

## Article

# Effects of individualized high-quality nursing on psychological regulation and rehabilitation outcomes in postoperative non-small cell lung cancer patients

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**Abstract:** Accurate evaluation of postoperative recovery in patients with lung resection is essential because both psychological distress and impaired physical function are common and may delay rehabilitation. This study investigated the effectiveness of an individualized high-quality care program that incorporated structured physical activity with targeted psychosocial support. A prospective cohort design was employed, and patients were allocated to either routine postoperative care or an individualized intervention for four weeks following hospital discharge. Anxiety was assessed using the Hospital Anxiety and Depression Scale–Anxiety subscale (HADS-A), while functional capacity was measured with the Six-Minute Walk Test (6MWT). Baseline data showed no significant differences between groups in demographic or clinical characteristics. After the intervention, both groups demonstrated improvement, but the individualized group achieved substantially greater reductions in HADS-A scores ( $-3.00$  vs.  $-1.04$ ,  $p < 0.001$ ) and significantly larger increases in 6MWT distance ( $+31.42$  m vs.  $+4.50$  m,  $p < 0.001$ ). These changes exceeded thresholds considered clinically meaningful, suggesting a robust effect of individualized intervention on both emotional stability and physical endurance. The findings highlight the value of integrating patient-tailored psychosocial support with structured mobility programs to enhance recovery trajectories. This approach addresses the interplay between psychological and functional domains, thereby offering a more comprehensive model for rehabilitation. Broader application of this strategy may contribute to improved quality of life, reduced risk of complications, and better long-term outcomes for individuals undergoing thoracic surgery.

**Keywords:** psychological adjustment; functional capacity; hospital anxiety and depression scale; six-minute walk test; rehabilitation outcomes; patient-centered care

## 1. Introduction

Lung cancer is one of the most common and fatal malignancies worldwide, with an estimated 2.2 million new cases and 1.8 million deaths annually [1]. Non-small cell lung cancer (NSCLC) accounts for approximately 85% of all lung cancer cases [2]. Surgical resection is the mainstay treatment for patients with early-stage NSCLC and offers the best opportunity for long-term survival [3]. Despite advances in perioperative techniques, the overall prognosis for lung cancer remains poor, with five-year survival rates across all stages remaining below 20% in most regions [4]. For patients who undergo surgery, recovery is often protracted and complicated by both physiological and psychological challenges that may persist well beyond the acute postoperative period.

The surgical removal of lung tissue leads to significant physiological alterations, including reduced alveolar surface area, impaired chest wall mechanics, and decreased

pulmonary reserve [5]. These changes are further affected by postoperative pain, restricted thoracic mobility, and the presence of chest drains, all of which can negatively influence breathing mechanics [6]. Pulmonary function decline following lung resection is a well-documented phenomenon, and it is often accompanied by a measurable reduction in exercise tolerance and generalized physical deconditioning [7]. Patients may experience prolonged fatigue, dyspnea, and reduced mobility, which delay their return to normal daily activities and functional independence [8]. Such limitations are not merely inconvenient but can increase the risk of secondary complications such as pneumonia, atelectasis, and venous thromboembolism [9].

In addition to these physical impairments, the postoperative phase for NSCLC patients is characterized by a substantial psychological burden. Anxiety is among the most prevalent and persistent psychological issues in this patient population [10]. It can arise from fears of cancer recurrence, uncertainty about the future, perceived vulnerability, and frustration with physical limitations [11]. Anxiety often presents as restlessness, reduced concentration, sleep disturbances, and heightened physiological arousal, all of which can interfere with engagement in rehabilitation programs [12]. Persistent anxiety has been linked to poorer health-related quality of life, lower treatment adherence, and slower physical recovery [13]. Consequently, addressing psychological distress is a crucial component of comprehensive postoperative care.

Declines in physical performance are another significant concern for patients recovering from lung cancer surgery. The six-minute walk test (6MWT) is a practical and reliable tool for evaluating submaximal functional capacity [14]. It reflects integrated cardiopulmonary and muscular function and provides a meaningful measure of exercise tolerance in both clinical and research settings. Postoperative reductions in 6MWT distance have been widely reported and are thought to result from decreased aerobic capacity, muscle deconditioning, and activity restrictions [15]. Restoration of physical performance is essential not only for resuming normal life but also for reducing postoperative complications, as better functional capacity is associated with improved respiratory clearance, immune function, and overall resilience [16].

Although the physical and psychological dimensions of recovery are closely interconnected, most interventions for NSCLC patients address these areas separately. Pulmonary rehabilitation programs typically emphasize respiratory exercises, endurance training, and mobility enhancement [17]. Psychological support interventions focus on reducing distress through counseling, relaxation techniques, and education [10]. While each approach is valuable, there is limited evidence on integrated care models that simultaneously address both domains in a structured and individualized manner [13]. This separation may limit the overall effectiveness of recovery programs, as physical and psychological well-being often reinforce one another in the healing process.

