels of individual resilience were more likely to be classified into this group, similar to other studies.[34,35] Of all the patients, this group deserves the most attention. Rehabilitation management self-efficacy describes the ability to carry out specific rehabilitation management activities and is also affected by social support and resilience.[8] Patients with a high level of resilience may better adapt and adjust their emotional state in rehabilitation management activities. Social support also provides a feeling of psychological well-being, positive perceptions and growth in cancer patients, which was viewed as a protective factor against negative psychological states.[36,37] Thus, lung cancer populations with higher levels of social support and resilience may feel more confident in conducting postsurgical rehabilitation management activities. In addition, the low educational level limits the ability of lung cancer patients to acquire, learn, and practice the knowledge and skills of postoperative rehabilitation exercise, resulting in a low level in the six dimensions of postoperative rehabilitation management self-efficacy. Therefore, for patients belonging to the low level of self-efficacy group, rehabilitation management guidance should cover six aspects of

Table 2
Fit indices for latent profile analyses ($N = 231$).

Model	AIC	BIC	aBIC	Entropy	VLMR-LRT	LMR-LRT	BLRT	Smallest class (%)
1	7113.501	7154.81	7116.777					
2	6537.583	6602.989	6542.77	0.937	0.0077	0.0085	0.000	19.5
3	6077.127	6166.629	6084.224	0.967	0.011	0.0121	0.000	17.7
4	5894.92	6008.52	5903.929	0.976	0.0037	0.0042	0.000	2.2

AIC, Akaike information criterion; BIC, Bayesian information criterion; aBIC, samp-corrected Bayesian information criterion; VLMR-LRT, Vuong-Lo-Mendell-Rubin likelihood ratio test; LMR-LRT, Lo-Mendell-Rubin likelihood ratio; BLRT, Bootstrapped likelihood ratio test.

