DOI: https://doi.org/10.52756/ijerr.2024.v40spl.016 ***Int. J. Exp. Res. Rev.*, Special Vol. 40: 191-199 (2024)**

Original Article | *Peer Reviewed* | *Open Access*

International Journal of Experimental Research and Review (IJERR)

ISSN: 2455-4855 (Online)
www.iaph.in

Impact of Pulmonary Rehabilitation on Fatigue and Quality of Life in Patients of Interstitial Lung Disease

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Article History:

Received: 08th Mar., 2024
Accepted: 21st June, 2024
Published: 30th June, 2024

Keywords:
Fatigue, Interstitial Lung Diseases, Pulmonary Rehabilitation, Quality of Life

How to cite this Article:
Cottadiyil Remi Issac, Chandrasekar Sundaram, Meenakshi Narasimhan and Sridhar Rathinam (2024). Impact of Pulmonary Rehabilitation on Fatigue and Quality of Life in Patients of Interstitial Lung Disease. *International Journal of Experimental Research and Review*, *40*(spl.), 191-199.
DOI:
https://doi.org/10.52756/ijerr.2024.v40spl.016

Abstract: Individuals with interstitial lung diseases (ILDs) often experience debilitating fatigue, impacting their quality of life. Pulmonary rehabilitation (PR), comprising tailored exercise, education, and behaviour change, aims to improve physical and psychological conditions in ILD patients. Evaluating fatigue and quality of life pre- and post-pulmonary rehabilitation provides insights into its effectiveness in enhancing patient outcomes. Following ethical approval, an exploratory cross-sectional study was conducted at the Department of Respiratory Medicine, Chettinad Hospital and Research Institute. The study enrolled 73 ILD patients admitted between August 2022 and August 2023. Comprehensive pulmonary function assessments and medical histories were obtained from reliable sources and were assessed with questionnaires like the Fatigue Assessment Scale (FAS) for fatigue and St. George Respiratory Questionnaire (SGRQ) for quality of life before and after a 6-month individualized home-based pulmonary rehabilitation program. Seventy-three (73) patients were enrolled in the study. The age group with the highest number of patients was between 50 – 60 years (40%), with a male predominance of 60 % (44). Independent samples of different tools in the research and their mean values were compared using the T-test. This study illustrates the considerable link between the ILD cases for FAS and SGRQ with statistically significant differences in FAS and SGRQ between time durations, at 3 and 6 months duration, indicating improvement in fatigue and quality of life in those patients at a 3 and 6-month duration ($p < 0.001$). The assessment showed a significant decline in fatigue levels ($p<0.001$) and a marked betterment in the overall quality of life ($p<0.0066$) among patients after participating in Pulmonary Rehabilitation when compared with FVC severity. These findings underscore the importance of integrating rehabilitation programs into the comprehensive care of these patients to improve their overall health and well-being.

Introduction

'Interstitial lung diseases' (ILD) are a set of diverse pulmonary disorders that share physiological symptoms and clinical aspects, as well as varied degrees of inflammation and pulmonary fibrosis (Mueller-Mang et al., 2019; Reddy and Khanaa, 2023). Individuals who have interstitial lung diseases (ILD), which are characterized by various radiological pictures, such as idiopathic pulmonary fibrosis (IPF), occupational diseases, hypersensitivity, or medication toxicity, may experience progressive worsening of dyspnoea, fatigue and an intractable cough (Yohannes et al., 2020). Fatigue affects up to 95% of patients with idiopathic pulmonary fibrosis (IPF) (Rajala et al., 2017). In the European IPF registry, patients with IPF (69.2%) had the same prevalence of fatigue as patients with non-IPF ILDs (70.6%) (Guenther et al., 2018). Fatigue was reported in up to 89% of patients with systemic sclerosis (Ibn Yacoub et al., 2012) and up to 87% of individuals with chronic hypersensitivity pneumonitis (Lubin et al., 2014).

