

Original Article

Factors influencing social avoidance and distress after radical lung cancer resection: a mediation analysis

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Abstract: Objective: To investigate factors influencing social avoidance and distress (SAD) in patients following radical resection of lung cancer (RRLC) and analyze the mediating effects among these factors. Methods: Clinical data from 320 patients who underwent RRLC between January 2022 and December 2023 at the General Hospital of Western Theater Command PLA were analyzed. Data were collected using the General Information Questionnaire, Social Avoidance and Distress Scale (SADS), Hospital Anxiety and Depression Scale (HADS), Perceived Social Support Scales (PSSS), General Self-Efficacy Scale (GSES), and Consumer Experiences of Stigma Questionnaire (CESQ). Spearman correlation analysis explored the relationships between SAD, anxiety and depression, social support, self-efficacy, and stigma. Multiple linear regression identified factors influencing SAD. The PROCESS tool was used to test the mediating effects of these factors. Results: The mean SADS score was 16.73 ± 4.69 . SAD was positively correlated with anxiety, depression, and stigma ($r=0.662$, $P<0.001$; $r=0.687$, $P<0.001$) and negatively correlated with self-efficacy and social support ($r=-0.682$, $P<0.001$; $r=-0.705$, $P<0.001$). Multiple linear regression indicated that anxiety, depression, social support, self-efficacy, and stigma were significant influencers of SAD ($\beta=0.132$, $P<0.001$; $\beta=-0.078$, $P<0.001$; $\beta=-0.178$, $P<0.001$; $\beta=0.115$, $P=0.002$). Mediation analysis revealed that anxiety and depression directly affected SAD and indirectly influenced SAD through social support, stigma, and self-efficacy, both independently and via chain mediation ($P<0.05$). Conclusions: Patients post-RRLC generally exhibit moderate SAD levels. Anxiety and depression directly influence SAD and also indirectly through the mediating effects of social support, stigma, and self-efficacy. Therefore, reducing depression and stigma while enhancing social support and self-efficacy is crucial for alleviating SAD in these patients.

Keywords: Radical resection of lung cancer, social avoidance and distress, influencing factors, mediating effect

Introduction

Lung cancer is the most prevalent and fatal malignant tumor globally, posing a serious threat to human life [1]. With advancements in medical technology, radical resection of lung cancer (RRLC) has become a crucial treatment method, effectively removing diseased tissues, significantly extending patients' lifespans, and improving their overall quality of life [2, 3]. However, following surgery, lung cancer patients often face challenges such as reduced physical function and increased psychological stress, which can lead to a diminished sense of self-worth and social adaptability. This may result in avoidance behaviors and feelings of distress during social interactions [4, 5].

Social avoidance and distress (SAD) refers to an individual's tendency to avoid social situations and the accompanying feelings of anxiety, often driven by a fear of negative evaluation by others [6]. This phenomenon is particularly significant in patients post-RRLC. On the one hand, physical changes from surgery, such as pain, fatigue, and altered appearance, may lead to feelings of inferiority and anxiety, causing patients to avoid social interactions. This social withdrawal can hinder their reintegration into society, negatively impacting their quality of life and interpersonal relationships. On the other hand, uncertainties and fears about recurrence and mortality, along with concerns about the future, further increase patients' psychological burdens, leading to social isolation. This, in

