

Cognitive behavioral therapy for anxiety in patients with respiratory cancer: effects on dyspnea and quality of life

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Abstract: Objective: This study examines how cognitive behavioral interventions influence anxiety manifestations, breathlessness perception, and life quality metrics among individuals diagnosed with pulmonary malignancies. The research specifically assesses therapeutic outcomes related to psychological distress management and physiological symptom interpretation in oncology patients with respiratory system involvement.

Methods: A clinical trial employing a randomized, controlled design recruited 118 individuals diagnosed with late-stage pulmonary malignancies exhibiting clinically significant anxiety symptoms (HAMA scores ≥ 14). Participants were allocated through randomization into two cohorts: an experimental arm ($n=59$) receiving tailored cognitive-behavioral interventions alongside standard care (8 weekly 50-minute sessions), and a comparator group ($n=59$) provided solely with routine treatment and basic psychological counseling. Key evaluation metrics encompassed the Hamilton Anxiety Assessment (HAMA), Modified Medical Research Council Dyspnea Index (mMRC), European Organization for Research and Treatment of Cancer Quality of Life Questionnaire Core 30 (EORTC QLQ-C30), along with its lung cancer-specific module (QLQ-LC13). Path analysis through structural equation modeling elucidated CBT's mechanistic effects on patient-reported quality of life outcomes.

Results: The research included 112 participants equally divided between intervention and control arms (56 per group). Post-intervention assessments revealed markedly reduced HAMA scores (12.3 ± 3.6 versus 18.5 ± 4.2 , $p < 0.001$) and mMRC values (1.6 ± 0.7 compared to 2.4 ± 0.8 , $p < 0.001$) in the treatment cohort. EORTC QLQ-C30 composite measurements demonstrated superior outcomes for emotional, occupational, and interpersonal functioning domains among recipients of the experimental protocol ($p < 0.01$).

Multivariable regression modeling, accounting for demographic and clinical covariates including age, gender, and pathology severity, identified three significant determinants of life quality: cognitive-behavioral therapy implementation ($\beta = -0.386$, $p < 0.001$), initial anxiety severity ($\beta = 0.275$, $p = 0.003$), and respiratory discomfort intensity ($\beta = 0.312$, $p < 0.001$). Mediation examinations confirmed that anxiety mitigation partially accounted for CBT's beneficial impacts on both breathing difficulty (indirect effect = 0.157, 95% CI 0.076-0.245) and wellbeing enhancement (indirect effect = 0.209, 95% CI 0.103-0.328), representing 42.7%

and 38.3% of total therapeutic effects respectively.

Path analysis through structural equation modeling substantiated the sequential mechanism: CBT implementation → Anxiety reduction → Respiratory symptom alleviation → Life quality augmentation ($X^2/DF=1.78$, $CFI=0.942$, $RMSEA=0.057$, $SRMR=0.043$).

Conclusion: Tailored cognitive behavioral interventions demonstrate significant efficacy in alleviating anxiety manifestations, reducing breathing difficulties, and enhancing overall wellbeing among individuals with progressive pulmonary malignancies. The mitigation of psychological distress serves as a crucial intermediary factor influencing CBT's impact on respiratory discomfort and life satisfaction metrics. These observations establish an empirical foundation for incorporating mental health strategies alongside standard medical protocols, while highlighting the critical interplay between psychological and physiological factors in holistic cancer care approaches for thoracic oncology cases.

Keywords: cognitive behavioral therapy; respiratory system tumor; anxiety; dyspnea; quality of life; mediating effect

