Original Article

Latent profile analysis of resilience and its influencing factors in patients with lung cancer undergoing chemotherapy

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ABSTRACT

Objective: This study aims to analyze the classification characteristics of resilience in patients with lung cancer undergoing chemotherapy using latent profile analysis and explore the influencing factors and their relationship with medical coping strategies.

Methods: A questionnaire survey was conducted on 265 patients with lung cancer undergoing chemotherapy at a tertiary Grade-A hospital in Guangzhou from November 2023 to March 2024, using the General Information Questionnaire, Resilience Scale Specific to Cancer (RS-SC), Lung Cancer Chemotherapy Symptom Cluster Assessment Questionnaire, and Medical Coping Modes Questionnaire (MCMQ). Latent profile analysis was performed using Mplus 8.3 to identify resilience classifications, estimate influencing factors, and evaluate their impact on medical coping strategy selection.

Results: A total of 259 valid questionnaires were collected, with an effective response rate of 97.74%. Patients were categorized into three groups based on resilience levels: low-resilience group (20.46%), mid-resilience group (40.52%), and high-resilience group (38.97%). Multinomial logistic regression analysis revealed that education level, family per capita monthly income, and gastrointestinal and emotional symptom cluster scores were significant influencing factors for different resilience classifications ($P < 0.05$). Statistically significant differences were found in the scores for the confrontation and resignation dimensions of medical coping strategies across different latent profiles ($P < 0.01$).

Conclusions: Resilience in patients with lung cancer undergoing chemotherapy is heterogeneous, presenting in three distinct categories. Medical staff should provide tailored interventions based on the characteristics and influencing factors of each patient profile to enhance resilience and coping strategies.

Introduction

Lung cancer is a common type of malignant tumors. The Global Cancer Statistics indicate that lung cancer ranks second in terms of incidence rate of malignant tumors in the world, accounting for 11.4%.[1] In China, lung cancer is the leading cause of new cancer cases and cancer deaths, accounting for 17.9% and 23.8% respectively.[2] Chemotherapy (CTX) is an important approach of lung cancer treatment. While patients benefit from the therapeutic effect, they are also negatively affected by long treatment time and many adverse reactions.[3,4] During chemotherapy, lung cancer patients will not only have to bear heavy economic pressure, but also be seriously disturbed in their daily life and work due to periodic treatment, so as their social function. Therefore, patients often have different degrees of emotional and psychological problems.

Resilience refers to the positive ability of individuals to protect or recover themselves confronting with adversity, trauma, disease and other adverse conditions.[5,6] It is a key factor for individuals to effectively cope with difficulties and stress. The higher the level of resilience is, the more helpful it will be to regulate negative emotions, discover the positive significance behind traumatic events, and promote individuals to recover from negative stress events.[7] The level of resilience can negatively predict the adverse adaptation outcomes of patients, and can also be regulated by external conditions.[8,9] So it is regarded as a breakthrough point to reflect and intervene the psychological state of patients undergoing lung cancer chemotherapy. At present, researches related to resilience of patients undergoing lung cancer chemotherapy are mostly variable-centered, which cannot effectively reflect the heterogeneity between individuals.

Latent profile analysis (LPA) is a person-centered analysis approach that classify participants into different groups based on different characteristics and symptom response patterns to identify their heterogeneity.[10] Moreover, this method can keenly capture the inequality of subgroups through distinguishing nature and degree of explicit variables, which is conducive for further analysis of the unique characteristics of various subgroups.[11]

Hence, this study aims to (1) identify subgroups of resilience in patients with lung cancer chemotherapy by LPA and (2) explore whether the subgroups differ on demographic data, symptom cluster and medical coping style, so as to provide a reference for customizing personalized and precise nursing intervention.

Methods

Study design and participants

Using convenience sampling, this cross-sectional survey study of lung cancer patients undergoing chemotherapy in the Oncology Department of a tertiary hospital was conducted from November 2023 to March 2024 in Guangzhou, China.

The inclusion criteria were as follows: (1) older than 18 years, (2) were diagnosed with lung cancer by histopathological examination and currently undergoing chemotherapy period, (3) had ability to understand and answer questions correctly, (4) voluntary participation in this research and signed informed consent. The exclusion criteria were as follows: (1) a history of psychiatric or mental disease, (2) critical patients, (3) participated in other studies over the past three months, (4) experienced major stressful events over the past three months, (5) pregnant or lactating women, (6) individuals who didn't know their disease condition and couldn't cooperate with the investigation.

