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Fear of recurrence in postoperative lung cancer patients: Trajectories, influencing factors and impacts on quality of life

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Abstract

Aims: To investigate the trajectory, influencing factors and dynamic relationships between fear of cancer recurrence (FCR) and quality of life (QOL) in lung cancer patients.

Design: Prospective longitudinal study.

Methods: Longitudinal data from 310 lung cancer patients across three hospitals in China were assessed at 1, 3, 6 and 12 months postoperatively (T_1–T_4). Descriptive statistics characterised patient demographics, clinical characteristics, levels of FCR and QOL. A linear mixed-effects model was employed to analyse FCR trajectories, identify influencing factors on these trajectories, and predict the impact of FCR on QOL.

Results: FCR changed significantly over time, with a slight decrease during T_1–T_2, an increase at T_3 and gradual decline at T_4. Higher fear levels were associated with female sex, suburban or rural residency, being a family breadwinner, presence of comorbidities and negative coping behaviours, and low family resilience. QOL negatively correlated with FCR, and FCR predicted lower QOL.

Conclusions: At 3 and 6 months postoperatively, lung cancer patients, especially women, suburban or rural residents, family breadwinners, those with comorbidities, negative coping behaviours and low family resilience, reported high levels of FCR. Healthcare providers should pay special attention to lung cancer patients especially during the period of 3–6 months post-surgery and offer tailored interventions to improve their QOL.

Implications for the Profession and Patient Care: Understanding the FCR trajectories, its influencing factors and its negative impacts on QOL can guide the development of targeted interventions to reduce fear and enhance well-being in patients with cancer.

Impact: Identifying the trajectories and influencing factors of fear of lung cancer recurrence in patients at different time points informs future research on targeted interventions to improve QOL.

Reporting Method: The study adhered to the guidelines outlined in the Statement on Reporting Observational Longitudinal Research.

KEYWORDS
change trajectory, fear of cancer recurrence, longitudinal studies, lung cancer, quality of life

Xiaoyan Yang and Yonglin Li should be considered joint first authors.

1 | INTRODUCTION

The number of cases of lung cancer continues to increase worldwide. According to the estimates reported by GLOBOCAN in 2020, newly diagnosed cases of lung cancer accounted for 11.40% of all malignant tumours, making it the leading cause of death (Sung et al., 2021). Although significant advancements in medical technology have improved the curative and survival rates of lung cancer, the rates of recurrence and metastasis remain higher than those of most other malignant tumours (Zeng et al., 2018). These factors remain the primary causes of treatment failure in patients with lung cancer. In the context of a comprehensive treatment model, the prevalence of cancer recurrence for patients with lung cancer with Stage I, Stage II and Stage III disease is 34%, 55% and 74%, respectively. Furthermore, the prevalence of recurrence and metastasis within 2 years of diagnosis can reach as high as 80% (Park & Kim, 2019). Often, initial treatment of recurrent or metastatic lung cancers fail and result in a poor prognosis. This not only imposes significant physical and mental pressures on patients, but also increases the economic burden on their families (Vijayvergia et al., 2015). Lee et al. (2020) revealed that >60%–70% of patients with lung cancer experienced varying degrees of psychological distress after diagnosis. Notably, the fear of cancer recurrence (FCR) was the most common psychological problem faced by patients with lung cancer (Lee et al., 2020). FCR is defined as emotional distress caused by cancer recurrence, progression or metastasis after anticancer treatment (Simard et al., 2013).

FCR is a primary psychological problem affecting patients with cancer (Mirosevic et al., 2019). High FCR levels were observed in 52.8% of patients with head and neck cancers, with 21.1% of these patients having a lifetime history of selective anxiety or major depression (Mirosevic et al., 2019). Additionally, 60.7% of patients with breast cancer exhibit moderate to high levels of FCR (Schapira et al., 2022), and approximately 46% of patients with lung cancer experience moderate-to-severe FCR (Maoni et al., 2017). Patients with cancer whom experience moderate-to-severe FCR often demonstrate long-lasting concerns regarding cancer recurrence or its progression. They may engage in unhelpful negative coping behaviours, such as excessive medical testing or avoidance, that lead to disruptions in daily activities and a limited capacity to plan for the future. These factors can result in increased medical costs, heightened psychological distress (e.g. depression, anxiety, and post-traumatic stress syndrome), impaired somatic functioning and reduced quality of life (QOL) (Otto et al., 2018).

What does this paper contribute to the wider global clinical community?

- The fear of cancer recurrence showed a slight decrease at 1–3 months after surgery, followed by a noticeable increase at 3–6 months, and a gradual decline at 6–12 months, postoperatively.
- Coping behaviours, levels of family resilience, sex, place of residence, economic role in the household and presence of comorbidities influenced the level of fear of cancer recurrence among patients with lung cancer.
- The importance of addressing and managing the fear of cancer recurrence among patients with lung cancer to enhance their quality of life is emphasised.
- The present evidence has identified time-sensitive periods for intervention delivery with vulnerable populations, allowing for tailored interventions in patients with lung cancer that may have a greater influence on quality of life.