1. Introduction

Respiratory tumors are one of the leading causes of cancer morbidity and mortality worldwide, and patients not only face the physiological challenges posed by the disease itself, but also bear a significant psychological burden ^[1]. Among them, anxiety is one of the most common and destructive psychological symptoms, affecting about 40-62% of patients with respiratory cancer. The experience of anxiety in patients with respiratory tumors is idiosyncratic and often forms a vicious cycle with the perception of dyspnea: anxiety exacerbates sensitivity to and negative interpretation of respiratory symptoms, and anxiety exacerbates the perception of dyspnea, the experience of increased dyspnea further enhances the anxiety response ^[2]. The psychophysiological interaction model proposes that anxiety affects the experience of dyspnea by increasing autonomic nervous system activity, regulating respiratory muscle tone, and affecting attentional focus. Cognitive appraisal theory emphasizes that the interpretation of somatic sensation has a decisive influence on the experience of symptoms. The catastrophizing cognitive tendency of respiratory system tumor patients may significantly amplify the subjective feelings of dyspnea, thereby affecting their quality of life and functional status ^[4]. Cognitive behavioral therapy (CBT-RRB-), as an evidence-based psychological intervention, has been shown to be effective in dealing with various anxiety disorders ^[5]. In patients with tumors, CBT helps alleviate psychological distress by identifying and reconstructing negative automatic thoughts, correcting cognitive distortions, and providing behavioral management strategies ^[6]. However, the research on CBT intervention for anxiety in patients with respiratory tumors is relatively limited, especially the research on how CBT affects the experience of dyspnea through psychological

regulation mechanisms is even scarcer. Based on the above theoretical basis and research gaps, this study designed a cognitive behavioral therapy program specifically aimed at anxiety in patients with respiratory system tumors, and explored the effects of cognitive behavioral therapy on anxiety in patients with respiratory system tumors, the effects on anxiety symptoms, perception of dyspnea and quality of life were assessed^[7]. This study hypothesizes that CBT can not only effectively reduce the level of anxiety, but also improve the patient's experience of dyspnea through cognitive restructuring and physiological regulation mechanisms, thereby improving the overall quality of life, therefore, the results will provide empirical evidence for the comprehensive psychological care of patients with respiratory cancer, and help to understand the internal mechanism of psychological intervention affecting the perception of somatic symptoms.

2. methods

2.1 study design and participants

This study used a prospective, single-center, Randomized controlled trial design and was conducted in a Grade III, Class A hospital oncology department from January 2021 to June 2022. Consecutive sampling was used to recruit eligible patients with respiratory system tumors. Inclusion criteria: (1) Age 18-75 years; (2) pathologically confirmed primary lung cancer or other respiratory malignancies^[8]; (3) clinical stage III or IV; (4) a Hamilton Anxiety Rating Scale (Hama-RRB- score of ≥ 14 , indicating the presence of moderate or greater anxiety, (5) expected survival of ≥ 3 months, (10) normal cognitive function, and ability to understand and complete questionnaires; (7) participation of informed consent in research. Exclusion criteria were: (1) previous history of mental illness or receiving psychiatric medication; (2) other conditions that may significantly affect respiratory function, such as severe cardiorespiratory insufficiency; (3) has participated in other psychological intervention research in the past 4 weeks.

Eligible patients were randomly assigned to the intervention or control groups in a 1:1 ratio. The random allocation sequence was computer-generated by statisticians not involved in patient recruitment and assessment, using a block randomization method, taking into account factors such as age, sex, and disease stage. The distribution plan is sealed in an opaque envelope and kept in escrow. This study protocol was approved by the Hospital Ethics Committee (Approval Number: TZXY-2020-112), and all patients signed informed consent. Based on previous studies, 11,12 the estimated effect size of CBT on anxiety symptoms was 0.55. Using G * Power 3.1 software, 49 patients were required for each group under the condition $\alpha = 0.05$ (two-sided), $1-\beta = 0.85$. Considering a possible attrition rate of 20%, it was planned to include 59 patients in each group, for a total sample size of 118.

2.2 interventions

Intervention group: Patients received 8 weeks of cognitive behavioral therapy consisting of about 60 minutes of weekly individual face-to-face interviews and daily family exercises. The CBT protocol was developed by a team of psycho-oncologists based on evidence-based practice guidelines and adapted to the specific needs of patients with respiratory cancer. The intervention consists of the following modules:

(1) psychoeducation and disease cognition (Week 1-2) : providing scientific information on the relationship between cancer, anxiety, and dyspnoea; discussing the mechanisms of the anxiety-dyspnoea vicious cycle; Establishing therapeutic alliances and expectations of intervention.

