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The relationship between perceived social support, coping style, and the quality of life and psychological state of lung cancer patients

Yiqian Ding¹, Xin Wang⁴, Fan Zhang¹, Hao Yan², Yaoyao Liu¹ and Lan Zhang^{3*}

Abstract

Background Lung cancer has always a cancer that threatens human health. Quality of life also has been an important research topic. psychological state in patients can influence their quality of life, and perceived social support and coping styles are relevant facilitators of Quality of life, but this specific relationship has not been adequately studied. The purpose of this study is focus on discussing the correlation of these four and understanding their potential mediating pathways.

Materials and methods This is a cross-sectional study. A total of 300 Lung Cancer patients from a cancer hospital in Suzhou were surveyed. The Data was collected using the scales. The collected data was analyzed using SPSS and AMOS software.

Results The study revealed a significant serial mediation model between perceived social support and coping style: Psychological state regulates patients' coping styles by influencing their perceived social support which ultimately has comprehensive impacts on their quality of life.

Conclusion Based on the empirical results discussed, this study proposes the following suggestion: Provide good online support to form a related social media intervention matrix. meanwhile, expand the patients' social network offline, provide channels for patients to express their troubles outwardly, and regularly assess the patients' psychological status to improve their level of psychosocial adaptation. This will in turn enhance their negative coping strategies towards the disease and strengthen their ability to buffer against it, ultimately promoting a better quality of life for the patients.

Keywords Lung Cancer, Perceived social support, Psychological state, Quality of life

*Correspondence:

Lan Zhang
zhang800519@126.com

¹Department of Nursing, Jinzhou Medical University, Jinzhou 121001, Liaoning, China

²School of Foreign Languages, Wuyi University, Wuyishan 354300, Fujian, China

³Department of Nursing, The First Affiliated Hospital of Jinzhou Medical University, Jinzhou 121001, Liaoning, China

⁴Department of Nursing, Huaian Hospital of Huaian City, Huaian 223200, Jiangsu, China



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Background

According to global Cancer data in 2023 [1], the Cancer mortality rate has been continuously declining since 1991, but lung Cancer remains the leading cause of cancer-related deaths. In China [2], lung cancer has the highest incidence and mortality rates among all Cancers. Clinical studies have demonstrated [3, 4] that surgical treatment is primarily utilized to extend the survival rate of lung cancer patients [5, 6]. Despite the overall lower survival rate compared to other Cancers [7], advancements in treatment have gradually improved the long-term survival rate of lung cancer patients. This improvement in survival rates has sparked increased interest among healthcare providers in issues related to patients' quality of life (QOL). The World Health Organization (WHO) defines QOL as individuals' experiences within different value systems and cultural backgrounds regarding their concerns, goals, standards, and expectations [8].

First and foremost, there are numerous influencing factors related to the QOL, among which psychological state is a crucial factor for patients with lung Cancer [9, 10]. The level of negative psychological state in lung cancer patients is higher compared to other tumor patients, significantly impacting their QOL [11]. Research on lung cancer patients [12] has shown that they generally exhibit more negative psychological state than those with other types of Cancer. Zabora [13] and colleagues discovered that 35.1% of their large sample ($N=4496$) reported experiencing negative psychological levels. In this sample, lung cancer patients reported the highest incidence of negative psychological states compared to Cancer patients with 13 other disease sites.

Additionally, several studies have indicated that perceived social support is a key factor influencing the QOL for patients [14–16]. Perceived social support refers to an individual's subjective emotional experience of feeling respected and understood by others [17]. For lung cancer patients, high levels of perceived social support can aid in their adaptation to the changes brought about by their illness. Substantial care and support from family and friends can alleviate suffering for lung cancer patients and contribute to an improved QOL [18].

Finally, in the analysis of the related influencing factors of QOL [19, 20], coping style is also identified as one of the influencing factors for lung cancer patients [21, 22]. Coping style refers to an individual's approach to managing stress and emotions, maintaining psychological balance, and achieving a higher quality of life during stressful situations [23]. From the onset of cancer symptoms through diagnosis and treatment, lung cancer patients experience significant stress [24]. Adopting a positive coping style to resist stress can enhance patients' adaptability and ultimately improve their QOL.

Previous studies [11, 12] have demonstrated a correlation among psychological state, QOL, and coping style. Individuals tend to choose different coping styles based on their psychological state when facing and adjusting to stress, thereby impacting their QOL. Scholar Poreba [25] suggested that a positive coping style can enhance QOL; further studies have confirmed that perceived high levels of social support can increase patients' confidence in fighting diseases and reduce negative psychological states, thus improving their QOL [22]. However, there is limited research on how perceived social support and coping style mediate between psychological state and QOL. The mechanism behind this relationship has been rarely reported. It remains undetermined whether perceived social support plays an intermediary role between psychological state and QOL through coping style. Furthermore, existing research has not thoroughly explored the internal pathway by which psychological state affects the QOL of lung cancer patients or considered the internal influence of perceived social support on patient's QOL. There is also insufficient attention given to how patients can improve their ability to cope with diseases.

