

# Home Rehabilitation Experience and Influencing Factors in Frail Elderly Patients with Lumbar Spine Surgery: A Qualitative Study

Wei Jiang<sup>1,\*</sup>, Mingyang Qian<sup>1,\*</sup>, Qingsong Zou<sup>1</sup>, Xiaowei Chen<sup>2</sup>, Mengyi Xu<sup>3</sup>, Jiangming Yu<sup>3</sup>

<sup>1</sup>Wuxi School of Medicine, Jiangnan University, Wuxi, Jiangsu Province, 214122, People's Republic of China; <sup>2</sup>Kunshan Hospital of Traditional Chinese Medicine, Suzhou, Jiangsu, 215399, People's Republic of China; <sup>3</sup>Tongren Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, 200336, People's Republic of China

\*These authors contributed equally to this work

Correspondence: Jiangming Yu, Department of Orthopedics, Tongren Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, 200336, People's Republic of China, Tel +86 13916949892, Email yjm\_st@163.com

**Purpose:** To explore the home rehabilitation experience of frail elderly patients with lumbar spine surgery and to analyse potential factors promoting and hindering their rehabilitation.

**Methods:** Purposive sampling method was used to select patients undergoing lumbar spine surgery in a tertiary general hospital in Shanghai, China, from January to March 2025 and 24 patients were chosen. A descriptive phenomenological research method was used with face-to-face semi-structured interview and raw data were analyzed using Colaizzi's seven-step method.

**Results:** The transcripts were synthesized into three main themes and nine sub-themes. (1) Barriers to exercise compliance, including poor compliance with rehabilitation, frail state of the body, negative emotions, and lack of professional guidance. (2) Facilitating factors, including health literacy, family responsibility and social support. (3) Latent demands, including diversified information support needs and continuity of care needs.

**Conclusion:** The home rehabilitation experience of frail patients was thoroughly explored, capturing physical, psychological, and rehabilitation needs. Future research should develop targeted home rehabilitation exercise programs for this vulnerable population and incorporate tele-rehabilitation modalities to facilitate safe and effective recovery at home.

**Keywords:** frail, elderly, lumbar spine surgery, experience, influence factors, home rehabilitation

## Introduction

Degenerative spine diseases (DSD) is a general term for a group of diseases in which the lumbar spine and accessory structures undergo aging and degeneration, generally referred to as lumbar spondylolisthesis, lumbar disc herniation and lumbar spinal stenosis,<sup>1</sup> and is an important cause of low back pain. Epidemiologic studies have shown that approximately 403 million people (5.5% of the world's population) suffer from symptomatic disc degeneration,<sup>2</sup> and the number of patients increases with age,<sup>3</sup> mostly experienced by middle-aged and older adults.

Conservative management represents the initial therapeutic approach, including exercise, physical therapy<sup>4,5</sup> and adjunctive techniques such as kinesio taping for analgesia,<sup>6</sup> resulting lower disease burden and financial expenditure.<sup>7</sup> Surgical intervention is indicated when conservative modalities prove refractory, which can improve some of the patients' symptoms of low back pain and lower limb numbness, but some patients may still have symptoms after surgery,<sup>8</sup> together with the early postoperative recommendation of bed rest and lack of exercise, which may lead to atrophy of the patients' low back muscles, and even limitation of daily life.<sup>9</sup> Therefore, in order to further improve the quality of life, a postoperative rehabilitation phase is essential, which contributes to the reduction of pain and disability in the early postoperative period,<sup>10,11</sup> and improves the long-term postoperative outcomes.<sup>12</sup> A large sample study involving

28,600 patients with lumbar spinal stenosis showed that more than 80% of patients chose to return home for rehabilitation after discharge.<sup>13</sup> The same is true in China. Chinese tradition emphasizes on familial interdependence positions the family as the primary unit orchestrating post-discharge care. Relatives typically assume responsibility for exercise supervision, emotional support, and resource.