(2) cognitive restructuring (Week 3-4) : identifying negative automatic thoughts and cognitive distortions associated with cancer, respiratory symptoms; learning to question and reshape non-adaptive thinking patterns such as catastrophizing and overgeneralization; Building a more balanced, realistic understanding of disease.

(3) respiratory awareness and regulation (week 5-6) : abdominal breathing and slow breathing techniques training; coping strategies for dyspnea; distraction and mindfulness meditation exercises; non-critical awareness training of body sensation.

(4) behavior activation and problem solving (Week 7-8) : values-based activity planning; energy preservation and activity rhythm adjustment; practical strategies for coping with dyspnea in daily life; problem-solving skills training; Develop a relapse prevention plan.

All CBT interventions were administered by a trained psychotherapist with experience in oncology psychotherapy. To ensure treatment fidelity, the therapist received regular supervision, and all treatment sessions were recorded with the patient's consent and assessed by an independent assessor using the cognitive therapy scale (CTS) .

Control group: patients received routine psychological support, including once every two weeks about 30 minutes of general emotional support and symptom management counseling. Counseling includes emotional expression, empathy support, and general health information provision, but does not include CBT-specific techniques and strategies. In addition, patients in both groups received standard medical care and symptom management.

2.3 assessment tools and outcome indicators

(1) General Information Questionnaire: collect demographic characteristics (age, sex, education, marital status, etc.) and clinical data (disease stage, pathological type, treatment methods, etc.) ;

(2) Hamilton Anxiety Rating Scale (Hama) : assessment of anxiety symptoms, consisting of 14 items, each on a scale of 0 to 4, with a total score range of 0 to 56, with higher scores indicating greater anxiety^[13] ;

(3) modified dyspnea scale -MMRCmMRC) : assesses the degree of dyspnea on a scale of 0-4, with higher scores indicating more severe dyspnea ^[14] ;

(4) EORTC QLQ-C30 Instrument: This cancer-specific evaluation tool measures patient wellbeing across functional capacity, symptomatic burden, and general health perception. Scoring ranges from 0-100, where elevated functional and global health scores denote improved conditions, while higher symptom scores reflect greater symptom severity ^[15].

(5) LC13 Supplementary Module: Designed as an adjunct to the QLQ-C30, this specialized instrument focuses exclusively on evaluating symptom patterns unique to pulmonary carcinoma patients ^[16].

(6) HADS Measurement Tool: Serving as a secondary evaluation mechanism, this instrument features dual subscales (anxiety and depression) containing seven items each. Scores range from 0-3 per item, with cumulative totals directly correlating with symptom intensity ^[17].

(7) PSQI Sleep Assessment: A comprehensive tool examining sleep characteristics across seven domains, producing aggregate scores between 0-21. In this scale, increased values correspond to diminished sleep quality ^[18].

The key efficacy endpoints comprised post-treatment Hamilton Anxiety Rating Scale (HAMA) values, Modified Medical Research Council (MMRC) dyspnea grades, and overall European Organization for Research and Treatment of Cancer Quality of Life Questionnaire (EORTC QLQ-C30) assessments. Additional evaluation parameters incorporated symptom-specific LC13 module results, Hospital Anxiety and Depression Scale (HADS) measurements, and Pittsburgh Sleep Quality Index (PSQI) outcomes.

2.4 statistical analysis

Prior research findings suggested the CBT intervention cohort would demonstrate a 3-point reduction in HADS-A scores compared to controls (standard deviation = 4.5). With statistical power set at 80% ($\beta=0.2$) and significance level at 5% (two-tailed $\alpha=0.05$), accounting for 15% attrition, each arm required 59 participants, yielding a total enrollment target of 118 subjects.

Statistical operations were conducted utilizing SPSS version 26.0 and Amos 24.0 software packages. The analytical approach adhered to intention-to-treat protocols, with missing values addressed through multiple imputation techniques. Initial demographic and clinical profiles underwent descriptive statistical evaluation, while intergroup comparisons employed Student's t-tests for metric data and χ^2 tests for categorical variables.

