Year in review of pulmonary rehabilitation

Chang Youl Lee MD, PhD

Hallym University

Contents

1. 2022 guideline
2. 2021 Cochrane review in pulmonary rehabilitation
3. PR of COPD
4. PR of Asthma
5. PR of ILD
6. PR amid COVID-19
7. Define of modern PR

Pulmonary rehabilitation

The use of

1. **exercise**
2. **education**
3. **behavioral intervention**

designed for people who have chronic lung disease

to improve how people with chronic lung disease function in daily life

to enhance their quality of life

Pulmonary rehabilitation

Pulmonary rehabilitation of 2022 GOLD guideline

Pulmonary rehabilitation

Pulmonary rehabilitation is defined as "a comprehensive intervention based on thorough patient assessment followed by patient-tailored therapies that include, but are not limited to, exercise training, education, self-management intervention aiming at behavior change, designed to improve the physical and psychological condition of people with chronic respiratory disease and to promote the long-term adherence to health-enhancing behaviors."[266]

GOLD 2022 KEY CHANGES SUMMARY IN PR

Pulmonary rehabilitation

References and a new paragraph have been added to outline the **RCT evidence** available for the effectiveness of pulmonary rehabilitation. A statement outlining options for pulmonary rehabilitation in **rural, remote, home-based or situations of economic limitation** has also been included.

Section of Tele-rehabilitation

A new section including 5 paragraphs on tele-rehabilitation for COPD has been added.

Pulmonary rehabilitation of 2022 GOLD guideline

PULMONARY REHABILITATION, SELF-MANAGEMENT AND INTEGRATIVE CARE IN COPD

PULMONARY REHABILITATION

- Pulmonary rehabilitation improves dyspnea, health status and exercise tolerance in stable patients **(Evidence A)**.
- Pulmonary rehabilitation reduces hospitalization among patients who have had a recent exacerbation (≤4 weeks from prior hospitalization) **(Evidence B)**.
- Pulmonary rehabilitation leads to a reduction in symptoms of anxiety and depression **(Evidence A)**.

EDUCATION AND SELF-MANAGEMENT

- Education alone has not been shown to be effective **(Evidence C)**.
- Self-management intervention with communication with a health care professional improves health status and decreases hospitalizations and emergency department visits **(Evidence B)**.

INTEGRATED CARE PROGRAMS

- Integrative care and telehealth have no demonstrated benefit at this time **(Evidence B)**.

TABLE 3.8

Pulmonary rehabilitation of 2022 GOLD guideline

Optimum benefits : 6 to 8 weeks (no additional benefits to 12 weeks)

Supervised exercise training twice weekly with feedback, individualized

endurance training, interval training, resistance/strength training

upper and lower limbs

walking exercise

flexibility, inspiratory muscle training

neuromuscular electrical stimulation

Dowman L, Hill CJ, May A, Holland AE.
Pulmonary rehabilitation for interstitial lung disease.
Cochrane Database of Systematic Reviews 2021, Issue 2. Art. No.: CD006322.
DOI: 10.1002/14651858.CD006322.pub4.

a total of 21 studies. 16 studies in the meta-analysis
(356 participants undertook pulmonary rehabilitation and 319 were control participants)

PR probably improves 6MWD, peak workload, peak oxygen consumption and maximum ventilation
PR may reduce dyspnoea
PR improves health-related quality of life
Chronic Respiratory Disease Questionnaire (CRQ)
St George's Respiratory Questionnaire (SGRQ)

PR on survival at long-term follow-up : uncertain

Cochrane Library
Pulmonary rehabilitation for interstitial lung disease (Review)

The Reduced exercise capacity in ILD d/t Impaired gas exchange occurs

destruction of the pulmonary capillary bed

-> ventilation-perfusion mismatch and oxygen diffusion limitations

The limitation of PR compared with other chronic lung diseases

exercise-induced hypoxia

pulmonary hypertension

arrhythmia

Cochrane Library
Pulmonary rehabilitation for interstitial lung disease (Review)

ILD of varying aetiology

sarcoidosis

IPF (with mean transfer factor of carbon dioxide (TLCO) % predicted ranging from 37% to 63%).

Outpatient setting

a small number conducted in home-based

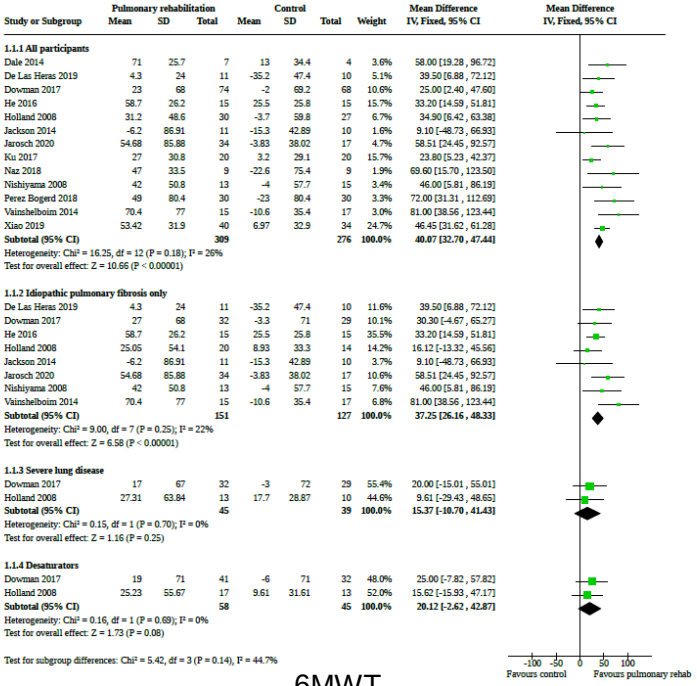
inpatient or tele-rehabilitation settings

The duration of pulmonary rehabilitation : 3 weeks to 1 year

Cochrane Library

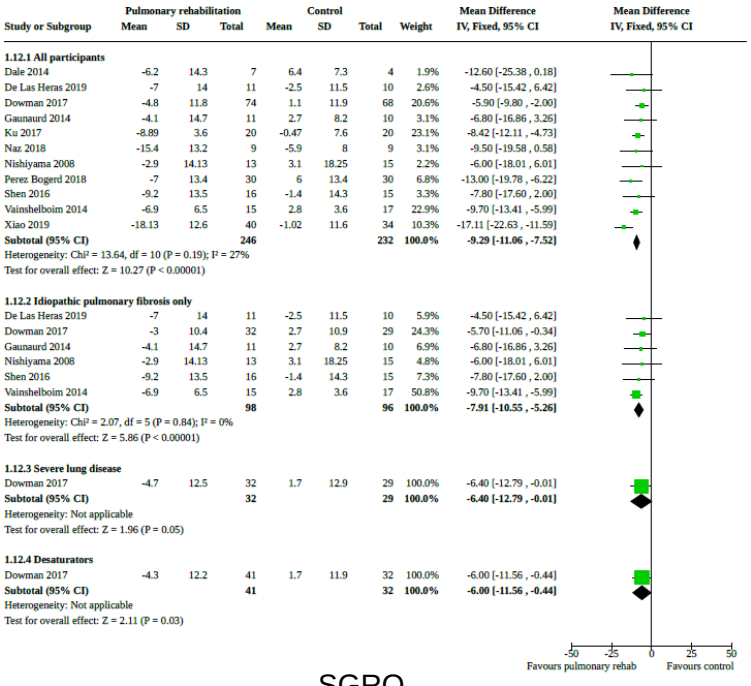
Pulmonary rehabilitation for interstitial lung disease (Review)

Figure 3. Forest plot of comparison: 1 Pulmonary rehabilitation versus no pulmonary rehabilitation, outcome: 1.1 Change in six-minute walk test immediately following pulmonary rehabilitation.



6MWT

Figure 7. Forest plot of comparison: 1 Pulmonary rehabilitation versus no pulmonary rehabilitation, outcome: 1.12 Change in quality of life (SGRQ Total) immediately following pulmonary rehabilitation.



SGRQ

Cochrane review

Cochrane Library

Cochrane Database of Systematic Reviews

Supervised maintenance programmes following pulmonary rehabilitation compared to usual care for chronic obstructive pulmonary disease (Review)

Malaguti C, Dal Corso S, Janjua S, Holland AE

Malaguti C, Dal Corso S, Janjua S, Holland AE.
Supervised maintenance programmes following pulmonary rehabilitation compared to usual care for chronic obstructive pulmonary disease.
Cochrane Database of Systematic Reviews 2021, Issue 8. Art. No.: CD013569.
DOI: 10.1002/14651858.CD013569.pub2.

21 studies (39 reports) with 1799 COPD patients

Programme duration : 1 month to 3 years

Supervised pulmonary rehabilitation maintenance programmes improve

- health-related quality of life (HRQoL)
- exercise performance
- health care utilisation

Cochrane Library

Supervised maintenance programmes following pulmonary rehabilitation compared to usual care for chronic obstructive pulmonary disease (Review)

21 studies (39 reports) with 1799 COPD patients

age : 52 - 88 yrs

FEV1 : 24% - 88%

Programme duration : 1 month to 3 years

Supervised maintenance programmes may improve **health-related quality of life** at 6 to 12 months following pulmonary rehabilitation compared to usual care (Low- to moderate-certainty evidence)

There was little to **no difference** between **the maintenance programme** and **the usual care group** in **exacerbations or all-cause hospitalizations, or the chance of death.**

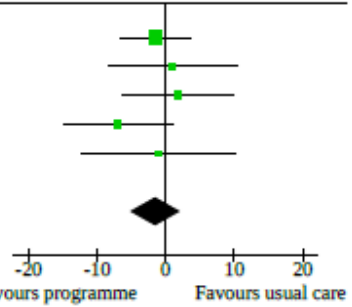
Cochrane Library

Supervised maintenance programmes following pulmonary rehabilitation compared to usual care for chronic obstructive pulmonary disease (Review)

Figure 3. Forest plot of comparison: 1 Supervised maintenance programme vs usual care; outcome: 1.6 QoL SGRQ total at time point six to 12 months following completion of pulmonary rehabilitation (points).

Study or Subgroup	Maintenance programme Mean [points]	SD [points]	Total	Usual care Mean [points]	SD [points]	Total	Weight	Mean Difference IV, Random, 95% CI [points]
Brooks 2002	47.6	8.1	18	49.1	8.6	24	43.6%	-1.50 [-6.58 , 3.58]
Spencer 2010	37	15	24	36	18	24	12.8%	1.00 [-8.37 , 10.37]
Wong 2014	42.6	18.5	41	40.8	18.5	38	16.9%	1.80 [-6.36 , 9.96]
Wootton 2018	40	17	38	47	17	33	17.9%	-7.00 [-14.93 , 0.93]
Jiménez-Reguera 2020	45.7	19.8	17	46.8	14	19	8.8%	-1.10 [-12.42 , 10.22]
Total (95% CI)			**138**			**138**	**100.0%**	**-1.57 [-4.93 , 1.78]**

Heterogeneity: Tau² = 0.00; Chi² = 2.75, df = 4 (P = 0.60); I² = 0%
Test for overall effect: Z = 0.92 (P = 0.36)
Test for subgroup differences: Not applicable



Cochrane Library

Supervised maintenance programmes following pulmonary rehabilitation compared to usual care for chronic obstructive pulmonary disease (Review)

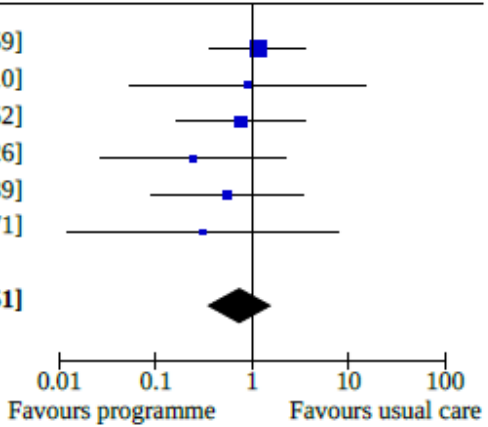
Figure 6. Forest plot of comparison: 1 Supervised maintenance programme vs usual care; outcome: 1.19 Mortality time point six to12 months following completion of pulmonary rehabilitation.

Study or Subgroup	Maintenance programme Events	Total	Usual care Events	Total	Weight	Odds Ratio M-H, Random, 95% CI
Ries 2003	7	83	6	81	40.2%	1.15 [0.37 , 3.59]
Spencer 2010	1	31	1	28	6.5%	0.90 [0.05 , 15.10]
Burns 2016	3	73	4	75	22.1%	0.76 [0.16 , 3.52]
Guell 2017	1	68	4	70	10.5%	0.25 [0.03 , 2.26]
Li 2018	2	82	3	69	15.7%	0.55 [0.09 , 3.39]
Wootton 2018	0	49	1	46	5.0%	0.31 [0.01 , 7.71]
Total (95% CI)		**386**		**369**	**100.0%**	**0.73 [0.36 , 1.51]**
Total events:	14		19			

Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 1.95$, df = 5 (P = 0.86); $I^2 = 0\%$

Test for overall effect: Z = 0.85 (P = 0.40)

Test for subgroup differences: Not applicable



[COPD Original Research]

CHEST

Long-Term Benefits of Pulmonary Rehabilitation in Patients With COPD

A 2-Year Follow-Up Study

Abebaw M. Yohannes, PhD; Sheila Dryden, Dip(Physiotherapy); Richard Casaburi, MD; and Nicola A. Hanania, MD

CHEST 2021; 159(3):967-974

165 patients with COPD

completed an **8-week**, community-based, comprehensive PR program, comprising 2-h sessions twice weekly

mMRC, SGRQ

anxiety measured with the Anxiety Inventory for Respiratory Disease (AIR), Depression Anxiety Stress Scale (DASS).

Over a 2-year period, an effective 8-week PR program

sustained improvement in anxiety and quality of life

Short-term improvements in dyspnea, depression, and stress symptoms at 8 weeks

not maintained at 2 years

PR of COPD

[COPD Original Research] CHEST

Long-Term Benefits of Pulmonary Rehabilitation in Patients With COPD
A 2-Year Follow-Up Study

Abebaw M. Yohannes, PhD; Sheila Dryden, Dip(Physiotherapy); Richard Casaburi, MD; and Nicola A. Hanania, MD

CHEST 2021; 159(3):967-974

TABLE 2] Long-Term Benefits of Pulmonary Rehabilitation in Patients With COPD[a]

Variable	Baseline	8 Weeks	2 Years	*F* Value; *P* Value
AIR	5.8 (5.8)	4.5 (4.9)[b]	4.9 (5.4)[c]	$F = 10.95$; $P < .001$
mMRC	2.8 (1.1)	2.5 (1.1)[b]	2.7 (1.2)	$F = 9.19$; $P < .001$
ISWT, m	220 (134.5)	285 (152.1)[b]	…	…
DASS-depression	9.6 (10.1)	7.6 (8.7)[b]	8.4 (9.4)	$F = 14.87$; $P < .001$
DASS-anxiety	9.2 (8.4)	7.8 (7.2)[b]	8.5 (8.4)	$F = 10.58$; $P < .001$
DASS-stress	10.5 (9.7)	8.9 (8.6)[b]	9.7 (9.1)	$F = 9.54$; $P < .001$
SGRQ				
Symptoms	63.2 (19.8)	60.7 (19.4)[b]	56.6 (23.4)[c]	$F = 7.86$; $P < .001$
Activity	66.6 (23.6)	62.4 (22.5)[b]	66.4 (22.9)	$F = 1.82$; $P = .89$
Impact	36.8 (19.7)	30.3 (17.4)[b]	33.4 (20.4)[c]	$F = 4.72$; $P < .001$
Total	50.8 (18.5)	45.1 (17.1)[b]	47.3 (19.6)[c]	$F = 5.02$; $P < .001$

AIR = Anxiety Inventory for Respiratory Disease (0-to-30 scale; higher is worse); DASS = Depression Anxiety Stress Scale (subscales) (0-to-42 scale, higher is worse); ISWT = Incremental Shuttle Walk Test; mMRC = modified Medical Research Council (0-to-4 scale; higher is worse); SGRQ = St. George's Respiratory Questionnaire (0-to-100 scale; higher is worse).