In addition, compared with young people, the elderly have a higher potential to suffer more perioperative risks, which are manifested as a frail state of reduced physiologic reserve, decreased body function, and increased sensitivity to adverse outcomes.<sup>14,15</sup> Frailty is a state of decline in body functions associated with aging, involving a decrease in the physiological reserves of the neuromuscular, metabolic and immune systems, resulting in an increased susceptibility to stress factors. The prevalence of frailty comorbid with lumbar spine diseases is rising steadily.<sup>16</sup> As a preoperative screening tool, frailty assessment effectively predicts postoperative recovery outcomes in patients with degenerative spinal conditions, thereby assisting in clinical decision-making and guiding perioperative management.<sup>17</sup> At present, there are various assessment methods for frailty. The two common evaluation systems are the physical frailty phenotype and the Frailty Index (FI) of accumulative deficits.<sup>18</sup>

Simultaneously, within the present medical landscape in China, patients encounter specific challenges when attempting to access professional rehabilitation services following hospital discharge. Besides, affected by the anxiety state,<sup>19</sup> exercise compliance<sup>20</sup> and other factors, the current rehabilitation effect of patients is general, and the deep reasons that hinder patients' exercise need to attract the attention of clinicians. However, the current research type is mostly quantitative research, the content of which focuses on the type of postoperative rehabilitation exercise, the optimal choice of exercise time.<sup>10</sup> There are few qualitative studies that deeply explore patients' experiences during home rehabilitation to elucidate factors influencing rehabilitation outcomes. By interviewing frail elderly individuals recovering from lumbar spine surgery about their home rehabilitation experiences, this study aims to identify factors impacting their rehabilitation effect, and comprehensively summarize their rehabilitation needs. Therefore, the findings can provide an empirical foundation for developing targeted clinical interventions and refining postoperative rehabilitation exercise programs for this vulnerable population.

The Health Belief Model (HBM) was first proposed by Professor Hochbaum in 1958 and subsequently revised and improved multiple times. It mainly includes the cognition of disease susceptibility, the cognition of disease severity, the cognition of behavioral benefits, the cognition of behavioral disorders, the cues for action, and self-efficacy.<sup>21</sup> Applying this model in qualitative research helps to deeply understand the decision-making process of the target population's health behaviors, based on this theory, the focus of this study is to explore the factors that influence patients' exercise behavior, thereby providing a foundation for developing more effective health promotion strategies.

## Materials and Methods

### Objects of Study

We used purposive sampling method combined with the maximum difference sampling strategy. Patients who underwent lumbar spine surgery in a tertiary general hospital in Shanghai, China, from January to March 2025 were included in the study. All the admitted patients underwent frailty assessment using the Tilburg Frailty Scale. This scale has high reliability and validity in evaluating frailty in elderly patients. The total score ranges from 0 to 15, with a score of  $\geq 5$  indicating frailty, and the higher the score, the more severe the degree of frailty.<sup>22</sup> All the included patients were screened for their cognitive status using the MMSE scale to ensure that they were capable of undergoing the interview. It is the most widely used cognitive screening test for general cognitive assessment, with a maximum score of 30 points, and it is related to whether the patient has dementia and their educational level.<sup>23</sup>

Inclusion criteria: ① aged 60 years or older; ② disease diagnosis of degenerative lumbar spine diseases such as lumbar spinal stenosis, lumbar spinal slippage, lumbar disc herniation (with or without sciatica); ③ diagnosis of frailty through the Chinese version of the Tilburg Frailty Scale;<sup>24</sup> ④ discharge from the hospital for 1 month or more; ⑤ normal cognition, hearing, and expression ability.

Exclusion criteria: ① unplanned re-admission within 30 days after discharge; ② inability to perform rehabilitation exercises due to physical reasons.

Before the patient is discharged from the hospital, we inform them that they should follow the doctor's instructions for postoperative exercises and visit the hospital for follow-up appointments on time. At that time, an interview will be conducted. The patient's informed consent and the informed consent form will be prepared in advance. If the patient is unable to come for a follow-up visit due to special circumstances, we will conduct a telephone follow-up. Initially, 24 physically frail patients were evaluated. Of these, 10 were excluded from the analysis as they reported no home exercise postoperatively, having undergone rehabilitation solely in a facility. Consequently, the final sample for the qualitative analysis consisted of 14 patients who had engaged in home exercise at least once following surgery. The general information of the participants is shown in [Table 1](#).