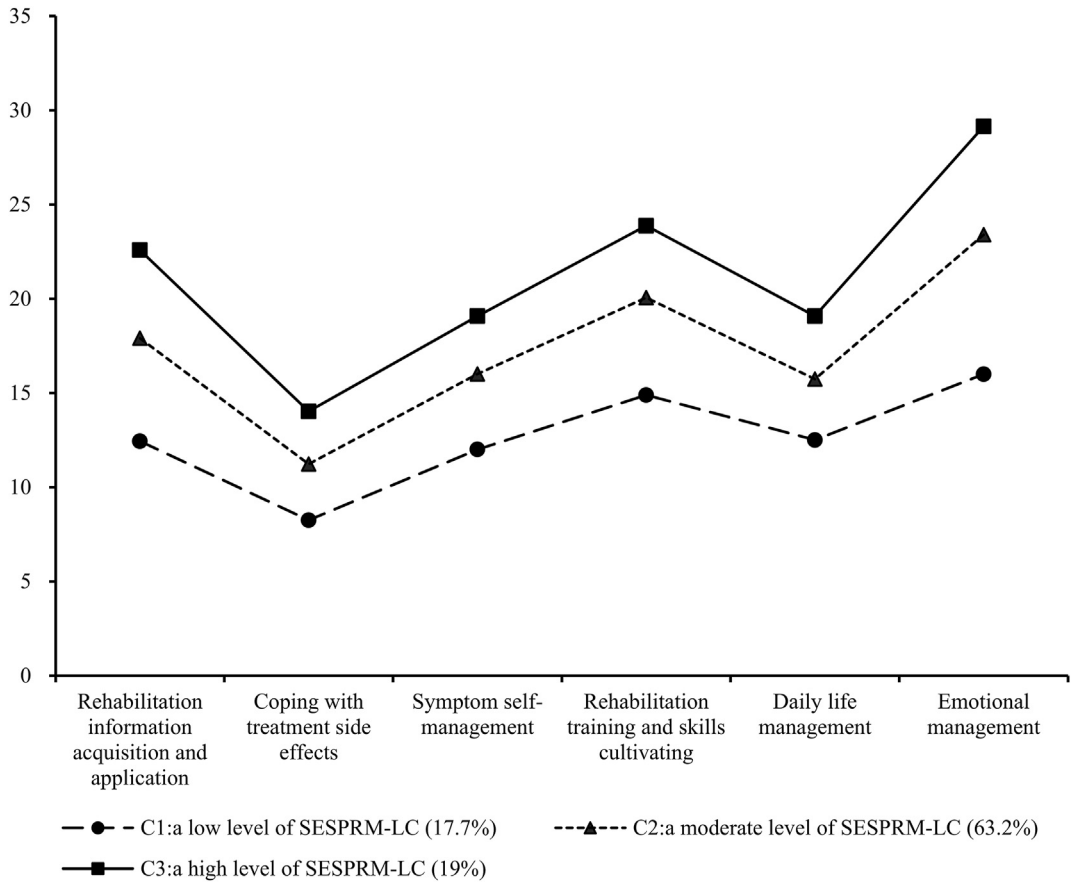

Fig. 1. The latent profile of SESPRM-LC of lung cancer patients. SESPRM-LC, Self-Efficacy Scale for Postoperative Rehabilitation Management of Lung Cancer.

Table 3
The multinomial logistics regression for latent profiles ($N = 231$).

Variables	C2 vs C1					C3 vs C1				
	β	SE	Wald	*P*	OR (95% CI)	β	SE	Wald	*P*	OR (95% CI)
Educational background										
College and above	−0.870	0.844	1.062	0.303	0.419 (0.080–2.192)	−1.203	1.231	0.956	0.328	0.300 (0.027–3.350)
Senior high school	0.620	0.647	0.918	0.338	1.858 (0.523–6.602)	−0.848	1.145	0.549	0.459	0.428 (0.045–4.037)
Junior high school	1.640	0.686	5.714	0.017*	5.154 (1.343–19.773)	1.028	1.068	0.926	0.336	2.796 (0.344–22.695)
Primary school and below	Ref.									
Monthly income per capita in family (yuan)										
> 4000	−0.281	0.919	0.094	0.760	0.755 (0.125–4.569)	−0.927	1.255	0.548	0.460	0.396 (0.034–4.626)
3001-4000	0.548	0.831	0.435	0.509	1.730 (0.339–8.824)	−0.043	1.206	0.001	0.971	0.958 (0.090–10.188)
2001-3000	0.229	0.796	0.083	0.774	1.257 (0.264–5.977)	−1.812	1.255	2.087	0.149	0.163 (0.014–1.909)
≤ 2000	Ref.									
Social support	0.089	0.028	10.262	0.001**	1.093 (1.035–1.155)	0.113	0.040	8.091	0.004**	1.119 (1.036–1.210)
Resilience	0.098	0.020	23.137	< 0.001***	1.103 (1.060–1.147)	0.229	0.033	47.959	< 0.001***	1.257 (1.178–1.341)

The reference category is: C1; *$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.

postoperative rehabilitation management: “rehabilitation information acquisition and application”, “coping with treatment side effects”, “symptom self-management”, “rehabilitation training and skills cultivating”, “daily life management” and “emotional management”, to provide patients with comprehensive disease rehabilitation information; Second, the rehabilitation instructions should be provided in a way that is easy to understand, such as oral explanation, picture display or animation video.[38] At the same time, we should also pay attention to the feedback of patients after learning and the actual difficulties encountered in practice, so as to provide good social support. In addition, certain positive psychological interventions and counseling for such patients are also necessary.

The vast majority of patients (63.2%) were in the medium level group, which was characterized by the overall medium level in all dimensions, and the difference between all dimensions was greater than that in the low level group. Another 19% of patients were in the high level of self-efficacy group, which was characterized by the overall high level of all dimensions, and the most obvious fluctuation among all dimensions. Both groups scored highest in “Rehabilitation information acquisition and application” and “Emotional management”, and scored lowest in “Coping with treatment side effects” and “Daily life management”. The results of disordered multi-classification analysis suggested that, compared with the low level group, people with higher education level (junior high school) were more likely to be classified as the middle