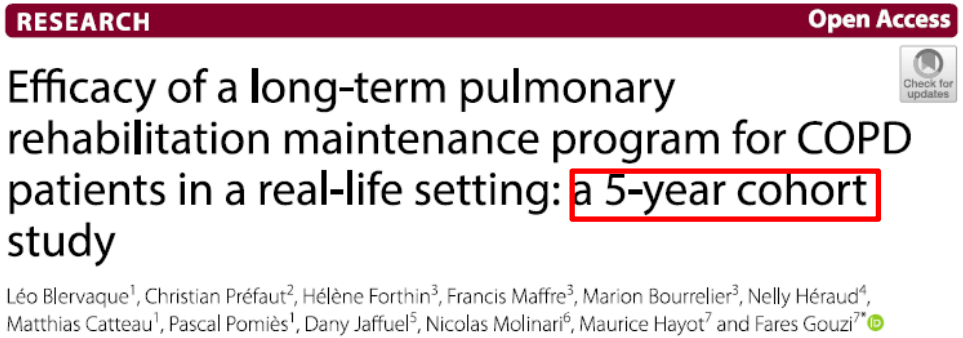
[a]Values shown represent mean (SD).

[b]$P < .001$, baseline vs 8 wk.

[c]$P < .001$, baseline vs 2 y.

Blervaque et al. Respir Res (2021) 22:79
https://doi.org/10.1186/s12931-021-01674-3

Respiratory Research



RESEARCH Open Access

Efficacy of a long-term pulmonary rehabilitation maintenance program for COPD patients in a real-life setting: a 5-year cohort study

Léo Blervaque[1], Christian Préfaut[2], Hélène Forthin[3], Francis Maffre[3], Marion Bourrelier[3], Nelly Héraud[4], Matthias Catteau[1], Pascal Pomiès[1], Dany Jaffuel[5], Nicolas Molinari[6], Maurice Hayot[7] and Fares Gouzi[7*]

144 COPD patients

Maintenance program

PR benefits at 4 years for 6MWD and HRQoI and 5 years for MRC

The 5-year survival probability

higher than for PR patients without PR maintenance

In contrast to short-term PR, **long-term PR maintenance appeared more beneficial in less severe COPD patients**

PR of COPD

Blervaque et al. Respir Res (2021) 22:79
https://doi.org/10.1186/s12931-021-01674-3

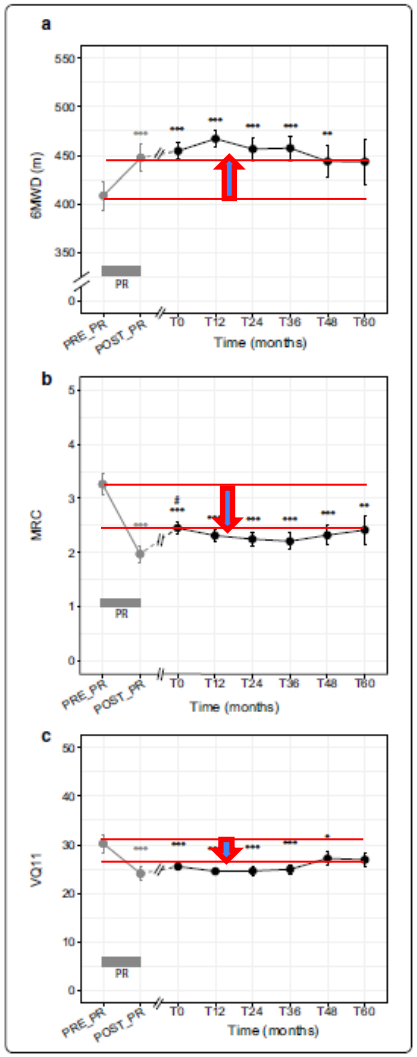
Respiratory Research

RESEARCH Open Access

Efficacy of a long-term pulmonary rehabilitation maintenance program for COPD patients in a real-life setting: a 5-year cohort study

Léo Blervaque[1], Christian Préfaut[2], Hélène Forthin[3], Francis Maffre[3], Marion Bourrelier[3], Nelly Héraud[4], Matthias Catteau[1], Pascal Pomiès[1], Dany Jaffuel[5], Nicolas Molinari[6], Maurice Hayot[7] and Fares Gouzi[7*]

Maintenance program patients showed significant PR benefits at 4 years for 6MWD and HRQol and 5 years for MRC.



PR of COPD

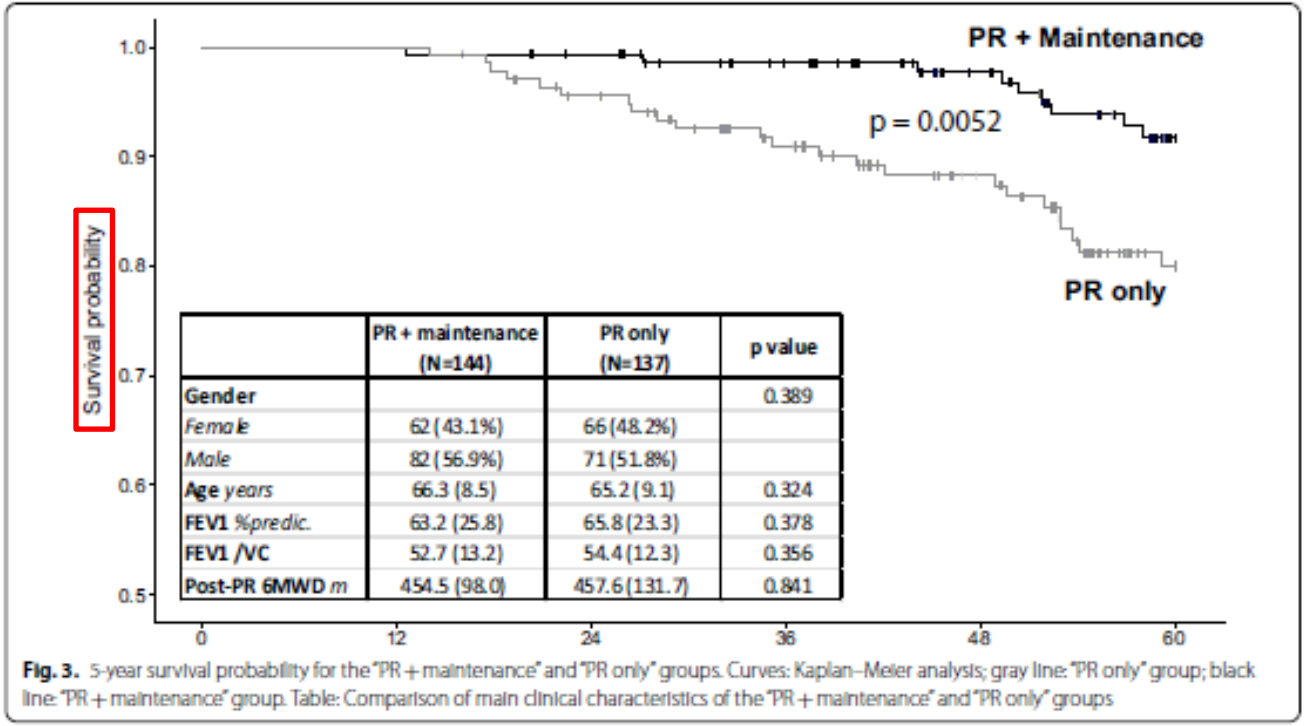
Blervaque et al. Respir Res (2021) 22:79
https://doi.org/10.1186/s12931-021-01674-3

Respiratory Research

RESEARCH Open Access

Efficacy of a long-term pulmonary rehabilitation maintenance program for COPD patients in a real-life setting: a 5-year cohort study

Léo Blervaque[1], Christian Préfaut[2], Hélène Forthin[3], Francis Maffre[3], Marion Bourrelier[3], Nelly Héraud[4], Matthias Catteau[1], Pascal Pomiès[1], Dany Jaffuel[5], Nicolas Molinari[6], Maurice Hayot[7] and Fares Gouzi[7*]



	PR + maintenance (N=144)	PR only (N=137)	p value
Gender			0.389
Female	62 (43.1%)	66 (48.2%)	
Male	82 (56.9%)	71 (51.8%)	
Age *years*	66.3 (8.5)	65.2 (9.1)	0.324
FEV1 *%predic.*	63.2 (25.8)	65.8 (23.3)	0.378
FEV1 /VC	52.7 (13.2)	54.4 (12.3)	0.356
Post-PR 6MWD *m*	454.5 (98.0)	457.6 (131.7)	0.841

Fig. 3. 5-year survival probability for the "PR + maintenance" and "PR only" groups. Curves: Kaplan–Meier analysis; gray line: "PR only" group; black line: "PR + maintenance" group. Table: Comparison of main clinical characteristics of the "PR + maintenance" and "PR only" groups

PR of COPD

Blervaque et al. Respir Res (2021) 22:79
https://doi.org/10.1186/s12931-021-01674-3

Respiratory Research

RESEARCH Open Access

Efficacy of a long-term pulmonary rehabilitation maintenance program for COPD patients in a real-life setting: a 5-year cohort study

Léo Blervaque[1], Christian Préfaut[2], Hélène Forthin[3], Francis Maffre[3], Marion Bourrelier[3], Nelly Héraud[4], Matthias Catteau[1], Pascal Pomiès[1], Dany Jaffuel[5], Nicolas Molinari[6], Maurice Hayot[7] and Fares Gouzi[7*]

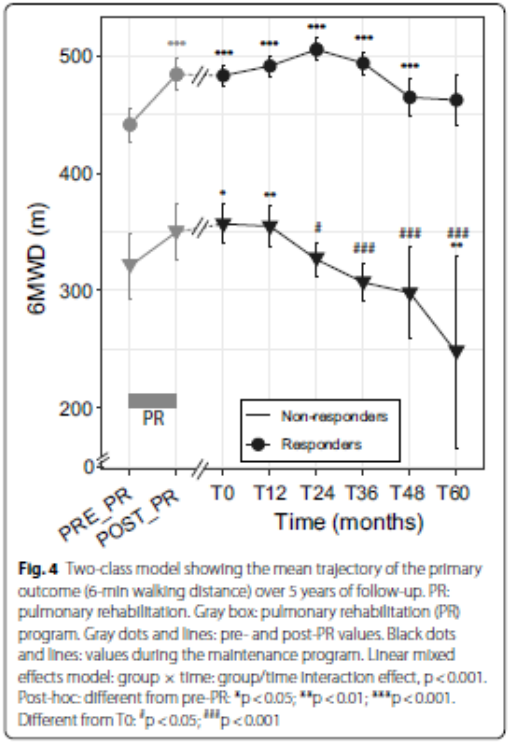


Fig. 4 Two-class model showing the mean trajectory of the primary outcome (6-min walking distance) over 5 years of follow-up. PR: pulmonary rehabilitation. Gray box: pulmonary rehabilitation (PR) program. Gray dots and lines: pre- and post-PR values. Black dots and lines: values during the maintenance program. Linear mixed effects model: group × time: group/time interaction effect, $p < 0.001$. Post-hoc: different from pre-PR: $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$. Different from T0: $^{\#}p < 0.05$; $^{\#\#\#}p < 0.001$

PR of COPD

Blervaque et al. Respir Res (2021) 22:79
https://doi.org/10.1186/s12931-021-01674-3

Respiratory Research

RESEARCH Open Access

Efficacy of a long-term pulmonary rehabilitation maintenance program for COPD patients in a real-life setting: a 5-year cohort study

Léo Blervaque[1], Christian Préfaut[2], Hélène Forthin[3], Francis Maffre[3], Marion Bourrelier[3], Nelly Héraud[4], Matthias Catteau[1], Pascal Pomiès[1], Dany Jaffuel[5], Nicolas Molinari[6], Maurice Hayot[7] and Fares Gouzi[7*]

Table 2 Baseline characteristics of the "PR + maintenance" COPD patients by trajectory class

	Non-responders (N = 30)	Responders (N = 114)	p value
Sex ratio (%*males*)	80.0%	50.9%	0.004
Age *years*	67.83 (10.21)	65.84 (7.97)	0.254
BMI *kg/m*	25.87 (5.20)	26.80 (5.32)	0.416
FEV_1 %*pred*	50.79 (23.66)	66.20 (25.48)	0.006
FEV_1/VC	46.74 (12.47)	54.47 (13.03)	0.028
Disease severity (GOLD)			0.022
I	11.5%	29.0%	
II	38.5%	41.1%	
III	26.9%	24.3%	
IV	23.1%	5.6%	
Smoking history *pack-year*	51.48 (27.32)	34.64 (24.55)	0.018
BODE Index	4.55 (1.77)	2.15 (1.58)	< 0.001
6MWD *m*	356.70 (87.13)	483.04 (81.43)	< 0.001
6MWD %*pred*	55.44 (12.53)	79.97 (13.96)	< 0.001
MRC	3.46 (1.21)	2.16 (1.12)	< 0.001
VQ11	29.83 (7.97)	24.40 (8.02)	0.004
Comorbidities *n* (% *total*)			
Mean number of comorbidities per patient	1.70 (2.14)	2.41 (1.57)	0.043
Pulmonary	7 (23.3%)	59 (51.8%)	0.005
Cardiovascular	14 (46.7%)	72 (63.2%)	0.101
Metabolic	7 (23.3%)	40 (35.1%)	0.222
Neurologic	1 (3.3%)	6 (5.3%)	0.662
Joint disorders	0 (0.0%)	16 (14.0%)	0.030
Others	2 (6.7%)	21 (18.4%)	0.118

Data are presented as means (SD). Disease severity classified according to the GOLD guidelines: stage I, mild, FEV1 > 80% of predicted normal value; stage II, moderate, FEV1 50–79%; stage III, severe, FEV1 30–49%; stage IV, very severe, FEV1 < 30%

BMI body mass index, *FEV1* forced expiratory volume in 1 s, *VC* vital capacity, *6MWD* 6-min walking distance, *%pred* % predicted, *MRC* modified Medical Research Council dyspnea score, *VQ11* a short health-related quality of life questionnaire

PR of COPD

Respiratory Medicine 185 (2021) 106478

Contents lists available at ScienceDirect

Respiratory Medicine

journal homepage: www.elsevier.com/locate/rmed

Original Research

Benefits of pulmonary rehabilitation in COPD patients with mild cognitive impairment – A pilot study

Vasileios Andrianopoulos [a,*], Rainer Gloeckl [a], Tessa Schneeberger [a], Inga Jarosch [a], Ioannis Vogiatzis [b], Emily Hume [b], Rembert A. Koczulla [a,c,d], Klaus Kenn [a,c,d]

[a] Institute for Pulmonary Rehabilitation Research, Schoen Klinik Berchtesgadener Land, Schoenau Am Koenigssee, Germany
[b] Department of Sport, Exercise and Rehabilitation, Faculty of Health and Life Sciences, Northumbria University Newcastle, United Kingdom
[c] Department of Pulmonary Rehabilitation, Philipps University Marburg, Marburg, Germany
[d] German Centre of Lung Research (DZL), Giessen-Marburg, Germany

Cognitive impairment might interfere with the efficacy of PR in COPD

60 patients and completed a 3-week inpatient PR program

25 COPD patients (42%) with mild CI prior to PR

Both, CI and CN patients significantly improved
- global cognitive function, health status (the majority of SF-36 components)
- exercise capacity (6MWT and cycle endurance)

Respiratory Medicine 185 (2021) 106478

Contents lists available at ScienceDirect

Respiratory Medicine

journal homepage: www.elsevier.com/locate/rmed

Original Research

Benefits of pulmonary rehabilitation in COPD patients with mild cognitive impairment – A pilot study

Vasileios Andrianopoulos [a,*], Rainer Gloeckl [a], Tessa Schneeberger [a], Inga Jarosch [a], Ioannis Vogiatzis [b], Emily Hume [b], Rembert A. Koczulla [a,c,d], Klaus Kenn [a,c,d]

[a] Institute for Pulmonary Rehabilitation Research, Schoen Klinik Berchtesgadener Land, Schoenau Am Koenigsee, Germany
[b] Department of Sport, Exercise and Rehabilitation, Faculty of Health and Life Sciences, Northumbria University Newcastle, United Kingdom
[c] Department of Pulmonary Rehabilitation, Philipps University Marburg, Marburg, Germany
[d] German Centre of Lung Research (DZL), Giessen-Marburg, Germany

Table 2
Cognitive function, health-related quality of life and psychological characteristics.

