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Recovery experiences among older adults with pre-frailty or frailty 3–6 months after lung cancer surgery: A qualitative study

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Abstract

Background

Older adults can experience persistent symptoms and functional limitations for several months after lung cancer surgery. Frailty can further impair physical function and engagement in postoperative rehabilitation, while older adults with frailty often have multimorbidity and a greater symptom burden. The 3–6-month postoperative period represents an important stage of ongoing recovery, yet evidence on the experiences of older adults with pre-frailty or frailty during this period remains limited. This study aimed to explore their recovery experiences 3–6 months after lung cancer surgery.

Methods

A qualitative descriptive study was conducted using individual semi-structured interviews. Participants were purposively recruited from a prospective observational study of older adults undergoing lung cancer surgery. Eligible participants had a FRAIL scale score of ≥ 2 at the 3-month postoperative assessment, including those with pre-frailty or frailty. Fifteen participants were interviewed face-to-face 3–6 months after surgery. Interviews were audio-recorded, transcribed verbatim, and analysed inductively using Braun and Clarke's thematic analysis.

Results

Five major themes comprising 13 subthemes were identified: (1) changes in physical function and activity, including diminished physical capacity, perceptions of bodily depletion, and recalibration of everyday activities; (2) psychological responses and social changes, including emotional distress, acceptance of illness and mortality, and a narrowing social world; (3) recovery complicated by concurrent health challenges, including treatment-related setbacks and pre-existing health conditions; (4) the dual role of family support, whereby practical and emotional support coexisted with protective restrictions and concerns about burdening the family; and (5) Healthcare Support and Unmet Rehabilitation Needs, characterized by trust in healthcare professionals alongside unmet needs for individualized rehabilitation and follow-up guidance.

Conclusion

Older adults with pre-frailty or frailty continued to experience complex recovery challenges 3–6 months after lung cancer surgery, involving physical limitations, treatment-related burdens, coexisting health conditions, and psychosocial adaptation. Although family members and healthcare professionals provided important support, post-discharge rehabilitation needs remained insufficiently addressed. These findings highlight the need for individualized and continuous rehabilitation and supportive care to promote functional recovery and maintain independence in this vulnerable population.

Background

According to global cancer statistics, lung cancer is one of the most commonly diagnosed cancers worldwide and remains the leading cause of cancer-related mortality[1]. Its incidence increases markedly with age, with older adults accounting for more than half of all cases, and lung cancer representing one of the most common malignancies in this population[2,3]. As population ageing accelerates, the number of older adults diagnosed with lung cancer is expected to continue to rise. Surgical resection remains a mainstay of curative treatment for patients with operable disease. Although advances in minimally invasive surgical techniques and perioperative care have improved short-term postoperative outcomes, patients may continue to experience fatigue, pain, dyspnoea, reduced physical capacity, and limitations in daily and social activities after discharge, with impairments in physical and role functioning persisting for several months after surgery[4,5]. These persistent symptoms and functional impairments are closely associated with frailty, which may further compromise postoperative recovery in older adults[6,7].

Frailty is highly prevalent among older adults undergoing lung cancer surgery, with studies reporting that approximately 44% of patients experience frailty three months after surgery[7]. Frailty is an age-related multidimensional condition characterized by diminished physiological reserve across multiple organ systems, resulting in increased vulnerability to stressors[8]. Among older adults undergoing surgical treatment for lung cancer, frailty has been associated with poorer survival, increased postoperative complications, treatment-related toxicity, and other adverse clinical outcomes[9,10]. Beyond these clinical consequences, frailty may also shape the postoperative recovery process by limiting physical function, reducing the ability to engage in rehabilitation activities, and impairing activities of daily living, thereby affecting quality of life[7,11,12]. Furthermore, older adults with frailty frequently experience multimorbidity, persistent symptom burden, and treatment-related challenges, which may further complicate their recovery after surgery.

The 3–6-month postoperative period may represent an important window for exploring recovery after lung cancer surgery, as patients have moved beyond the acute challenges of surgery while continuing to adapt to changes in physical function, daily activities, and social roles[6,7,13]. Quantitative studies have provided important evidence on postoperative outcomes, but offer limited insight into how older adults themselves understand and navigate the recovery process over time. Although qualitative studies have explored symptom experiences, psychological responses, supportive care needs, and adaptation following lung cancer surgery[14,15], studies specifically examining older adults remain limited, with even less attention given to those living with frailty. In particular, little is known about how older adults with pre-frailty or frailty perceive, manage, and adapt to recovery during the 3–6 months following surgery. Understanding these experiences may provide important insights into the complex and evolving nature of postoperative recovery and inform more tailored rehabilitation and supportive care strategies.

Therefore, this study aimed to explore the recovery experiences of older adults living with pre-frailty or frailty during the 3–6 months following lung cancer surgery. By gaining insight into patients' perspectives, this study sought to enhance understanding of the multidimensional nature of postoperative recovery and identify potential areas for improving rehabilitation and supportive care for this vulnerable population.