The self-determination theory, proposed by American scholars Deci and Ryan in the late 1970s [26], is a motivational theory of human behavior. According to this theory, three basic psychological needs - autonomy, competence, and relatedness are crucial for individual psychological growth, internalization, and overall well-being. "Autonomy" refers to the sense of psychological freedom experienced by individuals; "competence" refers to the feeling of control over one's environment and the development of abilities; "relatedness" refers to the experience of connection with others, love and caring for others as well as feeling loved and cared for. The core assumption of this theory is that when these three basic psychological needs are met, individuals will experience a sense of satisfaction which enhances or maintains autonomous motivation leading to more effective behavioral outcomes. It also promotes an individual's physical and mental health, thus improving their quality of life. Conversely, when an individual's three basic psychological needs are thwarted, they may experience a strong sense of frustration leading to controlled motivation or amotivation. At this point, individuals become more focused on external outcomes which can have negative effects on their behavioral outcomes and physical and mental health resulting in a decreased quality of life.

Based on this theory, we propose the following hypotheses for our study:

1. Perceived social support serves as an intermediary between psychological state and QOL.
2. Coping style acts as an intermediary between psychological state and QOL.

3. Mental state influences the perception of social support, subsequently influencing patients' coping styles, and ultimately impacting their QOL comprehensively.

Based on this framework, the study aims to investigate the impact of psychological state on QOL, explore its potential interaction with perceived social support and coping style, and clarify the potential mechanism through which patients' psychological state affects their QOL. The ultimate goal is to improve patients' quality of life through clinical intervention style for lung cancer patients.

Methods

Participants and procedures

A convenient sampling method was employed to select 300 lung cancer patients from a specific tumor hospital in Suzhou City between February and December 2023 as the research subjects. Inclusion criteria were as follows: ① diagnosed with lung cancer by histology or pathology [27]; ② aged ≥ 18 years; ③ aware of their own condition; ④ willing to participate in this study. Exclusion criteria included: ① combined with other major physical diseases; ② severe communication barriers; ③ suffering from severe mental disorders.

This study was conducted by two well-trained researchers from our research group in outpatient clinics and wards to collect data on lung cancer patients. The researchers explained the purpose and significance of the study to patients who met the inclusion and exclusion criteria, obtained their consent, and conducted surveys using standardized questionnaires. All patients completed self-assessments under the guidance of team members, with on-site explanations of the research content and significance taking approximately 30 min to complete a questionnaire. During each survey collection process, researchers asked about omissions, errors, or multiple selections, informed patients of the reasons, and requested supplementary records. The data collection process followed principles of informed consent, non-harm, and confidentiality. A total of 330 questionnaires were distributed in this study, with 300 valid responses obtained for an effective response rate of 90.9%. The data collection process for this study lasted for a total of 10 months.

Ethical approval and informed consent

We confirm that the study was conducted in accordance with the Declaration of Helsinki. Ethical approval for the study was obtained from the Jinzhou Medical University (Approval No.: JZMULL2023112). The study was carried out in a manner that was transparent to all the participants. All the participants in the study were well

informed of the aim of the study. Only those who gave their oral informed consent to participate in the study were included. The participants were assured that the data gathered would only be used for research purposes. In addition, the researcher offered the chance of getting the findings of the research to the participants.

Research Tools

General Information Questionnaire

The questionnaire was developed by the researchers themselves. The sociodemographic data mainly include gender, age, educational status, profession, place of residence, Marital status, primary caregiver, Per capita monthly household income, mode of payment, Smoking history, Disease awareness; Time of hospitalization, pathological type, Duration of disease, etc.

World Health Organization Quality of Life (WHO QOL-BREF)

The WHO QOL-BREF, was a questionnaire developed by the World Health Organization to assess quality of life (QOL) based on the concept of QOL [28]. It is a simplified version of the "World Health Organization Quality of Life Scale-100", comprising 26 items. The questionnaire utilizes a Likert 5-point scale and encompasses four dimensions: physical health (7 items), psychological well-being (6 items), social relationships (3 items), and environment (8 items). Its primary purpose is to evaluate an individual's quality of life, with original score ranges from 20 to 120 points, and the final total score needs to be converted into a percentage system; higher scores indicate better quality of life. In this study, the internal consistency coefficient for this questionnaire was determined to be 0.87.

Kessler Psychological Distress Scale (K10)

The K10, was developed by Kessler and Mroczek [29], consisting of 10 items. It uses a Likert 5-point rating scale and is primarily used to assess psychological distress. The total score ranges from 10 to 50, with lower scores indicating better psychological well-being in patients. In this study, the internal consistency coefficient of this scale was found to be 0.89.

Perceived Social Support Scale (PSSS)

The PSSS, revised by Zimet [30], consists of 12 items rated on a Likert 7-point scale, including family support (4 items), friend support (4 items), and other support (4 items) across three dimensions. This scale is primarily used to assess the level of perceived social support. The total score ranges from 12 to 84, with higher scores indicating better perceived social support. In this study, the internal consistency coefficient of this scale was found to be 0.88.

Simplified coping Style Questionnaire (SCSQ)

The SCSQ revised by Xie [31], comprises 20 items rated on a Likert 4-point scale, including positive coping (12 items) and negative coping (8 items) across two dimensions. This questionnaire is primarily used to assess coping levels in individuals facing stress or adversity. The total score ranges from 0 to 60, with higher scores in each dimension indicating a greater tendency for patients to use that particular coping style.