Baseline assessment	All Patients (n = 60)		CN (n = 35, 58%)		CI (n = 25, 42%)		P value
Cognitive/Psychological status							
Education, years, ±SD	12.4	±2.3	13.1	±2.3	11.4	±2.2	0.007
MoCA [/30], score	25.6	±2.8	27.4	±1.4	23.1	±2.5	<0.001
S-MMSE [/30], score	27.8	±1.4	28.5	±1.1	27.0	±1.3	<0.001
T-ICS [/41], score	34.3	±2.5	35.5	±1.9	32.6	±2.3	<0.001
ACE-R [/100], score	88.0	±7.1	92.5	±3.6	81.7	±5.9	<0.001
HADS Anxiety, score	5.3	±4.0	5.1	±4.1	5.5	±3.8	NS
HADS Depression, score	5.4	±4.0	5.4	±3.8	5.3	±4.4	NS
Health status (SF-36)							
Physical Functioning, %	34.2	±21.8	34.1	±18.9	34.4	±25.7	NS
Role Physical health, %	18.7	±33.4	18.6	±32.3	19.0	±35.6	NS
Bodily Pain, %	64.7	±32.0	65.4	±27.3	63.6	±38.1	NS
General Health, %	37.2	±16.0	39.3	±15.2	34.2	±16.9	NS
Vitality, %	42.7	±19.5	42.5	±17.1	43.0	±22.6	NS
Social Functioning, %	58.8	±30.7	62.3	±28.9	54.0	±33.0	NS
Role Emotional, %	52.0	±45.6	51.0	±45.9	53.3	±46.1	NS
Mental Health, %	58.6	±23.0	61.6	±22.2	54.6	±24.0	NS
Physical total, %	39.5	±17.7	40.0	±15.4	38.7	±20.7	NS
Mental total, %	48.6	±17.9	50.5	±17.7	46.0	±18.2	NS
Functional status							
6MWD, m, ±SD	370	±99	364	±86	378	±114	NS
6MWD, %predicted	58.3	±16.0	58.0	±14.9	58.8	±16.8	NS
CET 75%WRpeak, s	667	±356	719	±347	598	±362	NS
PASE activity, score	107.7	±66.5	112.9	±63.6	99.4	±71.6	NS

Data are mean ± SD unless specified otherwise. Within brackets the maximum score of each cognitive test is reported. Level of significance was set at $p < 0.05$.

PR of COPD

Respiratory Medicine 185 (2021) 106478

Contents lists available at ScienceDirect

Respiratory Medicine

journal homepage: www.elsevier.com/locate/rmed

Original Research

Benefits of pulmonary rehabilitation in COPD patients with mild cognitive impairment – A pilot study

Vasileios Andrianopoulos [a,*], Rainer Gloeckl [a], Tessa Schneeberger [a], Inga Jarosch [a], Ioannis Vogiatzis [b], Emily Hume [b], Rembert A. Koczulla [a,c,d], Klaus Kenn [a,c,d]

[a] Institute for Pulmonary Rehabilitation Research, Schoen Klinik Berchtesgadener Land, Schoenau Am Koenigsee, Germany
[b] Department of Sport, Exercise and Rehabilitation, Faculty of Health and Life Sciences, Northumbria University Newcastle, United Kingdom
[c] Department of Pulmonary Rehabilitation, Philipps University Marburg, Marburg, Germany
[d] German Centre of Lung Research (DZL), Giessen-Marburg, Germany

Table 3
Responsiveness to PR program from admission to discharge.

	CN patients (n = 35, 58%)						CI patients (n = 25, 42%)					
Cognitive status	*Post value*		Mean change		%R	ES	*Post value*		Mean change		%R	ES
S-MMSE [/30]	29.0	±0.8	0.5	±1.2*	21.2	0.58	27.8	±1.2†	0.7	±1.1*	20.8	0.58
T-ICS [/41]	36.5	±1.6	1.1	±1.7*	18.2	0.68	33.9	±2.3†	1.1	±1.9*	20.8	0.51
ACE-R [/100]	94.1	±3.0	1.8	±2.9*	15.2	0.54	86.4	±5.1†	4.4	±4.6*	54.2	0.80
Visuospatial skills	89.9	±10.6	0.4	±12.9	24.2	0.03	79.8	±16.0†	7.5	±14.4*	37.5	0.48
Memory	83.2	±6.3	4.2	±5.8*	33.3	0.67	74.0	±8.9†	6.0	±9.3*	50.0	0.75
Orientation	99.3	±2.8	0.9	±6.7	6.1	0.19	97.2	±5.4	0.3	±6.7	25.0	0.06
Attention	95.2	±5.4	−0.1	±4.1	3.0	0.01	89.6	±10.0†	2.5	±8.0	33.3	0.27
Language/executive	97.0	±2.6	1.9	±3.4*	24.2	0.62	91.6	±5.0†	2.1	±5.9	33.3	0.36
Fluency	83.9	±11.4	0.9	±9.5	18.2	0.08	67.2	±19.7†	8.3	±16.0*	50.0	0.44
Health status (SF-36)												
Physical Functioning	49.3	±23.4	15.1	±18.5*	67.6	0.72	47.6	±31.7	13.2	±20.2*	64.0	0.47
Role Physical health	30.7	±41.2	12.1	±43.0	40.0	0.33	23.0	±34.5	4.0	±17.2	16.0	0.12
Bodily Pain	82.1	±20.4	16.6	±18.8*	60.0	0.70	70.8	±32.6	7.2	±26.3	48.0	0.21
General Health	45.8	±16.0	6.6	±13.5*	40.0	0.43	42.6	±19.4	8.4	±16.7*	44.0	0.47
Vitality	54.0	±18.4	11.5	±14.3*	41.2	0.65	56.0	±25.1	13.0	±16.8*	44.0	0.56
Social Functioning	78.3	±22.5	15.6	±23.3*	64.7	0.61	68.5	±33.3	14.5	±29.5*	52.0	0.45
Role Emotional	69.6	±41.3	18.6	±42.0*	32.4	0.43	60.0	±47.1	6.7	±43.0	28.0	0.15
Mental Health	71.5	±19.7	10.0	±18.1*	42.9	0.48	69.8	±21.7	15.2	±15.5*	60.0	0.68
Summary Physical	52.9	±17.7	13.4	±15.0*	60.6	0.81	48.6	±22.8	9.9	±13.4*	48.0	0.46
Summary Mental	60.4	±17.1	10.2	±12.6*	56.3	0.59	58.5	±20.5	12.4	±12.4*	72.0	0.66
Functional status												
6MWD, m, ±SD	410	±85	46	±48*	53.3	0.54	403	±128	25	±59*	43.5	0.21
6MWD, %predicted	65.1	±14.5	7.1	±7.3*	46.7	0.49	62.4	±18.5	3.6	±9.3	39.1	0.20
CET 75%WRpeak, s	836	±344	117	±166*	41.4	0.34	737	±399	140	±142*	54.5	0.37

Asterisks denote significant difference between baseline and after PR measurement (Paired t-tests; *: $p < 0.05$). Crosses denote significant difference between post values in CN and CI patients (Independent t-tests; †: $p < 0.05$).

PR of COPD

Respiratory Medicine 185 (2021) 106478

Contents lists available at ScienceDirect

Respiratory Medicine

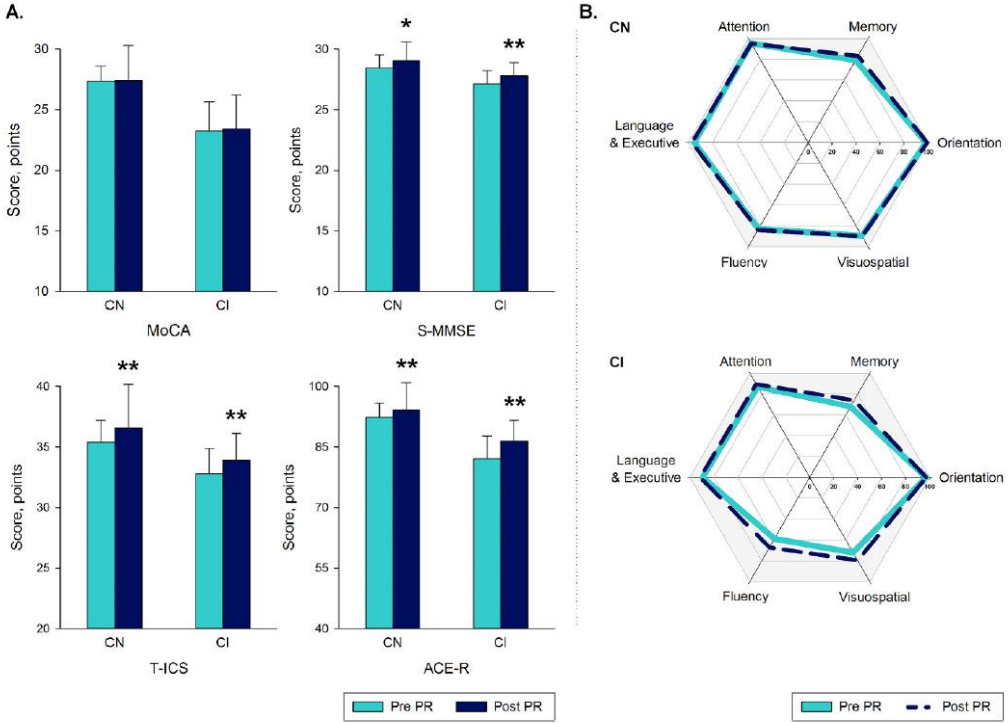
journal homepage: www.elsevier.com/locate/rmed

Original Research

Benefits of pulmonary rehabilitation in COPD patients with mild cognitive impairment – A pilot study

Vasileios Andrianopoulos [a,*], Rainer Gloeckl [a], Tessa Schneeberger [a], Inga Jarosch [a], Ioannis Vogiatzis [b], Emily Hume [b], Rembert A. Koczulla [a,c,d], Klaus Kenn [a,c,d]

[a] Institute for Pulmonary Rehabilitation Research, Schoen Klinik Berchtesgadener Land, Schoenau Am Koenigsee, Germany
[b] Department of Sport, Exercise and Rehabilitation, Faculty of Health and Life Sciences, Northumbria University Newcastle, United Kingdom
[c] Department of Pulmonary Rehabilitation, Philipps University Marburg, Marburg, Germany
[d] German Centre of Lung Research (DZL), Giessen-Marburg, Germany



PR of COPD

Respiratory Medicine 185 (2021) 106478

Contents lists available at ScienceDirect

Respiratory Medicine

journal homepage: www.elsevier.com/locate/rmed

Original Research

Benefits of pulmonary rehabilitation in COPD patients with mild cognitive impairment – A pilot study

Vasileios Andrianopoulos [a,*], Rainer Gloeckl [a], Tessa Schneeberger [a], Inga Jarosch [a], Ioannis Vogiatzis [b], Emily Hume [b], Rembert A. Koczulla [a,c,d], Klaus Kenn [a,c,d]

[a] Institute for Pulmonary Rehabilitation Research, Schoen Klinik Berchtesgadener Land, Schoenau Am Koenigsee, Germany
[b] Department of Sport, Exercise and Rehabilitation, Faculty of Health and Life Sciences, Northumbria University Newcastle, United Kingdom
[c] Department of Pulmonary Rehabilitation, Philipps University Marburg, Marburg, Germany
[d] German Centre of Lung Research (DZL), Giessen-Marburg, Germany

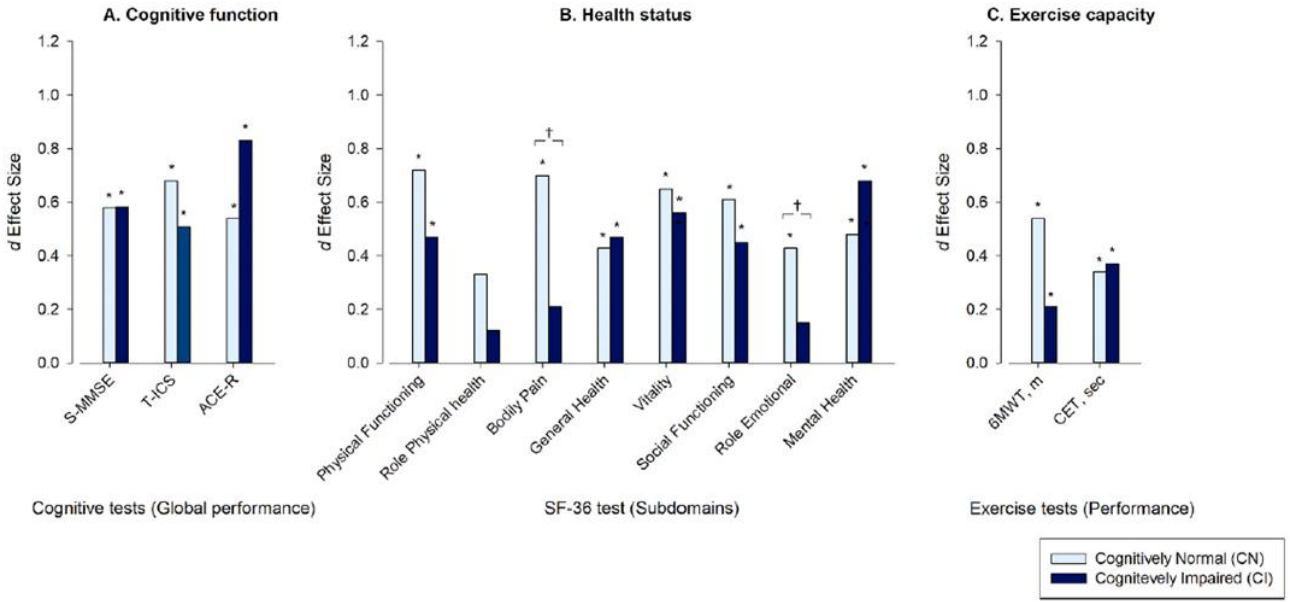


Fig. 3. The magnitude of changes in (A) cognitive function, (B) health status, and (C) exercise performance in response to PR between cognitively impaired and cognitively normal patients with COPD. Asterisks (*) denote significant changes in response to PR. Crosses (†) denote differences in changes between CI and CN patients.

ORIGINAL ARTICLE

Association between Initiation of Pulmonary Rehabilitation and Rehospitalizations in Patients Hospitalized with Chronic Obstructive Pulmonary Disease

Mihaela S. Stefan[1,2], Penelope S. Pekow[1,3], Aruna Priya[1,3], Richard ZuWallack[4], Kerry A. Spitzer[1], Tara C. Lagu[5,6], Quinn R. Pack[1,2,7], Victor M. Pinto-Plata[2,8], Kathleen M. Mazor[9], and Peter K. Lindenauer[1,2,10]

[1]Institute for Healthcare Delivery and Population Science, [2]Department of Medicine, [7]Division of Cardiovascular Medicine, and [8]Division of Pulmonary and Critical Care Medicine, University of Massachusetts Medical School–Baystate, Springfield, Massachusetts; [3]School of Public Health and Health Sciences, University of Massachusetts, Amherst, Massachusetts; [4]Pulmonary and Critical Care Division, Saint Francis Hospital and Medical Center, Hartford, Connecticut; [5]Center for Health Services and Outcomes Research, Institute of Public Health and Medicine and [6]Division of Hospital Medicine, Northwestern Feinberg School of Medicine, Chicago, Illinois; and [9]Meyers Primary Care Institute and [10]Department of Population and Quantitative Health Sciences, University of Massachusetts Medical School, Worcester, Massachusetts

ORCID ID: 0000-0002-7947-4932 (M.S.S.).

a retrospective cohort of Medicare beneficiaries (66 years of age or older) hospitalized for COPD in 2014 who survived at least 30 days after discharge

the risk of recurrent all-cause re-hospitalizations (1 yr)

197,376 total patients hospitalized in 4,446 hospitals : propensity-score–matched analysis

2,721 patients (1.5%) initiated PR within 90 days of discharge

1,534 (56.4%) patients initiated PR

125,720 (64.6%) did not : rehospitalized one or more times

The mean cumulative number of re-hospitalizations at 1 year was 0.95 for those who initiated PR within 90 days and 1.15 for those who did not (P , 0.001).

PR of COPD

ORIGINAL ARTICLE

Association between Initiation of Pulmonary Rehabilitation and Rehospitalizations in Patients Hospitalized with Chronic Obstructive Pulmonary Disease

Mihaela S. Stefan[1,2], Penelope S. Pekow[1,3], Aruna Priya[1,3], Richard ZuWallack[4], Kerry A. Spitzer[1], Tara C. Lagu[5,6], Quinn R. Pack[1,6,7], Victor M. Pinto-Plata[2,8], Kathleen M. Mazor[9], and Peter K. Lindenauer[1,2,10]

[1]Institute for Healthcare Delivery and Population Science, [2]Department of Medicine, [3]Division of Cardiovascular Medicine, and [4]Division of Pulmonary and Critical Care Medicine, University of Massachusetts Medical School-Baystate, Springfield, Massachusetts; [5]School of Public Health and Health Sciences, University of Massachusetts, Amherst, Massachusetts; [6]Pulmonary and Critical Care Division, Saint Francis Hospital and Medical Center, Hartford, Connecticut; [7]Center for Health Services and Outcomes Research, Institute of Public Health and Medicine and [8]Division of Hospital Medicine, Northwestern Feinberg School of Medicine, Chicago, Illinois; and [9]Meyers Primary Care Institute and [10]Department of Population and Quantitative Health Sciences, University of Massachusetts Medical School, Worcester, Massachusetts

ORCID ID: 0000-0002-7947-4932 (M.S.S.).

