2022 호흡재활 Year in Review

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Overview

- Pulmonary rehabilitation in 2023 guideline
- 2022 Cochrane review in pulmonary rehabilitation
- Pulmonary rehabilitation of COPD
- Pulmonary rehabilitation of ILD
- Pulmonary rehabilitation of COVID-19
- Pulmonary rehabilitation in Korea

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GOLD guideline 2023

- Pulmonary rehabilitation is defined as
  - 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

- Optimum benefits are achieved from programs lasting 6 to 8 weeks
  - No additional benefits from extending PR to 12 weeks

GOLD 2023 Report

GOLD guideline 2023

- Supervised exercise training at least twice weekly is recommended
  - Endurance training, interval training, resistance/strength training
  - Upper and lower limbs
  - Walking exercise
  - Fexibility, inspiratory muscle training
  - Neuromuscular electrical stimulation

- Rehabilitation intervention (content, scope, frequency, and intensity) should be individualized to maximize personal functional gains

GOLD 2023 Report

Pulmonary Rehabilitation, Self-Management and Integrative Care in COPD

Table 3.8

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)**

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[Intervention Review]

Inspiratory muscle training, with or without concomitant pulmonary rehabilitation, for chronic obstructive pulmonary disease (COPD)

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- To assess the effect of inspiratory muscle training (IMT) on COPD, as a stand-alone intervention and when combined with PR
- Included RCTs that compared
  - IMT in combination with PR versus PR alone
  - IMT versus control/sham
- 55 RCTs
- IMT and PR protocols varied significantly across the trials, especially in training duration, loads, devices, number/ frequency of sessions and the PR programs

Cochrane Database Syst Rev. 2023 Jan 6;1(1)

Summary of findings 1. Pulmonary rehabilitation plus inspiratory muscle training compared to pulmonary rehabilitation alone for people with chronic obstructive pulmonary disease

Pulmonary rehabilitation plus inspiratory muscle training compared to pulmonary rehabilitation alone for people with chronic obstructive pulmonary disease

Patient or population: people with chronic obstructive pulmonary disease (COPD)
Setting: community
Intervention: pulmonary rehabilitation (PR) + inspiratory muscle training (IMT)
Comparison: PR

22 trials (1446 participants)

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	№ of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with PR	Risk with PR +IMT				
Dyspnea assessed with Borg scale at submaximal exercise capacity Scale from 0 to 10 (worse) Follow-up: range 3 months to 4 months	The mean dyspnea was **4.65**	The mean dyspnea was **0.19 points higher** (0.42 lower to 0.79 higher)	-	202 (2 RCTs)	⊕⊕⊕⊖ Moderate[a]	The combination of PR+IMT probably results in little to no difference in dyspnea measured with Borg at submaximal exercise capacity compared to PR alone, considering an MCID of −1 unit
Dyspnea assessed with mMRC Scale from 0 to 4 (worse) Follow-up: range 1 month to 2 months	The mean dyspnea ranged from **−0.8 to −0.33**	MD **0.12 lower** (0.39 lower to 0.14 higher)	-	204 (2 RCTs)	⊕⊖⊖⊖ Very low[a,b]	The evidence is very uncertain about the effect of the combination of PR+IMT on dyspnea measured with the mMRC compared to PR alone, considering an MCID between −0.5 and −1 unit
Functional exercise capacity assessed with 6MWD Follow-up: range 2 weeks to 6 months	The mean functional exercise capacity was **304.72** meters[c]	MD **5.95 meters higher** (5.73 lower to 17.63 higher)	-	1199 (12 RCTs)	⊕⊖⊖⊖ Very low[d,e]	The evidence is very uncertain about the effect of the combination of PR+IMT on the 6MWD compared to PR alone, considering an MCID of 26 meters

Cochrane Database Syst Rev. 2023 Jan 6;1(1)

Health-related quality of life assessed with SGRQ total score Scale from 0 to 100 (worse) Follow-up: range 3 weeks to 6 months	The mean health-related quality of life was **14.9**[c]	MD **0.13 higher** (0.93 lower to 1.2 higher)	-	908 (7 RCTs)	⨁⨁◯◯ Low[f]	The combination of PR+IMT may result in little to no difference in health-related quality of life measured with the SGRQ compared to PR alone, considering an MCID of −4 units
Health-related quality of life assessed with CAT Scale from 0 to 40 (worse) Follow-up: range 3 weeks to 6 months	The mean health-related quality of life ranged from **−3.42 to −3**	MD **0.13 higher** (0.8 lower to 1.06 higher)	-	657 (2 RCTs)	⨁◯◯◯ Very low[g,h]	The evidence is very uncertain about the effect of the combination of PR+IMT on health-related quality of life measured with the CAT compared to PR alone, considering an MCID of about −1.6 units
Inspiratory muscle strength assessed with PImax Follow-up: range 3 weeks to 6 months	The mean inspiratory muscle strength was **67.37** cmH_2O[c]	MD **11.46 cmH_2O higher** (7.42 higher to 15.50 higher)	-	1329 (17 RCTs)	⨁⨁⨁◯ Moderate[d]	The combination of IMT+PR probably slightly increases inspiratory muscle strength (PImax) compared to PR alone, without reaching the MCID of 17.2 cmH_2O

***The risk in the intervention group** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: confidence interval; **CAT:** COPD [chronic obstructive pulmonary disease] Assessment Test; **IMT:** inspiratory muscle training; **MD:** mean difference; **mMRC:** modified Medical Research Council dyspnoea scale; **MCID:** minimum clinically important difference; **PImax:** Maximal Inspiratory Pressure; **PR:** pulmonary rehabilitation; **RCT:** randomized controlled trial; **SGRQ:** St George's Respiratory Questionnaire; **6MWD:** six-minute walk distance

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

Cochrane Database Syst Rev. 2023 Jan 6;1(1)

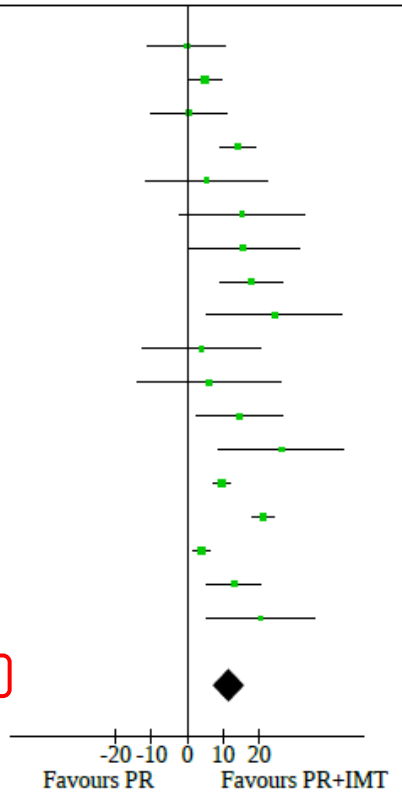
Analysis 1.12. Comparison 1: PR+IMT vs PR, Outcome 12: Inspiratory muscle strength: PImax (cmH20)

Study or Subgroup	PR+IMT Mean	PR+IMT SD	PR+IMT Total	PR Mean	PR SD	PR Total	Weight	Mean Difference IV, Random, 95% CI
Beaumont 2015	85.38	15.75	16	85.61	16.3	18	5.5%	-0.23 [-11.01 , 10.55]
Beaumont 2018	14.8	14.9	74	9.9	13.8	75	8.2%	4.90 [0.29 , 9.51]
Berry 1996	79	10.3	7	78.6	10.8	9	5.7%	0.40 [-9.99 , 10.79]
Charususin 2018	75	19	89	61	13	85	8.1%	14.00 [9.18 , 18.82]
De Farias 2019 (1)	90	18.5	12	84.7	15	5	3.5%	5.30 [-11.51 , 22.11]
De Farias 2019 (2)	100	17.4	9	84.7	15	5	3.4%	15.30 [-2.08 , 32.68]
Dekhuijzen 1991	81.2	27.53	20	65.56	22.5	20	3.9%	15.64 [0.06 , 31.22]
Dellweg 2017	55	11	15	37	13	14	6.4%	18.00 [9.20 , 26.80]
Fanfa Bordin 2020	95.12	20.5	12	70.7	24	10	3.1%	24.42 [5.56 , 43.28]
Larson 1999	90	16	14	86	27	14	3.6%	4.00 [-12.44 , 20.44]
Mador 2005	76.3	32.53	15	70.2	22.44	14	2.8%	6.10 [-14.13 , 26.33]
Magadle 2007	81.2	16	14	66.7	15.5	13	5.1%	14.50 [2.62 , 26.38]
Paneroni 2018	107.6	22.9	12	81.3	18.9	10	3.4%	26.30 [8.83 , 43.77]
Schultz 2018	18.66	16.11	300	8.97	14.89	302	8.8%	9.69 [7.21 , 12.17]
Tounsi 2021	22.9	5.8	16	1.7	1.6	16	8.7%	21.20 [18.25 , 24.15]
Wang 2017	5.2	4.7	28	1.3	4.7	27	8.8%	3.90 [1.42 , 6.38]
Weiner 1992	57.8	10	12	44.8	9	12	6.9%	13.00 [5.39 , 20.61]
Weiner 2000	77.5	17.5	11	57.07	11.4	4	4.0%	20.43 [5.21 , 35.65]
Total (95% CI)			**676**			**653**	**100.0%**	**11.46 [7.42 , 15.50]**