Referring to Kendall's work guidelines,[12] the sample size should be 5 to 10 times the number of variables. There were 27 variables in this study. Considering the 20% invalid response rate, the required sample size was 169–338 cases.

Measurements

Demographic and disease characterization questionnaire

The self-designed questionnaire included general information of patient with lung cancer chemotherapy. The demographic part included total 8 items, such as age, gender, educational, resident category, marital status, medical insurance, monthly income and smoking. The disease part included total 8 items, such as time since diagnosis, Chinese medicine syndrome,[13,14] tumor types, distant metastasis, chemotherapy cycles, operation, adjuvant treatment and underlying diseases.

Resilience Scale Specific to Cancer (RS-SC)

This scale was developed by Ye,[15] used to evaluate the psychological resilience of cancer patients. It includes 25 items, which are divided into five dimensions: nonspecific resilience components (items 1–6), disease benefits (items 7–11), support and response (items 12–16), hope for the future (items 17–21), and meaning of existence (items 22–25). Each item is rated on a five-point Likert scale, ranging from 1 (never) to 5 (always). The higher the score, the better the resilience. The Medical staff should pay necessary attention to patients who have a score below 70.5 and take proper intervene. The Cronbach's α coefficient for this scale was 0.85 in the original study and 0.953 in this study.

Symptom clusters assessment questionnaire for lung cancer patients undergoing chemotherapy

This scale was developed by Ma,[16] used to evaluate the severity of symptom clusters for lung cancer patients undergoing chemotherapy. It includes 30 items, which are divided into three dimensions: gastrointestinal (items 1–14), physical (items 15–23) and emotional (items 24–30) symptom clusters. Each item is rated on a five-point Likert scale, ranging from 1 (never) to 5 (always). The higher the score, the more severe the symptoms. The Cronbach's α coefficient for this scale was 0.909 in the original study and 0.863 in this study.

Medical Coping Modes Questionnaire (MCMQ)

This scale was developed by Feifel[17] and translated into Chinese by Shen,[18] used to evaluate the coping strategy selection of patients in medical situation. It includes 20 items, which are divided into three dimensions: confrontation (8 items), avoidance (7 items), and acceptance-resignation (5 items). Each item is rated on a four-point Likert scale, ranging from 1 (never) to 4 (very often), and items 1, 4, 9, 10, 12, 13, 18, 19 require a reverse rating. The score for each coping modes is calculated separately, and the dimension with highest score indicates the most commonly used medical coping mode among patients. The Cronbach's α coefficient for three dimensions of this scale was 0.69, 0.60, 0.76 in the original study and 0.695, 0.673, 0.717 in this study.

Data collection

All researchers received standardized training in advance to ensure that they used unified guidance to introduce the purpose, methods and precautions of this study. All subjects participated in this study should express full understanding and complete voluntariness as precondition. After obtaining their consent, researchers distributed and recovered the paper version of the questionnaire to subjects during hospitalization chemotherapy. All questionnaires were finished independently. For those who had difficulties to complete questionnaire by themselves, the researchers assisted in reading the questions and checking the answer without making any implications. Researchers should complete missing items in time after investigation. Finally, 265 questionnaires were collected, of which 6 were excluded due to incomplete information, and obtained 259 valid questionnaires, with an effective recovery rate of 97.74%.

Data analysis

SPSS 26.0 and Mplus 8.3 software were used for statistical analysis. Continuous variables were reported as mean and standard deviation (Mean $\pm$ SD), and categorical variables were presented as frequencies and percentages (*n*, %).

Mplus 8.3 software was used to explore latent profile of resilience based on RS-SC 25 items scores among patients with lung cancer chemotherapy. Estimating models with sequentially increasing number of profiles from 1 to 5, and the fitting evaluation indicators included the following: (1) Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC) and Adjusted BIC (aBIC) —the smaller the three indicators, the better the model fit; (2) Entropy—the value closer to 1 indicated a higher classification accuracy; (3) Lo-Mendell-Rubin (LMR) corrected likelihood ratio and the bootstrap-based likelihood ratio test (BLRT) were used to assess the model fit difference between k profiles and k-1 profiles, with $P < 0.05$, indicating that the k profile had a better fitting effect.[19,20] Finally, synthetically considering each index and combining with the clinical significance of classification to determine the optimal number of model profiles.

