

# Investigation of Exercise Interventions on Postoperative Recovery in Lung Cancer Patients: A Qualitative Study Using Web Crawling Technology

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**Background:** Rapid recovery after lung cancer surgery is challenging. Exercise is a low-cost, effective method to expedite recovery. Despite numerous exercise interventions, many fail to consider patient perspectives, leading to low adherence and short-term effects. Understanding lung cancer patients' perspectives on postoperative exercise and exploring their exercise-related concerns and needs are crucial for enhancing the effectiveness of exercise-based rehabilitation programs.

**Objective:** This study aims to analyze lung cancer patients' perspectives on postoperative exercise in their daily lives, exploring their concerns and needs related to postoperative exercise to help healthcare professionals develop personalized exercise plans.

**Methods:** An internet crawling technique collected online inquiries from Baidu webpages about postoperative physical activity in lung cancer patients, using "lung cancer", "surgery", and "exercise" as keywords. The data was encoded, categorized, and analyzed using a large-scale semantic analysis platform in natural language processing and information retrieval to examine term frequency, sentiment tendencies, and attributes in the inquiry texts.

**Results:** Initially, 2727 queries were retrieved; after screening, deduplication, and cleansing, 201 unique queries were identified. Queries related to "modes of exercise" constituted the largest proportion. The most frequently occurring words in the word frequency analysis were "lung", "cancer", "should", "can", "long", "early", and "surgery", "exercise", "respiratory". Postoperative lung cancer patients demonstrate significant interest in whether they should engage in exercise, as well as in the appropriate types and duration of such activities, indicating a strong need for detailed guidance and knowledge related to exercise. The sentiment analysis showed a positive score of 87.5% and a negative score of 12.5%, indicating that postoperative lung cancer patients view exercise positively and have an enthusiastic attitude towards it. Among the positive sentiment attributes, "good" was the most frequently mentioned term, whereas "bad" and "surprising" were the most prevalent terms within the negative sentiment attributes.

**Conclusion:** Postoperative physical activity receives limited attention from lung cancer patients, who emphasize their preferences for exercise modalities. Their inquiries often reflect psychological concerns, such as fear and helplessness caused by symptoms. Understanding patients' perspectives on postoperative physical activity within their real-life contexts can help integrate psychological support into exercise plans. This integration could guide healthcare professionals in developing more personalized postoperative exercise regimens for lung cancer patients.

**Keywords:** lung cancer, surgery, exercise, web crawling technology, needs, concern

## Introduction

According to the 2022 Global Cancer Report, the incidence and mortality rates of lung cancer are rising at an alarming pace.<sup>1</sup> For early-stage non-small cell lung cancer patients, surgical resection is considered the optimal treatment choice.<sup>2</sup> Despite

significant advancements in the clinical management of lung cancer, survivors often endure physical and psychological distress.<sup>3</sup> It has been reported that surgical resection is significantly associated with postoperative declines in lung function, reduced exercise capacity, and diminished quality of life.<sup>4–6</sup> Exercise represents a non-pharmacological intervention that has been demonstrated to enhance immune function, improve exercise capacity, and elevate activity levels among lung cancer patients through various pathways.<sup>7</sup> However, exercise management remains a significant challenge for postoperative lung cancer patients. Studies have indicated<sup>8–10</sup> that nearly two-thirds of lung cancer patients fail to achieve the recommended level of physical activity postoperatively, with poor adherence to exercise training and difficulties in sustaining long-term benefits. Fatigue, pain, and breathing difficulties are common barriers hindering their engagement in exercise.<sup>11</sup>

There is a substantial demand among patients in clinical practice for systematic rehabilitation programs and optimal approaches to managing their condition.<sup>12</sup> Improving adherence to early postoperative exercise can lead to better clinical outcomes for lung cancer patients.<sup>13</sup> Understanding patients' perspectives on postoperative exercise and analyzing their exercise-related concerns and needs are essential for achieving long-term effective exercise management. While an increasing number of studies are exploring barriers to patient exercise management, they primarily focus on aspects such as physician-patient communication, patient perceptions of disease management, and social environment,<sup>14–16</sup> overlooking patients' rational understanding of the disease and its compatibility with daily life. Therefore, collecting patient data from real-world settings and delving into the connection between barriers to exercise management and daily life is essential for addressing obstacles to postoperative exercise rehabilitation.