2 | BACKGROUND

Several longitudinal studies examining the course of FCR in patients with cancer have yielded mixed findings. In Savard and Ivers (2013), an 18-month study of 962 patients with different cancer types, FCR levels were highest during the perioperative period, significantly decreased at 2 months postoperatively and remained at a relatively stable baseline thereafter. In contrast, Séguin Leclair et al. (2019) found that FCR decreased significantly over time in most patients with cancer, although different decreasing trends were identified within various trajectory groups. Thus, there appears to be a lack of consensus regarding the trajectory of FCR in cancer populations, specifically with regard to the timing of changes in FCR levels.

The Lee–Jones theoretical model of FCR that explores the influencing factors of FCR trajectories in patients with cancer suggests that antecedent individual and interpersonal factors contribute to FCR development (Simard et al., 2013). Internal factors including sociodemographic and clinical characteristics, coping behaviours and illness perceptions can influence the FCR course in patients with cancer (Simard et al., 2013; Zeng et al., 2018). For instance, female sex, younger age and lower educational levels all predict more severe FCR (Rha et al., 2022; Tran et al., 2022; Tsai et al., 2018). Cancer survivors with higher FCR tend to employ more reassurance coping strategies but perceive them as ineffective (Simard et al., 2010). Simard et al. (2013) reported that optimistic illness perceptions are associated with lower FCR. Moreover, studies have shown that psychological resilience and family resilience in patients with cancer is negatively associated with FCR (Hu et al., 2021; Schapira et al., 2022). The evidence is limited regarding the specific influence of interpersonal factors on FCR in lung cancer patients. Collectively, these variables may serve as potential influencing factors of FCR trajectories in patients with lung cancer and necessitate further exploration to understand their predictive effects on FCR.

Apart from examining its trajectory at specific time points, the impact of FCR on QOL in patients with lung cancer has rarely been explored. Current research on the impact of FCR on QOL in patients with cancer has primarily focussed on breast cancer (Schapira et al., 2022; Tran et al., 2022), gynaecological cancer (Tsai

et al., 2018) and head and neck cancer (Mirosevic et al., 2019). These studies have consistently demonstrated negative correlations between FCR and QOL (Reb & Cope, 2019; Tsai et al., 2018). However, insufficient attention has been paid to patients with lung cancer with high risks of recurrence and metastasis. Most research is done using cross-sectional studies to explore FCR in patients with cancer (Simard et al., 2010; Tran et al., 2022) and focuses on assessing FCR levels and identifying influencing factors at specific time points. Consequently, few longitudinal studies have investigated the trajectory of FCR changes and the dynamic relationships between FCR and QOL in patients with cancer, providing impetus for this study.

A prospective longitudinal study was undertaken to examine the trajectory of changes in FCR levels and identify influencing factors of FCR in patients with lung cancer at 1, 3, 6 and 12 months after cancer surgery. The dynamic relationships between FCR and QOL over time were analysed. This study's findings contribute towards personalised and precise interventions to reduce FCR in patients with lung cancer.

3 | THE STUDY

3.1 | Aims

This study investigated the trajectory of FCR changes, its influencing factors, and the dynamic relationships between FCR and QOL in patients with lung cancer at four time points within 1 year post-surgery.

4 | METHODS

4.1 | Study setting and design

This prospective longitudinal study was conducted in Fujian Province, China, between March 2021 and September 2022. The study was approved by the Institutional Review Board of our institution and all recruited participants signed and provided informed consent. Participants were administered the baseline questionnaire 1 month after surgery (T_1) through face-to-face interviews and followed up at 3 (T_2), 6 (T_3), and 12 (T_4) months after surgery, using a special telephone in the thoracic surgery department, to investigate the level of FCR, illness perceptions, family resilience, coping behaviours and QOL. This study adhered to reporting guidelines as outlined in the Reporting Observational Longitudinal Research statement (Tooth et al., 2005) (Data S1).

4.2 | Participants

We recruited 310 patients with lung cancer from the thoracic surgery departments of one provincial cancer hospital and two large tertiary general hospitals in China. The inclusion criteria were: (1) diagnosed with non-small cell lung cancer (NSCLC) by cytology or pathology; (2) age ≥ 18 years; (3) Karnofsky Performance Status score of ≥60%; (4) literate in Mandarin; and (4) voluntary involvement in the study. Patients were excluded if they had: (1) mental illness or severe medical conditions and were diagnosed with other types of cancer or cognitive dysfunction; (2) severe intraoperative or postoperative complications or metastases after surgery; or (3) an expected survival time of less than 1 year, as assessed by doctors.

4.3 | Data collection

According to the principle of calculating sample sizes for regression, determined to be 5–10 times the number of independent variables (Charan & Biswas, 2013), the sample size was calculated as follows: Sample size = [number of independent variables × (5–10)] × [1 + (15%–20%)]. Considering this study involved a total of 25 variables, with a dropout rate of 15%–20% at each time point estimated, approximately 144–300 post-operative lung cancer patients were required.

4.3.1 | Sociodemographic characteristics

An information sheet was designed to collect participants' demographic data, including age, sex, religion, residential location, marital status, educational level, monthly household income (RMB, yuan), occupation, medical insurance type, smoking status and family breadwinner status.

4.3.2 | Clinical characteristics

Patient clinical variables including cancer stage, length of hospital stay (days), medical insurance type, comorbidities, surgical site, and type of surgery were collected using self-reports and through medical chart reviews.