To explore the resilience profiles characteristics, demographic informal, disease informal and symptom clusters were used as independent variables, resilience profiles were used as dependent variable for statistical analysis. Continuous variables were compared by *t* test or variance analysis, and categorical variables were compared by χ^2 test or rank sum test. Significant variables were included in the multiple logistic regression analysis.

To explore the relationship between resilience profiles and medical coping modes, each profile was used as an independent variable, and each dimension score of MCMQ were used as dependent variables for one-way analysis of variance (ANOVA). Least Significant Difference (LSD) was used for multiple comparisons. $P < 0.05$ was considered statistically significant.

Harman single-factor test was used to test the common method bias (CMB) of this questionnaire, for data were collected by self-report. Exploratory factor analysis (EFA) is the main method of Harman single-

factor test, which suggests that there is a method factor that explains the common variation across all items of a study with different traits.[21] The more variation explained by method factors, the more serious the bias. In this study, the first common factor explained the variance rate of 19.978%, which was less than the upper limit value of 40%. Thus, there is no serious CMB in the data, and further analysis can be carried out.

Ethical considerations

This study was reviewed and approved by the Ethics Committee of the first affiliated hospital of Guangzhou University of Traditional Chinese Medicine (IRB No. JY2023-193). All participants provided written informed consent.

Results

Demographic and disease characteristics

In total, 259 patients with lung cancer chemotherapy were included in our study. The mean age of included patients was 61.34 ± 8.96 years, ranging from 29 to 82 years. Most patients in our study were male (70.66%), married (95.75%), urban (40.54%), and had a primary school (26.64%) or

junior high school education (26.64%). The mean time since diagnosis was 17.22 ± 23.37 months, ranging from 1 to 161 months. Most patients were adenocarcinoma (50.97%), syndrome of lung-spleen qi deficiency (58.30%), with immunotherapy (46.72%), without surgery (81.85%), and had distant metastasis (76.83%). The characteristics of patients are presented in Table 1.

Latent profile analysis results

Based on 25 items of RS-SC, five models were established by LPA,[22] and the results of their LPA-fit indices are shown in Table 2. The values of AIC, BIC and aBIC decreased with the increase of the number of profiles. When the three latent profiles were retained, the LMRT and BLRT values were statistically significant ($P < 0.05$), and the Entropy value was ideal (> 0.8). Finally, we chose model 3 as the best categorization according to all of the fit indices.

In this model, 20.46% (53/259) of patients were classified into category 1 (named "low-resilience" group), and 40.15% (104/259) of patients were classified into category 2 (named "mid-resilience" group), and the remaining 39.77% (103/259) of the patients were classified into category 3 (named "high-resilience" group). According to the average value of the explicit index, the latent profile is drawn, as shown in Fig. 1.

Table 1
Demographic and disease characteristics of patients with lung cancer chemotherapy ($N = 259$).

Variables	n (%) or Mean ± SD (range)	Variables	n (%) or Mean ± SD (range)
Age (years)	61.34 ± 8.96 (29–82)	Time since diagnosis (months)	17.22 ± 23.37 (1–161)
Sex		Traditional Chinese medicine syndrome[b]	
Male	183 (70.66)	Lung-spleen qi deficiency	151 (58.30)
Female	76 (29.34)	Phlegm-heat obstructing lung	61 (23.55)
Resident category		Qi stagnation and blood stasis	19 (7.34)
Urban	105 (40.54)	Qi and yin deficiency	19 (7.34)
Town	59 (22.78)	Lung yin deficiency	9 (3.47)
Rural	95 (36.68)	Tumor type	
Education		Adenocarcinoma	132 (50.97)
Illiteracy	20 (7.72)	Squamous cell carcinoma	71 (27.41)
Primary school	69 (26.64)	Large cell carcinoma	5 (1.93)
Junior high	69 (26.64)	Small cell carcinoma	43 (16.60)
Senior high	63 (24.32)	Unknown	4 (1.54)
College degree or above	38 (14.67)	Other	4 (1.54)
Marital status		Distant metastasis	
Unmarried	3 (1.16)	No	54 (20.85)
Married	248 (95.75)	Yes	199 (76.83)
Widowed	8 (3.09)	Unknown	6 (2.32)
Medical insurance		Chemotherapy cycles	
Rural	95 (36.68)	≤ 3	99 (38.22)
Employee	105 (40.54)	4 ~ 6	53 (20.46)
Residents	59 (22.78)	> 6	107 (41.31)
Monthly income (person, Yuan)		Operation	
< 1000	56 (21.62)	No	212 (81.85)
1000 ~ 2999	73 (28.19)	Yes	47 (18.15)
3000 ~ 4999	81 (31.27)	Adjuvant treatment	
≥ 5000	49 (18.92)	No	77 (29.73)
Smoking[a]		Radiotherapy	1 (0.39)
Never	91 (35.14)	Immunotherapy	121 (46.72)
Yes	13 (5.02)	Targeted therapy	39 (15.06)
Giving up	155 (59.85)	Immune binding targeting	21 (8.11)
Number of underlying diseases		Symptom clusters score	
0	90 (34.75)	Total score	42.16 ± 7.12 (30–71)
1 ~ 2	109 (42.08)	Gastrointestinal syndrome	20.80 ± 4.99 (14–39)
3 ~ 4	45 (17.37)	Physical syndrome group	11.76 ± 2.57 (9–20)
≥ 5	15 (5.79)	Emotional symptoms	9.60 ± 2.25 (7–26)