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The Fatigue Assessment Scale (FAS) can be employed to assess fatigue (Kolner-Augustson et al., 2019). These scales measure the severity and impact of fatigue on daily functioning. To evaluate the quality of life, the 'St. George's Respiratory Questionnaire' (SGRQ) can be utilized (Fraser et al., 2018). These tools assess multiple domains related to well-being, including physical functioning, social functioning, and emotional well-being. Pulmonary rehabilitation comprises patient evaluation, persistent participation in an exercise-training program, education, and behavioural modification (Boyer et al., 2017; Shenoy et al., 2022). Pulmonary rehabilitation is well-established in patients with various chronic lung diseases, such as chronic obstructive pulmonary disease (COPD), where it improves exercise performance and alleviates symptoms (Kumar et al., 2013). Our aim is to evaluate fatigue and quality of life in individuals with interstitial lung disease before and after pulmonary rehabilitation.

Materials and Methods

Following ethical committee approval, the cross-sectional exploratory study was carried out at the Department of Respiratory Medicine, Chettinad Hospital and Research Institute. The researcher thoroughly assessed their pulmonary function and obtained a complete history from the subjects / reliable informant. Seventy-three (73) Patients diagnosed with ILD cases from the Respiratory Medicine Department, Chettinad Hospital and Research Institute who were admitted during the period of August 2022 to August 2023 were the source of study. The study involves the evaluation of fatigue and quality of life through validated questionnaires such as the fatigue assessment scale (De Vries et al., 2004) and St. George Respiratory Questionnaire (Nelsen et al., 2017) taken both before and after pulmonary rehabilitation for a period of 6 months. All study participants were subjected to baseline clinical evaluation to assess fitness for pulmonary rehabilitation. Eligible participants underwent individualised home-based pulmonary rehabilitation, which included exercise training as a core component, often comprising of walking, cycling or both and resistance training, each tailored according to individual patient needs for a period of 6 months with monthly follow-ups, and thereafter assessed again with validated questionnaires at a period of 3 and 6 months.

Inclusion criteria

- All diagnosed patients of interstitial lung disease
- Age ->18 years
- Gender – Both

Exclusion criteria

- Patients not willing to consent
- Contraindication for pulmonary rehabilitation
- Pregnancy
- Covid 19 active infection at the time of inclusion

Result

Age Distribution

Out of a total of 73 patients, the age group with the highest number of patients was between 50 - 60 years, which is 40 %, followed by 25 % in the 41 – 50 year age group, 19 % falling in the 61 - 70 year age group, while a small fraction of patient falling in 31 – 40 and > 70 year age group each consisting of 8 % (Table 1 & Figure 1).

Table 1. Age-wise distribution (n=73).

Age Category	Frequency	Percentage
31-40	06	8%
41-50	18	25%
51-60	29	40%
61-70	14	19%
≥70	06	8%
Total	73	100%

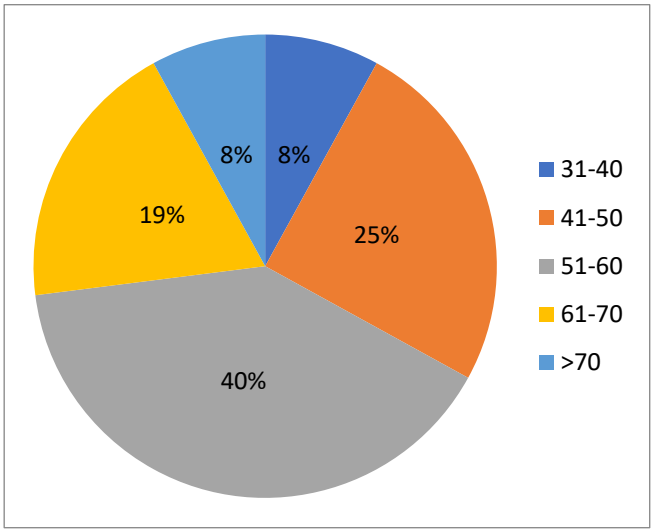

Figure 1. Age-wise distribution in percentage.