American Thoracic Society
the European Respiratory Society
American College of Chest Physicians

recommend initiation of PR within 3 weeks of an exacerbation

Table 1. Patient Characteristics in Full Cohort and among PR Initiators and Noninitiators or Late Initiators

Patient Characteristics	Total	No PR/Late PR	PR within 90 Days of Discharge*	Absolute Standardized Differences (%)†
n (%)	197,376 (100)	194,655 (98.5)	2,721 (1.5)	—
Age, yr	76.9 ± 7.6	77.0 ± 7.6	74.5 ± 6.1	35.92
Sex, F	115,690 (58.6)	114,263 (58.7)	1,427 (52.4)	12.62
Race/ethnicity				24.37
Non-Hispanic White	168,114 (85.2)	165,594 (85.1)	2,520 (92.6)	—
Black	16,885 (8.6)	16,759 (8.6)	126 (4.6)	—
Hispanic	8,084 (4.1)	8,038 (4.1)	46 (1.7)	—
Other	4,293 (2.2)	4,264 (2.2)	29 (1.1)	—
Frailty index indicator cut-off > 20%	71,860 (36.4)	71,377 (36.7)	483 (17.8)	43.50
Distance to nearest PR, miles	9.8 ± 14.8	9.8 ± 14.8	5.8 ± 6.4	34.99
Dual eligibility (Medicaid buy-in)	52,284 (26.5)	51,980 (26.7)	304 (11.2)	40.44
Current tobacco user	46,517 (23.6)	45,922 (23.6)	595 (21.9)	4.12
Weighted Charlson Comorbidity Index	4.2 ± 3.2	4.2 ± 3.2	3.5 ± 2.9	25.14
Prior year all-cause admissions				22.46
No admits	103,676 (52.5)	101,992 (52.4)	1,684 (61.9)	—
One admit	45,646 (23.1)	45,062 (23.1)	584 (21.5)	—
Two or more admits	48,054 (24.4)	47,601 (24.5)	453 (16.7)	—
Home oxygen use	62,834 (31.8)	61,761 (31.7)	1,073 (39.4)	16.15
Characteristics of index hospitalization				
Principal diagnosis				2.93
Acute respiratory failure	31,892 (16.2)	31,423 (16.1)	469 (17.2)	—
COPD	165,484 (83.8)	163,232 (83.9)	2,252 (82.8)	—
Pneumonia as secondary diagnosis	40,191 (20.4)	39,705 (20.4)	486 (17.9)	6.45
Noninvasive ventilation	15,175 (7.7)	14,960 (7.7)	215 (7.9)	0.81
Invasive ventilation	6,332 (3.2)	6,248 (3.2)	84 (3.1)	0.7
Admitted from SNF	24,482 (12.4)	24,341 (12.5)	141 (5.2)	26.01
Comorbidities				
Diabetes	63,684 (32.3)	62,999 (32.4)	685 (25.2)	15.93
Congestive heart failure	62,430 (31.6)	61,874 (31.8)	556 (20.4)	26.07
Deficiency anemias	36,408 (18.4)	36,071 (18.5)	337 (12.4)	17.06
Psychoses/depression	36,354 (18.4)	35,893 (18.4)	461 (16.9)	3.92
Renal failure	35,719 (18.1)	35,387 (18.2)	332 (12.2)	16.71
Hypothyroidism	35,156 (17.8)	34,724 (17.8)	432 (15.9)	7.41
Obesity	29,430 (14.9)	29,003 (14.9)	427 (15.7)	2.2
Obstructive sleep apnea	25,786 (13.1)	25,320 (13)	466 (17.1)	11.53
Neurological disorders	14,389 (7.3)	14,261 (7.3)	128 (4.7)	11.04
Weight loss	8,763 (4.4)	8,665 (4.5)	98 (3.6)	4.32

Definition of abbreviations: COPD = chronic obstructive pulmonary disease; PR = pulmonary rehabilitation; SNF = skilled nursing facility.
Data are presented as *n* (%) or mean ± SD unless otherwise indicated.
*PR within 3 months of discharge.
†Standardized differences of >10% are considered meaningful.

PR of COPD

ORIGINAL ARTICLE

Association between Initiation of Pulmonary Rehabilitation and Rehospitalizations in Patients Hospitalized with Chronic Obstructive Pulmonary Disease

Mihaela S. Stefan[1,2], Penelope S. Pekow[1,3], Aruna Priya[1,3], Richard ZuWallack[4], Kerry A. Spitzer[1], Tara C. Lagu[5,6], Quinn R. Pack[1,6,7], Victor M. Pinto-Plata[2,8], Kathleen M. Mazor[9], and Peter K. Lindenauer[1,2,10]

[1]Institute for Healthcare Delivery and Population Science, [2]Department of Medicine, [3]Division of Cardiovascular Medicine, and [4]Division of Pulmonary and Critical Care Medicine, University of Massachusetts Medical School–Baystate, Springfield, Massachusetts; [5]School of Public Health and Health Sciences, University of Massachusetts, Amherst, Massachusetts; [6]Pulmonary and Critical Care Division, Saint Francis Hospital and Medical Center, Hartford, Connecticut; [7]Center for Health Services and Outcomes Research, Institute of Public Health and Medicine and [8]Division of Hospital Medicine, Northwestern Feinberg School of Medicine, Chicago, Illinois; and [9]Meyers Primary Care Institute and [10]Department of Population and Quantitative Health Sciences, University of Massachusetts Medical School, Worcester, Massachusetts

ORCID ID: 0000-0002-7947-4932 (M.S.S.).

Table 2. Unadjusted Outcomes in the Full Cohort and Propensity-Matched Cohort

	Full Cohort*			Propensity-Score–Matched Cohort†		
	No PR/ Late PR	PR within 90 Days of Discharge	*P* Value (Chi-square Test)	No PR/ Late PR	PR within 90 Days of Discharge	*P* Value (Conditional Regression)
n (%)	194,655 (98.5)	2,721 (1.5)	—	2,710 (50.0)	2,710 (50.0)	—
Any unplanned all-cause rehospitalizations/SNF/ED visits in 1 year after discharge	147,631 (75.8)	1,901 (69.9)	<0.001	1,730 (63.8)	1,732 (63.9)	0.95
Mortality 1 year after discharge	38,104 (19.6)	198 (7.3)	<0.001	382 (14.1)	198 (7.3)	<0.001
Number of days spent in the hospital per person-year	22.7 ± 34.3	11.5 ± 19.1	<0.001‡	11.7 ± 30.5	7.9 ± 18.9	<0.001
Number of days spent in nursing home per person-year	4.9 ± 17.0	2.0 ± 8.7	<0.001‡	2.9 ± 14.0	1.8 ± 7.8	0.0003
Number of days spent in ED per person-year	1.4 ± 2.9	1.1 ± 2.0	0.001‡	1.1 ± 2.3	1.0 ± 2.0	0.025
Average number of unplanned rehospitalizations	1.5 ± 1.9	1.2 ± 1.5	<0.001‡	1.2 ± 1.7	1.1 ± 1.6	0.02
Categories of number of unplanned rehospitalizations in 1 year after discharge			<0.001			0.091
No rehospitalizations during follow-up	68,935 (35.4)	1,187 (43.6)	—	1,333 (49.2)	1,368 (50.5)	—
One rehospitalization during follow-up	55,626 (28.6)	756 (27.8)	—	576 (21.3)	624 (23.0)	—
Two or more rehospitalizations during follow-up	70,094 (36.0)	778 (28.6)	—	801 (29.6)	718 (26.5)	—
Unplanned COPD rehospitalizations in 1 year after discharge	61,344 (31.5)	914 (33.6)	0.021	735 (27.1)	726 (26.8)	0.78

Definition of abbreviations: COPD = chronic obstructive pulmonary disease; ED = emergency department; PR = pulmonary rehabilitation; SNF = skilled nursing facility.
Data are presented as *n* (%) or mean ± SD unless otherwise indicated.
*Outcomes assessed from discharge until 1 year or PR start after 90 days or death.
†Outcomes assessed from matched PR start day until 1 year after discharge or PR start after 90 days or death.
‡Kruskal-Wallis test.

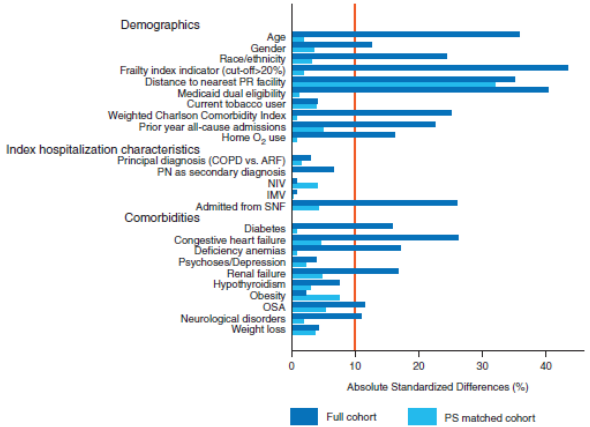


Figure 2. Absolute standardized differences for patient characteristics in the full cohort and propensity analysis. ARF = acute respiratory failure; COPD = chronic obstructive pulmonary disease; IMV = invasive mechanical ventilation; NIV = noninvasive ventilation; OSA = obstructive sleep apnea; PN = pneumonia; PR = pulmonary rehabilitation; PS = propensity score; SNF = skilled nursing facility.

PR of COPD

ORIGINAL ARTICLE

Association between Initiation of Pulmonary Rehabilitation and Rehospitalizations in Patients Hospitalized with Chronic Obstructive Pulmonary Disease

Mihaela S. Stefan[1,2], Penelope S. Pekow[1,3], Aruna Priya[1,3], Richard ZuWallack[4], Kerry A. Spitzer[1], Tara C. Lagu[5,6], Quinn R. Pack[1,6,7], Victor M. Pinto-Plata[2,8], Kathleen M. Mazor[9], and Peter K. Lindenauer[1,2,10]

[1]Institute for Healthcare Delivery and Population Science, [2]Department of Medicine, [3]Division of Cardiovascular Medicine, and [4]Division of Pulmonary and Critical Care Medicine, University of Massachusetts Medical School–Baystate, Springfield, Massachusetts; [5]School of Public Health and Health Sciences, University of Massachusetts, Amherst, Massachusetts; [6]Pulmonary and Critical Care Division, Saint Francis Hospital and Medical Center, Hartford, Connecticut; [7]Center for Health Services and Outcomes Research, Institute of Public Health and Medicine and [8]Division of Hospital Medicine, Northwestern Feinberg School of Medicine, Chicago, Illinois; and [9]Meyers Primary Care Institute and [10]Department of Population and Quantitative Health Sciences, University of Massachusetts Medical School, Worcester, Massachusetts

ORCID ID: 0000-0002-7947-4932 (M.S.S.).

PR initiation was associated with a lower risk of readmission in the year after PR initiation (hazard ratio, 0.83; 95% confidence interval, 0.77–0.90).

The mean cumulative number of rehospitalizations at 1 year was 0.95 for those who initiated PR within 90 days and 1.15 for those who did not (P , 0.001)

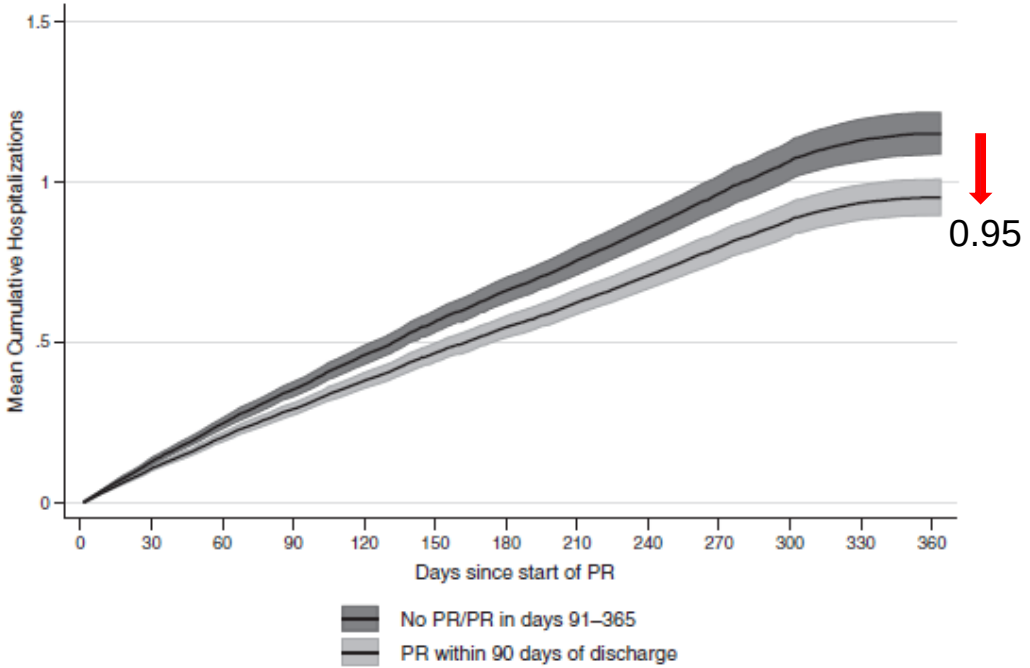


Figure 3. Multistate analysis using Cox proportional regression in the propensity-matched analysis. PR = pulmonary rehabilitation.

Article

Validation of Clinical Characteristics and Effectiveness of Pulmonary Rehabilitation in a COPD Population with Discrepancy between Exercise Tolerance and FEV1

Jun Horie [1,*], Koichiro Takahashi [2], Shuuichi Shiranita [3], Kunihiko Anami [4] and Shinichiro Hayashi [5]

[1] Department of Physical Therapy, Faculty of Health Science, Kyoto Tachibana University, 34 Yamada-cho Oyake, Yamashina-ku, Kyoto 607-8175, Japan
[2] Division of Hematology, Respiratory Medicine and Oncology, Department of Internal Medicine, Faculty of Medicine, Saga University, 5-1-1 Nabeshima, Saga 840-8502, Japan; takahak@cc.saga-u.ac.jp
[3] Choseido-Watanabe Clinic, Department of Rehabilitation, 7182-58 Kaigandoori, Karatsu City, Saga 847-0873, Japan; choseido-reha@po.people-i.ne.jp
[4] Department of Rehabilitation, Faculty of Health Sciences, Naragakuen University, 3-12-1 Sangou-cho Tatsunokita, Ikoma-gun, Nara 636-8503, Japan; anami@naragakuen-u.jp
[5] Department of Physical Therapy, School of Health Sciences at Fukuoka, Okawa Campus in Fukuoka Prefecture, International University of Health and Welfare, Okawa, 137-1 Enotsu, Okawa City, Fukuoka 831-8501, Japan; hayashs@hotmail.co.jp
* Correspondence: horie-j@tachibana-u.ac.jp; Tel.: +81-75-571-1111; Fax: +81-75-574-4122

(1) LoFlo + HiEx—patients with a six-minute walking distance (6MWD) ≥350 m and %FEV1.0)<50%
(2) HiFlo + HiEx—patients with a 6MWD ≥350 m and a %FEV1.0 ≥50%
(3) LoFlo + LoEx— patients with a 6MWD < 350 m and %FEV1.0 < 50%
(4) HiFlo + LoEx—patients with a 6MWD <350 m and %FEV1.0 ≥ 50%

The HiFlo + LoEx group
the greatest effect of three-month pulmonary rehabilitation compared to other groups.