[a] Smoking, "Yes" means continuous or cumulative smoking for more than six months, with at least one cigarette per day, and currently still smoking; otherwise, it is defined as "Never" smoking; "Giving up" means quit smoking for more than six months.
[b] Traditional Chinese medicine syndrome, "Lung-spleen qi deficiency" main symptoms are fatigue, cough weakness, short breath; "Phlegm-heat obstructing lung" main symptoms are yellow thick sputum hard coughed up, bitter taste in the mouth; "Qi stagnation and blood stasis" main symptoms are localized pain in chest and hypochondrium, blood in phlegm, purple lips; "Lung yin deficiency" main symptoms are dry cough, less phlegm, mouth and throat dryness, five feverish centres; "Qi and yin deficiency" main symptoms are both "Lung-spleen qi deficiency" and "Lung yin deficiency".

Table 2
Model fit indices for latent profile of patients with lung cancer chemotherapy (N = 259).

Models	AIC	BIC	SSA-BIC	LMRT	BLRT	Entropy	Categorical probability (%)
1	17407.205	17585.047	17426.529	–	–	–	–
2	15114.776	15385.095	15144.148	0.0006	0.0000	0.960	0.429/0.571
3	14474.849	14837.646	14514.269	0.0244	0.0000	0.960	0.205/0.405/0.390
4	14209.311	14664.585	14258.779	0.6516	0.0000	0.951	0.052/0.212/0.367/0.371
5	14057.294	14605.045	14116.810	0.2978	0.0000	0.932	0.046/0.166/0.313/0.278/0.197

AIC, Akaike Information Criterion; BIC, Bayesian Information Criterion; aBIC, adjusted BIC; LMR, Lo-Mendell-Rubin; BLRT, the Bootstrap Likelihood Ratio Test.
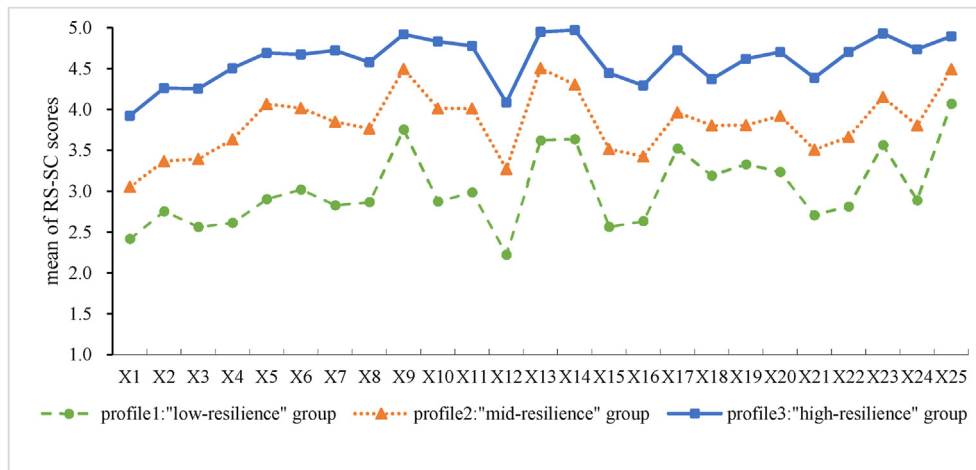

Fig. 1. Latent profiles based on the 25 items of RS-SC in patient with lung cancer chemotherapy. RS-SC, Resilience Scale Specific to Cancer.