Gender distribution

Our study had a male predominance, with 44 (60%) males and 29 (40%) females (Table 2 and Figure 2).

Table 2. Gender distribution.

Gender	Frequency	Percentage
Male	44	60%
Female	29	40%
Total	73	100%

FAS Score

The mean and standard deviation (SD) values for the FAS at baseline, 3 months, and 6 months were as follows, with a baseline mean of 31.96 with a SD of 9.05, a mean of 27.48 with an SD of 8.97 at the end of 3 months and

DOI: https://doi.org/10.52756/ijerr.2024.v40spl.016

Mean of 17.83 with a SD of 5.64 at the end of 6 months (Table 3 and Figure 3).

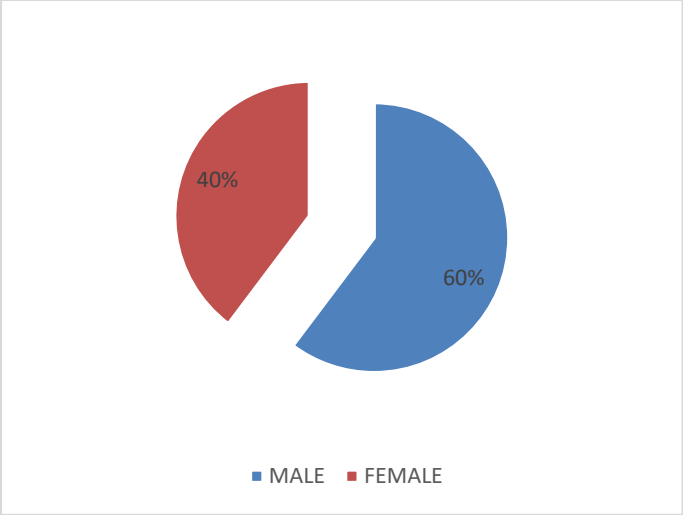

Figure 2. Gender distribution in Percentage.

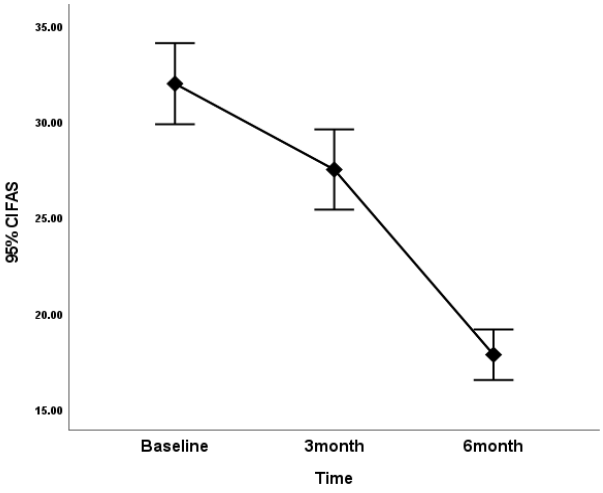

Figure 3. Mean distribution of FAS score.

Based on the mean and SD distribution, the calculated p-value was found to be less than 0.001. This indicates that there is a significant difference in the FAS scores among the time durations. When comparing the mean differences, the p-value for 3 and 6 months was calculated as <0.001 which suggests statistically significant difference. These findings highlight the potential for improvement over a longer duration of time.

SGRQ Score

The mean and standard deviation (SD) values for the SGRQ at baseline, 3 months, and 6 months were as follows with a baseline mean of 57.16 with an SD of 17.87, mean of 53.97 with an SD of 19.39 at the end of 3 months and Mean of 48.29 with an SD of 16.66 at the end of 6 months. (Table 4 and Figure 4).

