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Prevalence and influencing factors of the dyadic psychological stress among patients with lung cancer and their family caregivers: a cross-sectional study

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Abstract

Background A lung cancer diagnosis has a huge impact on the psychological well-being of both patients and family caregivers. However, the current psychological stress status among dyads remains unclear. We aimed to determine the prevalence of anxiety and depression and identify the factors that influence patients with lung cancer and their caregivers.

Methods We conducted a cross-sectional study of 254 dyads of lung cancer patients and family caregivers from four tertiary hospitals in Hunan Province, China from January 2021 to June 2021. Besides, we used several instruments to collect data on depression, anxiety, illness perception, mindfulness, self-compassion, and dyadic coping. The independent samples t-test, analysis of one-way variance, Spearman's correlation analysis, and multiple linear regression analysis were employed.

Results Results showed that 21.3% of patients and 29.5% of caregivers experienced depression, while 22.0% of patients and 33.5% of caregivers reported anxiety. For lung cancer patients, patients' illness perception positively predicted their depression scores and patients' level of mindfulness and level of self-compassion negatively predicted their depression scores; patients' illness perception positively predicted their anxiety scores, and only living with children, patients' mindfulness and self-compassion levels were negatively predicted their anxiety scores. For caregivers, caregivers' level of illness perception and the number of other caregivers positively predicted their depression and anxiety scores, and caregiver's dyadic coping level, residence (county or town, and city), and caregiver's self-compassion level, were negatively predicted their depression and anxiety scores.

Conclusion The prevalence of psychological stress response of lung cancer patients and caregivers was high and influenced by family living situation, number of persons assisting in care, place of residence, patient-caregiver relationship, levels of illness perception, mindfulness, self-compassion, and dyadic coping.

Trial registration ClinicalTrial.gov NCT06746948.

Keywords Lung cancer patients, Caregivers, Psychological stress, Prevalence, Influencing factors, Anxiety, Depression

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Background

Lung cancer has the second highest incidence rate and the first highest mortality rate among malignant tumors, and the 5-year survival rate of patients with lung cancer is only 15–30% [1]. Meanwhile, China will become the world's largest lung cancer country with more than one million lung cancer patients by 2025 [2]. Due to the low early diagnosis rate and short survival time, compared with other malignant tumors, patients with lung cancer suffer from greater psychological pressure and are more prone to psychological problems such as anger, anxiety, depression, decreased self-esteem, and a sense of isolation [3]. Of these, anxiety and depression, with prevalence rates ranging from 34.3–65.9%, were the most common psychological stress. The diagnosis of lung cancer not only causes severe psychological distress to the patients with lung cancer themselves but also is an obvious stressor to the whole family system. At present, in China, family caregivers (FCs) are the primary caregivers of patients, usually shouldering the primary caregiving responsibilities and serving as the main coping resource for patient [4], and therefore suffer from both physical and psychological stress. It has been found that 25–50% of FCs of patients with lung cancer have significant anxiety, depression and psychological distress [5], all of which would seriously affect quality of life and caregiving. The systemic transactional model suggests that stressors come from the social context and that individuals interact with the environment and FCs in coping with stress [6]. Literature review also confirms that there is a dyadic effect in the psychological stress response of both cancer patients and their FCs [7]. Therefore, it is necessary for the current focus of lung cancer research to include family caregiving considerations and move from the individual to the dyadic level.

Some researchers have investigated the current status of psychological stress and its influencing factors in individual patients with lung cancer or FCs, which may be influenced by individual, family, and social aspects [8]. First, individual factors include demographic-sociological, patient-illness-related, caregiver's own physical health status and individual psychological resources. Among the demographic-sociological factors, age, gender, economic conditions, and education level [9] have been identified as possible influences on the psychological stress of patients with lung cancer and FCs; among patient-illness-related factors, the clinical stage, presence of cancer metastasis [10], related symptoms [11], operation or not, and duration of illness [12] may also affect the psychological health status of both; the caregiver's own physical health status may also affect the caregiving burden [13]. In addition, an individual's psychological resources may influence the psychological stress of both patients with lung cancer and caregivers. Specifically, illness perceptions [14] refers to an individual's cognitive appraisal, emotional response, and understanding of the illness and its potential consequences, which is positively associated with psychological stress. Besides, mindfulness [15] refers to the process of being consciously and non-judgmentally aware of the experience of the internal and external world in the present moment, which is negatively associated with psychological stress in cancer patients [16]. Next, self-compassion [17] includes three components: self-kindness, mindfulness, and the sense of common humanity, which is important to maintain mental health. Secondly, family and social aspects include social support from family and social levels [18], which is an important external resource available during the stress process and has a role in protecting mental health.

However, limited researchers have examined the effects of dyadic factors on the dyadic psychological stress of patients with lung cancer and their FCs in the context of this particular kinship relationship [19–21]. For example, differences in relationship type and quality, communication functioning, and dyadic coping may influence dyadic psychological stress. Previous studies have shown that positive dyadic coping between patients with chronic illness [22] and depressed pregnant women and their spouses [23] can promote the physical and mental health and quality of life of both partners. Therefore, it can be hypothesized that it may be important to consider the dyadic factors between lung cancer patients and their FCs.

Currently, existing studies have focused on exploring the process of dyadic psychological stress and the effects of dyadic intervention between patients with lung cancer and their FCs. Still, few studies systematically determine the prevalence and influencing factors of psychological stress between the dyad. Specifically, current studies have mainly explored the influences of psychological stress on individual patients with lung cancer or FCs, while less consideration has been given to the effects of the relationship between the two, such as different types of relationships and different levels of dyadic coping; meanwhile, few current studies have compared the status of psychological stress and its influencing factors between the dyad. Therefore, the present study aimed to comprehensively determine the prevalence of anxiety and depression and their influencing factors in patients with lung cancer and their caregivers.

Methods

Study design

This study used a cross-sectional research design.

Study setting and sampling

During the period from January 2021 to June 2021, we employed a computer-generated sequence of random numbers to randomly select the eligible patients with lung cancer and their FCs from the departments of thoracic surgery, respiratory medicine, oncology, and radiotherapy of four tertiary hospitals in Hunan Province, China.

Inclusion and exclusion criteria

The inclusion and exclusion criteria were as follows:

(1) Patients with lung cancer

1) Inclusion criteria: aged ≥ 18 years; hospitalized patients with lung cancer diagnosed by pathological section or cytology; and relatively stable condition, conscious and able to express their willingness correctly. 2) Exclusion criteria: people with a combination of other cancers or serious life-threatening diseases; the presence of audiological disorders or previous mental or cognitive disorders, such as anxiety disorder, depression disorder; and receiving mental disorder treatments.

(2) Family caregivers

1) Inclusion criteria: aged ≥ 18 years; a primary caregiver with a cumulative caregiving time of more than 33 h; and a family member of the patient with lung cancer, such as spouse, children, parents, or other relatives. 2) Exclusion criteria: formal caregivers with employment relationships, such as nannies; the presence of audiological disorders or previous mental disorders or cognitive disorders, such as anxiety disorder, depression disorder; and receiving mental disorder treatments.