With the advancement of global digital health,<sup>17</sup> the State Council of the People's Republic of China issued the "Opinions on Promoting the Development of 'Internet Plus Healthcare'", advocating for the utilization of big data analysis techniques to forecast the trends in disease development.<sup>18</sup> Information technology and healthcare services have demonstrated significant efficacy in the rehabilitation of lung cancer patients.<sup>19</sup> Internet searching has become an indispensable electronic health service in contemporary society.<sup>20</sup> Before seeking medical consultation, the majority of lung cancer patients browse websites to acquire relevant information concerning physicians, lung cancer, its treatment modalities, and outcomes. Web crawlers,<sup>21</sup> also known as spiders or spider bots, are designed to automatically extract relevant data in bulk from the vast expanse of the internet. They have been widely employed in search engines, large-scale data mining and analysis, artificial intelligence, and the production of machine learning datasets.<sup>22</sup> Hu et al<sup>23</sup> utilized web crawling technology combined with qualitative interviews to explore the needs and preferences of self-management in type 2 diabetes. This study provides valuable insights for healthcare teams to optimize personalized care plans. Tian et al<sup>24</sup> employed web crawling technology to investigate dietary exercise-related concerns and needs post-gastric cancer surgery, offering a theoretical basis for clinical staff to devise dietary plans. Currently, the application of web crawling technology in exercise management for lung cancer patients remains largely unexplored.

This study employed web crawling techniques to capture content related to exercise retrieved by lung cancer patients on online platforms, aiming to identify and explore key rehabilitation aspects of exercise that are of utmost concern to patients in their real-life experiences. Grounded in the perspective of patients, text mining and sentiment analysis techniques were utilized to investigate the postoperative exercise-related concerns and needs of lung cancer patients. The findings contribute to the foundation for constructing postoperative exercise regimens tailored to the needs of lung cancer patients.

## Material and Methods

### Data Collection

We conducted a comprehensive search utilizing the keywords "lung cancer", "surgery", and "exercise". Initially, we utilized the Baidu search engine to retrieve web pages, with data collection concluding on March 11, 2024. Websites were selected based on their frequency of occurrence in addressing the initial search query, with those surpassing 15 mentions deemed pertinent for further examination. Subsequently, a secondary search was conducted on the above websites using the aforementioned keywords. Employing regular expression techniques, we extracted relevant content from the web pages. In instances where the extraction was incomplete, iterative searches were performed to supplement the retrieved information.

## Data Selection

### Inclusion and Exclusion Criteria

(1) Inclusion Criteria: Studies were included if they met the following criteria: ①participants were postoperative lung cancer patients and their caregivers, including both inpatients and postoperative home-care patients; ②the consultation topic pertained to exercise-related issues in postoperative lung cancer patients.

(2) Exclusion Criteria: Studies were excluded if they met any of the following criteria: ①participants were not specified as postoperative lung cancer patients; ②the consultation topic was unrelated to exercise; ③presence of inappropriate online discourse. The inclusion and exclusion process followed the “maximization principle”, prioritizing inclusion of studies when the relevance to exercise-related issues in postoperative lung cancer was ambiguous, for subsequent analysis.

### Incorporation of Data

Following the consolidation of all queries, data inclusion and exclusion were independently conducted by two proficient researchers (Liu and Ma), who had undergone systematic training, based on predefined study criteria and observation indicators. In cases of discrepancy, resolution was sought through consultation with a third researcher (Li) for consensus.

### Duplicate Data Removal Procedure

All included issues are entered into an Excel spreadsheet. Utilizing the sorting and filtering capabilities within Excel, the included issues are sorted in ascending order. Researchers (Liu and Ma) then manually review the records to identify and remove duplicates. In cases where complete issues cannot be obtained, relevant links are traced back to corresponding web pages for thorough examination. Issues with identical descriptions (including semantics and syntax) are then systematically identified and removed.

### Data Cleansing

The cleaned data from the aforementioned deduplication process involved several steps: (1) Removal of non-informative symbols such as “@”, “~”, “&”, and “-”; (2) Correction of misspellings based on semantic understanding, for instance, “non-cancerous” and “cloud movement”; (3) Standardization of punctuation marks, substituting non-standard Chinese symbols with those commonly used in Mandarin, such as replacing “。” with “。”; (4) Completion of fragmented sentences lacking punctuation marks to ensure grammatical integrity; and (5) Deduplication of identical sentences within a single query.