Heterogeneity: Tau² = 46.42; Chi² = 105.61, df = 17 (P < 0.00001); I² = 84%

Test for overall effect: Z = 5.56 (P < 0.00001)

Test for subgroup differences: Not applicable



Summary of findings 2. Inspiratory muscle training compared to control or sham for people with chronic obstructive pulmonary disease

Inspiratory muscle training compared to control or sham for people with chronic obstructive pulmonary disease

Patient or population: people with chronic obstructive pulmonary disease (COPD)
Setting: community
Intervention: inspiratory muscle training (IMT)
Comparison: control or sham

37 trials (1021 participants)

Outcomes	Anticipated absolute effects* (95% CI) Risk with control or sham	Anticipated absolute effects* (95% CI) Risk with IMT	Relative effect (95% CI)	№ of participants (studies)	Certainty of the evidence (GRADE)	Comments
Dyspnea assessed with Borg scale at submaximal exercise capacity Scale from 1 to 10 (worse) Follow-up: range 5 weeks to 4 months	The median dyspnea was **1.5**	MD **0.94 lower** (1.36 lower to 0.51 lower)	-	144 (6 RCTs)	⊕⊖⊖⊖ Very low[a,b]	IMT may improve dyspnea measured with Borg scale at submaximal exercise capacity compared to control/sham but the evidence is very uncertain, considering an MCID of −1 unit (only the lower limit of the 95% CI exceeded the MCID)
Dyspnea assessed with BDI-TDI focal score (TDI) Scale from −9 to +9 (better) follow-up: range 2 months to 6 months	The median dyspnea was **1.2**	MD **2.98 higher** (2.07 higher to 3.89 higher)	-	238 (8 RCTs)	⊕⊖⊖⊖ Very low[b,c]	IMT may improve dyspnea measured with the BDI-TDI (Focal score) compared to control/sham but the evidence is very uncertain, considering an MCID of +1 unit
Dyspnea assessed with mMRC Scale from 0 to 4 (worse) Follow-up: range 8 months to 8 months	The median dyspnea was **0.62**	MD **0.59 lower** (0.76 lower to 0.43 lower)	-	150 (4 RCTs)	⊕⊕⊖⊖ Low[b,d]	IMT may improve dyspnea measured with the modified mMRC compared to control/sham, considering an MCID between −0.5 and −1 unit

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Functional exercise capacity assessed with 6MWD Follow-up: range 2 weeks to 12 months	The mean functional exercise capacity was **298.4** meters	MD **35.71 meters higher** (25.68 higher to 45.74 higher)	-	501 (16 RCTs)	⊕⊕⊕⊖ Moderate[d]	IMT probably improves functional exercise capacity measured with the 6MWD compared to control/sham, considering an MCID of 26 meters
Health-related quality of life assessed with SGRQ total score Scale from 0 to 100 (worse) Follow-up: range 2 months to 12 months	The median health-related quality of life was **23.61**	MD **3.85 lower** (8.18 lower to 0.48 higher)	-	182 (6 RCTs)	⊕⊖⊖⊖ Very low[e,f]	IMT may improve health-related quality of life measured with the SGRQ compared to control/sham but the evidence is very uncertain, considering an MCID of −4 units (only the lower limit of the 95% CI exceeded the MCID)
Health-related quality of life assessed with CAT Scale from 0 to 40 (worse) Follow-up: mean 2 months	The mean health-related quality of life ranged from **−0.5 to 0.3**	MD **2.97 lower** (3.85 lower to 2.1 lower)	-	86 (2 RCTs)	⊕⊕⊕⊖ Moderate[b]	IMT probably improves health-related quality of life measured with CAT compared to control/sham, considering an MCID of about −1.6 units
Inspiratory muscle strength assessed with PImax Follow-up: range 2 weeks to 12 months	The mean inspiratory muscle strength was **51.23** cmH_2O	MD **14.57 cmH_2O higher** (9.85 higher to 19.29 higher)	-	916 (32 RCTs)	⊕⊕⊖⊖ Low[d,g,h]	IMT may increase inspiratory muscle strength (PImax) slightly compared to control/sham considering the MCID of 17.2 cmH_2O

***The risk in the intervention group** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

BDI-TDI: Baseline Dyspnea Index - Transition Dyspnea Index;**CI:** confidence interval; **CAT:** COPD Assessment Test; **IMT:** inspiratory muscle training; **MD:** mean difference; **mMRC:** modified Medical Research Council dyspnoea scale; **MCID:** minimum clinically important difference; **PImax:** Maximal Inspiratory Pressure; **PR:** pulmonary rehabilitation; **RCT:** randomized controlled trial; **SGRQ:** St George's Respiratory Questionnaire; **6MWD:** six-minute walk distance

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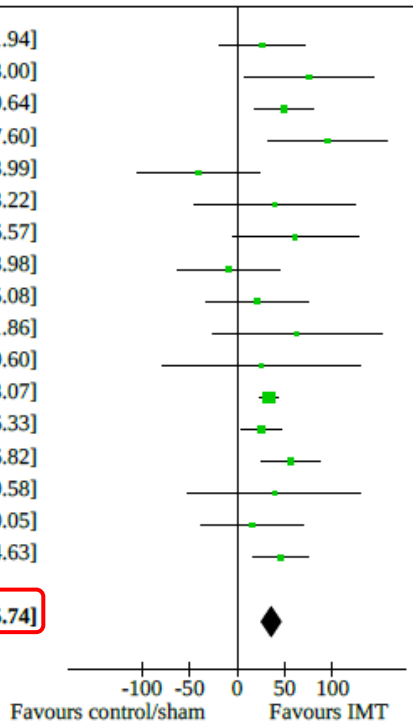
Analysis 2.5. Comparison 2: IMT vs control/sham, Outcome 5: Functional exercise capacity: 6-minute walk distance (6MWD) (meters)

Study or Subgroup	IMT Mean	IMT SD	IMT Total	Control/Sham Mean	Control/Sham SD	Control/Sham Total	Weight	Mean Difference IV, Random, 95% CI
Bavarsad 2015	491	68.44	15	464.4	57.82	15	4.4%	26.60 [-18.74 , 71.94]
Beckerman 2005	326	96.48	17	250.4	94.28	14	2.1%	75.60 [8.20 , 143.00]
Chuang 2017	266.15	48.69	27	216.34	66.84	28	8.5%	49.81 [18.98 , 80.64]
Cutrim 2019	486	74.56	11	391	75.25	11	2.4%	95.00 [32.40 , 157.60]
Hill 2006	472.8	104.3	16	513.2	82.4	17	2.3%	-40.40 [-104.79 , 23.99]
Hsiao 2003 (1)	459.6	98.8	10	420.8	66.3	5	1.4%	38.80 [-45.62 , 123.22]
Hsiao 2003 (2)	481.8	49	10	420.8	66.3	5	2.2%	61.00 [-4.57 , 126.57]
Koppers 2006	535	77	18	544	85	18	3.3%	-9.00 [-61.98 , 43.98]
Leelarungrayub 2017	340	55.97	10	318.9	66.72	10	3.2%	21.10 [-32.88 , 75.08]
Lisboa 1997	417	107.51	10	354	94.86	10	1.2%	63.00 [-25.86 , 151.86]
Ramirez Sarmiento 2002	433	81	7	407	114	7	0.9%	26.00 [-77.60 , 129.60]
Saher 2021	239.82	9.36	17	206.76	18.87	17	30.3%	33.06 [23.05 , 43.07]
Saka 2021	42.8	26.51	20	17.06	38.78	20	15.4%	25.74 [5.15 , 46.33]
Scherer 2000	69.38	42.4	15	12.9	42.4	15	8.7%	56.48 [26.14 , 86.82]
Weiner 2003	326.2	106.63	8	287.5	76.36	8	1.2%	38.70 [-52.18 , 129.58]
Xu 2018	24.17	88.05	23	8.47	99.65	23	3.2%	15.70 [-38.65 , 70.05]
ZhouL 2016	284.9	56.6	22	239.6	41.5	22	9.2%	45.30 [15.97 , 74.63]
Total (95% CI)			**256**			**245**	**100.0%**	**35.71 [25.68 , 45.74]**

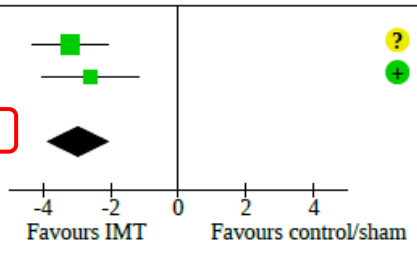
Heterogeneity: Tau² = 60.27; Chi² = 18.94, df = 16 (P = 0.27); I² = 16%
Test for overall effect: Z = 6.98 (P < 0.00001)
Test for subgroup differences: Not applicable