Sample size

Kendall's principle of sample size calculation states that the sample size should be five to ten times the number of independent variables [24]. In this study, there were 24 variables, and considering the 20% invalid response rate, the minimum sample size was 144–288.

Instruments

The Sociodemographic and Clinical Characteristics Sheet: this includes socio-demographic, illness, caregiving, and dyadic characteristics, such as age, gender, place of residence, TNM stage, pathology, duration of proving care, number of other caregivers, relationship to patient, etc.

We measured dyadic depressive symptoms using the Patient Health Questionnaire-9 (PHQ-9), which is a 9-item questionnaire. Scores range from 0 to 27, with higher scores indicating more severe depression. According to Kroenke et al.'s [25] scoring of the PHQ-9, a score of 0–4 indicates no depression, 5–9 indicates mild depression, 10–14 indicates moderate depression, 15–19 indicates moderate severe depression, and 20–27 indicates severe depression. The prevalence of depression is equal to the number of cases with a PHQ-9 score of 5 or greater divided by the total number of cases. Cronbach's alpha coefficients in this study were 0.85 and the KMO test value was 0.719 [26], which showed good reliability and validity.

We assessed anxious symptoms using the Generalized Anxiety Disorder-7 scale (GAD-7), which is a 7-item questionnaire. Scores range from 0 to 21, with higher scores indicating more severe anxiety. According to Spitzer et al.'s [27] evaluation of GAD-7 scale, a score of 0–4 indicates no anxiety, 5–9 indicates mild anxiety, 10–14 indicates moderate anxiety, and 15–21 indicates severe anxiety. The prevalence of anxiety was defined as the number of cases with a GAD-7 score of 5 or greater divided by the total number of cases. Cronbach's alpha coefficients in this study were 0.93, respectively and KMO test value was 0.927 [28], which showed good reliability and validity.

We administered the Brief Illness Perception Questionnaire (BIPQ) [29] to assess the dyads' cognitive and emotional reactions to illness. The scale has 9 items, with items 1–5 assessing cognition, items 6 and 8 assessing emotional status, item 7 assessing comprehension, and item 9 being an open-ended question about causality of the cause of the illness. Each item is scored on a scale of 0 to 10, and the total score ranges from 0 to 80, with higher scores indicating more negative perceptions of the illness. Cronbach's alpha coefficient in this study was 0.77.

We used the Mindful Attention Awareness Scale (MAAS) to assess the dyads' mindfulness tendencies [30]. The scale consists of 15 items and each item is assigned a score from 1 to 6, with the scale ranging from "almost always" to "almost never", with higher scores indicating higher levels of awareness and attention to the present moment. Cronbach's alpha coefficient in this study was 0.92.

The dyadic self-compassion was assessed using the Self-compassion Scale (SCS) [31], which includes six dimensions of self-kindness, self-criticism, common humanity, loneliness, stillness, and over-indulgence, with a total of 26 items, has a high re-test reliability ($r = 0.93$) and internal consistency reliability ($\alpha = 0.92$). Cronbach's α coefficient in this study was 0.88.

The Dyadic Coping Inventory (DCI) [32] was used to evaluate the coping ability of dyads. The Chinese version [33] has a total of 37 items, including six dimensions: stress communication, support, negativity, empowerment coping, cooperation, and evaluation. A 5-point Likert scale was used, with higher scores indicating higher levels of positive dyadic coping, and the negative supportive coping items (items 7, 10, 11, 15, 22, 25, 26, 27) were reverse scored, with higher scores indicating higher levels of negative dyadic coping. A total score below 111 is considered low, a total score between 111 and 145 is considered moderate, and a total score above 145 is considered high. Cronbach's alpha coefficients in this study were 0.93.

Data collection

Before conducting the study, we applied for ethical review to the Institutional Review Board. The uniformly trained research assistants in each hospital were screened to ensure that patients and FCs met the inclusion and exclusion criteria before distributing the questionnaires. Additionally, they explained the purpose and significance of the study to the participants and obtained signed informed consent forms from participants. Patients were asked to fill out the questionnaires in their wards, while FCs filled out the questionnaires in the department's conference room to ensure that patients and FCs did not interfere or communicate with each other to reduce the measurement bias.

Data analysis

All questionnaires were double-entered and statistically analyzed using SPSS 22.0. In most cases, a two-tailed test $P < 0.05$ was considered statistically significant, but in multiple linear regression analysis, a two-tailed test $P < 0.1$ was considered statistically significant. Kolmogorov–Smirnov test was used for normality test. In the current study, the data conforms to a normal distribution. Independent samples t-test and analysis of one-way variance (ANOVA) were used to explore the relationship between sociodemographic variables, illness-related variables, dyadic variables, psychological variables, and psychological stress in patients with lung cancer and FCs, respectively, and to compare differences in the means of scores for each variable between groups. Further post hoc multiple comparisons were performed using the Student–Newman–Keuls (SNK) test. Besides, paired t-tests or McNemar's test were used to test whether there were significant differences in scores or level for each variable between patients with lung cancer patients and FCs. According to the principle of upper and lower 27% in item analysis in psychometrics [34], according to the range of scale scores, the upper 27% can be defined as the high group, the lower 27% as the low group, and the middle 28% to 73% as the middle group.

Spearman's correlation analysis was used to analyze the correlation between the level of mindfulness, self-compassion, and psychological stress (anxiety and depression) of patients with lung cancer and the level of corresponding variables of their FCs, respectively.

In the current study, we performed multiple linear regression analysis by using the bidirectional stepwise procedure, which is a combination of forward selection and backward elimination [35]. We also included statistically significant covariates from one-way analyses in the equation. Depression and anxiety scores of lung cancer patients and caregivers were included as dependent variables, and statistically significant correlated variables from univariate analyses were included as independent variables. We set the significance level $\alpha \leq 0.10$ as the criterion for including the variables and $\alpha \geq 0.15$ for excluding the variables [36].

Ethical considerations

Ethical review of this study was obtained from the Behavioral Medicine and Nursing Ethics Review Committee of Our University in January 2021 (Approval number: E202109). The participants signed an informed consent form and confirmed before signing that they were fully aware of the purpose of the study, the study protocol, the risks and adverse effects, the benefits and advantages, and the confidentiality of the study data regarding the patients' personal information.

Results

Socio-demographic, illness, and dyadic characteristics of patients with lung cancer and their family caregivers

A total of 254 out of 300 patients with lung cancer and their FCs participated in the study (response rate: 84.7%), and 46 dyads of invalid questionnaires were excluded because of obvious duplication of questionnaire filling and patients and caregivers in the same family not completing the questionnaire at the same time.

As shown in Table 1, the age of patients with lung cancer ranged from 23 to 79 years, with a mean age of (58.37 ± 10.60) years and the age of caregivers ranged from 18 to 78 years, with a mean age of (51.82 ± 13.23) years old.