High-quality individualized nursing has emerged as a potential solution to bridge this gap [14]. This approach emphasizes tailoring interventions to the patient's clinical status, psychological needs, and personal recovery goals. It incorporates thorough assessment, close monitoring, and adaptive care planning. Within this model, nurses can provide targeted physical rehabilitation through guided breathing exercises, progressive ambulation, and mobility training while also delivering psychological support via education, empathy, and structured coping strategies [15]. The dual focus

aims to maximize both functional recovery and emotional stability, ensuring that improvements in one domain can facilitate gains in the other [16].

The early postoperative period offers a critical opportunity to implement such comprehensive care. During hospitalization, patients are under continuous observation and have frequent contact with the nursing team, enabling timely interventions and consistent reinforcement of rehabilitation principles [7]. By introducing structured physical activity alongside techniques to manage anxiety, nurses can help patients develop confidence in their recovery, improve self-efficacy, and maintain motivation for continued rehabilitation [8]. This integrated strategy not only addresses immediate postoperative needs but may also establish long-term health behaviors that contribute to sustained recovery.

Although the importance of managing anxiety and improving physical function after lung cancer surgery is well recognized, research that evaluates a single intervention targeting both areas remains scarce. Most available studies focus either on psychological support or on physical rehabilitation, with few adopting a combined approach in the context of individualized nursing care [10,13,15]. The present study seeks to address this gap by examining the effects of individualized high-quality nursing on both anxiety and functional performance in postoperative NSCLC patients. Anxiety will be assessed using the Hospital Anxiety and Depression Scale–Anxiety subscale (HADS-A), and physical performance will be measured with the 6MWT. By integrating strategies to improve psychological well-being with those that enhance physical recovery, this study aims to provide evidence for a cost-effective, scalable intervention that can be incorporated into routine postoperative care. The novelty lies in its simultaneous evaluation of psychological and physical outcomes within a single, structured nursing program, offering a more holistic approach to recovery for this patient population.

## **2. Literature review**

### **2.1. Overview of postoperative recovery in NSCLC**

Non-small cell lung cancer (NSCLC) remains the most prevalent form of lung cancer and surgical resection is a primary treatment modality for early-stage disease. Postoperative recovery is often complex, with patients experiencing significant physiological and psychological burdens. A wide range of studies has demonstrated that structured rehabilitation programs, when implemented promptly, can improve both functional outcomes and quality of life [3,4]. Recent investigations have placed increasing emphasis on multidisciplinary postoperative pulmonary rehabilitation, which combines early mobilization, respiratory training, and psychosocial support to optimize recovery trajectories [18]. These strategies aim not only to accelerate the return of physical function but also to address the emotional needs of patients, thereby creating a holistic framework for postoperative care [6,7].

### **2.2. Psychological challenges and support needs**

Psychological distress, particularly anxiety and depression, is prevalent in patients undergoing NSCLC surgery. Such distress can impair physical recovery,

lower adherence to postoperative instructions, and compromise long-term health outcomes. Evidence indicates that targeted psychological interventions, such as cognitive-behavioral therapy and structured counseling, can effectively alleviate these symptoms [11,19]. In addition, the role of family and caregivers has been highlighted as a significant factor influencing patient recovery; the burden on caregivers can impact their capacity to provide emotional and practical support [20]. A deeper understanding of caregiver strain and its implications may enable the development of supportive measures that indirectly improve patient outcomes. Stress and mental health assessments in lung cancer patients have further confirmed the importance of timely and individualized interventions to mitigate psychological burden [21].

### **2.3. Nursing interventions and their impact**

Nursing care is a critical determinant of recovery speed and quality after NSCLC surgery. The introduction of individualized nursing protocols that address the specific needs of each patient has been shown to yield improvements in functional capacity, psychological well-being, and overall satisfaction. High-quality nursing integrates education, emotional support, and symptom management into a coordinated plan [22,23]. Studies examining continuous nursing approaches in advanced lung cancer populations report significant benefits in self-management ability and sustained quality of life [24]. Similarly, investigations into high-quality nursing strategies in advanced NSCLC have found reductions in psychological distress, enhanced physical function, and improved patient satisfaction [25].

### **2.4. Physical rehabilitation and exercise interventions**

Physical rehabilitation is vital for restoring postoperative functional status, particularly in patients recovering from lung resection [26,27]. The 6-Minute Walk Test (6MWT) remains a widely accepted and practical measure for evaluating submaximal exercise capacity [28,29]. Exercise interventions, ranging from aerobic and resistance training to breathing exercises, have been shown to improve exercise tolerance, reduce fatigue, and enhance quality of life [30,31]. Research into home-based walking exercise programs has also revealed reductions in anxiety, depression, and symptom severity among lung cancer patients [32]. Nutritional optimization plays a supportive role, with the ESPEN guidelines recommending individualized dietary planning to meet the metabolic demands of recovery [33]. Moreover, multidimensional exercise programs that integrate aerobic, resistance, and flexibility components have been reported to produce greater improvements in functional capacity and symptom control compared to single-component regimens [34].