Analysis 2.14. Comparison 2: IMT vs control/sham, Outcome 14: Health-related quality of life (HRQoL): COPD Assessment Test (CAT)

Study or Subgroup	IMT Mean	IMT SD	IMT Total	Control Mean	Control SD	Control Total	Weight	Mean Difference IV, Random, 95% CI
Saka 2021	-3.7	2.36	20	-0.5	0.94	20	62.0%	-3.20 [-4.31 , -2.09]
Xu 2018	-2.3	2.78	23	0.3	2.09	23	38.0%	-2.60 [-4.02 , -1.18]
Total (95% CI)			**43**			**43**	**100.0%**	**-2.97 [-3.85 , -2.10]**

Heterogeneity: Tau² = 0.00; Chi² = 0.42, df = 1 (P = 0.51); I² = 0%
Test for overall effect: Z = 6.65 (P < 0.00001)
Test for subgroup differences: Not applicable



2022 Cochrane review in PR : IMT, with or without concomitant PR for COPD

- Conclusion
  - IMT may not improve dyspnea, functional exercise capacity and life quality when associated with PR
  - IMT is likely to improve these outcomes when provided alone

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[Intervention Review]

Pulmonary rehabilitation versus usual care for adults with asthma

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- To evaluate the effectiveness of PR compared to usual care on exercise performance, asthma control, and quality of life (co-primary outcomes), incidence of severe asthma exacerbations/hospitalisations, mental health, muscle strength, physical activity levels, inflammatory biomarkers, and adverse events
- Included RCTs in which pulmonary rehabilitation was compared to usual care in adults with asthma
- PR must have included a minimum of four weeks (or eight sessions) aerobic training and education or self-management

Cochrane Database Syst Rev. 2022 Aug 22;8(8)

Summary of findings 1. Pulmonary rehabilitation compared to usual care for adults with asthma

Pulmonary rehabilitation compared to usual care for adults with asthma

Patient or population: Adults with asthma
Setting: Inpatient hospitals and outpatient centres
Intervention: Pulmonary rehabilitation
Comparison: Usual care

10 trials (894 participants)

Outcomes		Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	№ of participants (studies)	Certainty of the evidence (GRADE)	Comments
		Risk with usual care in people with asthma (end-treatment)	Risk with pulmonary rehabilitation				
Exercise performance: peak oxygen uptake (VO_2 peak) on cycle ergometer incremental CPET	End-intervention: range 8 to 12 weeks	Mean peak oxygen uptake (VO_2 peak) was 23.7 mL/kg/min.	MD 3.63 mL/kg/min higher (1.48 higher to 5.77 higher); adjusted model data used	-	129 (3 RCTs)	⊕⊝⊝⊝ VERY LOW [1 2 3]	Higher value denotes greater peak oxygen uptake (i.e. better) following completion of pulmonary rehabilitation compared to usual care.
	Follow-up: range 9 to 12 months	Mean peak oxygen uptake (VO_2 peak) was 24.8 mL/kg/min.	MD 0.69 mL/kg/min lower (4.79 lower to 3.42 higher)	-	66 (3 RCTs)	⊕⊝⊝⊝ VERY LOW [2 4 5]	
Exercise performance: % predicted VO_2 max on incremental cardiopulmonary exercise test	End-intervention: mean 3 months	Mean peak oxygen uptake (% predicted VO_2 max) was 58.2%.	MD 14.88% higher (9.66 higher to 20.1 higher)	-	60 (2 RCTs)	⊕⊕⊝⊝ LOW [6 7]	Higher value denotes greater peak oxygen uptake (i.e. better) following completion of pulmonary rehabilitation compared to usual care.
	Follow-up: mean 12 months	Mean change in peak oxygen uptake (% predicted VO_2 max) was 1.33%.	MD 10.37% higher (1.6 lower to 22.34 higher)	-	24 (1 RCT)	⊕⊝⊝⊝ VERY LOW [8 9]	
Exercise performance: incremental shuttle walk test distance, metres	End-intervention: mean 12 weeks	Mean incremental shuttle walk test distance was 403 metres.	MD 74.0 metres further (26.4 further to 121.4 further); adjusted model data used	-	30 (1 RCT)	⊕⊝⊝⊝ VERY LOW [4 9]	Higher distance denotes greater exercise performance (i.e. better) following completion of pulmonary rehabilitation compared to usual care.
	Follow-up: mean 9 months	Mean incremental shuttle walk test distance was 421 metres.	MD 9 metres lower (140.38 lower to 122.38 further)	-	23 (1 RCT)	⊕⊝⊝⊝ VERY LOW [4 9]	

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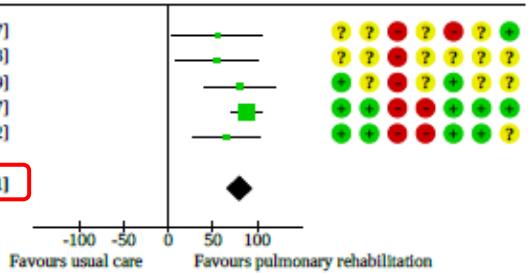
Exercise performance: 6-minute walk test distance, metres	End-intervention: range 3 to 12 weeks	Mean 6-minute walk test distance was 483 metres.	MD 79.8 metres further (66.5 further to 93.1 further)	-	529 (5 RCTs)	⊕⊕⊕⊖ MODERATE [10] [11]	Further distance denotes greater exercise performance (i.e. better) following completion of pulmonary rehabilitation compared to usual care. MCID = 26 to 30 m
	Follow-up: mean 12 months	Mean change in 6-minute walk test distance was −25.5 metres.	MD 52.3 metres further (0.7 further to 103.9 further)	-	42 (2 RCTs)	⊕⊖⊖⊖ VERY LOW [5] [8] [12]	
Asthma control: ACQ score	End-intervention: range 8 to 12 weeks	Mean change in ACQ score ranged from −0.3 to 0.4 points.	MD 0.5 points lower (0.8 lower to 0.2 lower); adjusted model data used	-	93 (2 RCTs)	⊕⊕⊖⊖ LOW [4] [5]	Lower score denotes better asthma control compared to usual care. MCID = 0.5 points
	Follow-up: range 9 to 12 months	Mean ACQ score was 1.4 points.	MD 0.1 points higher (0.4 lower to 0.5 higher)	-	48 (2 RCTs)	⊕⊕⊖⊖ LOW [4] [5]	
Asthma control: ACT score	End-intervention: range 3 to 8 weeks	Mean change in ACT score was 2.3 points.	MD 3.3 points higher (2.3 lower to 9.0 higher); adjusted model data used	-	442 (2 RCTs)	⊕⊖⊖⊖ VERY LOW [13] [14] [15]	Higher score denotes better asthma control compared to usual care. MCID = 3 points
	Follow-up: mean 3 months	Mean ACT score was 15.8 points.	MD 4.6 points higher (3.8 higher to 5.5 higher)	-	412 (1 RCT)	⊕⊖⊖⊖ VERY LOW [8] [16]	
Quality of life: AQLQ total score	End-intervention: range 3 to 12 weeks	Mean change in AQLQ total score ranged from −0.1 to 0.3 points.	MD 0.9 points higher (0.1 lower to 1.9 higher); adjusted model data used	-	442 (2 RCTs)	⊕⊖⊖⊖ VERY LOW [13] [14] [15]	Higher score denotes better quality of life compared to usual care. MCID = 0.5 points
	Follow-up: range 3 to 9 months	Mean change in AQLQ total score ranged from 0 to 0.5 points.	MD 0.6 points higher (0.2 lower to 1.4 higher); adjusted model data used	-	435 (2 RCTs)	⊕⊖⊖⊖ VERY LOW [4] [15] [17]	
Quality of life: SGRQ total score	End-intervention: range 3 to 6 weeks	Mean change in SGRQ total score was −2.2 points.	MD 18.5 points lower (20.8 lower to 16.3 lower); adjusted model data used	-	440 (2 RCTs)	⊕⊕⊕⊖ MODERATE [11] [13]	Lower score denotes better quality of life compared to usual care. MCID = 4 points
	Follow-up: range 3 to 12 months	Mean change in SGRQ total score ranged from −6 to 1.5 points.	MD 13.4 points lower (15.9 lower to 10.9 lower); adjusted model data used	-	430 (2 RCTs)	⊕⊖⊖⊖ VERY LOW [8] [11] [18] [19] [20]	
Adverse events	-	-	No data reported.	-	-	-	

Figure 6. Analysis 1.4 Exercise performance: 6-minute walk test distance at end-intervention. Schultz 2018 is endpoint data. Cambach 1997 and Turk 2017 are change from baseline data.

