"Comparison of diaphragmatic breathing and pursed-lip expiration exercises in patients with interstitial lung disease"

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INTRODUCTION

Interstitial lung diseases (ILDs) comprise a heterogeneous group of chronic conditions characterized by lung parenchymal involvement with different degrees of inflammation and fibrosis resulting in impaired gas exchange and restrictive physiology. Clinically, the development of irreversible and progressive parenchymal fibrosis leads to ventilator constraint and abnormal lung mechanics with limited exercise capacity and dyspnea on exertion. In particular, the impaired level of gas exchange seems to be the major cause leading to exercise intolerance in these patients [1]

ILDs comprise a heterogeneous group of disorders that lead to diffusing inflammation and/or fibrosis of the lung parenchyma and vasculature. Classifications of ILDs are based on known (inhaled agents, drugs, infections, etc.) or unknown (idiopathic pulmonary fibrosis—IPF, sarcoidosis, asbestosis and pneumonitis) etiology, specific disease entities, or clinical, histological, or radiological patterns. Roughly, one-third of all diagnosed ILDs are a consequence of known exogenous and endogenous causes, whereas two-thirds are idiopathic.
[2]

The genesis of ILDs is complex and involves a series of diffuse remodelling of the lung parenchyma due to direct or systemic injury. In brief, the persistent inflammatory process caused by injury of the lung tissue creates a cascade of events, causing an increase in reactive oxygen species, growth factors, cytokines, and chemokine release; hence more damage is caused along with tissue fibrosis. Based on this, multiple consequences are observed (i.e., alveolar-capillary membrane thickening, a decrease of pulmonary gas exchange, dyspnoea), ultimately leading to functional impairment and exercise intolerance. Due to the persistent

inflammatory process and formation of fibrotic tissue, structural and mechanical pulmonary system alterations are observed and considered the main causes of a pathological reduction of pulmonary and cardiovascular functions. For instance, ILD patients are reported to exhibit reduced static and dynamic lung volumes. Moreover, the diffusing capacity is also impaired. Collectively, these pathological reductions in cardiopulmonary function contribute to an increase in exertional dyspnoea and exercise intolerance; thus, ILD patients tend to avoid situations where they might experience breathlessness, fomenting a cycle of reduced physical activity levels and increasing sedentary lifestyles. [3]

The ILDs are associated with a high symptom burden, including dyspnoea (54 to 98% of patients) and a chronic dry cough (59 to 100% of patients). Fatigue and exhaustion may be more bothersome than dyspnoea for some patients. The physical, emotional, social, and financial burdens experienced by caregivers of people with ILD are increasingly being recognized, particularly as their loved one's disease becomes more severe. The direct costs of ILD to the health system are substantial and rising. Consequently, as ILD progresses, the patient's daily activities decline early following symptoms everyday performance begins even before that ventilator limitation with functional impairmentoccurs [4].

The current recommendation indicates that ILD patients have experienced exercise limitation, providing integration of contributors to functional limitation, disease progression, and enrolment in a pulmonary rehabilitation (PR) program. [5]Cardiopulmonary exercise testing (CPET) provides important information concerning exertional dyspnoea and mechanisms of exercise limitation as a comprehensive assessment of the physiological changes in the respiratory, cardiovascular, and musculoskeletal systems during exercise, which may be also useful for exercise prescription.[6,7]

However, the prognostic value of CPET parameters and responses of ILD patients remains controversial and requires additional research. Exercise tests provide a global assessment of functional capacity and this may be particularly relevant for ILDs with peripheral or respiratory muscle involvement, or where increased symptoms are not explained by changes in respiratory function variables.[8-10].

In summary, despite the beneficial effect of PR in ILD patients has been supported by a growing body of evidence, the ultimate IPF guidelines still provide a weak recommendation for PR, and the impact of disease severity and ILD etiology on PR outcomes remains not well understood. The present prospective observational two-center study has been designed to confirm the positive impact of pulmonary rehabilitation delivered both as an in- and outpatient program in a population of patients with ILDs of different etiology [1] and to further investigatewhether baseline exercise capacity, disease severity or ILD etiology might differently affect clinical outcomes following a standard PR course. . [12-14]

AIM OF THE STUDY

To compare the effect of diaphragmatic breathing and pursed-lip expiration exercises in improving pulmonary function in patients with ILD.