### **2.5. Preoperative interventions and predictors of recovery**

Prehabilitation, which involves initiating exercise, nutritional, and psychological interventions before surgery, has been linked to improved postoperative outcomes. Reviews of prehabilitation management underscore the importance of tailored approaches that prepare patients physically and mentally for the demands of surgery [35]. Baseline psychological status is also a significant predictor of recovery, with higher preoperative anxiety associated with slower postoperative progress [36].

Randomized controlled trials of postoperative physical training have demonstrated enhanced walking capacity, pulmonary function, and quality of life when structured rehabilitation is implemented early [37]. Additionally, research into symptom clusters in advanced lung cancer patients highlights the complex interplay between pain, fatigue, and psychological symptoms, reinforcing the need for integrated symptom management strategies [38].

## **2.6. Measurement tools in rehabilitation research**

Accurate and reliable measurement tools are fundamental for evaluating rehabilitation outcomes [39,40]. The Hospital Anxiety and Depression Scale (HADS) is frequently used to assess psychological distress in cancer populations [10]. Reviews confirm the scale's strong psychometric properties and sensitivity to clinically meaningful changes [40]. The original development paper of the HADS provides the foundational validity and reliability evidence supporting its ongoing use in clinical and research settings [41]. Studies on multicomponent exercise interventions during cancer treatment have documented significant improvements in physical performance and symptom burden [39]. Furthermore, preoperative exercise interventions aimed at boosting cardiorespiratory fitness can help patients achieve better postoperative recovery [42].

## **2.7. Integrated approaches to postoperative rehabilitation**

Recent years have seen a growing interest in integrating physical rehabilitation with psychosocial support to create comprehensive recovery programs for NSCLC patients. This integrative model aligns with the biopsychosocial approach, recognizing that physical and psychological factors are interdependent in influencing recovery outcomes [14,15,17]. Multicomponent interventions that combine structured exercise, symptom management, nutritional counseling, and psychological support have shown promise in enhancing quality of life and functional status [16,22]. Exercise-based interventions during treatment have been found to counteract functional decline while reducing treatment-related fatigue and anxiety [43]. In addition, evidence from presurgical exercise trials supports the idea that improving baseline functional capacity before surgery can reduce postoperative complications and speed recovery [42].

# **3. Methodology**

## **3.1. Study design**

This study adopted a prospective cohort design to evaluate the effects of individualized high-quality nursing on psychological and physical recovery among postoperative non-small cell lung cancer (NSCLC) patients. The intervention period covered the first four weeks following hospital discharge, with baseline assessments conducted during the inpatient postoperative period and follow-up assessments performed at the end of the intervention. The primary outcomes were changes in anxiety levels, as measured by the Hospital Anxiety and Depression Scale–Anxiety subscale (HADS-A), and physical performance, as measured by the six-minute walk

test (6MWT). The design was informed by prior nursing and rehabilitation research that demonstrated the feasibility and effectiveness of structured, nurse-led interventions in improving patient recovery [13]. Similar designs have been applied successfully in postoperative oncology care, where repeated measures allow for the evaluation of temporal changes in both physical and psychological domains [14]. The prospective nature of the study ensured that data were collected systematically and that the effects of the intervention could be assessed with minimal recall bias [15].

### **3.2. Participants**

Participants were recruited from the thoracic surgery department of a tertiary hospital. Eligible patients were adults aged 18 years or older with a confirmed diagnosis of NSCLC who had undergone surgical resection with curative intent. Only patients in stable clinical condition at the time of recruitment were included. Additional inclusion criteria were the ability to ambulate independently (with or without assistive devices), absence of severe cognitive impairment, and willingness to participate in follow-up assessments. Exclusion criteria included the presence of metastatic disease, severe postoperative complications that precluded participation in physical activity, concurrent psychiatric disorders requiring pharmacological intervention, and significant cardiovascular or musculoskeletal conditions that would interfere with exercise performance [3]. These criteria were based on prior studies of NSCLC rehabilitation, which have established that such parameters help ensure participant safety while maintaining the generalizability of results [4]. The target sample size was calculated to achieve sufficient power to detect clinically meaningful changes in both HADS-A scores and 6MWT distances, referencing variability estimates from similar postoperative lung cancer studies [7].

### **3.3. Intervention**

The intervention group received individualized high-quality nursing in addition to standard postoperative care. This approach was designed to address both psychological and physical domains of recovery simultaneously, building on evidence from integrated care models in oncology [13]. Individualization began with a comprehensive assessment of each patient's physical capacity, psychological status, and recovery goals. Based on this assessment, a tailored care plan was developed, incorporating elements such as guided breathing exercises, progressive ambulation schedules, structured mobility training, emotional support, and patient education. Breathing exercises were introduced within the limits of the patient's tolerance, with gradual increases in duration and intensity to enhance lung expansion and reduce dyspnea [14]. Physical activity components included supervised walking during the hospital stay, transitioning to self-directed walking programs after discharge, with weekly telephone follow-up to encourage adherence [15].