In this study, the Cronbach's α coefficient for this scale was found to be 0.78.

Statistical methods

Data analysis was conducted using SPSS 27.0 and AMOS 23.0 statistical software. Descriptive statistics (mean, standard deviation, skewness, and kurtosis) were utilized, and Pearson correlation was employed to examine the relationships between QOL, psychological state, perceived social support, and coping style. Structural equation modeling (Amos) was used for path analysis to examine the relationships between paths. Skewness and kurtosis were first calculated based on normality. The results indicated that the skewness of variables ranged from -0.32 to 0.29 , while kurtosis values varied from -1.34 to -0.86 . For a normal distribution, skewness and kurtosis values within ± 2 are considered acceptable [32]. The findings suggested that the data in this study were suitable for AMOS analysis. Goodness-of-fit tests including Goodness of Fit Index (GFI), Comparative Fit Index (CFI), Incremental Fit Index (IFI), Root Mean Square Error of Approximation (RMSEA), and the ratio of chi-square to degrees of freedom (X^2/df) were analyzed to assess the fit of the structural model.

To ensure significance of direct effects and indirect effects of variables included in AMOS, a 95.0% confidence interval was applied.

This study employed a mediation model to investigate the direct and indirect impacts of perceived social support coping style and psychological state on quality of life. In the mediation model, variables were examined as mediators in explaining the relationship between independent variables and dependent variables with $P < 0.05$ indicating statistical significance.

Results

Common method deviation check

The Harman single-factor test was utilized to examine any potential deviation. All variables were included in the non-rotating factor analysis. The results revealed 14 factors with eigenvalues greater than 1, and the first factor accounted for 11.4% of the variance, which is below the critical value of 40.0%. Therefore, this study does not exhibit a significant common methodological deviation.

Participant characteristics

A total of 300 participants took part in the study, with males representing 56.0% and females representing 44.0%. Among primary caregivers, spouses made up 39.7% and children made up 28.30%. In terms of pathological types, glandular cancer accounted for 45.3%, while squamous cell cancer accounted for 42.7%. More details can be found in Table 1.

QOL, Psychological State, Perceived Social Support, and coping style scores of Lung Cancer patients

The QOL score for lung cancer patients was 54.87 ± 18.63 (skewness=0.09, kurtosis=-1.09), at a moderate level. The psychological state score for lung cancer patients was 31.60 ± 7.62 (skewness=-0.38, kurtosis=-0.59), at a moderate level of emotional distress. The perceived social support (PSS) score for lung cancer patients was 54.20 ± 13.43 (skewness=-0.06, kurtosis=-0.88), at a moderate level. The coping style score for lung cancer patients was 9.73 ± 14.13 (skewness=-0.02, kurtosis=-1.22). Please refer to Table 2 for detailed information.

The relationship between Quality of Life, Psychological State, Perceived Social Support, and coping style in lung cancer patients

Initially, there is a negative correlation between the QOL and psychological state of lung cancer patients ($r = -0.38$); Additionally, the QOL is positively associated with the mediating factor of perceived social support ($r = 0.37$) as well as positively correlated with coping style ($r = 0.78$); Furthermore, there is a significant correlation ($r = 0.31$, $P < 0.05$) between the two mediating factors of perceived social support and coping style. The relationships among the primary variables suggest that further mediation analysis can be conducted. Please refer to Table 3 for more details.

The Mediating Role of QOL, Psychological State, Perceived Social Support (PSS), and coping style in lung cancer patients

Based on the correlation between variables such as quality of life, psychological state, perceived social support, and coping state, this study utilized Amos bias-corrected non-parametric percentile bootstrap procedures to verify the significance of the mediating effects. A random sample of 2000 was drawn from the original sample ($n = 300$) to reduce Type I errors in statistical inference. In line with the theoretical assumptions of this study, a structural equation model was constructed with psychological state related to lung cancer (an observed variable), serving as the predictor variable; perceived social support (PSS, comprising family support, friend support, and other support as latent variables) acting as mediator 1; coping style (including positive and negative coping style

Table 1 Demographic and medical characteristics of the population with lung cancer patients ($n = 300$)