The low p-value (< 0.001) suggests a significant difference in SGRQ scores across different time durations. When comparing the mean differences, the p-value for 3 months was calculated as 0.026, which suggests a statistically non-significant difference. However, for the SGRQ evaluation, the p-value was calculated as 0.001, indicating a statistically significant difference.

Age categories versus FAS

Out of the five age groups, the age groups with the strongest association with FAS are those 31–40 and >70. Both of these categories show higher significance, with p-values less than 0.05. (Table 5).

Age categories versus SGRQ

The age groups of 31–40 and >70 have the strongest association among the five age categories versus SGRQ.

Table 3. Means of FAS Score.

Time	N	FAS		P-Value	Change From Baseline		P-Value
		Mean	SD		Mean Difference	95% C.I	
Baseline	73	31.96	9.05	<0.001			
3 Month	73	27.48	8.97		-4.48	(-5.43,-3.53)	<0.001
6 Month	73	17.82	5.64		-14.14	(-15.09,13.18)	<0.001

Table 4. Mean of QOL [SGRQ].

Time	N	SGRQ		P-Value	Change From Baseline		P-Value
		Mean	SD		Mean Difference	95% C.I.	
Baseline	73	57.16	17.87	<0.001			
3 Month	73	53.97	19.39		-3.09	(-5.81,-0.36)	0.026
6 Month	73	48.29	16.66		-8.88	(-11.59,-6.17)	<0.001

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Both categories can have higher significance, with p-values less than 0.05 (Table 6).

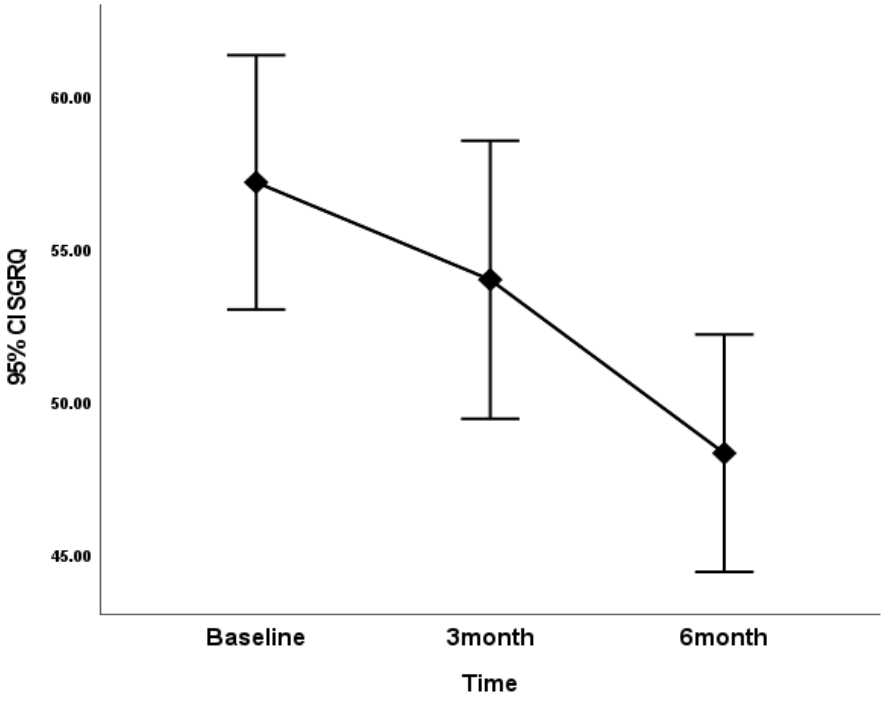

Figure 4. Mean Distribution of QOL.

Table 5. Linear relationship between age categories and FAS.

Age Category	Frequency	R Value	P Value
31-40	06	0.0098	>0.05
41-50	18	0.198	<0.05
51-60	29	0.258	<0.05
61-70	14	0.323	<0.05
≥70	06	0.032	>0.05

Table 6. Linear relationship between age categories and SGRQ.