Article

Validation of Clinical Characteristics and Effectiveness of Pulmonary Rehabilitation in a COPD Population with Discrepancy between Exercise Tolerance and FEV1

Jun Horie [1,*], Koichiro Takahashi [2], Shuuichi Shiranita [3], Kunihiko Anami [4] and Shinichiro Hayashi [5]

[1] Department of Physical Therapy, Faculty of Health Science, Kyoto Tachibana University, 34 Yamada-cho Oyake, Yamashina-ku, Kyoto 607-8175, Japan
[2] Division of Hematology, Respiratory Medicine and Oncology, Department of Internal Medicine, Faculty of Medicine, Saga University, 5-1-1 Nabeshima, Saga 840-8502, Japan; takahaki@cc.saga-u.ac.jp
[3] Choseido-Watanabe Clinic, Department of Rehabilitation, 7102-58 Kaigandoori, Karatsu City, Saga 847-0873, Japan; choseido-reha@pc.people-i.ne.jp
[4] Department of Rehabilitation, Faculty of Health Sciences, Naragakuen University, 3-12-1 Sangou-cho Tatsunokita, Ikoma-gun, Nara 636-8503, Japan; anami@naragakuen-u.jp
[5] Department of Physical Therapy, School of Health Sciences at Fukuoka, Okawa Campus in Fukuoka Prefecture, International University of Health and Welfare, Okawa, 137-1 Enotsu, Okawa City, Fukuoka 831-8501, Japan; hayashs@hotmail.co.jp
* Correspondence: horie-j@tachibana-u.ac.jp; Tel.: +81-75-571-1111; Fax: +81-75-574-4122

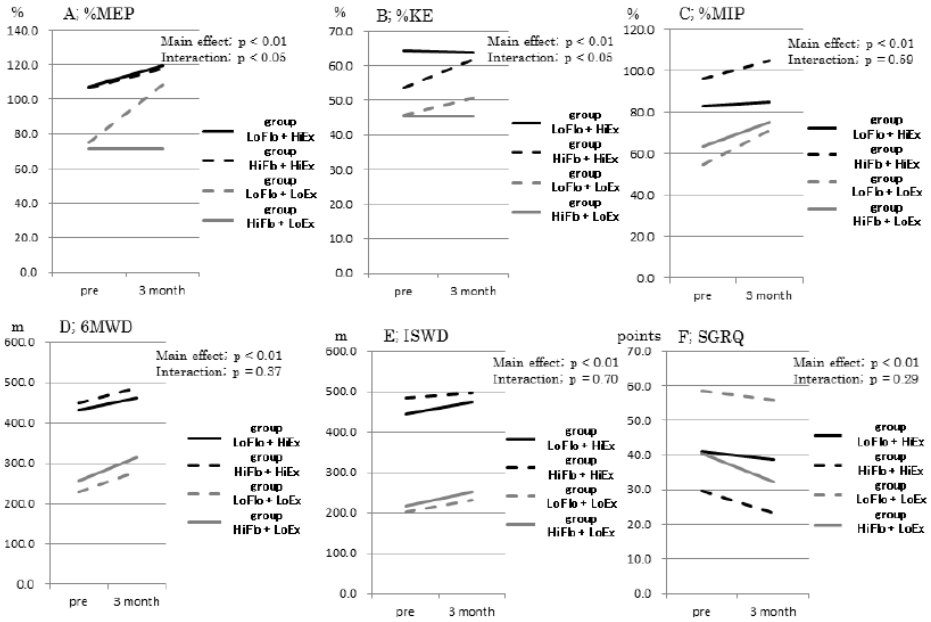


Figure 3. Comparison of the pulmonary rehabilitation effect for three months between each group. %KE, ratio of knee extension strength to body weight; %MEP, ratio of maximal expiratory pressure to body weight; %MIP, ratio of maximal inspiratory pressure to body weight; 6MWD, six-minute walking distance; ISWD, incremental shuttle walking distance; SGRQ, St. George's Respiratory Questionnaire.

COPD: JOURNAL OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE
2021, VOL. 18, NO. 1, 35–44
https://doi.org/10.1080/15412555.2021.1874897

Minimal Clinically Important Difference for Quadriceps Muscle Strength in People with COPD following Pulmonary Rehabilitation

Ana Oliveira[a,b,c], Patrícia Rebelo[c,d], Cátia Paixão[c,d], Cristina Jácome[e,f], Joana Cruz[g], Vitória Martins[h], Paula Simão[i], Dina Brooks[a,b], and Alda Marques[c,d]

[a]School of Rehabilitation Science, McMaster University, Hamilton, ON, Canada; [b]Respiratory Medicine, West Park Healthcare Centre, Toronto, ON, Canada; [c]Lab3R – Respiratory Research and Rehabilitation Laboratory, School of Health Sciences, University of Aveiro (ESSUA), Aveiro, Portugal; [d]iBiMED – Institute of Biomedicine, Department of Medical Sciences, University of Aveiro, Aveiro, Portugal; [e]CINTESIS –Center for Health Technology and Services Research, Faculty of Medicine, University of Porto, Porto, Portugal; [f]Department of Community Medicine, Information and Health Decision Sciences (MEDCIDS), Faculty of Medicine, University of Porto, Porto, Portugal; [g]School of Health Sciences, Polytechnic Institute of Leiria, Leiria, Portugal; Centre for Innovative Care and Health Technology (ciTechCare), School of Health Sciences (ESSLei), Polytechnic of Leiria, Leiria, Portugal; [h]Pulmonology Department, Hospital Distrital da Figueira da Foz, Figueira da Foz, Portugal; [i]Pulmonology Department, Unidade Local de Saúde de Matosinhos, Matosinhos, Portugal

Quadriceps strength training : a key component of pulmonary rehabilitation (PR)

the minimal clinically important difference (MCID) for the isotonic and isometric quadriceps muscle strength assessed with the one-repetition maximum (1RM) and hand-held dynamometry (HHD)

MCIDs found are estimates to improve interpretability of community-based PR effects on quadriceps muscle strength and may contribute to guide interventions.

PR of COPD

COPD: JOURNAL OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE
2021, VOL. 18, NO. 1, 35–44
https://doi.org/10.1080/15412555.2021.1874897

Taylor & Francis
Taylor & Francis Group

Check for updates

Minimal Clinically Important Difference for Quadriceps Muscle Strength in People with COPD following Pulmonary Rehabilitation

Ana Oliveira[a,b,c], Patrícia Rebelo[c,d], Cátia Paixão[c,d], Cristina Jácome[e,f], Joana Cruz[g], Vitória Martins[h], Paula Simão[i], Dina Brooks[a,b], and Alda Marques[c,d]

[a]School of Rehabilitation Science, McMaster University, Hamilton, ON, Canada; [b]Respiratory Medicine, West Park Healthcare Centre, Toronto, ON, Canada; [c]Lab3R – Respiratory Research and Rehabilitation Laboratory, School of Health Sciences, University of Aveiro (ESSUA), Aveiro, Portugal; [d]iBiMED – Institute of Biomedicine, Department of Medical Sciences, University of Aveiro, Aveiro, Portugal; [e]CINTESIS –Center for Health Technology and Services Research, Faculty of Medicine, University of Porto, Porto, Portugal; [f]Department of Community Medicine, Information and Health Decision Sciences (MEDCIDS), Faculty of Medicine, University of Porto, Porto, Portugal; [g]School of Health Sciences, Polytechnic Institute of Leiria, Leiria, Portugal; Centre for Innovative Care and Health Technology (ciTechCare), School of Health Sciences (ESSLei), Polytechnic of Leiria, Leiria, Portugal; [h]Pulmonology Department, Hospital Distrital da Figueira da Foz, Figueira da Foz, Portugal; [i]Pulmonology Department, Unidade Local de Saúde de Matosinhos, Matosinhos, Portugal

Table 3. Outcome measures before and after the 12-week community-based pulmonary rehabilitation programme in people with COPD.

Outcome measure	Baseline	Post-PR	△	% △	p-value	ES
1RM (leg extension, Kg) ($n = 65$)	37.2 ± 13.2	44.7 ± 17.9	7.5 ± 12.4	24.5 ± 42	<0.001*	0.5
HHD (leg extension, KgF) ($n = 70$)	31.7 ± 7.7	34.1 ± 8.2	2.1 ± 6.9	9.5 ± 26.5	0.015*	0.2
6MWD, metres ($n = 89$)	417.8 ± 127.5	460.2 ± 131.2	43.3 ± 63	15.5 ± 28.1	<0.001*	0.7
SGRQ (total score) ($n = 89$)	45.61 ± 19.2	38.5 ± 18.3	−7.9 ± 10.8	−16.2 ± 28.8	<0.001*	0.4

Notes: Values are presented as mean ± standard deviation. *$p < 0.05$.

Legend: △, mean change; 1RM, 1 repetition maximum; 6MWD, 6-minute walk distance; ES, Effect size; HHD, handheld dynamometry, PR, pulmonary rehabilitation; SGRQ, St. George's respiratory questionnaire.

COPD: JOURNAL OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE
2021, VOL. 18, NO. 1, 35–44
https://doi.org/10.1080/15412555.2021.1874897

Taylor & Francis
Taylor & Francis Group

Check for updates

Minimal Clinically Important Difference for Quadriceps Muscle Strength in People with COPD following Pulmonary Rehabilitation

Ana Oliveira[a,b,c], Patrícia Rebelo[c,d], Cátia Paixão[c,d], Cristina Jácome[e,f], Joana Cruz[g], Vitória Martins[h], Paula Simão[i], Dina Brooks[a,b], and Alda Marques[c,d]

[a]School of Rehabilitation Science, McMaster University, Hamilton, ON, Canada; [b]Respiratory Medicine, West Park Healthcare Centre, Toronto, ON, Canada; [c]Lab3R – Respiratory Research and Rehabilitation Laboratory, School of Health Sciences, University of Aveiro (ESSUA), Aveiro, Portugal; [d]iBiMED – Institute of Biomedicine, Department of Medical Sciences, University of Aveiro, Aveiro, Portugal; [e]CINTESIS –Center for Health Technology and Services Research, Faculty of Medicine, University of Porto, Porto, Portugal; [f]Department of Community Medicine, Information and Health Decision Sciences (MEDCIDS), Faculty of Medicine, University of Porto, Porto, Portugal; [g]School of Health Sciences, Polytechnic Institute of Leiria, Leiria, Portugal; Centre for Innovative Care and Health Technology (ciTechCare), School of Health Sciences (ESSLei), Polytechnic of Leiria, Leiria, Portugal; [h]Pulmonology Department, Hospital Distrital da Figueira da Foz, Figueira da Foz, Portugal; [i]Pulmonology Department, Unidade Local de Saúde de Matosinhos, Matosinhos, Portugal

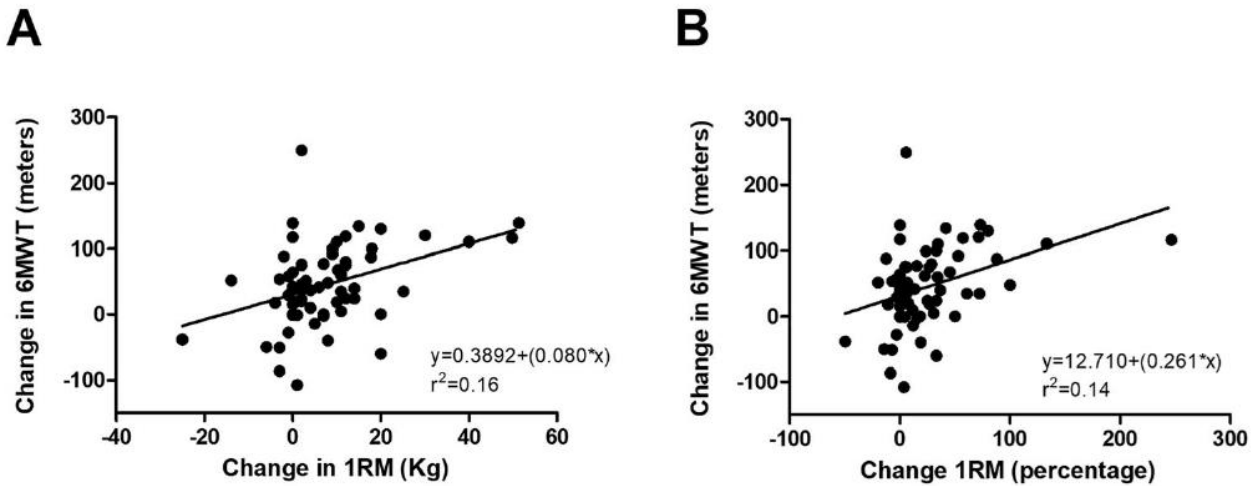


Figure 2. - Linear regression of A) changes in one-repetition maximum (1RM) of quadriceps muscle strength and changes in the six-minute walk test (6MWT) and B) percentage of changes in 1RM of quadriceps muscle strength and changes in the 6MWT.

Journal of *Clinical Medicine*

MDPI

Article

Evaluation of the Efficacy of Immersive Virtual Reality Therapy as a Method Supporting Pulmonary Rehabilitation: A Randomized Controlled Trial

Sebastian Rutkowski [1,*], Jan Szczegielniak [1] and Joanna Szczepańska-Gieracha [2]

[1] Department of Physical Education and Physiotherapy, Opole University of Technology, 45-758 Opole, Poland; j.szczegielniak@po.opole.pl
[2] Department of Physiotherapy, University School of Physical Education in Wrocław, 51-612 Wrocław, Poland; joanna.szczepanska@awf.wroc.pl
* Correspondence: s.rutkowski@po.opole.pl; Tel.: +48-507-027-792

J. Clin. Med. **2021**, *10*, 352. https://doi.org/10.3390/jcm10020352

Anxiety in 21–96% and depression in 27–79% of patients with COPD

50 COPD patients
symptoms of stress, depression, and anxiety, randomly assigned to one of two groups.

A reduction in stress levels only in the VR-group.

The symptoms of depression and anxiety were statistically significantly reduced only in the VR-group.

Journal of Clinical Medicine

MDPI

Article

Evaluation of the Efficacy of Immersive Virtual Reality Therapy as a Method Supporting Pulmonary Rehabilitation: A Randomized Controlled Trial

Sebastian Rutkowski [1,*], Jan Szczegielniak [1] and Joanna Szczepańska-Gieracha [2]

[1] Department of Physical Education and Physiotherapy, Opole University of Technology, 45-758 Opole, Poland; j.szczegielniak@po.opole.pl
[2] Department of Physiotherapy, University School of Physical Education in Wroclaw, 51-612 Wroclaw, Poland; joanna.szczepanska@awf.wroc.pl
* Correspondence: s.rutkowski@po.opole.pl; Tel.: +48-507-027-792

J. Clin. Med. **2021**, *10*, 352. https://doi.org/10.3390/jcm10020352

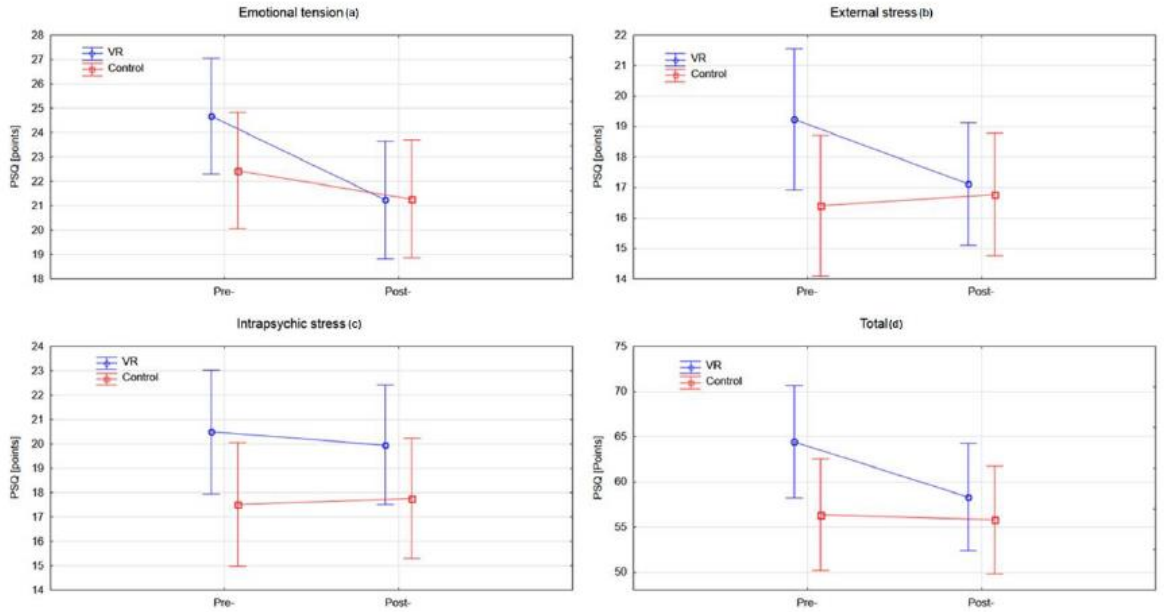


Figure 4. Analysis of the PSQ questionnaire in both groups pre- and post-rehabilitation program: (**a**) emotional tension (**b**) external stress (**c**) intrapsychic stress (**d**) total score. VR: virtual reality; PSQ: Perception of Stress Questionnaire.