Variable		<i>n</i>	%	QOL score
Gender	Male	168	56.0	55.86 ± 18.15
	Female	132	44.0	53.62 ± 18.63
Age(years)	18–44	29	9.7	62.82 ± 20.78
	45–59	104	34.6	54.88 ± 18.10
	≥ 60	167	55.7	53.49 ± 18.33
Education status	Primary and below	83	27.7	53.96 ± 16.67
	junior high school	86	28.7	54.49 ± 19.18
	High school	80	26.6	55.33 ± 19.57
	College degree or above	51	17.0	56.29 ± 19.61
profession	on the job	89	29.7	53.79 ± 17.96
	retirement	88	29.3	55.75 ± 20.50
	farmer	64	21.3	54.45 ± 17.42
	others	59	19.7	55.61 ± 18.27
place of residence	city	181	60.3	56.06 ± 18.53
	village	119	59.7	53.06 ± 18.71
Marital status	spinsterhood	19	6.3	51.12 ± 17.21
	married	156	52.0	57.16 ± 17.90
	divorced	68	26.7	54.92 ± 20.48
	bereft of one's spouse	57	19.0	49.78 ± 17.97
primary caregiver	spouse	119	39.7	58.08 ± 17.88
	children	85	28.3	53.46 ± 17.53
	parents	40	13.3	53.88 ± 21.50
	relative	26	8.7	51.94 ± 19.29
	others	30	10.0	54.87 ± 18.63
Per capita monthly household income	<1000¥	11	3.8	45.04 ± 20.07
	1000–1999¥	36	12.0	54.01 ± 21.24
	2000–2999¥	146	48.8	54.18 ± 17.97
	3000–3999¥	69	23.0	55.58 ± 18.49
	≥ 4000¥	37	12.4	56.73 ± 18.01
mode of payment	self-paying	32	10.7	52.00 ± 17.89
	health insurance	169	56.3	55.16 ± 19.28
	Agrarian insurance	99	33.0	55.31 ± 17.81
Smoking history	Yes	118	39.3	54.89 ± 18.17
	No or have stopped	182	60.7	54.86 ± 18.96
Disease awareness	incomprehension	62	20.7	53.35 ± 19.47
	Know something	159	53.0	56.74 ± 18.06
	Most understand	79	26.3	52.29 ± 18.88
Time of hospitalization	One times	116	38.7	55.45 ± 18.79
	Two or more times	184	61.3	54.50 ± 18.63
pathological type	squamous carcinoma	128	42.7	54.51 ± 18.36
	adenocarcinoma	136	45.3	55.70 ± 19.07
	large cell carcinoma	24	8.0	55.82 ± 17.45
	small cell carcinoma	12	4.0	47.40 ± 19.09
Duration of disease (month)	0–12	61	20.3	55.90 ± 19.36
	12–24	125	41.7	52.96 ± 18.44
	>24	114	38.0	56.42 ± 18.41

Table 2 The scores between QOL, Psychological State, Perceived Social Support, and coping style in LC patients($n = 300$)

Variable	Least value	Maximum value	Mean value	Standard deviation	Skewness	Kurtosis
Quality of Life	22.02	91.82	54.87	18.63	0.09	-1.09
PHYS	10	35	22.72	6.61	0.03	-1.15
PHUCH	8	30	19.41	5.37	0.13	-0.97
SOCIL	3	15	9.16	3.23	0.03	-0.91
ENVIR	8	40	26.11	8.45	-0.06	-1.11
Psychological State	14	48	31.60	7.62	-0.38	-0.59
Perceived Social Support	25	84	54.20	13.43	-0.06	-0.88
Family support	5	28	18.73	5.61	-0.24	-1.10
Friend support	5	28	18.44	4.99	-0.13	-0.50
Others support	4	28	17.03	6.13	0.06	-1.26
Coping style	-17	38	9.73	14.13	-0.02	-1.22
Positive	12	48	27.81	9.64	0.00	-1.16
Negative	8	32	18.07	6.91	0.18	-1.10

Table 3 The relationship between Quality of Life, Psychological State, Perceived Social Support, and coping style in LC patients($n=300$)

Variable	Quality of Life	Psychological State	Perceived Social Support	Coping Style
Quality of Life	1			
Psychological State	-0.38 ^{aa}	1		
Perceived Social Support	0.37 ^{aa}	-0.17 ^{aa}	1	
Coping Style	0.78 ^{aa}	-0.32 ^{aa}	0.31 ^{aa}	1

a is significant at the 0.01 level (two-tailed)

as observed variables) functioning as mediator 2; and quality of life (encompassing PHYS, PSYCH, SOCIL, and EENVIR as latent variables) serving as the outcome variable. Figure 1 provides detailed information.

The fit indices for the structural equation model were GFI=0.97, CFI=0.99, IFI=0.99, RMSEA=0.02, $\chi^2/df=1.23$, all meeting ideal standards indicating good model fit (Table 4).

The estimation of relevant parameters for QOL, Psychological State, Perceived Social Support, and coping style in lung cancer patients

The following estimations were made based on the relationships between various factors:

- (1) The psychological state of lung cancer patients significantly influences their quality of life ($\beta = -0.12$, $p = 0.003$).
- (2) The psychological state of lung cancer patients significantly affects their perceived social support ($\beta = -0.25$, $p < 0.001$).
- (3) The psychological state of lung cancer patients has a significant impact on their use of positive coping style ($\beta = -0.22$, $p < 0.001$).
- (4) The psychological state of lung cancer patients also plays a significant role in the use of negative coping style ($\beta = 0.25$, $p < 0.001$).
- (5) The perceived social support by lung cancer patients significantly impacts their quality of life ($\beta = 0.13$, $p < 0.0001$).

- (6) Lung cancer patients perceived social support has a significant effect on their positive coping style ($\beta = 0.25$, $p < 0.001$).
- (7) Lung cancer patients perceived social support has a significant effect on their negative coping styles ($\beta = -0.20$, $p = 0.001$).
- (8) Positive coping style in lung cancer patients have a significant impact on their quality of life ($\beta = 0.42$, $p < 0.001$).
- (9) Negative coping style in lung cancer patients have a significant impact on their quality of life ($\beta = -0.28$, $p < 0.001$).