Methods

Study design

This study adopted a qualitative descriptive design using individual semi-structured interviews to explore the recovery experiences of older adults with postoperative pre-frailty or frailty 3–6 months after lung cancer surgery. The design was chosen because limited research has explored the experiences of older adults with postoperative pre-frailty or frailty after lung cancer surgery, and a qualitative approach was needed to gain an in-depth understanding of their perspectives during recovery[16]. Quantitative measures can characterize specific postoperative outcomes, but provide limited insight into these subjective and adaptive processes. A qualitative descriptive approach was therefore considered appropriate for obtaining an in-depth and direct account of participants' recovery experiences. Data were analysed inductively using thematic analysis[17,18], and reported in line with the Consolidated Criteria for Reporting Qualitative Research (COREQ) checklist[19](Supplementary Material 1).

Setting

Participants were drawn from a completed prospective observational study examining frailty development and associated factors among older adults undergoing lung cancer surgery. In the parent study, frailty was assessed 3 months after surgery. The present qualitative study was conducted at a tertiary hospital in Hangzhou, China. Interviews were undertaken when participants attended follow-up visits or received postoperative adjuvant treatment at the hospital. Ethical approval was obtained from the Ethics Committee of the First Affiliated Hospital, Zhejiang University School of Medicine (Ethics Approval No. IIT20251246B). Written informed consent was obtained from all participants before data collection.

Participants

Participants were recruited from patients in the parent prospective observational study who had completed the 3-month postoperative assessment. The qualitative study initially sought to recruit patients identified as frail at this assessment. However, relatively few of these patients returned to the hospital for subsequent follow-up or postoperative adjuvant treatment, which limited opportunities for face-to-face recruitment. The eligibility criterion was therefore broadened to include patients with a FRAIL scale score of ≥ 2 at the 3-month postoperative assessment. Frailty was assessed using the FRAIL scale, a five-item screening tool with total scores ranging from 0 to 5. According to established criteria, scores of 1–2 indicate pre-frailty and scores of 3–5 indicate frailty[20]. In the present study, participants with FRAIL scores of ≥ 2 were included, representing participants with pre-frailty (score 2) or frailty (score 3–5). Participants with a score of 1 were not included.

Purposive sampling was used to ensure variation in key demographic and clinical characteristics[21]. Participants were selected with consideration of sex, age, marital status, place of residence (urban or rural), histological type of lung cancer, pathological stage, and receipt of postoperative adjuvant treatment. This strategy was intended to include participants with differing clinical and social contexts of recovery. Eligible participants were required to: (1) be aged 60 years or older; (2) have undergone surgery for lung cancer; (3) have a FRAIL scale score of ≥ 2 at the 3-month postoperative assessment; (4) be able to communicate verbally and describe their recovery experiences; and (5) provide informed consent to participate in the interview. Patients were excluded if postoperative pathological examination did not confirm lung cancer, or if severe cognitive impairment or other conditions prevented them from completing the interview.Recruitment continued until additional interviews no longer contributed substantially new insights relevant to the study aim. A total of 15 participants were included in the final analysis.

Data collection

Interviews were conducted 3–6 months after surgery, following completion of the 3-month postoperative follow-up assessment. This time window was selected to allow participants to move beyond the immediate postoperative period while still being able to reflect on recent changes in physical functioning, daily activities, treatment-related challenges, and adaptation during recovery. Eligible patients were contacted by telephone by a member of the research team within the week before a scheduled follow-up visit or postoperative adjuvant treatment. Those who expressed interest in participating were provided with information about the study and gave written informed consent before the interview. Interviews were conducted face-to-face in a private consultation room at the hospital and lasted approximately 30–60 minutes. No repeat interviews were conducted. Participants were permitted to have a family member present if they wished. Family members were asked to allow the participant to respond independently and to avoid interrupting the interview. In some interviews, family members provided occasional prompts when participants had difficulty recalling specific details. If their involvement began to influence or interrupt the participant's account, the interviewer redirected the conversation to the participant and invited the family member to provide any additional comments after the participant had finished speaking.

The full semi-structured interview guide is provided in Supplementary Material 2. The guide was developed to explore participants' experiences from surgery through postoperative recovery. It was informed by previous literature, the research team's experience from follow-up assessments conducted in the parent quantitative study, and the clinical experience of the research team. The interview guide was not pilot-tested or modified during data collection. All interviews were conducted by Jiayuan Ou, a female master's student in nursing who had received training in qualitative research and semi-structured interviewing. The

interviewer had no personal relationship with the participants before the qualitative study, although she had previously contacted them by telephone during three postoperative follow-up assessments as part of the parent study. She was not involved in their clinical care. Interviews were audio-recorded and subsequently transcribed verbatim. As interviews were conducted in Chinese, transcripts were analysed in the original language. Selected quotations presented in this manuscript were translated into English by Jiayuan Ou and reviewed by the research team to ensure that their meaning and context were accurately preserved. Transcripts were not returned to participants for comment or correction, and member checking of the findings or themes was not conducted. Demographic and treatment-related information was obtained from participants' medical records and data collected previously in the parent quantitative study.