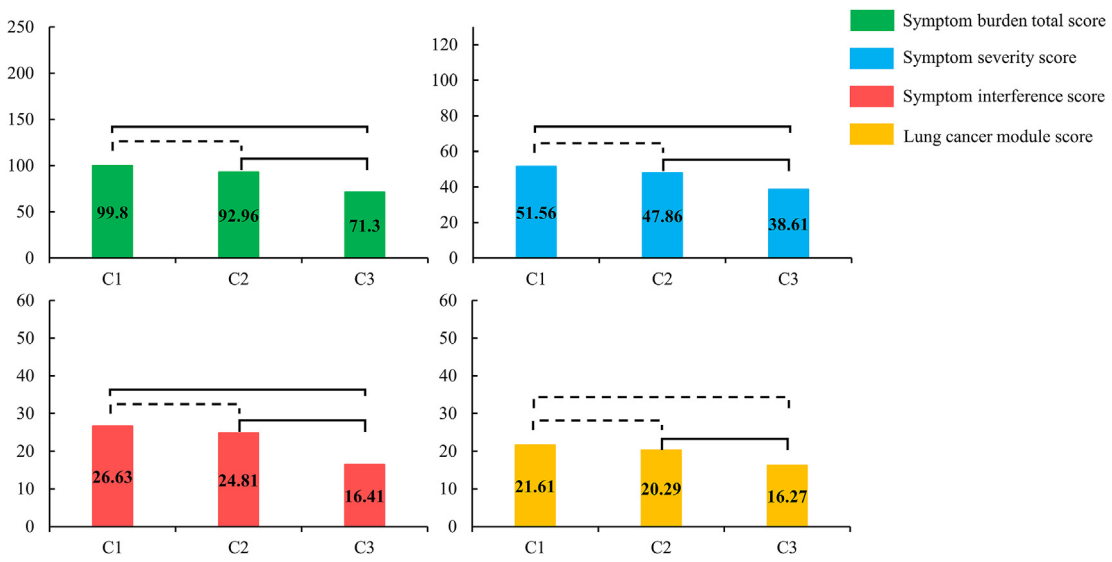

Fig. 2. Comparison of symptoms burden among latent profiles. C1: a low level of SESPRM-LC; C2: a moderate level of SESPRM-LC; C3: a high level of SESPRM-LC Solid line: $P < 0.05$, dotted line: $P > 0.05$.

level group, and those with higher social support levels and individual mental resilience levels were more likely to be classified as the middle or high level group. With the development of network technology and information platforms, access to information related to lung cancer postoperative rehabilitation has become more diversified and portable,[39–41] which enables patients with a certain degree of education and strong social support to get more information resources, and good resilience can help them better cope with emotional problems. However, due to the lack of medical knowledge, patients felt hard coping with side effects, and a series of postoperative problems that never experienced before, such as mobility inconvenience caused by thoracic drainage tube, pain, postoperative urinary retention, abdominal distension, etc.,[42,43] which could lead to difficulty in the adjustment and management of daily life. Therefore, for patients with moderate and high levels of self-efficacy, rehabilitation management guidance should focus on coping with postoperative side effects and life adaptation. The former mainly includes actively coping with postoperative complications of lung cancer, side effects of some treatments, and how to deal with common discomforts such as pain or fatigue. Some coping measures are not for patients to implement, but they could know how to solve them, so as to increase their confidence in overcoming the disease. In terms of life adaptation, guidance can be given from the aspects of regular diet and rest, appropriate physical exercise, and participation in socially beneficial activities under the premise of good recovery.[3]

Patients in different subgroups of rehabilitation management self-efficacy also showed significant differences in symptom burden. There are no clear clinically meaningful severity cut-off points for the total scores of the MDASI subscales. But the higher the score, the higher the degree of symptom distress. Symptom severity, symptom interference, and lung cancer module scores in the high level group were all low in our study. This suggests that the higher the level of self-efficacy of postoperative rehabilitation management in lung cancer patients, the better symptom management, resulting in less symptom burden and pain, which was consistent with the research results of general self-efficacy.[44] The presence of self-efficacy predicted higher physical and emotional well-being and may increase confidence to manage symptoms. When patients have low levels of self-efficacy, they may be unable to participate in symptom–management activities.[45] Therefore, the cultivation of self-efficacy cannot be ignored during the postoperative symptom management of lung cancer patients. In the lung cancer module, the symptoms of the high level group were milder than those of the medium level group, but the difference between the low level group and the high level group was not obvious. The reason may be that the symptoms of the lung cancer module are cough, hemoptysis, nausea, etc., mainly targeted at patients with middle and advanced lung cancer and chemotherapy. However, most of the lung cancer patients surveyed had coughs and pain after undergoing surgery, and few of them received chemotherapy. Patients undergoing surgery may have different symptom characteristics from those undergoing chemotherapy, so the lung cancer module should be adjusted according to the different stages of the patient's disease.