Each coefficient on the path is significantly different, indicating that the mediating role of perceived social support and coping style in the chain between psychological status and QOL is significant. Table 5 provides detailed information regarding this conclusion.

Calculation of total effect, direct effect, and mediating effect

1. Perceived social support acts as a mediating variable between psychological state and QOL with an 8.3% mediating effect.
2. Coping style also act as a mediating variable between psychological state and QOL, with a 25.0% positive coping style effectiveness and a 19.4% negative coping style effectiveness.

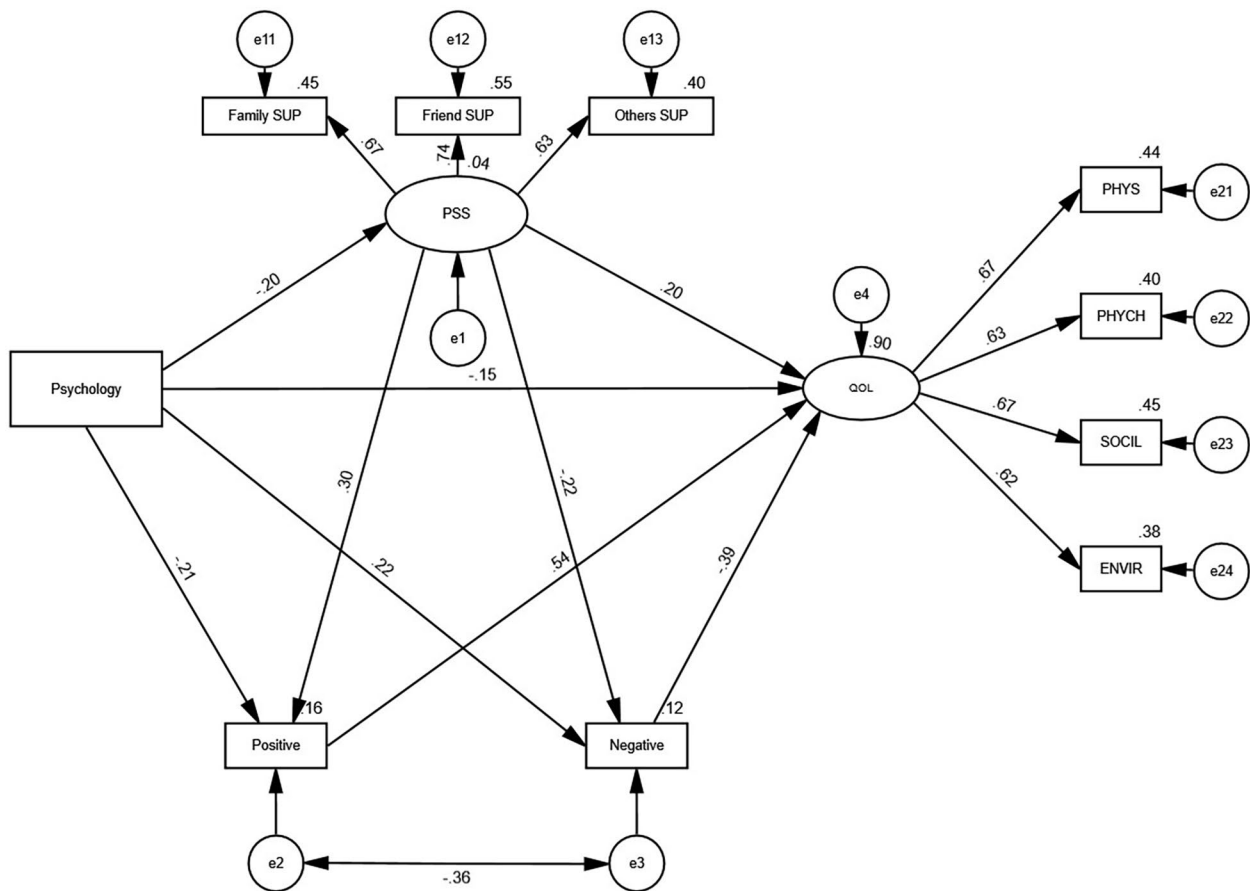


Fig. 1 The mediation model of Perceived social support and coping style in the psychological state and QOL of LC patients

Table 4 Structural equation Model fit index ($n = 300$)

Items	χ^2	χ^2/df	RMSEA	SRMR	GFI	CFI	IFI
fit index	34.61	1.23	0.02	0.03	0.97	0.99	0.99
acceptable standard		<3	<0.08	<0.05	>0.09	>0.9	>0.9

χ^2 represents degrees of freedom, χ^2/df is the ratio of chi-square to degrees of freedom, CFI stands for Comparative Fit Index, GFI stands for Goodness-of-Fit Index, IFI stands for Incremental Fit Index, and RMSEA represents Root Mean Square Error of Approximation

Table 5 The path relationship test for QOL, Psychological State, Perceived Social Support (PSS), and coping style (positive, negative) in LC patients ($n = 300$)