Data analysis

Identifying information was removed from the transcripts before analysis. The interview data were analysed using an inductive thematic analysis following Braun and Clarke's six-phase framework. First, Jiayuan Ou familiarised herself with the data by repeatedly reading the transcripts and referring back to the audio recordings when necessary to ensure accuracy and develop an overall understanding of the participants' accounts. Second, Jiayuan Ou generated initial codes inductively across the dataset, focusing on aspects of the accounts relevant to participants' postoperative recovery experiences. Third, related codes were compared and grouped to develop candidate themes and subthemes that captured broader patterns of meaning across participants' accounts. The developing codes, subthemes, and themes were reviewed and discussed with Lili Sun, Tiantian Shen, and Zhaodi Wang. These discussions also formed part of the reflexive analytic process, during which the research team reflected on how their nursing and clinical research backgrounds shaped their interpretations of participants' accounts. The team discussed initial interpretations, considered alternative understandings of the data, and refined themes iteratively to ensure that the analytic process remained transparent and closely connected to participants' experiences. Fourth, the candidate themes were reviewed against both the coded extracts and the full dataset to assess their coherence, distinctiveness, and relevance to the research aim. Themes were subsequently refined, defined, and named through iterative comparison and discussion among the research team. Finally, representative quotations were selected to illustrate each theme and support the interpretation of the findings. NVivo software was used to facilitate data organization and coding.

Results

Participant characteristics

A total of 25 eligible patients were approached by telephone. Seven declined participation because they were not interested in the study. Of the 18 patients who initially agreed to participate, three did not complete the interview: one because of poor physical condition and two because of time constraints. Fifteen participants ultimately completed the interviews and were included in the final analysis. The mean age of the participants was 67.0 ± 4.2 years. Participants varied in age, sex, marital status, place of residence, histological type and stage of lung cancer, and receipt of postoperative adjuvant treatment. Detailed demographic and clinical characteristics are presented in Table 1.

Table 1
Demographic and clinical characteristics of participants

Participant	Age (years)	Sex	Marital status	Residence	Chronic conditions (n)	Smoking history	Histology	Stage	Neoadjuvant treatment	Postoperative treatment	fı s
P1	73	Female	Married	Urban	2	No	Adenocarcinoma	IB	No	Targeted therapy	2
P2	71	Male	Married	Rural	1	Yes	Adenocarcinoma	IIB	No	Chemotherapy and immunotherapy	4
P3	72	Female	Widowed	Rural	2	No	Adenocarcinoma	IA	No	None	2
P4	62	Male	Married	Rural	1	Yes	Squamous cell carcinoma	IA	Yes	Chemotherapy and immunotherapy	3
P5	69	Male	Widowed	Rural	2	Yes	Squamous cell carcinoma	IB	No	Chemotherapy and immunotherapy	2
P6	68	Male	Married	Urban	4	Yes	Adenocarcinoma	IA	No	None	2
P7	69	Male	Married	Rural	2	Yes	Squamous cell carcinoma	IIIB	Yes	Immunotherapy	2
P8	62	Female	Married	Urban	4	No	Adenocarcinoma	IA	No	Targeted therapy	3
P9	68	Female	Married	Urban	5	No	Adenocarcinoma	IA	No	None	3
P10	66	Male	Married	Rural	1	Yes	Other	IIB	No	Chemotherapy and immunotherapy	2
P11	60	Male	Married	Rural	2	Yes	Squamous cell carcinoma	IIIB	Yes	Immunotherapy	3
P12	72	Male	Married	Rural	1	Yes	Other	IIIA	Yes	Chemotherapy	2
P13	67	Male	Married	Rural	3	Yes	Adenocarcinoma	IA	No	None	3
P14	65	Male	Married	Urban	0	Yes	Other	IIB	No	Chemotherapy and immunotherapy	2
P15	61	Male	Married	Urban	3	Yes	Squamous cell carcinoma	IIIA	Yes	Chemotherapy and immunotherapy	2

Thematic analysis of the interview data generated five major themes comprising 13 subthemes (Table 2). Together, these themes illustrated postoperative recovery as a multidimensional and ongoing process involving changes in physical function, psychological and social adjustment, management of concurrent health challenges, negotiation of support from family and healthcare professionals, and evolving needs for rehabilitation guidance.