Journal of Clinical Medicine

MDPI

Article

Evaluation of the Efficacy of Immersive Virtual Reality Therapy as a Method Supporting Pulmonary Rehabilitation: A Randomized Controlled Trial

Sebastian Rutkowski [1,*], Jan Szczegielniak [1] and Joanna Szczepańska-Gieracha [2]

[1] Department of Physical Education and Physiotherapy, Opole University of Technology, 45-758 Opole, Poland; j.szczegielniak@po.opole.pl
[2] Department of Physiotherapy, University School of Physical Education in Wroclaw, 51-612 Wroclaw, Poland; joanna.szczepanska@awf.wroc.pl
* Correspondence: s.rutkowski@po.opole.pl; Tel.: +48-507-027-792

J. Clin. Med. **2021**, *10*, 352. https://doi.org/10.3390/jcm10020352

Table 2. Analysis of the stress, anxiety, depression, and functional capacity assessment within the examined groups expressed as mean (SD).

Variable	VR Group			Control Group			Effect Size
	Pre	Post	*p*	Pre	Post	*p*	
Emotional tension	24.68 (6.12)	21.24 (6.03)	**0.0003**	22.44 (5.77)	21.28 (5.99)	0.1998	−0.377
External stress	19.24 (6.65)	17.12 (5.21)	**0.0092**	16.40 (4.71)	16.76 (4.77)	0.6470	−0.424
Intrapsychic stress	20.48 (5.85)	19.96 (5.78)	0.6356	17.52 (6.47)	17.76 (6.39)	0.8267	−0.121
PSQ Total score	64.40 (15.88)	58.32 (15.29)	**0.0069**	56.36 (14.91)	55.80 (14.19)	0.7961	−0.353
HADS-D mean (SD)	7.96 (2.76)	6.04 (3.21)	**0.0001**	6.64 (2.80)	7.08 (3.56)	0.4515	−0.836
HADS-A mean (SD)	10.36 (3.63)	8.24 (3.50)	**0.0009**	8.52 (3.22)	8.60 (2.87)	0.8941	0.631
HADS Total score	18.32 (4.90)	13.24 (4.05)	**0.0001**	15.16 (4.47)	15.68 (5.29)	0.6119	−1.175
6MWT [MET], mean (SD)	6.12 (2.12)	6.75 (2.24)	**0.0018**	5.98 (1.84)	6.76 (1.28)	**0.0002**	−0.074
FEV1 [%], mean (SD)	71.00 (23.66)	73.25 (23.24)	0.1893	86.48 (21.13)	90.24 (19.36)	**0.0429**	−0.066

Bold highlights statistical significance $p < 0.05$. 6MWT: 6 min walk test; FEV1: forced expiratory volume for 1 s; HADS: Hospital Anxiety and Depression Scale; MET: metabolic equivalent; SD: standard deviation; VR: virtual reality; PSQ: Perception of Stress Questionnaire.

MEDICINE

Original Article

In-Patient Pulmonary Rehabilitation to Improve Asthma Control

A Randomized Controlled Study (EPRA, Effectiveness of Pulmonary Rehabilitation for Patients with Asthma)

Konrad Schultz, Michael Wittmann, Rupert Wagner, Nicola Lehbert, Larissa Schwarzkopf, Boglárka Szentes, Dennis Nowak, Hermann Faller, Michael Schuler

Deutsches Ärzteblatt International | Dtsch Arztebl Int 2021; 118: 23–30

412 adults with uncontrolled asthma (ACT score < 20)

a 3-week course of PR

clinically relevant improvement in asthma control

PR of Asthma

Original Article

In-Patient Pulmonary Rehabilitation to Improve Asthma Control

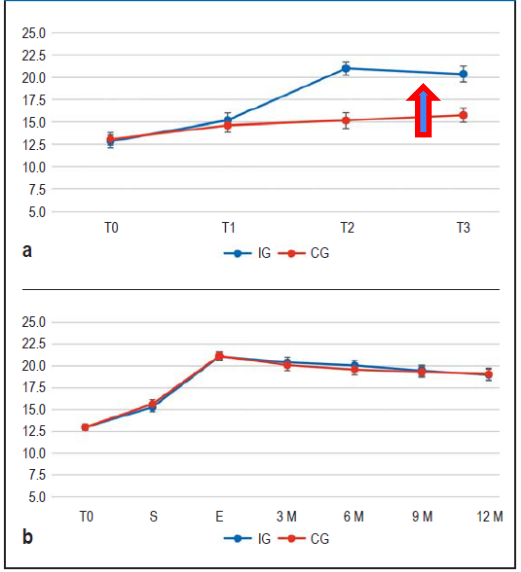
A Randomized Controlled Study (EPRA, Effectiveness of Pulmonary Rehabilitation for Patients with Asthma)

Konrad Schultz, Michael Wittmann, Rupert Wagner, Nicola Lehbert, Larissa Schwarzkopf, Boglárka Szentes, Dennis Nowak, Hermann Faller, Michael Schuler

Deutsches Ärzteblatt International | Dtsch Arztebl Int 2021; 118: 23–30

- Endurance and strength training (M)
- Whole-body vibration training (O)
- Inspiratory muscle training (O)
- Patient education about asthma (M)
- Inhalation technique training (M)
- Allergen avoidance education (O)
- Group respiratory physiotherapy (M) or individual respiratory physiotherapy (O)
- Buteyko breathing technique training (O)
- Respiratory physiotherapeutic mucolysis procedures (O)
- Psychological individual and group interventions (O)
- Social counseling (O)
- Nutritional counseling/therapy (O)
- Smoking cessation (O)

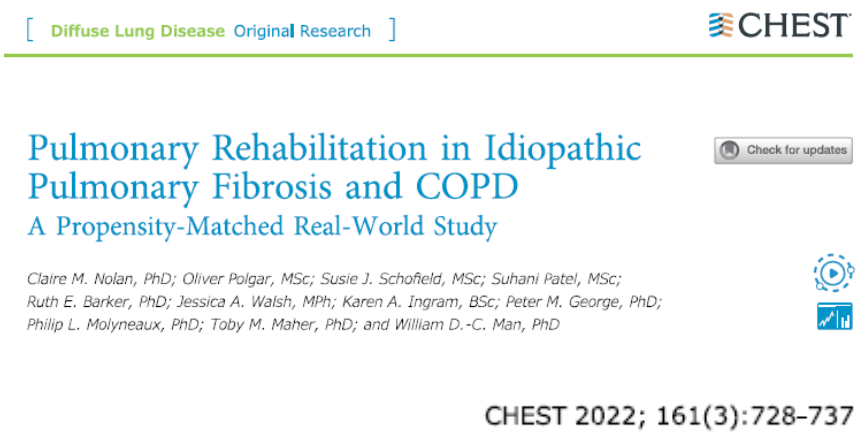
FIGURE 2



a) Randomized controlled trial (RCT; effects between IG and CG):
Mean values and 95% confidence intervals of the primary endpoint Asthma Control Test (ACT) from T0 to T3. ACT scores ≥ 20 indicate well-controlled asthma, ACT scores of 5–19 indicate poorly controlled asthma.

b) Pooled cohort observational study (follow-up of the EPRA trial):
Mean values and 95% confidence intervals of the ACT scores for the IG and the CG at T0 and at the start (S) and end (E) of rehabilitation. The interval from T0 to start of rehabilitation was 1 month for the IG, and 5 months for the CG.

T0, study inclusion/randomization; T1, start of rehab. for intervention group (IG) = 4 weeks after T0; T2, end of rehab. for IG; T3, 3 months after end of rehab. for IG, and start of rehab. for the control group (CG), who had been on the waiting list (with usual care) prior to T3



[Diffuse Lung Disease Original Research]

CHEST

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

Check for updates

CHEST 2022; 161(3):728–737

163 patients with IPF were matched 1:1 with a control group of 163 patients with COPD referred for pulmonary rehabilitation.

Similar pulmonary rehabilitation completion rates (IPF, 69%; COPD, 63%) and improvements in exercise response were observed in both groups with no significant mean between-group differences in incremental shuttle walk test (ISWT) change.

In IPF, **noncompletion** of and **nonresponse** to pulmonary rehabilitation were associated with **increased all-cause mortality.**

PR of ILD

[Diffuse Lung Disease Original Research] CHEST

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

CHEST 2022; 161(3):728-737

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[a]	Mean (95% CI)	*P* Value[a]	Mean (95% CI)	*P* Value
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

CRQ = Chronic Respiratory Questionnaire; IPF = Idiopathic Pulmonary Fibrosis; ISWT = incremental shuttle walk test; MRC = Medical Research Council; PR = pulmonary rehabilitation.

[a]Difference between the values before and after PR.

PR of ILD

[Diffuse Lung Disease Original Research]

CHEST

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

CHEST 2022; 161(3):728–737

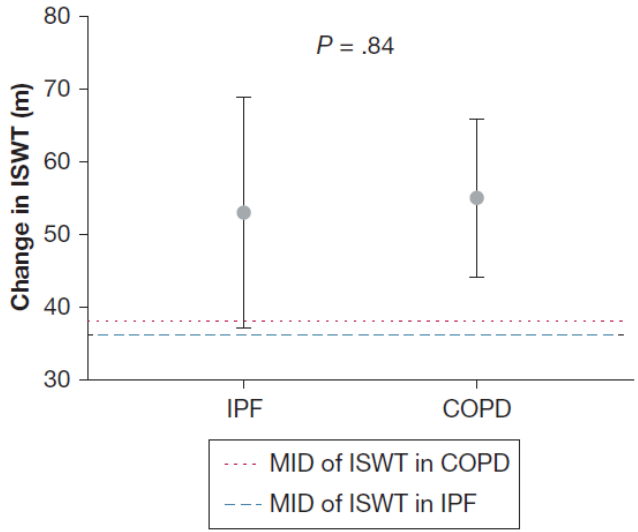
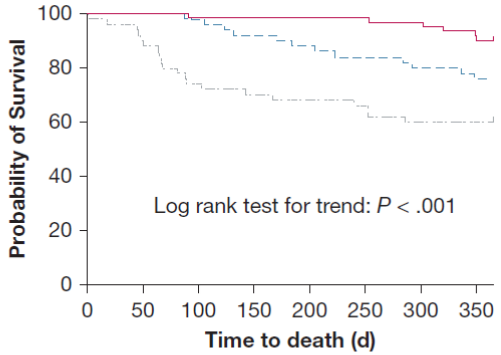


Figure 2 – *Graph showing the mean (95% CI) change in ISWT distance in participants with IPF and COPD (unmatched analysis). IPF = idiopathic pulmonary fibrosis; ISWT = incremental shuttle walk test; MID = minimal important difference.*



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

Figure 3 – *Kaplan-Meier curve and at-risk table demonstrating time to all-cause mortality at 1 year according to PR status, with table depicting the numbers at risk. PR = pulmonary rehabilitation.*

PR of ILD

Respiratory Medicine 185 (2021) 106473

Contents lists available at ScienceDirect

Respiratory Medicine

journal homepage: www.elsevier.com/locate/rmed

Original Research

Pulmonary rehabilitation in patients with interstitial lung diseases: Correlates of success

Giuseppe Brunetti [a,*], Alberto Malovini [b], Mauro Maniscalco [c], Antonella Balestrino [a], Mauro Carone [d], Dina Visca [e], Armando Capelli [f], Michele Vitacca [g], Riccardo Bellazzi [b,h], Giancarlo Piaggi [i], Salvatore Fuschillo [c], Maria Aliani [d], Antonio Spanevello [e], Ilaria Prince [f], Mara Paneroni [g], Nicolino Ambrosino [i]

240 in-patients (110 idiopathic pulmonary fibrosis (IPF), 106 ILD other than IPF and 24 undetermined ILD)

a 10-year period were retrospectively evaluated

6MWT, body weight–walking distance product tests
Dyspnoea and arterial blood gases

Improvements in all outcome measures

Non-significant greater benefits after rehabilitation were found in IPF patients under antifibrotic therapy.
after discharge, the benefits in 6MWD were not maintained

PR of ILD

Respiratory Medicine 185 (2021) 106473

Contents lists available at ScienceDirect

Respiratory Medicine

journal homepage: www.elsevier.com/locate/rmed

Original Research

Pulmonary rehabilitation in patients with interstitial lung diseases: Correlates of success

Giuseppe Brunetti [a,*], Alberto Malovini [b], Mauro Manisealco [c], Antonella Balestrino [a], Mauro Carone [a], Dina Visca [a], Armando Capelli [d], Michele Vitacca [d], Riccardo Bellazzi [b,h], Giancarlo Piaggi [e], Salvatore Fuschillo [e], Maria Aliani [f], Antonio Spanevello [a], Ilaria Prince [g], Mara Paneroni [d], Nicolino Ambrosino [a]

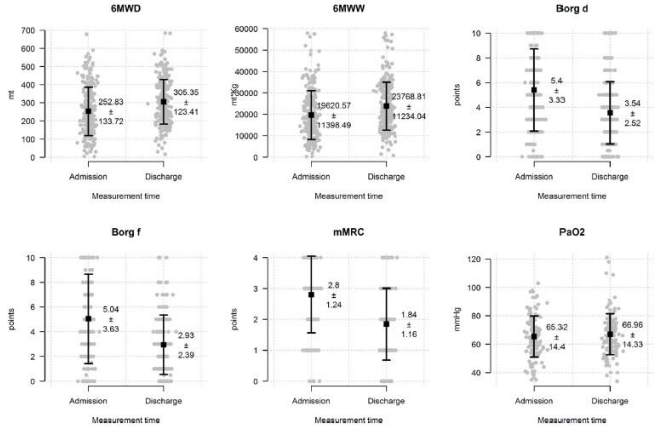


Fig. 2. Outcomes distribution at admission and discharge. The black squares represent the mean value while the black bars represent the standard deviation, the same information is reported as numeric values.

Table 1

– **Characteristics of patients.** Variables distribution is described by mean ± standard deviation or by absolute and relative (%) frequency. The number of non-missing observations is also reported for each variable (*observed*). p = p-value from the Pearson chi-square test for independence or Fisher's exact test (for categorical variables) or one-way ANOVA (for numeric variables) comparing variables distribution between disease categories

		IPF disease			
	Overall	IPF	n-IPF	U-ILD	p
Patients	240 (100%)	110 (45.83%)	106 (44.17%)	24 (10%)	
Gender					0.089
Males	154 (64.17%)	74 (62.27%)	61 (57.55%)	19 (79.17%)	
Females	86 (35.83%)	36 (32.73%)	45 (42.45%)	5 (20.83%)	
Observed	*240*	*110*	*106*	*24*	
Age, years	71 ± 8.73	70.37 ± 8.1	70.92 ± 9.3	74.21 ± 8.58	0.148
Observed	*240*	*110*	*106*	*24*	
Tobacco Smoke					0.046 [a]
Smokers	14 (7.49%)	6 (7.69%)	5 (5.88%)	3 (12.5%)	
Non Smokers	65 (34.76%)	21 (26.92%)	39 (45.88%)	5 (20.83%)	
Ex Smokers	108 (57.75%)	51 (65.38%)	41 (48.24%)	16 (66.67%)	
Observed	*187*	*78*	*85*	*24*	
BMI	28.51 ± 5.38	28.95 ± 4.95	28.26 ± 5.66	27.54 ± 6.15	0.439
Observed	*237*	*110*	*105*	*22*	
GAP score	4.21 ± 1.92	4.78 ± 1.71	3.44 ± 1.85	5.21 ± 1.96	<0.001 [a]
Observed	*230*	*108*	*103*	*19*	
mMRC admission	2.76 ± 1.23	2.77 ± 1.3	2.85 ± 1.18	2.44 ± 1.15	0.466
Observed	*140*	*61*	*61*	*18*	
Therapy					<0.001 [a]
No	90 (38.14%)	38 (34.55%)	40 (37.74%)	12 (60%)	
Steroids/Immun	109 (46.19%)	38 (34.55%)	63 (59.43%)	8 (40%)	
Antifibrotics	37 (15.68%)	34 (30.91%)	3 (2.83%)	0 (0%)	
Observed	*236*	*110*	*106*	*20*	
Oxygen therapy at rest					0.879
Yes	99 (41.25%)	47 (42.73%)	43 (40.57%)	9 (37.5%)	
No	141 (58.75%)	63 (57.27%)	63 (59.43%)	15 (62.5%)	
Observed	*240*	*110*	*106*	*24*	
VC%pred	71.61 ± 20.84	69.03 ± 20.87	73.09 ± 19.34	77.41 ± 27.45	0.198
Observed	*208*	*94*	*97*	*17*	
DLCO%pred	42.63 ± 17.77	39.74 ± 16	43.82 ± 18.69	51.79 ± 19.24	0.049 [a]
Observed	*160*	*74*	*72*	*14*	
PaO2 mmHg admission	67.61 ± 13.8	67.79 ± 12.62	66.54 ± 15.18	72.02 ± 11.55	0.250
Observed	*222*	*99*	*102*	*21*	
6MWD%pred admission	54.51 ± 28.85	51.5 ± 28.9	56.0 ± 28.8	57.6 ± 34.7	0.550
Observed	*237*	*109*	*105*	*24*	
6MWD, mt admission	252.83 ± 133.72	246.26 ± 129.02	258.37 ± 134.63	258.46 ± 154.26	0.784
Observed	*240*	*110*	*106*	*24*	
Pulm. Hypertension					0.203
Yes	57 (34.55%)	26 (30.23%)	30 (38.46%)	1 (100%)	
No	108 (65.45%)	60 (69.77%)	48 (61.54%)	0 (0%)	
Observed	*165*	*86*	*78*	*1*	
Training sessions	23.01 ± 11.33	21.79 ± 10.27	23.86 ± 12.06	24.83 ± 12.54	0.289
Observed	*240*	*110*	*106*	*24*	

Abbreviations: Idiopathic pulmonary fibrosis (IPF); Interstitial Lung Diseases other than IPF (n-ILD); Undetermined ILD (U-ILD). Body-Mass Index (BMI); GAP: Gender-Age-Physiology score (GAP score); modified Medical Research Council score (mMRC). Vital Capacity % predicted (VC% pred), carbon monoxide diffusion capacity (DLCO), Arterial Oxygen Tension (PaO2, mm Hg), Six minute walking distance meters (6MWD, mt), Six minute walking distance % predicted (6MWD% pred).