4.3.3 | FCR severity

The nine-item Fear of Cancer Recurrence Inventory-Short Form (FCRI-SF) is a short form of the comprehensive FCRI (42-item) (Simard et al., 2010) and corresponds to the severity subscale of the FCRI. A Chinese version of the FCRI-SF (Peng et al., 2019) was used in this study. The FCRI evaluates the presence and severity of intrusive thoughts associated with FCR. Each item is rated on a four-point Likert scale ranging from 1 (never) to 4 (always). Higher scores indicate higher FCR. When assessing the potential for clinical FCR, a cut-off score of 13 is recommended (Simard et al., 2010). The Cronbach's alpha coefficient of the Chinese version of the short form of the FCRI was 0.912 (Lin et al., 2018). In this study, Cronbach's α for the total scale was 0.893.

4.3.4 | Illness perceptions

The Brief Illness Perception Questionnaire (B-IPQ; Broadbent et al., 2006) was used to measure emotional and cognitive representations of illness on an eight-item continuous linear scale ranging from 0 to 10. Higher scores represented more negative perceptions of illness. The Chinese version of the B-IPQ has been widely used as a screening tool to assess illness perceptions in China (Zhang et al., 2017). In this study, Cronbach's α for the total scale was 0.769.

4.3.5 | Coping behaviours

The 19-item Medical Coping Modes Questionnaire (MCMQ) was used to evaluate the cognitive behavioural and illness-related coping strategies of patients with lung cancer, including confrontation, fear avoidance and acceptance of resignation (Feifel et al., 1987). The MCMQ is scored on a four-point Likert scale ranging from 1 (never) to 4 (very much). Higher scores indicated better coping behaviours. In this study, the Cronbach's α coefficient for the overall scale was 0.712.

4.3.6 | Family resilience

The 20-item Chinese version of the Family Hardiness Index (FHI) was used to evaluate the resilience of patients with lung cancer, including two dimensions of challenge control and commitment (Yang et al., 2014). The scale is rated on a scale of 0–3 (0 = false and 3 = true). Total scores ranged from 20 to 80, with higher scores indicating greater family resilience. In this study, the Cronbach's α coefficient for the overall scale was 0.827.

4.3.7 | QOL

The Functional Assessment of Cancer Therapy–Lung (FACT-L) scale (version 4) has been widely used to assess the QOL of patients with lung cancer and has adequate psychometric properties (Cella et al., 1995). The FACT-L contains 36 items covering factors of well-being in the physical, functional, emotional and social/family realms, and contains lung cancer subscales. All FACT-L items are rated on a five-point Likert-type scale ranging from 0 (not at all) to 4 (very much). Higher scores represented a better QOL, or fewer symptoms. The test–retest reliability of the Chinese version of the FACT-L was 0.84 (Wan et al., 2007). In this study, the Cronbach's α coefficient for the overall scale was 0.785.

At T_1, we administered the complete questionnaire. At T_2, T_3 and T_4, we used FCRI-SF, B-IPQ, MCMQ and FACT-L to assess the severity of FCR, emotional and cognitive representations of illness, cognitive behavioural and illness-related coping strategies, as well as the QOL of lung cancer patients.

4.4 | Statistical analysis

IBM SPSS Statistics for Windows, version 26.0 (IBM Corp., Armonk, NY, USA) and SAS 9.4 (SAS Institute, Cary, NC, USA) were used for data analysis. The significance level was set at $p < 0.05$ (two-tailed). Descriptive statistics were used to describe the demographic and clinical characteristics, FCR, and QOL. A linear mixed-effects model (LMM) was used to analyse the change trajectory of FCR at different measurement time points, the influencing factors of trajectories and the predicted effect of FCR on QOL. In the LMM, model-fit criteria were used to select the covariance structure with the best fit between the null model (without covariates) and the random intercept model (introduced measurement time points), including the −2 residual log-likelihood, Akaike information criterion (AIC) and Bayesian Information Criterion (BIC) (Herle et al., 2020). In addition, the LMM offered a simple alternative for handling missing data at random without requiring imputation (Herle et al., 2020).

4.5 | Ethical considerations

All study participants provided written informed consent and the study design was approved by the Human Ethics Committee of Fujian Medical University (No. 2021175).

