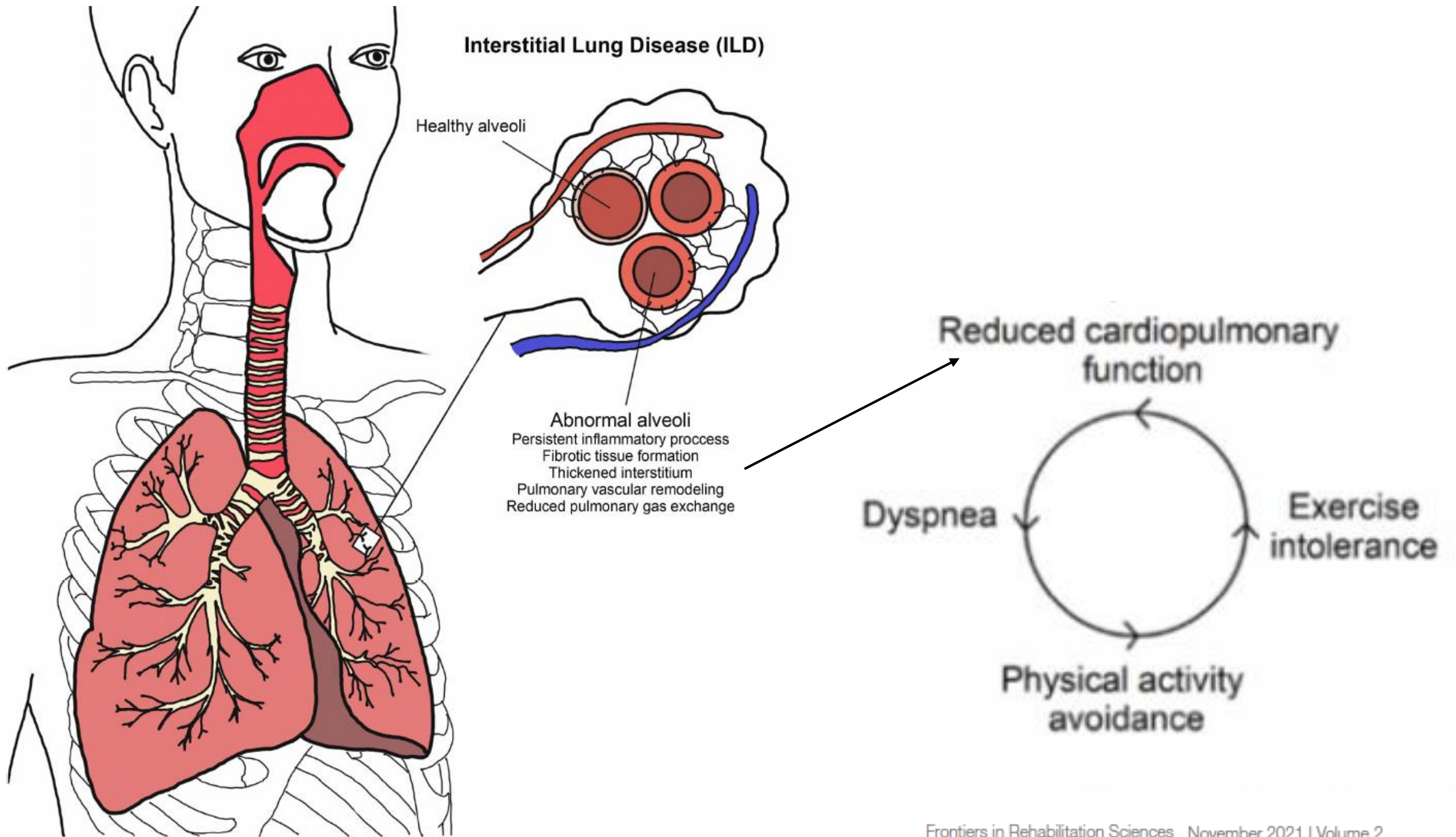


# Pulmonary Rehabilitation in ILD

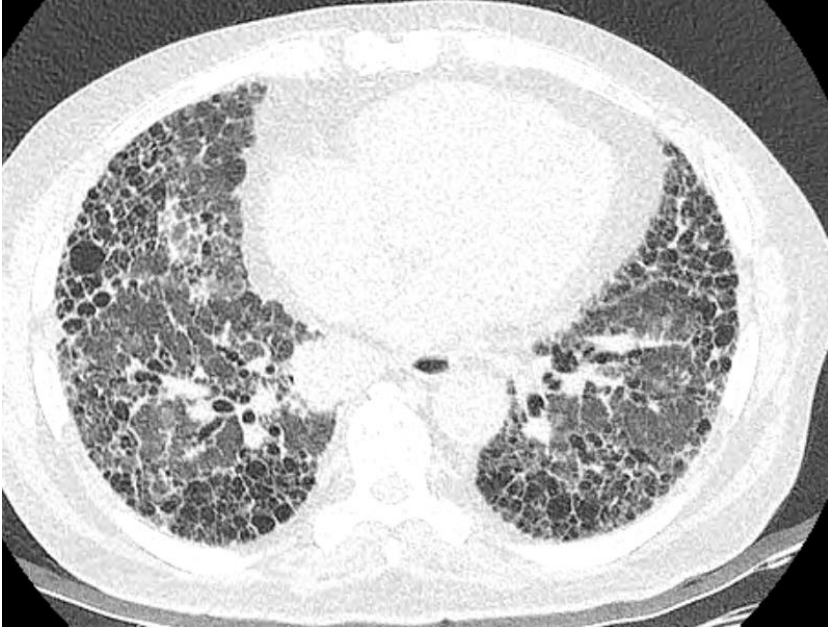
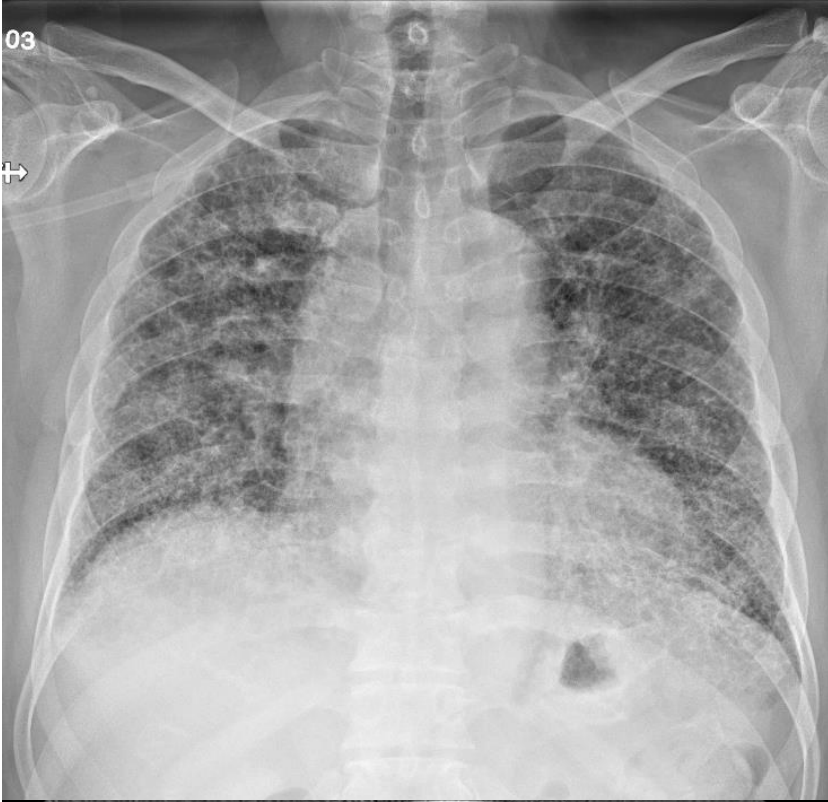


인제대학교 일산백병원  
호흡기내과 강형구



**FIGURE 1** | Pathophysiology and cycle of reduced physical activity levels in ILDs.

- Limitations
  - ventilatory: abnormal breathing patterns, ventilatory inefficiency, higher oxygen cost of breathing
  - diffusional: impaired pulmonary gas exchange, arterial hypoxemia
  - cardiovascular: increased pulmonary artery pressure
  - skeletal: reduced muscle strength and resistant fatigue
- Parameters
  - cardiopulmonary exercising test (CPET)
  - 6MWT
  - Peripheral muscle dysfunction
  - Respiratory muscle dysfunction

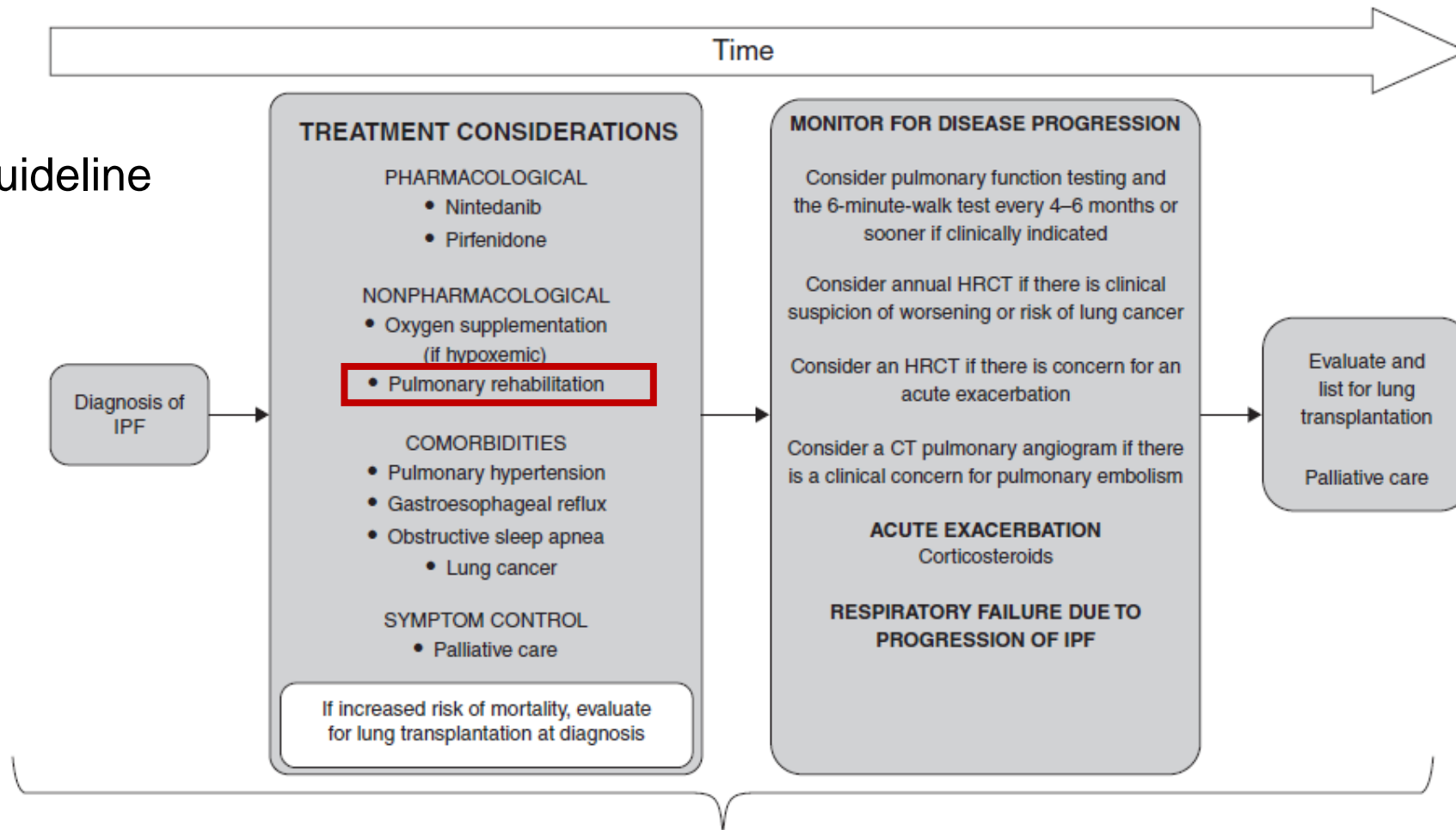


## M/60 IPF

- mMRC grade 4
- Home O<sub>2</sub> 2L
- FVC 1.86L (47%)  
DLCO 3.7mL/mmHg/min (18%)
- severe pulmonary hypertension  
(Vmax:4.04m/s, RVSP:75.13mmHg)

폐이식 권유 → reluctant  
호흡재활 권유

## 2022 guideline



Patients should be made aware of available clinical trials for possible enrollment at all stages

## 2011 guideline

Am J Respir Crit Care Med Vol 205, Iss 9, pp e18–e47, May 1, 2022

The majority of patients with IPF should be treated with pulmonary rehabilitation, but pulmonary rehabilitation may not be reasonable in minority

(weak recommendation, low-quality evidence)

Am J Respir Crit Care Med Vol 183, pp 788–824, 2011

# Question?

- 어떤 환자에게 어느 시점에 호흡재활을 권유할 것인가?  
(질환, 폐기능, 호흡곤란 정도 등)
- 호흡재활을 하면 환자에게 어떤 이득이 있는가?
- 얼마의 기간동안 어떤 방식으로 호흡재활을 하는가?

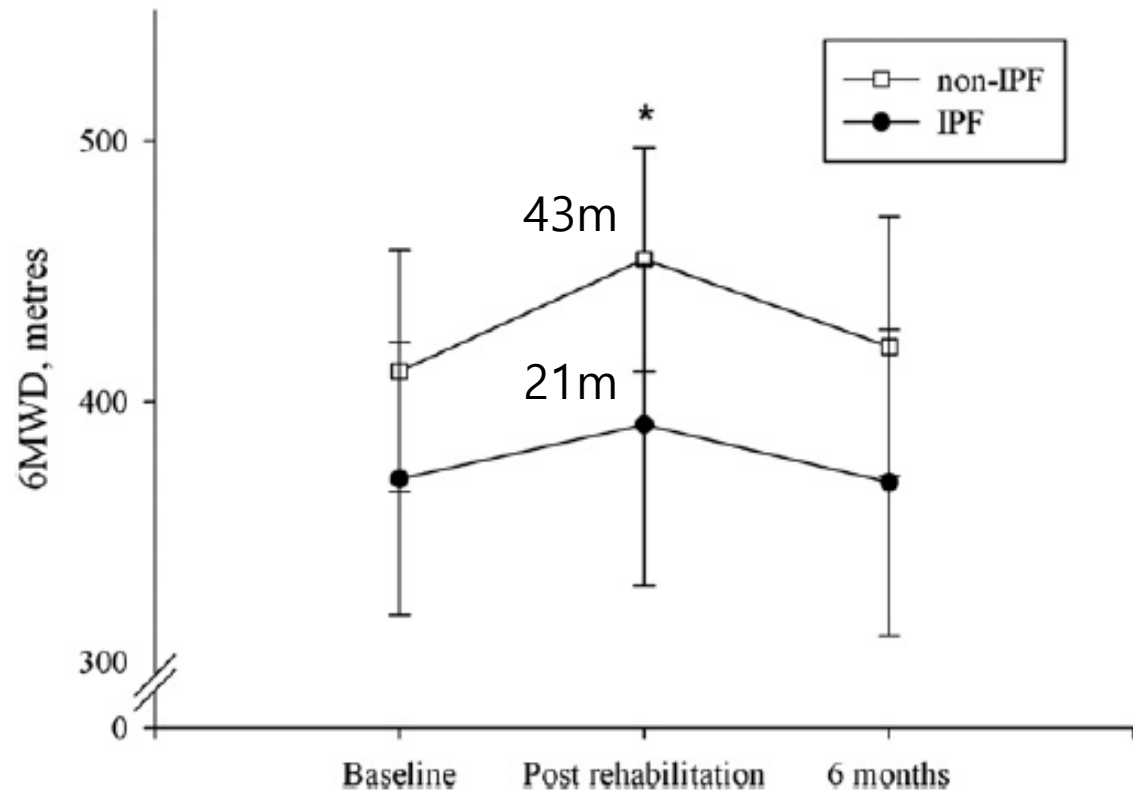
# Predictors of benefit following pulmonary rehabilitation for interstitial lung disease