## Data Analysis

### Text Classification

Text classification research aims to automate the mapping of text containing information into predefined classification systems.<sup>25</sup> The classification method serves as the basis for categorizing queries. Currently, question classification methods mainly consist of three types: classification based on answer types, classification based on question semantic information, and classification based on mixed information.<sup>26</sup> This study draws upon the network question classification in the Chinese health question classification system developed by Guo Haihong et al<sup>27</sup> which is suitable for large-scale health question collection.<sup>24</sup> Firstly, a thematic classification method is established. Subsequently, multiple members of the research team independently annotate a portion of the data to optimize and test the reliability of the classification method, forming an annotated semantic repository. Finally, health information needs are analyzed. The specific steps are as follows:

Initially, the questions were meticulously examined and recurring issues and demands were identified. Two researchers (Liu and Ma) categorized the cleaned-up questions based on patient inquiries and themes, establishing the scope of categorization. In cases of disagreement, a third researcher (Li) was consulted for consensus. Subsequently, the coded questions or content were categorized, and thematic extraction was performed according to different classifications. The frequency of patient question categories and occurrences of each category were tallied. For frequently occurring issues identified through the aforementioned statistical analysis, researchers employed an inductive approach to extract themes. Finally, the logical relationships among various themes were analyzed to serve as the foundation for further analyzing the textual sentiment attributes.

## Text Word Frequency Analysis

Word frequency analysis is a textual analytical approach that involves computing the frequency of occurrence of individual words in a text, facilitating the identification of keywords, topic analysis, text comparison, trend exploration, and information mining processes.<sup>28</sup> The Natural Language Processing & Information Retrieval Sharing Platform (NLPIR), also known as the Big Data Semantic Intelligence Analysis Platform,<sup>29</sup> developed by the team led by Zhang Huaping at the Chinese Academy of Sciences, is a platform capable of supporting various encodings, operating systems, and development languages. Its primary functionalities include segmentation for Chinese and English text, keyword extraction, word frequency analysis, identification of new words, adaptive segmentation, and sentiment analysis. In this study, we employed this platform for word frequency analysis.

## Text Sentiment Analysis

Sentiment Analysis, a process of extracting meaningful information and semantics from text to determine the author's attitude, has emerged as a novel research field.<sup>30</sup> It aims to delve into text to comprehend and predict users' emotions and emotional tendencies.<sup>31</sup> The NLPIR platform employs two primary techniques for sentiment analysis. One involves the automatic identification and weight calculation of sentiment words. Through co-occurrence relationships and Bootstrapping strategy for iterative refinement, new sentiment words are generated, and their weights are computed. The other technique extends sentiment word calculations based on deep neural networks, synthesizing them into the final outcome.<sup>32</sup> In this study, the sentiment analysis function module within this platform was utilized to analyze the emotional tendencies of all issues, revealing both positive and negative aspects, and including specific emotional attributes such as "good", "happy", "surprised", "angry", "disgusted", "sad", and "afraid".

## Result

### General Information

Upon querying the Baidu search engine, a total of 11,800,000 queries were identified. Due to limitations inherent to web crawling, the internet crawler technology retrieved content from the first 76 pages, yielding 714 questions. Notably, the searches were primarily conducted by the patients themselves and their family members. Inquiries on Zhihu.com garnered the highest search frequency, constituting approximately 9.94% of all queries, followed by inquiries on Quick Ask Doctor website. Websites with frequencies exceeding 15 occurrences included Zhihu, Quick Ask Doctor, Fuhe Health, 39 health Network, Sohu, Bohe Doctor, Baidu Knows, Health World, Medical Union Media, WeChat Official Accounts, Youlai Doctor Network, Minfukang, and XYWY. Subsequent querying of websites with frequencies exceeding 15 occurrences generated a total of 2,727 questions, of which 201 questions were ultimately included following data screening, deduplication, and cleansing procedures. The sources of the questions and their corresponding frequencies are presented in Table 1, with web pages appearing fewer than 5 times aggregated under "Others". The data collection process is illustrated in Figure 1.

## Semantic Analysis of Postoperative Exercise Issues in Lung Cancer Patients

### Text Classification

Initially, the issues were classified based on their content and themes into the following categories: "Is postoperative exercise necessary for lung cancer patients?", "How should lung cancer patients exercise postoperatively?", and