OBJECTIVES OF THE STUDY

To find the difference between the effect of diaphragmatic breathing and pursed-lip expiration exercises in improving pulmonary function in patients with ILD.

IPF affects about 3 million people worldwide, with an incidence increasingdramatically with age. PF has a limited response to pharmacological treatment and new approaches and complementary therapies to improve IPF control are urgently required.

Secondly from the review of the literature, it is found that Pulmonary Rehabilitation programs patients with IPF have not been distinguished from other restrictive lung diseases, such as bronchiectasis, scoliosis, and neuromuscular disease. Since the prognosis, the disease progression, and the response to therapy of IPF subjects are heterogeneous, therefore the ideal moment to initiate a PR program is still unknownand requires further studies.

4.1 HYPOTHESIS

Alternate: There is a significant difference between the effect of diaphragmatic breathing and a combination of diaphragmatic and pursed-lip expiration exercises in improving the pulmonary function in patients with ILD

Null: There is no significant difference between the effect of diaphragmatic breathing and a combination of diaphragmatic and pursed-lip expiration exercises in improving the pulmonary function in patients with ILD.

5.1 Study design- Comparative Study

5.2 Sample size – 100 (50 in each group)

5.3 Sample Method- Random sampling.

5.4 Selection criteria

Inclusion Criteria

- Moderate (FEV1/FVC:>60 %).
- Age – 45-75 years (both male and female).
- Patients diagnosed with ILD are diagnosed with symptoms based on imaging tests, bloodtests, lung function tests, Bronchoscopy, and Biopsy.
- Patients are feasible to perform 6 MWT
- Spo2 >=90%

Exclusion Criteria

- Non-co-operative patients
- Walking limitations including joint restrictions or other critical diseases
- Patients of other respiratory and cardiac diseases.
- Comorbidity conditions
- Current smoking status

5.5Variables: Independent variables

- Diaphragmatic breathing
- Pursed-lip expiration exercises

Dependent variables

- FeV1
- FVC
- FeV1/FVC
- 6 MWT

5.6Instruments required:

Stopwatch, Pulse Oximeter, PFT

5.7Outcome measure:

PFT, 6 MWT

5.8Procedure:

The participants were briefed about the nature of the study and the interventions. After the briefing, informed consent was taken from all the participants. Participants were randomly divided into two groups containing 50 participants in each group. Group A was given diaphragmatic breathing exercises and Group B pursed-lip expiration exercise.