The principal efficacy endpoints underwent examination via repeated-measures ANOVA, evaluating treatment effects, temporal patterns, and their interaction terms. Post-hoc simple effects analyses with Cohen's d calculations followed any significant interaction findings. Secondary analyses incorporated linear mixed modeling to assess therapeutic impact while adjusting for covariates.

To investigate how cognitive behavioral therapy (CBT) influences anxiety

symptoms, breathlessness perception, and life quality, structural equation modeling (SEM) was employed to examine potential mediation pathways. The analysis specifically assessed whether cognitive appraisal and bodily awareness sensitivity served as mediators. Model adequacy was determined through multiple indices including the comparative fit index (CFI), standardized root mean square residual (SRMR), and root mean square error of approximation (RMSEA). For all statistical analyses, a two-tailed significance threshold of $P < 0.05$ was applied.

3. results

3.1 research process and participants' characteristics

The study included 118 participants, evenly distributed between the intervention and control groups (59 each). Three participants from the intervention arm discontinued (one due to clinical deterioration and two lost to follow-up), while the control group also had three dropouts (two cases of worsening condition and one voluntary withdrawal). Ultimately, 112 subjects (56 per group) completed the trial, representing a 94.9% overall retention rate.

Demographic and clinical characteristics showed no meaningful variations between groups regarding age, gender distribution, educational background, marital status, tumor classification, disease progression, therapeutic approach, or initial scores on HAMA, MMRC, EORTC QLQ-C30, HADS, and PSQI assessments (all p -values exceeding 0.05). This confirmed balanced baseline parameters (refer to **Table 1**).

Table 1. comparison of baseline characteristics of subjects

Characteristics	Intervention Group(n=56)	Control Group(n=56)	t/ χ^2 /Z Value	P Value
Age($\bar{x} \pm s$)	61.4 $\pm$ 9.5	62.3 $\pm$ 8.7	-0.528	0.599
Gender[(%)]			0.143	0.705
Male	32(57.1)	34(60.7)		
Female	24(42.9)	22(39.3)		
Education[(%)]			0.775	0.856
Primary school and below	9(16.1)	11(19.6)		
Junior High School	18(32.1)	16(28.6)		
Senior Secondary/technical secondary	17(30.4)	15(26.8)		
College degree or above	12(21.4)	14(25.0)		
Marital status[(%)]			0.095	0.953
Married	48(85.7)	47(83.9)		
Divorce/widowhood	6(10.7)	7(12.5)		

Characteristics	Intervention Group(n=56)	Control Group(n=56)	t/ χ^2 /Z Value	P Value
Unmarried	2(3.6)	2(3.6)		
Type of pathology[(%)]			0.648	0.885
Adenocarcinoma	32(57.1)	29(51.8)		
Squamous cell carcinoma	15(26.8)	17(30.4)		
small-cell carcinoma	7(12.5)	8(14.3)		
In the news	2(3.6)	2(3.6)		
Stage of disease[例 (%)]			0.036	0.849
III 期	21(37.5)	20(35.7)		
IV 期	35(62.5)	36(64.3)		
Treatment options[例 (%)]			0.517	0.915
Chemotherapy	19(33.9)	21(37.5)		
Targeted therapy	16(28.6)	14(25.0)		
Immunotherapy	12(21.4)	13(23.2)		
Combination therapy	9(16.1)	8(14.3)		
Hama score($\bar{x}\pm s$)	19.8 $\pm$ 4.5	20.1 $\pm$ 4.3	-0.357	0.722
MMRC score($\bar{x}\pm s$)	2.3 $\pm$ 0.8	2.4 $\pm$ 0.7	-0.694	0.489
EORTC QLQ-C30Total score($\bar{x}\pm s$)	53.6 $\pm$ 11.2	52.9 $\pm$ 10.8	0.339	0.735
HADS-A ScoreScore($\bar{x}\pm s$)	10.5 $\pm$ 3.1	10.7 $\pm$ 3.0	-0.347	0.729
HADS-DScore($\bar{x}\pm s$)	8.7 $\pm$ 3.4	8.5 $\pm$ 3.2	0.323	0.747
PSQIScore($\bar{x}\pm s$)	9.3 $\pm$ 2.8	9.5 $\pm$ 2.9	-0.374	0.709