Differences in demographic factors, disease factors and symptom clusters in the three profiles

Single factor analysis showed that there were statistically significant in education, monthly income and total score of symptom clusters (P < 0.05). Further comparing the different dimensions of symptom clusters, it was found that gastrointestinal and emotional dimensions had statistically significance (P < 0.05), while physical dimension didn't show this, as shown in Table 3.

Setting "low-resilience" group as the benchmark comparison category, the statistically significant variables in the single factor analysis as independent variables, and the profiles as dependent variable, the multiple logistic regression analysis was performed. The results showed that education and emotional symptom clusters were the influence factors of the latent profile classification of "low-resilience" group and "mid-resilience" group. Education, monthly income, gastrointestinal and emotional symptom clusters were the influence factors of the latent profile classification of "low-resilience" group and "high-resilience" group, as shown in Table 4.

Comparison of MCMQ scores in the three profiles

The results showed that there were statistically significant differences in the scores of medical coping models in the confrontation and resignation dimensions of patients with lung cancer chemotherapy in different profiles (P < 0.01). Further multiple comparisons showed that the scores of "low-resilience", "mid-resilience" and "high-resilience" group increased in the confrontation dimension and decreased in the resignation dimension successively, as shown in Table 5.

Discussion

Identification of three resilience profiles

This study aimed to classify patients with lung cancer chemotherapy based on their RS-SC scores and to explore the factors associated with their class membership. We used the LPA to identify three latent profiles

of resilience. The "low-resilience" group had the lowest proportion, while the proportion of the "mid-resilience" and "high-resilience" group was close, accounting for 79.54% (206/259) in total. It is worse than patients with all cancer types in Wang' research,[23] which found that the proportion of low, medium and high resilience groups was 9%, 59% and 32% respectively. The "high-resilience" group scored higher and more stable in the disease benefit dimension (items 7–11) and the existence meaning dimension (items 22–25) than other categories, reflecting that such patients have a higher level of life pursuit and thinking, and can draw positive inspiration from negative events. While actively fighting cancer, they can further realize the valua of life and cherish the present. The score of item 13 (my family will support my decision) in "mid-resilience" group was the highest, and the score trend of the future hope dimension (items 17–21) was stable, reflecting that these patients regarded family support as the core power to fight against cancer, and had positive expectations for the treatment and rehabilitation of the disease. The "low-resilience" group got the lowest score in the non-specific resilience dimension (items 1–6), reflecting that these patients were poor in positive adjustment ability of self-protection or recovery when face to adverse conditions. This result shows that most patients with lung cancer chemotherapy have good psychological quality and self-cognition. Although the proportion of patients with low resilience is small, it should be paid enough attention.

Influence factors of three resilience profiles

This study shows that, education level, personal monthly income and symptom clusters influence the profiles of resilience, which is in line with previous studies.[24–26]

Patients in the "high-resilience" group generally had a high economic and cultural level, owned strong ability to understand and respond to the disease correctly, which allowed them to mobilize psychological resources and maintain an optimistic attitude well. Moreover, their physical discomfort was usually mild relatively, so they had enough energy to actively participate in the diagnosis and treatment activities. The "mid-

Table 3
Differences in demographic factors, disease factors and symptom clusters of the three resilience profiles.