Table 2
Themes and Subthemes Describing Recovery Experiences Among Older Adults With Postoperative Pre-frailty Or Frailty

Major themes	Subthemes
Theme 1. Changes in Physical Function and Activity	1.1 Recognizing diminished physical capacity
	1.2 Perceiving the body as depleted after surgery
	1.3 Recalibrating everyday activities
Theme 2. Psychological Responses and Social Changes	2.1 Emotional distress and uncertainty
	2.2 Coming to terms with illness and mortality
	2.3 A narrowing social world
Theme 3. Recovery Complicated by Concurrent Health Challenges	3.1 Treatment-related setbacks
	3.2 Pre-existing health conditions
Theme 4. The Dual Role of Family Support	4.1 Practical and emotional support from family
	4.2 Family protection and restricted autonomy
	4.3 Concern about becoming a burden on the family
Theme 5. Healthcare Support and Unmet Rehabilitation Needs	5.1 Trust in healthcare professionals
	5.2 Need for individualized rehabilitation guidance

Theme 1. Changes in Physical Function and Activity

1.1Recognizing diminished physical capacity

Participants became aware of diminished physical capacity through changes in everyday activities that had previously required little effort. Fatigue, breathlessness, and reduced tolerance for sustained or physically demanding activities were particularly apparent when participants compared their postoperative abilities with their preoperative functioning.

"If I sit at the computer for too long, I start to feel tired and have to lie down for a while… Before, I could sit there for seven or eight hours, even more than ten hours, without any problem."(p14)

"At first, even walking made me sweat. I felt weak, and I became short of breath more easily than before."(p05)

"After part of the lung was removed, it was definitely a little worse than before… even speaking takes more effort… and climbing stairs can be tiring."(p10)

1.2 Perceiving the body as depleted after surgery

Some participants described surgery as causing a more fundamental depletion of the body. They perceived the operation not simply as the removal of diseased tissue, but as an event that had weakened their overall physical constitution. This perception was often expressed through culturally familiar descriptions of diminished "vitality" or "energy," reflecting participants' perceptions that surgery had caused a lasting change in their bodily strength and vitality.

"Once the body has been cut open, it is different. It feels as though your vitality has been damaged. It is definitely not the same as before."(P02)

"Once you've had an operation, of course you become weaker. How could you not?

In our Hangzhou dialect, we say that once the abdomen has been opened, all the 'qi' inside has been let out."(p14)

1.3 Recalibrating everyday activities

Participants adjusted their everyday activities according to what they felt their postoperative bodies could manage. Some gradually increased walking as their strength returned, whereas others reduced or gave up routine household and physical tasks. These changes reflected an ongoing adjustment to their perceived physical capacity after surgery.

"After I first came home from surgery, I would just walk back and forth between the kitchen and the living room. Then I started with about 800 steps and gradually increased it. As I slowly began to feel better, I could go out for a walk after dinner."(p01)

"I still do some things, but much less than before. I do not cook anymore, but I can still do small tasks, such as clearing the dishes."(P09)

Theme 2. Psychological Responses and Social Changes

2.1 Emotional distress and uncertainty

For some participants, emotional distress arising from uncertainty about prognosis and disease progression affected aspects of daily life, including sleep.

"I sometimes wonder how many years I have left, and whether this can really be cured… Sometimes I think about it so much that I cannot sleep." (p06)

"My surgery kept being postponed—first by one month and then by another. I was very anxious because I was afraid the cancer might change or progress. Cancer can become advanced, can't it? That was what I was afraid of." (p04)

2.2 Coming to Terms With Illness and Mortality

Alongside experiences of distress and uncertainty, some participants expressed a degree of acceptance regarding illness and the possibility of death, influenced by advanced age, concerns about treatment burden, and seeing peers undergo similar experiences.

"I do not think much about how much time I have left. I am already in my seventies, which is quite old. Actually, I did not really want treatment at first. I thought there was little point if it could not cure me and would only make the two of us suffer."(p07)

"He used to keep asking why he had developed this illness and felt very upset about it. Now, after coming here for chemotherapy and seeing so many other patients, he has gradually learned to take it more lightly." (p13)

2.3 A narrowing social world

Participants' social worlds often became narrower after surgery. Reduced participation was partly related to physical limitations, but social withdrawal also reflected disruption of familiar networks, treatment away from home, discomfort in previous social environments, reluctance to disclose illness, and concerns about creating obligations for others. Some participants therefore withdrew voluntarily rather than simply being unable to participate.

"I used to play cards, but I don't anymore. I haven't even gone back home, so how could I? I don't know anyone here—who would I play with?" (The participant was receiving treatment in Hangzhou and had not yet returned to his hometown, where his usual social network was located.(p13)

"I used to meet up with my colleagues and travel with them. Now that I'm ill, I don't go anymore. My physical condition can't really keep up… They smoke and drink, and I feel uncomfortable sitting there. I'd rather step back myself." (p15)

"I don't really go downstairs partly because I don't want people to know that I'm ill. It becomes bothersome—one person comes to visit today, another tomorrow. Then you feel you owe people something."(p14)

Theme 3. Recovery Complicated by Concurrent Health Challenges

3.1 Treatment-related setbacks

For some participants, recovery was complicated by the effects of anticancer treatment, particularly chemotherapy. Treatment-related symptoms included poor appetite, weight loss, weakness, and breathlessness, which could temporarily worsen physical functioning and interrupt the recovery process. Participants described treatment-related symptoms as additional barriers that interrupted their recovery after surgery.