Table 1 Relationships between depression and anxiety scores and sociodemographic, illness characteristics, caregiving characteristics, and psychologically relevant variables in different patients with lung cancer and their family caregivers (*N* = 254)

Variables		**Number of patients (percentage)**	**Patients' depression scores (*N* = 254, M ± SD)**	**t/F**	***P* value**	**Patients' anxiety scores (*N* = 254, M ± SD)**	**t/F**	***P* value**	**Number of caregivers (percentage)**	**Caregivers' depression scores (*N* = 254, M ± SD)**	**t/F**	***P* value**	**Caregivers' anxiety scores (*N* = 254, M ± SD)**	**t/F**	***P* value**
Age (year)	M ± SD	58.3 ± 10.60							51.8 ± 13.23						
	Range (minimum, maxmum)	23, 79							18, 78						
	≤ 20	0 (0.0)	-	0.666	.515	-	0.193	.824	3 (1.2)	7.00 ± 4.00	.540	.655	8.67 ± 1.53	0.248	.862
	21–40	15 (5.9)	6.27 ± 3.39			7.53 ± 1.25			60 (23.6)	6.85 ± 4.78			8.07 ± 1.83		
	41–60	124 (48.8)	6.72 ± 4.45			7.73 ± 1.54			122 (48.0)	6.89 ± 3.68			8.01 ± 1.78		
	≥ 61	115 (45.3)	6.63 ± 3.48			7.64 ± 1.42			69 (27.2)	6.77 ± 4.56			7.90 ± 1.68		
Gender	Male	161 (63.5)	6.63 ± 4.45	−0.231	.818	7.60 ± 1.40	−1.126	.261	100 (39.4)	6.98 ± 3.75	.934	.351	8.07 ± 1.82	0.511	.610
	Female	36.6 (36.6)	7.18 ± 3.48			7.82 ± 1.57			154 (60.6)	7.28 ± 4.62			7.95 ± 1.72		
Residence	Countryside	107 (42.1)	6.65 ± 3.42	1.791	.169	7.36 ± 1.41	1.820	.164	140 (55.1)	7.34 ± 4.72	14.477	.000*	7.46 ± 1.70	11.451	.000*
	Town	56 (22.0)	6.36 ± 4.47			6.74 ± 1.49			48 (18.9)	6.29 ± 3.57			6.42 ± 1.39		
	City	91 (35.8)	4.82 ± 3.48			6.82 ± 1.36			66 (26.0)	4.24 ± 3.29			8.12 ± 1.66		
Average monthly earnings (RMB)	≤ 1000	49 (19.3)	6.82 ± 5.36	0.646	.630	6.57 ± 1.62	0.539	.707	51 (20.1)	6.94 ± 5.54	0.539	.707	7.09 ± 1.87	0.254	.907
	1001–3000	90 (35.4)	6.57 ± 2.41			7.63 ± 1.62			68 (26.8)	6.97 ± 2.84			7.86 ± 1.78		
	3001–5000	80 (31.5)	6.63 ± 2.62			7.00 ± 1.51			90 (35.4)	6.76 ± 2.69			6.00 ± 1.83		
	5001–7000	22 (8.7)	5.00 ± 2.51			7.77 ± 1.24			29 (11.4)	5.83 ± 2.65			6.06 ± 1.39		
	≥ 7001	13 (5.1)	4.77 ± 3.24			6.84 ± 1.54			16 (6.3)	4.75 ± 3.48			8.42 ± 1.95		
Occupation	Personnel of enterprises	19 (7.5)	6.58 ± 1.64	0.771	.593	8.07 ± 1.54	0.719	.634	45 (17.7)	7.04 ± 1.78	1.340	.240	8.50 ± 1.70	2.433	.026*
	Personnel of institutions	27 (10.6)	7.11 ± 1.22			8.07 ± 1.54			30 (11.8)	7.27 ± 1.53			8.50 ± 1.70		
	Farmer	85 (33.5)	6.51 ± 1.46			7.47 ± 1.39			63 (24.8)	7.10 ± 1.68			8.15 ± 1.85		
	Freelancer	25 (9.8)	6.48 ± 2.45			7.60 ± 1.50			30 (11.8)	6.57 ± 2.83			7.30 ± 1.73		
	Retired	58 (22.8)	6.62 ± 1.57			7.41 ± 1.46			37 (14.6)	6.46 ± 1.61			5.57 ± 1.57		
	Unemployed	35 (13.8)	6.86 ± 1.26			7.77 ± 1.37			40 (15.7)	6.55 ± 1.47			5.73 ± 1.45		
	Others	5 (2.0)	5.60 ± 2.07			7.80 ± 1.48			9 (3.6)	5.89 ± 1.90			8.44 ± 1.88		

Table 1 (continued)

Variables		Number of patients (percentage)	Patients' depression scores (*N* = 254, M ± SD)	t/F	*P* value	Patients' anxiety scores (*N* = 254, M ± SD)	t/F	*P* value	Number of caregivers (percentage)	Caregivers' depression scores (*N* = 254, M ± SD)	t/F	*P* value	Caregivers' anxiety scores (*N* = 254, M ± SD)	t/F	*P* value
Family living situation	With couple only	123 (48.4)	6.82 ± 1.45	2.467	.045*	7.84 ± 1.50	2.700	.031*	-	-			-		
	With children only	50 (19.7)	6.20 ± 2.26			7.12 ± 1.29			-	-			-		
	With parents and children	20 (7.9)	6.30 ± 3.78			7.55 ± 1.57			-	-			-		
	Alone or with parents	8 (3.1)	7.38 ± 2.92			8.25 ± 1.75			-	-			-		
	With couple and children	53 (20.9)	6.70 ± 1.35			8.81 ± 1.36			-	-			-		
Duration of illness (year)	≤ 0.5	191 (75.2)	6.57 ± 2.38	2.101	.068	8.70 ± 2.16	2.487	.041*	-	-			-		
	0.5–1	32 (12.6)	6.59 ± 2.52			8.00 ± 1.55			-	-			-		
	1–1.5	10 (3.9)	7.70 ± 2.16			6.59 ± 1.52			-	-			-		
	≥ 1.5	21 (1.2)	7.00 ± 2.55			6.57 ± 1.38			-	-			-		
Number of complications	0	161 (63.4)	6.70 ± 2.46	2.389	.047*	6.70 ± 1.50	2.472	.045*	-	-			-		
	1	55 (21.7)	6.29 ± 2.23			7.35 ± 1.28			-	-			-		
	2	27 (10.6)	6.78 ± 1.55			7.89 ± 1.40			-	-			-		
	≥ 3	11 (4.3)	7.45 ± 2.92			8.55 ± 1.70			-	-			-		
Number of hospitalisations	1	95 (37.4)	6.61 ± 2.32	3.097	.016*	7.72 ± 1.39	1.543	.190	-						
	2	35 (13.8)	6.23 ± 2.35			7.14 ± 1.22			-						
	3	29 (11.4)	6.62 ± 1.47			7.76 ± 1.55			-						
	4	19 (7.5)	6.05 ± 2.65			7.63 ± 1.34			-						
	≥ 5	76 (29.9)	7.25 ± 2.65			7.87 ± 1.63			-						