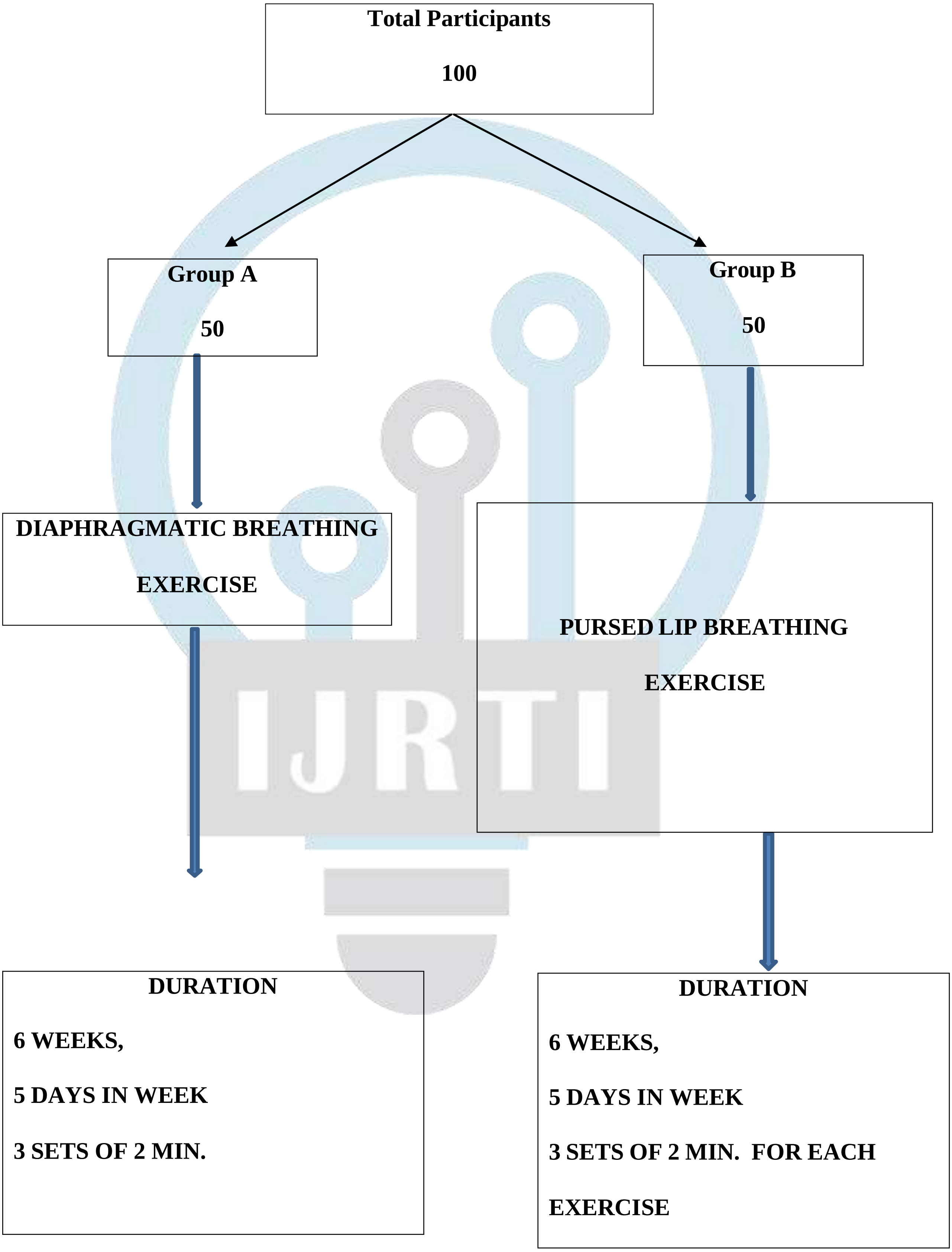
Group – A(Diaphragmatic Breathing Exercises)

Patients were given diaphragmatic breathing exercises for 6 weeks, 5 days a week, 6 min of quiet breathing, and 6 min of diaphragmatic breathing (3 sets of 2 min each). Ask the patientto relax and be positioned in a comfortable position so that his/her back and head are fully supported and his/her abdominal wall relaxed. The researcher places his hands on the rectus abdominals just below the anterior costal margin. A patient was asked to breathe in slowly and

deeply through the nose. A patient was instructed to keep the shoulders relaxed and upperchest quiet, following the abdomen to rise. Then the patient was asked to slowly let all the air out using controlled expiration with pursed lips. This was applied for 2 min and then rest. Three sets will be applied in a 6 minutes treatment session.

Group - B (Pursed-lip expiration exercise)

Patients were given a combination of diaphragmatic breathing & pursed-lip expiration exercisefor 6 weeks (5 days a week, 6 minutes per session per exercise). Patients were given diaphragmatic breathing exercises after 6 min of quiet breathing, and 6 min of diaphragmatic breathing (3 sets of 2 min each). After completion of diaphragmatic breathing for 6 min and then asked for rest. Patients were given pursed-lip expiration exercise after 6 min of quiet breathing, and 6 min of pursed-lip expiration exercise (3 sets of 2 min each). The patient was asked to relax his or her shoulder muscles and asked to breathe in (inhale) slowly through hisor her nose for two counts, keeping the mouth closed. Then he/she was asked to pursue their lips as if they were going to whistle or gently flicker the flame of a candle. Finally, breathe out (exhale) slowly and gently through pursed lips while counting to four. This was applied for 2 min and then rest. Three sets will be applied in a 6 minutes treatment session.