Study or Subgroup	Pulmonary rehabilitation Mean [metres]	SD [metres]	Total	Usual care Mean [metres]	SD [metres]	Total	Weight	Mean Difference IV, Random, 95% CI [metres]
Cambach 1997	63	89	18	8	63	17	6.9%	55.00 [4.13 , 105.87]
Manzak 2020	538.6	43.6	14	483.9	82.5	16	8.2%	54.70 [8.27 , 101.13]
Orooj 2020	401.9	63.5	14	321.2	43.4	14	10.9%	80.70 [40.41 , 120.99]
Schultz 2021	642.35	88.05	202	553.85	87.61	210	61.6%	88.50 [71.53 , 105.47]
Turk 2020	52	40	14	-14	51	10	12.3%	66.00 [28.08 , 103.92]
Total (95% CI)			**262**			**267**	**100.0%**	**79.79 [66.47 , 93.11]**

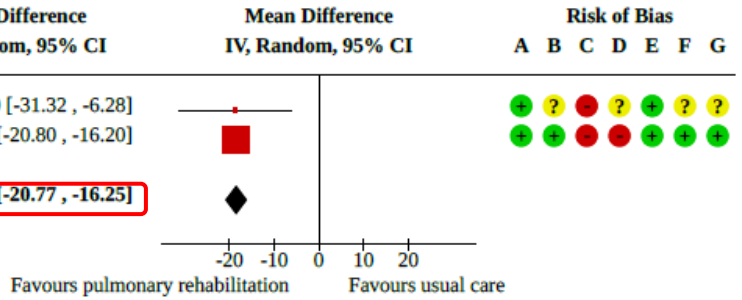
Heterogeneity: Tau² = 0.00; Chi² = 3.56, df = 4 (P = 0.47); I² = 0%
Test for overall effect: Z = 11.74 (P < 0.00001)
Test for subgroup differences: Not applicable



Analysis 1.13. Comparison 1: Pulmonary rehabilitation vs usual care for adults with asthma (end-intervention), Outcome 13: Health-related quality of life: St George's Respiratory Questionnaire total score at end-intervention

Study or Subgroup	MD	SE	Pulmonary rehabilitation Total	Usual care Total	Weight	Mean Difference IV, Random, 95% CI
Orooj 2020	-18.8	6.3898	14	14	3.3%	-18.80 [-31.32 , -6.28]
Schultz 2021	-18.5	1.1735	202	210	96.7%	-18.50 [-20.80 , -16.20]
Total (95% CI)			**216**	**224**	**100.0%**	**-18.51 [-20.77 , -16.25]**

Heterogeneity: Tau² = 0.00; Chi² = 0.00, df = 1 (P = 0.96); I² = 0%
Test for overall effect: Z = 16.04 (P < 0.00001)
Test for subgroup differences: Not applicable



Cochrane Database Syst Rev. 2022 Aug 22;8(8)

2022 Cochrane review in PR : PR versus usual care for adults with asthma

- Conclusion
  - Moderate certainty evidence shows that PR is probably associated with clinically meaningful improvements in functional exercise capacity and quality of life upon programme completion in adults with asthma
  - The certainty of evidence relating to maximal exercise capacity was very low to low
  - PR appears to confer minimal effect on asthma control
    - The certainty of evidence is very low to low.

Cochrane Database Syst Rev. 2022 Aug 22;8(8)

Overview

- Pulmonary rehabilitation in 2023 guideline
- 2022 Cochrane review in pulmonary rehabilitation
- Pulmonary rehabilitation of COPD
- Pulmonary rehabilitation of ILD
- Pulmonary rehabilitation of COVID-19
- Pulmonary rehabilitation in Korea

CHEST

Effectiveness of a Long-term Home-Based Exercise Training Program in Patients With COPD After Pulmonary Rehabilitation

A Multicenter Randomized Controlled Trial

Anja Frei, PhD; Thomas Radtke, PhD; Kaba Dalla Lana, BSc; Patrick Brun, MD; Thomas Sigrist, MD; Marc Spielmanns, PhD, MD; Swantje Beyer, MD; Thomas F. Riegler, MSc; Gilbert Büsching, BSc; Sabine Spielmanns; Ramona Kunz, MSc; Tamara Cerini, MSc; Julia Braun, PhD; Yuki Tomonaga, PhD; Miquel Serra-Burriel, PhD; Ashley Polhemus, MSc; and Milo A. Puhan, PhD, MD

- Whether a 12-month home-based, minimal-equipment strength training program after PR have an effect on dyspnea, exercise capacity, and patient-reported outcomes in patients with COPD
- Multicenter, randomized, parallel-group controlled trial
  - Patients with COPD were allocated randomly (1:1 ratio) into an intervention group (IG; homebased strength training program, trunk and upper and lower limb exercises at different intensity levels) or to no intervention and usual care (control group [CG])
  - 123 patients with COPD (IG, n=61; CG, n=62)

CHEST 2022; 162(6):1277-1286

TABLE 2] Between-Group Differences in Primary and Secondary Outcomes at 12-Mo Follow-up in the Intention-to-Treat Analysis

Variable	Intervention Group (n = 53[a])		Control Group (n = 51[a])		Adjusted Between-Group Difference (Intervention Minus Control Group)	
	Baseline	12 Mo	Baseline	12 Mo	Mean Difference (95% CI)	*P* Value
Primary end point						
CRQ dyspnea scale score, 1-7	4.65 ± 1.33	4.43 ± 1.49	4.61 ± 1.27	4.06 ± 1.45	0.28 (−0.23 to 0.80)	.27
Secondary end points						
6MWT distance, m[b]	396 ± 110	379 ± 143	417 ± 125	393 ± 133	1.37 (−35.06 to 37.79)	.94
1MSTST, repetitions[c]	16.9 ± 5.8	18.9 ± 8.1	18.2 ± 8.9	17.8 ± 11.4	2.62 (0.22-5.03)	.033
CRQ scale score, 1-7						
Fatigue	5.17 ± 0.93	4.76 ± 1.33	5.07 ± 1.07	4.67 ± 1.28	0.02 (−0.47 to 0.50)	.95
Emotional function	5.58 ± 0.92	5.10 ± 1.23	5.37 ± 1.08	5.01 ± 1.25	−0.12 (−0.56 to 0.31)	.58
Mastery	5.56 ± 1.05	5.50 ± 1.33	5.35 ± 1.06	5.25 ± 1.30	0.03 (−0.42 to 0.49)	.90
CAT score, scale 0-5	14.3 ± 6.1	15.3 ± 7.8	15.3 ± 6.7	16.5 ± 7.2	−0.01 (−2.25 to 2.24)	.99
HADS scale score, 0-21						
Depression	4.0 ± 2.7	4.2 ± 3.6	4.0 ± 3.0	4.8 ± 3.7	−0.43 (−1.57 to 0.71)	.46
Anxiety	4.5 ± 2.7	4.8 ± 3.4	4.5 ± 3.5	5.3 ± 3.4	−0.49 (−1.64 to 0.66)	.40
EQ VAS, 0-100	65.3 ± 16.6	62.6 ± 19.0	66.8 ± 18.1	60.7 ± 20.0	2.53 (−5.10 to 10.17)	.51
EQ-5D-5L index value	0.85 ± 0.13	0.78 ± 0.19	0.82 ± 0.17	0.76 ± 0.19	−0.017 (−0.08 to 0.05)	.62
No. of exacerbations over 12 mo	1.8 ± 1.7	2.1 ± 1.3	2.0 ± 1.8	2.6 ± 1.9	−0.29 (−0.89 to 0.31)	.34

Data are presented as mean ± SD or coefficient (95% CI) from linear models, unless otherwise indicated. Linear models were adjusted for age, sex, and the stratification of the variables No. of repetitions on the 1MSTST (≤ 19 vs > 19 repetitions) and study center. CAT = COPD Assessment Test; CRQ = Chronic Respiratory Questionnaire; EQ VAS = EuroQol Visual Analogue Scale; EQ-5D-5L = 5-level EuroQol-5D version; HADS = Hospital Anxiety Depression Scale; 1MSTST = 1-min sit-to-stand test; 6MWT = 6-min walk test; VAS = visual analog scale.

[a]Unless stated otherwise.

[b]n = 44 in the intervention group; n = 37 in the control group.

[c]n = 49 in the intervention group; n = 46 in the control group.

