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Physiotherapy Interventions in Diseases Idiopathic Pulmonary Fibrosis: Literature Review

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ABSTRACT

Introduction: Idiopathic Pulmonary Fibrosis (IPF) is a chronic lung disease that causes lung tissue to stiffen and progressively decreases respiratory function. Patients often experience shortness of breath, fatigue, and decreased capacity for daily activities, which impacts their quality of life. While there is no cure for IPF, physiotherapy plays an important role in helping to manage symptoms and maintain lung function. Various interventions such as physical exercise, breathing techniques and pulmonary rehabilitation have been shown to improve patients' condition. Therefore, this study is needed to understand the effectiveness of physiotherapy interventions in supporting more optimal management of IPF. To assess the effectiveness of physiotherapy interventions such as physical exercise and breathing techniques in improving lung function and quality of life of IPF patients. **Methods:** Literature review was conducted by searching articles through Google Scholar, PEDro, PubMed, and Scopus databases using keywords related to IPF and physiotherapy interventions. Selection was done using inclusion-exclusion criteria with the help of PRISMA diagram. **Results:** Interventions such as aerobic exercise, strength training, breathing techniques (including *pursed-lip breathing* and diaphragmatic breathing), and pulmonary rehabilitation were shown to be effective in increasing functional capacity, reducing dyspnea, and improving the quality of life of IPF patients. **Conclusion:** Physiotherapy interventions effectively improve functional capacity, reduce symptoms, and enhance quality of life in idiopathic pulmonary fibrosis patients.

***Keywords**: Idiopathic Pulmonary Fibrosis, Physiotherapy, Pulmonary Rehabilitation*.

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INTRODUCTION

Idiopathic Pulmonary Fibrosis (IPF) is a chronic interstitial lung disease characterized by progressive fibrosis of the lung tissue, leading to irreversible decline in lung function. It is difficult to determine the disease spread pattern of IPF due to several reasons, one of which is that cases often go undiagnosed until the advanced stage. In addition, IPF cases are rare, making it difficult to analyze the distribution of the disease by time and region (Sauleda *et al.*, 2018) . Although Idiopathic Pulmonary Fibrosis (IPF) is categorized as a rare disease - with an incidence of less than 5 cases per 10,000 people per year - the impact of the disease remains significant. In the European region, there are an estimated 40,000 new cases of IPF diagnosed each year (Navaratnam *et al.*, 2011) . The main symptoms of IPF include exertional dyspnea, dry cough, and decreased exercise capacity, which significantly reduce the patient's quality of life. Although the exact cause of IPF is unknown, the disease commonly occurs in individuals over the age of 50 and more frequently in men (Nicholson *et al.* ., 2025)

Current treatments for IPF focus on slowing down disease progression and managing symptoms. In this context, physiotherapy, particularly through pulmonary rehabilitation programs, plays an important role. Interventions such as aerobic exercise and breathing exercises have been shown to increase exercise capacity,

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reduce dyspnea, and improve the quality of life of patients with IPF. A systematic review showed that chest physiotherapy can improve ventilation capacity, gas exchange, and exercise capacity in patients with IPF (Martín-Núñez et al. , 2023)

In addition, whole-body exercise-based pulmonary rehabilitation programs have shown improvements in exercise capacity and quality of life in IPF patients. However, the effectiveness of pulmonary rehabilitation in IPF is still the subject of further research. Several systematic reviews show variations in the quality and outcomes of studies regarding the role of pulmonary rehabilitation in IPF (Zamparelli *et al.*, 2024) .

Nonetheless, existing evidence supports that pulmonary rehabilitation can provide significant benefits to IPF patients. A well-designed rehabilitation program can help improve functional capacity, reduce symptoms, and improve overall quality of life. Therefore, a deeper understanding of effective physiotherapy interventions is needed to optimize the management of patients with IPF.

METHODS

This research was conducted by the author using the literature review method. There were ten articles that were appropriate to the case raised. Evidence was searched in various databases that can be accessed online through *Google Scholar*, *Pedro*, *PubMed*, and *Scopus* databases. The data processing process used PRISMA flow diagram with inclusion and exclusion criteria. Inclusion criteria include articles in full text, *cohort* research design, *randomized controlled trial*, *quasi-experimental*, *and cross sectional*, with the year published in the last 5 years with Scimago indexed Q1-Q3. Exclusion criteria in this study, articles are not full text, research designs that do not meet the inclusion and exclusion criteria, and the year of publication exceeds the last 5 years

RESULTS

Based on previous research through several journals used from the last 5 years, it is explained that there are several physiotherapy interventions that are effective in treating idiopathic pulmonary fibrosis conditions, as follows:

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Table 1. Literature review

Title	Methods	Results
New pulmonary rehabilitation exercise for pulmonary fibrosis to improve the pulmonary function and quality of life of patients with idiopathic pulmonary fibrosis: a randomized control trial (Shen *et al.*, 2021)	**Research Methods** Randomized Controlled Trial **Sample Quantity** There were 82 subjects who were randomized into two groups, group and control. **Variables** Independent: Simple Breathing Exercise Dependents: - Lung function is measured using Vibration Response Imaging (V R I). - Quality of Life measured using St. George's Respiratory Questionnaire **Intervention** Exercise dosage: - Frequency: 3x a day - Duration: 4-6 minutes per session - Rest: 1 minute after 1 set **Implementation Method** The intervention given is breathing exercise which consists of 3 kinds of movements, namely: Deep breath of the whole lung Objective: Improve overall lung capacity. How to do: - Stand straight with feet shoulder-width apart. - Place both hands next to your thighs. - Raise both arms to the sides slowly while taking a deep breath until the hands meet above the head. - Slowly lower both arms while exhaling deeply. - Repeat this movement 4-6 times a minute. Deep breath of unilateral lower lung	**Results** - Lung Function FVC and FEV1 values were significantly increased in the exercise group compared to the control group ($p = 0.001$ and $p = 0.017$, respectively). Diffusing Capacity of the Lungs for Carbon Monoxide (DLCO) was significantly increased in the exercise group ($p < 0.001$), indicating improved oxygen exchange efficiency in the lungs. - Physical Capacity (6MWT) Patients in the exercise group walked farther after the exercise compared to the control group ($p = 0.041$), indicating improved physical capacity and endurance. Quality of Life Patients in the exercise group reported a significant improvement in quality of life compared to the control group ($p = 0.003$). - Risk of Exacerbation and Mortality Patients in the exercise group had fewer exacerbations compared to the control group. Only 7.69% of patients in the exercise group had an exacerbation within one year, compared to 20.9% in the control group. Moreover, the one-year mortality rate was lower in the exercise group (2.56%) than in the non-exercise control group. The mortality rate in the exercise group was lower, although the statistical p value = 0.090 indicated that this result was not significant. - Exercise Safety In terms of safety, the exercise has been shown not to cause any serious side effects. Electrocardiogram (ECG) examinations showed that the exercise had no

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Title	Methods	Results
	Objective: Maximize ventilation of the lower lung. How to do: - Stand straight with feet shoulder-width apart. - Place both hands next to your thighs. - Raise the right hand slowly, while bending the body to the left by about 30-60° while taking a deep breath. - Return to an upright position, then lower your right hand while exhaling. - Repeat this movement with your left hand and bend your body to the right. - Do each side 4-6 times a minute Deep breath of the upper lung Objective: Focusing ventilation to the upper lung to improve oxygen exchange. How to do: - Stand straight with feet shoulder-width apart. - Place both hands behind the neck in a crossed position. - Bow your head and neck forward, while exhaling deeply. - Take a deep breath while raising your head and moving your arms back slowly. - Repeat this movement 4-6 times a minute.	negative impact on heart function, and blood oxygen levels (SpO2) remained stable throughout the exercise. **Conclusion** Overall, the results of this study prove that LHP's RRPF breathing exercise is an effective, simple and safe pulmonary rehabilitation method for Idiopathic Pulmonary Fibrosis (IPF) patients. It improves lung function, physical endurance, and quality of life, while helping to reduce the risk of exacerbations and mortality, although the difference in mortality is not significant. It is therefore recommended as an adjunctive therapy in pulmonary rehabilitation for IPF patients to support more optimal management of their disease. **Mechanism** The physiological mechanisms include opening of collapsed alveoli, reduction of airway resistance, and increased lung expansion through deep breathing and segmental breathing techniques. It also improves lung perfusion, as evidenced by an increase in Diffusing Capacity of the Lungs for Carbon Monoxide (DLCO). In addition, it optimizes respiratory muscle coordination, reduces accessory muscle work, and helps patients control breathing patterns, thereby reducing breathlessness and improving quality of life.
The Efficacy of Pulmonary Rehabilitation in Patients with Idiopathic Pulmonary Fibrosis (Choi *et al.* ., 2023)	Research **Methods** Randomized Control Trial **Sample Quantity** There were a total of 25 patients in this study consisting of: 13 patients in the pulmonary rehabilitation group (PR Group) and 12 patients in the non-pulmonary rehabilitation group (Non-PR Group).	**Results** - Exercise Capacity 6MWD significantly increased in the PR group (p=0.002), while the non-PR group experienced a slight decrease. VO_2max increased significantly in the PR group (p=0.013), indicating an improvement in the patients' aerobic capacity.