5.9 Statistical analysis

The statistical analysis was carried out using IBM SPSS (Statistical Package for Social Sciences) statistical version 20. In the comparison of two types of breathing exercises i.e. diaphragmatic breathing exercise and pursed-lip expiration exercise between two groups, all quantitative variables were estimated using measures of central location (mean and median) and measures of dispersion (standard deviation).The normality of data was checked. For normality distributed data, Mean was compared with respect to T-test (for two groups) and Paired t-test (pre-score and post-score comparison). All statistical tests were seen at a two-tailed level of significance (p ≤0.01 and p≤0.05).

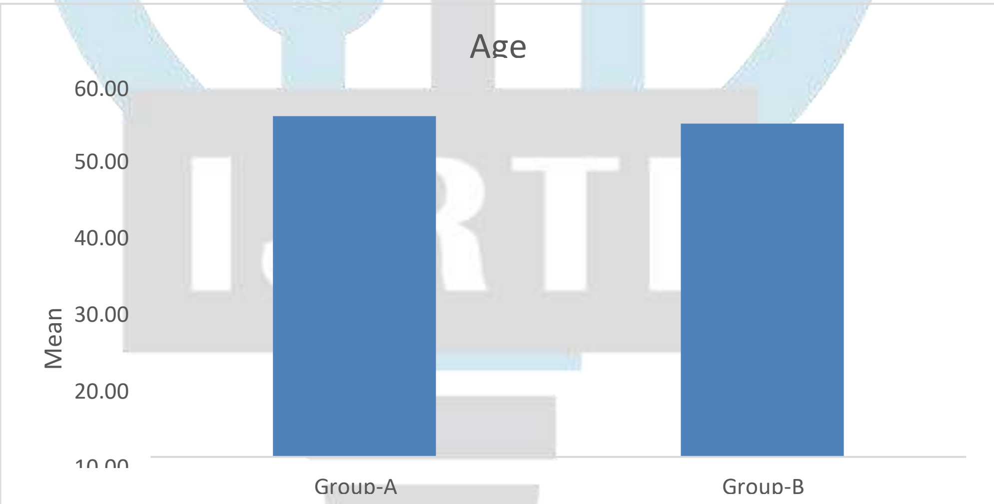
5.10 DATA ANALYSIS

Independent t-test for compare group-A and group-B

TABLES 1

Group		N	Mean	Std. Deviation	t-value	p-value
Age	Group-A	50	54.84	7.53	.884	.379
	Group-B	50	53.62	6.22		

FIGURE 1



Mean value of Age of Group A and Group B

Difference between Pre and Post Value of (6MWT) Of Group A and Group B

TABLES 2

Group		N	Mean	Std. Deviation	t-value	p-value
Distance	Group-A	50	328.800	112.729	.921	.359
	Group-B	50	349.400	110.830		
Distance-Post	Group-A	50	355.060	110.852	1.202	.232
	Group-B	50	382.160	114.663		

FIGURE 2

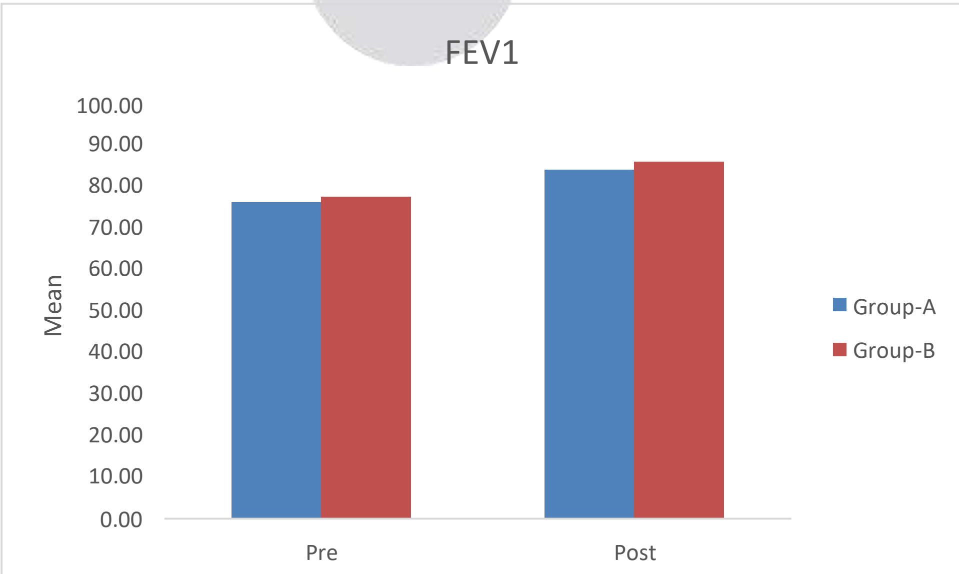
Difference between Value of Pre and Post Distance (6mwt) of Group A and Group B