5 | RESULTS

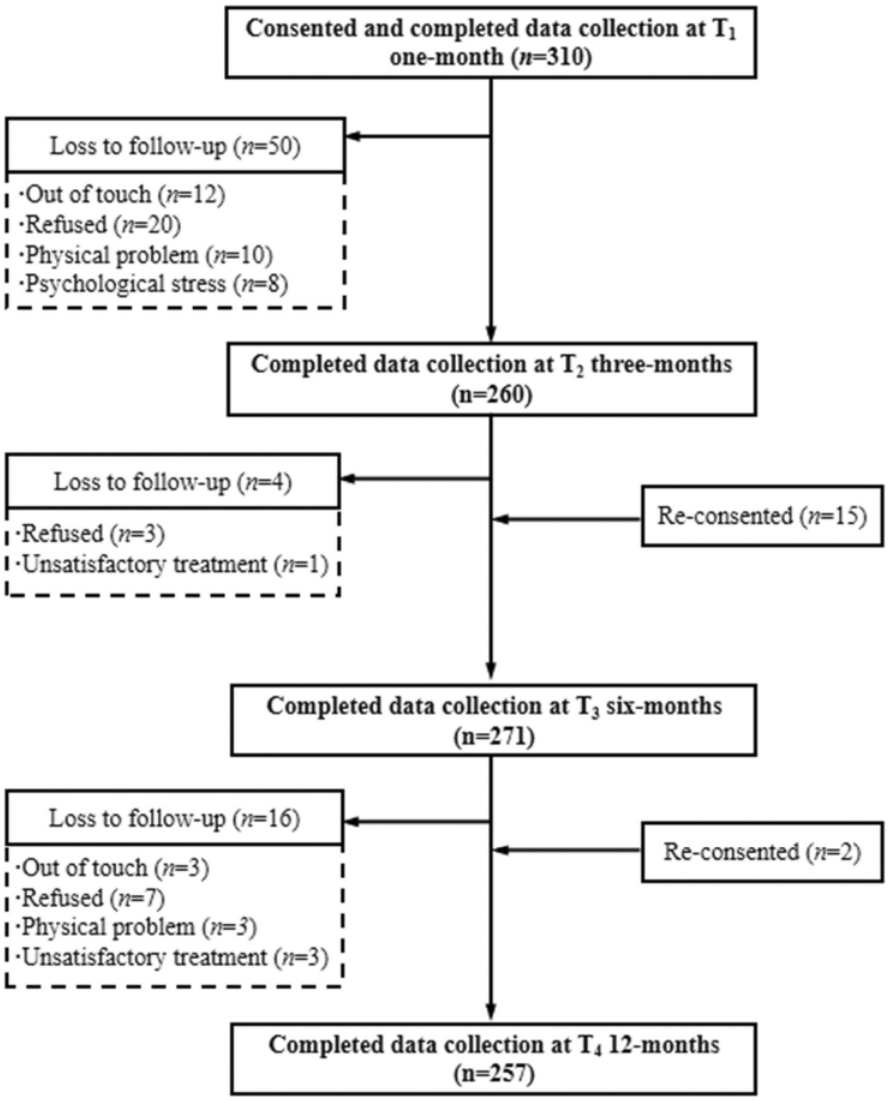
5.1 | Participant characteristics

As shown in Figure 1, the initial sample included 310 lung cancer patients. However, 53 participants (17.09%) were subsequently excluded from the analysis due to physical problems or loss of follow-up data. Among these, 50 (16.13%), 39 (12.58%) and 53 (17.10%) participants were lost to follow-up at T_2, T_3 and T_4, respectively. At T_3 and T_4, 15 (5.52%) and 2 (0.78%) participants, respectively, provided re-consent to participate in the study. At T_1, the mean patient age was 57.18 years (standard deviation [SD], 11.80 years; range, 50–66 years). Approximately 56.13% of participants were male and 67.10% were married. Furthermore, most of the participants (80.65%) had Stage I disease. The mean length of hospital stay was 12.79 days (SD = 5.86). The sociodemographic and clinical characteristics of the participants at each data collection time point are presented in Table 1.

5.2 | Trajectory of FCR

Table 2 presents the fixed-effect coefficient estimates for FCR in the mixed-effects models. Patients with lung cancer with clinical FCR at baseline continued to display clinically significant levels of FCR (FCR-SF ≥13) at all subsequent time points. The random intercepts model displayed a significant change in FCR levels over time;

FIGURE 1 The study flow diagram.



more specifically, a slight decrease was observed between T_1 and T_2, followed by an obvious increase at T_3 and a gradual decline at T_4 (Figure 2a,b).

5.3 | Multivariable analysis of factors associated with FCR trajectory

Table 3 displays the results of the multivariate analysis that examined factors influencing the trajectory of FCR levels. Among patients with lung cancer, females, individuals residing in suburban or rural areas and those functioning as family breadwinners exhibited higher levels of FCR. Additionally, patients with lung cancer and comorbidities such as hypertension or diabetes demonstrated elevated FCR levels compared to those without comorbidities. Furthermore, FCR demonstrated a significant interaction with measurement time points, indicating that postoperative rehabilitation time influenced and altered FCR in patients with lung cancer. Moreover, an increase of one point in coping behaviours and family resilience significantly decreased the FCR score by 0.02 points ($p=0.028$ and 0.001, respectively). There was no significant interaction observed between illness perceptions and FCR ($p=0.527$).

5.4 | Predicted effects of FCR on QOL

After controlling for the effects of sociodemographic and clinical variables, the FCR of patients with lung cancer was an independent predictor of QOL. That is, a one-point increase in FCR significantly decreased the FACT-L score by 0.46 points ($t=15.414$, $p<0.001$). The changing trajectory of QOL echoes the negative predictive effects of FCR on QOL. That is, a slight increase was observed between T_1 and T_2, followed by an obvious decrease at T_3 but a gradual increase at T_4 (Figure 3a,b).

6 | DISCUSSION

Our study is the first to prospectively examine the course of FCR and its associated factors in patients with lung cancer at 1–12 months

TABLE 1 Sociodemographic and clinical characteristics of lung cancer patients by time point since surgery.