Age Category	Frequency	R-Value	P-Value
31-40	06	0.0233	>0.05
41-50	18	0.322	<0.05
51-60	29	0.189	<0.05
61-70	14	0.29	<0.05
≥70	06	0.098	>0.05

Table 7. Correlation of FVC severity and FAS change.

Degree Of Restriction	N	FAS change		P-value
		Mean	SD	
Moderate Reduction	56	12.57	4.42	<0.001
Severe Reduction	12	19.92	3.92	

Correlation of FVC severity with pulmonary rehabilitation and FAS change

Out of a total of 72 patients, 56 showed moderate reduction, whereas 12 showed severe reduction, with none showing mild restriction. Two sample T-tests with equal variances were used to find the correlation between FVC severity and FAS score change at the end of 6 months (Table 7 and Figure 5).

The study found a statistically significant correlation between FVC severity and FAS changes ($p<0.001$),

implying a strong association between reduced FVC severity and FAS alterations at the end of 6 months.

The correlation between FVC severity and SGRQ changes in the present study appears to be statistically non-

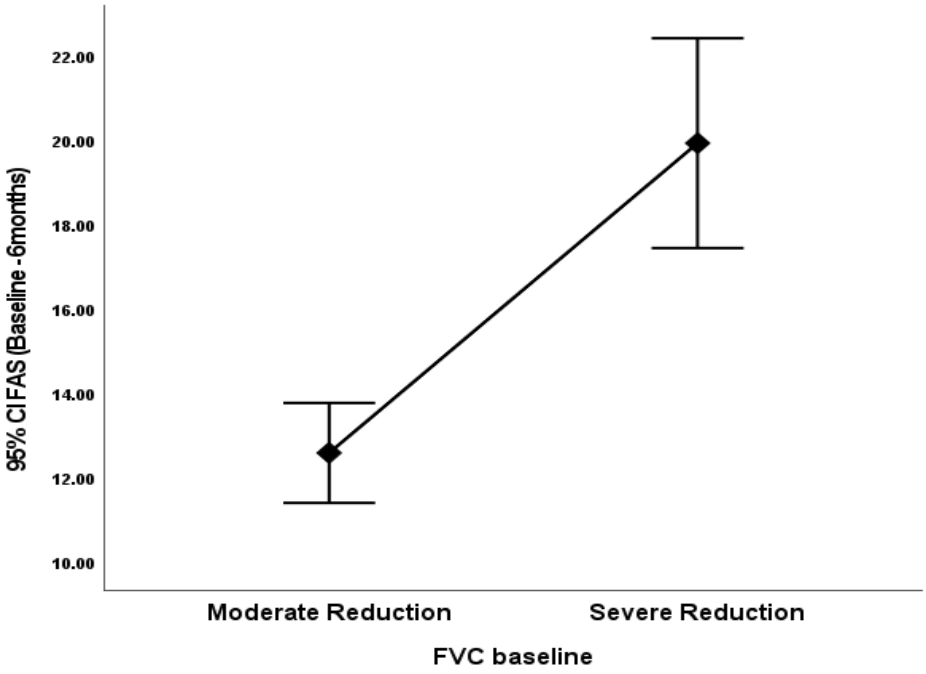

Figure 5. The plot shows the correlation between the degree of restriction and FAS change.