Table 1 (continued)

Variables		Number of patients (percentage)	Patients' depression scores (*N* = 254, M ± SD)	t/F	*P* value	Patients' anxiety scores (*N* = 254, M ± SD)	t/F	*P* value	Number of caregivers (percentage)	Caregivers' depression scores (*N* = 254, M ± SD)	t/F	*P* value	Caregivers' anxiety scores (*N* = 254, M ± SD)	t/F	*P* value
Treatment method	Surgery	86 (33.9)	6.56 ± 2.38	0.437	.898	6.69 ± 1.51	.522	.839	-	-			-		
	Chemotherapy only	54 (21.3)	6.76 ± 2.69			7.69 ± 1.69			-	-			-		
	Radiotherapy only	9 (3.5)	7.11 ± 1.78			8.11 ± 0.78			-	-			-		
	Surgery combined with chemotherapy	25 (9.8)	6.40 ± 1.32			7.44 ± 1.12			-	-			-		
	Surgery combined with radiotherapy and chemotherapy	6 (2.4)	6.50 ± 1.52			7.83 ± 1.17			-	-			-		
	Chemotherapy combined with immunotherapy	8 (3.1)	6.52 ± 1.36			6.42 ± 1.34			-	-			-		
	Chemotherapy combined with targeted therapy	31 (12.2)	6.88 ± 2.17			6.50 ± 1.77			-	-			-		
	Radiotherapy combined with chemotherapy	8 (3.1)	6.75 ± 1.28			7.75 ± 2.17			-	-			-		
	Immunotherapy only or other	27 (10.7)	6.89 ± 1.50			8.04 ± 1.56			-	-			-		

Table 1 (continued)

Variables		Number of patients (percentage)	Patients' depression scores (*N* = 254, M ± SD)	t/F	*P* value	Patients' anxiety scores (*N* = 254, M ± SD)	t/F	*P* value	Number of caregivers (percentage)	Caregivers' depression scores (*N* = 254, M ± SD)	t/F	*P* value	Caregivers' anxiety scores (*N* = 254, M ± SD)	t/F	*P* value
TNM Stage	Ia	14 (5.5)	7.00 ± 1.47	.878	.525	8.57 ± 2.91	1.232	.286	-	-			-		
	Ib	4 (1.6)	6.00 ± 1.16			7.50 ± 2.92			-	-			-		
	IIa	3 (1.2)	5.67 ± 1.16			6.67 ± 1.16			-	-			-		
	IIb	13 (5.1)	7.08 ± 0.86			7.54 ± 0.88			-	-			-		
	IIIa	6 (2.4)	5.33 ± 1.03			7.17 ± 2.60			-	-			-		
	IIIb	18 (7.1)	7.00 ± 1.61			7.94 ± 1.43			-	-			-		
	IV	52 (20.5)	5.73 ± 1.84			7.73 ± 1.73			-	-			-		
	Unknown	144 (56.7)	6.56 ± 1.35			6.60 ± 1.33			-	-			-		
Pathology	Squamous carcinoma	48 (18.9)	6.88 ± 1.76	.884	.474	7.58 ± 1.65	.613	.654	-	-			-		
	Adenocarcinoma	127 (50.0)	6.48 ± 1.39			7.61 ± 1.48			-	-			-		
	Adenosquamous carcinoma	4 (1.6)	6.75 ± 2.36			7.75 ± 2.36			-	-			-		
	Small cell carcinoma	23 (9.1)	6.78 ± 1.17			7.65 ± 1.23			-	-			-		
	Unknown	52 (20.5)	6.79 ± 1.36			6.96 ± 1.30			-	-			-		
Patient informed diagnosis	No	64 (25.2)	6.30 ± 1.39	−2.256	.025*	7.55 ± 1.47	.722	.398	-	-			-		
	Yes	190 (74.8)	6.77 ± 1.47			7.73 ± 1.47			-	-			-		
Relationship to patient	Parents	-	-			-			53 (20.9)	6.98 ± 1.74	2.101	.081	8.08 ± 1.92	3.445	.009*
	Spouse	-	-			-			160 (63.0)	6.73 ± 1.58			7.79 ± 1.61		
	Children	-	-			-			28 (11.0)	7.61 ± 1.97			9.07 ± 1.96		
	Siblings	-	-			-			7 (2.8)	6.14 ± 1.57			7.71 ± 2.80		
	Other relatives	-	-			-			6 (2.4)	6.67 ± 1.63			8.33 ± 1.63		

Table 1 (continued)

Variables		Number of patients (percentage)	Patients' depression scores ($N=254$, M ± SD)	t/F	*P* value	Patients' anxiety scores ($N=254$, M ± SD)	t/F	*P* value	Number of caregivers (percentage)	Caregivers' depression scores ($N=254$, M ± SD)	t/F	*P* value	Caregivers' anxiety scores ($N=254$, M ± SD)	t/F	*P* value
Duration of providing care (year)	≤ 0.5	-	-			-			141 (55.5)	7.06 ± 1.71	1.901	.111	8.24 ± 1.84	2.268	.062
	0.5–1	-	-			-			49 (19.3)	6.39 ± 1.63			7.43 ± 1.43		
	1–1.5	-	-			-			25 (9.8)	7.04 ± 1.54			8.16 ± 1.70		
	1.5–2	-	-			-			14 (5.5)	6.43 ± 1.79			7.71 ± 1.98		
	≥ 2	-	-			-			25 (9.8)	6.68 ± 1.46			7.76 ± 1.62		
Number of other caregivers	0	-	-			-			131 (51.6)	6.46 ± 1.60	6.602	.000*	7.54 ± 1.60	8.273	.000*
	1	-	-			-			75 (29.5)	7.27 ± 1.66			8.53 ± 1.71		
	2	-	-			-			41 (16.1)	7.49 ± 1.65			8.63 ± 1.95		
	≥ 3	-	-			-			7 (2.8)	6.29 ± 1.50			7.14 ± 1.07		
Illness perception of patients	Low level	-	4.89 ± 0.93	38.627	.000*	6.08 ± 1.12	25.625	.000*	-	-			-		
	Moderate level	-	7.10 ± 1.48			8.02 ± 1.48			-	-			-		
	High level	-	9.75 ± 0.96			9.75 ± 0.96			-	-			-		
Self-compassion of patients	Low level	-	9.38 ± 1.92	17.318	.000*	8.88 ± 2.23	15.726	.000*	-	-			-		
	Moderate level	-	5.94 ± 1.43			7.93 ± 1.38			-	-			-		
	High level	-	3.85 ± 1.14			5.94 ± 1.30			-	-			-		
Mindfulness of patients	Low level	-	9.93 ± 1.86	11.558	.000*	9.14 ± 1.70	16.016	.000*	-	-			-		
	Moderate level	-	6.70 ± 1.41			7.74 ± 1.40			-	-			-		
	High level	-	3.86 ± 1.09			5.74 ± 1.12			-	-			-		
Dyadic coping of patients	Moderate level	-	5.87 ± 1.51	18.543	.000*	7.91 ± 1.51	19.339	.000*	-	-			-		
	High level	-	3.00 ± 1.08			7.02 ± 1.10			-	-			-		
Illness perception of family caregivers	Low level	-	-			-			-	3.93 ± 1.32	38.368	.000*	7.17 ± 1.38	24.933	.000*
	Moderate level	-	-			-			-	6.94 ± 1.54			8.08 ± 1.70		
	High level	-	-			-			-	10.71 ± 0.99			10.50 ± 1.29		