3.2 analysis of intervention effect

3.2.1 anxiety level

Statistical analysis using repeated measures ANOVA revealed significant effects for group ($F=16.579$, $p<0.001$), time ($F=89.423$, $p<0.001$), and their interaction ($F=49.865$, $p<0.001$). Post-intervention comparisons demonstrated markedly reduced HAMA scores in the treatment group (12.3 ± 3.6) compared to controls (18.5 ± 4.2) ($t=-8.428$, $p<0.001$). Longitudinal analysis within the intervention group showed substantial score reductions from baseline ($t=13.215$, $p<0.001$), whereas the control group exhibited no meaningful pre-post differences ($t=1.947$, $p=0.057$) (see **Table 2**).

Degree of dyspnea

Statistical analysis employing repeated measures ANOVA revealed significant effects for group ($F = 13.672$, $p < 0.001$), time ($F = 33.458$, $p < 0.001$), and

their interaction ($F = 26.941$, $p < 0.001$). Post-intervention comparisons demonstrated markedly reduced MMRC scores in the experimental group (1.6 ± 0.7) relative to controls (2.4 ± 0.8) ($t = -5.625$, $p < 0.001$). Longitudinal assessment within the intervention cohort showed substantial improvement from baseline measurements ($t = 8.647$, $p < 0.001$), whereas control participants exhibited no meaningful change ($t = 0.635$, $p = 0.528$) as detailed in **Table 2**.

Quality of life

Repeated measures analysis of variance showed that the EORTC QLQ-C30 total score was statistically significant in terms of group ($f = 14.872$, $p < 0.001$), time ($f = 40.637$, $p < 0.001$), and their interaction ($F = 37.951$, $p < 0.001$). After the intervention, the total score of EORTC Qlq-c30 in the intervention group (67.2 ± 12.3) was significantly higher than that in the control group (54.1 ± 11.5) ($t = 5.958$, $p < 0.001$). Within the intervention group, the total score of Qol after the intervention was significantly higher than that at baseline ($t = -10.429$, $p < 0.001$); within the control group, there was no significant difference before and after the intervention ($t = -0.847$, $P = 0.401$) (**Table 2**).

In the EORTC QLQ-C30 comparison of dimensions, after the intervention, the intervention group was superior to the control group in emotional function (74.2 ± 13.1 vs 55.3 ± 12.7 , $p < 0.001$), role function (68.5 ± 14.2 vs 52.6 ± 13.5 , $p < 0.001$), social function (70.1 ± 15.3 vs 56.2 ± 14.8 , $p < 0.001$), fatigue symptoms (38.2 ± 13.7 vs 58.6 ± 14.2 , $p < 0.001$) and pain symptoms (32.5 ± 12.8 vs 48.7 ± 13.4 , $p < 0.001$). In terms of LC13-specific symptoms, the intervention group had significantly lower scores of dyspnea symptoms (32.6 ± 10.5 vs 47.8 ± 11.3 , $p < 0.001$) and cough symptoms (35.7 ± 11.2 vs 46.9 ± 12.4 , $p < 0.001$) than the control group.

Table 2. Comparison of evaluation indexes between two groups before and after intervention ($x \pm s$)

Indicator	Intervention Group (n=56)	Control Group (n=56)	t-value	P-value
HAMA Score				
Before intervention	19.8±4.5	20.1±4.3	-0.357	0.722
After intervention	12.3±3.6**	18.5±4.2	-8.428	<0.001
mMRC Score				
Before intervention	2.3±0.8	2.4±0.7	-0.694	0.489
After intervention	1.6±0.7**	2.4±0.8	-5.625	<0.001
EORTC QLQ-C30 Total Score				
Before intervention	53.6±11.2	52.9±10.8	0.339	0.735