Anne E. Holland<sup>a,b,c,\*</sup>, Catherine J. Hill<sup>c,d</sup>, Ian Glaspole<sup>e</sup>, Nicole Goh<sup>c,e,f</sup>,  
Christine F. McDonald<sup>c,f,g</sup>

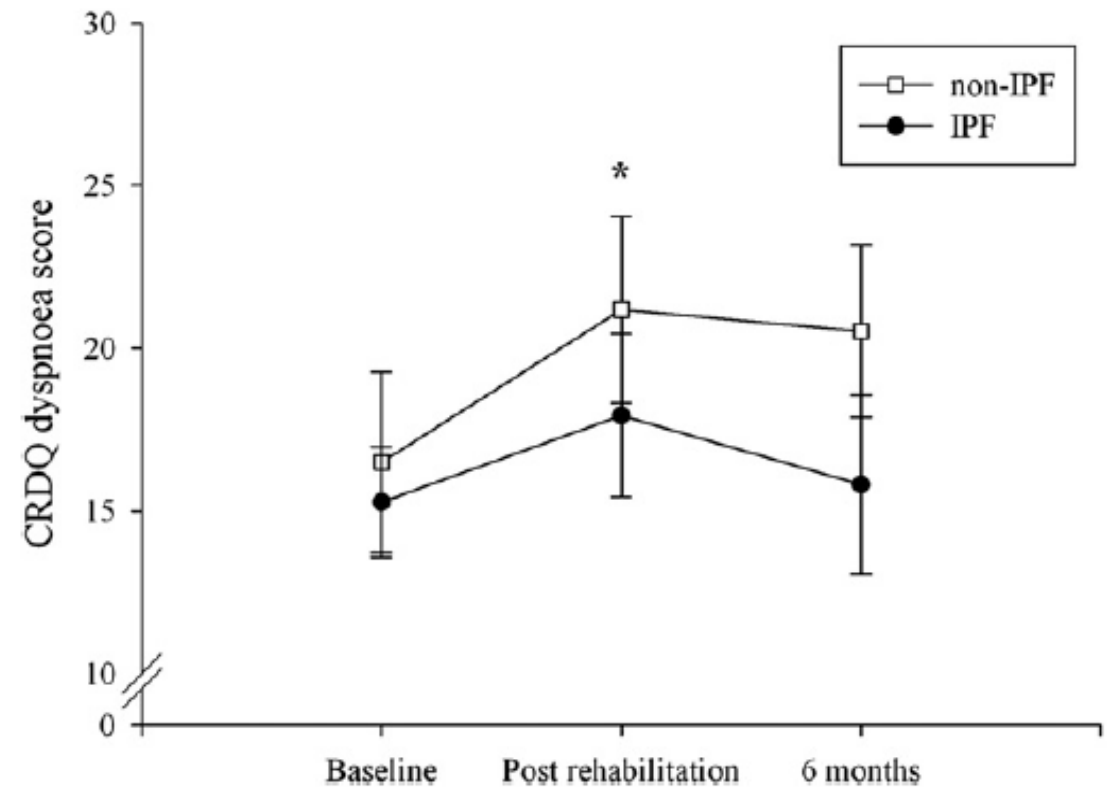
- 44 Patients  
Ambulant and reported dyspnea on exertion on stable medical therapy
- Twice-weekly for 8 weeks exercise training program of endurance and strength training

Table 1 Baseline demographic characteristics of participants with IPF compared to those with other ILDs.

	IPF, <i>n</i> = 25	Other ILD, <i>n</i> = 19	<i>p</i> value
Age, years	72.9 (6.8)	68.1 (8.4)	0.05
FVC, %predicted	76.4 (20.3)	72.1 (23.6)	0.53
TLCO, %predicted	48.5 (19.1)	51.7 (19.3)	0.48
TLC, %predicted	74.9 (16.7)	73.2 (16.2)	0.79
RVSP, mmHg	36.5 (15.7)	36.0 (11.4)	0.93
6MWD, m	370 (127)	411 (96)	0.24
Nadir SpO <sub>2</sub> , %	85 (7)	88 (5)	0.13
CRQ dyspnoea	15.3 (3.8)	16.5 (5.6)	0.42



**Figure 1** Comparison of exercise response to pulmonary rehabilitation in participants with IPF and other ILDs. IPF – idiopathic pulmonary fibrosis, 6MWD – 6-minute walk distance. \* $p < 0.05$  vs baseline for both groups.



**Figure 2** Comparison of symptoms response to pulmonary rehabilitation in participants with IPF and other ILDs. IPF – idiopathic pulmonary fibrosis, CRDQ – chronic respiratory disease questionnaire. \* $p < 0.05$  vs baseline for both groups.

Table 2 Relationship between baseline characteristics and response to pulmonary rehabilitation.

	Short-term response				Long-term response			
	Change in 6MWD		Change in CRQ dyspnoea		Change in 6MWD		Change in CRQ dyspnoea	
	IPF	Non-IPF	IPF	Non-IPF	IPF	Non-IPF	IPF	Non-IPF
FVC %pred	0.49*	-0.07	-0.01	-0.09	0.40†	0.16	-0.04	-0.26
DLCO %pred	0.29	-0.31	0.03	-0.26	0.08	-0.05	-0.06	-0.34
RVSP, mmHg	-0.47†	0.03	-0.42	0.33	-0.18	-0.09	-0.006	0.21
Nadir SpO <sub>2</sub> , %	0.43*	-0.21	0.16	-0.14	0.55*	-0.02	0.29	-0.21
Baseline 6MWD, m	0.20	-0.39	0.18	-0.14	-0.31	-0.28	-0.03	0.07
Baseline CRQ dyspnoea	0.25	-0.12	-0.34	-0.39	0.08	0.17	-0.52*	-0.60*

Data are Pearson's *r*, except for short-term 6MWD response in non-IPF which are Spearman's rho. †*p* < 0.1, \**p* < 0.05.

FVC forced vital capacity; TLCO – diffusing capacity for carbon monoxide; TLC – total lung capacity; RVSP – right ventricular systolic pressure on trans-thoracic echocardiogram; 6MWD – 6-minute walk distance; nadir SpO<sub>2</sub> – oxyhaemoglobin saturation on baseline 6-minute walk test; CRQ – Chronic Respiratory Questionnaire.

IPF: greater FVC, lower RVSP, less desaturation → change in 6MWD

# The evidence of benefits of exercise training in interstitial lung disease: a randomised controlled trial

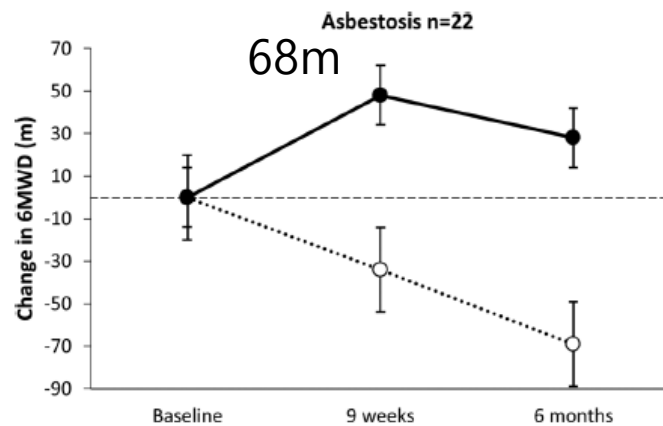
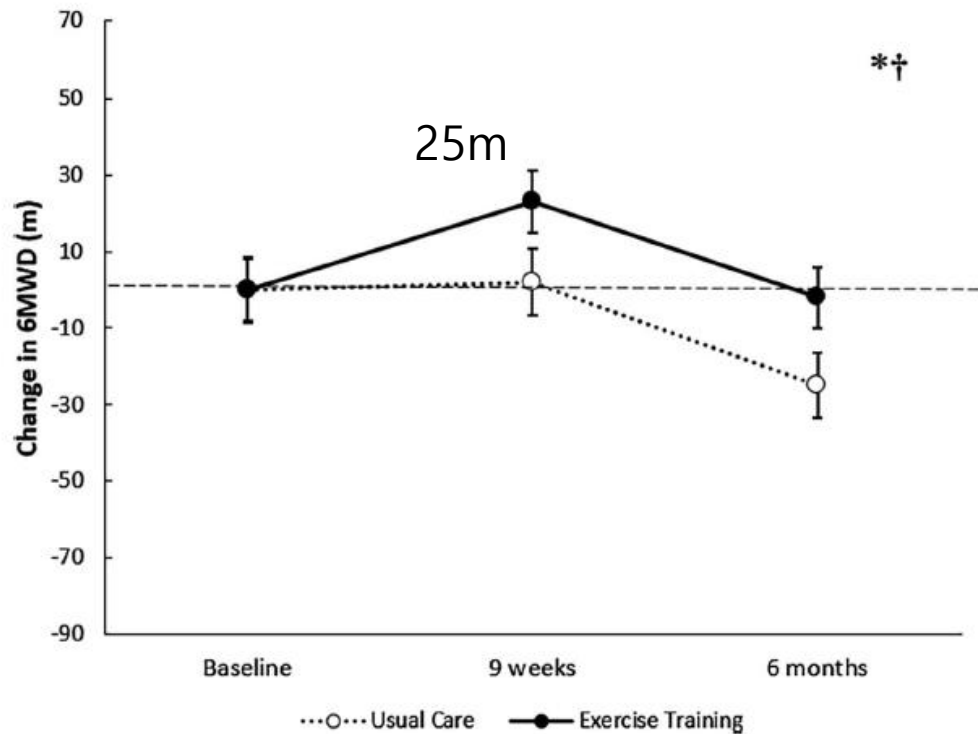
- Patients

Inclusion: **Clinically stable, ambulant, and reported dyspnea** on exertion despite maximal medical treatment

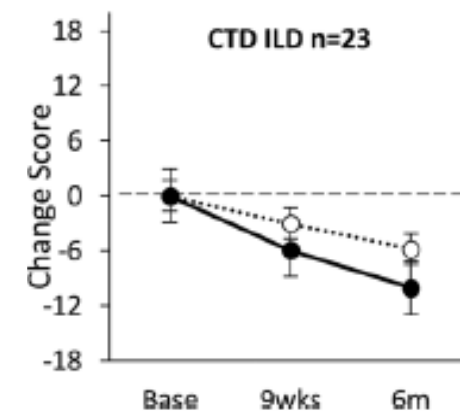
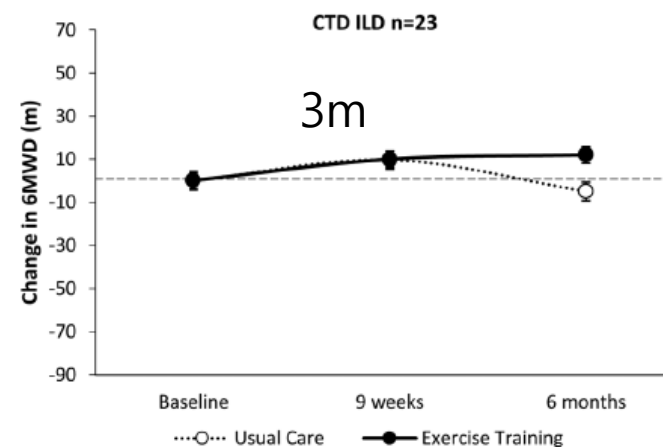
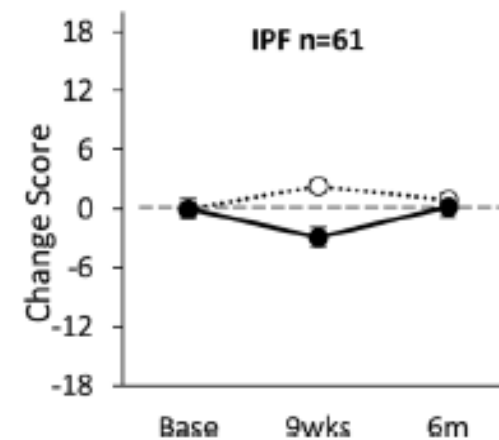
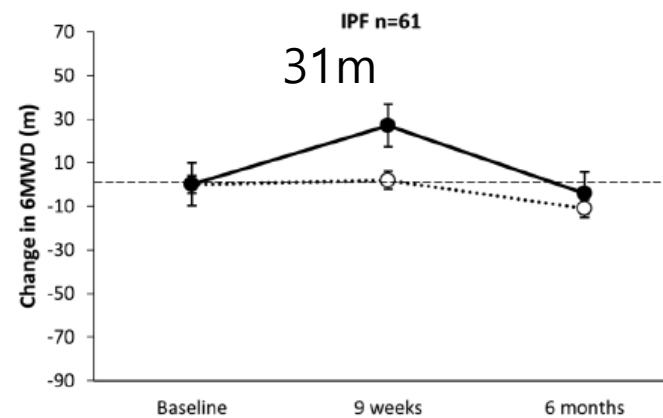
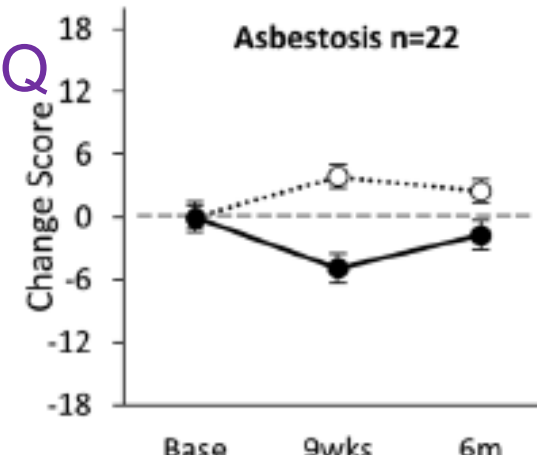
Exclusion: history of syncope on exertion, any comorbidities that preclude exercise

- 142 patients (61 IPF, 22 asbestosis, 23 CTD-ILD, 36 others)
- **8 weeks** of supervised exercise training or usual care

	IPF			Asbestosis			CTD-ILD		
	Usual care n=29	Exercise training n=32	p Value	Usual care n=11	Exercise training n=11	p Value	Usual care n=12	Exercise training n=11	p Value
Age (years)	73 (9)	70 (10)	0.4	72 (9)	72 (7)	0.1	65 (11)	63 (10)	0.6
Gender, male	20 (69%)	21 (66%)	0.8	11 (100%)	11 (100%)		3 (25%)	1 (9%)	0.3
Oxygen therapy									
Long term	4 (14%)	2 (6%)	0.4	0 (0%)	0 (0%)		1 (8%)	0 (0%)	1.0
Exertional	10 (35%)	5 (16%)	0.1	2 (18%)	0 (0%)	0.2	1 (8%)	1 (9%)	1.0
Treatment									
Prednisolone	10 (35%)	5 (16%)	0.1	0 (0%)	0 (0%)		6 (50%)	7 (64%)	0.7
Immunosuppressant	3 (10%)	0 (0%)	0.1	0 (0%)	0 (0%)		2 (17%)	5 (46%)	0.2
Pirfenidone	1 (3%)	1 (3%)	1.0	0 (0%)	0 (0%)		0 (0%)	0 (0%)	
Nintedanib	0 (0%)	0 (0%)		0 (0%)	0 (0%)		0 (0%)	0 (0%)	
N-Acetylcysteine	2 (7%)	0 (0%)	0.2	0 (0%)	0 (0%)		0 (0%)	0 (0%)	
FVC (%pred)	78 (19)	74 (18)	0.4	78 (14)	85 (19)	0.3	71 (26)	78 (16)	0.5
TLCO (%pred)	49 (11)	50 (17)	0.1	54 (15)	54 (12)	1.0	51 (14)	53 (18)	0.7
TLC (%pred)	77 (13)	75 (15)	0.6	80 (17)	91 (22)	0.2	78 (17)	82 (19)	0.7
PASP (mm Hg)	37 (11)	35 (16)	0.4	34 (12)	28 (12)	0.3	30 (10)	28 (6)	0.7
6MWD (m)	398 (166)	456 (126)	0.1	498 (113)	453 (67)	0.3	486 (99)	526 (74)	0.3



SGRQ



**Table 5** Comparison of change in 6MWD between intention to treat and per protocol analyses for each subgroup

	Mean difference (95% CI)	
	9 week follow-up	6 month follow-up
<b>IPF</b>		
ITT n=29/32	31 (–5 to 66)	0.9 (–36 to 38)
PP Completion n=29/15	26 (–14 to 67)	–18 (–63 to 26)
PP Progression n=29/16	55 (13–97)	15 (–30 to 60)
<b>Asbestosis</b>		
ITT n=11/11	68 (10 to 124)	92 (36 to 148)
PP Completion n=11/10	75 (19 to 132)	93 (38 to 148)
PP Progression n=11/10	75 (19 to 132)	93 (38 to 148)
<b>CTD-ILD</b>		
ITT n=12/11	3 (–53 to 60)	21 (–35 to 77)
PP Completion n=12/6	14 (–50 to 78)	38 (–25 to 101)
PP Progression n=12/6	14 (–50 to 78)	38 (–25 to 101)

Values are mean difference (SE). Data are exercise group – control group. n=number of participants in usual care group/exercise training group for the corresponding analysis.