Variable	T_1 ($n=310$)	T_2 ($n=260$)	T_3 ($n=271$)	T_4 ($n=257$)
Age (years), mean (SD)	57.18 (11.80)	57.63 (11.75)	57.31 (11.95)	56.94 (11.91)
Gender, *n* (%)				
Male	174 (56.13)	148 (56.92)	153 (56.46)	140 (54.47)
Female	136 (43.87)	112 (43.08)	118 (43.54)	117 (45.53)
Religion, *n* (%)				
No	114 (36.77)	97 (37.31)	100 (36.90)	93 (36.19)
Yes	196 (63.23)	163 (62.69)	171 (63.10)	164 (63.81)
Residential location, *n* (%)				
Urban	83 (26.77)	69 (26.54)	69 (25.46)	72 (28.02)
Suburban	78 (25.16)	63 (24.23)	72 (26.57)	64 (24.90)
Rural	149 (48.06)	128 (49.23)	130 (47.97)	121 (47.08)
Marital status, *n* (%)				
Married	208 (67.10)	175 (67.31)	182 (67.16)	169 (65.76)
Unmarried/divorced/separated/widowed	102 (32.90)	85 (32.69)	89 (32.84)	88 (34.24)
Educational level, *n* (%)				
Primary school or below	84 (27.10)	77 (29.62)	76 (28.04)	69 (26.85)
Middle school degree	88 (28.39)	75 (28.85)	76 (28.04)	74 (28.79)
High school/technical school degree	100 (32.26)	83 (31.92)	86 (31.73)	80 (31.13)
Bachelor or higher	38 (12.26)	25 (9.62)	33 (12.18)	34 (13.23)
Occupation, *n* (%)				
Other worker	34 (10.97)	24 (9.23)	32 (11.81)	28 (10.89)
Farmer	21 (6.77)	18 (6.92)	12 (4.43)	18 (7.00)
Full-time employment	62 (20)	54 (20.77)	55 (20.3)	52 (20.24)
Self-employed entrepreneur	45 (14.52)	33 (12.69)	40 (14.76)	35 (13.62)
Homemaker	12 (3.87)	10 (3.85)	11 (4.06)	11 (4.28)
Retried	136 (43.87)	121 (46.54)	121 (44.65)	113 (43.97)
Monthly household income (RMB, Yuan), *n* (%)				
<1000	27 (8.71)	22 (8.46)	23 (8.49)	21 (8.17)
1000–1999	38 (12.26)	31 (11.92)	33 (12.18)	31 (12.06)
2000–2999	88 (28.39)	74 (28.46)	75 (27.68)	71 (27.63)
3000–3999	63 (20.32)	54 (20.77)	56 (20.66)	54 (21.01)
4000–4999	49 (15.81)	43 (16.54)	45 (16.61)	42 (16.34)
>5000	45 (14.52)	36 (13.85)	39 (14.39)	38 (14.79)
Family breadwinner status, *n* (%)				
No	87 (28.06)	76 (29.23)	71 (26.20)	73 (28.40)
Yes	223 (71.94)	184 (70.77)	200 (73.80)	184 (71.60)
Smoking status, *n* (%)				
Non-smoker	210 (67.74)	180 (69.23)	183 (67.53)	173 (67.32)
Former smoker	44 (14.19)	35 (13.46)	40 (14.76)	35 (13.62)
Current smoker	56 (18.06)	45 (17.31)	48 (17.71)	49 (19.07)
Medical insurance type, *n* (%)				
Uninsured	38 (12.26)	26 (10.00)	33 (12.18)	33 (12.84)
Provincial basic medical	17 (5.48)	14 (5.38)	17 (6.27)	16 (6.23)
Urban basic medical	91 (29.35)	79 (30.38)	81 (29.89)	78 (30.35)
New agricultural cooperative medical	148 (47.74)	127 (48.85)	124 (45.76)	116 (45.14)
Other	16 (5.16)	14 (5.38)	16 (5.90)	14 (5.45)

TABLE 1 (Continued)

Variable	T_1 ($n=310$)	T_2 ($n=260$)	T_3 ($n=271$)	T_4 ($n=257$)
Comorbidities, *n* (%)				
No	250 (80.65)	208 (80.00)	219 (80.81)	210 (81.71)
Yes	60 (19.35)	52 (20.00)	52 (19.19)	47 (18.29)
Cancer stage, *n* (%)				
I (Ia + Ib)	250 (80.65)	214 (82.31)	217 (80.07)	205 (79.77)
II (IIa + IIb)	42 (13.55)	30 (11.54)	40 (14.76)	37 (14.40)
III (IIIa + IIIb)	18 (5.81)	16 (6.15)	14 (5.17)	15 (5.84)
Surgical site, *n* (%)				
Right lung	191 (61.61)	160 (61.54)	168 (61.99)	161 (62.65)
Left lung	119 (38.39)	100 (38.46)	103 (38.01)	96 (37.35)
Type of surgery, *n* (%)				
Wedge resection	33 (10.65)	27 (10.38)	33 (12.18)	29 (11.28)
Segmentectomy	79 (25.48)	64 (24.62)	67 (24.72)	65 (25.29)
Lobectomy	194 (62.58)	167 (64.23)	168 (61.99)	161 (62.65)
Sleeved lobectomy	4 (1.29)	2 (0.77)	3 (1.11)	1 (0.78)
Length of hospital stay (days), mean (SD)	12.79 (5.86)	12.64 (5.68)	12.60 (5.32)	12.77 (5.51)

TABLE 2 Results of linear mixed effects model on FCR.