**Table 1** Number of Initial Search Hits and Their Source Websites

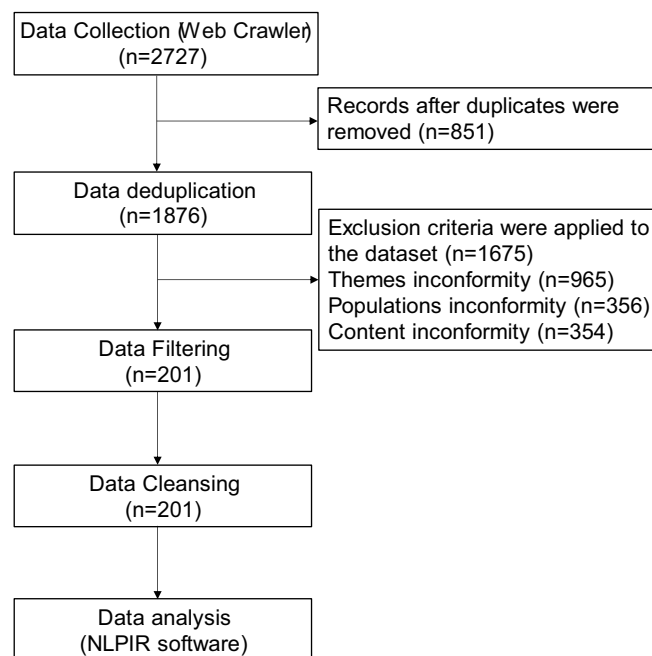
Source Website	Number	Proportion (%)
Zhihu	71	9.94%
Rapid Ask Doctor	47	6.58%
Fuhe Health	44	6.16%
39 health Net	39	5.46%

(Continued)

**Table I** (Continued).

Source Website	Number	Proportion (%)
Sohu	37	5.18%
Bohe Doctor	35	4.90%
Baidu Knows	31	4.34%
Health World	28	3.92%
Medical Media	25	3.50%
WeChat Official Account	24	3.36%
Youlai Doctor Network	15	2.10%
Minfukang	15	2.10%
XYWY	15	2.10%
Personal Library	13	1.82%
NetEase	11	1.54%
Ark Health Customer	8	1.12%
Haodafu Online	7	0.98%
Doctor Online	7	0.98%
Bilibili	5	0.70%
Others	237	33.19%

“Precautions for postoperative exercise in lung cancer patients”. Additionally, during the text classification process, we found that postoperative exercise rehabilitation for lung cancer patients involves not only the patients themselves but also their family members. Some family members expressed a willingness to encourage and participate in the patient’s

**Figure 1** Network Spider and Data Analysis Flowchart.

exercise regimen. This is reflected in questions such as, “Can grandfather with lung cancer undergo bed rest after surgery?” and “Father underwent lung cancer surgery, what is the best way to recover? Can exercise promote recovery?” These examples demonstrate the active role that family members play in supporting the patient’s rehabilitation journey. For specific classifications and example inquiries, refer to [Table 2](#).

### Word Frequency Analysis

Word frequency analysis was conducted on the entire dataset, categorizing words into nouns, verbs, and adjectives. The analysis revealed that words such as “lung”, “cancer”, “should”, “can”, “long”, “early”, and “surgery”, “exercise”, “respiratory” appeared with high frequency. High-frequency words such as “lung”, “cancer”, “surgery”, “should”, and “can” were commonly used by patients when discussing postoperative exercise and recovery, reflecting their typical language habits. For instance, patients often inquire, “Can postoperative lung cancer patients exercise?”. Words like “long” and “early” indicated patients’ concerns about the duration and timing of postoperative recovery and exercise. For instance, questions such as “After mid-to-late stage central lung cancer surgery, how long after can one play badminton?” and “After surgery, when is the earliest I can start exercising?” illustrate these concerns. Additionally, terms like “exercise” and “respiratory” appeared frequently, reflecting patients’ needs for knowledge regarding

**Table 2** Themes and Content Classification Results of Postoperative Lung Cancer Patients’ Questions in Online Networks