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TABLE 3] Health Care Use During the Study Year by Group

Variable	Intervention Group (n = 53)				Control Group (n = 51)				*P* Value[a]	SMD	*P* Value[b]
	Mean	SD	Median	IQR	Mean	SD	Median	IQR			
Days of hospitalization[c]	6.74	12.3	0	7.50-0.00	5.14	10.34	0	9.00-0.00	.476	0.141	.305
No. of pneumologist visits	3.96	3.61	3	4.00-2.00	3.53	3.71	3	6.00-2.00	.548	0.118	.618
Days of work lost	2.79	13.14	0	0.00-0.00	0.86	3.35	0	0.00-0.00	.311	0.201	.39
No. of specialist visits	4.13	8.65	2	5.50-1.00	4.08	6.91	3	4.00-1.00	.972	0.007	.681
No. of general practitioner visits	7.70	5.81	6	9.50-4.00	7.61	6.65	6	12.00-4.00	.941	0.014	.847
Days of inpatient rehabilitation	2.77	18.4	0	0.00-0.00	6.06	19.97	0	0.00-0.00	.385	0.171	.873

e-Table 11a: Experience of changes in daily life attributed to the training (n=50 out of 53 intervention group participants)

Question 6	Response options	N (%)
Have you experienced any changes in daily life that you attribute to the performance of the HOMEX training exercises?	Yes	42 (79)
	Yes and no#	2 (4)
	No+	5 (9)
	Unclear / missing	1 (2)
	Interview not conducted	3 (6)

*Specifications see e-Table 10b. #Specifications: "At the beginning my endurance was better, then I have had problems with my lung" (n=1); "The same as before, but the training kept me from smoking" (n=1). +Specifications: "I hardly trained" (n=1), "I have not really done the exercises" (n=1), "Not really, I still have breathing difficulties" (n=1), "Despite training, my oxygen saturation is worse again" (n=1)

PR of COPD: Effectiveness of a lung-term home-based exercise training program in patients with COPD after PR

- Conclusion
  - The home exercise program had no effect on dyspnea, but improved 1MSTST performance and patient-perceived fitness
  - The supported program was well accepted by patients with COPD and may facilitate continued exercise training at home

CHEST 2022; 162(6):1277-1286

EUROPEAN RESPIRATORY JOURNAL
ORIGINAL RESEARCH ARTICLE
M. KAASGAARD ET AL.

Use of Singing for Lung Health as an alternative training modality within pulmonary rehabilitation for COPD: a randomised controlled trial

Mette Kaasgaard [1,2], Daniel Bech Rasmussen [1,3], Karen Hjerrild Andreasson [1,3,4], Ole Hilberg [3,5], Anders Løkke [5], Peter Vuust [2] and Uffe Bodtger [1,3,6]

- Multicenter RCT in Denmark
  - Included 270 COPD patients, and 195 completed the study
- Investigated the effectiveness of 10 weeks of PR
  - Intervention arm: Singing for Lung Health (SLH)
    - Physical, vocal and breathing exercises, with a focus on improving strength, endurance and flexibility of the respiratory muscles
    - Carefully adapted to the respiratory challenges in COPD and included movement and/or dancing
    - 20 min of physical warm-ups, 20 min of vocal warm-up with rhythm and pitch games, 40 min of singing and 10 min of cooling down
  - Control arm: Standard physical exercise training (PExT)
    - Supervised strength and endurance training to enhance exercise tolerance and capacity
    - 20 min of physical warm-ups, 60 min of PExT, including handling of dyspnoea, and 10 min of cooling down

Eur Respir J. 2022 May 19;59(5))

TABLE 1 Overview of content in the two study groups

	SLH	PExT
Per session (min)[#]	90	90
Warm-up exercise (body)	✓	✓
Warm-up exercise (voice)	✓	×
Breathing techniques	✓	✓
Handling dyspnoea	✓	✓
Posture	✓	✓
Resting positions	✓	✓
Endurance exercises (circuit/interval)[¶]	✓	✓
Respiratory muscle training	✓	×
Strength exercises and limb endurance training	×	✓
Home exercise instructions/continuation of physical activity	✓	✓
Muscle stretching	✓	✓
Relaxation and body awareness	✓	✓
Singing	✓	×
Education and self-management as part of PR[+]	✓	✓

SLH: Singing for Lung Health; PExT: physical exercise training. [#]: dose of intervention for both groups was 90 min twice weekly over 10 weeks; [¶]: both groups were trained in coordination of breathing and use of pursed lip breathing (resistance on exhalation), while the SLH group did respiratory muscle training (resistance on inhalation) and the PExT group did strength exercises and limb endurance training (comprising walking, stepping, stair climbing, exercise bikes and, if possible, jogging, cross trainer and/or row machine); [+]: dose of education and self-management for both groups varied between 60–120 min once weekly for 10 weeks and comprised knowledge about chronic obstructive pulmonary disease, behaviour change, smoking cessation, correct use of inhaler devices, nutrition, sexuality, handling of stress and anxiety, early recognition of exacerbation, decision-making and taking action on symptoms, motivation goals and maintenance post-pulmonary rehabilitation.

Eur Respir J. 2022 May 19;59(5))

TABLE 3 Physical performance and quality of life

	SLH	PExT	Difference p-value	95% CI
6MWD, m				
Baseline	374.1±105.0	391.6±99.0	0.17	
Follow-up	387.2±100.5	405.7±104.5	0.14	
Change from baseline	13.1±36.3***	14.1±32.3***	0.81	−7.3–9.3
MID achieved	31 (21.8%)	31 (25.0%)	0.57	
SGRQ				
Total score				
Baseline	46.1±17.1	44.0±17.0	0.32	
Follow-up	43.0±16.6	42.5±18.9	0.81	
Change from baseline	−3.0±8.8***	−1.5±9.2	0.16	−0.6–3.7
MID achieved	51 (35.2%)	35 (28.0%)	0.21	
Symptoms score				
Baseline	48.9±22.4	47.8±22.7	0.71	
Follow-up	45.0±21.9	43.5±24.4	0.61	
Change from baseline	−3.9±15.0**	−4.3±17.2**	0.83	−4.3–3.5
MID achieved	53 (36.6%)	46 (36.8%)	0.97	
Activity score				
Baseline	65.4±20.6	64.0±21.4	0.59	
Follow-up	63.9±20.0	61.6±23.2	0.39	
Change from baseline	−1.5±10.4	−2.4±11.5*	0.49	−3.7–1.7
MID achieved	44 (30.3%)	44 (35.2%)	0.40	
Impact score				
Baseline	34.2±18.1	31.3±18.1	0.20	
Follow-up	30.5±18.1	31.3±19.1	0.74	
Change from baseline	−3.7±12.1***	−0.1±10.5	0.01	0.9–6.6
MID achieved	52 (35.9%)	28 (22.4%)	0.02	

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HADS				
Anxiety score				
Baseline	4.8±3.8	5.1±3.7	0.52	
Follow-up	4.9±3.7	4.9±3.7	0.97	
Change from baseline	0.1±2.4	−0.2±2.3	0.33	−0.9–0.3
Depression score				
Baseline	3.4±3.2	3.0±2.9	0.28	
Follow-up	3.2±2.9	3.1±3.0	0.78	
Change from baseline	−0.2±2.1	0.1±1.5	0.19	−0.1–0.7
FEV_1 % predicted				
Baseline	49.7±16.9	53.6±16.6	0.06	
Follow-up	50.8±17.8	53.9±17.4	0.14	
Change from baseline	1.1±6.6*	0.4±4.6	0.01	−2.1– −0.7
Borg-CR10 (after 6MWD)				
Baseline	7.1±2.8	6.6±2.8	0.10	
Follow-up	6.9±2.7	6.4±2.5	0.15	
Change from baseline	−0.3±1.8	−0.2±2.2	0.66	−0.4–0.6
mMRC				
Baseline	2.2±1.2	2.0±1.2	0.25	
Follow-up	2.0±1.2	2.0±1.3	0.97	
Change from baseline	−0.2±0.7***	−0.1±0.8	0.07	−0.0–0.4
Adherence to intervention				
Sessions, n	16.6±3.0	16.3±3.1	0.41	−2.1–1.0
Adherence rate 0–24%	22 (15.2%)	21 (16.8%)	0.90	
Adherence rate 25–49%	11 (7.6%)	12 (4.4%)		
Adherence rate 50–74%	24 (16.6%)	21(16.8%)		
Adherence rate 75–100%	88 (60.7%)	71 (56.8%)		
Dropout rate	37 (25.5%)	38 (30.4%)	0.42	

Data are presented as mean±SD or n (%), unless otherwise stated. SLH: Singing for Lung Health; PExT: physical exercise training; 6MWD: 6-min walking distance; MID: minimal important difference; SGRQ: St George's Respiratory Questionnaire; HADS: Hospital Anxiety and Depression Score; FEV_1: forced expiratory volume in 1 s; Borg-CR10: modified Borg category-ratio dyspnoea scale; mMRC: modified Medical Research Council dyspnoea score. Within-group significance: *: $p<0.05$, **: $p<0.01$; ***: $p<0.001$.