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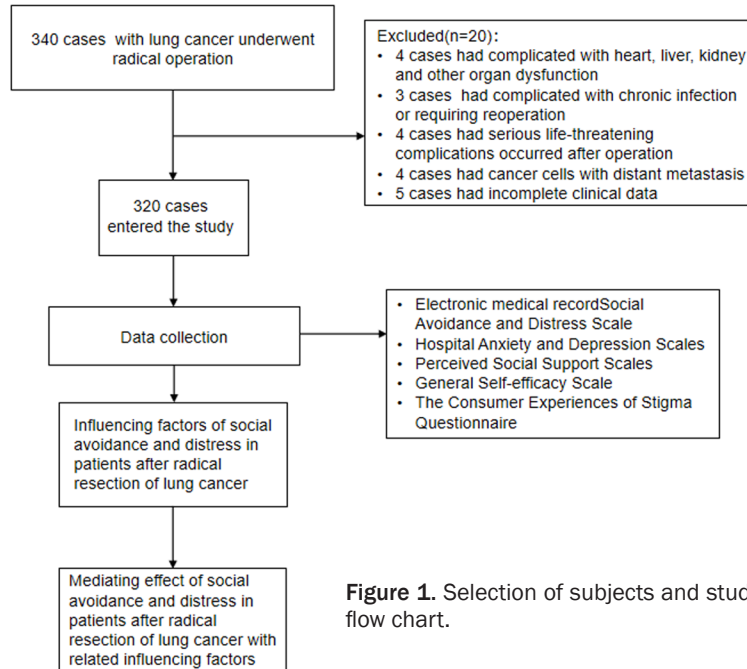


Figure 1. Selection of subjects and study flow chart.

turn, can impede physical recovery, diminish therapeutic effectiveness, and impose significant economic and medical burdens on both families and society [7, 8].

In recent years, the growing focus on the psychological and social aspects of cancer rehabilitation has led to increased attention on the mental health and social functioning of cancer patients post-surgery. Studies on SAD have proven beneficial for patients with breast and ovarian cancer [9]. However, most lung cancer studies have focused primarily on prognosis and survival following RRLC, with little investigation into the SAD experienced by these patients [10].

Given this background, this study aims to explore the influencing factors and mediating mechanisms of SAD in patients post-RRLC. Unlike previous studies that focused on single factors, this research considers the interplay of multiple variables, constructing and validating a mediation model to reveal the complex interactions among these factors. This study seeks to provide a theoretical basis for understanding the social and psychological challenges faced by patients post-RRLC and to offer practical psychological intervention strategies to help medical staff support patients in managing SAD, ultimately promoting comprehensive rehabilitation.

Materials and methods

Subjects

This study analyzed the clinical data of 320 lung cancer patients who underwent RRLC between January 2022 and December 2023 at The General Hospital of Western Theater Command PLA (Figure 1). Inclusion criteria were: (1) age ≥ 18 years; (2) confirmed pathological diagnosis of lung cancer before surgery with subsequent radical resection; (3) absence of severe cognitive or psychiatric disorders; (4) informed consent provided. Exclusion criteria included: (1) significant dysfunction of the heart, liver, kidneys, or other organs; (2) chronic infection or

the need for reoperation; (3) life-threatening postoperative complications; (4) distant metastasis; (5) incomplete clinical data. This study was approved by the Ethics Committee of The General Hospital of Western Theater Command PLA.

Data collection

Patient data, including sex, age, monthly income, education level, marital status, disease course, TNM stage, postoperative chemoradiotherapy, and levels of SAD, anxiety, depression, social support, self-efficacy, and stigma, were collected from the electronic medical record system. The levels of social avoidance and distress, anxiety, depression, social support, self-efficacy, and stigma were gathered through questionnaires and entered into the system.

Patients meeting the inclusion criteria were selected as study participants. Research members received standardized training on patient communication and questionnaire administration to ensure consistent understanding and explanation of each item. To minimize measurement bias, research members guided patients uniformly during questionnaire completion, reducing the influence of subjective factors and ensuring the accuracy and authenticity of the responses. After completing each question-

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naire, research members promptly reviewed it, clarifying any doubts with the patients and addressing any missing responses to maximize the integrity and validity of the data. Following data collection, two individuals entered the data independently and cross-checked it. Any abnormal values identified during data entry were scientifically addressed to ensure data accuracy.

Outcome measurement

The main indicators for this study were social avoidance and distress, anxiety and depression, social support, self-efficacy, and stigma.