Indicator	Intervention Group (n=56)	Control Group (n=56)	t-value	P-value
After intervention	67.2±12.3**	54.1±11.5	5.958	<0.001
HADS-A Score				
Before intervention	10.5±3.1	10.7±3.0	-0.347	0.729
After intervention	6.7±2.5**	10.3±3.1	-6.873	<0.001
HADS-D Score				
Before intervention	8.7±3.4	8.5±3.2	0.323	0.747
After intervention	6.2±2.8**	8.3±3.1	-3.798	<0.001
PSQI Score				
Before intervention	9.3±2.8	9.5±2.9	-0.374	0.709
After intervention	6.8±2.5**	9.2±2.8	-4.763	<0.001

Note: * * p < 0.01

3.3 multiple Regression analysis

Taking the total score of EORTC QLQ-C30 as the dependent variable, multivariate Regression analysis was performed using intervention grouping, baseline anxiety level, post-intervention improvement in anxiety, dyspnea, and demographic and clinical characteristics as independent variables. The results showed that after controlling for confounding factors such as age, sex, and disease stage, cBT intervention ($\beta = -0.386$, $p < 0.001$), degree of improvement in anxiety ($\beta = 0.342$, $p < 0.001$), baseline anxiety level ($\beta = 0.275$, $p = 0.003$), and degree of dyspnea ($\beta = 0.312$, $p < 0.001$) were independent predictors of qol, and the presence of CBT intervention ($\beta = -0.386$, $p < 0.001$) was associated with higher qol, the model explained 57.3% of the total variation in Qol (Table 3).

Table 3. Regression analysis factors affecting quality of life

Variables	B	SE	β	t	P 值	95%CI
Constant	42.186	10.547	-	3.999	<0.001	21.274-63.098
CBT intervention	10.762	2.153	0.386	4.998	<0.001	6.493-15.031
Degree of improvement in anxiety	0.965	0.218	0.342	4.427	<0.001	0.533-1.397
Baseline anxiety level	0.685	0.227	0.275	3.018	0.003	0.236-1.134
Degree of difficulty in breathing	4.267	1.047	0.312	4.076	<0.001	2.191-6.343
Age	-0.185	0.098	-0.145	-1.888	0.062	-0.379-0.009
Gender	-2.167	1.846	-0.097	-1.174	0.243	-5.828-1.494
Stage of disease	-3.254	1.873	-0.142	-1.738	0.085	-6.968-0.460

Variables	B	SE	β	t	P 值	95%CI
Education	0.876	0.762	0.086	1.149	0.253	-0.636-2.388
Marital status	1.256	1.472	0.063	0.853	0.396	-1.664-4.176

Note: After adjustment, $R^2=0.573$, $F=17.426$, $P<0.001$

3.5 structural equation modeling analysis

Based on the results of mediating effect analysis, a path model of CBT $\rightarrow$ Anxiety Improvement $\rightarrow$ dyspnea alleviation $\rightarrow$ Quality of life improvement was constructed. The model fitting indicators showed: $X^2/DF = 1.78$, $CFI = 0.942$, $RMSEA = 0.057$, $SRMR = 0.043$, indicating that the model fitted well.

The path coefficient showed that: (1) CBT had a significant direct effect on anxiety ($\beta = 0.613$, $p < 0.001$) ; (2) anxiety had a significant direct effect on dyspnea ($\beta = 0.476$, $p < 0.001$) ; (3) the relief of dyspnea had a significant direct effect on the improvement of quality of life ($\beta = 0.398$, $p < 0.001$) . (4) the improvement of anxiety also had a direct effect on the quality of life ($\beta = 0.325$, $p < 0.001$) (5) CBT had an indirect effect on QOL through anxiety improvement and dyspnea relief ($\beta = 0.172$, $p < 0.001$) . This suggests that anxiety improvement partially mediates the effect of CBT on dyspnea and quality of life, while dyspnea alleviation also partially mediates the effect of anxiety improvement on quality of life (Figure 1) .