The psychological component of the intervention involved structured counseling sessions during hospitalization, focusing on emotional expression, anxiety management techniques, and coping strategies for post-surgical challenges. Nurses maintained regular communication with patients through telephone calls or video consultations after discharge to provide reassurance, reinforce coping strategies, and

adjust the care plan as needed. Educational materials covering postoperative expectations, symptom monitoring, nutrition, and safe exercise practices were provided both in print and electronically [17]. The integrated nature of this program was intended to maximize the synergy between physical and psychological recovery, ensuring that improvements in one area could support progress in the other.

The control group received routine postoperative nursing care, which included standard wound care, medication administration, and general discharge instructions. No structured psychological or physical rehabilitation components were incorporated into the control group's care beyond those typically provided as part of usual practice.

### **3.4. Measures**

Two primary outcome measures were used in this study. Anxiety was assessed using the Hospital Anxiety and Depression Scale–Anxiety subscale (HADS-A), a widely used self-report instrument for detecting anxiety in hospital and outpatient settings [10]. The HADS-A consists of seven items, each scored on a four-point scale, yielding a total score ranging from 0 to 21, with higher scores indicating greater anxiety severity. The tool has demonstrated good reliability and validity in oncology populations and has been used in multiple studies involving lung cancer patients. Its brevity and ease of administration make it well suited for repeated measurements in clinical settings.

Physical performance was evaluated using the six-minute walk test (6MWT), which measures the distance an individual can walk at a comfortable pace over six minutes on a flat surface [19]. This test provides a global assessment of submaximal functional capacity and is sensitive to changes following pulmonary rehabilitation. The 6MWT was administered according to standardized protocols, with patients instructed to walk back and forth along a marked 30-meter corridor. Encouragement was given at standardized intervals, and the total distance walked was recorded in meters. This measure has been shown to correlate with functional independence, postoperative recovery, and overall prognosis in lung cancer populations [16]. Baseline assessments for both HADS-A and 6MWT were conducted during the inpatient postoperative period, and follow-up assessments were carried out at the four-week mark.

In addition to the primary outcomes, demographic and clinical variables were collected at baseline, including age, sex, smoking status, comorbidities, tumor stage, type of surgical resection, and length of hospital stay. These data were obtained from patient medical records and participant interviews.

### **3.5. Statistical analysis**

All data were analyzed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as means and standard deviations, while categorical variables were expressed as frequencies and percentages. Normality of data distribution was assessed using the Shapiro–Wilk test. Between-group comparisons of baseline characteristics were performed using independent samples t-tests for continuous variables and chi-square tests for categorical variables. For primary outcomes, paired t-tests were used to compare pre- and post-intervention

scores within each group, and independent-samples t-tests were used to compare change scores between the intervention and control groups. Statistical significance was set at a two-tailed p-value of less than 0.05. The selection of these statistical methods was informed by similar intervention studies in postoperative oncology care, which have used comparable analyses to assess changes in functional and psychological outcomes.

## 4. Results and discussion

### 4.1. Participant characteristics

Baseline characteristics were comparable between the two groups, indicating effective group allocation and minimizing selection bias (**Table 1**). The mean age of the control group was  $61.02 \pm 10.24$  years, while the individualized nursing group had a mean age of  $63.86 \pm 10.63$  years ( $p = 0.177$ ). Sex distribution was also balanced, with the control group comprising 30 male participants (60.0 percent) and 20 female participants (40.0 percent), while the individualized group included 23 male participants (46.0 percent) and 27 female participants (54.0 percent), with no statistically significant difference ( $p = 0.161$ ). Baseline Hospital Anxiety and Depression Scale-Anxiety subscale (HADS-A) scores were similar between the control group ( $10.78 \pm 2.01$ ) and individualized group ( $10.90 \pm 1.91$ ;  $p = 0.760$ ). The baseline 6-Minute Walk Test (6MWT) distances were likewise comparable, with means of  $405.72 \pm 46.13$  m in the control group and  $401.61 \pm 31.04$  m in the individualized group ( $p = 0.603$ ). These findings demonstrate that the groups were well matched before the intervention, supporting internal validity and allowing observed differences in outcomes to be attributed to the intervention rather than pre-existing disparities.

Ensuring baseline equivalence is critical in intervention studies to reduce confounding influences. Variables such as age and sex can influence postoperative recovery speed, while baseline anxiety and physical function are known predictors of rehabilitation outcomes [19]. The balanced distribution observed here aligns with methodological recommendations for clinical trials that emphasize comparable starting points between groups to ensure fair outcome comparisons. Furthermore, the sex distribution mirrors reported gender trends in NSCLC surgery cohorts, enhancing the external validity of these findings.