					Model fit		
Model	Effect	β	SE	95% CI	-2 residual log-likelihood	AIC	BIC
Null model	Intercepts	25.19	0.10	24.99 ~ 25.39	4886.7	4890.7	4898.2
Random intercept model	Intercepts	25.71	0.12	25.48 ~ 25.94	4230.2	4234.2	4241.7
	T_2	−0.43	0.11	−0.64 ~ −0.22			
	T_3	0.80	0.11	0.59 ~ 1.01			
	T_4	−2.66	0.11	−2.88 ~ −2.45			
	T_1	0	-	-			

Abbreviations: AIC, Akaike information criterion; BIC, Schwarz Bayesian criterion; SE, standard error.

after cancer surgery. Unexpectedly, lung cancer patients exhibited clinically meaningful levels of FCR at baseline and maintained these levels (FCRI-SF ≥13) throughout the entire study's duration. This finding further confirms that FCR remains a significant concern in patients with lung cancer, even after surgical treatment. Regarding the overall trend in change, the FCRI-SF scores showed a slight but significant decrease between 1 and 3 months after surgery. However, we observed a noticeable increase in FCR levels at 3 and 6 months after surgery, followed by a gradual decline at 6 and 12 months after surgery.

Currently, there is a lack of consensus regarding the trajectory of FCR in patients with cancer, particularly with regard to the timing of specific points of change in FCR levels. However, our study of patients with lung cancer provides valuable insights. We identified crucial turning points in FCR levels at 3 and 6 months after surgery. The initial decrease in FCR levels during the early postoperative period may be attributed to a sense of relief and hope following successful surgery and initial recovery. However, over time, patients with lung cancer may encounter new challenges and uncertainties related to additional treatments, such as chemotherapy or radiation therapy after surgery, as well as in the management of their survivorship. These factors can contribute to an upsurge in FCR at 3 and 6 months post-surgery. The subsequent decline in FCR levels between 6 and 12 months may reflect psychological adjustments, adaptation to the lung cancer survivorship phase and improved coping mechanisms. This pattern is consistent with the changing trajectory of QOL during the first year after lung cancer surgery. These findings highlight the importance of providing tailored and effective FCR support to patients with lung cancer during the 3- and 6-month periods after surgery, with the goal of improving their QOL. Healthcare providers can play a significant role in offering personalised assistance and interventions to address FCR and enhance the well-being of patients with lung cancer during critical postoperative periods.

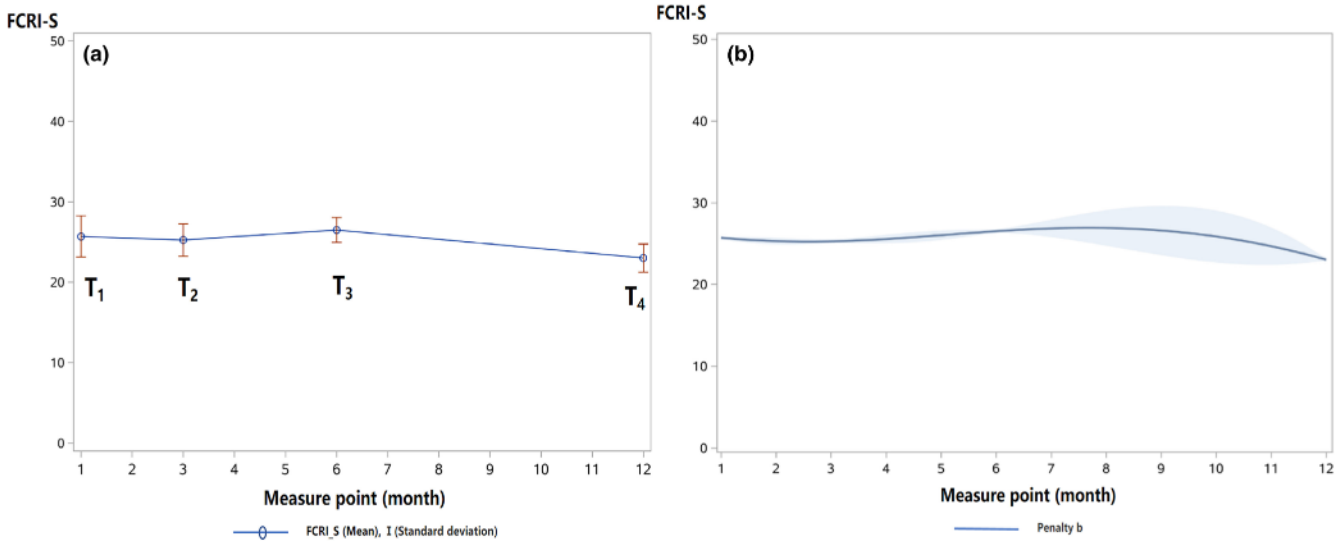


FIGURE 2 The fear of recurrence trajectory of lung cancer patients at different time points. (a) Changes trajectory of FCR level in lung cancer patients at different time points. (b) Prediction trajectory of FCR in lung cancer patients at different time points. Light blue area represents 95% confidence interval; T1: 1 month after surgery; T2: 3 months after surgery; T3: 6 months after surgery; T4: 12 months after surgery; FCRI-S: the Fear of Cancer Recurrence Inventory-Short Form. [Colour figure can be viewed at wileyonlinelibrary.com]

TABLE 3 Results of multivariate analysis of influencing factors on FCR trajectory ($\bar{x} \pm s$).