Eur Respir J. 2022 May 19;59(5))

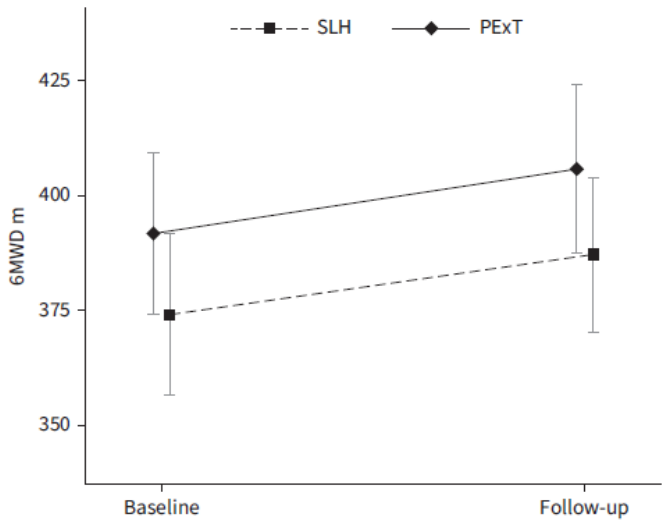

FIGURE 2 Change in 6-min walk distance (6MWD). SLH: Singing for Lung Health; PExT: physical exercise training.

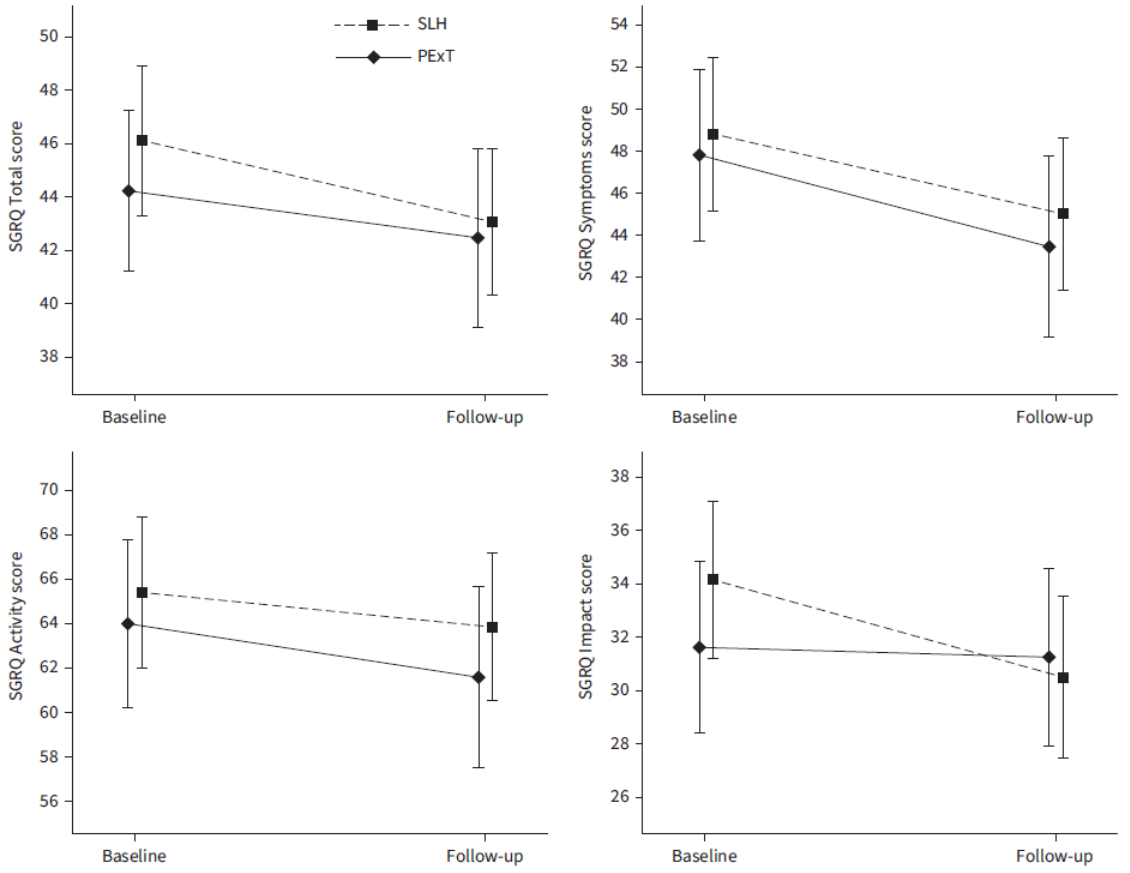

FIGURE 3 Change in St George's Respiratory Questionnaire (SGRQ) scores. SLH: Singing for Lung Health; PExT: physical exercise training.

- Conlusion
  - SLH provides positive and clinically relevant physiological and psychological changes in COPD
  - SLH was non-inferior to PExT in improving 6MWD post 10 weeks in community-based PR

Eur Respir J. 2022 May 19;59(5))

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Original Research

Clustering of COPD patients and their response to pulmonary rehabilitation

Yara Al Chikhanie [a,b], Sébastien Bailly [b], Ines Amroussa [b], Daniel Veale [a,b], Frédéric Hérengt [a,b,1], Samuel Verges [b,*,1]

- Aimed to
  - Cluster patients with COPD admitted to PR, based on patients' clinical characteristics and 6MWT results (6MWD, SpO2, HR and dyspnea)
  - Evaluate the response to PR in each of these clusters based on the improvement in 6MWD
- A single center cohort-based analysis of COPD patients (n=835)
- PR program
  - Consisted in a 3-to-4-weeks in-patient program, with activities 5 days per week
  - 25-min aerobic training on a cycling ergometer or a treadmill (5-min warm-up, 15-min training, 5-min cool-down)
  - 30-min low-intensity group gym session (upper and lower limbs exercises, respiratory exercises)
  - 30-min group walk outdoors
  - 30-min muscle strength training

Respir Med, 2022. 198: p.106861.

Table 2
Characteristics of the 4 identified clusters.

Variables	Cluster 1 n = 137 (16)	Cluster 2 n = 305 (37)	Cluster 3 n = 264 (32)	Cluster 4 n = 129 (15)
Sex (F)	56 (41)	172 (56)*	121 (46)	48 (37)+
(M)	81 (59)	133 (44)*	143 (54)	81 (63) +
Age (years)	59 [10]	65 [12]*	70 [10]*	67 [11]* +
BMI (kg/m^2)	36 [6]	22 [4]*	26 [5]*	25 [6]* +
TLC (% predicted)	104 [26]	109 [35]	109 [26]	103 [34]
FEV1 (% predicted)	62 [22]	56 [25]	59 [23]	39 [20]* +$
LTOT	5 (4)	29 (10)	10 (4)	126 (98)* +$
Pre-PR 6MWT				
6MWD (m)	430 [116]	362 [118]*	388 [114]*	290 [103]* +$
6MWD (% predicted)	70 [17]	58 [18]*	65 [17]*	47 [17]* +$
Minimal SpO_2 (%)	89 [5]	89 [5]	88 [5]	86 [6]* +$
Δ SpO_2 (%)	−3 [4]	−4 [5]	−4 [5]	−7 [6]* +$
Δ HR (bpm)	23 [14]	14 [15]*	20 [15]	15 [13]* $
End-of-test dyspnea	5 [2]	4 [2]*	6 [2]*	6 [2]* +
Post-PR 6MWT				
6MWD (m)	507 [111]	459 [118]*	467 [114]*	356 [113] *+$
6MWD (% predicted)	82 [15]	73 [18]*	78 [17]	57 [18] *+$
Minimal SpO_2 (%)	89 [6]	88 [6]	88 [5]	85 [6] *+$
Δ SpO_2 (%)	−3 [4]	−4 [5]	−4 [5]	−8 [6] *+$
Δ HR (bpm)	28 [17]	19 [16]*	22 [16]*	19 [16]*
End-of-test dyspnea	4 [2]	4 [2]	5 [2]*	6 [2]* +
Response to PR (Δ 6MWD)				
Non-Responders (<30 m)	22 (16)	33 (11)	47 (18)	36 (28) +
Responders (≥30 m)	115 (84)	272 (89)	217 (82)	93 (72) +

- Four distinctive homogeneous clusters were identified using the pre-PR patients' clinical characteristics and 6MWT responses
- Cluster 1 (n=16%)
  - Younger men, GOLD I-II, Average walkers, obese, responders
- Cluster 2 (n=37%)
  - Older women, GOLD II-III, slow walkers, responders
- Cluster 3 (n=32%)
  - Older men, GOLD II-III, dyspneic, slow walkers, responders
- Cluster 4 (n=15%)
  - Older men, GOLD III-IV, very slow walkers, oxygen-dependent, very dyspneic, non-responders

Respir Med, 2022. 198: p.106861.