Difference between Pre and Post Values of PFT of Group A and Group B

TABLE 3

Group		N	Mean	Std. Deviation	t-value	p-value
FEV1	Group-A	50	76.080	23.848	.245	.807
	Group-B	50	77.320	26.587		
FEV1-Post	Group-A	50	83.900	21.817	.430	.668
	Group-B	50	85.820	22.848		

FIGURE 3

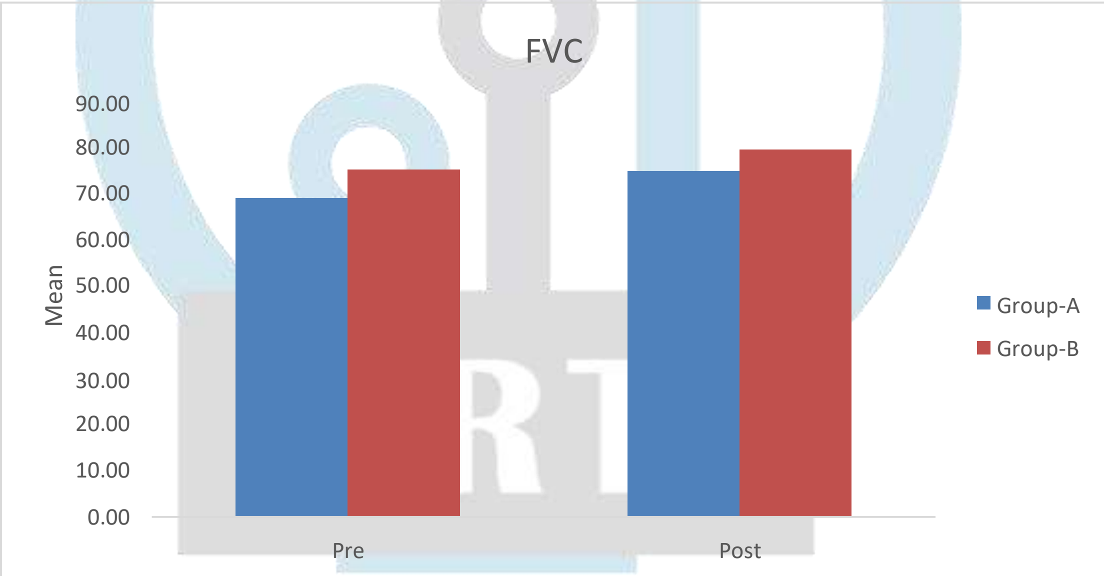


Difference between pre and post values of FeV1 of Group A and Group B

TABLE 4:

Group		N	Mean	Std. Deviation	t-value	p-value
FVC	Group-A	50	69.080	24.677	1.183	.240
	Group-B	50	75.200	27.021		
FVC-Post	Group-A	50	74.860	22.506	1.038	.302
	Group-B	50	79.560	22.788		