Variables	The "low-resilience" group (C1, n = 53)	The "mid-resilience" group (C2, n = 104)	The "high-resilience" group (C3, n = 102)	P value
Age (year, Mean ± SD)	60.81 ± 9.08	61.05 ± 8.93	61.34 ± 8.98	0.703
Sex				
Male	34	77	72	0.438
Female	19	27	30	
Resident category				
Urban	18	45	42	0.157
Town	8	22	29	
Rural	27	37	31	
Education				
Illiteracy	8	7	5	0.039*
Primary school	18	27	24	
Junior high	12	30	27	
Senior high	10	25	28	
College degree or above	5	15	18	
Marital status				
Unmarried	0	1	2	0.258
Married	50	102	96	
Widowed	3	1	4	
Medical insurance				
New rural cooperative medical insurance	23	40	32	0.923
Health insurance for employees	16	37	52	
Health care for residents	14	27	18	
Monthly income (person, Yuan)				
< 1000	19	21	16	0.004*
1000～2999	14	36	23	
3000～4999	13	30	38	
≥ 5000	7	17	25	
Smoking				
Never	22	35	34	0.133
Yes	7	5	1	
Giving up	24	64	67	
Traditional Chinese medicine syndrome				
Syndrome of lung-spleen qi deficiency	29	61	61	0.891
Syndrome of phlegm-heat obstructing lung	14	27	20	
Syndrome of Qi stagnation and blood stasis	5	6	8	
Syndrome of deficiency of both qi and yin	4	7	8	
Syndrome of deficiency of lung yin	1	3	5	
Tumor type				
Adenocarcinoma	25	52	55	0.778
Squamous cell carcinoma	15	30	26	
Large cell carcinoma	2	1	2	
Small cell carcinoma	11	17	15	
Unknown	0	2	2	
Other	0	2	2	
Distant transfer				
No	9	25	20	0.425
Yes	43	78	78	
Unknown	1	1	4	
Time since diagnosis (months)	12.13 ± 14.18	19.36 ± 26.82	17.70 ± 23.24	0.181
Chemotherapy cycles				
≤ 3	24	33	42	0.307
4～6	6	24	23	
> 6	23	47	37	
Operation				
No	47	86	79	0.220
Yes	6	18	23	
Treatment regimen				
No	13	34	30	0.561
Radiotherapy	0	0	1	
Immunotherapy	27	47	47	
Targeted therapy	6	18	15	
Immune-binding targeted therapy	7	5	9	
Number of underlying diseases				
0	19	42	29	0.456
1～2	19	39	51	
3～4	13	17	15	
≥ 5	2	6	7	
Symptom clusters score (Mean ± SD)				
Total score	45.89 ± 8.56	42.70 ± 6.48	39.68 ± 5.93	0.000**
Gastrointestinal syndrome	22.87 ± 6.27	21.16 ± 4.55	19.35 ± 4.20	0.000**
Physical syndrome group	12.21 ± 2.51	11.92 ± 2.60	11.36 ± 2.53	0.107
Emotional symptoms	10.81 ± 2.97	9.62 ± 2.05	8.96 ± 1.72	0.000**

*P < 0.05, **P < 0.01. SD, Standard deviation.

Table 4

Logistic regression analysis of latent profiles of resilience in patients with lung cancer chemotherapy ($N = 259$).

Variable	Profile 1 vs Profile 2			Profile 1 vs Profile 3		
	OR	95% CI	P value	OR	95% CI	P value
Education (College degree or above as a reference)						
Illiteracy	0.136	0.025 ~ 0.731	0.020	0.066	0.011 ~ 0.420	0.004
Primary school	0.133	0.032 ~ 0.559	0.006	0.170	0.039 ~ 0.736	0.018
Junior high	0.575	0.127 ~ 2.609	0.473	0.512	0.108 ~ 2.427	0.399
Senior high	0.263	0.063 ~ 1.100	0.067	0.210	0.047 ~ 0.934	0.040
Monthly income (person, yuan, ≥ 5000 as a reference)						
< 1000	0.374	0.116 ~ 1.206	0.100	0.214	0.064 ~ 0.713	0.012
1000 ~ 2999	1.064	0.340 ~ 3.336	0.915	0.490	0.152 ~ 1.581	0.233
3000 ~ 4999	1.037	0.320 ~ 3.362	0.952	0.945	0.294 ~ 3.044	0.925
Symptom clusters score						
Gastrointestinal	0.961	0.896 ~ 1.032	0.275	0.900	0.832 ~ 0.974	0.009
Emotional	0.818	0.697 ~ 0.959	0.013	0.709	0.589 ~ 0.853	0.000

OR, Odds ratio; CI, confidence interval.

Table 5

Comparison of MCMQ scores in different categories of resilience in patients with lung cancer chemotherapy (Mean $\pm$ SD).

Category	Name	Number	Proportion (%)	Confrontation	Avoidance	Resignation
Profile 1	The "low-resilience" group	53	20.46	15.79 ± 2.98	14.68 ± 2.53	11.34 ± 2.34
Profile 2	The "mid-resilience" group	104	40.52	17.69 ± 3.05	14.16 ± 2.29	9.78 ± 2.08
Profile 3	The "high-resilience" group	102	38.97	18.52 ± 2.57	14.48 ± 2.57	7.84 ± 2.02
P-value				0.000	0.416	0.000
Multiple comparisons				C3 > C2 > C1*		C1 > C2 > C3**