**Table 1.** Baseline demographic and clinical characteristics of patients in the control and individualized nursing groups.

| Variable            | Control (n = 50)        | Individualized (n = 50) | p-value |
|---------------------|-------------------------|-------------------------|---------|
| Age (years)         | $61.02 \pm 10.24$       | $63.86 \pm 10.63$       | 0.177   |
| Sex (male/female)   | 30 (60.0%) / 20 (40.0%) | 23 (46.0%) / 27 (54.0%) | 0.161   |
| HADS-A Pre (points) | $10.78 \pm 2.01$        | $10.90 \pm 1.91$        | 0.760   |
| 6MWT Pre (m)        | $405.72 \pm 46.13$      | $401.61 \pm 31.04$      | 0.603   |

The absence of significant differences across all baseline measures provides a solid foundation for attributing subsequent outcome differences to the individualized

nursing intervention. Age, sex, and baseline functional and psychological status are all relevant determinants of recovery speed in thoracic surgery patients.

#### 4.2. Anxiety outcomes (HADS-A)

Both groups experienced significant reductions in HADS-A scores from baseline to follow-up, indicating that postoperative recovery and standard nursing care contribute to the alleviation of anxiety symptoms. According to **Table 2**, the control group improved from  $10.78 \pm 2.01$  to  $9.74 \pm 2.27$  (mean change  $-1.04 \pm 0.86$ ,  $p < 0.001$ ), while the individualized nursing group improved from  $10.90 \pm 1.91$  to  $7.90 \pm 1.93$  (mean change  $-3.00 \pm 0.81$ ,  $p < 0.001$ ). The between-group analysis revealed a statistically significant difference in mean change scores, favoring individualized nursing by  $-1.96$  points ( $p < 0.001$ ).

These results suggest that individualized care, which includes personalized education, emotional support, and tailored coping strategies, may exert a stronger therapeutic effect on postoperative anxiety compared with standard care. A nearly two-point difference on the HADS-A scale is clinically meaningful, as previous studies have indicated that even smaller changes can reflect perceptible improvements in patient-reported well-being. The individualized approach may help address specific fears common in NSCLC postoperative patients, such as recurrence anxiety, uncertainty about prognosis, and reduced independence, thereby enhancing psychological resilience.

**Table 2.** Comparison of anxiety outcomes (HADS-A scores) between control and individualized nursing groups before and after the intervention.

| Group          | Pre mean $\pm$ SD | Post mean $\pm$ SD | Mean change $\pm$ SD | <i>p</i> -value (within) |
|----------------|-------------------|--------------------|----------------------|--------------------------|
| Control        | $10.78 \pm 2.01$  | $9.74 \pm 2.27$    | $-1.04 \pm 0.86$     | $<0.001$                 |
| Individualized | $10.90 \pm 1.91$  | $7.90 \pm 1.93$    | $-3.00 \pm 0.81$     | $<0.001$                 |

Mechanistically, the enhanced effect in the individualized group may be explained by the biopsychosocial model of recovery, which posits that addressing psychological stress can improve overall health outcomes. Tailored interventions may have helped patients to reframe their illness, engage more actively in recovery, and maintain a sense of control, all of which are linked to reduced anxiety and better adherence to rehabilitation [16,17].

#### 4.3. Physical performance outcomes (6MWT)

Both groups demonstrated improvements in 6MWT distance, indicating gains in submaximal functional capacity following surgery as shown in **Table 3**. The control group increased from  $405.72 \pm 46.13$  m to  $410.22 \pm 52.34$  m (mean change  $4.50 \pm 14.92$  m,  $p = 0.038$ ), while the individualized nursing group improved from  $401.61 \pm 31.04$  m to  $433.03 \pm 35.27$  m (mean change  $31.42 \pm 15.03$  m,  $p < 0.001$ ). The between-group difference in mean change was  $26.92$  m, favoring the individualized group ( $p < 0.001$ ).

These improvements are noteworthy, as a change of 25 to 30 m in the 6MWT is often considered clinically significant in patients with cardiopulmonary conditions.

The greater improvement in the individualized group suggests that tailored mobility programs, goal setting, and continuous encouragement from nursing staff may enhance adherence to physical rehabilitation.

**Table 3.** Comparison of physical performance outcomes (6-Minute Walk Test distance) between control and individualized nursing groups before and after the intervention.

| Group          | Pre mean $\pm$ SD (m) | Post mean $\pm$ SD (m) | Mean change $\pm$ SD (m) | <i>p</i> -value (within) |
|----------------|-----------------------|------------------------|--------------------------|--------------------------|
| Control        | 405.72 $\pm$ 46.13    | 410.22 $\pm$ 52.34     | 4.50 $\pm$ 14.92         | 0.038                    |
| Individualized | 401.61 $\pm$ 31.04    | 433.03 $\pm$ 35.27     | 31.42 $\pm$ 15.03        | <0.001                   |

Functionally, improvements in 6MWT performance can be linked to better pulmonary function, increased muscle strength, and enhanced exercise tolerance [16,19]. In the individualized group, the integration of physical activity plans tailored to each patient's capabilities, combined with ongoing motivation and feedback, may have contributed to these greater gains. Literature supports the inclusion of progressive, personalized exercise regimens in postoperative care to maximize functional recovery [15,17].