Table 1 (continued)

Variables		Number of patients (percentage)	Patients' depression scores ($N = 254$, M ± SD)	t/F	*P* value	Patients' anxiety scores ($N = 254$, M ± SD)	t/F	*P* value	Number of caregivers (percentage)	Caregivers' depression scores ($N = 254$, M ± SD)	t/F	*P* value	Caregivers' anxiety scores ($N = 254$, M ± SD)	t/F	*P* value
Self-compassion of family caregivers	Low level	-	-			-			-	7.17 ± 1.52	16.552	.000*	8.42 ± 1.83	18.226	.000*
	Moderate level	-	-			-			-	7.19 ± 1.65			8.33 ± 1.65		
	High level	-	-			-			-	3.85 ± 1.46			5.90 ± 1.49		
Mindfulness of family caregivers	Low level	-	-			-			-	6.55 ± 1.04	2.386	.094	8.91 ± 1.81	2.855	.059
	Moderate level	-	-			-			-	5.91 ± 1.70			8.05 ± 1.74		
	High level	-	-			-			-	5.46 ± 1.62			5.59 ± 1.76		
Dyadic coping of family caregivers	Moderate level	-	-			-			-	6.10 ± 1.72	8.949	.000*	8.26 ± 1.79	9.862	0.000*
	High level	-	-			-			-	3.08 ± 1.24			6.15 ± 1.34		

Personnel of enterprises, e.g., office staffs, workers. Personnel of institutions, e.g., teachers, doctors

* $P < .05$, ** $P < .01$

Patients with lung cancer were predominantly male (161, 63.5%), and caregivers were predominantly female (154, 60.6%). Most patients were diagnosed within 0.5 years (191, 75.2%); more than one third of patients were first-time hospitalized (95, 37.4%); the treatment modality was predominantly surgery (86, 33.9%), followed by chemotherapy alone (54, 21.3%); more than one quarter of patients (20.5%) were stage IV; and about half of the patients had adenocarcinoma (127, 50.0%). Caregivers were mainly spouses of patients (160, 63.0%); and the main duration of caregiving by caregivers was mainly within 0.5 years (141, 55.5%).

Characteristics of psychological stress in patients with lung cancer and their family caregivers

In this study, the average score of depression in patients with lung cancer was (6.65 ± 4.46), and the positive rate of depression was 21.3% (95%CI = 16.2% ~ 26.3%); and the average score of anxiety in patients with lung cancer was (6.68 ± 3.47), and the positive rate was 22.0% (95% CI = 16.9% ~ 27.2%). Besides, the average score of depression in family caregiver was (6.86 ± 5.67), and the positive rate was 29.5% (95% CI = 23.9% ~ 35.2%); and the mean score of anxiety in FCs was (6.30 ± 3.76), and the positive rate was 33.5% (95% CI = 27.6% ~ 39.3%).

There was no statistically significant difference in depression scores between patients with lung cancer and caregivers ($P = 0.088$), but there was a statistically significant difference in anxiety scores between the dyads ($P = 0.011$), and caregivers' anxiety scores were higher than patients' scores. In addition, the positive rate of depression was lower in patients with lung cancer than in caregivers, and the difference was statistically significant ($P = 0.012$). The positive rate of anxiety in lung cancer patients was lower than that of caregivers, and the difference was statistically significant ($P < 0.001$).

Relationship of psychological stress of patients with lung cancer and their family caregivers with socio-demographic, illness characteristics, dyadic, and psychological variables

As shown in Table 1, the results of the univariate analysis showed that differences in the depression scores of patients with lung cancer in terms of number of complications, number of hospitalizations, whether the patient was informed about the cancer diagnosis or not, the patient's illness perception, the patient's self-compassion, the patient's mindfulness, and the patient's level of dyadic coping were statistically significant ($p < 0.05$). Meanwhile, the differences in anxiety scores of patients with lung cancer in terms of family living situation, duration of illness, number of complications, patients' illness perception, patients' self-compassion, patients' mindfulness, and patients' dyadic coping were statistically significant ($P < 0.05$). Further post hoc multiple comparisons showed that, in terms of family living situation, there was no statistically significant differences in depression and anxiety scores among patients ($p > 0.05$). In terms of duration of illness, there was a statistically significant difference between the scores of the groups with 1–1.5 years of illness and the rest of the duration of illness among patients. As for the number of complications, there was no statistically significant difference between the depression and anxiety scores of patients in each group ($p > 0.05$) except for the difference between patients who suffered from more than three complication and those who suffered from less than three complications ($p < 0.05$). As for the number of hospitalizations, the scores of the group with four times hospitalizations were significantly different from those of the other groups, while the differences in the scores of the other groups were not statistically significant ($p < 0.05$). As for illness perception, mindfulness, and self-compassion of patients, there were statistically significant differences in depression and anxiety scores among patients with high, moderate, and low levels of illness perception, mindfulness, and self-compassion ($p < 0.05$).

Meanwhile, the results of univariate analysis showed that the differences in caregivers' depression scores of were statistically significant ($p < 0.05$) with respect to place of residence, number of other caregivers, caregivers' perception of illness, caregivers' self-compassion, and caregivers' level of dyadic coping. In addition, the differences in their caregivers' anxiety levels were statistically significant ($P < 0.05$) in terms of place of residence, occupation, type of relationship with the patient, number of other caregivers, caregivers' perception of illness, caregivers' self-compassion, and caregivers' level of dyadic coping. Further post hoc multiple comparisons showed that, in terms of residence, there were statistically significant differences in depression and anxiety scores for caregivers in cities, counties, or towns versus countryside ($p < 0.05$). In terms of occupation, there was no statistically significant differences in anxiety scores among caregivers in each occupational group ($p > 0.05$). As for illness perception,mindfulness of caregivers, there were statistically significant differences in depression and anxiety scores among caregivers with high, moderate, and low levels of illness perception and mindfulness($p < 0.05$). As for self-compassion of caregivers, the differences in depression and anxiety scores between caregivers in the high and moderate, between high and low levels of self-compassion groups were statistically significant($p < 0.05$).