## Research Methodology

According to the content and purpose of the study, the descriptive phenomenological research method is used, which requires that the objectivity of the phenomenon is obtained by observing the phenomenon itself, which reveals the meaning and essence of the participant's experience in order to reach a deeper understanding.<sup>25</sup> In this study, it is suitable for observing the current status of patients' home rehabilitation environment and attempting to analyze the influencing factors and potential needs affecting patients' rehabilitation effects. This study was approved by the Ethics Committee of Shanghai Tongren Hospital (Approval No. 2025-008-01), and the patients all voluntarily participated in this study.

### Develop an Interview Outline

The researcher developed an interview outline based on the study purpose and relevant literature, combined with the opinions of qualitative research experts and clinical nursing experts, and after pre-interviewing three outpatient post-operative patients, the interview outline was modified in light of them, and the formal interview outline is as follows:

1. How did you carry out your rehabilitation exercises in the past few months? How do you feel about your recovery?
2. How did you feel during the recovery process? (Discomfort experience?)
3. How did you gain knowledge about home rehabilitation? Can you understand the rehabilitation program?
4. Do you have any concerns during the home rehabilitation process? Is there any time when you do not want to exercise and how do you solve it?
5. What other support and help do you need in the recovery process?
6. Have you encountered any difficulties or obstacles in your recovery? How did you resolve them?
7. What else do you need to add about home rehabilitation exercises?

**Table 1** General Information of Frail Elderly Patients Undergoing Lumbar Spine Surgery (n=14)

Number	Sex	Age	Educational Attainment	Previous Exercise	Discharged Time (Months)
P1	Female	66	Primary school	Never	5
P2	Female	71	Junior high school	Never	4
P3	Female	72	Junior high school	Never	5
P4	Female	71	Primary school	Never	4
P5	Male	66	High School	Non-recurrent	4
P6	Female	75	Primary school	Never	3
P7	Female	75	Junior high school	Non-recurrent	2
P8	Female	78	Bachelor's degree	Seldom	2
P9	Female	62	Primary school	Seldom	3
P10	Female	64	High School	Never	3
P11	Male	73	Junior high school	Non-recurrent	2
P12	Male	65	Primary school	Non-recurrent	2
P13	Female	69	Primary school	Non-recurrent	2
P14	Male	76	Junior high school	Never	1

## Data Collection Methods

A rich observation sample was selected for this study, based on the principle of qualitative research theme saturation,<sup>26</sup> which is defined as when no new themes or sub-themes emerge at the time of data analysis. It means that based on the current collected and analyzed data, further data collection will not help researchers gain a deeper understanding of the story or theory, so there is no need to continue collecting and analyzing data.<sup>27</sup> Face-to-face, semi-structured interviews were used to collect data. The formal interview was conducted in the outpatient office by the researcher after selecting the respondents according to the inclusion criteria and negotiating with them about the time and place, synthesizing the time of the patient's postoperative review; if the patient was unable to go to the site for review, the interview would be conducted through the telephone. At the beginning of the interview, a comfortable and favorable atmosphere was created through daily conversations, led by the interview outline, combined with exploratory questions and encouraging the interviewees to express their own views, and the order and content of the interview were adjusted according to the specific situation during the interview.

The interview process was based on listening attentively to the interviewees' viewpoints, and the interview content was recorded to record the interviewees' expressions, tone of voice, intonation and other information. Three patients were unable to attend the site and were interviewed by phone. The drawback of the phone interview is that it is impossible to observe and record the patients' body language and facial expressions. The data analysis process ensured as much objectivity in data interpretation as possible by writing a reflective memo. Within 24 hours after the interview, based on the memo, the interview content was transcribed, and the interviewers' thoughts and assumptions were captured, which helped to reduce the bias of the interviewers, and the voice content was converted into textual information word by word. The interview text was sent to the patients via WeChat for them to confirm if it accurately reflected their intentions. The interview time in this study was 24~44 minutes.

## Methods of Analyzing Information

Colaizzi's phenomenological method was used,<sup>28</sup> including (1) familiarization; (2) identification of meaningful statements; (3) construction of meaning; (4) clustering of themes; (5) detailed description; (6) generation of a basic structure; and (7) verification of the basic structure. Data collection and analysis were synchronized, and all interview data were imported into Nvivo 14.0 software, and the information was extracted by 2 researchers at the same time period.