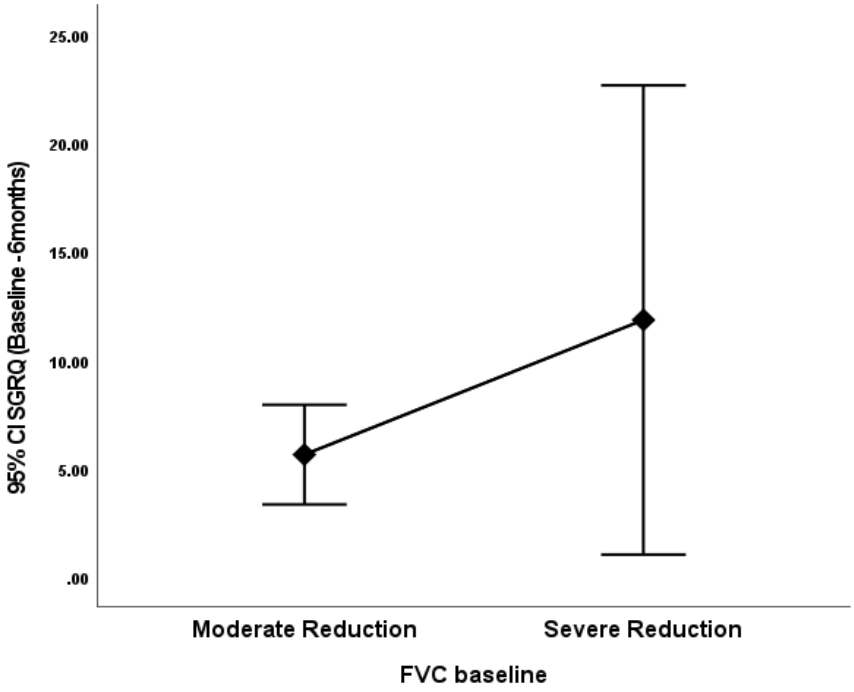

Figure 6. The plot shows the correlation between the degree of restriction and SGRQ change.

Table 8. Correlation of degree of restriction and SGRQ change.

Degree Of Restriction	N	SGRQ Change		P-Value
		Mean	SD	
Moderate Reduction	56	5.63	8.57	0.066
Severe Reduction	12	11.83	17.02	

Correlation of FVC severity with pulmonary rehabilitation and SGRQ change

significant, as indicated by the reported p-value of less

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than 0.066. This suggests no association exists between the severity of FVC reduction and changes in SGRQ.

Discussion

This study was carried out to evaluate the impact of pulmonary rehabilitation on the quality of life of patients with interstitial lung disease. In conjunction with recent studies like that of Dowman et al. (2021), they assessed if pulmonary rehabilitation improves exercise capacity, symptoms, quality of life and survival in ILD patients.

Age distribution

Out of a total of 73 patients, the age group with the highest number of patients was between 50 - 60 years, which is 40 %, followed by 25 % in the 41 – 50 year age group, 19 % falling in the 61 - 70 year age group, while a small fraction of patient falling in 31 – 40 and > 70 year age group each consisting of 8 %. Like our study, Niranjan Jaganathan et al., 2022 found that ILDs prevalence rose with age, peaking at 45-55 years. In 2019, ILDs were more common in males over 75 years and less common in males below that age (Jeganathan, N & Sathananthan et al., 2021; Kaul et al., 2021). Another study by Lanza et al. (2019) revealed that All participants were adults with a mean age ranging from 36 to 72 years. The maximum number of cases was between 40 and 60 years of age. Both the age-specific mortality and disability-adjusted life years (DALYs) rates rose as both genders aged. However, males saw a proportionately bigger rise in DALYs and mortality rates than females, and as a result, the gap grew as age increased (Lanza M et al., 2019)

Gender distribution

Our study had a male predominance, with 60% (40) males and 40% of females. Gender may also have an impact on a patient's prognosis; the male gender is linked to a higher death rate from interstitial lung disease (ILD). While the presence of a gender component may boost diagnostic confidence, erroneous or underdiagnosed cases may arise if the strength of the gender and illness link is not supported by well-confirmed data (Kawano-Dourado et al., 2021). On the other hand, Mary E. Strek et al. (2020) found that female patients received a diagnosis of hypersensitivity pneumonitis or an ILD associated with connective tissue disease more frequently (Strek ME & Adegunsoye et al., 2022).