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Title	Methods	Results
	Variables Independent variable - PR group: Underwent an 8-week pulmonary rehabilitation program. - Non-PR group: Did not undergo a pulmonary rehabilitation program and only received standard medical care. Dependent Variable - Exercise capacity: 6-Minute Walk Distance (6MWD): Measures the distance a patient can walk in 6 minutes. VO_2max (maximum oxygen consumption): Measures the patient's aerobic capacity. VE/VCO_2 slope → Assess lung ventilation efficiency. - Pulmonary function: Forced Vital Capacity (FVC) → Measures the vital capacity of the lungs. Forced Expiratory Volume in 1 Second (FEV1) → Measures the forced expiratory volume in one second. Diffusing Capacity of the Lungs for Carbon Monoxide (DLCO) → Measures gas exchange efficiency. Quality of life: Saint George's Respiratory Questionnaire (SGRQ) → Measures the impact of lung disease on patients' quality of life. **Intervention** Each pulmonary rehabilitation session consists of: - Breathing Exercise and Chest Expansion (10 minutes) - Aerobic Exercise (47 minutes)	VE/VCO_2 slope decreased, but was not significantly different between PR and non-PR groups (p = 0.067). - Lung Function There were no significant changes in FVC, FEV1, or DLCO in either group (p > 0.05). This suggests that pulmonary rehabilitation does not directly improve lung function within eight weeks. - Quality of Life There was no significant change in patients' quality of life in either the PR group or the non-PR group (p > 0.05). This suggests that despite increased exercise capacity, patients did not experience any noticeable improvement in daily life. - Safety and Side Effects No serious side effects were reported in the PR group. There were no cardiovascular or musculoskeletal disorders associated with the PR program. Patients in the PR group were able to complete the exercise without complications. **Conclusion** Eight weeks of pulmonary rehabilitation can improve the exercise capacity of patients with Idiopathic Pulmonary Fibrosis (IPF), as evidenced by significant improvements in 6-Minute Walk Distance (6MWD) and VO_2max. However, pulmonary rehabilitation did not result in significant changes in pulmonary function or quality of life, as measured by FVC, FEV1, DLCO, and SGRQ scores. The program was also shown to be safe, with no serious side effects during its implementation. Nonetheless, as there was no significant improvement in pulmonary function or quality of life, further studies with a longer duration of rehabilitation and a larger sample size are

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Title	Methods	Results
	Exercises were performed using the interval training method using a treadmill. - Muscle Endurance Training (10 minutes): Upper and lower extremity muscle strengthening exercises after aerobic exercise. Patients are given resistance exercises that can be repeated at home. PR (Pulmonary Rehabilitation) Group: Followed the pulmonary rehabilitation program for 8 weeks (3 sessions per week). Exercise was adjusted based on the results of the cardiopulmonary exercise test (CPET). Non-PR Group: Only received one initial training session, and then were given recommendations to exercise independently. Patients in this group still underwent evaluation before and after 8 weeks, but did not receive supervision during exercise.	needed to evaluate the long-term benefits of pulmonary rehabilitation in patients with IPF. **Mechanism:** Pulmonary rehabilitation improves the exercise capacity of patients with IPF through cardiopulmonary adaptation, improved ventilation efficiency, as well as respiratory muscle strengthening. In addition, the anti-inflammatory and anti-fibrotic mechanisms associated with aerobic exercise may help slow the progression of pulmonary fibrosis. Although there is no significant change in lung function, pulmonary rehabilitation still provides physiological benefits that support patient well-being and quality of life.
Short-Term Effects of Comprehensive Pulmonary Rehabilitation and its Maintenance in Patients with Idiopathic Pulmonary Fibrosis: A Randomized Controlled Trial (Jarosch *et al.* ., 2020)	**Methods** Randomized Controlled Trial **Variables** Independent Variable PR group: Underwent a 3-week comprehensive pulmonary rehabilitation program on an inpatient basis. Usual Care (UC) group: Did not receive the PR intervention and only received standard medical care. Dependent Variable - Exercise Capacity: 6-Minute Walk Distance (6MWD) → Assess the distance a patient can walk in 6 minutes.	**Results** The results showed that the pulmonary rehabilitation group (PR Group) had a significant improvement in exercise capacity compared to the Usual Care group (UC Group). 6MWD increased significantly in the PR group ($p=0.006$), while the increase in the control group was not significant. VO_2max increased significantly, indicating an increase in aerobic capacity of patients after participating in the rehabilitation program - Lung Function Despite improved exercise capacity, the patients' pulmonary function did not significantly change after three weeks of PR. There were no significant

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Title	Methods	Results
	VO_2max (maximum oxygen consumption) → Assess the patient's aerobic capacity. VE/VCO_2 slope → Assessing ventilatory efficiency and metabolic response to exercise - Lung Function: Forced Vital Capacity (FVC, % predicted) → Measures lung vital capacity. Diffusing Capacity of the Lungs for Carbon Monoxide (DLCO, % predicted) → Assess the efficiency of gas exchange in the lungs - Quality of Life: Chronic Respiratory Disease Questionnaire (CRQ) → Assess the impact of lung disease on patients' quality of life. Hospital Anxiety and Depression Scale (HADS) → Assess patients' level of anxiety and depression. Short-Form 36 Health Survey (SF-36) → Measures the physical and mental well-being of patients **Intervention** - Aerobic Training (Endurance Training) It is performed on a stationary bike (cycle training). Exercise intensity is determined based on 60% to 100% of the patient's maximal work capacity, which is calculated through an initial cardiopulmonary exercise test (CPET - Cardiopulmonary Exercise Testing). The duration of exercise is gradual, starting at 15 minutes per session and increasing to 30 minutes if the patient can tolerate it. - Resistance Training Exercises involve both upper and lower extremities, using resistance machines or body	differences in FVC and DLCO after pulmonary rehabilitation, suggesting that PR has no direct impact on lung function. - Quality of Life Patients in the PR group experienced significant improvements in quality of life, especially in the CRQ and HADS, suggesting that pulmonary rehabilitation helps reduce patients' anxiety and depression. - Safety and Side Effects No serious side effects were reported during pulmonary rehabilitation. Patients in the PR group were able to complete the exercise without complications. Oxygen saturation was monitored and remained within safe limits throughout the PR program **Conclusion** This study showed that three weeks of pulmonary rehabilitation significantly improved the exercise capacity and quality of life of patients with IPF, but did not provide significant changes in pulmonary function. As improved exercise capacity has a potential impact on long-term survival, further studies with longer PR duration and larger sample size are needed to evaluate the benefits of pulmonary rehabilitation in IPF patients. **Mechanism** Pulmonary rehabilitation in Idiopathic Pulmonary Fibrosis (IPF) patients works by improving aerobic capacity, ventilation efficiency and respiratory muscle strength, although it does not directly improve lung function. Aerobic exercise increases VO_2max, reflecting improved oxygen transport in the body, while a decrease in VE/VCO_2 slope indicates better ventilation efficiency. Muscular resistance training helps reduce reliance on respiratory accessory muscles,