## Quality Control Methods

The two researchers who conducted the interviews and analyzed the data all received training in qualitative research. To enhance the reliability and reflexivity of the research, this study adopted the method of member verification. The participants read and reviewed the extracted themes to ensure the accurate reproduction of the interview content. The research team included orthopedic doctors and nursing experts. During the coding and transcription process, they provided constructive suggestions and conducted critical analysis of the results through reflection meetings. The interview content and results were comprehensively recorded, and the researchers wrote reflection memos during the data collection and analysis process. Professional personnel conducted back-and-forth translations of the Chinese and English materials to ensure the accuracy of the language. All analysts completed basic theoretical methods and reflective interview skills training before data collection. Data were analyzed by the two researchers independently, and the coding process used manual coding combined with Nvivo 14.0 software coding; in case of disagreement, the team discussed further analysis and finally reached a consensus.

## Results

Through data analysis, a total of 102 initial codes were extracted and analyzed to identify 3 core themes and 9 sub-themes, including the promoting and hindering factors influencing rehabilitation exercise and patients' needs for rehabilitation exercise.

## Theme I: Barriers

### Poor Compliance with Rehabilitation Hinders Exercise

Most patients will engage in light physical activity after surgery, usually within their ability to do so without causing uncomfortable symptoms.

P3: Just moving around inside the neighborhood now, half an hour of exercise in the morning, half an hour in the afternoon... It's tolerable, nothing uncomfortable.

P13: Mainly more light activities like walking.

Some of the patients were predominantly on bed rest with less rehabilitation exercises.

P2: I stay in bed all the time and exercise less.

P10: I did not work out, I just walked around the house.

P12: Did not carry out rehabilitation, just stayed at home.

The small number of patients who specialize in lumbar spine rehabilitation exercises requires special attention from clinical staff.

P8: Every day I would bend over or move around in bed a little bit.

P12: Just general walking, no rehabilitation exercises were carried out.

Only a few patients would follow their physician's discharge instructions for lumbar spine functional exercises and reported that they could understand the rehabilitation program.

P9: Lay down on the bed, straighten your legs out, and push up at the waist a little bit, and you can push up about 10 times at a time.

P11: When I was discharged from the hospital the doctors all told me to do it when I had time, and I did it when I had time while I was in bed.

### Frail State of the Body Hinders Exercise

Patients suffer from somatic discomfort due to a multidimensional debilitating state of the body or residual postoperative symptoms that interfere with postoperative rehabilitation exercises.

The older the age, the more likely it is to complicate a frail state, leading to poorer physical functioning and hindering the patient's recovery.

P1: I am older, so my recovery is not as complete, and my health may be worse.

P4: I am old and I am not even physically fit now.

P8: I am not very fit either... I have been a little sick.

Elderly people are prone to a wide range of concomitant illnesses that lead to a frail physiological state.

P5: I fell on my knee three years ago and had an operation, and I cannot walk very well myself.

Most of the residual postoperative symptoms are early pain, leading to a low willingness to exercise.

P1: I have had lumbar spine problems for a long time, even now I can walk on my own, I still have the feeling of swelling and pain in my lower back.

P5: Now wearing a lumbar support made it a bit uncomfortable for me to walk and then I stayed in bed.

P10: My back hurt a little bit when I stood up, so I was too afraid to exercise.

Some patients experience back discomfort in rainy weather after surgery, which affects their recovery.

P13: When it's rainy, cloudy or when it gets to winter, I ache all over... Then I will lie in bed.

P9: If the weather is not so good, I cut back on my workouts.

### Negative Emotions Hinder Exercise

As a chronic disease, rehabilitation after lumbar spine surgery is also a long process. The elderly undergoing a multidimensional frail state is prone to a variety of negative emotions, hindering the patient's recovery process. This

study shows that the patient often appear inertia psychology as well as potential fear of exercise, resulting in a lack of rehabilitation initiative.

Inertia can lead to poor compliance with rehabilitation and reluctance to exercise despite knowing the importance of exercise.

P5: I did it for two days and then I do not want to do it anymore.

P9: I usually just walked since I am too lazy to exercise.

A small number of patients appear to be afraid to exercise after surgery, fearing that postoperative exercise will cause disease recurrence or serious consequences.