[a] p-value < 0.05. Some variables are characterized by missing values.

ORIGINAL ARTICLE
BRONCHIECTASIS

Home-based pulmonary rehabilitation in people with bronchiectasis: a randomised controlled trial

Anderson José[1], Anne E. Holland[2,3], Jessyca P.R. Selman[4], Cristiane Oliveira de Camargo[4], Diogo Simões Fonseca[5], Rodrigo A. Athanazio[6], Samia Z. Rached[6], Alberto Cukier[6], Rafael Stelmach[6] and Simone Dal Corso[4]

Affiliations: [1]Postgraduate Program in Rehabilitation Sciences and Physical Functional Performance, Universidade Federal de Juiz de Fora, Juiz de Fora, MG, Brazil. [2]Physiotherapy, Alfred Health, Melbourne, Australia. [3]Allergy, Immunology and Respiratory Medicine, Institute for Breathing and Sleep, Monash University, Melbourne, Australia. [4]Postgraduate Program in Rehabilitation Sciences, Universidade Nove de Julho, Sao Paulo-SP, Brazil. [5]Universidade Federal de Juiz de Fora, Juiz de Fora, MG, Brazil. [6]Pulmonary Division, Heart Institute (InCor), Hospital das Clínicas da Faculdade de Medicina da Universidade de Sao Paulo-SP, Brazil.

Correspondence: Anderson José, Postgraduate Program in Rehabilitation Sciences and Physical Functional Performance, Universidade Federal de Juiz de Fora, Juiz de Fora, MG, Brazil. E-mail: dr.andersonjosel@gmail.com

Randomised controlled trial with 63 participants with bronchiectasis

The HBPR group performed three sessions per week for 8 weeks
(aerobic exercise: step training for 20 min resistance training: exercises for quadriceps, hamstrings, deltoids and biceps brachii using elastic bands)

HBPR is an effective alternative offering of pulmonary rehabilitation for people with bronchiectasis.
However, the programme was not effective in maintaining the benefits after 6 months of follow-up

PR of Bronchiectasis

TABLE 3 Change in quality of life differences from baseline to 2 months and follow-up (6 months)

	Within-group differences from baseline (95% CI)				Between-group differences	
	HBPR (n=33)		Control (n=30)		HBPR minus control	
	End rehabilitation (n=27)	6 months (n=19)	End rehabilitation (n=28)	6 months (n=18)	End rehabilitation	6 months
QoL-B (physical)	10.30±18.05 (2.79–17.80)*	−10.11±18.78 (−18.26– −1.95)#	−1.15±20.73 (−8.66–6.36)	−1.76±15.94 (−10.39–6.86)	11.44 (0.83–22.06)¶	−8.34 (−20.21–3.53)
QoL-B (role)	11.30±12.85 (4.84–17.76)*	−5.58±12.74 (−11.09– −0.07)#	−0.22±19.87 (−6.69–6.24)	−1.24±10.67 (−7.06–4.59)	11.52 (2.38–20.66)¶	−4.34 (−12.36–3.67)
QoL-B (vitality)	0.37±15.90 (−5.85–6.59)	−11.79±16.74 (−19.18– −4.40)#	−1.00±16.29 (−7.22–5.22)	−2.24±14.81 (−10.05–5.58)	1.37 (−7.42–10.16)	−9.55 (−20.31–1.21)
QoL-B (emotional)	3.52±12.34 (−1.08–8.12)	−0.89±12.98 (−5.83–7.62)	−3.63±11.46 (−8.23–0.97)	−4.41±15.90 (−11.52–2.70)	7.15 (0.65–13.65)¶	5.31 (−4.48–15.10)
QoL-B (social)	1.26±26.41 (−7.83–10.35)	1.68±17.82 (−7.24–10.61)	−3.41±20.28 (−12.50–5.68)	−0.06±20.53 (−9.49–9.38)	4.67 (−8.19–17.52)	1.74 (−11.24–14.73)
QoL-B (treatment burden)	−5.30±25.15 (−15.10–4.51)	5.68±19.69 (−4.92–16.29)	−0.07±25.63 (−9.88–9.73)	−2.71±25.76 (−13.92–8.51)	−5.22 (−19.09–8.64)	8.39 (−7.04–23.82)
QoL-B (health)	−2.63±17.71 (−9.05–3.79)	9.84±18.64 (1.73–17.96)#	−1.15±15.44 (−7.57–5.26)	8.65±15.91 (0.07–17.23)#	−1.48 (−10.56–7.59)	1.20 (−10.62–13.01)
QoL-B (respiratory)	3.04±11.31 (−1.93–8.00)	−4.68±11.33 (−10.26–0.89)	−0.56±14.23 (−5.52–4.41)	−7.88±2.62 (−13.78– −1.99)#	3.59 (−3.43–10.61)	3.20 (−4.91–11.31)

Data are presented as mean±SD (95% CI). HBPR: home-based pulmonary rehabilitation; QoL-B: Quality of Life Questionnaire Bronchiectasis. *: p<0.05 *versus* baseline; #: p<0.05 *versus* end rehabilitation; ¶: p<0.05 between groups.

ORIGINAL ARTICLE | https://doi.org/10.4046/trd.2020.0135
ISSN: 1738-3536(Print)/2005-6184(Online) • Tuberc Respir Dis 2021;84:148-158

The Effects of Simultaneous Pulmonary Rehabilitation during Thoracic Radiotherapy in the Treatment of Malignant Diseases

Myeong Geun Choi, M.D.[1], Hyang Yi Lee, B.P.T.[1], Si Yeol Song, M.D., Ph.D.[2], Su Ssan Kim, M.D., Ph.D.[2], Seung Hak Lee, M.D., Ph.D.[3], Won Kim, M.D., Ph.D.[3], Chang-Min Choi, M.D., Ph.D.[1,4] and Sei Won Lee, M.D., Ph.D.[1]

Departments of [1]Pulmonary and Critical Care Medicine, [2]Radiation Oncology, [3]Rehabilitation Medicine, and [4]Oncology, Asan Medical Center, University of Ulsan College of Medicine, Seoul, Republic of Korea

133 patients in the control group, 33 were matched with 11 patients in the PR group

Changes in FEV1, FEV1/FVC : significantly different (240 mL vs. –10 mL and 5.5% vs. 1.0%)

The median distance of 6MWT in the PR group : increased significantly, from 407.5 m to 493.0 m

Simultaneous PR improved pulmonary function, particularly in measures of FEV1, and exercise capacity for patients with lung or esophageal cancer even after radiotherapy treatment.

PR of Malignant disease

ORIGINAL ARTICLE
https://doi.org/10.4046/trd.2020.0135
ISSN: 1738-3536(Print)/2005-6184(Online) • Tuberc Respir Dis 2021;84:148-158

The Effects of Simultaneous Pulmonary Rehabilitation during Thoracic Radiotherapy in the Treatment of Malignant Diseases

Myeong Geun Choi, M.D.[1], Hyang Yi Lee, B.P.T.[1], Si Yeol Song, M.D., Ph.D.[2], Su Ssan Kim, M.D., Ph.D.[2], Seung Hak Lee, M.D., Ph.D.[3], Won Kim, M.D., Ph.D.[3], Chang-Min Choi, M.D., Ph.D.[1,4] and Sei Won Lee, M.D., Ph.D.[1]
Departments of [1]Pulmonary and Critical Care Medicine, [2]Radiation Oncology, [3]Rehabilitation Medicine, and [4]Oncology, Asan Medical Center, University of Ulsan College of Medicine, Seoul, Republic of Korea

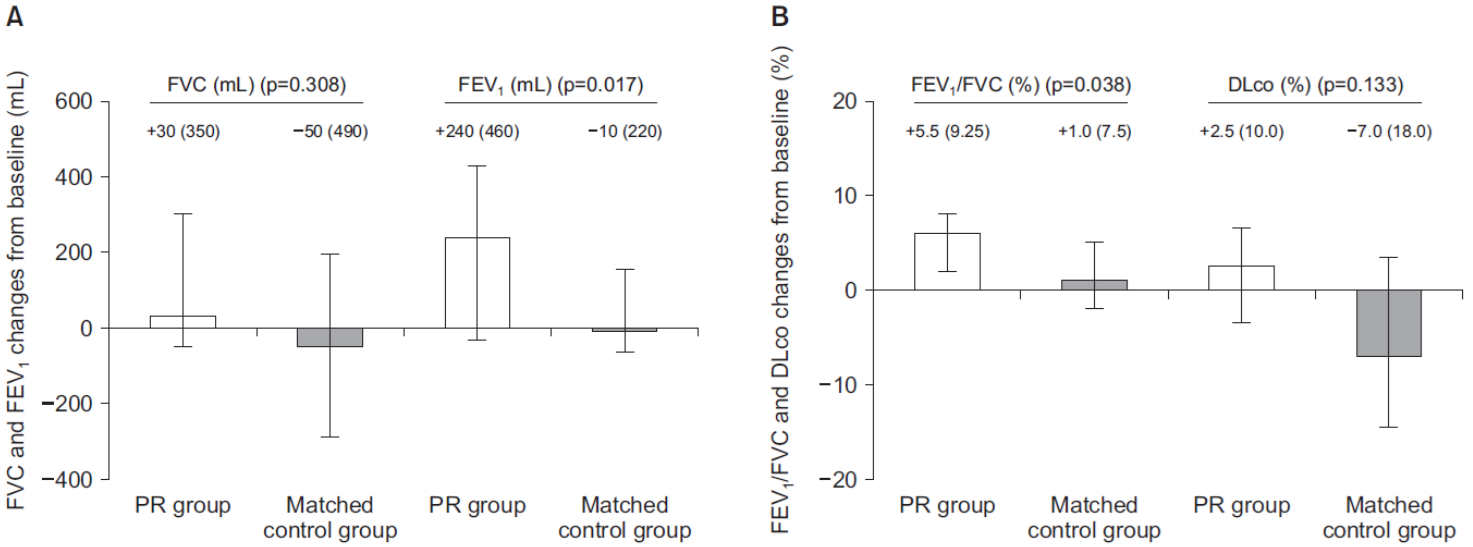


Figure 2. Changes from baseline in pulmonary function test. (A) The forced vital capacity (FVC, mL) change from baseline was greater than that of the pulmonary rehabilitation (PR) group (+30 mL vs. −50 mL, p=0.308), and the forced expiratory volume in 1 second (FEV_1, mL) change from baseline was significantly greater than that of the PR group (+240 mL vs. −10 mL, p=0.017). (B) FEV_1/FVC (%) increased more in the PR group (+5.5% vs. +1.0%, p=0.038), and the diffusing capacity for carbon monoxide (DLco, %) change from baseline was greater in the PR group (+2.5% vs. −7.0%, p=0.133); Error bars represent the interquartile ranges (IQR) of the median. The text above each column indicates the median (IQR).

Respiration

Clinical Investigations

Respiration 2021;100:416–422
DOI: 10.1159/000514387

Received: October 26, 2020
Accepted: December 22, 2020
Published online: March 30, 2021

Pulmonary Rehabilitation in Patients Recovering from COVID-19

Elisabetta Zampogna[a] Mara Paneroni[b] Stefano Belli[c] Maria Aliani[d]
Alessandra Gandolfo[e] Dina Visca[a, f] Maria Teresa Bellanti[c]
Nicolino Ambrosino[g] Michele Vitacca[b]

[a]Respiratory Rehabilitation of the Institute of Tradate, Istituti Clinici Scientifici Maugeri, IRCCS, Tradate, Italy; [b]Respiratory Rehabilitation of the Institute of Lumezzane, Istituti Clinici Scientifici Maugeri, IRCCS, Brescia, Italy; [c]Respiratory Rehabilitation of the Institute of Veruno, Istituti Clinici Scientifici Maugeri, IRCCS, Veruno, Italy; [d]Respiratory Rehabilitation of the Institute of Bari, Istituti Clinici Scientifici Maugeri, IRCCS, Bari, Italy; [e]Respiratory Rehabilitation of the Institute of Pavia, Istituti Clinici Scientifici Maugeri, IRCCS, Pavia, Italy; [f]Department of Medicine and Surgery, Respiratory Diseases, University of Insubria, Varese-Como, Italy; [g]Respiratory Rehabilitation of the Institute of Montescano, Istituti Clinici Scientifici Maugeri, IRCCS, Montescano, Italy

140 patients

Improvements in SPPB and BI, as well as in other assessed outcome measures

Pulmonary rehabilitation is possible and effective in patients recovering from COVID-19

Respiration

Clinical Investigations

Respiration 2021;100:416–422
DOI: 10.1159/000514387

Received: October 26, 2020
Accepted: December 22, 2020
Published online: March 30, 2021

Pulmonary Rehabilitation in Patients Recovering from COVID-19

Elisabetta Zampogna[a] Mara Paneroni[b] Stefano Belli[c] Maria Aliani[d]
Alessandra Gandolfo[e] Dina Visca[a, f] Maria Teresa Bellanti[c]
Nicolino Ambrosino[g] Michele Vitacca[b]

[a]Respiratory Rehabilitation of the Institute of Tradate, Istituti Clinici Scientifici Maugeri, IRCCS, Tradate, Italy; [b]Respiratory Rehabilitation of the Institute of Lumezzane, Istituti Clinici Scientifici Maugeri, IRCCS, Brescia, Italy; [c]Respiratory Rehabilitation of the Institute of Veruno, Istituti Clinici Scientifici Maugeri, IRCCS, Veruno, Italy; [d]Respiratory Rehabilitation of the Institute of Bari, Istituti Clinici Scientifici Maugeri, IRCCS, Bari, Italy; [e]Respiratory Rehabilitation of the Institute of Pavia, Istituti Clinici Scientifici Maugeri, IRCCS, Pavia, Italy; [f]Department of Medicine and Surgery, Respiratory Diseases, University of Insubria, Varese-Como, Italy; [g]Respiratory Rehabilitation of the Institute of Montescano, Istituti Clinici Scientifici Maugeri, IRCCS, Montescano, Italy

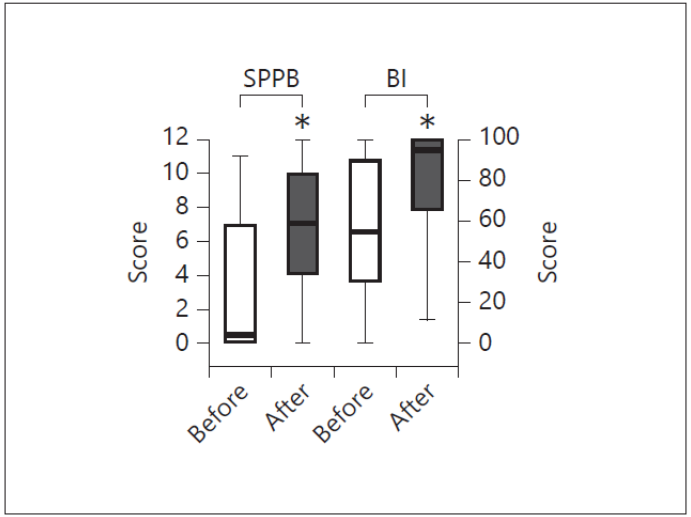


Fig. 2. Changes in SPPB and BI scores before and after pulmonary rehabilitation. SPBB, Short Physical Performance Battery; BI, Barthel Index.