"The chemotherapy was quite intense. I could hardly eat properly and lost about 10 jin [approximately 5 kg]. My whole body hurt… and my feet and hands became numb."(p04)

"After chemotherapy, I would feel that I had no strength for those few days… When I got home, I would also feel a little short of breath."(p05)

3.2 Pre-existing health conditions;

Pre-existing health conditions shaped the course of recovery for some participants. Cardiovascular disease, impaired pulmonary function, musculoskeletal problems, and multiple chronic conditions could compound postoperative limitations and make it difficult to distinguish the effects of surgery from those of underlying health problems. In particular, previous major surgery or chronic conditions had already reduced physical functioning in some participants before lung cancer surgery, while joint or respiratory problems continued to affect mobility during recovery.

"After the coronary bypass surgery, I lost a lot of strength and never really recovered. After the lung surgery, I became more short of breath because part of my lung had been removed. My underlying lung condition was also poor—I had bullous disease and pulmonary fibrosis, and my oxygen saturation was quite low after surgery, so I required supplemental oxygen."(p07)

"I already had several health problems and was not in very good physical condition… I had hypertension and gout, and the gout sometimes affected my activity."(p13)

Theme 4. The Dual Role of Family Support

4.1 Practical and emotional support from family

For most participants, family members provided both practical and emotional support throughout recovery. Emotional support included reassurance and encouragement, while practical support involved accompanying patients to hospital visits, arranging transportation, assisting with treatment-related matters, preparing meals, and providing daily care.

"My daughter always tells me not to get worked up or argue with others. She keeps telling me to stay calm… When your mood is better, everything feels smoother."(p12)

"My son has had a hard time these past few days. He has to bring me here, and he handles everything. It is more than 300 kilometres each way… I couldn't manage all this by myself; he has to come with me and take care of everything."(p10)

"There were always people coming to see me or bringing food… I have many friends. My wife looked after me at home and took care of all my daily needs. She took very good care of me."(p11)

4.2 Family protection and restricted autonomy;

Family members' concerns about patients' health sometimes led to protective restrictions on daily activities. Although intended to prevent overexertion or potential harm, these restrictions could limit patients' opportunities to resume physical and social activities during recovery.

"I used to do all the housework—cooking, mopping the floor, cleaning the windows, and washing vegetables. Now they don't really let me do those things… I basically just take care of my own personal hygiene, and I don't do the other housework anymore."(p06)

"My daughter told me not to go out to town, so I have rarely gone out during this period. ……I went to play cards for two days recently, and my daughter was unhappy about it because there was a lot of cigarette smoke there."(P01)

4.3 Concern about becoming a burden on the family

For some participants, limited household income and reliance on adult children for treatment expenses contributed to worries about placing a financial burden on the family.

"When you get an illness like this, there is no other choice—you have to find the money somehow. We are farmers; we farm the land and do not have regular jobs, so we have very little income… There is pressure. When you become ill, even if you do not want to put pressure on your children, you have no choice."(p13)

"When I first found out about the illness, of course I had things on my mind… The main concern was money. Whether I live or die does not matter that much to me… If you spend too much on treatment, you are inevitably placing a burden on your children." (p10)

Theme 5. Healthcare Support and Unmet Rehabilitation Needs

5.1 Trust in healthcare professionals

Some participants expressed trust in healthcare professionals, reflected in positive evaluations of their care, willingness to follow medical advice, and reliance on clinicians for treatment and recovery-related guidance.

"Whether it was the surgery or the nursing care afterward, the nurses were all very good."(P08) She also agreed that the supportive attitudes of healthcare staff had a positive effect on his psychological recovery.

"We have a doctor we can contact directly. We send him the test results, and he tells us how things should be adjusted… He is very responsible, and he also gives us guidance about recovery."(p07)

5.2 Unmet need for individualized rehabilitation guidance

Despite this trust, some participants felt that post-discharge rehabilitation guidance was limited or insufficiently individualized. They were often aware that exercise and self-management were important but remained uncertain about how to adapt these activities to their own physical condition. In response, some sought additional information from digital sources or expressed a preference for more direct access to healthcare professionals during follow-up.

"They told me to walk and exercise, but I don't really know how I should exercise. I just walk and sometimes try a little jogging." (P02)

"There wasn't really much guidance after surgery… The follow-up calls mainly ask whether you are taking your medication regularly and attending your check-ups. I think it would be better to have a person call, so that if you have a problem, you can ask about it directly."(p04)

"Sometimes I ask Doubao on my phone(a Chinese AI chatbot)… If I come across something, I ask it and it explains it to me straight away. I ask whether I can take a certain medicine and how much it costs… Sometimes it is even more detailed than what the experts tell you." (p05)

Discussion

This study extends existing evidence on recovery after lung cancer surgery by showing how the 3–6-month postoperative period remains a vulnerable and active phase of adjustment for older adults with pre-frailty or frailty. During this stage, participants not only had to cope with persistent changes in physical function and adjustments to daily activities, but also faced complex challenges arising from the interactions among perioperative treatment, frailty, and coexisting chronic conditions. Family members and healthcare professionals played important supportive roles throughout the recovery process; however, gaps remained in the existing support provided to patients. Furthermore, patients' perceptions of and responses to the impact of illness were shaped by multiple factors, among which the role of family appeared particularly prominent.