6MWD, six-minute walk distance; CTD, connective tissue disease; ILD, interstitial lung disease; IPF, idiopathic pulmonary fibrosis; ITT, intention to treat; PP, per protocol.

**Table 6** Stepwise multiple linear regression model for change in 6MWD following intervention

	B	SE of B	Standardised $\beta$	p Value	R <sup>2</sup> (%)
<b>Change from baseline to 9 weeks</b>					
Constant	58.468	21.572		0.008	
Group	36.595	11.722	–0.296	0.002	
Baseline 6MWD (m)	–0.141	0.045	0.297	0.002	15
<b>Change from baseline to 6 months</b>					
Constant	–12.182	36.166		0.737	
PASP (mm Hg)	–1.544	0.637	–0.266	0.018	13
FVC (mL)	0.021	0.010	0.224	0.044	

p Values <0.05 were considered statistically significant.

6MWD, six-minute walk distance; B, unstandardised coefficient; Group, exercise versus usual care with usual care group as reference category; PASP, pulmonary artery systolic pressure; R<sup>2</sup>, R square—proportion of variation in change in 6MWD explained by the model.

Baseline 6MWD ↓ → Great benefits

FVC ↑, PASP ↓

→ sustained improvements

Progression of exercise intensity and participation in exercise training earlier in the disease course are crucial to optimize and sustain physiological benefits

# Pulmonary Rehabilitation for Exercise Tolerance and Quality of Life in IPF Patients: A Systematic Review and Meta-Analysis

TABLE 1: Characteristics of the studies included in the review.

Author year	Country	Study design	No. of patients (n)	Gender (M/F)	Age	Duration	Program of PR	CG group	Outcomes
Vainshelboim et al. 2016[16]	Israel	RCTs, 2arms	32 PR 15 CG 17	PR 10/5 CG 11/6	PR 68.8±6 CG 66±9	12-week	Aerobic, Resistance, Flexibility exercise, Modes and deep breathing exercises	Regular care	FVC%%, DLCO%%, 6MWD, IPAQ SGRQ scores
Vainshelboim et al. 2015[17]	Israel	RCTs, 2arms	28 PR 14 CG 14	/	PR 68.8±6 CG 66±9	11-month follow-up	Aerobic, Resistance, Flexibility exercise, Modes and deep breathing exercises	Regular care	FVC%%, DLCO%%, 6MWD, SGRQ scores, IPAQ
He et al. 2016[18]	China	RCTs, 2arms	30 PR 15 CG 15	PR 9/6 CG 8/7	PR 64.87±7.36 CG 65.33±7.74	12-week	Cycle ergometer	Regular care	FVC%%, DLCO%%, 6MWD, TLC%, ATAQ-IPF scores
Gaunard et al.2014[19]	America	RCTs, 2arms	21 PR 11 CG 10	/	PR 71±6 CG 66±7	12 weeks 3-month follow-up	Educational lectures, Supervised aerobic, Strengthening exercises.	Regular care	IPF-specific SGRQ scores IPAQ, FVC%, DLCO%
Robert et al. 2014[20]	America	RCTs, 2arms	21 PR 11 CG 10	/	PR 71±6 CG 66±7	12 weeks	Educational lectures, Treadmill walking, Semi recumbent cycling, Self-administered, Flexibility exercises, Strength training Treadmill, Cycle ergometer test, Supplemental oxygen, Elastic bands, Arm raising, Knee extensions, Educational lectures	Regular care	6MWD, TLC%
Nishiyama et al. 2008[21]	Japan	RCTs, 2arms	28, PR 13 CG 15	PR 12/1 CG 9/6	PR 68.1±8.9 CG 64.5±9.1	10 weeks		Regular care	6MWD, SGRQ scores FVC%, FEV1, TLC, BDI
Dariusz et al. 2008[22]	Poland	RCTs, 2arms	30 PR 16 CG 14	PR 10/6 CG 9/5	PR 56.5 ± 6.5 CG 56.2 ± 7.2	12 weeks	Inspiratory muscle training	Regular care	6MWD, BDI, SF-36

Clinically stable without infection or exacerbation  
FVC 70%, DLCO 53%,  
6MWD 513, mMRC 1.7

Clinically stable  
FVC 60%, DLCO 44%,  
6MWD 361

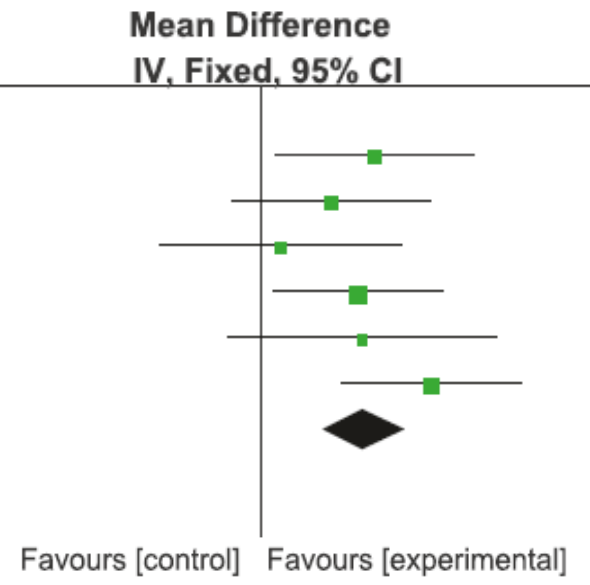
Absence of RHF, FVC  
40-90%, DLCO 30-  
90%, 150 ≤ 6MWD ≤ 500

Age ≤ 75, shortness of  
breath on effort, stable  
condition  
FVC 68%, DLCO 48%,  
6MWD 475

Study or Subgroup	Experimental			Control			Weight	Mean Difference IV, Fixed, 95% CI
	Mean	SD	Total	Mean	SD	Total		
<b>2.1.1 All included IPF patients</b>								
Dariusz et al. 2008	113	84.73	16	58.9	43.86	14	17.0%	54.10 [6.65, 101.55]
He et al. 2016	58.01	77.01	15	24.77	53.17	15	17.1%	33.24 [-14.12, 80.60]
Jackson et al. 2014	-6.2	86.91	11	-15.3	42.89	10	11.5%	9.10 [-48.73, 66.93]
Nishiyama et al. 2008	42	50.8	13	-4	57.7	15	23.7%	46.00 [5.81, 86.19]
Vainshelboim et al. 2015	-1	86	14	-49	86	14	9.4%	48.00 [-15.71, 111.71]
Vainshelboim et al. 2016	70.4	77	15	-10.6	35.4	17	21.3%	81.00 [38.56, 123.44]
<b>Subtotal (95% CI)</b>			<b>84</b>			<b>85</b>	<b>100.0%</b>	<b>48.60 [29.03, 68.18]</b>

Heterogeneity: Chi<sup>2</sup> = 4.50, df = 5 (P = 0.48); I<sup>2</sup> = 0%  
 Test for overall effect: Z = 4.87 (P < 0.00001)

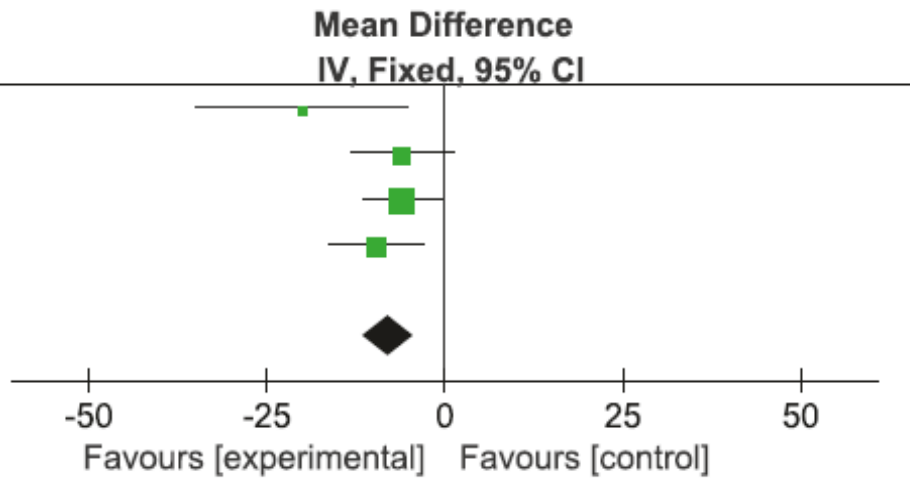
### 6MWD



Study or Subgroup	Experimental			Control			Weight	Mean Difference IV, Fixed, 95% CI
	Mean	SD	Total	Mean	SD	Total		
Gaunard et al. 2014	-9.1	22.2	15	11	15.55	10	5.8%	-20.10 [-34.90, -5.30]
Nishiyama et al. 2008	-2.9	9.27	13	3.1	10.11	15	24.7%	-6.00 [-13.18, 1.18]
Vainshelboim et al. 2015	-2	7	14	4	8	14	41.1%	-6.00 [-11.57, -0.43]
Vainshelboim et al. 2016	-6.9	6.5	15	2.8	12.3	17	28.3%	-9.70 [-16.41, -2.99]
<b>Total (95% CI)</b>			<b>57</b>			<b>56</b>	<b>100.0%</b>	<b>-7.87 [-11.44, -4.30]</b>

Heterogeneity: Chi<sup>2</sup> = 3.60, df = 3 (P = 0.31); I<sup>2</sup> = 17%  
 Test for overall effect: Z = 4.32 (P < 0.0001)

### SGRQ



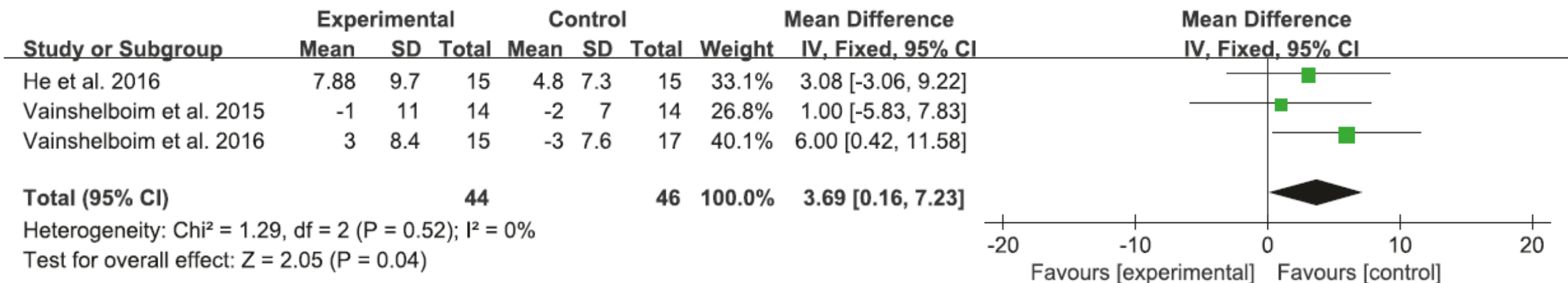


FIGURE 6: PR group versus control group, FVC%.

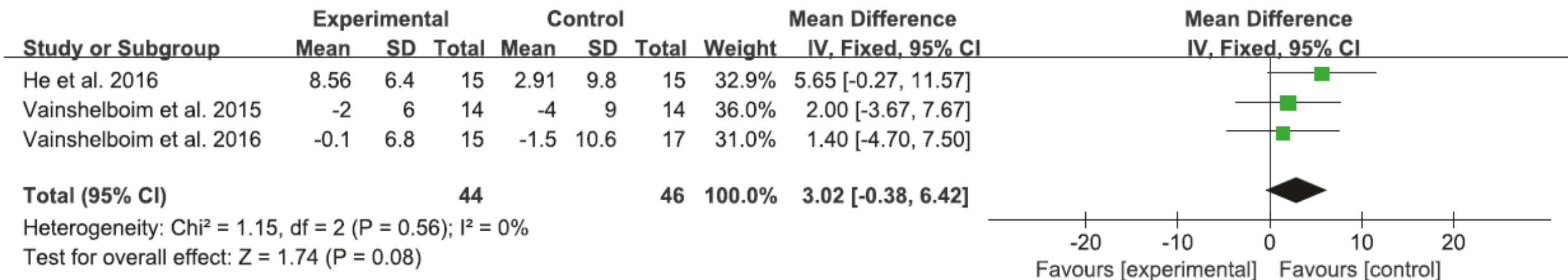


FIGURE 7: PR group versus control group, DLCO%.