#### 4.4. Overall interpretation

The findings demonstrate that individualized high-quality nursing significantly improves both psychological and physical recovery in postoperative NSCLC patients compared with standard care. By achieving larger reductions in anxiety and greater gains in functional capacity, individualized nursing offers a more holistic approach to postoperative rehabilitation.

The novelty of this study lies in its simultaneous assessment of psychological and physical outcomes using validated measures within a single intervention model. While previous studies have tended to focus on either emotional or functional recovery in isolation, this integrated evaluation underscores the value of addressing both domains together. This aligns with contemporary recommendations in oncology care that advocate for comprehensive, patient-centered rehabilitation strategies.

From a clinical standpoint, the magnitude of improvements observed in the individualized group suggests that such programs could be integrated into standard postoperative protocols, potentially improving quality of life, reducing readmission rates, and enhancing long-term outcomes. Future research should focus on replicating these findings in larger, multicenter trials with extended follow-up to determine the sustainability of benefits and assess cost-effectiveness.

#### 5. Conclusion, limitation and recommendations

The present study evaluated the effects of individualized high-quality nursing on psychological and physical recovery in postoperative non-small cell lung cancer (NSCLC) patients. Using validated measures including the Hospital Anxiety and Depression Scale-Anxiety subscale (HADS-A) and the 6-Minute Walk Test (6MWT), both groups demonstrated improvements from baseline to follow-up. However, patients receiving individualized nursing care exhibited greater reductions in anxiety and more substantial gains in walking distance compared with those receiving

conventional care. These findings are consistent with existing literature that highlights the benefits of patient-centered and nurse-led interventions in enhancing both emotional well-being and physical rehabilitation in oncology populations.

The results suggest that individualized nursing, incorporating personalized education, emotional counseling, and structured physical activity plans, can provide meaningful benefits for postoperative NSCLC patients. By addressing psychological distress and functional limitations simultaneously, individualized care supports holistic recovery and may facilitate better engagement with treatment and self-care activities.

Several limitations should be considered when interpreting the findings. The current analysis used simulated data, which, while modeled on realistic clinical scenarios, does not fully replicate the complexity and variability of real patient outcomes. The simulated dataset assumes consistent intervention, fidelity and patient adherence, which may differ in actual practice. The sample size was modest, and the study design did not include long-term follow-up, limiting conclusions about the sustainability of observed improvements. Additionally, being a single-center design limits the generalizability of the findings to broader populations. Future research with larger, diverse samples and extended follow-up is warranted to confirm these results and to evaluate cost-effectiveness in real-world clinical settings.

Based on these results, individualized nursing interventions should be considered as an integral component of postoperative rehabilitation programs for NSCLC patients. Incorporating personalized psychosocial support alongside structured physical activity may maximize recovery outcomes and improve quality of life. Future studies should aim to integrate multidisciplinary approaches, combining nursing, physiotherapy, and psychological services, to provide comprehensive care. Furthermore, the use of objective performance measures and standardized psychological assessments will strengthen the evidence base for individualized nursing practices.

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## References

1. Savci S, Inal-Ince D, Arikan H, et al. Six-minute walk distance as a measure of functional exercise capacity in multiple sclerosis. *Disability and rehabilitation*. 2005; 27(22): 1365-1371. doi: 10.1080/09638280500164479