P6: I was worried that this (rehabilitation exercise) was not good for the body, because I had an operation.

P8: I was worried that walking or exercising too much would not be good for recovery.

P9: I was just worrying if the disease would come back in three months.

### Lack of Professional Guidance Hinders Exercise

Professional guidance from healthcare professionals was the main source of knowledge about rehabilitation for patients, many of whom expressed trust in their doctors.

P5: Listening to the ones the doctor told me was pretty much it.

P9: It was mostly up to what the doctors say... We do not know if what the internet says is right or not.

P11: Mr. Gu told me to exercise in this position.

However, some patients also reported that they did not receive guidance during their hospitalization and that there was a lack of professional guidance.

P4: No one told me what to do for exercise and the therapist did not get to me.

P8: I did not get specific instruction while I was hospitalized, and then I did not know how to exercise while at home.

## Theme II: Facilitating Factors

### Health Literacy Promotes Exercise

Health literacy refers to the experience related to information access, understanding status, receiving status, and information utilization and feedback in home rehabilitation, and higher health literacy can enhance their adherence to rehabilitation exercise and is the foundation of scientific exercise.

Some patients will voluntarily study the department's rehabilitation exercise manual, which can increase understanding of the rehabilitation program and reduce the risk of inappropriate exercise.

P8: There's a rehabilitation manual in the department ah, and then you just follow it.

P11: The doctor also gave me leaflets to look at.

Surrounding relatives are also an important source of correct rehabilitation information and can help patients screen and control credible sources of information to avoid missteps in the rehabilitation process.

P3: This (rehabilitation) is something my daughter will also look at in her textbooks.

P6: My family would also give me all kinds of advice to not bend over.

### Family Responsibility Promotes Exercise

Some of the elderly people have working roles in their families and would like to lighten the burden of their children by doing some household chores during their rehabilitation at home.

P7: The ones that have to do something in the house, I can help them with the cooking.

P9: Would also like to help the family with small things... Could do little things to help the family.

And participation in household chores or collective family affairs has also indirectly become low-intensity exercise.

P3: Now that I can walk, I go grocery shopping and move around a little bit every day.

P10:

Will go for a walk in the neighborhood, do some grocery shopping, and did not the doctor say I could get back to my normal life?

### Social Support Promotes Exercise

Patients' social support is also an important part of the postoperative rehabilitation outcome, and encouragement from family members can enhance patients' confidence and determination to recover.

P3: When I work out over there my partner is right there with me... And then I get motivated.

P7: My family will help me to see what I am doing, remind me how much I am bending, and then I will keep working out.

And, because the patient's activities were limited in the early postoperative period, the family was able to help the patient gradually transition to normal life.

P2: I cannot bend over now, my son washes my feet... It's been two months.

P11: Sometimes I go out for a walk and my daughter will hold me.

## Theme III: Latent Demands

### Diversified Information Support Needs

Given the potentially serious consequences of inappropriate postoperative rehabilitation, and despite the wider availability of Internet rehabilitation videos, many patients have raised the desire for specialized support from clinical staff.

P1: There are relevant (rehab exercises) on the internet, but we cannot believe everything, we still have to listen to the doctor, right?

P3: The doctor told me a lot when I was discharged from the hospital, and I felt pretty good about understanding. But I am just over a month out of surgery now, so I cannot be strenuously active yet, so I have to work out slowly.

Due to the inconvenience of traveling to the hospital, some patients would like to receive rehabilitation information from community hospitals.

P10: Worried about problems without doctor's guidance...

P12: I am not sure what I should do... Is it just to lie in bed and move your legs?

### Continuity of Care Needs

Due to the strain on healthcare resources, patients are unable to complete early rehabilitation in the hospital. If patients need further rehabilitation exercises, they may need to be seen in a rehabilitation hospital or a rehabilitation unit, which may not be possible for older people due to their restricted mobility.

P4: I practiced at home after I was discharged from the hospital... It's not very convenient to go to the hospital for rehabilitation.

P14: The recovery process is too much of a hassle... Not really wanting to exercise.

Therefore, some patients have raised expectations for online review and would like to receive remote rehabilitation guidance.

P7: If only I could communicate with my doctor on WeChat, I do not know how to exercise when I get home.