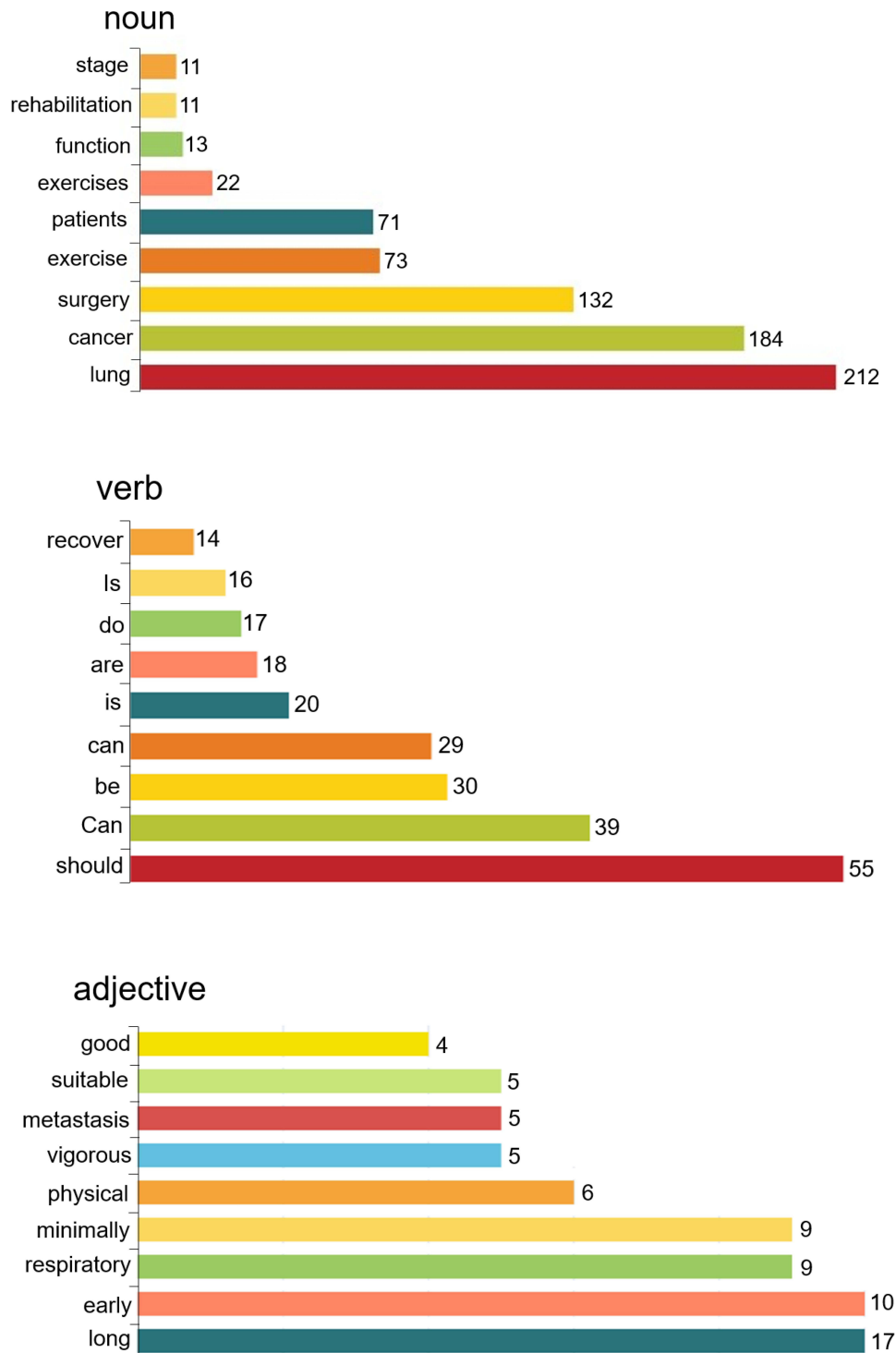
Category	Subcategory	Research Questions (Examples)
Can postoperative lung cancer patients exercise?	Should exercise be done?	Can postoperative lung cancer patients exercise?
		Can grandfather with lung cancer undergo bed rest after surgery?
		Is it better to rest or be active twenty days after right lung resection surgery?
		After lung cancer surgery, why does chest discomfort and pain occur during exercise?
		Elders often say “three parts treatment, seven parts nursing”. How should one recuperate after lung cancer surgery? Can vigorous activities be done?
		Lung cancer surgery more than two months, feel chest tightness pain abdominal distension, in this case I can also exercise?
		I have recovered well after lung cancer surgery and hope to enhance resistance and distract attention through exercise. Is it permissible to exercise?
	Are there benefits to exercising after lung cancer surgery?	Is exercise combined with traditional Chinese medicine effective for lung cancer post-surgery?
		Father underwent lung cancer surgery, what is the best way to recover? Can exercise promote recovery?
		After lung lobe surgery, the loss of sensation has a significant impact on physical strength. How to improve during exercise?
		In early stages of lung cancer, just after resection surgery, with low weight and persistent cough, can exercise help alleviate symptoms?
		How to quickly recover after lung cancer surgery? What are the benefits of timely exercise?
		There are news reports that running five kilometers every day after lung cancer surgery resulted in recurrence and metastasis. Does exercise accelerate tumor development?

(Continued)

Table 2 (Continued).