*$P < 0.05$, **$P < 0.01$. The family-wise error rate of each outcome is controlled at alpha = 0.05. MCMQ, Medical Coping Modes Questionnaire.

resilience" group patients had increased severity of symptoms, and their economic conditions and ideological awareness were also lower than those in high group, nevertheless, their inner expectations for future life were always maintained. Specifically, external support coming from family, friends and medical staff will enhance patients' vision of rehabilitation and provide powerful psychological motivation to accept treatment. The "low-resilience" group patients mostly suffered serious physical symptoms, and the continuous physical discomfort caused great psychological distress. In addition, low education level hindered the establishment of rational cognition, and low income limited the choice of treatment options. Therefore, patients fell into a physically and mentally exhausted situation, and performed regulation failure and maladjustment.

Education level is related to individual cognition and behavior closely. Liu et al.[27] confirmed that the higher the education level of patients, the more likely they hold pleasant health literacy and disease management ability. On the contrary, patients who only receive primary school or less education usually lack scientific understanding of cancer, and it is difficult to master effective disease coping strategies or skills through independent learning and thinking.[28] Some patients even can't have basic daily communication with medical staff due to language barriers. Thus, in clinical practice, nurses are suggested to pay more attention to patients with low education level, and easy-to-understand diversified health education methods should be adopted to enhance their knowledge and skills of health management, which in favour of resilience enhancement.

Personal monthly income directly reflects the patient's economic status. Studies have shown that individuals from families with higher monthly income tend to have more resources and opportunities to cope with challenges and adversities in their lives, having more possibilities to develop better psychological resilience. Patients with lung cancer chemotherapy not only face huge treatment costs, but also suffer from long-term repeated return to the hospital for treatment, which could bring their normal work to a standstill and interrupt their source of income. As a result, those patients are prone to fall into a vicious cycle of low income, unemployment and poor financial reserves.[29] Therefore, they may grow a strong sense of self-blame and guilt, feeling difficult to adapt to plight and powerlessness. Those with a poor economic base even

choose to give up treatment.[30] Although medical stuff cannot change the economic conditions of patients, they can provide patients with cost-effective treatment options, analysis and advice on health insurance policies, and guidance on approaches to seek help from the public welfare. Through rational planning and exerting of limited resources, patients' economic difficulties can be alleviated and their psychological resilience can be improved to a certain extent.

Symptom clusters are defined as three or more symptoms occurring simultaneously and are interrelated and synergistic.[31] The gastrointestinal symptom cluster includes the most common side effects of chemotherapy, such as nausea, vomiting and loss of appetite. Studies have shown that gastrointestinal symptom cluster in patients with lung cancer chemotherapy can deteriorate with the prolongation of the chemotherapy cycle,[32] which will not only increase the negative experience of the patients, but also cause adverse consequences such as water imbalance, electrolyte disturbance and nutritional deficiencies. A qualitative study by Ma et al.[33] found that patients with severe symptoms were often plagued by depression, sensitivity and frustration, and some even reported that they were unable to adapt to the current treatment regimen because of severe gastrointestinal symptoms and had extreme fear and resistance to subsequent chemotherapy. The side effects of chemotherapy drugs are predictable. Therefore, it is recommended that adjuvant drugs, such as Shenqi Fuzheng injection, be given prophylactically prior to chemotherapy in order to reduce the incidence of adverse effects.[34] For patients who have already experienced nausea and vomiting, external treatments of traditional Chinese medicine, such as auricular bean-pressing therapy and acupoint application, can be operated to relieve the symptoms, reducing the patients' burden both mentally and physically and improving their psychological resilience.[35]

Emotional symptom clusters were most prominently represented by sadness, distress, and sleep disturbances, according to the findings of Wang et al.[36] Sadness, as the most common emotional distress, can lead to depressed mood, mental retardation and motor inhibition, with a subsequent decrease in psychological resilience.[37] Emotional cognitive interventions such as mindfulness-based stress reduction and group counselling have been proven effective to alleviate patients' negative emotions and improve their psychological resilience.[38] Thus, paramedics can take advantage of resource of the departments to set up a

paramedics-patient communication platform, inviting patients with successful treatments to share their own anti-cancer experiences and mental process, which may guide and encourage those who are undergoing treatments; and organizing regular activities for inpatients to enrich their hospital life and help them relax wholeheartedly. In addition, flowers can be routinely placed around the nurses' station, ward corridors and other areas to maintain a vibrant environment and exert influence unconsciously.