Following lung cancer surgery, patients commonly experience persistent symptoms, including fatigue, dyspnea, and reduced exercise capacity[22]. Previous quantitative studies have described the trajectory of postoperative symptoms and functional outcomes, while qualitative studies have further explored patients' experiences of symptom burden[7], psychological adjustment, and adaptation after surgery[14,15]. However, these studies have largely focused on lung cancer survivors in general, and less is known about how older adults with pre-frailty or frailty experience and interpret recovery-related challenges during the postoperative period. Our study extends previous evidence by demonstrating that pre-frailty or frailty older adults continued to experience substantial physical limitations 3–6 months after surgery, which affected their daily activities and independence. Although some participants actively increased their activity levels in an effort to regain physical function, most reported reduced activity and social participation compared with their preoperative status. These changes were attributable not solely to physical condition but also to sociocultural influences. Within the Chinese cultural context, harmonious interpersonal relationships are highly valued[23]. Some participants expressed concerns about being perceived differently by others or becoming a burden to those around them, which influenced how they adjusted their daily activities and social participation. These findings highlight the need for postoperative care to move beyond monitoring physical recovery alone and to incorporate patients' psychological adjustment, social participation, and individual perceptions of recovery when developing rehabilitation strategies for older adults with pre-frailty or frailty.

For older adults with pre-frailty or frailty, postoperative recovery after lung cancer surgery represents a complex process involving multiple and overlapping challenges. Larger surgical resections may result in greater declines in postoperative pulmonary function and exercise capacity[24].In our qualitative, Some participants attributed their postoperative weakness to a perceived depletion of "qi" (vital energy) following surgery, which shaped their understanding of frailty and recovery. Similar culturally embedded beliefs have been reported among Chinese patients after surgery, who may perceive surgical trauma as causing a loss of vitality that influences their recovery experiences[25]. Previous quantitative research has shown that postoperative frailty among older adults with lung cancer is associated with multimorbidity[26]. Our qualitative findings further illustrate that coexisting chronic conditions, particularly chronic respiratory diseases, contributed to greater symptom burden and psychological stress during recovery. Previous studies have suggested that systemic anticancer therapies may increase treatment-related toxicity and functional vulnerability among older adults with frailty[27,28]. Our qualitative findings extend this evidence by illustrating how neoadjuvant and adjuvant therapies were experienced by participants as additional challenges during postoperative recovery, with treatment-related symptoms interfering with their physical recovery and daily activities. Although multimodal perioperative treatment has become increasingly common in lung cancer care, the effects of treatment timing and cumulative treatment burden on recovery trajectories among older adults with frailty remain incompletely characterized.

Family and healthcare professional support shaped postoperative recovery experiences among older adults with pre-frailty or frailty after lung cancer surgery, with our findings highlighting both their supportive roles and the unmet rehabilitation and post-discharge support needs. Previous studies have highlighted the importance of family involvement in supporting older adults with cancer during illness and recovery[29]. Consistent with previous evidence, our study found that family members provided practical assistance and emotional support, helping patients cope with physical limitations after surgery. However, our findings further extend previous research by showing that family support was not uniformly beneficial: protective behaviours motivated by concerns for patients' safety could unintentionally limit opportunities for independent activity. In addition, our findings suggest that supportive interactions with doctors and nurses provided patients with reassurance and confidence during recovery. This finding is consistent with previous qualitative studies highlighting the importance of information, communication, and professional support among lung cancer survivors[14]. Such support may be particularly valuable in the context of high workloads and limited opportunities for patient–professional communication in Chinese cancer care[30]. However, our findings also revealed limited guidance on postoperative rehabilitation strategies, symptom management, and gradual resumption of activities after discharge, consistent with previous studies reporting unmet rehabilitation and supportive care needs among lung cancer survivors[31,32].

This study has several limitations. First, participants were recruited from a single clinical setting in China, and the findings may therefore reflect specific healthcare and sociocultural contexts, limiting their transferability to other settings. Second, the study focused on the 3–6-month postoperative period and thus did not capture changes in recovery experiences over a longer trajectory. Finally, participants were eligible if they had a FRAIL scale score of ≥ 2, meaning that the sample included both older adults with pre-frailty and those with frailty. Although this broader criterion facilitated recruitment and enabled exploration of recovery experiences among older adults with greater frailty-related vulnerability, the findings may not fully represent the experiences of patients with more advanced frailty. Despite these limitations, this study contributes to a better understanding of the multidimensional recovery experiences of older adults with pre-frailty or frailty following lung cancer surgery and identifies important opportunities to improve individualized rehabilitation and supportive care.