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Title	Methods	Results
	weight. Performed in 3 sets per exercise, aiming for 15-20 reps per set. Exercise load is adjusted gradually to increase endurance without causing excessive fatigue. - Respiratory Therapy and Patient Education Subjects were given breathing exercises as well as education on disease and activity management, strategies for coping with shortness of breath, and recommended diet and hydration.	thereby optimizing breathing patterns and reducing breathlessness. In addition, pulmonary rehabilitation has potential anti-fibrotic and anti-inflammatory effects, where physical exercise can suppress Transforming Growth Factor-β (TGF-β), which plays a role in pulmonary fibrosis. With a combination of cardiopulmonary, neuromuscular, and psychological adaptations, pulmonary rehabilitation improves the exercise capacity and quality of life of IPF patients, although it does not directly affect lung function.
Long-term effect of pulmonary rehabilitation in idiopathic pulmonary fibrosis: a randomized controlled trial (Kataoka *et al.*, 2023)	**Methods** *Randomized Controlled Trial (RCT), open-label* (non-blinded) design. Conducted at 19 institutions in Japan. Study duration was 52 weeks (1 year) **Number of samples** There were a total of 88 patients with IPF divided into two groups randomly into a Pulmonary Rehabilitation (PR) group of 45 patients and a Control Group (without PR) of 43 patients. **Variables** Dependent Variable - Changes in exercise capacity and lung function Independent Variable - Pulmonary Rehabilitation (PR) Program **Intervention** The intervention group was given exercises such as static cycling for 30 minutes, walking exercises, and muscle endurance exercises. After that, independent rehabilitation was continued in the form of squatting, standing calf raises, and walking exercises. Meanwhile, the control group did not receive pulmonary rehabilitation exercises and	**Results** - 6MWD: Rehabilitation group dropped 33m, control group dropped 53m (not significant, p=0.38). - Endurance time: Rehabilitation group increased by 64 seconds, control group decreased by 123 seconds (significant, p = 0.019). - Pulmonary function, quality of life, and level of breathlessness: There was no significant difference between the two groups. - Compliance: Patients with high compliance experienced a slower decline in exercise capacity. **Conclusion** The combination of nintedanib and pulmonary rehabilitation did not significantly improve 6MWD, but did improve endurance time. There was no significant change in lung function, quality of life, or breathlessness. Exercise adherence had a large effect, so a more effective long-term rehabilitation strategy is needed. **Mechanism** Providing pulmonary rehabilitation interventions in patients with idiopathic pulmonary fibrosis works by

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Title	Methods	Results
	only received standard therapy with the drug nintedanib.	improving endurance, respiratory efficiency, and muscle strength, although it does not directly improve lung function. Exercises such as stationary cycling, walking exercises, and muscle resistance training help optimize oxygen use, reduce fatigue, and improve breathing patterns.
Feasibility of a telehealth breathing intervention for patients with idiopathic pulmonary fibrosis (Bussa-Carlson *et al.*, 2024)	**Methods** Experimental with *Single-group pre-post intervention study*. The study was conducted in the United States with a duration of 4 weeks. **Number of samples** There were 30 patients, but 1 patient dropped out before the study was conducted so the total sample was 29. **Variables** Dependent Variable - Level of dyspnea, quality of life, anxiety, and depression. Independent Variable - Breathing exercise intervention via telehealth. **Intervention** Breathing exercises through telehealth with types of breathing exercises, namely Pursed-lip breathing and Diaphragmatic breathing which are carried out 1x per week for 4 weeks with a duration of 10 minutes per day at home.	**Results** The results showed that Dyspnea (Shortness of Breath) with a mean score decreased after the intervention, but was not statistically significant ($p = 0.07$). Quality of Life (QOL) improved slightly, but also not significantly ($p = 0.20$) and anxiety and depression with a mean score reduced after the intervention, but these changes were not statistically significant ($p > 0.05$). Nonetheless, these results suggest that telehealth may be a useful method in improving patient access to respiratory technique education. **Conclusion** These data suggest that a telehealth breathing exercise intervention is a viable option to increase access to symptom management strategies through breathing techniques, to address perceived breathlessness and positively influence symptoms experienced by patients with Idiopathic Pulmonary Fibrosis (IPF). **Mechanism** The pursed-lip breathing technique helps slow the breath rate and reduce airway pressure, while diaphragmatic breathing optimizes the use of the diaphragm to increase oxygen exchange. It also strengthens the respiratory muscles, reduces fatigue, and allows patients to better control their breathing while on the move.