The main medical coping styles are different among three resilience profiles

The study showed that, compared with the other two groups, the "high-resilience" group in patients with lung cancer chemotherapy was more inclined to adopt the coping style of confrontation rather than resignation coping style, while it was opposite in the "low-resilience" group, which was consistent with the result reported by Yao et al.[39] Confrontation belongs to positive coping styles, which means that patients accept and adapt to the adversity of the disease and actively seek medical help; resignation is a negative response, symbolizes compromise and acceptance of the disease.[40] Psychological resilience and coping style influence each other and advance in chain. High level of resilience can help patients make full use of internal positive psychological quality and external resources to face disease actively, meanwhile this process is conducive to establish better resilience. Giving up struggle is adverse to the physical and mental health, which aggravate resignation mental state and reduces psychological resilience.[41] It is suggested that medical staff should pay attention to the patients' medical coping style, guide them to choose the positive one, face disease bravely, and don't compromise lightly, so as to improve their psychological resilience.

Implications for nursing practice

Resilience among patients of lung cancer chemotherapy exhibit three profiles, indicating that different profile of patients may have varying needs and responses when facing disease and treatment. This requires medical practitioners to accurately identify and provide targeted guidance to enhance resilience by evaluating educational level, economic status, symptom clusters and other characteristics of patients. Nurses are expected to provide altruistic treatment recommendations and health education that matches patients' cognition. It is necessary to actively address and manage physical symptoms, preventive administration and symptomatic treatment can effectively alleviate the side effects of chemotherapy drugs. Emotion is the external manifestation of psychological state, so guiding patients to reduce the degree of sadness and distress can improve resilience. The psychological state and coping style influence each other, so medical stuff should encourage patients to face the disease correctly, not to give up lightly or escape passively. It is noteworthy that the application of these measures in different cultural backgrounds on resilience subgroups of patients with lung cancer chemotherapy needs to be verified. Therefore, future interventions to improve resilience should take into account the patients' disease characteristics and cultural sensitivity comprehensively.

Limitations

This study has several limitations. Firstly, this study is a cross-sectional survey, which cannot infer causality or capture dynamic changes. Secondly, all subjects in this study are only from one hospital, which limited the generalizability of the results. Thirdly, only patient self-report instruments were used, which was highly subjective and may lead to bias. In addition, the exclusion of critical or unclear own disease condition patients who cannot self-report may lead to an overestimation of the average level of resilience.

The study required five months to recruit 265 cases, aligning with the sample size estimation of 165–338, thereby supporting the scientific

validity and reliability of the results. As lung cancer chemotherapy patients require repeated hospitalizations, and this study does not recommend collecting the same patients' information repeatedly, it became increasingly difficult to obtain new cases after continuous data collection for five months. While a larger sample size or a multicenter study could enhance the robustness of the findings, the associated labor and time costs present significant challenges.

In the future, longitudinal surveys can be carried out to explore the development trend of resilience in patients with lung cancer chemotherapy. Interventional studies can be conducted to provide clinical practice basis for resilience improvement. It is also suggested to conduct future research in multi-centers, combining subjective and objective instruments to improve the credibility and universality of the final results.

Conclusions

From an individual-centered perspective, this study used LPA to identify three subgroups of resilience in patients with lung cancer chemotherapy, the "high-resilience" group, "mid-resilience" group and "low-resilience" group. Risk factors, such as education level, monthly income per capita, gastrointestinal and emotional symptom cluster scores were relevant to the above subgroups. Different subgroups tend to adopt different medical coping styles. Therefore, medical staff are expected to take targeted intervention measures to improve the resilience of patients, so as to guide patients to adapt to the disease, face the difficulties and struggle actively.

Ethics statement

This study was reviewed and approved by the Ethics Committee of the first affiliated hospital of Guangzhou University of Traditional Chinese Medicine (IRB No. JY2023-193). All participants provided written informed consent.

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CRediT authorship contribution statement

Sirui Zhang: Conceptualization, Methodology, Formal analysis, Data Curation, Writing – Original draft. Limin Luo: Investigation, Data Curation, Writing – Original draft. Liqun Zhou: Resources, Project administration. Lingying Ji: Funding acquisition, Supervision. Baogui Deng: Conceptualization, Writing – reviewing and Editing. 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.

Declaration of competing interest

The authors declare no conflict of interest.

Data availability statement

Data available on request from the authors. The data that support the findings of this study are available from the corresponding author, Deng BG, 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.

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