Table 2 Comparisons and associations of illness perception, self-compassion, mindfulness, dyadic coping, depression, and anxiety scores between patients with lung cancer and family caregivers ($N = 254$)

Variables	Patients with lung cancer	Family caregivers	Difference	t/χ2 value	*P* value	Correlation of patients with lung cancer and family caregivers	
	Mean ± SD, n (%)	Mean ± SD, n (%)				ρ	*P* value
Illness perception	25.72 ± 11.91	31.37 ± 14.03	−5.654 ± 16.349	−5.511 [a]	.000***	0.134	.0033*
Low level	103 (40.6)	48 (18.9)		-b	.000***		
Moderate level	147 (57.9)	144 (56.7)		-b	.088		
High level	103 (40.6)	48 (18.9)		-b	.000***		
Self-compassion	84.43 ± 11.19	82.45 ± 12.39	0.460 ± 3.093	2.399[a]	.017*	0.290	.000**
Low level	8 (3.1)	48 (18.9)		- b	.000***		
Moderate level	175 (68.9)	144 (56.7)		- b	.000***		
High level	71 (28.0)	62 (24.4)		- b	.045*		
Mindfulness	56.92 ± 12.82	57.46 ± 13.08	−0.537 ± 13.893	-.616[a]	.539	0.308	.000**
Low level	14 (5.5)	11 (4.3)		- b	.795		
Moderate level	205 (80.7)	197 (77.6)		- b	.096		
High level	35 (13.8)	46 (18.1)		- b	.043*		
Dyadic coping	122.77 ± 18.46	120.85 ± 19.48	1.920 ± 17.264	1.773[a]	.078	0.438	.000**
Moderate level	189 (74.4)	194 (76.4)		- b	.096		
High level	65 (25.6)	60 (23.6)		- b	.058		
Depression	6.65 ± 4.46	6.86 ± 5.67	−0.209 ± 1.944	−1.711[a]	.088	0.212	.001**
Negative group	200 (78.7)	179 (70.5)		- b	.032*		
Positive group	54 (21.3)	75 (29.5)		- b	.012*		
Anxiety	6.68 ± 4.47	6.30 ± 3.76	−0.319 ± 1.973	−2.576[a]	.011*	0.287	.000**
Negative group	198 (78.0)	169 (66.5)		- b	.000***		
Positive group	56 (22.0)	85 (33.5)		- b	.000***		

Participants with a score of < 5 points were in the negative group, and those with a score of ≥ 5 were in the positive group. Spearman's correlation analysis was used to analyze the correlation between the level of mindfulness, self-compassion, anxiety, and depression of patients with lung cancer and the level of corresponding variables of their FCs, respectively

* $P < .05$, **$P < .01$, ***$P < .001$

[a] Indicates using paired t-test paired samples t-test

[b] Indicates using McNemar's test with no statistics, only *P*-values

Correlation analysis of illness perception, self-compassion, mindfulness, dyadic coping, depression, and anxiety in patients with lung cancer and family caregivers

As shown in Table 2, patients' illness perception, self-compassion, mindfulness, dyadic coping, depression, and anxiety were all correlated with these variables in caregivers ($\rho = 0.134 \sim 0.438$, $P < 0.05$).

Multiple linear regression analyses of factors influencing psychological stress in patients with lung cancer and their caregivers

Multiple linear regression analysis of depression scores in patients with lung cancer

As shown in Table 3, the results showed that the model explained 31.4% of the total variance in the variance of depression in patients with lung cancer, which was statistically significant ($F = 20.309$, $P = 0.000$). Patients' illness perception ($\beta = 0.402$, $P < 0.001$) positively predicted depression scores in patients with lung cancer, and patients' level of mindfulness ($\beta = -0.128$, $P < 0.001$) and level of self-compassion ($\beta = -0.214$, $P < 0.001$) negatively predicted their depression scores.

Multiple linear regression analysis of anxiety scores in patients with lung cancer

As shown in the Table 4, the results showed that the model explained 27.1% of the total variance in the variance of anxiety in patients with lung cancer, which was statistically significant ($F = 19.798$, $P = 0.000$). Patients' level of illness perception ($\beta = 0.298$, $P < 0.001$) positively predicted patients with lung cancer' anxiety scores; patients' level of mindfulness ($\beta = -0.209$,

Table 3 Multiple linear regression analysis of depression in patients with lung cancer ($N=254$)

Predictor variable	B	β	t	*P* value
Constant	2.721		4.124	.000***
Illness perception of patients	1.127	0.402	7.420	.000***
Dyadic coping of patients	−0.228	−0.068	−1.186	.237
Family living situation				
With couple only (reference)				
With parents and children	−0.395	−0.073	−1.368	.172
With children only	−0.206	−0.056	−1.024	.307
Mindfulness of patients	−0.432	−0.128	−2.308	.022*
Self-compassion of patients	−0.622	−0.214	−3.609	.000***
R^2	0.330			
Adjusted R^2	0.314			
F	20.309			
P value	.000***			

Bidirectional stepwise multiple linear regression method applied

$^{*}P<.10$, $^{***}P<.001$

Table 4 Multiple linear regression analysis of anxiety in patients with lung cancer ($N=254$)

Predictor variable	B	β	t	*P* value
Constant	3.712		5.433	.000**
Illness perception of patients	0.840	0.298	5.344	.000***
Dyadic coping of patients	−0.284	−0.085	−1.426	.155
Family living situation				
With couple only (reference)				
With children only	−0.328	−0.089	−1.588	.113
Mindfulness of patients	−0.708	−0.209	−3.696	.000***
Self-compassion of patients	−0.536	−0.183	−2.999	.003**
R^2	0.285			
Adjusted R^2	0.271			
F	19.798			
P value	.000**			

Bidirectional stepwise multiple linear regression method applied

$^{**}P<.01$, $^{***}P<.001$

$P<0.001$), and level of self-compassion ($\beta=-0.183$, $P=0.003$) all negatively predicted their anxiety scores.

Multiple linear regression analysis of depression scores in family caregivers

As shown in Table 5, the results showed that the model explained 29.6% of the total variance in the variance of caregivers' depression, which was statistically significant ($F=16.230$, $P=0.000$). The results showed that caregivers' level of illness perception ($\beta=0.344$, $P<0.001$), and the number of people assisting with caregiving ($\beta=0.175$, $P=0.001$) positively predicted caregivers' depression score. Caregiver's dyadic coping level ($\beta=-0.102$, $P=0.079$), residence in county or town ($\beta=-0.184$, $P=0.001$), and city ($\beta=-0.179$, $P=0.002$) negatively predicted caregiver's depression scores. However, caregiver's level of mindfulness ($\beta=-0.077$, $P=0.163$) did not predict their depression scores.