Social Avoidance and Distress Scale (SADS) [11], includes 28 items assessing two dimensions: social avoidance and social distress. The scale uses a binary “yes/no” format, with “yes” scoring 0 points and “no” scoring 1 point. Scores range from 0 to 28, with higher scores indicating greater SAD severity. A total score of 0-10 denotes mild SAD, 11-20 indicates moderate SAD, and 21-28 signifies severe SAD. The Cronbach’s α coefficient is 0.94.

Hospital Anxiety and Depression Scale (HADS) [12] is used to screen for anxiety and depression in non-psychiatric patients. It comprises 14 items: seven for depression and seven for anxiety. Scores are assessed using a Likert scale, with a total score ranging from 0 to 42. Higher scores reflect more severe symptoms of anxiety and depression. The Cronbach’s α coefficient is 0.91.

Perceived Social Support Scale (PSSS) [13], consists of 12 items. It uses a seven-point Likert scale, where 1 indicates strong disagreement and 7 indicates strong agreement. The total score ranges from 12 to 84, with higher scores indicating better perceived social support. The Cronbach’s α coefficient is 0.88.

General Self-Efficacy Scale (GSES) [14] assesses self-efficacy levels using 10 items, each rated on a 4-point Likert scale. The total score ranges from 10 to 40, with higher scores indicating greater self-efficacy. The Cronbach’s α coefficient is 0.90.

The Stigma Experience Questionnaire (CESQ) [15] includes nine items covering shame and

discrimination. It uses a 5-point Likert scale, where each item is rated from 1 (“never”) to 5 (“often”). The average score determines the level of stigma, with higher scores indicating greater stigma. The Cronbach’s α coefficient is 0.94.

Statistical analysis

Statistical analysis was performed using SPSS 26.0. The SADS score, which passed the Shapiro-Wilk test, is presented as mean \pm standard deviation. Scores for HADS, PSSS, GSES, and CESQ, which did not pass the Shapiro-Wilk test, are reported as median and interquartile range. T-tests and ANOVA were used to assess the impact of general information on SAD in patients after RRLC. Spearman correlation analysis explored the relationships among anxiety, depression, social support, self-efficacy, stigma, and SAD. Multiple linear regression was employed to identify factors influencing SAD in these patients. PROCESS’s Bootstrap method was used to test the mediating effects between influencing factors and SAD. A p -value of <0.05 was considered statistically significant.

Results

General data of patients undergoing RRLC

This study included 320 patients who underwent RRLC. Among them, 188 were male (58.75%) and 132 were female (41.25%). The majority of patients were over 60 years old (55.31%). Most patients were married (69.38%) and resided in urban areas (59.38%). Patients with education below high school comprised 57.19%, and those with a monthly income less than 3000 yuan accounted for 42.19%. Most patients had a disease duration of over 2 years (74.69%) and did not receive postoperative chemoradiotherapy (68.44%). The majority were in TNM stage II (54.38%) (**Figure 2**).

Scores of SAD in patients after RRLC

Among the 320 patients, SADS scores ranged from 3 to 28, with a mean score of 16.73 ± 4.69 . The social avoidance dimension scored 9.01 ± 1.93 , and the social distress dimension scored 7.72 ± 3.84 . Overall, patients exhibited moderate levels of SAD (**Figure 3**).