P10: Home is too far away... I did not get to review at one month, so now I am just walking.

## Discussion

### Strengthen the Management of Frailty and Pay Attention to the Physical and Mental State of Patients

The present study demonstrated diminished exercise adherence among a substantial proportion of participants exercise due to impaired physical capacity or adverse psychological states. This is consistent with the findings of Brintz's study,<sup>29</sup> which explains that postoperative chronic pain has a significant impact on patients' rehabilitation experience and daily

functions. This phenomenon may be mechanistically related to the high prevalence of the frailty syndrome in the geriatric surgical patients. Frailty, a pivotal geriatric concept defined by the American Geriatrics Society (2004) as

A clinical state characterized by reduced physiological reserves across the neuromuscular, metabolic, and immune systems secondary to aging, resulting in diminished resistance to stressors.

Demonstrates multidimensional etiology including biological factors such as advanced age<sup>30</sup> and surgical stress.<sup>31</sup> There is also a significant correlation with psychological factors such as depression and anxiety.<sup>32</sup>

Notably, epidemiological data reveal substantial variability in frailty prevalence contingent upon assessment methodology. For instance, a Canadian study showed that 19.6% of the elderly population undergoing surgery for simple lumbar degenerative disease were in a frail state,<sup>33</sup> while another study showed that the incidence of frailty was as high as 50.6% in elderly patients after lumbar spinal fusion.<sup>34</sup> In conclusion, these findings collectively underscore frailty is an important component of the Comprehensive Geriatric Assessment (CGA)<sup>35</sup> as both a prognostic indicator for spine surgery complications<sup>17</sup> and a predictor of orthopedic postoperative rehabilitation outcomes, particularly following hip fracture<sup>36</sup> and total knee arthroplasty.<sup>37</sup> Consequently, current clinical guidelines emphasize frailty evaluation as an essential component of the preoperative risk stratification.<sup>31</sup>

The conventional postoperative rehabilitation protocols for lumbar spine surgery demonstrate notable limitations in clinical application. For patients' physiological index testing and functional exercise, it fails to fully consider the multidimensional characteristics of elderly patients with concurrent frail syndromes, which may be an important mechanism leading to the failure of some patients' rehabilitation effects to meet expectations. Based on this finding, we propose constructing a precise rehabilitation framework stratified by frailty severity.

First, systematic frailty assessment should be implemented using validated instruments such as Fried Phenotype or Modified Frail Index. For pre-frail or frail individuals, a multidimensional management is recommended, including personalized nutritional support based on NRS-2002, progressive resistance rehabilitation exercise training, and integrated cognitive-behavioral therapy incorporating psychological rehabilitation and cognitive function screening and training. Physical activities and exercises are the most effective ways to improve the quality of life and organic function in older adults<sup>38</sup> and structured exercise interventions can significantly improve somatic function and frail states.

In addition, the prevalence of kinesiophobia after lumbar spine surgery is associated with postoperative disability or constant pain.<sup>39,40</sup> Cognitive-behavior therapy is an effective method to alleviate kinesiophobia, which can reduce the psychological pressure of patients.<sup>41</sup> In addition, graded exposure to exercise is able to enable patients to reduce perceived threat, thereby reducing kinesiophobia. It has also been demonstrated that postoperative kinesiophobia is associated with preoperative sedentary behavior,<sup>42</sup> and a preoperative screening of patients' exercise behavior is suggested to identify the high-risk group for the occurrence of exercise fear and to intervene in a timely manner. Medical staff can inform patients of disease knowledge, surgical methods, and precautions before and after the operation to improve their cognitive ability regarding the disease, thereby improving their negative emotions.

## Optimize Knowledge and Education Pathways and Explore Efficient Rehabilitation Processes

Studies have shown that there is a positive correlation between patient's health literacy levels and rehabilitation exercise adherence.<sup>43</sup> However, current orthopedic postoperative education exhibit three critical limitations. First, there is a single form to transfer knowledge, based on the doctor's verbal instruction and distribution of pamphlets. Second, knowledge transfer efficiency may be compromised by variations in patients' educational backgrounds,<sup>44</sup> particularly affecting geriatric populations who demonstrate reduced comprehension of rehabilitation protocols. In addition, age-related cognition decline frequently leads to impaired memory of rehabilitation exercise movements and precautions after discharge, ultimately failing to meet the patients' rehabilitation needs. A study conducted a qualitative analysis of the rehabilitation experiences of patients after lumbar disc removal surgery.<sup>45</sup> The study found that there were differences in the post-operative rehabilitation needs between patients and physiotherapists, which indicated that better coordination of

communication between patients and medical staff was needed during the rehabilitation process to meet the individualized rehabilitation needs of patients.