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Title	Methods	Results
Muscle stimulation in advanced idiopathic pulmonary fibrosis: a randomized placebo-controlled feasibility study (Nolan *et al.*, 2021)	**Methods** *Randomized, parallel, two-group, participant and assessor-blinded, placebo-controlled feasibility trial*. The study was conducted in the Outpatient department, Royal Brompton and Harefield Hospitals, UK for 6 weeks. **Number of samples** There were a total of 22 samples divided into 11 in the intervention group given active NMES and 11 in the control group given placebo NMES. **Variables** Dependent Variable - Study eligibility includes recruitment, retention, adherence to intervention. - Side effects of intervention such as redness, burning sensation on the skin - Changes in thigh muscle strength, namely with quadriceps strength - Change in functional capacity with 6-Minute Walk Test - Patient quality of life with King's Brief Interstitial Lung Disease questionnaire Independent Variable - Neuromuscular Electrical Stimulation (NMES) on the thigh muscle (quadriceps). **Intervention** The Intervention Group was given active Neuromuscular Electrical Stimulation (NMES) on the thigh muscle (quadriceps) for 30 minutes per day for 6 weeks. While the Control Group was given a fake NMES (placebo) which only provides a mild sensation without causing real muscle contractions.	**Results** The results showed that out of 364 people screened, 23 participants were recruited, with 11 participants in each group, while 1 participant dropped out before randomization. There was no significant improvement in exercise capacity (6MWT) or thigh muscle strength (QMVC) in the NMES group over controls. Some patients in the NMES group actively experienced mild side effects such as redness and burning sensation, but continued with the intervention anyway. This study also faced challenges in participant recruitment, so further research with larger samples is needed. **Conclusion** The conclusion of this study shows that Neuromuscular Electrical Stimulation (NMES) is feasible in Idiopathic Pulmonary Fibrosis (IPF) patients, but does not provide significant benefits in improving exercise capacity or quality of life compared to the control group. **Mechanism** *Neuromuscular Electrical Stimulation* (NMES) intervention works by sending electrical impulses to the thigh muscles to stimulate contraction without physical activity. This helps to strengthen muscles, maintain muscle mass, and reduce the impact of immobilization in IPF patients who are limited in movement. NMES also allows muscle exercise without overloading the respiratory system

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Title	Methods	Results
Ambulatory oxygen therapy in lung transplant candidates with idiopathic pulmonary fibrosis for pulmonary rehabilitation (Miozzo *et al.*, 2023)	**Methods** Research type: Quasi-experimental study Study design: Data analysis of functional capacity and quality of life of idiopathic pulmonary fibrosis (IPF) patients on the lung transplant waiting list and undergoing pulmonary rehabilitation (PR). **Number of samples** There were 45 patients with Idiopathic Pulmonary Fibrosis (IPF) undergoing PR and awaiting lung transplantation, and were divided into 3 groups based on oxygen flow rate: - 0 L/min (Control group) - 1-3 L/min - 4-5 L/min **Variables** Independent variable: use of ambulatory oxygen therapy during pulmonary rehabilitation. Dependent variable: - Functional capacity (measured by 6-minute walk test / 6MWT) - Quality of life (HRQoL, measured by SF-36) **Intervention** All patients underwent 36 pet rehabilitation sessions, which included: - Aerobic exercise (walking on a treadmill) - Psychosocial support (psychiatric evaluation, nutritional counseling) The oxygen therapy group received customized oxygen flow during exercise to maintain O2 saturation greater than or equal to 92%.	**Results** The results of this study showed functional improvement in all groups: - 0 L/min group: + 61 meters ($p < 0.001$) - Group 1-3 L/min: +58 meters ($p = 0.014$) - Group 4-5 L/min: +35 meters ($p = 0.031$) The improvement in quality of life (HRQoL) was greater in the group receiving oxygen: - Physical function scores improved in all groups. - The group with oxygen experienced greater improvements in general health, social functioning, and mental health. **Conclusion** The conclusion of this research is: - Oxygen therapy during pulmonary rehabilitation can improve the functional capacity and quality of life of idiopathic pulmonary fibrosis (IPF) patients awaiting lung transplantation. - Although functional capacity improvement increased in all groups, patients receiving oxygen showed better exercise tolerance and improvement in mental and social health aspects. **Mechanism** The mechanics of this research include: Data were collected before and after pulmonary rehabilitation through: - 6MWT - SF-36 questionnaire to assess quality of life - oxygen saturation (SpO2) monitoring during exercise. Statistical analysis was performed using paired t-test, Mann-Whitney test, and Wilcoxon test to compare before intervention and after intervention.