Conclusion

Older adults with pre-frailty or frailty continued to experience substantial physical and psychological challenges 3–6 months after lung cancer surgery. Recovery was further complicated by reduced physical capacity, ongoing anticancer treatment, pre-existing health problems, patients' perceptions of illness and recovery, and broader psychological and social factors. Social participation also declined after surgery, influenced by physical limitations, changes in living environment, illness-related concerns, and psychological considerations. Family support played an important role in recovery, but excessive protection and concerns about burdening family members could negatively affect patients' autonomy and psychological well-being. Although professional and emotional support from healthcare professionals was highly valued during treatment, individualized rehabilitation and follow-up guidance after discharge remained limited. These findings highlight the need for rehabilitation and follow-up approaches tailored to the specific needs of older adults with pre-frailty or frailty.

Declarations

Supplementary Information

Supplementary Material 1.

Supplementary Material 2.

Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki and all relevant ethical guidelines and regulations. This study has been approved by the Ethics Committee of the First Affiliated Hospital of Zhejiang University School of Medicine, and the ethics approval document is IIT20251246B. Written informed consent was obtained from all participants before the interviews were conducted.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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Author Contribution

Jiayuan Ou: Conceptualization, Methodology, Investigation, Data curation, Formal analysis, Writing – original draft, and Visualization. Lili Sun: Methodology, Formal analysis, Supervision, and Writing – review & editing. Tiantian Shen: Formal analysis, Validation, and Writing – review & editing. Zhaodi Wang: Formal analysis, Validation, Supervision, and Writing – review & editing. All authors contributed to the interpretation of the findings, critically revised the manuscript for important intellectual content, and approved the final version of the manuscript.

Data Availability

Availability of Data and Materials Due to the privacy of the subjects involved, the data sets analyzed during the current study period are not publicly available, but are available from the corresponding authors at their reasonable request.

References

1. Bray F, Laversanne M, Sung H, et al. Global cancer statistics 2022: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2024;74(3):229–63. 10.3322/caac.21834.
2. Ju W, Zheng R, Zhang S, et al. Cancer statistics in chinese older people, 2022: current burden, time trends, and comparisons with the US, japan, and the republic of korea. Sci China Life Sci. 2023;66(5):1079–91. 10.1007/s11427-022-2218-x.
3. Li L, Shan T, Zhang D, Ma F. Nowcasting and forecasting global aging and cancer burden: analysis of data from the GLOBOCAN and global burden of disease study. J Natl Cancer Cent. 2024;4(3):223–32. 10.1016/j.jncc.2024.05.002.
4. Avery KNL, Blazeby JM, Chalmers KA, et al. Impact on health-related quality of life of video-assisted thoracoscopic surgery for lung cancer. Ann Surg Oncol. 2020;27(4):1259–71. 10.1245/s10434-019-08090-4.
5. Linwan Z, Kondo K, Bando T, et al. Assessment of dyspnea, ADL, and QOL in the perioperative period in lung cancer patients treated with minimally invasive surgery. J Med Invest. 2023;70(34):388–402. 10.2152/jmi.70.388.
6. Mizutani T, Takei H, Kunitoh H, et al. Longitudinal assessment of functional independence of older adults after lung cancer surgery: final results of the JCOG1710A prospective cohort study. J Geriatr Oncol. 2025;16(6):102268. 10.1016/j.jgo.2025.102268.
7. Chen K, Yang D, Li F, et al. Changes in the symptom clusters of elderly patients with lung cancer over the course of postoperative rehabilitation and their correlation with frailty and quality of life: a longitudinal study. Eur J Oncol Nurs: Off J Eur Oncol Nurs Soc. 2023;67:102388. 10.1016/j.ejon.2023.102388.
8. Azhimamatova R, Salieva RS, Zalova TB, et al. Frailty in COPD: Clinical Impact, Diagnosis, Biomarkers, and Management Strategies. Int J Chronic Obstr Pulm Dis. 2025;20:2445–58. 10.2147/COPD.S522862.
9. Lee ACH, Lee SM, Ferguson MK. Frailty Is Associated With Adverse Postoperative Outcomes After Lung Cancer Resection. JTO Clin Res Rep. 2022;3(11):100414. 10.1016/j.jtocrr.2022.100414.
10. Cooper L, Gong Y, Dezube AR, et al. Thoracic surgery with geriatric assessment and collaboration can prepare frail older adults for lung cancer surgery. J Surg Oncol. 2022;126(2):372–82. 10.1002/jso.26866.