To address these challenges, we propose a hierarchical health education system incorporating three strategies. First, while big data technologies can improve patients' postoperative outcomes by expanding digital education channels and multi-channel publicity for patients,<sup>46</sup> current digital tools demonstrate significant quality deficiencies in educational content,<sup>47</sup> which requires the government to collaborate with healthcare institutions to establish standardized quality control protocols to provide qualified education for the elderly. In addition, implementation of simplified instructional materials featuring large-print formats could enhance knowledge retention in elderly patients. Moreover, integration of intelligent reminder systems with structured telephone follow-ups may sustain patient engagement in postoperative rehabilitation.

This study shows that the lack of follow-up accessibility is also one of the important reasons for the interruption of patients' rehabilitation exercise. Given the longitudinal nature of orthopedic rehabilitation, we advocate for the "Internet + Nursing Service" for the convalescent patients. The model has demonstrated efficacy in chronic disease management through improved compliance with health behaviors and self-management capacity.<sup>48,49</sup> Remote rehabilitation also demonstrates certain effectiveness in post-operative rehabilitation after joint replacement, including main mediums such as mobile applications and video conferences,<sup>50</sup> which is also safe and effective for post-lumbar spine surgeries.<sup>51</sup> The "Internet + Nursing Service" emerges as a promising model to enhance elderly healthcare, whose key obstacles include limited digital literacy, high costs, and inadequate tech infrastructure, significantly impeding feasibility and acceptance among older and frail patients.<sup>52</sup> A Chinese cross-sectional study reported only 17.14% of adults aged  $\geq 50$  use internet-based healthcare, with cost, distrust, and poor access as major deterrents.<sup>53</sup> Consistent findings from Italian research highlight low digital literacy and tool complexity as barriers to telenursing adoption.<sup>54</sup> Therefore, measures specific to the characteristics of the elderly should be formulated to enhance the utilization rate of remote rehabilitation measures.

Therefore, hospital-community-family integrated management should be established, which incorporates assessment of patients' characteristics, recognition of demands and allocation of resources. By recording the patients' human characteristic labels and current rehabilitation state, community physicians can make an identification of their primary rehabilitation needs. Also, we can strengthen the community practitioners' diagnostic and rehabilitative capabilities based on the patients' demands. Besides, evidence-based allocation of rehabilitation assets can minimize resource redundancy. This model can promote the realization of full-cycle management of patients, which is conducive to the improvement of patients' rehabilitation effects.

## Increase Patient Social Participation and Broaden External Support Pathways

Empirical evidence confirms that social support can enhance health outcomes through improved stress coping mechanisms and quality of life optimization.<sup>55</sup> In Asian populations, where family-central cultural paradigms predominate, family support systems serve as critical determinants of health behavior modification.<sup>56</sup> Previous studies have shown that social support is significantly associated with recovery outcomes in orthopedic surgery patients,<sup>57</sup> with particular emphasis on emotional and instrumental support requirements during home rehabilitation phases.<sup>56</sup> Nevertheless, previous studies have shown that more than 75% of older adults' social support needs are currently unmet.<sup>58</sup> Our findings demonstrate a bidirectional interaction between social support and rehabilitation behaviors. Specifically, offspring's instrumental support significantly enhances patients' adherence to rehabilitation exercises. Furthermore, patients' perceived value of family involvement can mediate self-efficacy development, which subsequently facilitates recognition of rehabilitation necessity.