어떤 환자에게 어느 시점에 호흡재활을 권유할 것인가?  
(질환, 폐기능, 호흡곤란 정도 등)

- Patients

ILD patients including IPF with clinically stable without infection or exacerbation

Regardless of pulmonary HT and pulmonary function

Dyspnea on exertion (prefer)

Absence of history of syncope on exertion or any comorbidities that preclude exercise

- Good benefits

Baseline 6MWD↓

FVC↑, PASP↓ → sustained improvements

# Effects of inpatient pulmonary rehabilitation in patients with interstitial lung disease

N=402

## Underlying disease

Idiopathic pulmonary fibrosis	202 (50)
Nonspecific interstitial pneumonia/cryptogenic organising pneumonia	21 (5)
Hypersensitivity pneumonitis	59 (15)
Sarcoidosis	50 (12)
Connective tissue disease	24 (6)
Radiogenic/drug induced	11 (3)
Asbestosis/silicosis/berylliosis	4 (1)
Other	31 (8)

- 5h of exercise training (aerobic and resistance training)
- 30min of breathing exercises (4~5회/주)
- Three sessions of group education (1회/주)

## Long-term oxygen therapy

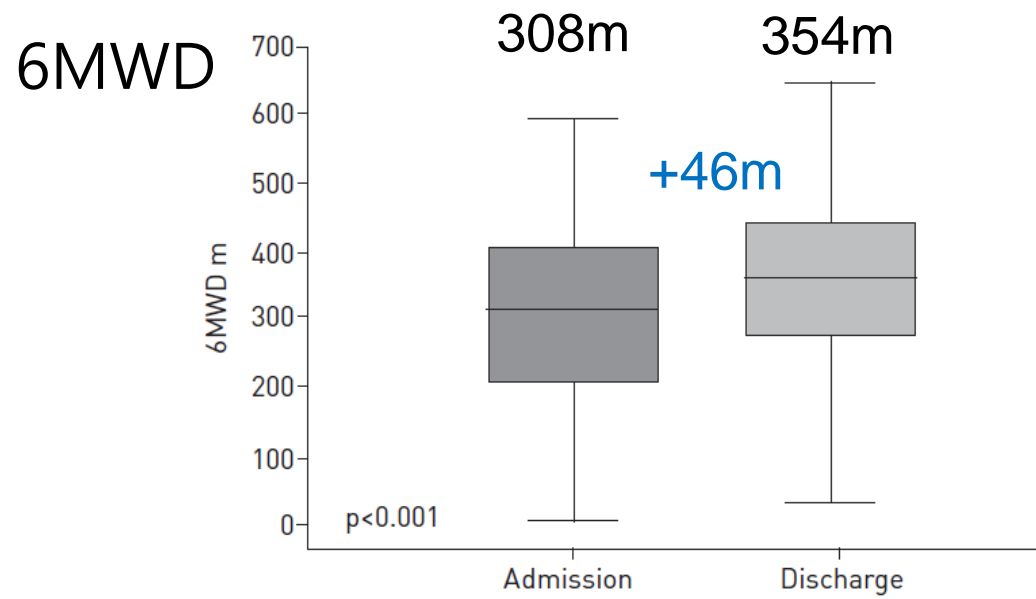
Yes	321 (80)
No	62 (15)
NA	19 (5)
<b>Vital capacity % pred</b>	<b>54 ± 1</b>
>90	24 (6)
70-89	64 (16)
50-69	124 (31)
<50	190 (47)

## Signs of pulmonary hypertension

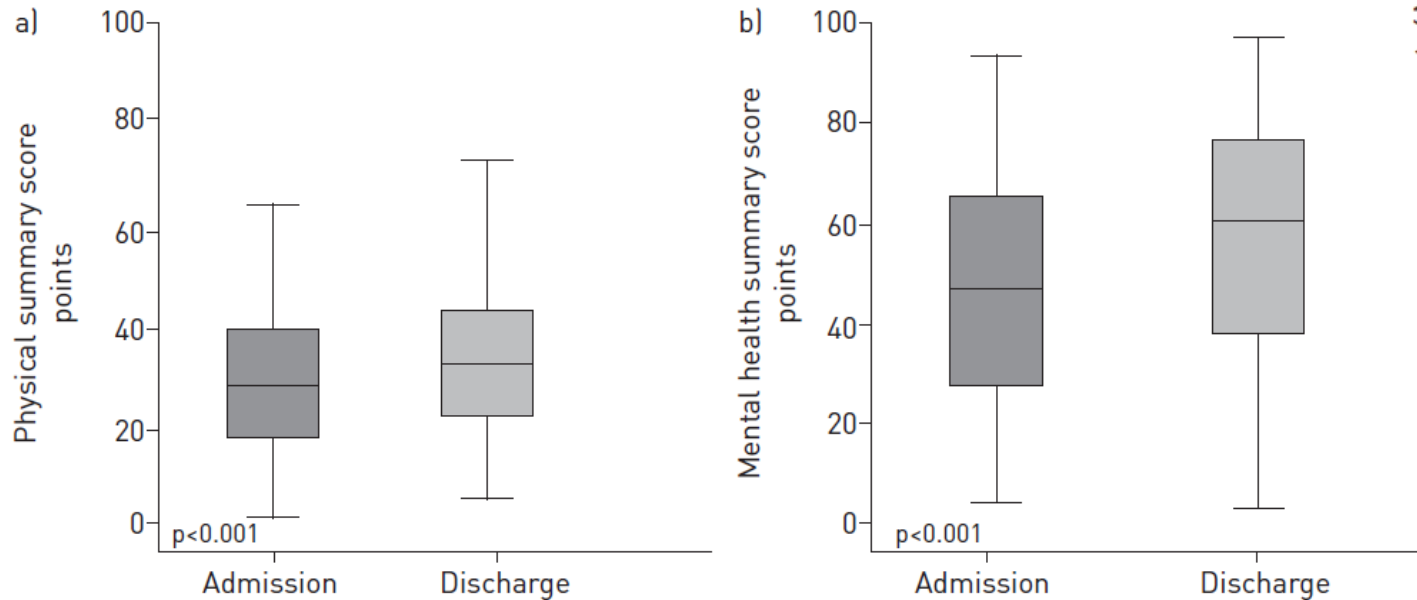
No	286 (71)
Yes	111 (28)
NA	5 (1)

## Listed for lung transplantation

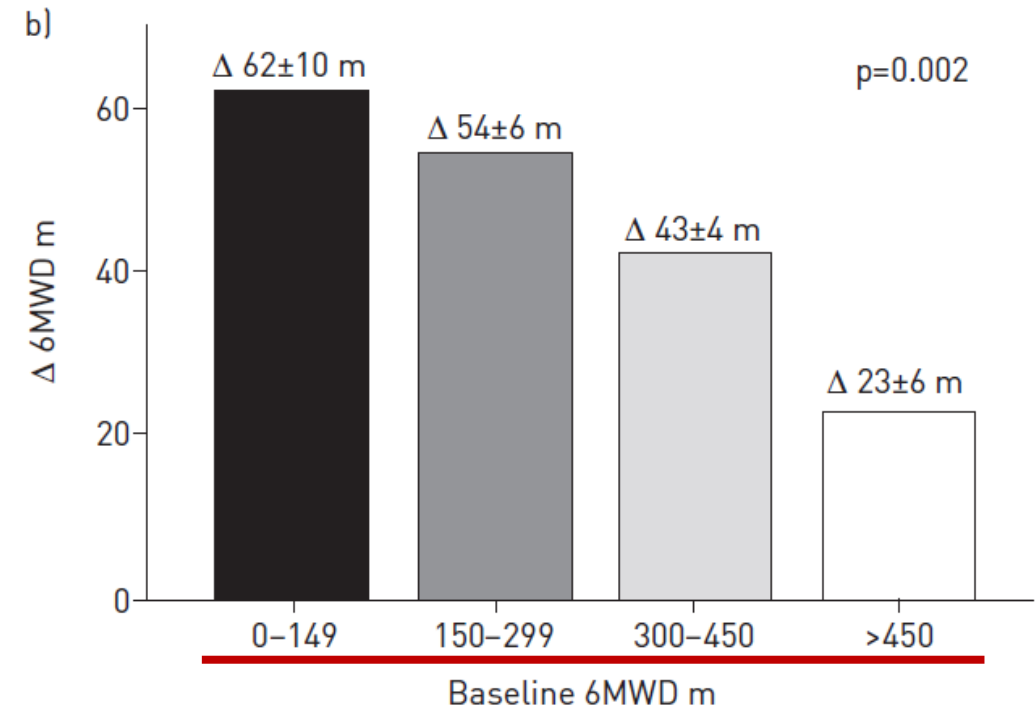
Yes	299 (74)
No	103 (26)



## Health related quality of life



SF-36



Parameters	No signs of PH				Signs of PH			
	Admission	Discharge	Change	p-value	Admission	Discharge	Change	p-value
<b>Lung function parameters<sup>#</sup></b>								
<i>P</i> <sub>O<sub>2</sub></sub> mmHg	62 ± 1	64 ± 1	2 ± 1	0.013	57 ± 2	58 ± 2	1 ± 1	0.722
<i>P</i> <sub>CO<sub>2</sub></sub> mmHg	38 ± 0	39 ± 0	1 ± 0	0.003	41 ± 1	41 ± 1	0 ± 1	0.862
VC % pred	56 ± 2	57 ± 1	1 ± 1	0.041	50 ± 2	52 ± 2	2 ± 1	0.007
TLC % pred	66 ± 1	65 ± 1	1 ± 1	0.105	62 ± 2	63 ± 2	1 ± 1	0.506
FEV <sub>1</sub> % pred	57 ± 1	58 ± 1	1 ± 0	0.001	52 ± 2	53 ± 2	1 ± 1	0.267
<b>6MWT and dyspnoea-rating<sup>†</sup></b>								
6MWD m	322 ± 8	370 ± 7	48 ± 3	<0.001	277 ± 12	313 ± 12	36 ± 6	<0.001
Dyspnoea-free walk distance m	305 ± 9	363 ± 8	58 ± 4	<0.001	256 ± 14	293 ± 14	37 ± 7	<0.001
VAS (before exercise)	2.9 ± 0.2	3.1 ± 0.2	0.2 ± 0.1	0.167	3.8 ± 0.3	3.6 ± 0.3	-0.2 ± 0.3	0.554
VAS (after exercise)	6.3 ± 0.1	6.1 ± 0.2	-0.2 ± 0.1	0.287	6.9 ± 0.2	6.9 ± 0.2	-0.1 ± 0.2	0.730
<b>Health status (SF-36)<sup>+</sup></b>								
Physical functioning	23 ± 1	26 ± 1	2 ± 1	<0.001	21 ± 2	23 ± 2	2 ± 1	0.058
Bodily pain	45 ± 1	48 ± 1	3 ± 1	<0.001	46 ± 1	48 ± 1	2 ± 1	0.060
Physical role functioning	30 ± 1	32 ± 1	2 ± 1	0.019	29 ± 1	30 ± 1	1 ± 1	0.162
General health perceptions	33 ± 1	36 ± 1	3 ± 1	<0.001	31 ± 1	33 ± 1	2 ± 1	0.067
Vitality	34 ± 1	41 ± 1	7 ± 1	<0.001	32 ± 1	40 ± 1	8 ± 1	<0.001
Social role functioning	32 ± 1	37 ± 1	5 ± 1	<0.001	29 ± 2	36 ± 2	7 ± 2	<0.001
Emotional role functioning	35 ± 1	37 ± 1	2 ± 1	0.117	35 ± 2	39 ± 2	3 ± 2	0.115
General mental health	40 ± 1	45 ± 1	5 ± 1	<0.001	40 ± 2	46 ± 1	6 ± 1	<0.001
Physical summary score	29 ± 1	32 ± 1	2 ± 1	<0.001	28 ± 1	29 ± 1	0 ± 1	0.600
Mental summary score	39 ± 1	45 ± 1	6 ± 1	<0.001	39 ± 2	46 ± 2	7 ± 2	<0.001

TABLE 4 Comparison of results with recent published literature

	HOLLAND [24]	NISHIYAMA [23]	FERREIRA [22]	SWIGRIS [25]	Present study
Publication year	2008	2008	2009	2011	2013
Subjects n	57	28	99	21	402
Inpatient/outpatient	Outpatient	Outpatient	Outpatient	Outpatient	Inpatient
ILD group	ILD	IPF only	ILD	IPF only	ILD
Age years	67	68±9	66	71.5±7.4	60±1
Time of PR	8 weeks	8 weeks	8 weeks	8 weeks	30±1 days
VC % pred	75	66±13	62	73±22	54±1
Po <sub>2</sub> mmHg	NA	80±12	NA	NA	61±1
LTOT %	NA	CI	65	NA	80
Δ6MWD m	35	46	56	61±41	46±3



**Cochrane  
Library**

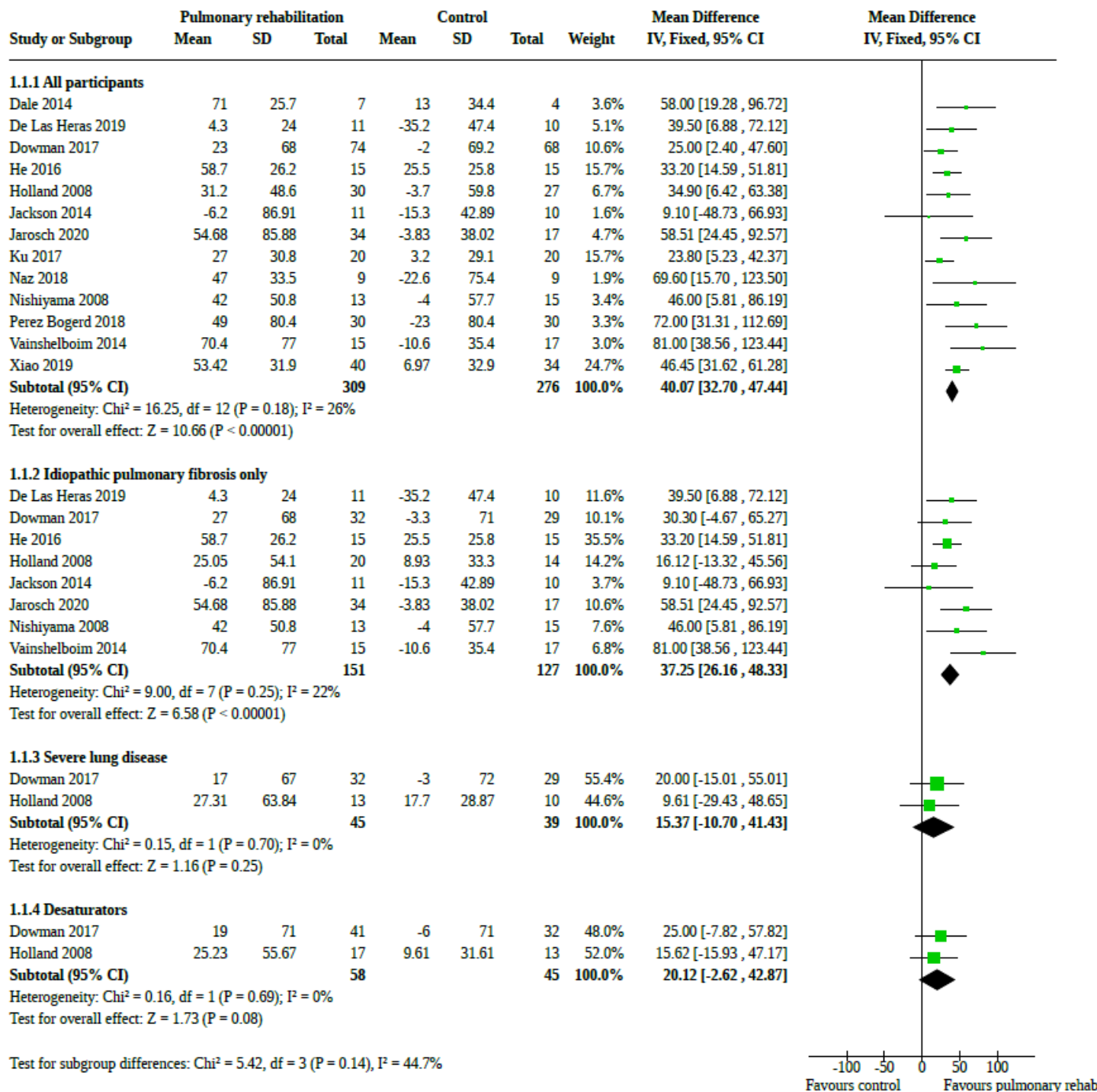
Cochrane Database of Systematic Reviews

## Pulmonary rehabilitation for interstitial lung disease (Review)

Dowman L, Hill CJ, May A, Holland AE

Type of ILD: IPF vs. others

Severity of lung disease: DLCO < 45%, desaturated during exercise testing (SpO<sub>2</sub> 88% or less)



# Change in 6MWD

ILD

585  
(13 RCTs)

⊕⊕⊕⊖  
**Moderate<sup>a</sup>**

**Change in 6MWD**  
assessed with: 6MWT  
Follow-up: range 3–48  
weeks

The mean change in 6MWD ranged from -35 metres to 26 metres  
**MD 40.07 metres higher**  
(32.70 higher to 47.44 higher)

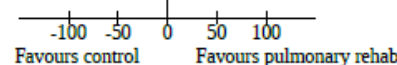
IPF

278  
(8 RCTs)