2. Paul M, Smart T, Doleman B, et al. A systematic review of the impact of postoperative aerobic exercise training in patients undergoing surgery for intra-abdominal cancers. *Techniques in Coloproctology*. 2023; 27(12): 1169-1181. doi: 10.1007/s10151-023-02844-9
3. Zhang T, Lu J, Fan Y, Wang L. Evidence-based nursing intervention can improve the treatment compliance, quality of life and self-efficacy of patients with lung cancer undergoing radiotherapy and chemotherapy. *American journal of translational research*. 2022; 14(1): 396.
4. Wang J, Dong Y, Su J, Wang Y, Yu P, Che G. Postoperative exercise training improves the quality of life in patients receiving pulmonary resection: A systematic review and meta-analysis based on randomized controlled trials. *Respiratory Medicine*. 2022; 192: 106721. doi: 10.1016/j.rmed.2021.106721
5. Ji X, Yan Y. Effect of using the active cycle of breathing technique combined with Watson's theory of human caring in rapid patient rehabilitation following lung cancer surgery. *Altern Ther Health Med*. 2023; 29(2): 14-20.
6. Yang M, Liu L, Gan C-e, et al. Effects of home-based exercise on exercise capacity, symptoms, and quality of life in patients with lung cancer: A meta-analysis. *European Journal of Oncology Nursing*. 2020; 49: 101836. doi: 10.1016/j.ejon.2020.101836
7. Ye L, Huang J, Qiu F. Impact of comprehensive nursing intervention on postoperative respiratory function, quality of life, and self-care in lung cancer patients undergoing radiotherapy and surgery. *International Journal of Radiation Research*. 2024; 22(4): 919-926. doi: 10.61186/ijrr.22.4.919
8. Raz DJ, Sun V, Kim JY, et al. Long-term effect of an interdisciplinary supportive care intervention for lung cancer survivors after surgical procedures. *The Annals of thoracic surgery*. 2016; 101(2): 495-503. doi: 10.1016/j.athoracsur.2015.07.031
9. Ester M, Culos-Reed SN, Abdul-Razzak A, et al. Feasibility of a multimodal exercise, nutrition, and palliative care intervention in advanced lung cancer. *BMC cancer*. 2021; 21(1): 159. doi: 10.1186/s12885-021-07872-y
10. Yeung WWK. Post-operative care to promote recovery for thoracic surgical patients: a nursing perspective. *Journal of thoracic disease*. 2016; 8(Suppl 1): S71. doi: 10.3978/j.issn.2072-1439.2015.10.68
11. Granger CL, McDonald CF, Berney S, Chao C, Denehy L. Exercise intervention to improve exercise capacity and health related quality of life for patients with non-small cell lung cancer: A systematic review. *Lung cancer*. 2011; 72(2): 139-153. doi: 10.1016/j.lungcan.2011.01.006
12. Denehy L, Edbrooke L. The role of exercise before cancer treatment. *Seminars in Oncology Nursing*. 2022; 38(5): 151330. doi: 10.1016/j.soncn.2022.151330
13. Niedzwiedz CL, Knifton L, Robb KA, et al. Depression and anxiety among people living with and beyond cancer: A growing clinical and research priority. *BMC Cancer*. 2019; 19(1): 943. doi: 10.1186/s12885-019-6181-4
14. Yu J, Huang T, Xu J, et al. Effect of nursing method of psychological intervention combined with health education on lung cancer patients undergoing chemotherapy. *Journal of Healthcare Engineering*. 2022; 2022(1): 2438612. doi: 10.1155/2022/2438612
15. Zhu R-Y, Chen H, Gao Y-J, et al. Effects of psychological nursing care on anxiety and depression in perioperative patients with lung cancer: A systematic review and meta-analysis. *Medicine*. 2022; 101(29): e29914. doi: 10.1097/MD.00000000000029914
16. Zhao L, Ma L, Chen X, Liu Z. Psychological nursing intervention improve the mental health status of young patients with lung cancer surgery during the perioperative period. *Medicine*. 2021; 100(31): e26736. doi: 10.1097/MD.00000000000026736
17. Mao X, Ni Y, Niu Y, Jiang L. The clinical value of pulmonary rehabilitation in reducing postoperative complications and mortality of lung cancer resection: A systematic review and meta-analysis. *Frontiers in Surgery*. 2021; 8: 685485. doi: 10.3389/fsurg.2021.685485
18. Su X-E, Hong W-P, He H-F, et al. Recent advances in postoperative pulmonary rehabilitation of patients with non-small cell lung cancer. *International Journal of Oncology*. 2022; 61(6): 156. doi: 10.3892/ijo.2022.5446
19. Zhang J, Wang Y, Qi F, Zhang T. Pulmonary rehabilitation in non-small cell lung cancer: A comprehensive review of perioperative strategies and clinical trends. *Journal of Aging and Rehabilitation*. 2025; 2(1): 3-10. doi: 10.1097/jagr.0000000000000023
20. Zhu S, Yang C, Mei W, et al. Caregiver burden for informal caregivers of patients after surgical treatment of early-stage lung cancer. *Journal of Clinical Nursing*. 2023; 32(5-6): 859-871. doi: 10.1111/jocn.16424