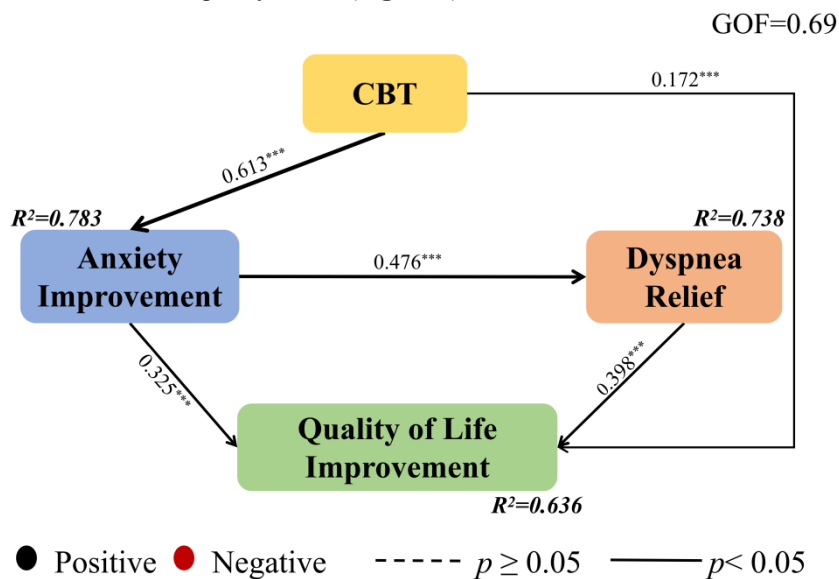


Figure 1. A path model of CBT effects on anxiety, dyspnea, and quality of life

3.5 secondary outcome measures and adverse events

Patients in the intervention group were more satisfied with CBT, with 92.6% of participants expressing satisfaction or very satisfaction and 89.3% expressing willingness to recommend it to other patients. The degree of satisfaction in the control group was relatively low (67.8% indicated satisfactory or very satisfactory) . No intervention-related serious adverse events were observed during

the study period. A small number of participants (3 in the intervention group and 2 in the control group) reported transient mood swings or increased mild anxiety, but all were relieved with therapist support. Anxiolytic medication use showed that more patients in the intervention group decreased medication use during the study period (35.2% in the intervention group vs. 18.5% in the control group, $P = 0.042$).

4. discussion

In this Randomized controlled trial study, the effects of cognitive behavioral therapy on anxiety, dyspnea and quality of life in patients with respiratory cancer were investigated, and the mechanism was analyzed. The results showed that the 8-week individualized CBT could significantly improve the anxiety symptoms, relieve the feeling of dyspnea, and improve the quality of life. More importantly, this study is the first to verify the role path of CBT → Anxiety Improvement → dyspnea relief → Quality of life improvement through mediation effect analysis and structural equation modeling, and to provide a theoretical basis for the improvement of the quality of life of the elderly, the mechanism of CBT on the clinical outcome of patients with respiratory system tumors was revealed.

Anxiety is a common psychological problem in patients with respiratory tumors, which not only affects the emotional experience of patients, but also may aggravate somatic symptoms through a variety of physiological and psychological mechanisms^[19]. This study found that after CBT intervention, the Hama score in the intervention group decreased from 19.8 ± 4.5 to 12.3 ± 3.6 , which was significantly greater than that in the control group, consistent with previous studies^[20,21]. CBT reduces anxiety levels by helping patients identify and correct cognitive biases associated with illness and symptoms (such as catastrophizing, overgeneralization, etc.) and by establishing more adaptive thought patterns.^[22] At the same time, relaxation training and breathing technique training in this study may also directly alleviate anxiety-related physiological responses by reducing sympathetic nervous system activity^[23].

An important finding of this study was that CBT significantly improved dyspnea symptoms in patients, with the MMRC score decreasing from 2.3 ± 0.8 to 1.6 ± 0.7 in the intervention group, while there was little change in the control group. This result supports the important role of psychological factors in the perception of dyspnea^[24]. Dyspnea, as a subjective experience, is influenced by both physiological factors (such as tumor invasion, airway obstruction) and psychological factors (such as anxiety, Fear)^[25]. Studies have shown that anxiety can increase respiratory rate, induced hyperventilation, increased respiratory muscle tension and other mechanisms to aggravate the feeling of dyspnea^[26]. In the present study, CBT may indirectly improve these physiological responses by reducing anxiety, while also reducing the subjective perception of symptoms by changing patients' catastrophized interpretation and excessive attention to dysp-

nea^[27].