Influencing factors of SAD

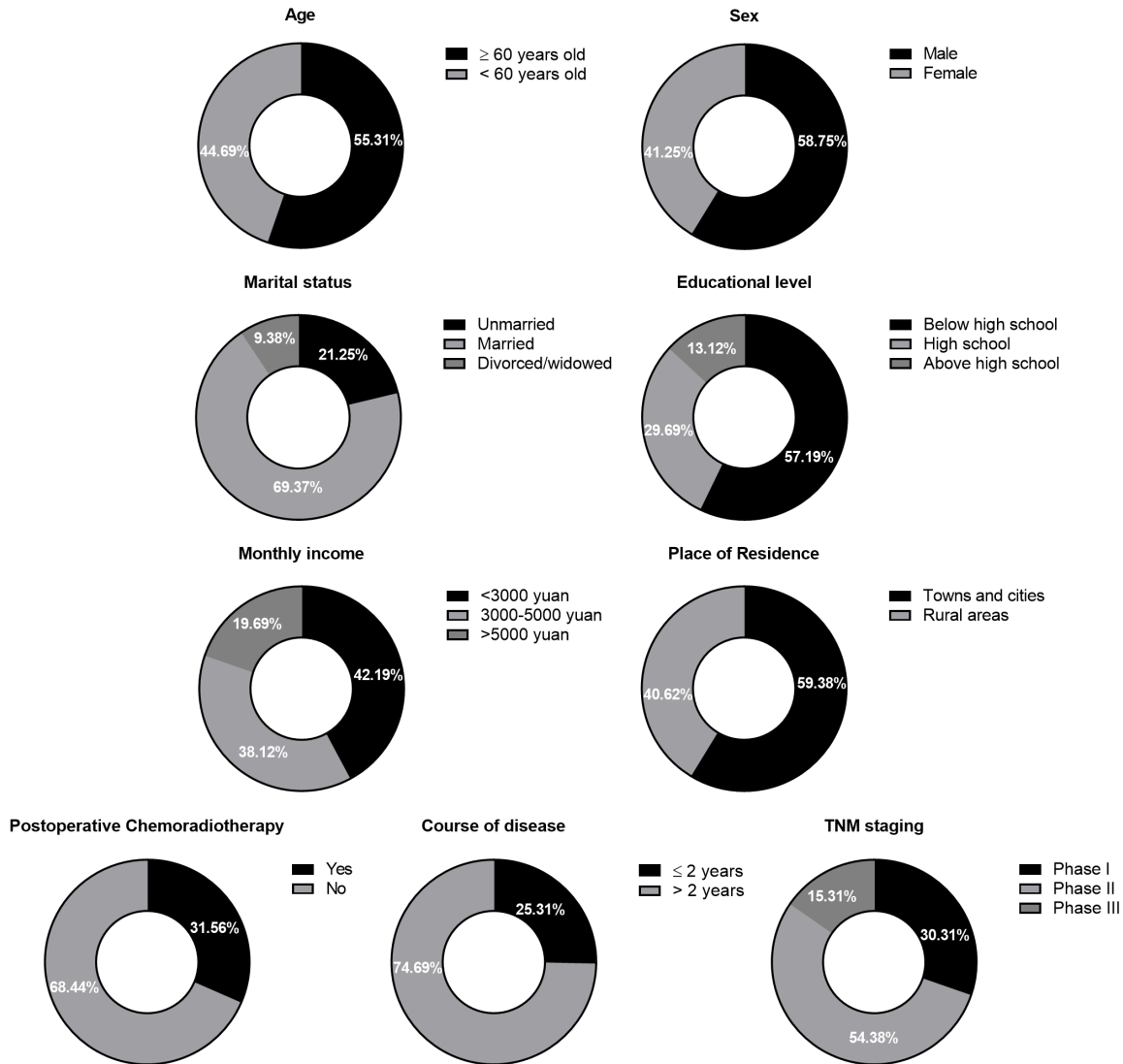


Figure 2. General data on patients undergoing radical resection of lung cancer.

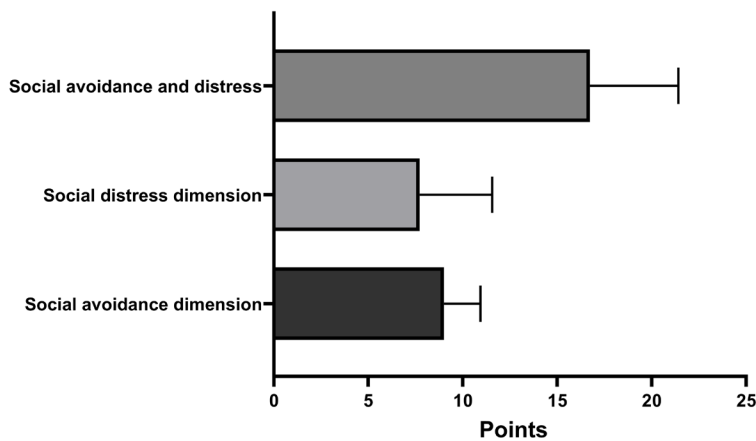


Figure 3. SADS score of patients after radical resection of lung cancer. SADS, Social Avoidance and Distress Scale.