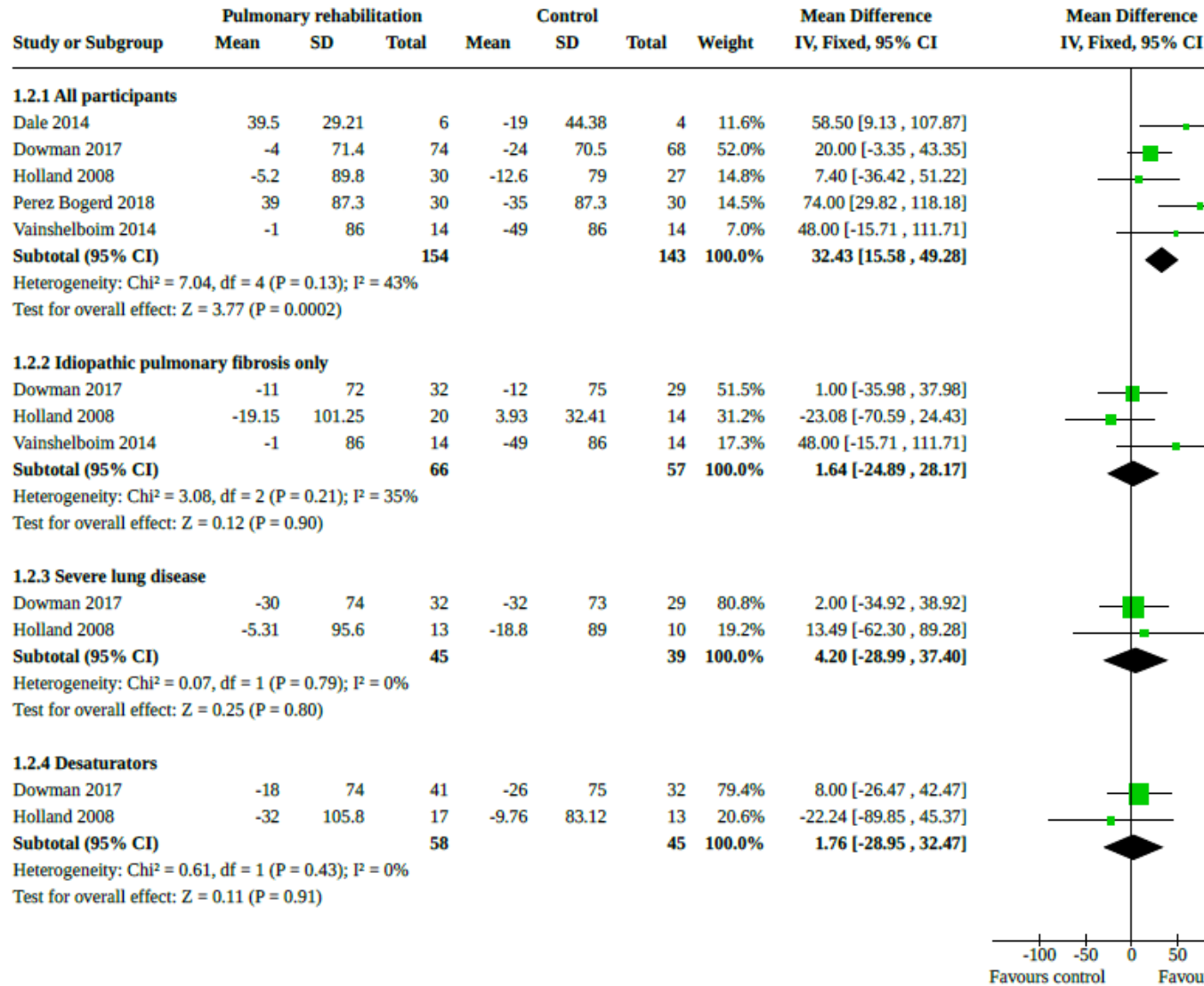
⊕⊕⊕⊖  
**Moderate<sup>a</sup>**

**Change in 6MWD**  
assessed with: 6MWT  
Follow-up: range 3–12 weeks

The mean change in 6MWD ranged from -35 metres to 26 metres  
**MD 37.25 metres higher**  
(26.16 higher to 48.33 higher)



# Change in 6MWD at long term follow-up: range 6-11 months



ILD 321 (6 RCTs) ⊕⊕⊕⊕ Moderate<sup>b</sup>

The mean change in 6MWD at long-term follow-up ranged from -49 metres to -6 metres  
**MD 32.43 metres higher**  
 (15.58 higher to 49.28 higher)

IPF 123 (3 RCTs) ⊕⊕⊕⊕ Low<sup>b,c</sup>

The mean change in 6MWD at long-term follow-up ranged from -49 metres to 4 metres  
**MD 1.64 metres higher**  
 (24.89 lower to 28.17 higher)

# Change in peak work rate

ILD

159  
(4 RCTs)

⊕⊕⊕⊕  
Low c,d

**Change in peak work capacity**  
assessed with: cardiopulmonary exercise test  
Follow-up: range 8 weeks to 6 months

The mean change in peak work capacity ranged from -10 watts to 0.6 watts

**MD 9.04 watts higher**  
(6.07 higher to 12.0 higher)

IPF

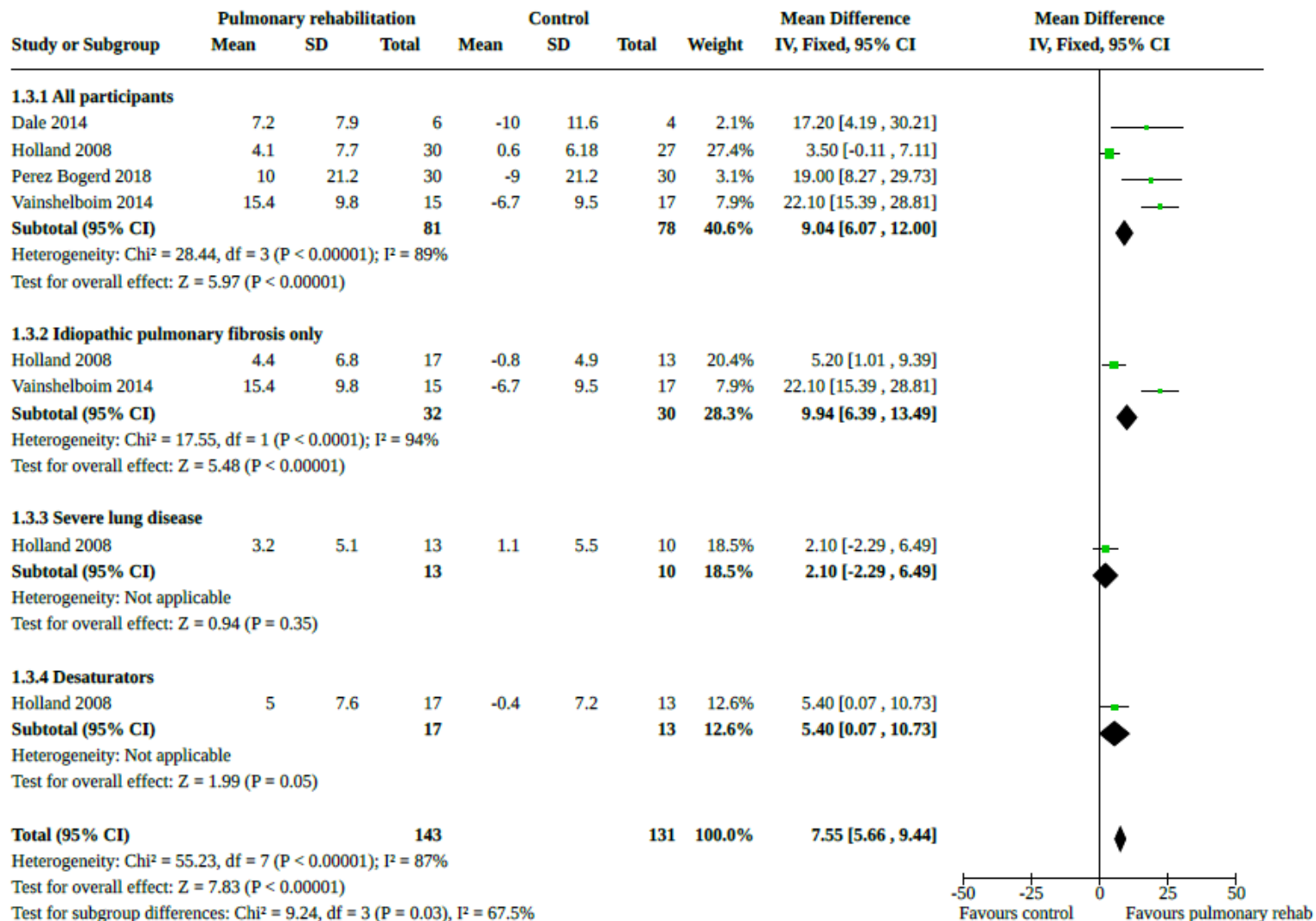
62  
(2 RCTs)

⊕⊕⊕⊕  
Low b,d,e

**Change in peak work capacity**  
assessed with: cardiopulmonary exercise test  
Follow-up: range 8-12 weeks

The mean change in peak work capacity ranged from -7 watts to -0.8 watts

**MD 9.94 watts higher**  
(6.39 higher to 13.49 higher)



Study or Subgroup	Pulmonary rehabilitation			Control			Weight	Std. Mean Difference		Std. Mean Difference	
	Mean	SD	Total	Mean	SD	Total		IV, Fixed, 95% CI	IV, Fixed, 95% CI		
<b>1.7.1 All participants</b>											
Dale 2014	-0.29	0.49	7	0	0.82	4	3.0%	-0.43 [-1.68, 0.82]		[Forest plot point]	
Dowman 2017	-0.2	0.9	74	0.07	0.9	68	42.7%	-0.30 [-0.63, 0.03]		[Forest plot point]	
Holland 2008	-0.57	1.36	30	0.11	0.91	27	16.6%	-0.57 [-1.10, -0.04]		[Forest plot point]	
Naz 2018	-1	0.7	9	0.2	0.7	9	3.8%	-1.63 [-2.74, -0.53]		[Forest plot point]	
Nishiyama 2008	0	1.3	13	0.4	1.5	15	8.4%	-0.28 [-1.02, 0.47]		[Forest plot point]	
Perez Bogerd 2018	0.1	0.8	30	-0.2	0.8	30	17.9%	0.37 [-0.14, 0.88]		[Forest plot point]	
Vainshelboim 2014	-0.73	0.8	15	0.35	0.7	17	7.6%	-1.41 [-2.19, -0.62]		[Forest plot point]	
<b>Subtotal (95% CI)</b>			<b>178</b>			<b>170</b>	<b>100.0%</b>	<b>-0.36 [-0.58, -0.14]</b>		<b>[Forest plot diamond]</b>	
Heterogeneity: Chi <sup>2</sup> = 20.59, df = 6 (P = 0.002); I <sup>2</sup> = 71%											
Test for overall effect: Z = 3.27 (P = 0.001)											
<b>1.7.2 Idiopathic pulmonary fibrosis only</b>											
Dowman 2017	-0.05	0.9	32	-0.06	0.9	29	42.0%	0.01 [-0.49, 0.51]		[Forest plot point]	
Holland 2008	-0.55	1.47	20	0.23	1.17	14	21.8%	-0.56 [-1.26, 0.14]		[Forest plot point]	
Nishiyama 2008	0	1.3	13	0.4	1.5	15	19.0%	-0.28 [-1.02, 0.47]		[Forest plot point]	
Vainshelboim 2014	-0.73	0.8	15	0.35	0.7	17	17.2%	-1.41 [-2.19, -0.62]		[Forest plot point]	
<b>Subtotal (95% CI)</b>			<b>80</b>			<b>75</b>	<b>100.0%</b>	<b>-0.41 [-0.74, -0.09]</b>		<b>[Forest plot diamond]</b>	
Heterogeneity: Chi <sup>2</sup> = 9.18, df = 3 (P = 0.03); I <sup>2</sup> = 67%											
Test for overall effect: Z = 2.48 (P = 0.01)											
<b>1.7.3 Severe lung disease</b>											
Dowman 2017	0.1	1.1	32	0.2	1.1	29	74.3%	-0.09 [-0.59, 0.41]		[Forest plot point]	
Holland 2008	-0.76	1.48	13	0.1	0.57	10	25.7%	-0.70 [-1.56, 0.15]		[Forest plot point]	
<b>Subtotal (95% CI)</b>			<b>45</b>			<b>39</b>	<b>100.0%</b>	<b>-0.25 [-0.68, 0.19]</b>		<b>[Forest plot diamond]</b>	
Heterogeneity: Chi <sup>2</sup> = 1.47, df = 1 (P = 0.23); I <sup>2</sup> = 32%											
Test for overall effect: Z = 1.12 (P = 0.26)											
<b>1.7.4 Desaturators</b>											
Dowman 2017	-0.1	0.9	41	0.1	0.9	32	72.8%	-0.22 [-0.68, 0.24]		[Forest plot point]	
Holland 2008	-0.71	1.21	17	0.15	0.55	13	27.2%	-0.85 [-1.61, -0.09]		[Forest plot point]	
<b>Subtotal (95% CI)</b>			<b>58</b>			<b>45</b>	<b>100.0%</b>	<b>-0.39 [-0.79, 0.00]</b>		<b>[Forest plot diamond]</b>	
Heterogeneity: Chi <sup>2</sup> = 1.94, df = 1 (P = 0.16); I <sup>2</sup> = 48%											
Test for overall effect: Z = 1.94 (P = 0.05)											
Test for subgroup differences: Chi <sup>2</sup> = 0.38, df = 3 (P = 0.94), I <sup>2</sup> = 0%											

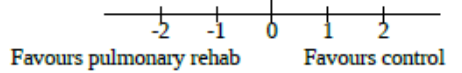
# Change in dyspnea score (range 8 weeks to 6 months)