Table 5 Multiple linear regression analysis of depression in family caregivers ($N=254$)

Predictor variable	B	β	t	*P* value
Constant	1.189		1.763	.079*
Illness perception of family caregivers	1.135	0.344	6.131	.000**
Number of persons assisting in care	0.349	0.175	3.267	.001**
Dyadic coping of family caregivers	−0.394	−0.102	−1.764	.079*
Residence				
Countryside (reference)				
Town	−0.784	−0.184	−3.277	.001**
City	−0.684	−0.179	−3.106	.002**
Mindfulness of family caregivers	−0.283	−0.077	−1.399	.163
Self-compassion of family caregivers	−0.223	−0.088	−1.526	.128
R^2	0.316			
Adjusted R^2	0.296			
F	16.230			
P value	.000**			

Bidirectional stepwise multiple linear regression method applied

$^{*}P<.10$, $^{**}P<.01$

Multiple linear regression analysis of anxiety scores in family caregivers

As the results are shown in Table 6, the model explained 30.2% of the total variance in the variance of caregivers' depression, which was statistically significant ($F=11.929$, $P=0.000$). Caregiver's illness perception ($\beta=0.262$, $P<0.001$), relationship with the patient as a couple ($\beta=0.173$, $P=0.002$), and the number of other caregiver ($\beta=0.157$, $P=0.005$) positively predicted caregiver's anxiety scores; caregiver's level of dyadic coping ($\beta=-1.948$, $P=0.053$), occupation as a farmer ($\beta=-0.146$, $P=0.008$) or working in a government institution ($\beta=-0.112$, $P=0.057$), living in a county ($\beta=-0.161$, $P=0.006$) or city ($\beta=-0.181$, $P=0.004$), caregiver's level of mindfulness ($\beta=-0.113$, $P=0.042$), caregiver's level of self-compassion ($\beta=-0.140$, $P=0.016$) all negatively predicted their anxiety scores.

Discussion

To our knowledge, this is one of the few dyadic studies to comprehensively explore the influencing factors of depression and anxiety among patients with lung cancer and their FCs. We found a high prevalence of depression

Table 6 Multiple linear regression analysis of anxiety in family caregivers (*N* = 254)

Predictor variable	B	β	t	*P* value
Constant	3.260		4.029	.000**
Illness perception of family caregivers	0.907	0.262	4.686	.000**
Relationship to patient				
Parents (reference)				
Spouse	0.971	0.173	3.197	.002**
Dyadic coping of family caregivers	−0.457	−0.113	−1.948	.053*
Number of persons assisting in care	0.329	0.157	2.860	.005**
Occupation				
Personnel of enterprises (reference)				
Famers	−0.792	−0.146	−2.670	.008**
Personnel of institutions	−0.455	−0.112	−1.912	.057*
Residence				
Countryside (reference)				
Town	−0.722	−0.161	−2.794	.006**
City	−0.722	−0.181	−2.923	.004**
Mindfulness of family caregivers	−0.436	−0.113	−2.045	.042*
Self-compassion of family caregivers	−0.374	−0.140	−2.434	.016*
R^2	0.329			
Adjusted R^2	0.302			
F	11.929			
P value	0.000**			

Bidirectional stepwise multiple linear regression method applied

* *P* < .10, ** *P* < .01

and anxiety among lung cancer patients and their FCs. Notably, the prevalence of depression and anxiety in FCs exceeded that of patients. Importantly, we systematically determined that depression and anxiety in lung cancer patients and caregivers were influenced by several socio-demographic, disease, dyadic, and psychological variables, such as family living situation, number of other caregivers, place of residence, and patient-caregiver relationship, as well as levels of illness perception, mindfulness, self-compassion, and dyadic coping.

Specifically, the study found that 21.3% of lung cancer patients and 29.5% of caregivers experienced depression, which was consistent with previous studies which found that the prevalence of depression in patients with lung cancer ranged from 11 to 44% [37], and in caregivers of cancer patients ranged from 20 to 30% [38]. Additionally, 22.0% of lung cancer patients and 33.5% of caregivers reported anxiety, which was consistent with previous findings that the prevalence of anxiety among patients with lung cancer ranged from 8% to 50.7% [39] and that 46.56% of caregivers experienced anxiety [40, 41]. This may be because patients with lung cancer have depression or anxiety reactions due to uncertainty about the illness and suffering from severe physical symptoms. Similarly, caregivers are prone to depression or anxiety due to the disruption of their previous life pattern and the need to balance caring for the patient, managing work and life issues, and worrying about their loved one's prognosis. Interestingly, the prevalence of depression and anxiety in FCs was higher among FCs than among patients, which was partly similar to those in previous studies [42]. The possible reasons may be as follows: first, more than half of the patients with lung cancer were recently diagnosed with cancer, while most of the caregivers had been providing care for less than half a year, and family members were thrust into their new caregiving roles without preparation. This lack of preparation can lead to a lack of confidence in their ability to care and feelings of anxiety and depression due to the uncertain future demands of their caregiving role. Meanwhile, more than half of the caregivers were the sole caregiver of patients, and nearly half of the caregivers had other full-time jobs. Thus, primary caregivers may lack adequate social support, along with other family and social responsibilities, and may experience higher levels of anxiety and depression than the patients. Therefore, screening and intervening for anxiety and depression in caregivers early in the patient's illness and providing appropriate social support may reduce the ongoing burden on caregivers and enhance their ability to care for patients.

Interestingly, we did not find a significant effect of socio-demographic, disease-related, and dyadic variables on depression in patients with lung cancer. This may be because more than three-quarters of the patients in this study were in the early stages of cancer diagnosis and had limited knowledge about the disease [43], and more than one-third were suffering from complications, so patients regardless of their demographic and disease background were facing severe psychological stress and exhibited depression. Additionally, the present study may have neglected to investigate some of the potential influencing factors of depression, such as patient's ethnicity, religiosity [44], current disease status [45], physical activity [45], work conditions [45], and presence of pain. However, in the post hoc multiple comparisons, we found that patients who were diagnosed with cancer for 1–1.5 years had higher depression and anxiety scores than the patients with less than one year or more than 1.5 years. This may be because patients in the early stages of diagnosis (within one year of diagnosis) usually need to receive regular treatment (such as chemotherapy, radiotherapy, etc.), and may experience a series of adverse reactions to treatment, which gradually increases the patient's negative emotions [46]. After regular treatment, with the further prolongation of the disease duration (more than 1.5 years), patients have accumulated more knowledge and skills about the disease and have become more and more adapted to the impact of the disease on their lives [46]. Therefore, their negative emotions such as anxiety and depression have gradually been alleviated. As for the number of complications, patients who suffered from three complications have higher depression and anxiety scores than those who suffered from fewer than three complications. This may be because the more complications a patient has, the more severe the physical symptoms may be, the worse the prognosis of the disease, and the greater the impact on the patient's psychological condition [47].

Additionally, different living situations influenced patients' anxiety, with those living with their children having lower levels of anxiety than those living with their parents only. This may be due to the fact that patients living only with their children are older, and their children are usually adult children with full-time jobs who can provide more adequate support in terms of information about the illness, decision making about the treatment plan, financial and daily life care, etc., and the patients themselves need to bear less family responsibility, which generates less psychological pressure [48].

We also found that differences in the number of other caregivers and residence influenced caregiver depression. Specifically, the higher the number of other caregivers, the higher the caregiver depression scores, which is inconsistent with previous research. Previous studies [49] have found that the greater the number of other caregivers, the greater the perceived social support of the patient and primary caregiver, and the lower level of negative affect. This inconsistency could be explained by the fact that when there are more caregivers caring for the patient, different family members may have different preferences regarding treatment expectations and may be more likely to disagree about treatment decisions [50]. Therefore, primary caregivers are likely to experience decision-making conflict. Moreover, depression scores were lower for caregivers living in towns than for those living in rural areas. Previous studies have also found that caregivers living in rural areas may lack illness-related knowledge and medical resources, and may be more prone to feelings of loss of control and powerlessness, which may also affect their involvement in patients' treatment decisions.