Univariate analysis of SAD in patients after RRLC

Univariate analysis indicated that sex significantly influenced SAD levels ($P < 0.05$) (Table 1).

Effects of anxiety and depression, social support, self-efficacy and stigma on SAD in patients after RRLC

Spearman correlation analysis revealed significant positive correlations between SADS scores and both HADS and

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Table 1. Univariate analysis of SAD in patients after RRLC

| Factors | n | SADS score | t/F | P |
|---------------------------------|-----|------------|-------|--------|
| Age | | | 0.103 | 0.918 |
| <60 years | 143 | 16.76±4.71 | | |
| ≥60 years | 177 | 16.70±4.69 | | |
| Sex | | | 3.684 | <0.001 |
| Male | 188 | 15.93±4.72 | | |
| Female | 132 | 17.86±4.43 | | |
| Marital status | | | 0.224 | 0.799 |
| Unmarried | 68 | 17.01±4.82 | | |
| Married | 222 | 16.68±4.74 | | |
| Divorced/widowed | 30 | 16.37±4.13 | | |
| Place of residence | | | 1.538 | 0.125 |
| Towns and cities | 190 | 17.06±4.55 | | |
| Rural areas | 130 | 16.24±4.87 | | |
| Educational level | | | 0.327 | 0.721 |
| Below high school | 183 | 16.74±4.74 | | |
| High school | 95 | 16.92±4.76 | | |
| Above high school | 42 | 16.21±4.39 | | |
| Monthly income | | | 0.127 | 0.881 |
| <3000 yuan | 135 | 16.87±4.61 | | |
| 3000-5000 yuan | 122 | 16.67±5.05 | | |
| >5000 yuan | 63 | 16.52±4.19 | | |
| Course of disease | | | 0.211 | 0.833 |
| ≤2 years | 81 | 16.63±4.61 | | |
| >2 years | 239 | 16.76±4.73 | | |
| Postoperative Chemoradiotherapy | | | 0.108 | 0.914 |
| Yes | 101 | 16.68±4.45 | | |
| No | 219 | 16.74±4.81 | | |
| TNM staging | | | 2.068 | 0.128 |
| Phase I | 97 | 17.40±4.71 | | |
| Phase II | 174 | 16.25±4.53 | | |
| Phase III | 49 | 17.08±5.11 | | |

SAD, social avoidance and distress; RRLC, radical resection of lung cancer; SADS, Social Avoidance and Distress Scale; TNM, Tumor, Node, Metastasis.

Table 2. Correlation analysis of anxiety and depression, social support, self-efficacy and stigma with SAD

| Variables | Score | SAD | |
|-----------|-------------|--------|--------|
| | | r | P |
| HADS | 23 (19, 29) | 0.662 | <0.001 |
| PSSS | 42 (26, 52) | -0.705 | <0.001 |
| GSES | 23 (16, 26) | -0.682 | <0.001 |
| CESQ | 24 (20, 30) | 0.687 | <0.001 |

SAD, social avoidance and distress; HADS, Hospital Anxiety and Depression Scale; PSSS, Perceived Social Support Scales; GSES, General Self-efficacy Scale; CESQ, consumer experiences of stigma questionnaire.

CESQ scores ($r=0.662$, $P<0.001$; $r=0.687$, $P<0.001$). There were notable negative correlations with GSES and PSSS scores ($r=-0.682$, $P<0.001$; $r=-0.705$, $P<0.001$) (Table 2).