Variable	FCRI score	95% CI/β	X^2/F	P
Time point				
T_1	25.91 ± 2.75	(25.59, 26.23)	986.35	<0.001
T_2	24.82 ± 2.88	(24.48, 25.16)		
T_3	26.41 ± 2.74	(26.09, 26.73)		
T_4	23.22 ± 2.75	(22.90, 23.54)		
Gender				
Female	25.36 ± 2.88	(25.02, 25.70)	13.194	<0.001
Male	24.82 ± 2.71	(24.50, 25.13)		
Residential location				
Urban	24.66 ± 3.2	(24.29, 25.04)	24.953	<0.001
Suburban	25.05 ± 3.16	(24.68, 25.41)		
Rural	25.56 ± 2.64	(25.25, 25.87)		
Family breadwinner				
No	24.75 ± 3.11	(24.38, 25.11)	22.208	<0.001
Yes	25.43 ± 2.41	(25.15, 25.72)		
Comorbidities				
No	24.71 ± 2.43	(24.43, 25.00)	21.341	<0.001
Yes	25.47 ± 3.22	(25.09, 25.84)		
Illness perceptions		0.003	0.633	0.527
Coping behaviour		−0.02	2.208	0.028
Family resilience		−0.02	3.455	0.001

Abbreviation: FCRI, Fear of Cancer Recurrence Inventory.

This study also investigated the factors that influenced the trajectory of FCR in patients with lung cancer. Female patients demonstrated higher FCR than male patients, although the Lane et al. (2019) study in Canada found no significant differences in FCR scores based on sex. This difference may be influenced by societal factors, including traditional concepts and Confucianism. In Chinese cultures, the belief that 'men are the head of the family' places the onus of family responsibilities on women, particularly in rural areas. These women often have lower education levels, limited job opportunities and little to no independent income, and

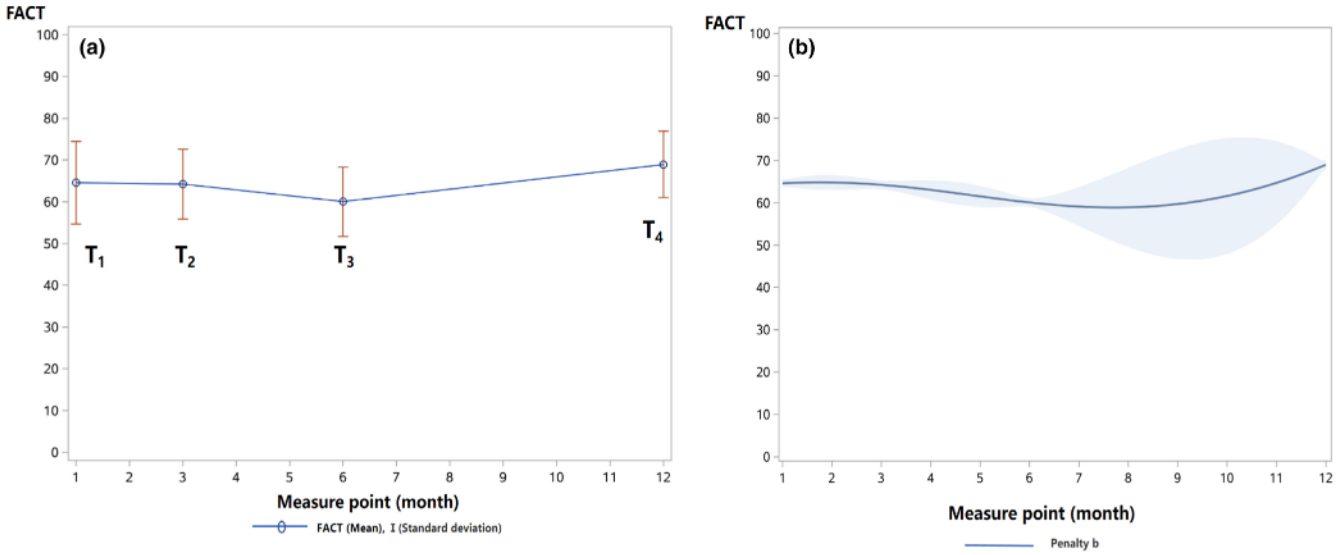


FIGURE 3 The quality of life trajectory of lung cancer patients at different time points. (a) Changes trajectory of quality of life in lung cancer patients at different time points. (b) Prediction trajectory of quality of life in lung cancer patients at different time points. Light blue area represents 95% confidence interval; T1: 1 month after surgery; T2: 3 months after surgery; T3: 6 months after surgery; T4: 12 months after surgery; FACT: the Functional Assessment of Cancer Therapy. [Colour figure can be viewed at wileyonlinelibrary.com]

primarily fulfil caregiver roles within their families. Consequently, the financial burden associated with cancer treatment, along with the considerable time and energy expended, adds to their psychological burden and mental strain, which contributes to their heightened FCR.

Participants residing in less economically developed counties and in rural areas demonstrated higher FCR than those in urban populations. However, the exact mechanism underlying the impact of place of residence on FCR remains unclear (Simard et al., 2013). This disparity may stem from the fact that patients living in urban areas benefit from a more comprehensive system of social resources, which can provide outside assistance to alleviate the physical and mental burdens associated with the disease and its treatments (Nahm et al., 2021). Consequently, these patients may exhibit lower FCR than their counterparts in less developed areas (Vandraas et al., 2021).