11. Gu X, Shen X, Chu JH, Fang TT, Jiang L, Frailty. Illness Perception and Lung Functional Exercise Adherence in Lung Cancer Patients After Thoracoscopic Surgery. Patient Prefer Adherence. 2023;17:2773–87. 10.2147/PPA.S435944.
12. Hu FW, Sun CY, Su WC, Chang CM. Frailty and intrinsic capacity as predictors of recovery in older patients surgically treated for cancer: a longitudinal study. Cancer Nurs Published online March. 2025;27. 10.1097/NCC.0000000000001497.
13. Takei H, Kunitoh H, Wakabayashi M, et al. Prospective, multi-institutional observational study of deterioration in activities of daily living in elderly patients after lung cancer surgery. JTO Clin Res Rep. 2023;4(8). 10.1016/j.jtocrr.2023.100550.
14. Xiao J, Peng Y, Li Y, et al. Exploring the symptoms and psychological experiences among lung cancer convalescence patients after radical lobectomy: a qualitative study. Cancer Med. 2024;13(15):e70048. 10.1002/cam4.70048.
15. Kyte K, Ekstedt M, Rustoen T, Oksholm T. Longing to get back on track: patients' experiences and supportive care needs after lung cancer surgery. J Clin Nurs Published online. 2019. 10.1111/jocn.14751.
16. Doyle L, McCabe C, Keogh B, Brady A, McCann M. An overview of the qualitative descriptive design within nursing research. J Res Nurs. 2020;25(5):443–55. 10.1177/1744987119880234.
17. Braun V, Clarke V. Using thematic analysis in psychology. Qual Res Psychol. 2006;3(2):77–101. 10.1191/1478088706qp063oa.
18. Braun V, Clarke V. Reflecting on reflexive thematic analysis. Qual Res Sport Exerc Health. 2019;11(4):589–97. 10.1080/2159676X.2019.1628806.
19. Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. Int J Qual Health Care. 2007;19(6):349–57. 10.1093/intqhc/mzm042.
20. Morley JE, Malmstrom TK, Miller DK. A SIMPLE FRAILTY QUESTIONNAIRE (FRAIL) PREDICTS OUTCOMES IN MIDDLE AGED AFRICAN AMERICANS. J Nutr Health Aging. 2012;16(7):601–8. 10.1007/s12603-012-0084-2.
21. Moeller AK, Creswell JW, Saville N, editors. Second Language Assessment and Mixed Methods Research. Cambridge University Press; 2016.
22. Heiden BT, Subramanian MP, Liu J, et al. Long-term patient-reported outcomes following non-small cell lung cancer resection. J Thorac Cardiovasc Surg. 2022;164(3):615–e6263. 10.1016/j.jtcvs.2021.11.100.
23. Xiao C, Patrician PA, Montgomery AP, Wang Y, Jablonski R, Markaki A. Filial piety and older adult caregiving among chinese and chinese-american families in the United States: a concept analysis. BMC Nurs. 2024;23:115. 10.1186/s12912-024-01789-0.
24. Nezu K, Kushibe K, Tojo T, Takahama M, Kitamura S. Recovery and limitation of exercise capacity after lung resection for lung cancer. Chest. 1998;113(6):1511–6. 10.1378/chest.113.6.1511.
25. Chen J, Zhu X, Jiang J, Qi Y, Shi Y. Needs of chinese patients undergoing home-based rehabilitation after hip replacement: a qualitative study. PLoS ONE. 2019;14(7):e0220304. 10.1371/journal.pone.0220304.
26. Su Xe, Lin Cliu, Wang H et al. gang,. Development and validation of a machine learning-based predictive model for postoperative frailty in patients with non-small cell lung cancer and its relation to early recovery. *Ann Surg Oncol*. 2025;32(8):5936–5947. 10.1245/s10434-025-17353-2
27. Baltussen JC, de Glas NA, van Holstein Y, et al. Chemotherapy-related toxic effects and quality of life and physical functioning in older patients. JAMA Netw Open. 2023;6(10):e2339116. 10.1001/jamanetworkopen.2023.39116.
28. Lee HJ, Boscardin J, Walter LC, et al. Associations of frailty with survival, hospitalization, functional decline, and toxicity among older adults with advanced non-small cell lung cancer. Oncologist. 2025;30(8):oyae349. 10.1093/oncolo/oyae349.
29. Knox N, Agar M, McErlean G, Vinod SK, Hickman L. Exploring the unmet needs of older people living with lung cancer: a qualitative study. Age Ageing. 2026;55(2):afag023. 10.1093/ageing/afag023.
30. Lyu XC, Jiang HJ, Lee LH, Yang CI, Sun XY. Oncology nurses' experiences of providing emotional support for cancer patients: a qualitative study. BMC Nurs. 2024;23(1):58. 10.1186/s12912-024-01718-1.
31. Yun YH, Shon EJ, Yang AJ, et al. Needs regarding care and factors associated with unmet needs in disease-free survivors of surgically treated lung cancer. Ann Oncol. 2013;24(6):1552–9. 10.1093/annonc/mdt032.
32. Lee PY, Chen YA, Tsai TH, Chen CY, Shieh SH. Unmet supportive care needs of lung cancer survival patients at different cancer stages and treatment phases. J Multidiscip Healthc. 2025;18:435–44. 10.2147/JMDH.S482232.

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