FIGURE 4

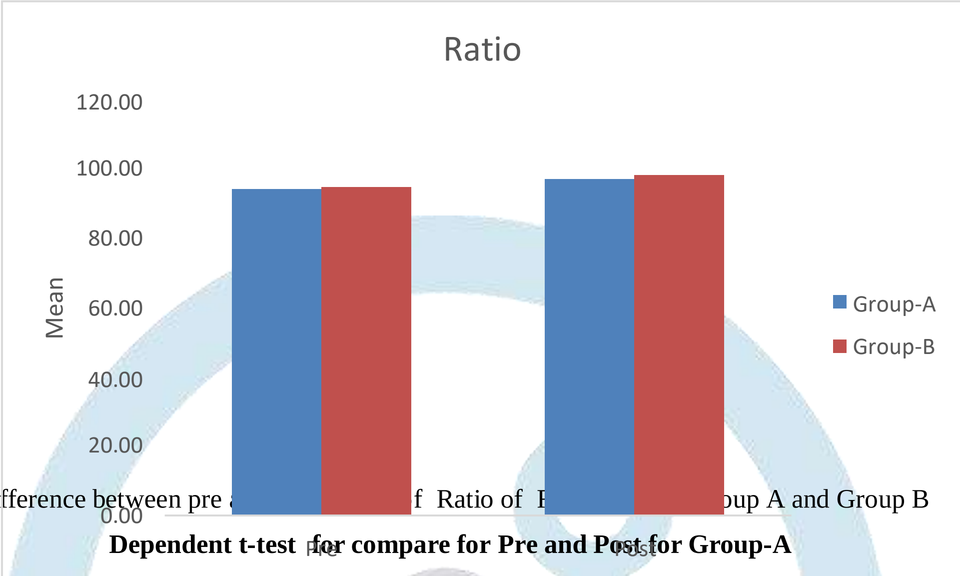


Difference between pre and post values of FVC of Group A and Group B

TABLE 5:

Group		N	Mean	Std. Deviation	t-value	p-value
Ratio	Group-A	50	94.176	14.894	.221	.826
	Group-B	50	94.759	11.261		
Ratio-Post	Group-A	50	97.120	7.829	.717	.475
	Group-B	50	98.300	8.615		

FIGURE 5



Difference between pre a f Ratio of F oup A and Group B

Dependent t-test for compare for Pre and Post for Group-A

Group = Group-A

TABLE 6

		N	Mean	Std. Deviation	t-value/ Wilcoxon SignedRanks#	p-value
Distance	Pre	50	328.800	112.729	2.391	.021*
	Post	50	355.060	110.852		
SPO2	Pre	50	95.480	2.845	0.268#	.789
	Post	50	95.520	3.436		
LowestSPO2	Pre	50	93.080	5.473	0.095#	.925
	Post	50	93.060	5.730		

Difference between Pre And Post Value of (6MWT) Of Group A

TABLE 8

		N	Mean	Std. Deviation	t-value	p-value
FEV1	Pre	50	76.080	23.848	2.060	.045*
	Post	50	83.900	21.817		
FVC	Pre	50	69.080	24.677	1.556	.126
	Post	50	74.860	22.506		
Ratio	Pre	50	94.176	14.894	1.258	.214
	Post	50	97.120	7.829		

Difference Between Pre And Post Values of PFT of Group A

Dependent t-test for compare for Pre and Post for Group-B

Group = Group-B

TABLE 7

		N	Mean	Std. Deviation	t-value/ Wilcoxon SignedRanks#	p-value
Distance	Pre	50	349.400	110.830	4.352	.0001**
	Post	50	382.160	114.663		
SPO2	Pre	50	95.200	3.117	1.491#	.136
	Post	50	94.500	4.027		
LowestSPO2	Pre	50	92.180	5.439	0.224#	.822
	Post	50	92.060	6.374		

Difference between Pre And Post Value of (6MWT) Of Group B

TABLE 9

		N	Mean	Std. Deviation	t-value	p-value
FEV1	Pre	50	77.320	26.587	2.288	.026*
	Post	50	85.820	22.848		
FVC	Pre	50	75.200	27.021	1.201	.235
	Post	50	79.560	22.788		
Ratio	Pre	50	94.759	11.261	2.013	.050*
	Post	50	98.300	8.615		

Difference Between Pre And Post Values of PFT of Group B

RESULT

The result of present study after the statistical analysis of data obtained. 100 participants matched the inclusion criteria and their characteristics details are:

All the participants were divided into two groups: Group A and Group B. Both groups have different protocols using Diaphragmatic breathing and pursed lips breathing for 6 weeks.

In Group A (Diaphragmatic breathing) , there were 50 participants. The mean age of 54.84 ±

7.53 years. In Group B (pursed lips breathing) there were 50 participants. The mean age is 53.62 ± 6.22 years.

The result of the present study states that both groups have better effects. By applying Independent -t test we compared Group A & Group B. The results were found insignificant while comparing mean value of pre & post of the both groups.