Items	Estimate	S.E.	p	Confidence interval	
				Lower	Upper
Psychological State \rightarrow QOL	-0.12	-0.15	$p=0.003$	-0.24	-0.05
Psychological State \rightarrow PSS	-0.25	-0.20	$p<0.001$	-0.33	-0.06
Psychological State \rightarrow Positive	-0.22	-0.21	$p<0.001$	-0.31	-0.09
Psychological State \rightarrow Negative	0.25	0.22	$p<0.001$	0.08	0.31
PSS \rightarrow QOL	0.13	0.20	$p<0.001$	0.09	0.31
PSS \rightarrow Positive	0.25	0.30	$p<0.001$	0.16	0.42
PSS \rightarrow Negative	-0.20	-0.22	$p=0.001$	-0.36	-0.08
Positive \rightarrow QOL	0.42	0.53	$p<0.001$	0.44	0.62
Negative \rightarrow QOL	-0.28	-0.39	$p<0.001$	-0.48	-0.29

Regression weights

3. The mediating role of perceived social support and coping style is evident in the relationship between psychological state and QOL. The mediating effect value is calculated as $[(-0.03) + (-0.09) + (-0.07) + (-0.03) + (-0.02)] = -0.25$, with a total effect (mediating effect + direct effect) of $[(-0.24) + (-0.12)] = -0.36$. The proportion of the mediating effect to the total effect is 66.7%.
4. The serial mediation model between perceived social support and coping style is evident in the relationship, the proportion of the mediating effect for perceived social support and positive coping style accounted for 8.3% of the total effect.
5. The serial mediation model between perceived social support and coping style is evident in the relationship, the proportion of the mediating effect for perceived social support and negative coping style accounted for 5.6% of the total effect. Please refer to Table 6 for more details.

Discussion

Analysis of the current status of quality of life in lung cancer patients

The results of this study show that the QOL score for LC patients is 54.87 ± 18.63 , which is similar to the results of LC patients surveyed by Lee et al. [33]. However, the scores vary under different circumstances. Gender: In this study, male patients had a higher level of QOL. This may be because females tend to be more sensitive than males and are prone to negative psychological states such as depression and low self-esteem, leading to a more pessimistic coping attitude towards the disease and consequently a decrease in their QOL. Age: The research results indicate that the older the age, the lower the QOL level. This analysis may be due to the fact that as patients age, their physical functions gradually weaken over time. Additionally, long-term illness can lead to negative psychological states such as anxiety and depression, which may contribute to a decline in their QOL [2]. In this study, older patients have lower QOL scores. [34]. Education level: Patients with higher education levels have better QOL scores. The analysis suggests that patients with higher education levels can seek psychological adjustment through various means and ways. They also possess a higher level of disease cognition and are more

Table 6 Total, direct, and mediating effects

Name	STD Estimate	Lower	Upper
Total Effect	-0.36	-0.46	-0.24
Direct Effect	-0.12	-0.20	-0.05
Indirect Effect	-0.24	-0.33	-0.15
Proportion of total indirect effects	66.7%(-0.24/-0.36)		
IND1	-0.03	-0.07	-0.01
Proportion of indirect effects	8.3%(-0.03/-0.36)		
IND21	-0.09	-0.15	-0.04
Proportion of indirect effects	25.0%(-0.09/-0.36)		
IND22	-0.07	-0.12	-0.03
Proportion of indirect effects	19.4%(-0.07/-0.36)		
IND31	-0.03	-0.05	-0.01
Proportion of indirect effects	8.3%(-0.03/-0.36)		
IND32	-0.02	-0.04	-0.00
Proportion of indirect effects	5.6%(-0.02/-0.36)		
IND1-IND21	0.07	-0.01	0.15
IND1-IND22	0.05	-0.03	0.02
IND1-IND31	-0.01	-0.04	0.02
IND1-IND32	-0.02	-0.06	0.00
IND21-IND31	-0.08	-0.15	-0.01
IND22-IND32	-0.07	-0.12	-0.01

IND1: Psychological State → PSS → QOL

IND21: Psychological State → Positive → QOL

IND22: Psychological State → Negative → QOL

IND31: Psychological State → PSS → Positive → QOL

IND32: Psychological State → PSS → Negative → QOL

The bootstrap method is utilized for estimating the standard error of the indirect effect, as well as determining the lower and upper limits of the 95% confidence interval

likely to adopt positive coping strategies when facing illness. Marital status and primary caregiver: Multiple studies have confirmed that cancer patients derive significant emotional support from their spouses [35]. Spousal support helps alleviate negative emotions in patients and increases their expectations for life. Substantial care and support from family members—especially caregivers such as spouses or children who assist with daily activities or transportation for appointments—result in less suffering for lung cancer patients and improved quality of life. In this study, married patients receiving care from spouses had better QOL scores; social support was primarily derived from family support.

In addition, Time of hospitalization and pathological type also play an important role. First-time hospitalized patient's condition was better than those who were re-hospitalized; similarly non-small cell lung cancer type showed better patient outcomes compared to other types. This difference may be attributed to varying etiological subtypes leading to different clinical outcomes and prognoses resulting in diverse physical and cognitive impairments.