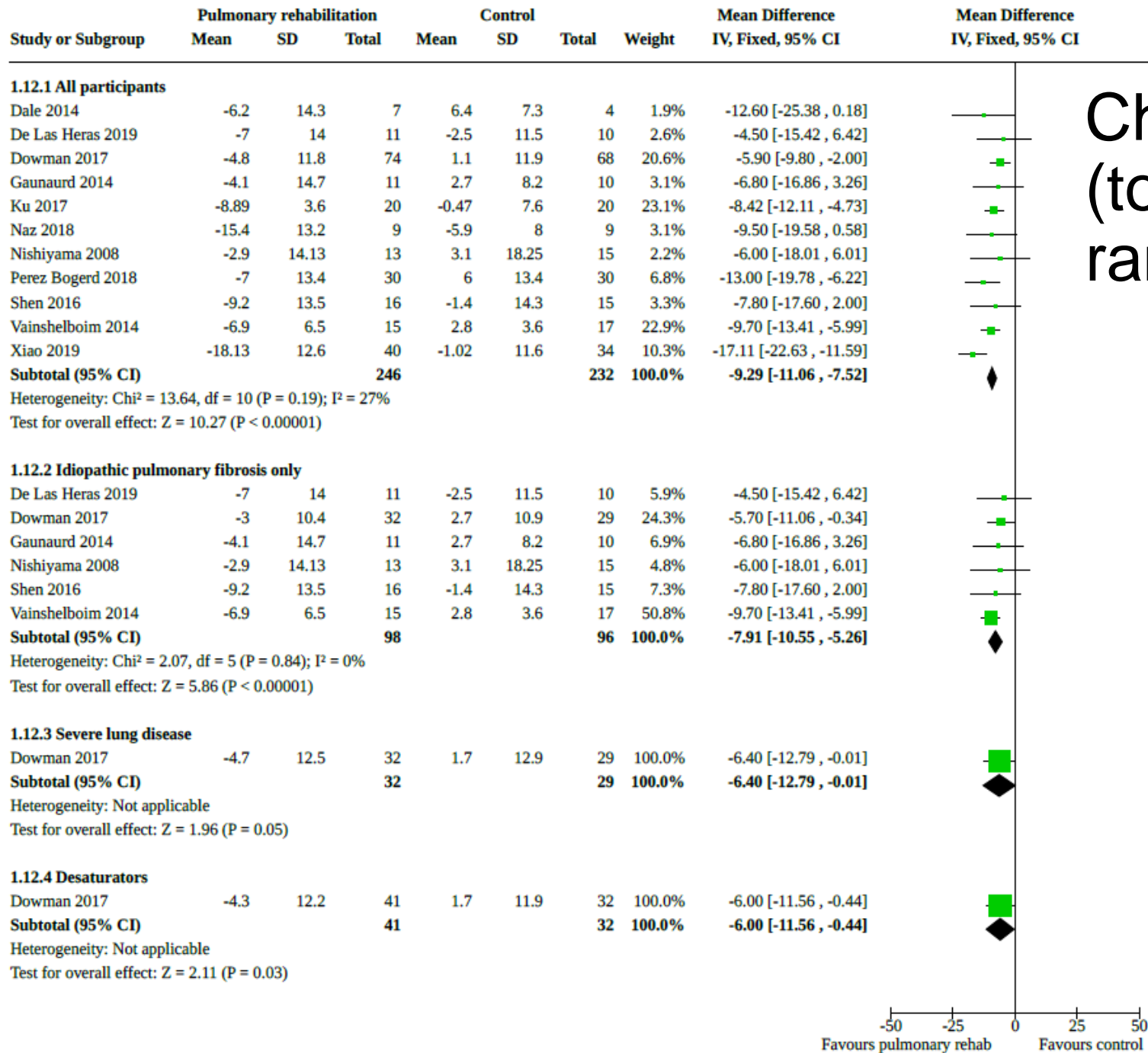
**ILD** 348 (7 RCTs)  $\oplus\oplus\oplus\oplus$  **Low e,f**

The mean change in dyspnoea score ranged from -0.2 to 0.4  
**SMD 0.36 SD lower**  
 (0.58 lower to 0.14 lower)

**IPF** 155 (4 RCTs)  $\oplus\oplus\oplus\oplus$  **Low b,f**

The mean change in dyspnoea score ranged from -0.06 to 0.4  
**SMD 0.41 lower**  
 (0.74 lower to 0.09 lower)





# Change in quality of life (total SGRQ) follow-up: range 8 weeks to 6 months

**ILD**      478 (11 RCTs)      ⊕⊕⊕⊕  
**Moderate  $\alpha$**

The mean change in quality of life ranged from -7 to 6 points

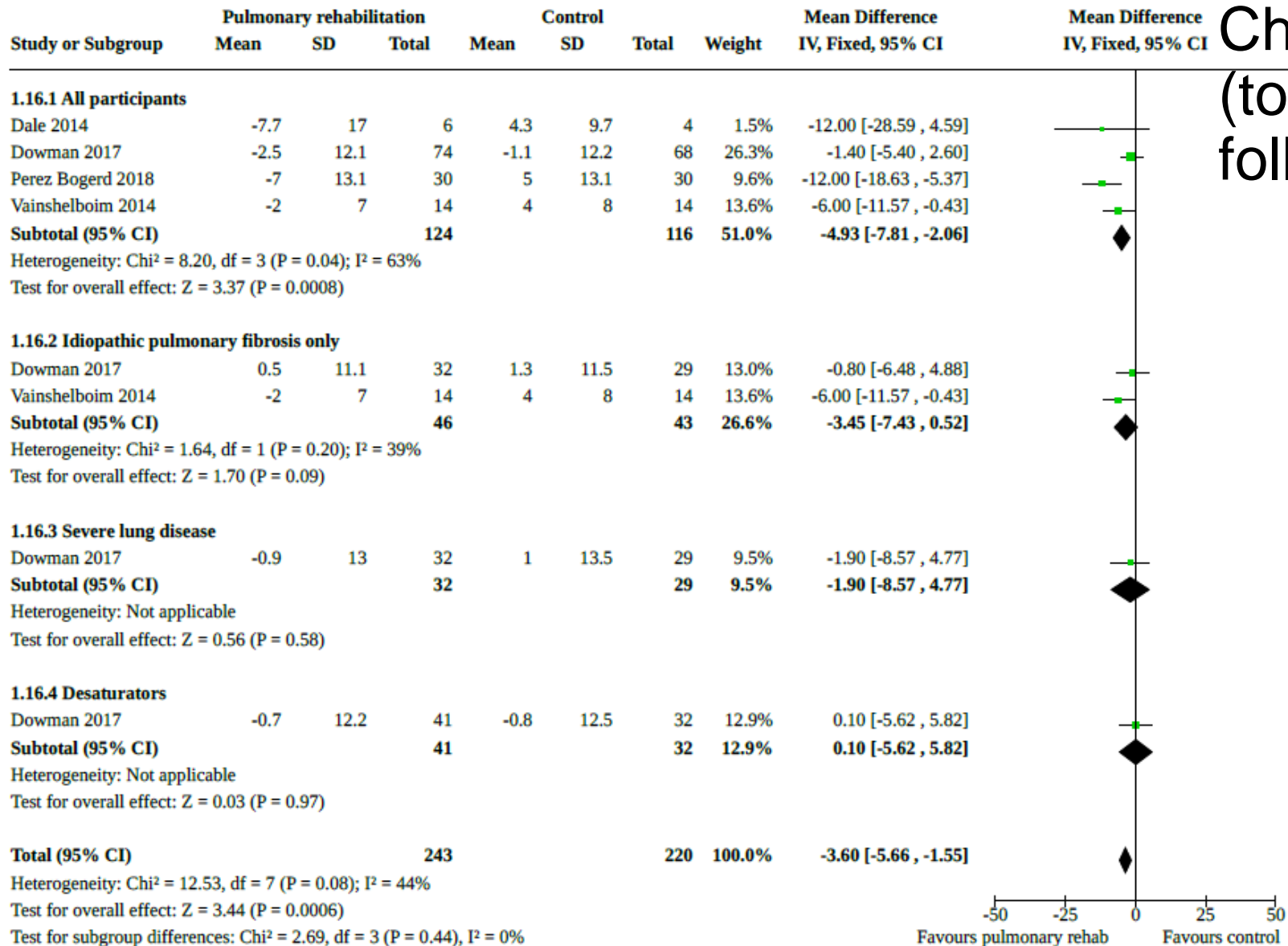
**MD 9.29 points lower**  
 (11.06 lower to 7.52 lower)

**IPF**      194 (6 RCTs)      ⊕⊕⊕⊕  
**Moderate  $\alpha$**

The mean change in quality of life ranged from -3 to 3 points

**MD 7.91 points lower**  
 (10.55 lower to 5.26 lower)

-50   -25   0   25   50  
 Favours pulmonary rehab   Favours control



# Change in quality of life (total SGRQ) at long term follow-up: range 6-11 months

**ILD**      240 (4 RCTs)      ⊕⊕⊕⊕  
**Low c,f**

The mean change in quality of life at long-term follow-up ranged from -1 to 5 points

**MD 4.93 points lower**  
(7.81 lower to 2.06 lower)

---

**IPF**      89 (2 RCTs)      ⊕⊕⊕⊕  
**Low b,e**

The mean change in quality of life at long-term follow-up ranged from 1 to 4 points

**MD 3.45 points lower**  
(7.43 lower to 0.52 higher)

# Long term survival (incidence of mortality) follow up 6-11 months

ILD

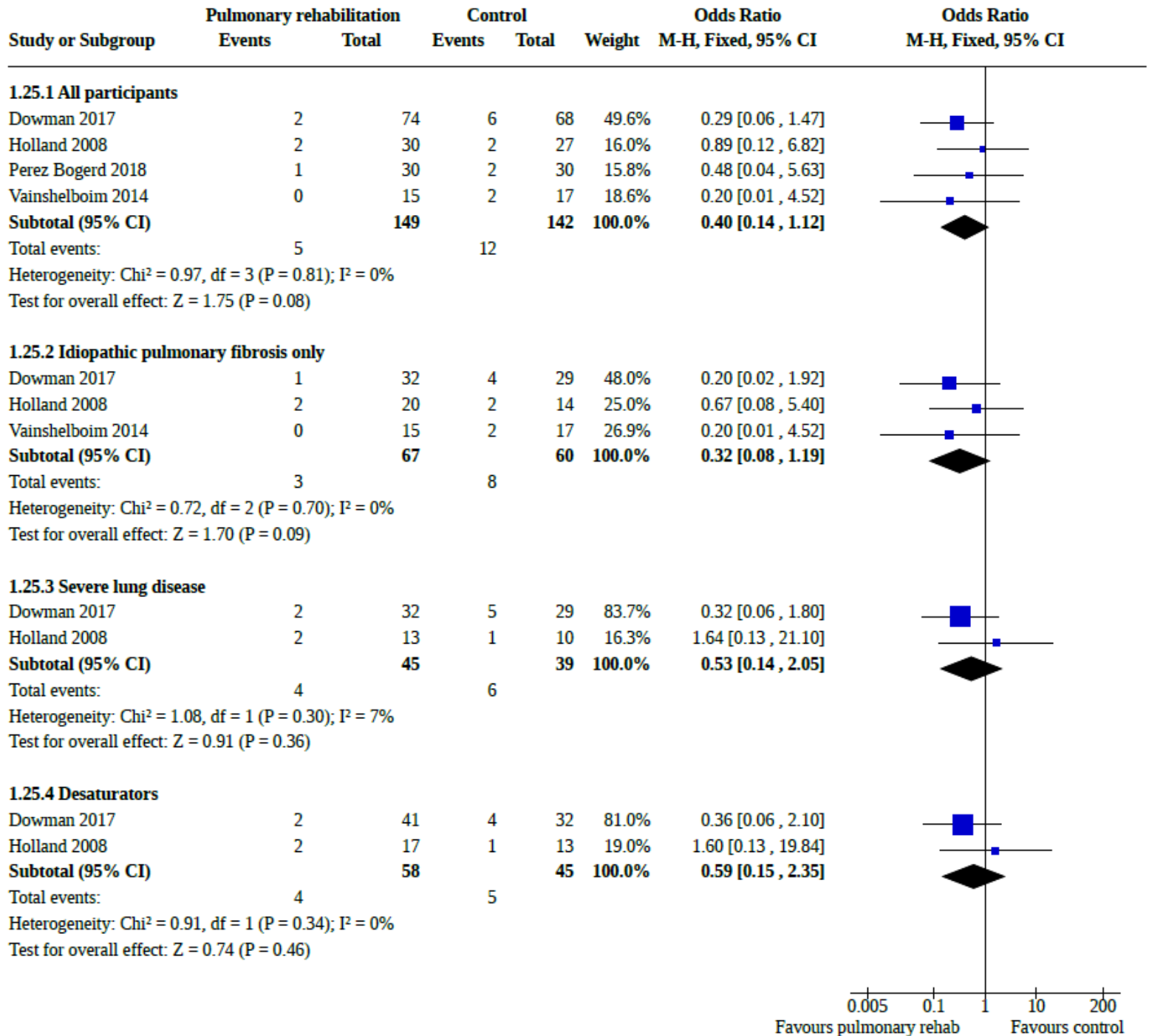
Study population	
85 per 1000	36 per 1000 (13 to 94)

**OR 0.40**  
(0.14 to 1.12)      291  
(4 RCTs)      ⊕⊕⊕⊕  
**Low c,g**





IPF

Study population	
133 per 1000	47 per 1000 (12 to 155)

**OR 0.32**  
(0.08 to 1.19)      127  
(3 RCTs)      ⊕⊕⊕⊕  
**Low b, c**



# Benefits of Pulmonary Rehabilitation in Patients with Idiopathic Pulmonary Fibrosis Receiving Antifibrotic Drug Treatment

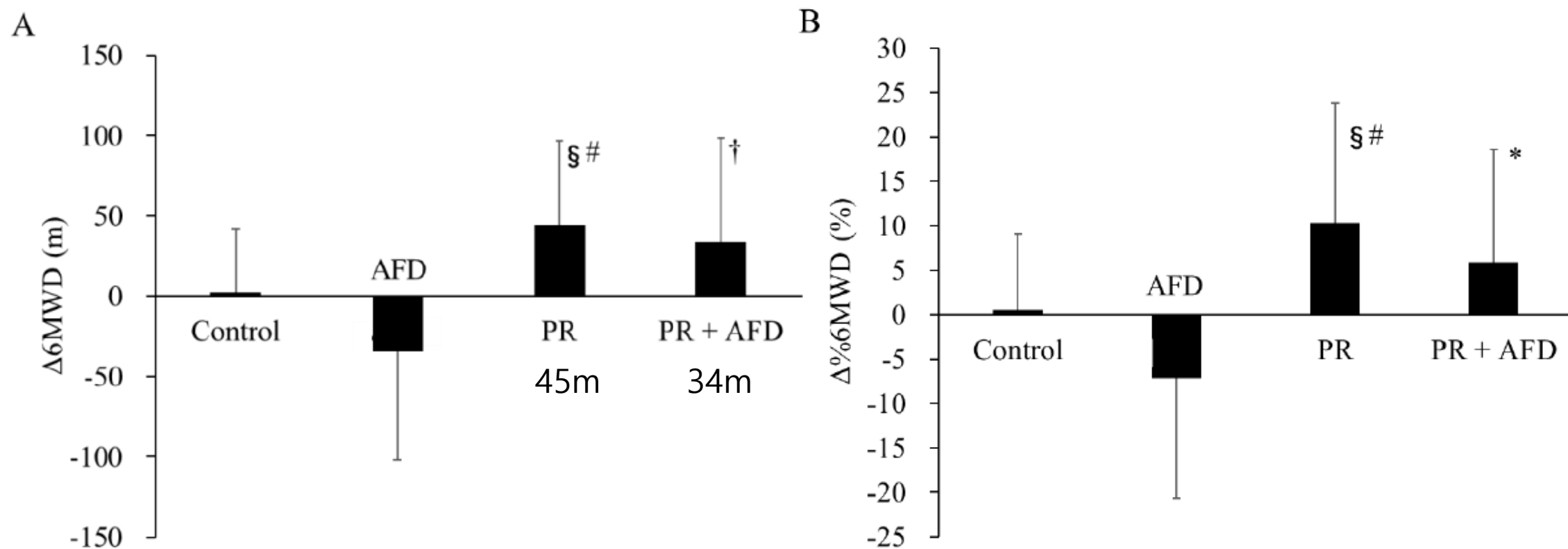
Yuji Iwanami <sup>1</sup>, Kento Ebihara <sup>1</sup>, Keiko Nakao <sup>1</sup>, Naofumi Sato <sup>1</sup>, Midori Miyagi <sup>1</sup>, Yasuhiko Nakamura <sup>2</sup> ,  
Susumu Sakamoto <sup>2</sup> , Kazuma Kishi <sup>2</sup> , Sakae Homma <sup>3</sup> and Satoru Ebihara <sup>1,4,\*</sup> 

- Prospective, nonrandomized, controlled observation study
- Inclusion: IPF, medically stable, and able to walk independently
- Exclusion: orthopedic or CNS disorders that cause gait disturbance, dementia, other disease with poor prognosis (terminal cancer, severe heart disease)
- Pulmonary Rehabilitation Program

Weekly PR session for 3 months on outpatient basis and each session lasted 60min

aerobic exercise, upper and lower limb resistance training, breathing exercises (pursed lip breathing, diaphragmatic breathing), trunk centered stretching, and patient education