By applying Dependent -t test, both group compared within-group values of 6MWT and PFT In Group A (Diaphragmatic breathing), We found a significant difference between the distance covered in 6MWTand the value of FEV1, with a mean of 355.060 ± 110.852 SD, 83.900 ± 21.817 SD respectively. In Group B (Pursed lips breathing), We found a significant difference between the value of distance covered in 6MW T,FEV1 and Ratio of FEV1/FVC, with a mean of 382.160 ± 114.663 SD , 85.820 ± 22.848 SD, 98.300 ±
8.615 SD respectively.

Thus experimental hypothesis stated in the beginning of the study i.e. there is a difference between the effect of diaphragmatic breathing and a pursed-lip expiration exercises in improving pulmonary function in patients with

ILD holds true.

In Group B (Plus pursed lips breathing) the distance covered in 6MWT and the value of FEV1 more significantly improved as compared to Diaphragmatic breathing given in Group A. The ratio of FEV1/FVC is significantly improved in Group B as non-significant changes were noticed in Group A.

DISCUSSION

The main results of this study were the following: (1) the diaphragmatic breathing and the pursed-lips breathing resulted in significant increases in distance covered in 6 min. (2) the diaphragmatic breathing and pursed-lips breathing resulted in significant increases the value of FeV1 (3) Pursed-lips breathing provided better changes in the ratio of FeV1 and FVC. Other studies also reported significant increases in tidal volume during diaphragmatic breathing and during pursed-lips breathing when performed separately. During pursed-lips breathing, the end-expiratory chest wall volume is important, once there is an increase in the expiratory time associated with the reduction of the breathing frequency that may contribute tothe reduction of this volume, as reported by Bianchi et al.2017. [28] However, the effects of thepursed-lips breathing on end-expiratory chest wall volume are not consistent because studies demonstrated different effects, such as increases, decreases, or no changes, in this volume in subjects with COPD. Both breathing exercises promoted a decrease in the breathing frequency due to the increase of inspiratory time and expiratory time. Those changes in breathing patterns supported the findings of previous studies of the effects of diaphragmatic breathing and pursed-lips breathing assessed separately. Jones et al also evaluated oxygen consumption during spontaneous breathing at rest and during breathing exercises (diaphragmatic breathing and diaphragmatic breathing plus pursed lips).[29]

The effects of PR on pulmonary function tests are largely controversial, unlike COPD where a definite improvement in PFT has been demonstrated with exercise training. The study by Vonbank *et al*. concluded a significant improvement in FVC values after endurance and RMT in patients with ILD. Limited evidence is available regarding long‑ term effects of PR. In the Cochrane meta‑ analysis, only two studies reported long‑ term outcomes, with no significant effects of PR on clinical variables or survival at 3 or 6 months. Most of these studies have beenpublished from developed countries where PR program is already well established for COPD patients and now its utility is increasingly being recognized for patients with ILD. Literature evidence regarding this issue is lacking from the Indian subcontinent.[30]

A pilot Indian study by Gupta *et al*. demonstrated similar benefits in dyspnoea and quality of life scales after 6 weeks of a domiciliary PR program. The currently available literature presents 2 different opinions on responses to PR. Some authors estimate that greater improvement is observed in patients whose baseline FVC is higher and whose desaturation after exercise is lower. These authors conclude that it is crucial to introduce PR as early as possible in this group of patients. Other authors observe that lower 6MWT baseline values result in the greatest increase after PR, suggesting that even in very advanced diseases respiratory rehabilitation makes sense. It seems that both opinions are correct, proving that improvements in ILD patients can be achieved in a variety of diseases with a broad spectrum of progression.[31]

CONCLUSION

The results showed that diaphragmatic breathing and diaphragmatic breathing plus pursed-lips breathing improved the distance in 6min walk test and value of FeV1. In addition of pursed- lips breathing to diaphragmatic breathing provided better changes in ratio of FeV1 and FVC. Therefore, this study supported the positive acute effects of these breathing exercises for subjects with ILD. These breathing exercises are low cost and do not require special instrumentation or continuous assistance from a health care provider, which can improve adherence of the patients to their routine.

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