The impact of psychological state on QOL

In this study, the psychological state is a significant negative predictor of Lung cancer patients' QOL levels. The analysis results indicate a significant negative correlation between psychological state and QOL. Lung cancer patients with poor psychological states have lower QOL levels, while those with good psychological states have higher QOL levels [33]. This suggests that the psychological state directly influences QOL. One possible reason for this is that the level of Lung cancer patient's psychological state can directly affect their mindset when facing illness, and improving their psychological state can alleviate the unpleasant physiological and psychological effects caused by major life events. When Lung cancer patients tend to experience negative emotions such as depression and anxiety, they may feel powerless in coping with the disease, increasing their burden and hindering treatment and recovery, ultimately leading to a decrease in their QOL levels. Therefore, medical staff should pay more attention to the psychological state of Lung cancer patients and guide them to face the disease correctly, improve their psychosocial adaptation level, and enhance their confidence in overcoming the disease. In addition, it is important to promote health education for cancer patients and implement cancer prevention and control measures, so that patients can have a more thorough understanding of the diagnosis and treatment of cancer, thereby improving their quality of life.

The mediating role of perceived social support in the prediction of QOL by psychological state

This study found that psychological state significantly negatively affects QOL, while perceived social support significantly positively influences QOL. Perceived social support partially mediates the relationship between psychological state and QOL. This suggests that the impact of psychological state on QOL is partially mediated by perceived social support, supporting our initial hypothesis. Patients with higher levels of perceived social support have better QOL. This finding is consistent with Yao's research [36]. According to surveys, cancer patients who receive higher levels of support are more likely to reduce the risk of physiological dysfunction and therefore increase their quality of life [37]. High levels of perceived social support can alleviate Lung cancer patients' mental stress and depressive emotions, thus improving their QOL [38]. However, when there is a lack or dysfunction in support, the positive impact of perceived social support on Lung cancer patients' QOL often diminishes or disappears [39]. This indicates that perceived social support indirectly affects lung cancer patients' QOL through psychological state because better-supported patients can utilize substantial care and support from family and friends to enhance their resilience and optimistic positive traits, thereby reducing the impact on themselves and better tolerating negative emotions related to cancer [40], ultimately leading to an improved level of QOL [41]. Therefore, medical staff should pay special attention to the psychological state of patients, provide targeted psychological counseling, and utilize perceived social support as an important external resource. This can help mobilize the patient's internal resources such as a positive psychological state, enhancing their strength in coping with the disease. Additionally, education should be provided to caregivers of lung cancer patients to increase their level of care. Furthermore, medical staff should actively assess the patient's perceived social support systems and utilization, stimulate the patient's inner potential, alleviate their psychological pressure and negative emotions, and actively face and manage the disease to promote a high quality of life for the patients.

The mediating role of coping style in the prediction of QOL by psychological state

It was found that psychological state significantly negatively affects QOL, while negative coping style also has a significant negative impact on QOL, and positive coping style has a significant positive impact on QOL. This indicates that the outcome of psychological state affecting QOL levels is partially mediated by coping style, thus supporting hypothesis two. Patients with higher levels of negative coping style tend to have lower QOL, whereas those with higher levels of positive coping style tend

to have better QOL. The research suggests that when patients adopt a negative coping style, it can reduce their positive attitude towards cancer and hinder disease progression [42], ultimately leading to a decrease in their QOL [43]. When facing the negative event of cancer, patients who adopt a negative coping style are more likely to compromise with the disease, leading to decreased treatment compliance and impacting the effectiveness of disease recovery, thus exacerbating the progression of the illness. However, when patients have a good psychological state, they typically use a positive coping style to regulate their mental state and better adapt to the discomfort caused by illness [44]. Patients with good psychological states are more likely to seek help positively and stimulate their initiative for treatment, enabling them to adopt an optimistic and positive mindset in facing the challenges brought about by the disease and improving their belief in recovery as well as their quality of life [45]. Patients with higher levels of psychological state are more likely to actively learn about lung cancer and self-adjust, correct cognitive biases, and adopt positive coping style, continuously affirming themselves in the disease process and promoting their QOL. Therefore, medical staff should pay attention to the psychological state and coping style of patients. They can mobilize patients' internal resources by teaching them about lung cancer and self-care skills to encourage a positive outlook. At the same time, utilizing the internet or multimedia to educate patients on the importance of facing the disease positively can help reduce negative psychological states and improve maladaptive coping style, ultimately enhancing patients' quality of life.

The serial mediation model of perceived social support and coping style in the impact of psychological state on QOL

This study found that perceived social support and coping style play a significant mediating role in the impact of psychological state on QOL, indicating that psychological state can not only significantly predict QOL through the separate mediating effects of perceived social support and coping style, but also jointly influence QOL through the chain mediation of perceived social support and coping style, thus supporting Hypothesis 3. According to the analysis results, perceived social support is positively correlated with positive coping style and QOL, and negatively correlated with negative coping style. Perceived social support as an effective external resource is advantageous for enhancing patients' adaptability and adjustment abilities, embracing positive coping style, and elevating their QOL levels. That is, an increase in perceived social support level can significantly improve an individual's level of positive coping style, thereby enhancing QOL. However, a decrease in perceived social

support level can simultaneously increase an individual's level of negative coping style, leading to a decrease in QOL.