Category	Subcategory	Research Questions (Examples)
Postoperative exercise for lung cancer patients	Types of exercise	Can yoga be practiced one month after lung surgery?
		My father was diagnosed with lung cancer and just underwent right lung resection. What should be paid attention to after surgery? The doctor mentioned exercise, how should it be done?
		Lung cancer with lymph node metastasis, currently undergoing chemotherapy + carboplatin + bevacizumab, what exercises are suitable? Can Tai Chi still be practiced?
		Early lung cancer surgery results in decreased lung function, how can one exercise at home without spending money?
		Is exercising and shouting loudly beneficial for lung cancer patients in the morning?
		After more than two years since lung cancer surgery, I exercise by hiking every day. Is it okay?
		Can respiratory exercises be done by lung cancer patients? How to do them?
		Is blowing balloons beneficial for the recovery of lung cancer patients?
		Can you do flat shake work half a year after early lung cancer operation?
		Is chest expansion exercise contraindicated after lung cancer surgery?
	When and how often to exercise	Regarding morning running exercise: 1. How many kilometers or how long is appropriate for morning running? 2. Is it better to run in the morning or evening? 3. Other considerations?
		After mid-to-late stage central lung cancer surgery, how long after can one play badminton?
		After lung cancer surgery, I returned home. Is it okay to exercise from 4 pm to 5 pm?
		How long after minimally invasive lung surgery can one start exercising?
		How long after lung cancer surgery can one start exercising? Can running be done?
	Exercise intensity and duration	After lung cancer surgery, should one walk 3000 steps per day or 10,000 steps?
		Can lung cancer patients engage in vigorous exercise after surgery?
		How soon after lung cancer surgery can leg exercises be practiced?
		How should lung cancer patients exercise intensity to maintain health after surgery?
	Precautions for postoperative exercise in lung cancer	After finishing lung cancer operation, a movement chest discomfort pain, what is this reason?
How to recover after lung cancer surgery? What should be paid attention to?		
What should be noted after lung cancer surgery?		
Which exercises are best avoided after lung cancer surgery? Why?		
How should lung adenocarcinoma be maintained after surgery?		

postoperative exercise and respiratory function recovery. This is evident in questions like “Can respiratory exercises be done by lung cancer patients? How to do them?” and “After lung lobe surgery, the loss of sensation has a significant impact on physical strength. How to improve during exercise?” These examples highlight the demand for information on postoperative exercise and respiratory rehabilitation among lung cancer patients. Detailed results of the word frequency analysis are illustrated in Figure 2.