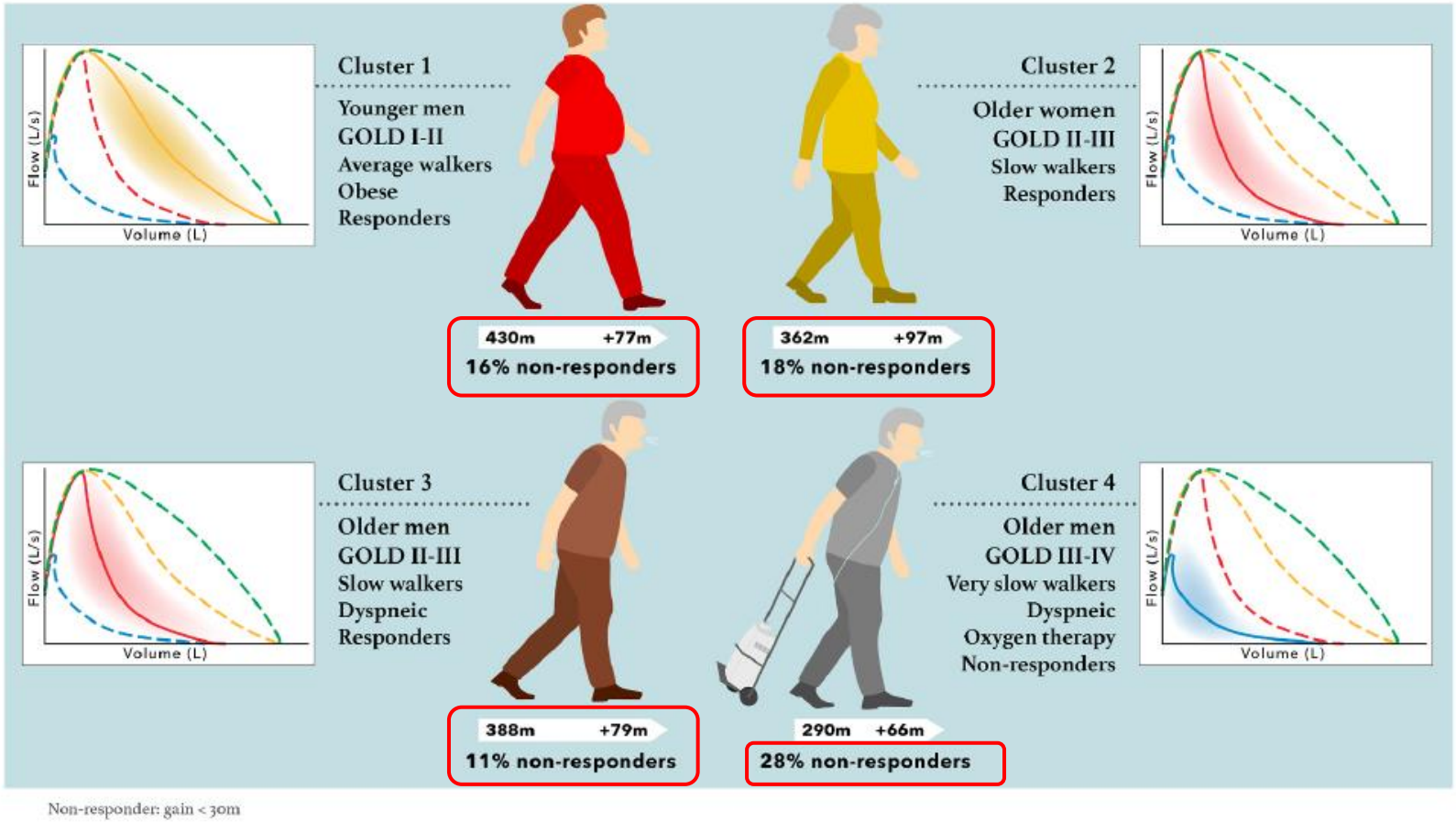

Fig. 2. Infographic illustrating the four identified clusters of COPD patients and their respective 6-min walking distance response to pulmonary rehabilitation.

Respir Med, 2022. 198: p.106861.

PR of COPD: Clustering of COPD patients with their response to PF

- Conclusion
  - The present study identified four clusters of COPD patients admitted to PR based on their clinical characteristics and 6MWT responses
  - Among these clusters, there were different rates of response to PR
  - The cluster showing the highest probability of having a post-PR 6MWD improvement <30 m included older patients, GOLD III-IV, with walking limitation, severe desaturation, severe dyspnea

Respir Med, 2022. 198: p.106861.

Overview

- Pulmonary rehabilitation in GOLD guideline
- 2022 Cochrane review in pulmonary rehabilitation
- Pulmonary rehabilitation of COPD
- Pulmonary rehabilitation of ILD
- Pulmonary rehabilitation of COVID-19
- Pulmonary rehabilitation in Korea

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

- Aim
  - To compare the responses of patients with IPF with a matched group of patients with COPD undergoing the same supervised, outpatient pulmonary rehabilitation program
  - To determine whether pulmonary rehabilitation is associated with survival in IPF
- Using propensity score matching, 163 patients with IPF were matched 1:1 with 163 patients with COPD referred for PR
  - Age, sex, BMI, MRC dyspnea scale grade, self-reported Chronic Respiratory Questionnaire (CRQ) total score and incremental shuttle walk test (ISWT) distance
- PR
  - 8-week outpatient exercise and multidisciplinary education program: two supervised sessions of exercise and education, and at least one additional home-based exercise session per week

CHEST 2022; 161(3):728-737

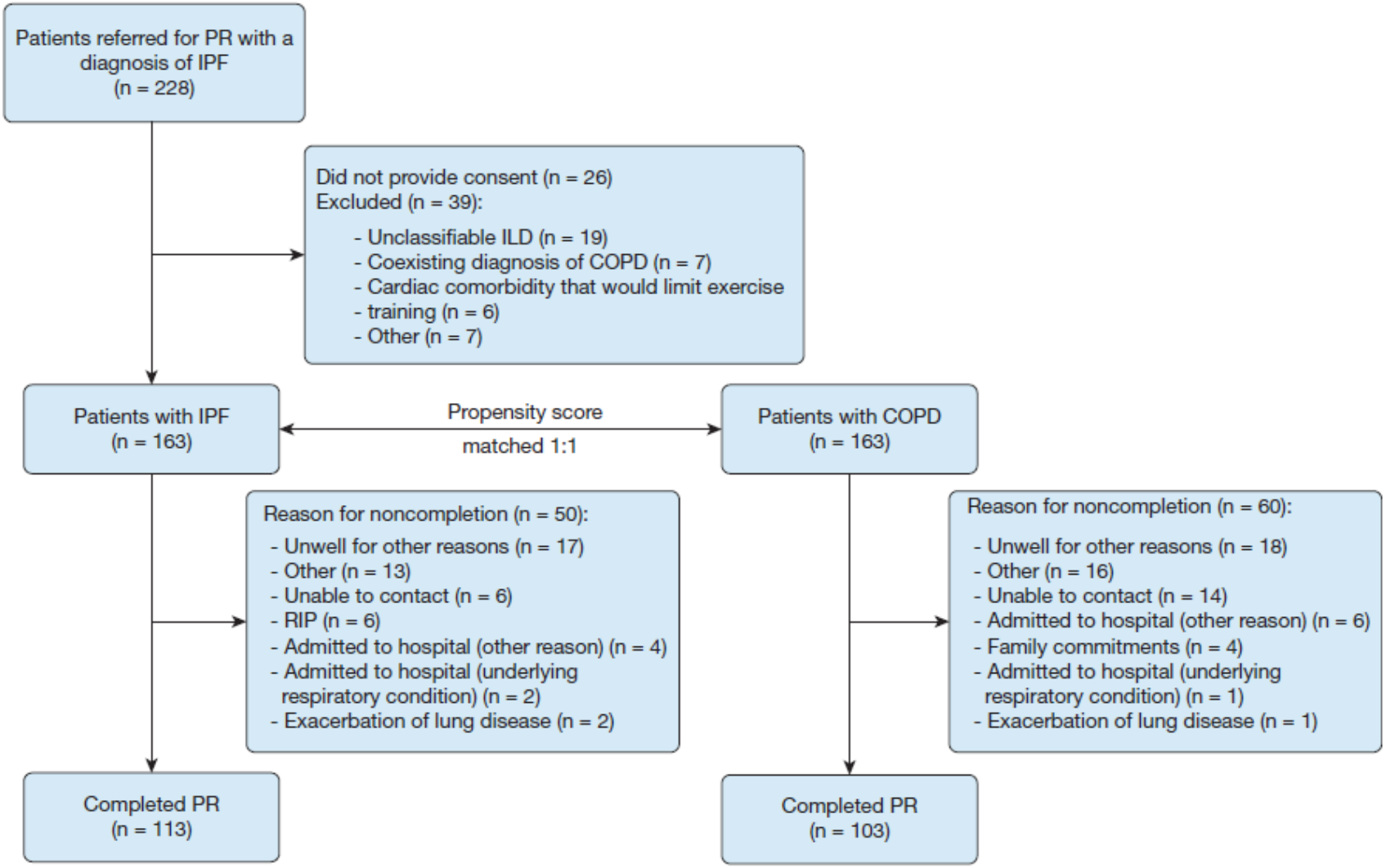

Figure 1 – *Flow chart showing participant recruitment and reasons for PR noncompletion. ILD = interstitial lung disease; IPF = idiopathic pulmonary fibrosis; PR = pulmonary rehabilitation; RIP = rest in peace.*

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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.