The classic buffering hypothesis of perceived social support [46] suggests that perceived social support, as a determinant of psychological state, can alleviate the negative impact on psychological state and act as a buffer against external stress or challenges. Previous studies have also confirmed that perceived social support can increase patients' confidence in coping with illness, which is beneficial for overall health [47, 48]. Similarly, emotional support and understanding from caregivers can help patients better cope with the stress of illness, thereby enhancing their ability to fight disease [49, 50], consistent with the negative correlation between perceived social support and mental state in this study. This study further considers the role of perceived social support and coping style in the relationship between mental state and quality of life (QOL). The results show that perceived social support is significantly positively correlated with positive coping style and QOL, while it is significantly negatively correlated with negative coping style and mental state. Mental state influences perceived social support, which then moderates patients' coping style, ultimately having a comprehensive impact on QOL. This may be because patients with a negative mental state are unwilling to confide their troubles to family or friends, leading to negative coping style and lower QOL levels. Patients with a positive mental state tend to communicate with caregivers for care and support, thus adopting a positive coping style to fight disease and improve their QOL.

Therefore, it is recommended that healthcare professionals assess patients' attitudes toward perceived social support, evaluate their characteristics, increase online support, and guide patients in the correct use of social media platforms. At the same time, healthcare professionals and social workers can provide authoritative popular science or Q&A on dedicated media platforms to form a four-level social media intervention matrix for relevant medical departments-hospitals-society-patients, providing patients with good online support including medical support, information support, emotional support and companionship [51]. Meanwhile, personalized symptom management plans can be developed for patients to encourage family members to participate in treatment decisions and care plans. This will help create a harmonious and positive atmosphere between family members and patients while improving the patient's negative perception of the disease. It is important to develop a correct understanding of the disease and establish courage and confidence in fighting against it. This will enhance the patient's ability to cope with the disease both physically and mentally by using a positive

coping style to combat illness thus promoting physical and mental health ultimately enhancing the quality of life for patients. In addition, it is possible to expand the social network of patients by establishing communication groups for fellow patients and support groups within the community. And can provide home palliative care and psychological education, helping them improve their physical and mental health conditions. Regular implementation of cancer prognosis-related work can also deepen patients' understanding of cancer treatment and prognosis. Furthermore, increasing channels for patients to express their troubles externally through communication with the outside world can enhance their psychosocial level and ability in coping with the disease, thereby improving their QOL.

Conclusion

Advantages and limitations

Advantages: This study incorporates the two mediating variables into the path model, and attempts to understand the complex mechanisms of Lung cancer patients based on empirical testing. It not only provides empirical references and theoretical support for further exploration of how psychological state increases lung cancer QOL levels but also has practical significance for guiding lung cancer patients to correctly understand the importance of social support and coping style for QOL.

Limitations

Firstly, the experimental subjects are too homogeneous, and convenience sampling was used for questionnaire selection, which may affect the representativeness of the sample. Future research should expand the sample range to verify the generalizability of the results. Secondly, not all intermediate variables were included in this study, resulting in limited explanatory power. Future research should consider more diverse predictive variables to further reveal potential pathways through which influences; Finally, this study is a cross-sectional study, so future longitudinal tracking experiments are needed to explore multi-level mechanisms comprehensively.

Conclusion

- ① There is a correlation between perceived social support, coping style, psychological state and quality of life.
- ② The study further reveals significant chain-mediated effects between perceived social support and coping style - where psychological state affects understanding social support thereby regulating patient's coping style ultimately having a comprehensive impact on quality of life.

The research findings serve as a source of inspiration for healthcare professionals, encouraging them to prioritize

effective communication and the right to informed decision-making for patients. In addition to addressing the psychological state of lung cancer patients, it is crucial to systematically consider their coping strategies toward the disease. Moreover, providing assistance to patients in developing a more comprehensive understanding of social support systems and implementing individualized interventions can ultimately have a positive impact on their QOL.

Abbreviations

LC	Lung cancer
QOL	Quality of Life
PSS	Perceived Social Support

Supplementary Information

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Supplementary Material 1

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Author contributions

Yiqian Ding: Conceptualization, Data curation, Supervision, Formal analysis, Methodology, Su-pervision, Validation, Visualization, Writing – original draft, Writing – review & editing, Inves-tigation. Lan Zhang; Writing – review & editing, Method ology, Visualization. Xin Wang: Con-ceptualization, Formal analysis, Supervision. Fan Zhang: Conceptualization, Formal analysis, Supervision. Hao Yan: Data curation, Data curation, Software, Supervision. Yaoyao Liu: Concep-tualization. Declaration of generative AI and AI-assisted technologies in the writing process There was no use of generative AI or AI-assisted technology in the writing process.

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Data availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

The experimental protocol was established, according to the ethical guidelines of the Helsinki Declaration and was approved by the Ethics Committee of Jinzhou Medical University (Approval No.: JZMULL2023112). Written informed consent was obtained from individual or guardian participants.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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