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Title	Methods	Results
Pulmonary Daoyin as a traditional Chinese medicine rehabilitation program for patients with IPF: A randomized controlled trial (Zhou *et al.* ., 2021)	**Methods** Randomized Control Trial (RCT). The study was conducted in China at three clinics for a duration of 6 months. **Number of samples** There were 96 participants who had been diagnosed with idiopathic pulmonary fibrosis (IPF) randomly divided into three groups **Variables** Independent variable: - Change in walking distance for 6 minutes (6MWD) - Health-related quality of life (HRQoL, as measured by the SGRQ-I) Dependent variable: - Forced Vital Capacity (FVC) - Diffusing capacity of the lung for carbon monoxide (DLco) - Modified British Medical Research Council (mMRC) **Intervention** The Pulmonary Daoyin (PD) group performed the Pulmonary Daoyin exercise program 2 times a day, 5 days a week for 2 months. The Physical Exercise Group performed exercises using a stationary bicycle ergometer for 30 minutes per day, 5 days a week for 2 months. The Control Group did not receive any specific intervention and just went about their daily activities.	**Results** The results of this study showed that 6MWD increased more significantly in the PD group than the physical exercise group and the control group. **Conclusion** The conclusion of this study is that the pulmonary daoyin (PD) program is proven to be safe and effective in increasing exercise tolerance in idiopathic pulmonary fibrosis (IPF) patients. Where for the results are comparable or better than conventional rehabilitation exercises, and make a viable alternative for rehabilitation of pulmonary conditions in idiopathic puLmonary fibrosis (IPF) patients. **Mechanism** The study was conducted by comparing changes in pulmonary functional capacity and exercise tolerance through the measurement of 6-minute walking distance and various indicators of pulmonary function. The results showed that the traditional method (Pulmonary Daoyin) can improve the exercise capacity of patients in an effective way.
Effects of home-based telerehabilitation-assisted inspiratory muscle training in	**Methods** Single-centre, randomized controlled trial. **Number of samples**	**Results** The results showed that the group receiving the intervention had significant improvements in functional

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Title	Methods	Results
patients with idiopathic pulmonary fibrosis: A randomized controlled trial (Aktan *et al.*, 2024)	A total of 28 patients in this study were divided into 14 subjects each into two different groups: intervention group (receiving IMT) and control group (receiving placebo IMT). **Variables** Independent variable: Inspiratory muscle training with the help of telerehabilitation Dependent variable: - Changes in functional capacity - Inspiratory muscle strength - Patient quality of life **Intervention** Patients in the exercise group received an intervention of inspiratory breathing muscle training using Philips Threshold Inspiratory Muscle Training (IMT) with an exercise load of 50% of the initial maximal inspiratory pressure (MIP). The training load is then increased based on the modified Borg scale (kept at level 4-6) to ensure patients are training at the highest level of respiratory effort that can still be tolerated. The control group received placebo exercise with no inspiratory load using the same device.	capacity and inspiratory muscle strength compared to the control group. **Conclusion** This study concluded that home telerehabilitation-assisted inspiratory muscle training is effective in improving functional capacity, inspiratory muscle strength, and quality of life in patients with idiopathic pulmonary fibrosis. **Mechanism** This study evaluated the effectiveness of inspiratory muscle exercises performed at home with the aid of telerehabilitation in patients with idiopathic pulmonary fibrosis. Patients in the intervention group underwent inspiratory muscle exercises using a specialized device, with intensity adjusted based on a modified Borg scale, while the control group performed sham exercises without inspiratory load. The exercises were performed twice daily for eight weeks, with weekly sessions supervised via video call by a physiotherapist. As a result, the intervention group showed significant improvements in functional capacity and inspiratory muscle strength compared to the control group. It can be concluded that telerehabilitation-based inspiratory muscle training at home is effective in improving respiratory function and quality of life of patients with idiopathic pulmonary fibrosis.
Tele-Rehabilitation Program in Idiopathic Pulmonary Fibrosis-A Single-Center Randomized Trial (Cerdán-De-las-heras *et al.* ., 2021)	**Methods** Single-centre, randomized clinical trial. Exercises were performed independently with the help of telerehabilitation for 12 weeks at home. **Number of samples** 29 patients with *Idiopathic Pulmonary Fibrosis* (IPF), with 15 patients in the intervention group	**Results** This study found that exercise capacity was better at the 3- and 6-month evaluations compared to the control group. However, there was no difference in the number of daily steps and quality of life and the patient compliance rate was more than 63%, and patient satisfaction was high. So it can be said that

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Title	Methods	Results
	(tele-rehabilitation) and 14 patients in the control group. **Variables** Independent variable: Tele-rehabilitation program with Virtual Autonomous Physiotherapist Agent (VAPA). Dependent variable: - Exercise capacity (6-Minute Walk Test Distance / 6MWTD) - Number of steps in 7 days (7-day pedometry) - Patient quality of life (St. George's Respiratory Questionnaire and King's Brief Interstitial Lung Disease Questionnaire) - Anxiety level (General Anxiety Disorder-7 Questionnaire) - Lung function (Forced Vital Capacity / FVC and Diffusion Capacity for Carbon Monoxide / DLCO) **Intervention** The intervention group received a tele-rehabilitation program using the Virtual Autonomous Physiotherapist Agent (VAPA) including several interventions such as video consultations, e-learning, chat sessions with physiotherapists, and physical exercises with VAPA for 12 weeks of intervention. The control group did not receive the rehabilitation program but continued to receive standard care for IPF such as regular check-ups and monitoring.	telerehabilitation with VAPA is beneficial for patients with IPF. **Conclusion** Tele-rehabilitation with VAPA was shown to be beneficial for IPF patients, as it was able to maintain exercise capacity up to 3 and 6 months, while the control group experienced a decline. The program has a high compliance rate and good patient satisfaction and safety. Therefore, tele-rehabilitation with VAPA could be an alternative for rehabilitation of IPF patients and help them lead a more physically active lifestyle. **Mechanism** This study compared the intervention group who received a telerehabilitation program with VAPA and the control group who received standard care for 12 weeks. As a result, patients who participated in tele-rehabilitation were able to maintain their exercise capacity up to 3 and 6 months, while the control group experienced a decrease in exercise capacity.