Multiple linear regression analysis of SAD in patients after RRLC

Using SADS scores as the dependent variable, and significant variables from univariate and Spearman correlation analyses (sex, HADS, PSSS, GSES, and CESQ scores) as independent variables (Table 3), multiple linear regression analysis revealed that anxiety and depression, social support, self-efficacy, and stigma were significant predictors of SAD ($\beta=0.132$, $P<0.001$; $\beta=-0.078$, $P<0.001$; $\beta=-0.178$, $P<0.001$; $\beta=0.115$, $P=0.002$) (Table 4).

Mediating effects of anxiety and depression, social support, self-efficacy and stigma on SAD in patients after RRLC

To explore the mediating relationships between SAD and its influencing factors, a mediation model was constructed with anxiety and depression as independent variables, and social support, self-efficacy, and stigma as mediators, with SAD as the dependent variable. The

Bootstrap method was used for testing the mediating effects. Results showed that all Bootstrap 95% CI paths did not contain zero, indicating significant direct and indirect effects ($P<0.05$). Anxiety and depression had a direct effect on SAD with a value of 0.132, accounting for 29.07% of the total effect. The mediating effects of social support, stigma, and self-efficacy were 0.123 (38.20%), 0.042 (13.05%), and 0.038 (11.80%), respectively. Additionally, chain mediating effects through social support → stigma, social support → self-efficacy, stigma → self-efficacy, and social support → stig-

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Table 3. Assignment and description

| Factors | Assignment of value |
|------------|---------------------|
| Sex | 0= female, 1= male |
| HADS score | Original value |
| PSSS score | Original value |
| GSES score | Original value |
| CESQ score | Original value |

HADS, Hospital Anxiety and Depression Scale; PSSS, Perceived Social Support Scales; GSES, General Self-efficacy Scale; CESQ, consumer experiences of stigma questionnaire.

Table 4. Multiple linear regression analysis affecting SAD

| Factors | β | S.E. | Beta | t | P |
|------------|---------|-------|--------|--------|--------|
| Sex | -0.246 | 0.315 | -0.026 | -0.783 | 0.434 |
| HADS score | 0.132 | 0.034 | 0.210 | 3.923 | <0.001 |
| PSSS score | -0.078 | 0.017 | -0.263 | -4.676 | <0.001 |
| CESQ score | 0.115 | 0.037 | 0.182 | 3.100 | 0.002 |
| GSES score | -0.178 | 0.038 | -0.253 | -4.670 | <0.001 |

SAD, social avoidance and distress; HADS, Hospital Anxiety and Depression Scale; PSSS, Perceived Social Support Scales; GSES, General Self-efficacy Scale; CESQ, consumer experiences of stigma questionnaire.

ma → self-efficacy were 0.043 (13.35%), 0.026 (8.08%), 0.025 (11.80%), and 0.025 (7.76%), respectively (Table 5 and Figure 4).

Discussion

Lung cancer, a prevalent malignancy, often relies on radical resection as a crucial treatment modality. Although radical surgery can extend survival, postoperative psychological and social adaptation issues remain significant. SAD, a common psychological challenge post-surgery, can lead to substantial resistance to normal social interactions and negative responses to social activities, severely impacting patients' reintegration into society and their rehabilitation process [16]. This research aims to investigate the prevalence and contributing factors of SAD in patients after RRLC, providing a foundation for developing targeted interventional strategies.

The study found that the postoperative SADS score for 320 RRLC patients was 16.73 ± 4.69 , higher than the scores reported for healthy individuals by Liu et al. [17]. This indicates that patients after RRLC generally experience a sig-

nificant degree of SAD. This phenomenon may be attributed to the considerable psychological pressure associated with lung cancer. Despite the tumor's removal, surgical trauma and potential postoperative complications contribute to a temporary state of vulnerability, often leading to psychological distress and avoidance behaviors. Additionally, patients' psychological factors, such as excessive concern about their illness or uncertainty about the future, further predispose them to SAD following RRLC [18].