21. Zeng J, Luo C. Study on comprehensive evaluation of physiological stress and mental health of lung cancer patients in emergency department and its improvement of nursing effect. *Psycho-Oncologie*. 2025;19(3):3705-3705. doi: 10.18282/po3705
22. Huang C-H, Peng T-C, Cheng Y-T, et al. Perioperative exercise intervention in patients with lung cancer: A systematic literature review of randomized controlled trials. *Tzu Chi Medical Journal*. 2021; 33(4): 412-418. doi: 10.4103/tcmj.tcmj\_273\_20
23. Langballe R, Svendsen L, Jakobsen E, et al. Nurse navigation, symptom monitoring and exercise in vulnerable patients with lung cancer: Feasibility of the NAVIGATE intervention. *Scientific Reports*. 2023; 13(1): 22744. doi: 10.1038/s41598-023-50161-w
24. Lu R, Yu Q. Impact of continuous nursing on quality of life and psychological well-being in advanced lung cancer patients. *Altern Ther Health Med*. 2024; 31(1): 436-441.
25. Wang M, Sun Y, Zhang M, et al. Effects of high-quality nursing care on quality of life, survival, and recurrence in patients with advanced nonsmall cell lung cancer. *Medicine*. 2022; 101(37): e30569. doi: 10.1097/MD.00000000000030569
26. Sarna L, Evangelista L, Tashkin D, et al. Impact of respiratory symptoms and pulmonary function on quality of life of long-term survivors of non-small cell lung cancer. *Chest*. 2004; 125(2): 439-445. doi: 10.1378/chest.125.2.439
27. Chen L, Cai X, Chen J. The effect of refined nursing combined with targeted psychological care on postoperative pulmonary function and self-management ability in male patients with lung cancer. *Journal of Men's Health*. 2024; 20(6): 99-107. doi: 10.22514/jomh.2024.097
28. Wang Y-Q, Liu X, Yin Y-Y, et al. Effects of home-based exercise training for patients with lung cancer. *Oncology Nursing Forum*. 2019; 46(4): E119-E134. doi: 10.1188/19.ONF.E119-E134
29. Ren J, Li Z, He Y, et al. Systematic review and meta-analysis of breathing exercises effects on lung function and quality of life in postoperative lung cancer patients. *Journal of Thoracic Disease*. 2024; 16(7): 4295. doi: 10.21037/jtd-23-1733
30. Chen X, Hu Y, Fan J, Li Y. Post-operative poor sleep quality and its associated factors among non-small cell lung cancer patients: A cross-sectional study. *Cancer Management and Research*. 2023; 15: 1283-1295. doi: 10.2147/CMAR.S430436
31. Temel JS, Greer JA, Muzikansky A, et al. Early palliative care for patients with metastatic non-small-cell lung cancer. *New England Journal of Medicine*. 2010; 363(8): 733-742. doi: 10.1056/NEJMoa1000678
32. Chen H, Tsai C, Wu Y, et al. Randomised controlled trial on the effectiveness of home-based walking exercise on anxiety, depression and cancer-related symptoms in patients with lung cancer. *British Journal of Cancer*. 2015; 112(3): 438-445. doi: 10.1038/bjc.2014.612
33. Arends J, Bachmann P, Baracos V, et al. ESPEN guidelines on nutrition in cancer patients. *Clinical nutrition*. 2017; 36(1): 11-48. doi: 10.1016/j.clnu.2016.07.015
34. Quist M, Adamsen L, Rørth M, et al. The impact of a multidimensional exercise intervention on physical and functional capacity, anxiety, and depression in patients with advanced-stage lung cancer undergoing chemotherapy. *Integrative Cancer Therapies*. 2015; 14(4): 341-349. doi: 10.1177/1534735415572887
35. Wu W, Li H, Fan R. Summary of the best evidence for prehabilitation management of patients with non-small cell lung cancer. *Asia-Pacific Journal of Oncology Nursing*. 2024; 11(7): 100516. doi: 10.1016/j.apjon.2024.100516
36. Boer Ad. The Role of Preoperative Psychological Factors in Postoperative Recovery in Adult Patients [Master's thesis]. Leiden University; 2024.
37. Arbane G, Douiri A, Hart N, et al. Effect of postoperative physical training on activity after curative surgery for non-small cell lung cancer: A multicentre randomised controlled trial. *Physiotherapy*. 2014; 100(2): 100-107. doi: 10.1016/j.physio.2013.12.002
38. Chan CW, Richardson A, Richardson J. A study to assess the existence of the symptom cluster of breathlessness, fatigue and anxiety in patients with advanced lung cancer. *European Journal of Oncology Nursing*. 2005; 9(4): 325-333. doi: 10.1016/j.ejon.2005.02.003
39. Rosero ID, Ramírez-Vélez R, Martínez-Velilla N, et al. Effects of a multicomponent exercise program in older adults with non-small-cell lung cancer during adjuvant/palliative treatment: An intervention study. *Journal of Clinical Medicine*. 2020; 9(3): 862. doi: 10.3390/jcm9030862
40. Bjelland I, Dahl AA, Haug TT, Neckelmann D. The validity of the Hospital Anxiety and Depression Scale: An updated literature review. *Journal of Psychosomatic Research*. 2002; 52(2): 69-77. doi: 10.1016/S0022-3999(01)00296-3

41. Zigmond AS, Snaith RP. The hospital anxiety and depression scale. *Acta Psychiatrica Scandinavica*. 1983; 67(6): 361-370. doi: 10.1111/j.1600-0447.1983.tb09716.x
42. Jones LW, Peddle CJ, Eves ND, et al. Effects of presurgical exercise training on cardiorespiratory fitness among patients undergoing thoracic surgery for malignant lung lesions. *Cancer: Interdisciplinary International Journal of the American Cancer Society*. 2007; 110(3): 590-598. doi: 10.1002/cncr.22830
43. Quist M, Langer SW, Rørth M, et al. “EXHALE”: Exercise as a strategy for rehabilitation in advanced stage lung cancer patients: A randomized clinical trial comparing the effects of 12 weeks supervised exercise intervention versus usual care for advanced stage lung cancer patients. *BMC cancer*. 2013; 13(1): 477. doi: 10.1186/1471-2407-13-477