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DISCUSSION

Idiopathic pulmonary fibrosis (FPI) is the most common type of idiopathic interstitial pneumonia (PII) and is also associated with the highest mortality rate; the disease is characterized by progressive parenchymal fibrosis of unknown etiology (Brokowski C, 2019) . The condition leads to decreased lung elasticity, difficulty breathing, as well as reduced oxygen exchange capacity, which can worsen over time. The main symptoms of FPI include progressive shortness of breath, chronic dry cough, fatigue, and decreased tolerance to physical activity.

As the disease progresses, increased dyspnea and skeletal muscle dysfunction contribute to decreased exercise capacity, impaired activities of daily living (ADL) and health-related quality of life (HRQL). Physiotherapy plays an important role in the rehabilitation of patients with FPI to help reduce symptoms and improve quality of life. There are several physiotherapy rehabilitations that can be used as interventions for idiopathic pulmonary fibrosis cases.

Breathing Exercise

Breathing exercise in cases of idiopathic pulmonary fibrosis is a series of breathing techniques that aim to improve lung ventilation efficiency, reduce shortness of breath, and help patients breathe more comfortably. In a study conducted by Shen Li regarding pulmonary rehabilitation techniques in idiopathic pulmonary fibrosis patients, significant results were obtained ($p < 0.05$) in the group given breathing exercise techniques as an intervention, compared to the control group who did not get breathing exercises. Giving breathing exercise is proven to improve lung function (FEV1 and FVC). In patients with IPF, scar tissue formation (fibrosis) occurs in the lungs which causes the lungs to become stiff, reducing lung elasticity and inhibiting lung expansion during inspiration, so this condition causes a decrease in FEV1 and FVC values. Breathing techniques such as deep breathing can reduce lung wall resistance and help maintain lung tissue flexibility. Slow and sustained movements can increase the strength and efficiency of the respiratory muscles so that the lungs can expand better. Combining deep breathing with simple movements 3 times can train respiratory muscles, maintain lung elasticity, slow lung volume reduction, and increase exercise endurance, and improve quality of life (Shen et al. . , 2021)

Aerobic Exercise

Aerobic exercise for idiopathic pulmonary fibrosis patients is a form of physical activity designed to improve cardiorespiratory capacity, optimize oxygen utilization and reduce breathlessness. It includes activities of mild to moderate intensity performed over a period of time, such as walking, stationary cycling or using a treadmill. Physical capacity is known to be a major factor influencing physical activity levels in idiopathic pulmonary fibrosis patients, including those awaiting lung transplantation.

There was a meta-analysis of aerobic exercise combined with breathing exercises by Hanada et al 2020 Aerobic exercise, whether performed alone or combined with Inspiratory Muscle Training (IMT) or breathing exercises, can improve exercise capacity (Hanada et al. . , 2020)

An RCT study was conducted in 2016 and found that IMT with aerobic exercise in patients with IPF for 8 weeks can increase exercise capacity and decrease dyspnea symptoms compared to the control group. The combination of aerobic exercise and Inspiratory Muscle Training (IMT) can provide benefits because increasing inspiratory muscle strength helps improve the efficiency of respiratory muscles that play a role in ventilation. In addition, increased endurance during exercise can strengthen aerobic capacity, thereby reducing the workload of the respiratory system during physical activity.

Strengthening Exercise

Patients with IPF are usually characterized by progressive polmonary restriction, ventilatory ineffectiveness, shortness of breath, impaired gas exchange, and low oxygen levels in the blood (hypoxemia). These conditions cause IPF patients to experience shortness of breath more easily and tend to be less physically active to avoid these symptoms. These conditions certainly have a negative impact on the functional ability and quality of life of IPF patients (Directors and Committie, 2000) .

Several recent studies on the provision of short-term exercise training in pulmonary rehabilitation programs are safe and effective

methods to improve exercise ability, reduce shortness of breath, and improve the quality of life of IPF patients. One of them is by giving strengthening exercise. In a study conducted by Choi et al. (2023) the addition of strengtening exercises on the upper and lower extremities in the pulmonary rehabilitation program for patients with idiopathic pulmonary fibrosis gave significant results on maximal oxygen uptake (VO2max) (p=0.006) and six minute walking distance (6MWD) during the six minute walk test (6MWT) (p=0.013). Giving strengthening exercise can increase the strength and endurance of skeletal muscles, so that muscles become more efficient in using oxygen. By increasing the efficiency of oxygen use in the muscles, the workload of the heart and lungs is reduced, so that aerobic capacity increases. In addition, this exercise also contributes to increased muscle capillarization, which improves oxygen distribution to tissues and optimizes oxygen transport in the blood. Increased muscle strength also reduces fatigue during physical activity, which results in increased tolerance to exercise, allowing patients to walk longer distances without experiencing excessive shortness of breath (Choi *et al.* ., 2023)