The findings of this study revealed that anxiety, depression, social support, self-efficacy, and stigma were the influencing factors of SAD in patients after RRLC. SAD was positively correlated with anxiety, depression, and stigma, and negatively correlated with self-efficacy and social support. Further analysis of the mediating effects among these variables showed that anxiety and depression not only directly affected SAD but also influenced it through multiple mediating pathways involving social support, stigma, and self-efficacy.

Anxiety and depression were found to be positively correlated with SAD, with the direct effect accounting for 29.07% of the total effect value. This highlights the critical role of negative emotions in the development of SAD. Ye et al. [19] demonstrated a direct link between anxiety, depression, and social dysfunction in cancer patients. The psychological stress from the disease and treatment can lead to increased anxiety and depression, which may directly impact social intentions and skills, resulting in SAD. Similarly, O'Suilleabhain et al. [20] found that anxiety and depression scores can predict social dysfunction, and treating these conditions can reduce social avoidance behaviors, which aligns with our findings.

Social support, stigma, and self-efficacy emerged as key mediators in the relationship between anxiety, depression, and SAD.

Social Support: This study found a negative correlation between social support and SAD, with social support mitigating SAD, consistent with Khalid et al. [21]. The impact of anxiety and depression on SAD is significantly mediated by social support, with the strongest effect accounting for 38.20%. This supports the social support theory, which posits that social support can alleviate negative emotions and psycho-

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Table 5. Mediating effects of anxiety and depression, social support, self-efficacy and stigma on SAD of patients after RRLC

| The path | Coeff | S.E. | LLCI | ULCI | Relative effect size (%) |
|---|-------|-------|-------|-------|--------------------------|
| Total effect | 0.454 | 0.024 | 0.406 | 0.502 | 100.00 |
| Direct effect Anxiety and Depression → SAD | 0.132 | 0.034 | 0.066 | 0.199 | 29.07 |
| Indirect effect | 0.322 | 0.028 | 0.268 | 0.379 | 70.93 |
| Effect 1 Anxiety and Depression → Social Support → SAD | 0.123 | 0.028 | 0.070 | 0.180 | 38.20 |
| Effect 2 Anxiety and Depression → Social Support → Stigma → SAD | 0.043 | 0.013 | 0.017 | 0.070 | 13.35 |
| Effect 3 Anxiety and Depression → Social Support → Self-efficacy → SAD | 0.026 | 0.010 | 0.011 | 0.051 | 8.08 |
| Effect 4 Anxiety and Depression → Social Support → Stigma → Self-efficacy → SAD | 0.025 | 0.007 | 0.013 | 0.042 | 7.76 |
| Effect 5 Anxiety and Depression → Stigma → SAD | 0.042 | 0.015 | 0.016 | 0.074 | 13.05 |
| Effect 6 Anxiety and Depression → Stigma → Self-efficacy → SAD | 0.025 | 0.007 | 0.014 | 0.040 | 7.76 |
| Effect 7 Anxiety and Depression → Self-efficacy → SAD | 0.038 | 0.013 | 0.017 | 0.067 | 11.80 |

LLCI, Lower limit of 95% confidence interval; ULCI, Upper limit of 95% confidence interval; SAD, social avoidance and distress; RRLC, radical resection of lung cancer.

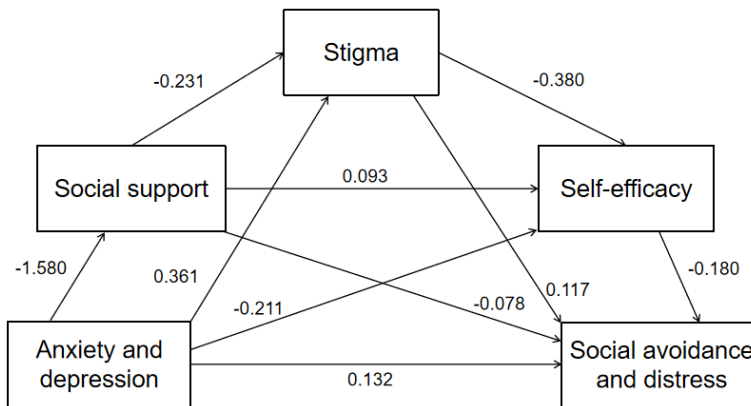


Figure 4. The mediating effect model.

logical distress in response to stress or illness [22]. For lung cancer patients, adequate social support provides emotional comfort and practical assistance, helping them establish positive coping mechanisms and reduce SAD.