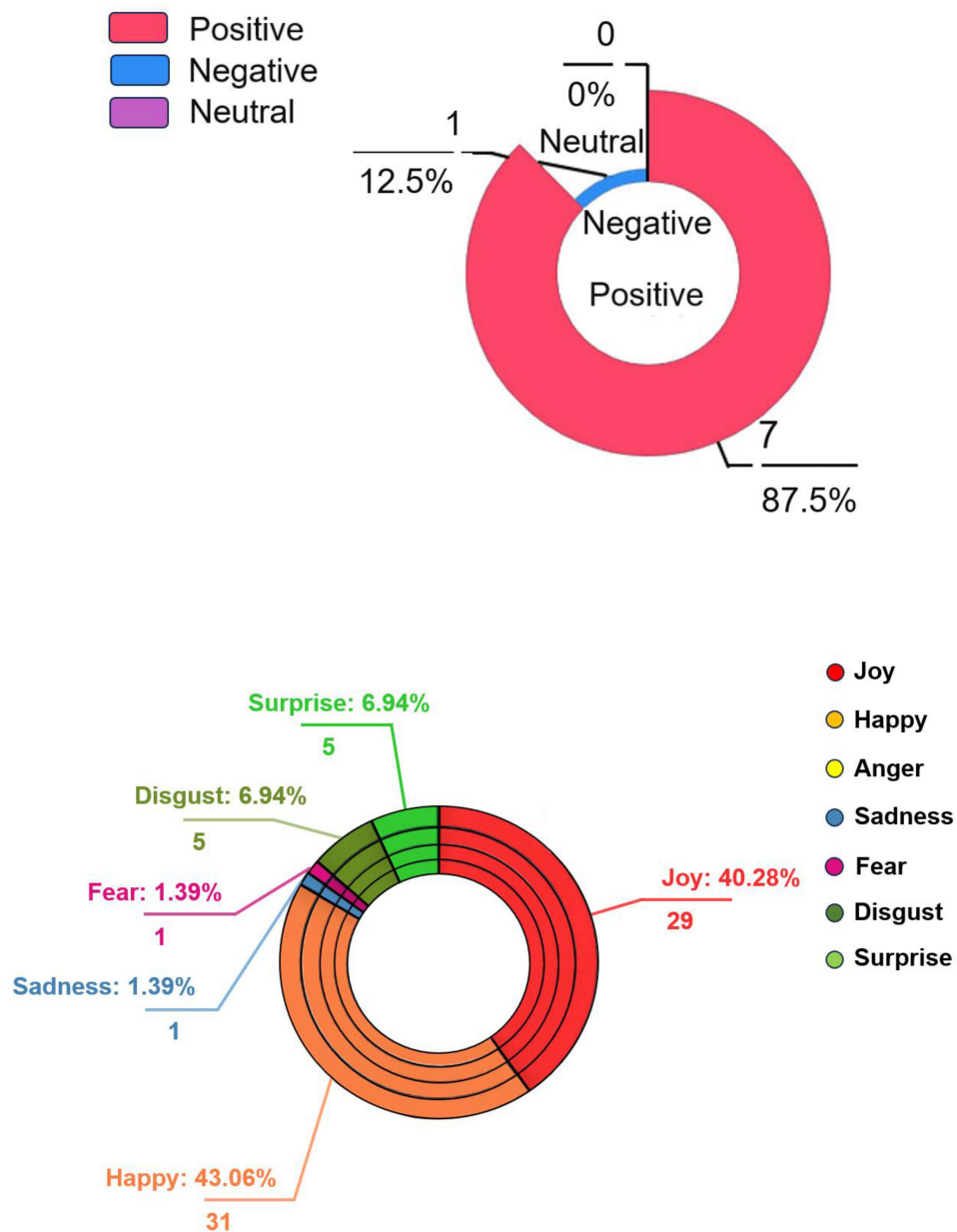


**Figure 2** Word Frequency Statistics of Postoperative Exercise-Related Issues in Patients with Lung Cancer.



### Sentiment Analysis

In the emotional analysis of postoperative exercise among lung cancer patients, we found that patients generally have a positive attitude toward engaging in exercise after surgery. The positive sentiment score accounted for 87.5% of all responses, while the negative sentiment score accounted for 12.5%, with the positive sentiment score being seven times that of the negative sentiment score. This indicates that although patients exhibit a tendency towards negative emotions regarding postoperative exercise issues in lung cancer, the overall sentiment remains positive. Specifically, among the positive emotional attributes, “Happy“ and “Joy“ were the most prominent, reflecting that many patients experienced improvements in their physical condition and a sense of happiness during postoperative exercise. For example, one patient asked, “Exercising makes me feel stronger. How long can I exercise each day?“ However, negative emotions such as ”Sadness“ and ”Fear“ were also frequently reported. These emotions were primarily associated with challenges patients faced in their daily lives, such as, ”After finishing lung cancer operation, a movement chest discomfort pain, what is this reason?“ Despite these negative emotions, most patients maintained a positive outlook on exercise and expressed a willingness to try it. Emotional analysis of the data is depicted in Figure 3.



**Figure 3** Emotional Analysis of Postoperative Exercise-Related Issues in Patients with Lung Cancer.

## Discussion

In this study, we employed web crawling techniques to collect questions posted online by lung cancer patients regarding postoperative exercise. By analyzing the perspectives of lung cancer patients on postoperative exercise in their daily lives and real-life scenarios, we aimed to investigate patients' exercise-related concerns and needs regarding postoperative exercise. During the web crawling process, we discovered that prominent websites such as "Zhihu", "Quick Ask Doctor", and "Fuhe Health" provided a wealth of information on lung cancer surgery and exercise queries, serving as channels through which patients and their families accessed relevant medical information. During the process of question analysis, the questioners included not only the patients themselves but also their family members, demonstrating the caregivers' concern and their desire to participate in the patients' recovery process. While some websites appeared infrequently, they are not to be overlooked as they may contain viewpoints or information specific to certain demographics. Through text classification, frequency analysis, and sentiment analysis, a series of questions and concerns regarding postoperative exercise for lung cancer were identified, reflecting the worries and requirements of lung cancer patients and their caregivers in this domain.

Exercise is an effective means to facilitate postoperative recovery in lung cancer patients. A qualitative study on exercise therapy among lung cancer patients<sup>33</sup> suggests that those with limited professional competence and poor self-management skills express a greater desire for exercise support and guidance. However, for postoperative lung cancer patients at home, timely assistance from healthcare professionals regarding exercise-related issues is often unavailable.<sup>34</sup> Utilizing web crawling technology to explore postoperative exercise-related concerns among lung cancer patients transcends geographical and temporal constraints of the real world, thereby uncovering patients' exercise needs in daily life. This approach aids in enhancing adherence to exercise rehabilitation, ensuring the sustainability of its effects. In the process of information retrieval, many patients raise queries such as "Can I exercise after lung cancer surgery?" Influenced by traditional beliefs, most patients lack understanding regarding postoperative exercise and its modalities.<sup>35</sup> This phenomenon underscores the necessity of enhancing relevant health education in clinical practice. Categorization of inquiries by theme and content reveals that "How should one exercise after lung cancer surgery?" constitutes the largest proportion, thus offering valuable insights for formulating postoperative exercise regimens for lung cancer patients in clinical practice. Li et al<sup>14</sup> also indicate that factors influencing postoperative exercise among lung cancer patients include unpleasant exercise experiences, short-term supervision of postoperative exercise by medical staff, and inadequate understanding of exercise-related knowledge.