Similar results were also obtained in a study conducted by Cerdán-de-las-Heras et al. (2021) where the addition of strengthening exercises to a Tele-Rehabilitation-based rehabilitation program in patients with IPF showed significant results (p = 0.03) in the six-minute walk test distance (6MWTD) after administering the intervention for 3 months. Increased muscle strength especially in the lower extremities directly contributes to the patient's ability to walk further, due to reduced muscle fatigue during repetitive activities. In this study, although the rehabilitation was based on Tele-Rehabilitation, it had a relatively high compliance rate and high patient satisfaction and safety. All exercises can be done at home under the supervision of a physiotherapist. Patients perform exercises for 10-20 minutes 3-5 times a week and can use exercise aids such as elastic bands, weights, and fitness- steps to achieve the highest exercise intensity (Cerdán-De-las-heras *et al.* ., 2021)

Neuromuscular Electrical Stimulation

Neuromuscular Electrical Stimulation (NMES) is a therapeutic technique that uses electrical impulses to stimulate muscle contractions. Neuromuscular Electrical Stimulation (NMES) can help with muscle weakness that often occurs due to progressive diseases. This method uses a lightweight stimulator device and electrodes placed on the skin to induce muscle contractions in a controlled and comfortable manner (Jones *et al.* . , 2016)

NMES is potentially a therapeutic option to address muscle weakness in advanced progressive disease and may be considered as a suitable intervention for home use, particularly for individuals with muscle weakness who have difficulty in accessing available pulmonary rehabilitation services (Nolan *et al.* , 2021)

NMES utilizes a small, battery-powered stimulator that, through surface electrodes placed on the front of the thigh, stimulates muscle contraction and relaxation in a controlled manner. A meta-analysis conducted by revealed that compared to placebo, NMES significantly improved quadriceps muscle strength, muscle mass, as well as exercise capacity.

Pulmonary Douyin

Pulmonary Daoyin (PD) is a skill-based traditional Chinese medicine (TCM) pulmonary rehabilitation technology. Pulmonary Daoyin (PD), derived from the traditional Chinese daoyin technique, is a rehabilitation method that integrates special movements of the arms and body with controlled breathing exercises, aiming to improve the physiological and psychological conditions of patients with chronic respiratory diseases (Zhang *et al.*, 2017)

There is research conducted by *Zhou et al, 2020* which discusses Pulmonary daoyin against idiopathic pulmonary fibrosis with the results of research showing that there is an increase in exercise tolerance in idiopathic pulmonary fibrosis patients. This study concluded that the Pulmonary Daoyin (PD) program was proven safe and effective in increasing exercise tolerance in idiopathic pulmonary fibrosis (IPF) patients. The results showed equivalent or better effectiveness compared to conventional rehabilitation exercises, so PD can be a feasible alternative for

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pulmonary rehabilitation in patients with IPF (Zhou *et al., 2014).*, 2021)

Inspiratory Muscle Training

In a study conducted by Aktan et al. (2024) on the provision of inspiratory muscle training in patients with idiopathic pulmonary fibrosis obtained significant changes in inspiratory muscle strength, functional exercise capacity, and decreased tightness. When the patient inspires, the device in the form of a threshold will provide resistance, this forces the respiratory muscles, especially the diaphragm and intercostal muscles, to work harder to overcome the inspiratory load given (Chung *et al.* . , 2021)

If this exercise is done repeatedly, of course, adaptation will occur which in the long term will increase the strength and endurance of the respiratory muscles so as to reduce muscle fatigue when breathing which results in increased ventilation efficiency. Increased inspiratory muscle strength also has an impact on increasing functional exercise capacity as seen in improved performance on the 6-Minute Walk Test (6MWT) and VO_2max. With increased respiratory efficiency, the body can reduce energy consumption during physical activity, allowing patients to perform longer activities before experiencing fatigue (Charususin *et al.* ., 2016)

CONCLUSION

Physiotherapy interventions have an important role in the management of idiopathic pulmonary fibrosis (FPI) with the aim of increasing functional capacity, reducing symptoms, and improving patients' quality of life. Interventions include *breathing exercises*, which help improve breathing efficiency and reduce shortness of breath, and strengthening exercises, which aim to strengthen the respiratory muscles and extremities to improve endurance. In addition, aerobic exercises contribute to improving cardiorespiratory capacity and oxygen utilization efficiency, while Neuromuscular Electrical Stimulation (NMES) is used to prevent muscle weakness due to mobility limitations by providing electrical stimulation that stimulates muscle contraction. As an additional method, Pulmonary Daoyin has been shown to be safe and effective in improving exercise tolerance and can be an equal or even better alternative to conventional rehabilitation. By combining these various interventions, FPI patients can maintain pulmonary functional capacity, improve tolerance to physical activity, and reduce the progressive impact of the disease. Therefore, a structured and continuous physiotherapy program is an important part of the rehabilitation strategy for patients with FPI.

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