We propose an integrated intervention strategy comprising the following parts: restructuring family role, reinforcing social support and optimizing transitional care. First, it is recommended to help the elderly take the initiative to adapt to the family role and share family responsibilities within the ability. Besides, the patient's social support system should be mobilized to increase the sense of trust and belonging. It is conducive to obtaining more emotional and informational support to assess the adaptability of the external environment dynamically and encourage the patient to take the initiative to participate in social activities, thereby reducing the psychological burden, and helping the patient to improve the

rehabilitation exercise adherence. In addition, it is necessary to identify the patient's need for social support, and include primary caregivers into the standardized discharge education modules to help the patient's smooth transition from the hospital.<sup>59</sup>

## Limitations

This study has some limitations in its design and implementation, which may have an impact on the generalizability and interpretability of the research results.

Firstly, the sample size of this study was 14 patients, and all participants were from a single tertiary hospital in a certain city in China. This single-center research design may limit the general applicability of the research results. We excluded patients who did not exercise at home in order to focus on the specific barriers and facilitators in home rehabilitation for postoperative patients. However, we acknowledge that this exclusion criterion could potentially introduce selection bias. Patients who do not exercise may have unique barriers or different perspectives that are not captured in our sample. For example, they might face more severe physical limitations, lack of motivation, or inadequate home support, which could be important factors to consider in a comprehensive understanding of post-lumbar surgery rehabilitation. Therefore, the findings of this study may not be fully representative of all postoperative patients, especially those who are unable or unwilling to engage in home exercises. Future research should aim to include a broader range of patients, to gain a more comprehensive understanding of the barriers and facilitators in rehabilitation. This would help to develop more inclusive and effective rehabilitation strategies for all patients.

In addition, the sample was predominantly female and had a relatively low educational level, which may restrict the generalizability of the research results to other populations. Future studies can consider increasing the sample size and recruiting participants from multiple regions or hospitals to enhance the representativeness and generalizability of the research results.

Secondly, this study adopted a qualitative research method, which allowed for an in-depth exploration of the experiences and influencing factors of family rehabilitation after lumbar spine surgery in elderly patients. However, it lacked quantitative data support, making it impossible to conduct statistical inferences on the research results. Future studies can consider using a mixed-methods approach, combining quantitative data to support the qualitative research results, thereby enhancing the persuasiveness of the study.

Thirdly, some interviews in this study were conducted over the phone, which may have affected the depth and richness of the data. Compared to face-to-face interviews, phone interviews may not capture non-verbal information, thereby affecting the comprehensive understanding of the patients' experiences. When conditions permit, future studies should try to use face-to-face interviews to obtain more comprehensive and in-depth data.

Finally, this study mainly explored the factors influencing rehabilitation but did not propose specific intervention measures or recommendations, which limits the direct application value of the research results in clinical practice. Future studies can propose specific intervention measures or recommendations based on the research results to promote the effectiveness of family rehabilitation after lumbar spine surgery in elderly patients, thereby enhancing the practical value of the study.

## Conclusion

This study used the descriptive phenomenological research method to restore the home rehabilitation experience of elderly frail patients with lumbar spine surgery, and deeply excavated the factors promoting and hindering the exercise, and identify the unmet potential needs that remain to be addressed. In this study, the home rehabilitation experience of frail patients was rich and saturated, describing the main physical obstacles, psychological problems, and a richer understanding of the needs during the rehabilitation process. Given that frailty has a predictive effect on postoperative complications and rehabilitation outcomes, clinical personnel and rehabilitation professionals should increase their attention to frailty assessment and form a multidisciplinary team to address frailty issues.

There is a question that this study is only a preliminary suggestion in terms of addressing countermeasures and has not developed a more feasible intervention approach. Future research could consider developing and validating home rehabilitation exercise programs for the frail population, with support from remote rehabilitation digital tools. In addition,

it is possible to explore implementation models that are suitable for Chinese communities and integrate the plan effectively into the existing community health service system.

## Ethics Approval and Informed Consent

The study was approved by the Ethics Committee of Tongren Hospital, Shanghai Jiaotong University School of Medicine (Ethic Approval Form 2025-008-01). All participants signed an informed consent form. The principles of voluntariness and confidentiality were strictly adhered to, and the study participants could terminate the interviews at any time during the interview process; the interview data were in the form of anonymous numbering to protect the privacy of the patients, and the researcher kept the interview information and basic personal information appropriately. Participants consented to the anonymous information including “publication of anonymized responses/direct quotes” being used for publication.

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## Author Contributions

All authors made a significant contributions to the work, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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## Disclosure

The authors report no conflicts of interest in this work.

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