Interestingly, in our analysis of word frequency regarding postoperative exercise-related concerns among lung cancer patients, we found that terms such as "lung", "cancer", "should", "can", "long", "early", "surgery", "exercise", and "respiratory" appeared most frequently. The prominence of "lung", "cancer", and "surgery" reflects patients' keen interest in understanding aspects of lung cancer disease and surgical treatments. Similar to Chai,<sup>36</sup> many cancer patients often turn to the internet for information on diagnosis and treatment. Moreover, high-frequency terms like "long", "early", "exercise", and "respiratory" indicate a strong desire among lung cancer patients for detailed guidance on exercise rehabilitation and respiratory exercises. This aligns with findings by Ha et al<sup>37</sup> highlighting patients' preference for professional exercise guidance from healthcare providers to facilitate postoperative recovery. These findings underscore significant patient demand for disease treatment, rehabilitation information, and expert advice. Therefore, in clinical practice, it is imperative to offer more effective health counseling and support services to better meet the needs of patients and caregivers.

In this study, the overall scores of emotional tendencies regarding postoperative physical activity issues in lung cancer patients were predominantly positive. Within the positive emotional attributes, "good" and "joyful" were notably prominent. Conversely, within the negative emotional attributes, "fearful" and "startled" were more prevalent. Specific inquiries from patients reflected semantic concerns regarding postoperative recovery, engagement in physical activity, and associated symptoms, which evoked feelings of helplessness and anxiety among lung cancer patients and their family members. Research indicates<sup>38–40</sup> that the prevalence of anxiety and depression among postoperative non-small cell lung cancer patients ranges from 20.9% to 57.1%. In addition, psychosocial factors such as disease-related shame, lack of adequate social support, fear, and helplessness are strongly correlated with postoperative quality of life

among patients.<sup>41</sup> Notably, our analysis reveals that not only do patients seek advice for themselves, but many family members also express support and concern for the recovery process of lung cancer patients. This suggests that family members may play a crucial role in providing social and psychological support. Future considerations could include incorporating caregivers into the patient's rehabilitation plan. Research indicates that collaborative provision of social and psychological support by patients' family members has a significant facilitative effect on the recovery of lung cancer patients.<sup>42</sup> Missel et al<sup>43</sup> found that engaging in group exercises can enhance social benefits, making it easier for patients to endure illness and treatment, and better cope with the atmosphere of disease adversity. Encouraging group exercises can promote patients' physical activity and exercise motivation.<sup>44</sup> This underscores the importance of not only focusing on postoperative exercise programs for lung cancer patients but also providing essential social and psychological support. This support may involve teamwork and collaborative family caregiving to collectively facilitate patients' exercise rehabilitation.

## Limitations

This study has several limitations. Firstly, the analysis and discussion of real patient inquiries using web crawler technology may only represent the viewpoints of users on specific platforms, thus may not be generalizable to the entire population's concern and needs. Secondly, data collection may be affected by access restrictions or privacy protection policies, leading to incomplete data acquisition. Thirdly, our analysis relies solely on web crawler data, potentially overlooking information such as socio-demographic characteristics and insurance coverage. Future research may consider incorporating qualitative methods to further explore the exercise-related concerns and needs of lung cancer patients.

## Conclusion

In summary, lung cancer patients generally have a positive attitude toward postoperative exercise, with a significant need for knowledge about exercise and detailed guidance on how to perform it. To meet these needs and promote their recovery, providing personalized exercise guidance is crucial. Additionally, incorporating psychosocial support and involving family caregivers in exercise guidance is especially important for lung cancer patients. Understanding patients' perspectives and needs regarding postoperative exercise in their daily living contexts can help healthcare teams optimize collaborative strategies and develop personalized care plans. In the future, when creating individualized exercise programs for postoperative lung cancer patients, it will be essential to enhance education on exercise rehabilitation and integrate psychosocial support to safeguard patients' recovery comprehensively.

## Data Sharing Statement

The datasets used during the current study are available from the corresponding author Jing Luo on reasonable request.

## Acknowledgments

The authors extend their gratitude to all the teachers who provided guidance and assistance with this project.

## Author Contributions

All listed authors made significant contributions to this study, whether in research design, data collection, organization and analysis, or in the writing and revision of the manuscript. All listed authors gave final approval of the version to be published, agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

## Funding

This work was supported by the grant from Open Projects of State Key Laboratory of Radiation Medicine and Protection. (No. GZK1202225).

## Disclosure

The authors report that they have no conflicts of interest in this work.

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