Assessment of fatigue

To measure fatigue in patients with ILD, the 10-point Fatigue Assessment Scale (FAS) was created (Kahlmann et al., 2020) . When comparing the mean differences, the p-value for 3 and 6 months was calculated as <0.001, which suggests a statistically significant difference. These findings highlight the potential for improvement over a longer duration of time.

While cognitive behavioural treatment has been advocated for those with ILD, no study has been conducted on the subject as of yet. Customized therapies by psychologists or social workers may occasionally improve fatigue, which is also increased by inactivity, a lack of social support, and psychological well-being (Pumar et al., 2019). Of the age groups, the strongest association with FAS is those that are 31–40 and >70. Both of these categories show higher significance, with p-values less than 0.05. The study found a strong association between FVC severity and FAS changes, supported by a statistically significant p-value below 0.001. Many patients hit important FAS, dyspnea, and depression levels post-rehab. Results stayed notable at 6-month follow-up for quality of life, depression, and activity (Wong et al., 2020; Ryerson et al., 2014).

Assessment of quality of life

When comparing the SGRQ assessment between and within pulmonary rehabilitation for ILD patients, a statistically significant t value of 5.3967 is seen. We must admit that the SGRQ has significant limitations, especially when it comes to evaluating quality of life-related to ILD, as it was originally created for patients with obstructive lung disorders (Jones et al., 1991). The age groups of 31–40 and >70 have the strongest association among the five age categories versus SGRQ. Higher significance can be seen in both of these categories, with p-values less than 0.05. The correlation between FVC severity and SGRQ changes in the present study appears to be statistically non-significant, as indicated by the reported p-value of less than 0.0066. This suggests no association exists between the severity of FVC reduction and changes in SGRQ (Aronson et al., 2021; Swigris et al., 2018).

Conclusion

Pulmonary rehabilitation programs should adopt a comprehensive and multi-disciplinary approach, integrating various therapeutic modalities such as exercise training, education, breathing exercises, and psychosocial support (Mendes et al., 2021). This multi-faceted approach can contribute to the efficacy of the program regardless of its duration. Pulmonary rehabilitation must be a part of comprehensive care for ILD patients, especially in the case of chronic obstructive pulmonary disease patients (Nakazawa et al., 2017). Our study indicated a substantial decrease in fatigue levels and a notable improvement in the overall quality of life among patients after undertaking

DOI: https://doi.org/10.52756/ijerr.2024.v40spl.016

home-based pulmonary rehabilitation, which is a safe, patient-friendly, and cost-effective intervention (Holland et al., 2012). The study's findings suggest that longer intervals, such as the 6-month duration of pulmonary rehabilitation, may yield more significant improvements in pulmonary function. Therefore, for patients with more severe conditions or persistent respiratory impairments, a longer duration of rehabilitation may be recommended to maximize long-term benefits. Hence, comprehensive home-based pulmonary rehabilitation become one of the modalities of long-term management of ILD patients.

Limitations

Follow-up studies with a large sample size, including evaluation of pulmonary function, exercise capacity and detailed psychiatric assessment for anxiety and depression, are needed.

Acknowledgement

I would like to thank the Department of Respiratory Medicine, Chettinad Hospital and Research Institute, and all my esteemed faculty for their timely guidance. I would also like to thank my colleagues and my family for their never-ending support.

Conflict of Interest

The authors declare no conflict of interest.

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How to cite this Article:

Cottadiyil Remi Issac, Chandrasekar Sundaram, Meenakshi Narasimhan and Sridhar Rathinam (2024). Impact of Pulmonary Rehabilitation on Fatigue and Quality of Life in Patients of Interstitial Lung Disease. *International Journal of Experimental Research and Review*, *40*(spl.), 191-199.

DOI: https://doi.org/10.52756/ijerr.2024.v40spl.016