The improvement of quality of life is an important goal of comprehensive management of cancer patients, especially for advanced patients. This study found that the CBT intervention group had a significant increase in EORTC QLQ-C30 total score (from 53.6 ± 11.2 to 67.2 ± 12.3), and was better than the control group in many dimensions such as emotional function, role function, and social function. This reflects not only the direct improvement of psychological status by CBT, but also the positive effect of symptom control on overall functional status^[28]. Multiple regression analysis further confirmed that CBT intervention, degree of improvement in anxiety, and dyspnea relief were independent predictors of QOL after controlling for relevant confounders, suggesting that CBT intervention may be an important predictor of QOL, together they explained 57.3% of the variance in quality of life.

The innovation of this study is to explore the mechanism of CBT affecting dyspnea and quality of life. Both mediation effect analysis and structural equation modeling results supported the mediating role of anxiety improvement in the process of CBT affecting dyspnea and quality of life, and the mediating role of anxiety improvement in the relationship between CBT and dyspnea and quality of life was also discussed, anxiety improvement mediated the positive effects of CBT on dyspnea (mediating effect 42.7% of the total effect) and quality of life (mediating effect 38.3% of the total effect). At the same time, the relief of dyspnea also plays an intermediary role in the process of anxiety improving the quality of life. These findings reveal the action pathway of CBT in patients with respiratory system tumors: CBT first improves the anxiety state of patients, and the alleviation of anxiety directly improves the quality of life of patients on the one hand, and improves the quality of life of patients on the other hand, on the other hand, by reducing the sense of dyspnea indirectly improve the quality of life. This mechanistic explanation supports the importance of mind-body interactions in symptom management and provides a rationale for integrating psychological interventions with conventional treatment^[29].

The results of this study have important clinical significance. Firstly, the effectiveness of CBT as a non-drug intervention method in the comprehensive management of patients with respiratory system tumors was confirmed, which provided evidence-based basis for clinical practice. Secondly, the association path between anxiety-dyspnea-quality of life is revealed, which suggests that clinical workers should pay attention to the psychological state of patients and take psychological intervention as an important part of symptom management. The individualized CBT protocol provided in this study can be used as a reference template for clinical practice, especially the key components such as cognitive restructuring, relaxation training, and breathing techniques may be the core elements to improve patients' symptom experience.

However, this study also has some limitations. First, as a single-center study, the sample size is relatively limited, which may affect the external validity

of the results. Second, the follow-up period was too short to assess the long-term effects of CBT. Thirdly, the biomarkers (such as inflammatory factors, stress hormones, etc.) were not measured in this study, which could not explain the mechanism of CBT from the biological point of view. Although the structural equation model was used to analyze the action path, the causal relationship could not be fully established due to the limitation of research design. Future research directions include: (1) conducting multicentre, large sample studies to improve the external validity of the results; (2) extending the follow-up period to evaluate the long-term effects of CBT; (3) incorporating biomarker measurements, to explore the biological mechanisms of CBT; (4) to compare the effects of different CBT components and identify the core active ingredients; and (5) to explore comprehensive intervention regimens that combine CBT with other interventions such as exercise, nutritional support, etc^[30].

5. Conclusion

The research demonstrates that cognitive behavioral therapy (CBT) targeting anxiety in respiratory cancer patients yields multiple benefits, including substantial anxiety reduction, decreased dyspnea awareness, and enhanced life quality. By modifying threat interpretation and bodily sensitivity, CBT disrupts the interconnected cycle of anxiety and breathing difficulties, offering novel perspectives on how psychological approaches impact physical symptoms. Investigations should prioritize three key areas: sustainability of therapeutic outcomes, variability in individual treatment responses, and practical methods for incorporating CBT into standard oncology protocols. Within clinical settings, addressing both psychological distress and breathing discomfort through targeted interventions must become a fundamental component of holistic respiratory cancer management, ensuring broader support for these high-need individuals.

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