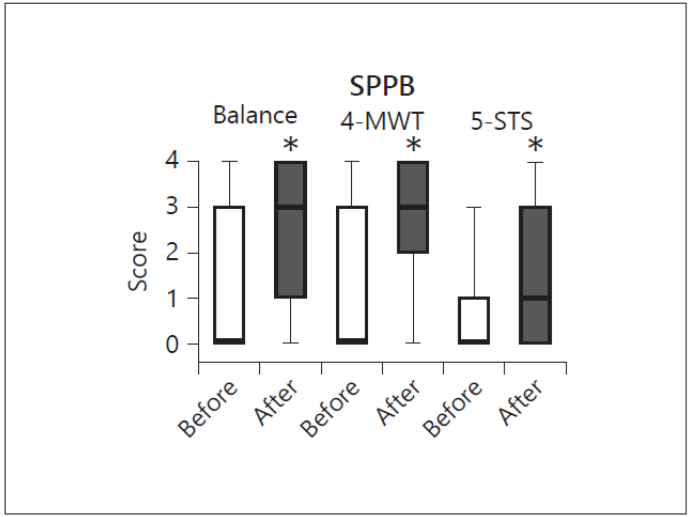


Fig. 3. Change of SPPB components (balance, 4MWT, and 5-STS) before and after rehabilitation. The lines indicating the medians of before rehabilitation data correspond to zero. SPBB, Short Physical Performance Battery; BI, Barthel Index; 4MWT, 4-m walking test; 5-STS, sitting position 5 times.

PR amid COVID-19

Respiration

Clinical Investigations

Respiration 2021;100:416–422
DOI: 10.1159/000514387

Received: October 26, 2020
Accepted: December 22, 2020
Published online: March 30, 2021

Pulmonary Rehabilitation in Patients Recovering from COVID-19

Elisabetta Zampogna[a] Mara Paneroni[b] Stefano Belli[c] Maria Aliani[d] Alessandra Gandolfo[e] Dina Visca[a, f] Maria Teresa Bellanti[c] Nicolino Ambrosino[g] Michele Vitacca[b]

[a]Respiratory Rehabilitation of the Institute of Treviso, Istituti Clinici Scientifici Maugeri, IRCCS, Treviso, Italy; [b]Respiratory Rehabilitation of the Institute of Lumezzane, Istituti Clinici Scientifici Maugeri, IRCCS, Brescia, Italy; [c]Respiratory Rehabilitation of the Institute of Veruno, Istituti Clinici Scientifici Maugeri, IRCCS, Veruno, Italy; [d]Respiratory Rehabilitation of the Institute of Bari, Istituti Clinici Scientifici Maugeri, IRCCS, Bari, Italy; [e]Respiratory Rehabilitation of the Institute of Pavia, Istituti Clinici Scientifici Maugeri, IRCCS, Pavia, Italy; [f]Department of Medicine and Surgery, Respiratory Diseases, University of Insubria, Varese-Como, Italy; [g]Respiratory Rehabilitation of the Institute of Montescano, Istituti Clinici Scientifici Maugeri, IRCCS, Montescano, Italy

Table 1. Demographic, anthropometric, physiological, and clinical characteristics of patients in study

Age, years	71.0 (61.5–78.0)
Male, *n* (%)	95 (67.8)
BMI, kg/m^2	25.2 (23.2–29.3)
LoS in acute hospitals, days	47.0 (33.5–64.0)
Previous invasive ventilation, *n* (%)	56 (40.0)
Previous NIV, *n* (%)	70 (50.0)
Previous oxygen need, *n* (%)	117 (83.6)
PaO_2/FiO_2 (*n* = 130)	338.1 (310.5–371.4)
PaO_2, mm Hg (*n* = 130)	72.4 (67.1–84.0)
$PaCO_2$, mm Hg (*n* = 130)	37.8 (34.00–42.1)
pH (*n* = 130)	7.43 (7.40–7.45)
CIRS-SI, score	1.6 (1.60–2.1)
CIRS-CI, score	4.0 (3.0–5.0)

Data are expressed as *n* (%) or median (IQR). BMI, body mass index; LoS, length of stay; NIV, noninvasive ventilation; PaO2, arterial oxygen tension; PaCO2, arterial carbon dioxide tension; FiO2, inspired oxygen fraction; CIRS-SI, Cumulative Illness Rating Score Severity Index; CIRS-CI, Cumulative Illness Rating Score Comorbidities Index; IQR, interquartile range.

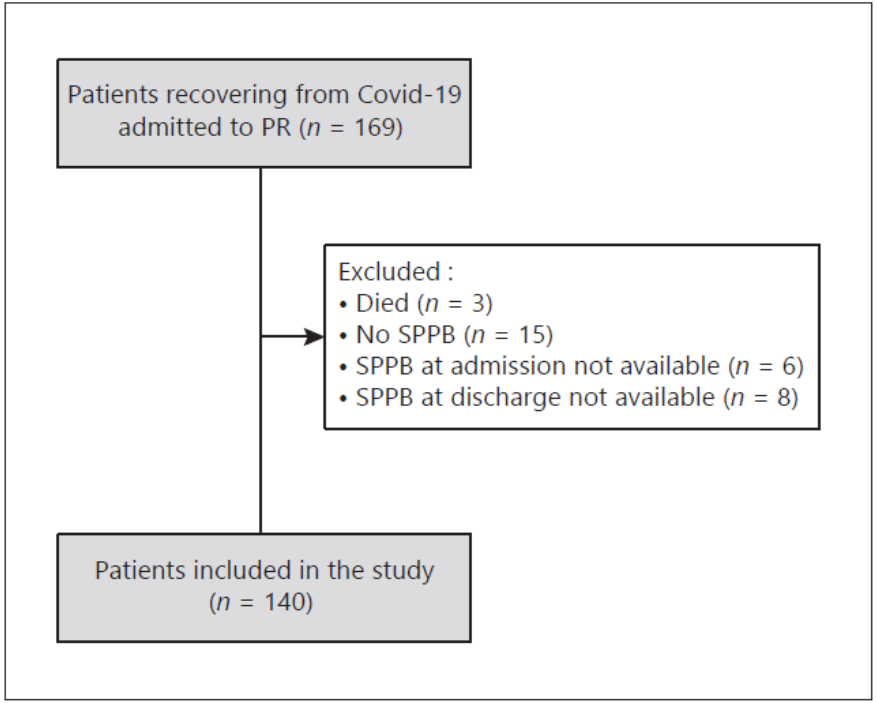


Fig. 1. CONSORT diagram of patient selection. SPBB, Short Physical Performance Battery; BI, Barthel Index.

ORIGINAL ARTICLE
COVID-19

Benefits of pulmonary rehabilitation in COVID-19: a prospective observational cohort study

Rainer Gloeckl[1,2,7], Daniela Leitl[1,2,7], Inga Jarosch[1,2], Tessa Schneeberger[1,2], Christoph Nell[3], Nikola Stenzel[4], Claus F. Vogelmeier[5], Klaus Kenn[1,2] and Andreas R. Koczulla[1,2,6]

Affiliations: [1]Dept of Pulmonary Rehabilitation, Philipps-University of Marburg, Member of the German Center for Lung Research (DZL), Marburg, Germany. [2]Institute for Pulmonary Rehabilitation Research, Schoen Klinik Berchtesgadener Land, Schoenau am Koenigssee, Germany. [3]Dept of Pulmonology, Philipps-University Marburg, Marburg, Germany. [4]Psychologische Hochschule Berlin (PHB), Berlin, Germany. [5]Dept of Medicine, Pulmonary and Critical Care Medicine, University Medical Centre Giessen and Marburg, Philipps-University of Marburg, Member of the DZL, Marburg, Germany. [6]Teaching Hospital, Paracelsus Medical University, Salzburg, Austria. [7]These authors contributed equally.

Correspondence: Rainer Gloeckl, Institute for Pulmonary Rehabilitation Research, Schoen Klinik Berchtesgadener Land, Malterhoeh 1, 83471 Schoenau am Koenigssee, Germany. E-mail: RGloeckl@Schoen-Klinik.de

50 patients were included in the study

improved in 6MWD, FVC and SF-36 mental component.

No adverse event was observed.

PR amid COVID-19

ERJ open research

ORIGINAL ARTICLE
COVID-19

Benefits of pulmonary rehabilitation in COVID-19: a prospective observational cohort study

Rainer Gloeckl[1,2,7], Daniela Leitl[1,2,7], Inga Jarosch[1,2], Tessa Schneeberger[1,2], Christoph Nell[3], Nikola Stenzel[4], Claus F. Vogelmeier[5], Klaus Kenn[1,2] and Andreas R. Koczulla[1,2,6]

Affiliations: [1]Dept of Pulmonary Rehabilitation, Philipps-University of Marburg, Member of the German Center for Lung Research (DZL), Marburg, Germany, [2]Institute for Pulmonary Rehabilitation Research, Schoen Klinik Berchtesgadener Land, Schoenau am Koenigssee, Germany, [3]Dept of Pulmonology, Philipps-University Marburg, Marburg, Germany, [4]Psychologische Hochschule Berlin (PHB), Berlin, Germany, [5]Dept of Medicine, Pulmonary and Critical Care Medicine, University Medical Centre Giessen and Marburg, Philipps-University of Marburg, Member of the DZL, Marburg, Germany, [6]Teaching Hospital, Paracelsus Medical University, Salzburg, Austria, [7]These authors contributed equally.

Correspondence: Rainer Gloeckl, Institute for Pulmonary Rehabilitation Research, Schoen Klinik Berchtesgadener Land, Malterhoeh 1, 83471 Schoenau am Koenigssee, Germany. E-mail: RGloeckl@Schoen-Klinik.de

TABLE 1 Description of the standardised pulmonary rehabilitation programme in coronavirus disease 2019 (COVID-19)

Diagnostics and medical treatment	Initial physical check-up including body plethysmography, electrocardiography, cardiac ultrasound, blood sampling Continuous adaptation of drug treatment Initiation and adjusting of long-term oxygen therapy, if necessary If necessary, patients received a high-resolution chest computed tomography, sleep lab diagnostics or an online consultation with a neurologist
Endurance training	Cycle endurance training was performed for 10–20 min per session at 60–70% of peak work rate 5 days per week
Strength training	Strength training was performed using resistance training machines The following exercises were performed: leg press, knee extension, pull-down and push-down If possible, the following additional exercises were applied: butterfly forward/backward, rowing, back extension and abdominal trainer Patients performed three sets per exercise at an individual intensity to reach momentary muscular failure after 15–20 repetitions Resistance training usually took ~30 min per session and was applied 5 days per week
Patient education	Patients visited two educational sessions per week about COVID-19 as well as on general topics such as physical activity, oxygen therapy and smoking cessation
Respiratory physiotherapy	Individually tailored chest physiotherapy using various techniques such as breathing retraining, cough techniques, mucus clearance, connective tissue massage, energy conservation techniques, *etc.* was applied two to four times per week for 30 min each
Activities of daily living training	Activities of daily living training (calisthenics) was applied four to five times per week for 30 min In addition, Nordic walking or aqua fitness were applied twice per week for 30 min
Relaxation techniques	QiGong or progressive muscle relaxation (Jacobson technique) were applied twice per week for 30 min
Occupational therapy	Occupational therapy was used to treat individual neurological issues such as limited motor ability in the hands or insecure gait (if needed) Brain-performance training was performed to improve memory and concentration
Psychological support	A psychologist supported COVID-19 patients individually as well as during group therapy on aspects of disease management and coping with COVID-19 and its sequelae
Nutritional counselling	If necessary, nutritional counselling or nutritional supplements were provided to recover body composition (after body weight loss during hospital stay)

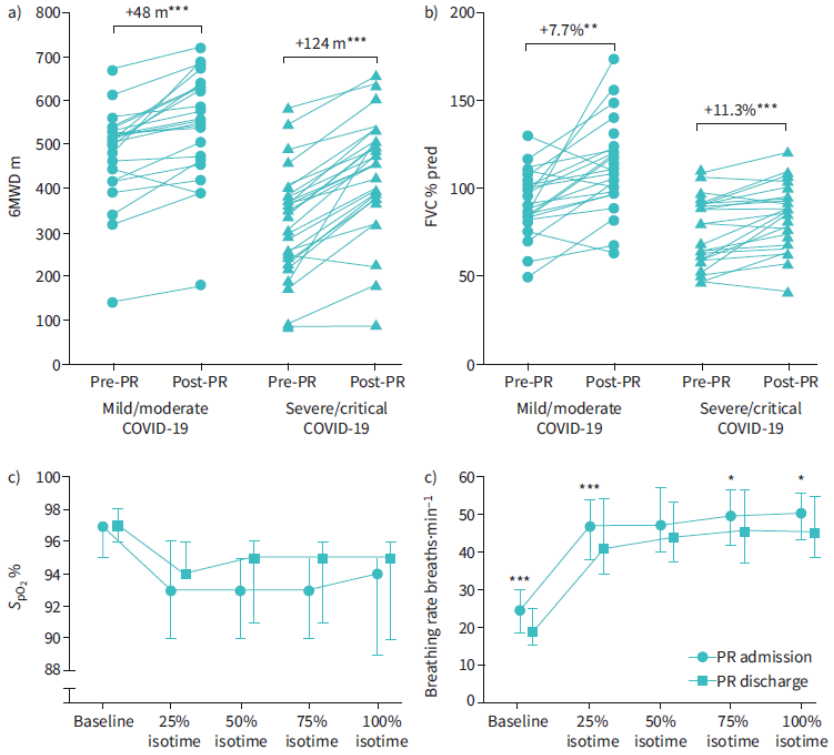


FIGURE 1 Changes in a) 6-min walk distance (6MWD) and b) forced vital capacity (FVC) pre- to post-comprehensive pulmonary rehabilitation (PR) in patients with mild/moderate (n=24) and severe/critical (n=26) coronavirus disease 2019 (COVID-19). c) Development of oxygen saturation (S_{pO_2}) during endurance shuttle walk test (ESWT) from baseline to isotime in patients with severe to critical COVID-19 before and after PR. d) Development of breathing rate during ESWT from baseline to isotime in patients with severe to critical COVID-19 before and after PR. Data are presented as median and interquartile range. *: p<0.05, **: p<0.01, ***: p<0.001.

Define of modern PR

AMERICAN THORACIC SOCIETY DOCUMENTS

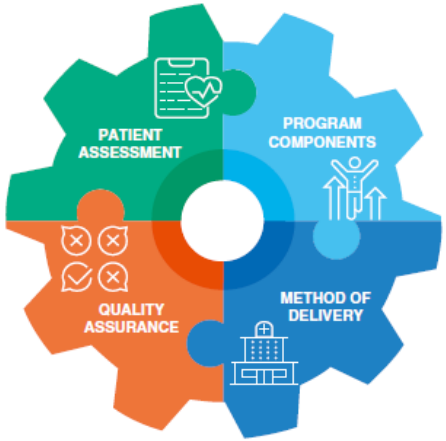
Defining Modern Pulmonary Rehabilitation

An Official American Thoracic Society Workshop Report

Anne E. Holland, Narelle S. Cox, Linzy Houchen-Wolloff, Carolyn L. Rochester, Chris Garvey, Richard ZuWallack, Linda Nici, Trina Limberg, Suzanne C. Lareau, Barbara P. Yawn, Mary Galwicki, Thierry Troosters, Michael Steiner, Richard Casaburi, Enrico Clini, Roger S. Goldstein, and Sally J. Singh; on behalf of the American Thoracic Society Assembly on Pulmonary Rehabilitation

THIS OFFICIAL WORKSHOP REPORT OF THE AMERICAN THORACIC SOCIETY WAS APPROVED FEBRUARY 2021

AMERICAN THORACIC SOCIETY DOCUMENTS



ESSENTIAL COMPONENTS OF PULMONARY REHABILITATION

1. An initial center-based assessment by a health care professional
2. An exercise test at the time of assessment
3. A field exercise test
4. Quality of life measure
5. Dyspnea assessment
6. Nutritional status evaluation
7. Occupational status evaluation

8. Endurance training
9. Resistance training

10. An exercise program that is individually prescribed
11. An exercise program that is individually progressed
12. Team includes a health care professional with experience in exercise prescription and progression

13. Health care professionals are trained to deliver the components of the model that is deployed

Figure 1. Essential components of pulmonary rehabilitation. Essential components of the pulmonary rehabilitation model were identified through a Delphi process. An essential component was defined as having a median score ≤2 (strongly agree or agree it is essential) and high consensus (interquartile range, 0).

THANK YOU