Participants who were family breadwinners exhibited significantly higher scores on the FCRI-SF than those who were not the primary economic providers for their families. When patients who are the main source of income for the family are diagnosed with lung cancer, they often experience a decreased ability to work, or even an inability to remain in the labour force, resulting in little to no household income. Consequently, the family's financial resources may be significantly affected. Additionally, cancer treatment itself requires substantial financial support. This disparity between income and expenses tends to increase patients' psychological burdens, thereby heightening their FCR (Thewes et al., 2016).

Consistent with the Koch et al. (2014) study of patients with breast cancer, our study of patients with lung cancer revealed significantly higher FCR scores among those with comorbidities. This could be attributed to two factors. First, patients with lung cancer with comorbidities experience a greater physical burden, leading to increased psychological strain and reduced confidence in their ability to recover (Thewes et al., 2016). Second, the additional treatment burdens and high long-term costs associated with comorbidities contribute to anxiety, thereby perpetuating persistent, intense levels of FCR.

Consistent with prior studies in patients with other cancers (Faccio et al., 2018; G, D. R, et al., 2022), our findings indicated that increased positive coping behaviours and family resilience among patients with lung cancer resulted in significant decreases in FCR scores. Positive coping strategies such as seeking support from loved ones, sharing experiences with fellow patients and engaging in constructive behaviours can effectively reduce stress levels in patients with lung cancer. These strategies improve treatment compliance, facilitate the development of structured follow-up plans, enhance illness perceptions, lead to better treatment outcomes and ultimately reduce FCR (Hu et al., 2021). Modern cancer treatments have shifted towards a family-centred model that recognises the importance of harnessing the collective strengths and resilience of families within the framework of comprehensive cancer care (Lebel et al., 2013). This approach acknowledges the crucial role of family resilience. The negative relationship between family resilience and FCR suggests that families exhibiting resilience in the face of adversity are better equipped to adapt to the challenges posed by cancer and to support their loved ones throughout their treatment journey. By fostering a supportive and resilient family environment, healthcare providers can play a vital role in reducing FCR and improve the overall well-being of patients and their families.

Our findings provide additional evidence for the effects of FCR on QOL among patients with lung cancer. Specifically, FCR is an

independent predictor of QOL in this group of patients (Nugent et al., 2020). Several possible explanations exist for this association. First, increased FCR in patients with lung cancer may heighten their psychological distress, leading to conditions such as depression and anxiety (Lucas et al., 2023). Consequently, these patients may engage in maladaptive coping behaviours and even limit their participation in social activities, work and hobbies (Yang et al., 2012). Collectively, these factors contribute to lower QOL (Simard et al., 2013). These findings highlight the importance of addressing and managing FCR among patients with lung cancer to maximise QOL. By addressing psychological distress and promoting adaptive coping strategies, healthcare providers can help patients enhance their well-being and overall QOL.

6.1 | Limitations

Despite the study findings, the study also has its limitations. First, the study was conducted in three tertiary care hospitals within a single province of China, which may limit the generalisability of the findings to other regions. Second, the investigation focussed solely on the trends and influencing factors of FCR in patients with lung cancer during the first year after surgery. Future studies should consider extending the follow-up period to explore the changing trajectory of FCR in patients with lung cancer across longer periods of time. Additionally, this study only included patients with lung cancer who underwent early surgical resection, which may have affected the representativeness of the sample. Future studies could enhance sample diversity by including patients with lung cancer who received radical radiotherapy.

7 | CONCLUSIONS

In this longitudinal study, noticeable increases in FCR levels were observed at 3 and 6 months after surgery, followed by a gradual decline at 6 and 12 months post-surgery. Adaptive coping behaviours and family resilience emerged as major protective factors in the trajectory of FCR, while being female, residing in suburban or rural areas, acting as family breadwinners and having comorbidities were associated with higher levels of FCR.

The study results enhance our understanding of the dynamic negative relationships between FCR and QOL in patients with lung cancer. These findings provide compelling evidence to identify time-sensitive periods for intervention delivery with vulnerable populations. The influencing factors identified in this study inform future research directions and guide the development of tailored interventions that aim to reduce FCR and improve the QOL of patients with lung cancer.

DISCLOSURE STATEMENT

The authors acknowledge that they have no financial interest or benefit that arises from the direct application of their research.

STATISTICS STATEMENT

The authors have confirmed that the submission conforms to the Journal's statistical guidelines, as applicable.

AUTHOR CONTRIBUTIONS

All authors listed meet the authorship criteria according to the latest guidelines of the International Committee of Medical Journal Editors, and all authors agree with the manuscript. The study concept and design were developed by Feifei Huang and Huimin Xiao. Data acquisition was performed by Xiaoyan Yang, Yonglin Li and Jialing Lin. Data analysis and interpretation were conducted by Jialing Lin and Jianqing Zheng. The manuscript was drafted by Xiaoyan Yang and Yonglin Li. Weiti Chen and Feifei Huang critically revised the manuscript for important intellectual content.

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CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflict of interest.

DATA AVAILABILITY STATEMENT

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

ETHICS STATEMENT

All study participants provided written informed consent and the study protocol was approved by the human ethics committee at Fujian Medical University (No. 2021175).

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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