	All Non-PR (n = 87)	Control (n = 26)	AFD (n = 21)	PR	PR (n = 29)	PR+AFD (n =11)	p Value
Age, year	72.0 ± 8.1	73.0 ± 8.5	70.3 ± 6.6		73.5 ± 8.9	69.0 ± 7.4	0.29 <sup>a</sup>
Sex, male/female	61/26	14/12	18/3		18/11	11/0	<0.05 <sup>b</sup>
BMI, kg/m <sup>2</sup>	22.9 ± 3.9	24.0 ± 3.6	22.3 ± 4.2		22.5 ± 3.9	22.5 ± 4.1	0.38 <sup>a</sup>
Oxygen use (%)	21 (30)	3 (15)	6 (40)		9 (33)	3 (37.5)	0.34 <sup>b</sup>
Smoking status (current/former/never)	1/44/25	1/13/12	0/14/7		0/19/10	0/9/2	0.47 <sup>b</sup>
Medications							
Azathioprine	0	0	0		0	0	
Cyclophosphamide	0	0	0		0	0	
Cyclosporine	2	1	0		1	0	
Tacrolimus	0	0	0		0	0	
Prednisolone	19	5	6		3	4	
Pirfenidone	15	0	10		0	5	
Nintedanib	17	0	11		0	6	
N-Acetylcysteine	18	4	4		6	2	
Severity							
GAP stage	1.6 ± 0.7	1.4 ± 0.6	1.6 ± 0.7		1.7 ± 0.7	2.0 ± 0.7	0.15 <sup>a</sup>
(I/II/III)	26/32/12	16/8/2	10/8/3		11/13/5	3/5/3	
Pulmonary function							
FVC, % pred	77.1 ± 20.5	84.2 ± 18.2	71.6 ± 15.7		77.9 ± 23.2	68.5 ± 22.1	0.08 <sup>a</sup>
FEV <sub>1</sub> , % pred	91.2 ± 22.6	95.7 ± 18.6	85.5 ± 17.3		95.1 ± 28.6	81.5 ± 19.5	0.15 <sup>a</sup>
FEV <sub>1</sub> /FVC, %	86.1 ± 13.2	79.9 ± 8.0 <sup>c</sup>	90.5 ± 14.5		87.7 ± 15.7	88.3 ± 9.4	<0.05 <sup>a</sup>
DL <sub>CO</sub> , % pred	60.1 ± 21.1	69.6 ± 22.4	55.8 ± 22.1		57.8 ± 18.1	53.1 ± 18.9	0.056 <sup>a</sup>
PaO <sub>2</sub> , torr	81.9 ± 13.4	86.1 ± 13.2	84.1 ± 14.2		77.2 ± 12.0	79.9 ± 13.8	0.07 <sup>a</sup>
PaCO <sub>2</sub> , torr	41.7 ± 5.2	41.2 ± 4.1	41.4 ± 3.6		41.7 ± 6.7	43.7 ± 5.6	0.61 <sup>a</sup>



**Figure 2.** Comparison of the (A) change in six-minute walk distance ( $\Delta 6\text{MWD}$ ) and (B) change in the percentage of predicted six-minute walk distance ( $\Delta\%6\text{MWD}$ ) at 3 months between groups. Abbreviations: PR, pulmonary rehabilitation; AFD, antifibrotic drugs; 6MWD, six-minute walk distance; %6MWD, percent predicted six-minute walk distance. Vertical columns indicate means  $\pm$  SD. *p* values were calculated using a one-way analysis of variance with post hoc Tukey's test. §: *p* < 0.05 vs. control, #: *p* < 0.001 vs. AFD, †: *p* < 0.01 vs. AFD, \*: *p* < 0.05 vs. AFD.

# Survival after inpatient or outpatient pulmonary rehabilitation in patients with fibrotic interstitial lung disease: a multicentre retrospective cohort study

- Pulmonary rehabilitation

Inpatient PR (2-4주 입원, 5-6일/주)

Outpatient PR (2~3 session/주, 6~12주)

Aerobic training and/or interval training with a gradual symptom-limited increase in workload.

Resistance training covered all large muscle groups and typically consisted of three sets with 8-12 repetitions.

Supplemental oxygen if needed to maintain a SpO<sub>2</sub> ≥88%

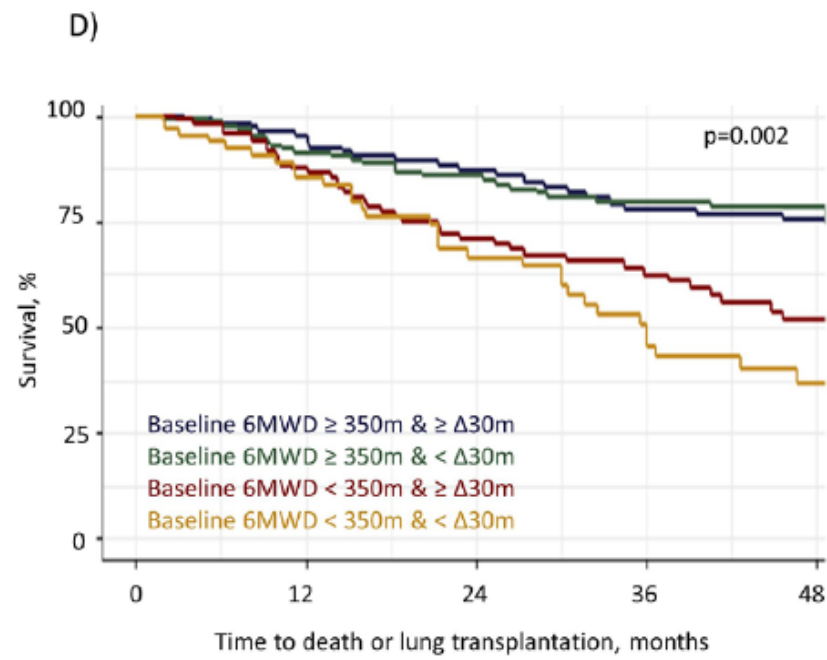
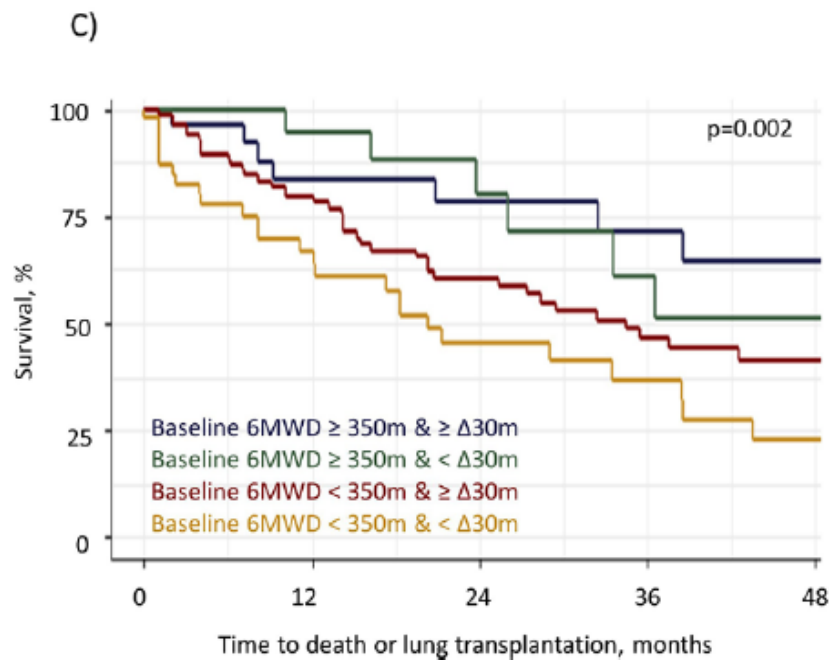
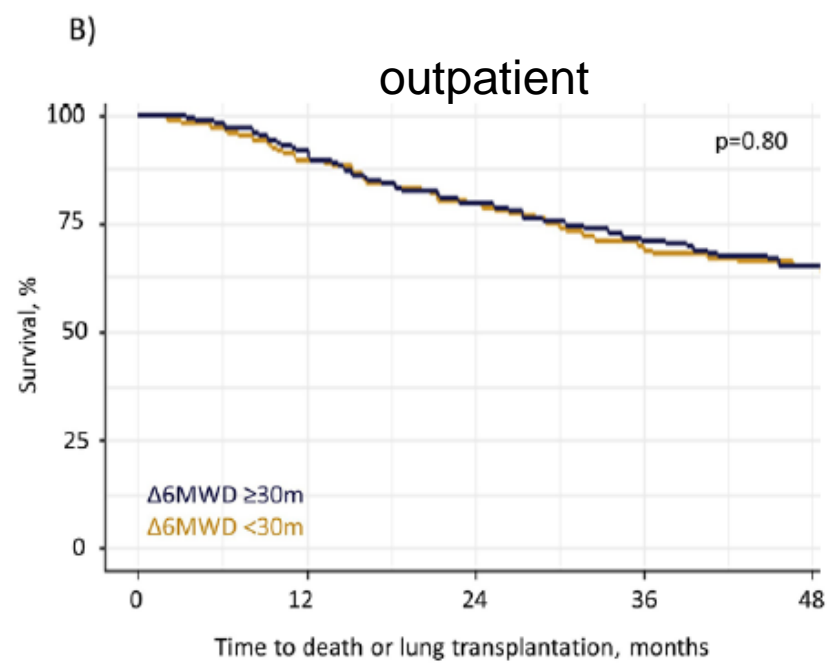
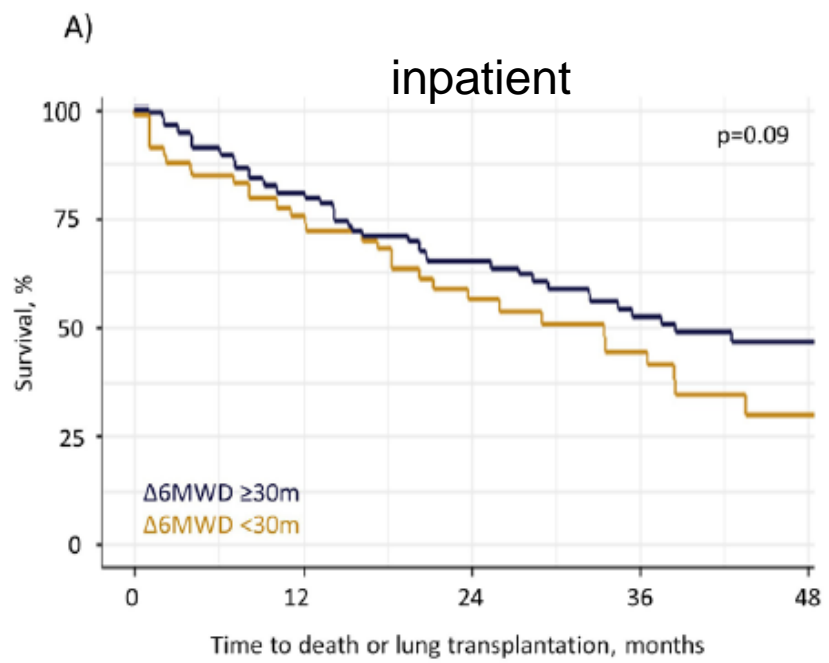
Educational sessions covered information on the pathophysiology of lung disease, oxygen and medication use, symptom control, coping mechanisms and self-management, with additional counselling on smoking cessation, nutrition and psychological support if needed.

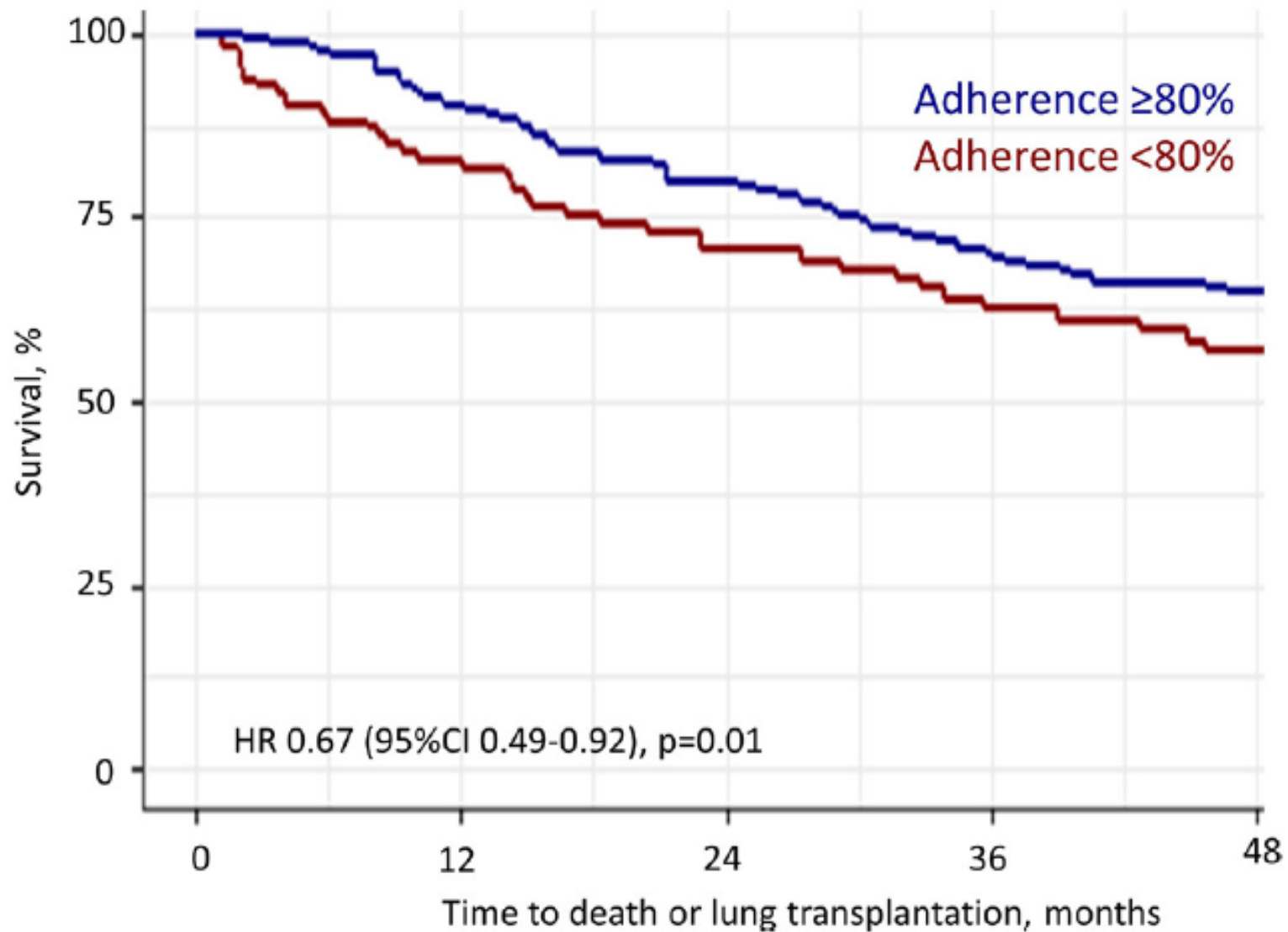
**Table 1** Patient characteristics for inpatient and outpatient pulmonary rehabilitation (PR)

	Inpatient PR (n=196)	Outpatient PR (n=505)
Sex, men	129 (66%)	316 (63%)
Age, years	70 (11)	69 (12)
Ever smokers	122 (65%)	330 (67%)
Smoked pack years	30 (15–47.5)	24 (12–40)
Height, metres	1.69 (0.88)	1.67 (0.93)
Body mass index, kg/m <sup>2</sup>	26.8 (6.2)	29.9 (6.2)
FVC, %-predicted	62 (19)	70 (22)
FEV <sub>1</sub> , %-predicted	66 (20)	72 (22)
DLCO, %-predicted	37 (18)	49 (18)
IPF diagnosis	121 (62%)	182 (36%)
Emphysema	26 (14%)	64 (15%)
Depression	27 (14%)	44 (10%)

**Table 2** Pulmonary rehabilitation (PR) features for inpatient and outpatient PR

	Inpatient PR (n=196)	Outpatient PR (n=505)
PR duration, weeks	3 (2.7–4.2)	8 (8–8)
Adherence, % (attended/planned sessions)	100 (83–100)	92 (77–100)
Good adherence ( $\geq 80\%$ ), yes/no	57/12	328/115
Long-term oxygen therapy	106 (54%)	135 (27%)
Oxygen flow rate at PR start, L/min	2 (0–3.3)	0 (0–2)
Oxygen flow rate at PR end, L/min	2 (0–4)	0 (0–1.4)
Oxygen flow rate increase during PR	50 (27%)	50 (11%)
6MWD at PR start, metres	262 (128)	358 (125)
6MWD at PR start, %-predicted	54 (25)	77 (28)
6MWD at PR end, metres	320 (127)	405 (127)
6MWD at PR end, %-predicted	66 (26)	87 (28)
Change in 6MWD, metres	55 (83)	34 (65)
Change in 6MWD, %-predicted	12 (17)	7.3 (14)
Any 6MWD increase	147 (79%)	328 (76%)
6MWD increase $\geq 30$ m	120 (65%)	227 (52%)





**Figure 4** Survival stratified by adherence to pulmonary rehabilitation sessions (attendance of  $\geq$ / $<$ 80% of sessions) during outpatient pulmonary rehabilitation.

