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Research Progress on the Feasibility and Effectiveness of Home-Based Exercise Rehabilitation in the Management of Chronic Obstructive Pulmonary Disease (COPD)

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Abstract: Chronic obstructive pulmonary disease (COPD) is a common chronic respiratory disease that severely affects patients' quality of life. Current clinical treatments primarily rely on medication, with limited rehabilitation options and uncertain efficacy. Home-based exercise rehabilitation, as a non-pharmacological therapy, can promote the improvement of respiratory muscle function and cardiopulmonary endurance, exerting a positive preventive effect on COPD. However, due to factors such as the home environment and lack of health knowledge, COPD patients face numerous difficulties in accepting home-based exercise rehabilitation. This article reviews domestic and international research on the feasibility and effectiveness of home-based exercise rehabilitation for COPD, aiming to provide references for medical workers to better implement home-based exercise rehabilitation for COPD, assist patients in performing rehabilitation exercises at home, improve their quality of life, reduce hospitalization rates, and lower medical costs.

Keywords: Home-based exercise rehabilitation; Chronic obstructive pulmonary disease; Feasibility; Effectiveness

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1. Introduction

Home-based exercise rehabilitation is a treatment method that encourages patients to enhance their physical function and improve their health status within the home environment [1]. Specifically, it refers to completing exercises at home that help improve physical activity and quality of life, including activities of daily living (ADL), housework, gardening, and more. In 1976, the World Health Organization introduced the concept of home-based exercise rehabilitation, emphasizing its important role in improving patients' quality of life. Currently, home-based exercise rehabilitation has been widely used in the management of various chronic diseases, particularly cardiovascular diseases, cancers, chronic pain, endocrine and metabolic diseases, and Alzheimer's disease [2]. In the United States, home-based exercise rehabilitation has become a standard clinical practice model [3]. However,

in China, due to the uneven distribution of medical resources and high demand for community medical services, home-based exercise rehabilitation has not received adequate attention. In recent years, with the increasing awareness of health among the population, the concept of home-based rehabilitation has gradually gained popularity. Since the 1990s, researchers have begun to focus on combining exercise rehabilitation with home-based rehabilitation, providing new ideas for addressing issues such as the lack of professional guidance for the elderly and their reluctance to seek medical attention.

2. Concept and feasibility of home-based exercise rehabilitation

2.1. Feasibility analysis

The greatest advantage of home-based exercise rehabilitation lies in its convenience for patients, which can meet their demand for a high-quality life [4]. Simultaneously, it also helps alleviate the pressure on healthcare professionals and social institutions in terms of medical resource allocation [5]. As chronic disease patients often require long-term treatment, they need continuous health management support in their daily work, study, and life. However, there is currently a lack of relevant services for home-based exercise rehabilitation targeted at chronic disease patients in China, which is one of the reasons driving the development of home-based rehabilitation.

Although studies have shown that pure home-based training cannot achieve ideal results, compared with traditional hospital rehabilitation, home-based exercise rehabilitation has many advantages [6]. Firstly, patients can develop personalized exercise programs based on their physical conditions, thereby improving exercise efficiency [7]. Secondly, patients can flexibly arrange exercises at home, reducing the time cost of traveling to hospitals or participating in group activities [8]. In addition, home-based exercise rehabilitation can also reduce patients' transportation costs and time spent commuting to and from hospitals.

According to reports, compared with conventional outpatient treatment, home-based exercise rehabilitation can save patients 50% to 80% of costs per year [9]. At the same time, home-based exercise rehabilitation can help patients maintain good health, avoid unnecessary outings, and reduce the risk of infection [10].

In summary, home-based exercise rehabilitation not only meets the needs of patients but also plays a positive role in reducing the pressure on medical resources and improving patients' quality of life. Therefore, incorporating home-based exercise rehabilitation into chronic disease management is a feasible and worthwhile direction to explore.

2.2. Differences between home-based exercise rehabilitation and traditional rehabilitation methods

Traditional rehabilitation methods are typically conducted under the guidance of professionals, requiring patients to visit hospitals for treatment or rehabilitation training. This approach not only increases patients' medical costs but also often fails to achieve ideal rehabilitation effects due to a lack of targeted and personalized design. In contrast, home-based exercise rehabilitation emphasizes that patients complete exercise programs at home, enabling them to adjust the intensity and content of exercises according to their needs and preferences and participate with family members. Furthermore, the implementation of home-based exercise rehabilitation is more convenient and not restricted by time and location, allowing patients to exercise at any time. On the other hand, traditional rehabilitation is limited to hospitals, rehabilitation centers, and other facilities, requiring patients to make appointments, arrange travel, and potentially encounter traffic congestion. Therefore, the main differences

between home-based exercise rehabilitation and traditional methods lie in: higher autonomy for patients, flexible adjustment of exercise plans based on individual needs and physical conditions; no additional costs, while reducing the pressure on the healthcare system; easier monitoring of patients' health status, timely detection of abnormalities, and corresponding measures; and the provision of more health education and support to help patients understand disease-related knowledge and improve self-management abilities.