Implications for nursing practice and research

The research showed that postoperative rehabilitation management self-efficacy among lung cancer patients was divided into three profiles: “low level”, “medium level” and “high level”. The low level group showed low scores in all dimensions, which should be paid special attention to, and health education should be carried out in all six aspects of SESPRM-LC. In the medium and high level groups, the highest scores were in “Rehabilitation information acquisition and application” and “Emotional management”, while the lowest scores were in “Coping with treatment side effects” and “Daily life management”. Rehabilitation management guidance should focus on coping with postoperative side effects and life adaptation. This study identified factors associated with the SESPRM-LC subgroup of lung cancer patients, including educational background, social support, and psychological resilience. By understanding the SESPRM-LC profile characteristics and related factors among lung cancer patients, health care professionals can better tailor personalized support and intervention measures to help them improve self-efficacy and better manage rehabilitation activities. In addition, we found that the higher the level of self-efficacy of postoperative rehabilitation management in lung cancer patients, the lower the symptom burden. This suggests that the influence of self-efficacy should not be ignored when coping with patients’ symptom burden. The above-related factors and some positive psychological intervention methods can be used to guide patients to produce positive emotions, build up the confidence to overcome the disease, improve their self-efficacy level, and reduce the symptom burden.

Limitations

This study had several limitations. First, questionnaires were collected only in the thoracic surgery departments of two tertiary hospitals in Changsha City. In the future, the sample size can be expanded and the results of this study need to be validated in a wider

population. Second, lung cancer patients in our study all received thoracoscopic segmentectomy or lobectomy. But we didn't collect information on the specific surgical method of each patient, which may have impacts on results. However, it has been suggested that thoracoscopic segmentectomy and lobectomy may have similar early postoperative symptom burden and functional impairment in patients with lung cancer.[46] But compared with patients undergoing thoracotomy, lung cancer patients undergoing thoracoscopic surgery have significantly less postoperative symptom burden (especially pain), fewer complications, and less interference with daily function.[47–49] Since we didn't include patients undergoing thoracotomy, the results of this study should be further tested in those patients. Third, all psychological variables were assessed using self-report tools, which may not fully reflect actual mental functioning and behavior. Fourth, we only collected one symptom burden data within 24 hours after the patient's surgery. Data at multiple time nodes may better reflect the postoperative symptom changes of patients.

Conclusions

In our study, the latent profile analysis method was used to identify three latent profiles of postoperative rehabilitation management self-efficacy of lung cancer patients, which were low level self-efficacy group, medium level self-efficacy group, and high level self-efficacy group. There was obvious heterogeneity among these potential categories. Educational background, resilience, and social support were the influencing factors of different classes. Lung cancer patients in different self-efficacy subgroups reported differences in symptom severity and symptom interference, as well as differences in lung cancer module. The higher the postoperative rehabilitation management self-efficacy level, the less symptom burden. In the future, precise interventions could be devised and executed according to the features of each profile of postoperative rehabilitation management self-efficacy in lung cancer patients to maximize intervention efficacy.

CRediT authorship contribution statement

Yujie Chen: Conceptualization, Methodology, Data curation, Formal analysis, Writing – original draft. **Xuting Li**: Conceptualization, Formal analysis, Writing – original draft. **Tian Chen**: Data collection, Formal analysis. **Tian Liu**: Data collection, Formal analysis. **Qi Lei**: Data collection, Formal analysis. **Jianfeng Qiao**: Data curation, Formal analysis. **Man Ye**: Writing – review & editing, Supervision. **Lihua Huang**: Conceptualization, Writing – review & and editing and Supervision. The authors have read and approved the final manuscript. All authors had full access to all the data in the study, and the corresponding author had final responsibility for the decision to submit for publication. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

Ethics statement

The study was conducted in accordance with the principles stated in the Declaration of Helsinki and was approved by the Ethics Committee of Xiangya Nursing school of Central South University (IRB No. E2022166). Informed consent was obtained from all study participants.

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Data availability statement

The data that support the findings of this study are available from the corresponding author, Lihua Huang, upon reasonable request.

Declaration of generative AI and AI-assisted technologies in the writing process

No AI tools/services were used during the preparation of this work.

Declaration of competing interest

The authors declare no conflict of interest.

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