# Pulmonary Rehabilitation in Idiopathic Pulmonary Fibrosis and COPD

## A Propensity-Matched Real-World Study

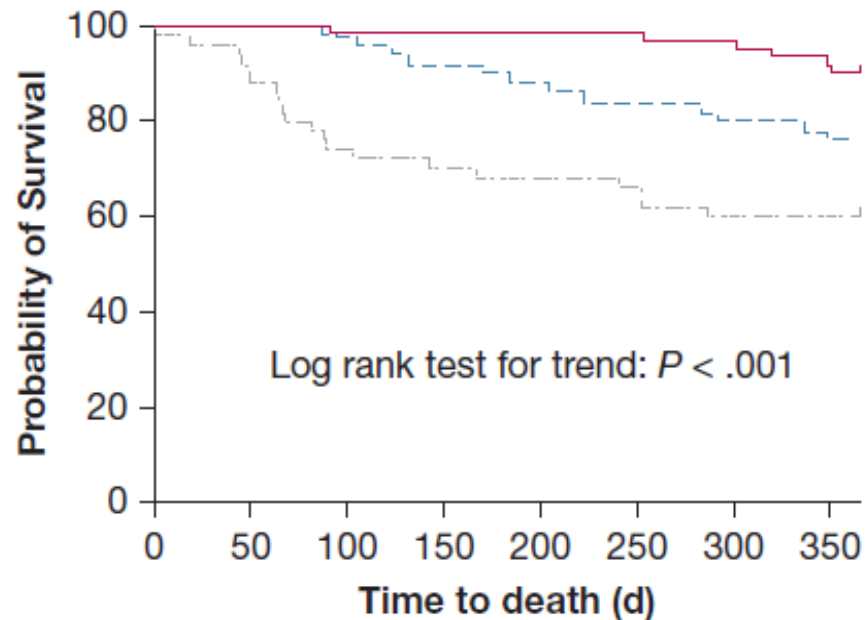
*Claire M. Nolan, PhD; Oliver Polgar, MSc; Susie J. Schofield, MSc; Suhani Patel, MSc; Ruth E. Barker, PhD; Jessica A. Walsh, MPh; Karen A. Ingram, BSc; Peter M. George, PhD; Philip L. Molyneaux, PhD; Toby M. Maher, PhD; and William D.-C. Man, PhD*

- 163 IPF vs. control 163 COPD
- 8 week outpatient program
  - two supervised exercise (60 min) and education (45min) sessions
  - at least one additional unsupervised home-based exercise per week

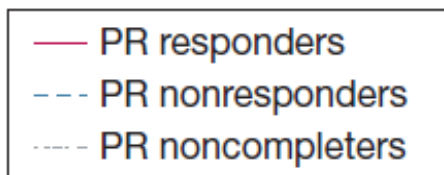
Variable	IPF (n = 163)	COPD (n = 163)	SMD	P Value
<b>Propensity-matched analysis</b>				
Age, y	73 ± 9	73 ± 8	0.00	...
Male sex	110 (67)	111 (68)	0.00	...
BMI, kg/m <sup>2</sup>	27.4 ± 6.0	27.9 ± 6.5	0.07	...
MRC dyspnea scale grade	3.3 ± 1.2	3.2 ± 1.1	0.00	...
ISWT distance, m	196 ± 158	197 ± 149	0.04	...
CRQ total score	77.6 ± 23.0	78.8 ± 22.4	0.01	...
<b>Other</b>				
FEV <sub>1</sub> to FVC ratio	0.81 ± 0.08	0.47 ± 0.13	...	< .001
FEV <sub>1</sub> , %	70.0 ± 20.8	47.3 ± 17.3	...	< .001
FVC, %	66.7 ± 23.2	74.8 ± 19.8	...	< .01
Prescribed supplemental oxygen <sup>a</sup>	49 (30)	7 (20)	...	< .001
Prescribed ABOT	41 (25)	11 (7)	...	< .001
<b>Pulmonary hypertension</b>	<b>15 (9)</b>	<b>3 (2)</b>	<b>...</b>	<b>&lt; .01</b>
<b>CRQ domain</b>				
Dyspnea	14.9 ± 6.1	14.9 ± 6.3	...	.96
Fatigue	13.9 ± 5.8	14.0 ± 5.3	...	.89
Emotional function	31.2 ± 9.1	31.6 ± 9.2	...	.70
Mastery	17.7 ± 5.9	18.4 ± 5.7	...	.26
No. of supervised sessions attended	10 ± 6	10 ± 6	...	.39
Completed PR	113 (69)	103 (63)	...	.24

TABLE 2 ] Response to PR

Variable	Within-Group Response to PR				Between-Group Difference in Response to PR	
	IPF (n = 113)		COPD (n = 103)		Mean (95% CI)	P Value
	Mean (95% CI)	P Value <sup>a</sup>	Mean (95% CI)	P Value <sup>a</sup>		
ISWT distance change, m	53 (37-69)	< .001	55 (44-66)	< .001	2 (-18 to 22)	.84
MRC dyspnea scale grade change	-0.7 (-0.8 to -0.5)	< .001	-0.7 (-0.9 to -0.6)	< .001	0.0 (-0.2 to 0.3)	.36
CRQ score change						
Dyspnea scale	4.0 (2.9-5.1)	< .001	5.0 (3.7-6.2)	< .001	1.0 (-0.7 to 2.6)	.25
Fatigue scale	1.9 (1.0-2.8)	< .001	2.2 (1.3-3.1)	< .001	0.3 (-0.9 to 1.5)	.62
Emotional function scale	2.3 (1.0-3.5)	< .01	3.3 (2.0-4.7)	< .001	1.1 (-0.7 to 2.9)	.24
Mastery scale	1.4 (0.6-2.2)	< .001	2.2 (1.3-3.1)	< .001	0.8 (-0.4 to 1.94)	.19
Total	9.6 (6.5-12.6)	< .001	12.7 (9.2-16.2)	< .001	3.2 (-1.4 to 7.7)	.18



PR responders (No.)	61	61	61	61	61	61	58	57
PR nonresponders (No.)	50	50	50	47	45	43	41	39
PR noncompleters (No.)	50	45	37	36	35	34	31	31



- Responder: completed pulmonary rehabilitation and ISWT distance change  $\geq 38\text{m}$
- Nonresponder: completed pulmonary rehabilitation but ISWT distance change  $< 38\text{m}$
- Noncompleter: did not complete pulmonary rehabilitation

Covariate: PR Status	Multivariate Analysis 2 <sup>b</sup>	
	HR (95% CI)	P Value <sup>c</sup>
Responder <sup>d</sup>	Reference category	.01
Nonresponder <sup>e</sup>	3.94 (1.43-10.81)	
Noncompleter <sup>f</sup>	4.42 (1.53-12.79)	

<sup>b</sup>Variables included: baseline age, sex, smoking status, FVC % predicted, incremental shuttle walk test distance, prescription of antifibrotic therapy, frailty status, PR status. (Note that Medical Research Council dyspnea scale grade was not included because of colinearity.)

# 호흡재활을 하면 환자에게 어떤 이득이 있는가?

- ILD

  - 6MWD, peak work capacity, dyspnea, quality of life

  - 6MWD, quality of life at long term

- IPF

  - 6MWD, peak work capacity, dyspnea, quality of life

- Survival gain

  - Responders in PR, completed pulmonary rehabilitation

**TABLE 1 |** Randomized controlled trials involving exercise-based pulmonary rehabilitation in patients with interstitial lung disease.

Authors, year	Sample, age (years)	Setting	Exercise/functional tests	Intervention	Duration, frequency and intensity	Effect of intervention	Adverse effect/adherence
Perez-Bogerd et al. (30)	ILD, $n = 60$ CG: $64 \pm 8$ ET: $64 \pm 13$	Outpatient	6MWT	CG: medical care ET: cycling, treadmill walking, arm cranking, stair climbing and peripheral muscle training + patient education.	60 sessions, 3x/week first 3 months and thereafter 2x/week, 90'. Cycling at 60–85% of the initial maximal work rate on the cycle ergometer and walking at 75–110% of their maximal walking speed during 6MWT + stair climbing (1–3 repetitions of 2'), peripheral muscle training → 70% of 1RM (3 sets of 8 rep).	PR improves exercise tolerance, health status and muscle force in ILD. The benefits are maintained at 1-year follow-up. The intervention did not change physical activity.	Measured/ Measured
Nishiyama et al. (40)	IPF, $n = 28$ CG: $64.5 \pm 9.1$ ET: $68.1 \pm 8.9$	Outpatient	6MWT, Cycle ergometer test	Treadmill + strength training + educational lectures.	8 weeks, 2x/week Treadmill (80% of the patient's maximal walking speed assessed at the 6MWT or 80% of the initial maximum workload at the cycle ergometer + strength training (20').	PR improves functional exercise capacity and health-related quality of life in patients with IPF.	Not measured/ Not reported
Gaunaud et al. (41)	IPF, $n = 21$ CG: $71 \pm 6$ ET: $66 \pm 7$	Outpatient	6MWT	Educational lectures + supervised aerobic training and strength training + home-based program (on days they did not do PR).	12 weeks, 2x/week (supervised ET) 90' + 2x/week (home-based program), 10 education sessions 30' cardiopulmonary endurance training (70–80% of the maximum predicted heart rate), 20' flexibility exercises, and 25' strength training (initial: 2 sets of 10 repetitions; progression: 3 sets of 15 repetitions).	A 3-month PR significantly improved symptoms (SGRQ-I) and physical activity levels (IPAQ) in subjects with IPF while they actively participate in the program.	Not measured/ Not measured
Jackson et al. (42)	IPF, $N = 21$ CG: $66 \pm 7$ ET: $71 \pm 6$	Outpatient	6MWT, Cycle ergometer test	Educational lectures + cardiopulmonary aerobic training, strength training + flexibility exercise.	12 weeks, 2x/week, 120'; educational lectures (1 session biweekly) 30' cardiopulmonary endurance training (up to 80% maximum heart rate), flexibility exercises (3 sets x 30') and 15–30' strength training (up to 3 sets x 15 repetitions).	PR effectively maintained exercise oxygen uptake over 3 months and lengthened constant load exercise time in patients with moderately severe IPF.	Unclear/Unclear
Dowman et al. (43)	ILD, $n = 142$ IPF: CG: $73 \pm 9$ ET: $70 \pm 10$ Asbestosis: CG: $72 \pm 9$ ET: $72 \pm 7$ CTD-ILD: CG: $65 \pm 11$ ET: $63 \pm 10$	Outpatient	6MWT	CG: phone calls for support ET: supervised exercise program → aerobic training, cycling and walking, plus upper and lower limb strength training + home-based program.	8 weeks, 2x/week, 30' Initial intensity for walking: 80% of peak walking speed of the 6MWT; cycling at 70% of the maximum work rate estimated from the 6MWT and, strength training at an initial load (10–12 RM). Exercise progressed weekly.	ET promoted improvement in 6MWD, symptoms and HRQoL. Magnitude of change was greater in those with asbestosis compared with IPF. Individuals with a range of severity stand to benefit, however longer-lasting effects may occur in milder disease.	No adverse event/Measured
Vainshelboim et al. (44)	IPF, $n = 34$ CG: $66 \pm 9$ ET: $68.8 \pm 6$	Outpatient	6MWT, 30-S Chair- Stand to Test Leg Strength, CPET	CG: medical care ET: supervised exercise program → aerobic training interval + upper and lower limb strength training + flexibility exercises.	12 weeks, 2x/week, 60' First 6 weeks: 50–60% of peak work rate in cycling and, 70–80% of individual average walking speed measured during the 6MWD and moderate intensity to strength training (1 set of 12–15 repetitions). Last 6 weeks: duration maintained, 60–70% of peak work rate in cycling and 80–90% of individual average walking speed, strength and flexibility training maintained and increased load+stair climbing (3–5').	ET showed clinical outcomes were preserved at baseline levels with improvements in leg strength and HRQoL. The CG showed a trend of deterioration in the outcomes.	Unclear/Unclear
Greening et al. (45)	CRD, $n = 389$ CG: $71.2 \pm 10.0$ ET: $71.1 \pm 9.4$	Inpatient	ISWT, ESWT	CG: standard care ET: supervised strength training and aerobic training + neuromuscular electrical stimulation. After discharge → unsupervised home-based program, + telephone consultations.	Walking was performed at a set walking speed predetermined by the ESWT at 85% oxygen consumption, ST (3 sets of 8 repetitions based on the 1RM, neuromuscular electrical stimulation (both quadriceps 30' daily, symmetrical biphasic pulse at 50Hz, pulse duration of 300ms, 15' on and five' off.	Early rehabilitation during hospital admission for CRD did not reduce the risk of subsequent readmission or enhance recovery of physical function following the event over 12 months.	Unclear/ Measured
Holland et al. (46)	ILD (60% with IPF), $n = 57$ CG: $67 \pm 13$ ET: $70 \pm 8$	Outpatient	6MWT, CPET	CG: phone calls for support ET: supervised and unsupervised exercise program → aerobic training (cycling and walking training) + upper and lower limb strength training.	8 weeks, 2x/week, 30' Initial intensity for walking: 80% of peak walking speed achieved on the 6MWT.	ET improves exercise capacity and symptoms in patients with ILD, but these benefits are not sustained 6 months following intervention.	Unclear/ Measured

# 얼마의 기간동안 어떤 방식으로 호흡재활을 하는가?

- Aerobic conditioning, strength and flexibility training, educational lectures, nutritional interventions, and psychosocial support
- Twice a week for 8~12 weeks in outpatients

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- The intensity of training aerobic training
  - based on previous 6MWT, heart rate, oxygen consumption, peak work rate.
  - Borg scale scores to increment workload of the training
- Strength training
  - repetition maximum, peripheral muscle training was performed with a variation of 1,2,and 3 sets of 8,10,12,15 repetitions
  - strength training according to time (only one study)

# Take home messages

- For whom

ILD patients including IPF with clinically stable without infection or exacerbation

Patients with dyspnea on exertion as early as possible

(long term outcome, completed pulmonary rehabilitation )

Absence of history of syncope on exertion or any comorbidities that preclude exercise

# Take home messages

- Benefits

Functional capacity, quality of life, sensation of dyspnea

- Exercise prescription in ILD

outpatients from 8 to 12 weeks

intensity of training aerobic training and increment workload