3. The therapeutic effects of home-based exercise rehabilitation on COPD

Research both domestically and internationally has confirmed that home-based exercise rehabilitation can improve patients' respiratory muscle function, respiratory function, and pulmonary ventilation, enhance the body's immunity and resistance, effectively reduce the acute exacerbation rate of COPD, and prevent COPD complications [11, 12]. Some scholars have proposed that exercise can improve the symptoms of COPD through the following mechanisms [13]:

(1) Increasing oxygen intake and diffusion in the lungs.

(2) Promoting gas exchange and increasing carbon dioxide excretion

(3) Strengthening the glycoprotein receptor expression on bronchial smooth muscle cell membranes and inhibiting inflammatory responses;

(4) Activating glycoprotein receptors, increasing interleukin-10 (IL-10) and transforming growth factor-β1 (TGF-β1) levels, and reducing the production of proinflammatory mediators,

(5) Stimulating ciliary movement in the airways, promoting mucus clearance, and diluting sputum, thereby reducing sputum blockage.

Additionally, some scholars believe that exercise can enhance the activity of the thoracic cage and diaphragm, increase lung capacity, improve lung volume, increase pulmonary vascular tension, improve blood circulation, increase tissue oxygenation, reduce pulmonary congestion, alleviate hypoxic states, and improve ventilation and gas exchange functions [14].

3.1. Improving respiratory muscle function

Respiratory muscle function is an important factor affecting the quality of daily life for COPD patients, and its decline can lead to symptoms such as respiratory muscle fatigue and dyspnea. Research has found that systematic and standardized rehabilitation training can significantly improve patients' exercise capacity and physical fitness, enhance cardiopulmonary function during aerobic endurance exercise, and reduce oxygen consumption [15].

Zeng *et al.* conducted a randomized controlled trial to evaluate the efficacy of home-based exercise rehabilitation intervention on 40 COPD patients. The results showed that compared to the control group, the exercise rehabilitation group had significant improvements in maximal oxygen uptake (VO2max) and subjective physical activity capacity scores, with no significant adverse reactions. This indicates that home-based exercise rehabilitation can effectively improve respiratory muscle function and increase exercise endurance [16]. Therefore, home-based rehabilitation exercise can improve the exercise capacity and respiratory function of COPD patients, thereby enhancing their quality of life.

3.2. Promoting lung function recovery

Home-based exercise rehabilitation not only improves patients' respiratory muscle function but also promotes

the recovery of lung function. A study on healthy individuals found that exercise had no effect on lung capacity but could improve indicators such as forced expiratory volume in one second (FEV1), FEV1 as a percentage of predicted value (FEV1/PEF), forced expiratory volume during the first second of expiration (VFEV1), forced vital capacity (FVC), and FEV1/FVC ratio at rest and after activity [17]. Similar effects can be achieved through exercise intervention in COPD patients [18].

Tang randomly divided 90 COPD patients into an exercise training group and a control group. The exercise group performed walking rehabilitation exercises twice a day, while the control group only received routine care for 8 weeks. The results showed that compared to the control group, the lung capacity of the exercise training group was significantly higher, and the difference was statistically significant [19]. There is considerable evidence supporting such research, such as another randomized controlled trial involving 112 patients, which demonstrated that aerobic exercise therapy could significantly improve participants' FEV1/FVC ratio and FEV1%pred, alleviating dyspnea symptoms [20]. Additionally, home-based exercise rehabilitation for COPD can complement treatments such as inhaled bronchodilators and inhaled corticosteroids, thereby reducing the frequency and severity of acute exacerbations [21, 22].

Based on the above, domestic and foreign studies have shown that home-based exercise rehabilitation can improve exercise endurance, lung capacity, and quality of life for patients with COPD. However, there is currently limited research on home-based exercise rehabilitation for COPD in China, and there is a lack of unified and standardized criteria. Some studies divide COPD rehabilitation into three stages [23]: initial assessment, education and training, and intervention implementation. However, existing home-based rehabilitation programs lack a comprehensive assessment process for patients and do not clarify the training content, time, and frequency for different stages [24]. Additionally, some studies have found that elderly COPD patients still experience symptoms such as limited mobility and cough after undergoing home-based exercise rehabilitation [25, 26]. Therefore, it is necessary to strengthen health education for patients undergoing home-based rehabilitation, provide detailed home care guidance including a balanced diet, smoking cessation, and moderate exercise, and design individualized exercise rehabilitation programs based on patient characteristics to improve patient compliance and self-management skills, thereby promoting better participation in rehabilitation exercises.

4. Conclusion

In summary, although home-based exercise rehabilitation has a certain preventive and therapeutic effect on COPD patients, its clinical application is still limited due to factors such as small research sample size, incomplete methodological approaches, and single intervention measures. Therefore, relevant research should be continued to enrich the intervention methods of home-based exercise rehabilitation, optimize the specific implementation plan of home-based exercise rehabilitation, make it more suitable for China's national conditions, and provide scientific, safe, and effective home-based exercise rehabilitation services for patients, thereby improving their quality of life, enhancing living standards, reducing hospitalization risks, and lowering medical costs.

Disclosure statement

The author declares no conflict of interest.

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