Furthermore, differences in the type of relationship to patient, occupation, and place of residences affect caregiver anxiety. This may be related to Chinese Confucian culture; spouses are usually in an interdependent relationship with the patient, with each being the other's main source of emotional support, and spouses may be more concerned about the patient's health and the risk of losing their loved one [51]. Meanwhile, caregivers who are farmers have lower anxiety scores than those who are enterprise personnel. This may be due to the fact that patients who are farmers tend to have a lower level of education, have limited knowledge about the illness and treatment, and tend to adopt a passive mode of treatment decision-making, such as relying on the doctor or family members to make decisions. They have a lower level of anticipation of treatment outcomes and the need for social reintegration. On the other hand, the more educated employees working in companies are more actively involved in the treatment decision-making process and therefore perceive more decision-making conflict [52].

Collectively, we found that the higher the level of illness perception, the lower the level of mindfulness and self-compassion of patients with lung cancer or FCs, the higher the patients' depression or anxiety scores; also, the lower the level of dyadic coping of FCs, the higher the FCs' anxiety scores. First, we found that the higher the level of illness perception among patients with lung cancer and caregivers, the correspondingly higher depression and anxiety scores of the patients and caregivers, which was similar to findings among breast cancer patients and their spouses [53]. Previous studies [54] have shown that the more negative perceptions patients and caregivers have, the more likely they are to exaggerate the negative impact of cancer itself on patients, weaken t individuals' and families' confidence in self-control and overcoming the illness, and lead to a sense of loss of control and anxiety among patients and FCs, resulting in the expression of negative emotions.

Second, we showed that the lower the mindfulness level of lung cancer patients and caregivers, the higher the depression and anxiety scores of patients and caregivers. Related studies have pointed out that mindfulness can improve an individual's attention to the moment, emotional regulation ability and flexibility, enhance the activity of attention-related brain neural networks, and reduce the negative automatic cognitive thinking process [55], which in turn reduces the use of negative emotion regulation, such as rumination and avoidance, and produces lower levels of negative emotions, such as depression and anxiety.

Third, the lower the level of self-compassion of lung cancer patients and caregivers, the higher the depression and anxiety scores of patients and caregivers. The lower the patient's level of self-compassion, the more likely the patient is to be obsessed with the pain of cancer, self-critical, and unable to tolerate the symptoms and psychological distress caused by the disease [56]. Because caregivers have family and social responsibilities and are influenced by Chinese Confucian culture, caregivers usually follow the spirit of "devotion" [57] and often prioritize the patient's needs to detriment of their own caregiving abilities and psychological needs.

Finally, we demonstrated that the lower the level of dyadic coping in FCs, the higher the caregivers' anxiety scores, confirming that dyadic coping is one of the behaviors of dyadic management and affects health conditions of dyads [58]. Previous studies have showed that FCs may view lung cancer as a "we-disease" and coping as a unit with patients in the face of cancer [59], such as communicating about stress, providing and receiving support from each other, engaging in joint problem solving, and providing emotional support. As a result, FCs with higher levels of dyadic coping are more likely to take a positive approach to communicating about stress and providing mutual support, and are less likely to experience anxiety and depression [60]. However, we did not find an effect of patients' dyadic coping levels on their own anxiety or depression. A possible explanation for this may be that the patient's involvement in a range of dyadic coping activities, such as providing life and emotional support to caregivers, may increase their own physical burden and lead to physical exhaustion, thereby affecting their overall health [59].

Limitations

This study has some potential limitations. First, the present study may not have fully investigated some important influencing factors and neglected some potentially influencing factors, such as patient's ethnicity, religiosity, current disease status, physical exercise, working conditions, and presence of pain. Thus, more factors are needed to be further studied in future. In addition, in terms of data analysis, we did not use the actor-partner independence model to validate dyadic effects between patients and FCs, which is considered appropriate for application to dyadic data. Future studies are recommended to apply the actor-partner independence model to analyze dyadic effects. Another limitation is the limited representativeness of the sample, as the study may have included only those patients and FCs who were willing to share their experiences and who may have higher levels of dyadic coping than those who declined to participate in the study. Future studies may employ qualitative study design to explore the experience of dyadic coping among those lost to follow-up.

Clinical implications

Our findings highlight the prevalence of psychological stress (depression and anxiety) among patients with lung cancer and FCs, and help to identify who is most likely to suffer from psychological stress. Furthermore, healthcare providers could accurately identify controllable adverse factors and provide targeted palliative care and psychosocial interventions to the dyads. For example, providing lung cancer families with disease-related information and knowledge to improve their perceived level of illness, as well as targeted psychosocial skills training such as mindfulness-based intervention [61], compassion-based intervention [62], dyadic coping skills programs [63], etc.

Conclusion

Patients with lung cancer and caregivers have a relatively high prevalence of psychological stress. Depression and anxiety of the patient-caregiver dyads were influenced by family living situation, number of other caregivers, place of residence, patient-caregiver relationship, level of illness perception, mindfulness, self-compassion, and dyadic coping, suggesting that oncology nurses should promptly screen high-risk patient-caregiver dyads who may suffer from severe psychological stress and provide them with targeted psychosocial interventions. These factors need to be further investigated in the future, as the factors considered in this study are limited but cover a wide range of dyadic domains; and dyadic effects also need to be further explored using dyadic data analysis methods.

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Authors' contributions

Juan LI: conceptualization, methodology, formal analysis, writing-original draft preparation, writing-reviewing and editing. Chan LI: investigation, data curation, writing-reviewing and editing. Jie ZOU: formal analysis, investigation, writing-reviewing and editing. Fang-qun CHENG: investigation, writing-reviewing and editing. Li PENG: investigation, writing-reviewing and editing. Li-hong DENG: investigation, writing-reviewing and editing. Pei-pei WU: investigation, writing-reviewing and editing. Sai-yu GAO: investigation, writing-reviewing and editing. Zhi-yao XIONG: investigation, writing-reviewing and editing. Ying ZUO: investigation, writing-reviewing and editing. Yan LUO: investigation, writing-reviewing and editing. Xiao-hua RAO: investigation, writing-reviewing and editing. Bo YUAN: writing-reviewing and editing. Ou-ying CHEN: conceptualization, supervision, writing-reviewing and editing. Jing-ping ZHANG: conceptualization, supervision, writing-reviewing and editing.

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Data availability

The datasets used and analyzed during the current study are available upon reasonable request from the corresponding author.

Declarations

Ethics approval and consent to participate

Ethical review of this study was obtained from the Behavioral Medicine and Nursing Ethics Review Committee of Central South University in January 2021 (Approval number: E202109). The Helsinki Declaration and institutional procedures guided the study. The participants signed an informed consent form and confirmed before signing that they were fully aware of the purpose of the study, the study protocol, the risks and adverse effects, the benefits and advantages, and the confidentiality of the study data.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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