Stigma: Stigma was positively correlated with SAD, and played a mediating role in the relationship between anxiety, depression, and SAD, accounting for 13.05% of the total mediating effect. This is in line with research on the impact of stigma on mental health [23, 24]. The specific nature of lung cancer can exacerbate feelings of shame, and heightened anxiety and depression can further intensify this sense of stigma, worsening SAD [25]. This result aligns with Zhao et al. [23].

Self-Efficacy: Self-efficacy was negatively correlated with SAD and served as a mediating variable, contributing 11.80% to the total mediating effect. This finding is consistent with

self-efficacy theory, which suggests that higher self-efficacy enhances an individual's ability to cope with stress and challenges [26, 27]. Improving self-efficacy can therefore mitigate the impact of anxiety and depression on SAD, reducing its occurrence.

Chain-mediated effects associated with SAD:

Social support → stigma: Anxiety and depression, as negative emotional states, can directly impact patients'

social behavior and mental health. Our study found that these negative emotions contribute to SAD by decreasing patients' social support and subsequently increasing their sense of stigma, consistent with previous research [28]. This chain effect underscores the critical role of social support in alleviating psychological stress and stigma. Insufficient social support can lead to feelings of isolation and misunderstanding, which in turn can generate stigma and exacerbate SAD.

Social support → self-efficacy: This study also observed that anxiety and depression can diminish patients' self-efficacy by reducing their social support. Self-efficacy, or confidence in one's ability to accomplish specific tasks, is essential for maintaining mental health and social functioning. When social support is lacking, patients may doubt their own abilities and worth, leading to reduced self-efficacy and worsening SAD [29].

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Stigma → self-efficacy: Stigma, as a negative experience, can directly impact self-efficacy, aligning with findings from prior studies [30]. Our research reveals a chain mediating effect where anxiety and depression decrease self-efficacy by increasing stigma, which in turn affects SAD.

Social support → stigma → self-efficacy: We identified a chain mediating effect involving social support, stigma, and self-efficacy. Anxiety and depression initially reduce social support, leading to increased stigma and lower self-efficacy, which ultimately impacts SAD. This pathway highlights the complex interplay between multiple psychological variables and their collective effect on SAD. To mitigate SAD in patients post-RRLC, it is essential to address anxiety and depression, enhance social support, reduce stigma, and improve self-efficacy. Strengthening social support through emotional, informational, and practical assistance, coupled with health education and psychological interventions to address stigma, can alleviate psychological stress and negative emotions. Additionally, rehabilitation training and psychological counseling can help restore physical function and boost self-efficacy [31].

This study has certain limitations. It focused solely on patients undergoing RRLC at a single hospital, resulting in a relatively small sample size and limited scope. Future research should consider multi-center and cross-regional sample collections to enhance sample representativeness and the accuracy of findings. As a cross-sectional study, it could not establish a definitive causal relationships between the factors and SAD. Longitudinal or intervention studies are needed to further verify these mechanisms. Additionally, other potential influencing factors were not explored in this study. Future research should incorporate a broader range of factors and review both domestic and international literature to enhance the reliability and applicability of the findings.

In conclusion, patients after RRLC generally experience moderate levels of SAD. Anxiety and depression affect SAD both directly and indirectly through social support, stigma, and self-efficacy. Consequently, to alleviate SAD in patients post-RRLC, it is crucial to address anxiety and depression, enhance social support,

reduce stigma, and improve self-efficacy levels.

Disclosure of conflict of interest

None.

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