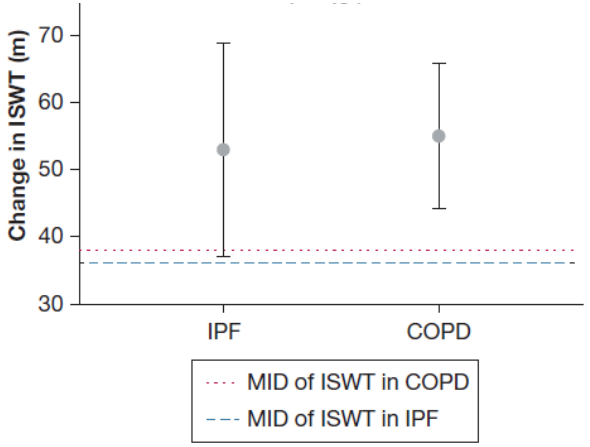

Figure 2 – *Graph showing the mean (95% CI) change in ISWT distance in participants with IPF and COPD (unmatched analysis). IPF = idiopathic pulmonary fibrosis; ISWT = incremental shuttle walk test; MID = minimal important difference.*

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TABLE 3] Univariate and Multivariate Cox Proportional Hazards Regression Analysis for the Association Between PR Status and Time to All-Cause Mortality at 1 Year From PR Completion in IPF

	Univariate Analysis		Multivariate Analysis 1[a]		Multivariate Analysis 2[b]	
Covariate: PR Status	HR (95% CI)	*P* Value[c]	HR (95% CI)	*P* Value[c]	HR (95% CI)	*P* Value[c]
Responder[d]	Reference category	.01	Reference category	.01	Reference category	.01
Nonresponder[e]	3.91 (1.54-9.93)		3.45 (1.24-9.57)		3.94 (1.43-10.81)	
Noncompleter[f]	5.62 (2.24-14.08)		4.70 (1.66-13.34)		4.42 (1.53-12.79)	

HR = hazard ratio; PR = pulmonary rehabilitation.

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

[b]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.)

[c]Overall *P* value for PR status.

[d]PR completion plus meeting the minimal important difference of incremental shuttle walk test distance. >=38m

[e]PR completion plus not achieving the minimal important difference of incremental shuttle walk test distance.

[f]Not completing PR.

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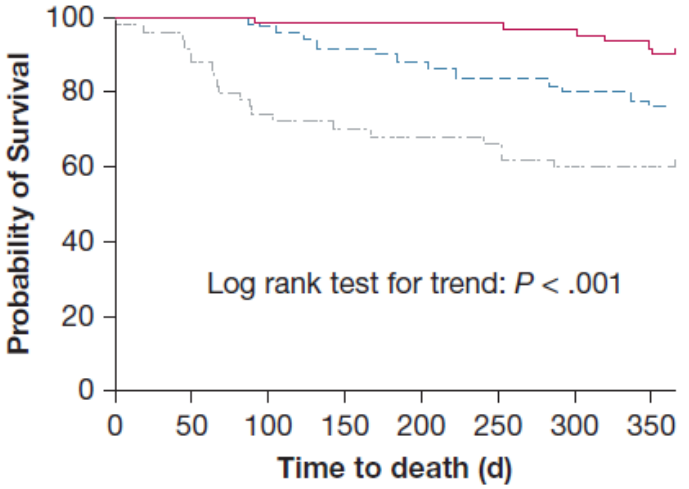

PR responders (No.)	61	61	61	61	61	61	58	57
PR nonresponders (No.)	50	50	50	47	45	43	41	39
PR noncompleters (No.)	50	45	37	36	35	34	31	31

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.*

- Conclusion
  - Patients with IPF have similar completion rates and magnitude of response to PR compared with a matched group of patients with COPD
  - In IPF, noncompletion of and nonresponse to PR were associated with increased all-cause mortality

  => Reinforce the benefits of pulmonary rehabilitation in patients with IPF

CHEST 2022; 161(3):728-737

Original research

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

Sabina Anna Guler,[1] Seo Am Hur,[2] Michael K Stickland,[3] Patrick Brun,[4] Luc Bovet ,[4] Anne E Holland,[5] Janet Bondarenko,[5] Nathan Hambly,[6] Joshua Wald,[6] Nima Makhdami,[7] Michael Kreuter,[8] Rainer Gloeckl,[9] Inga Jarosch,[9] Benjamin Tan,[2] Kerri A Johannson ,[10] S Ainslie McBride,[10] Kaissa De Boer,[11] Jacqueline S Sandoz,[12] Kelly Sun,[12] Deborah Assayag,[13] Surya P Bhatt ,[14] Julie Morisset,[15] Vincent Ferraro,[15] Chris Garvey,[16] Pat G Camp,[17,18] Christopher J Ryerson[2,18]

- To determine whether <u>improvement in 6MWD during PR</u> was associated with subsequent <u>survival</u>
- Retrospective, international cohort study included patients with <u>fibrotic ILD</u> participating in either <u>inpatient or outpatient PR</u> (n=701)
- PR
  - Inpatient PR: usually stay for 2–4 weeks in a specialised PR clinic
    - 2-3 sessions of exercise training per day for 5–6 days/week, with additional psychological support and educational sessions
  - Outpatient PR: outpatient setting for a total of 6–12 weeks
    - 2-3 sessions/week of structured exercise and education

Thorax 2022;77:589–595

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 (≥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 ≥30 m	120 (65%)	227 (52%)

Data shown are number (% (number of participants with available information in the denominator)), mean (SD) or median (IQR). Missing data (≥10%) (inpatient/outpatient PR) included PR duration (2%/15%), adherence (65%/12%), oxygen flow rate at PR end (5%/11%) and 6MWD at PR end (5%/14%).
6MWD, 6-minute walk distance.

Table 3 Association of change in 6-minute walk distance (6MWD) during inpatient or outpatient pulmonary rehabilitation with survival

	Unadjusted analysis*		Adjusted for age, sex, baseline 6MWD†	
	HR (95% CI)	P value	HR (95% CI)	P value
Inpatient pulmonary rehabilitation				
Δ6MWD, m	0.97 (0.94 to 0.99)	0.02	0.94 (0.91 to 0.97)	<0.001
Outpatient pulmonary rehabilitation				
Δ6MWD, m	0.99 (0.97 to 1.01)	0.3	0.97 (0.95 to 1.00)	0.042

HR effect estimates are reported per 10 m change in 6MWD.
*Accounting for clustering by centre (random effect).
†Random effect: centre; fixed effects: age, sex, baseline 6MWD.
Δ, change.

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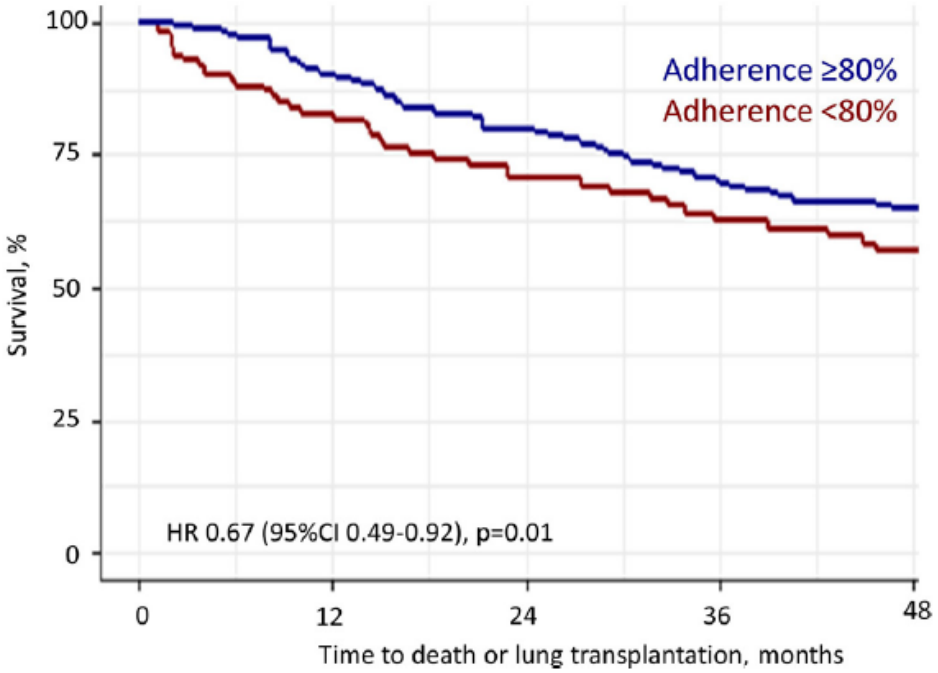

Figure 4 Survival stratified by adherence to pulmonary rehabilitation sessions (attendance of ≥/<80% of sessions) during outpatient pulmonary rehabilitation.

- Conclusion
  - Patients with fibrotic ILD who improved physical performance during PR had better survival compared with those who did not improve performance

Thorax 2022;77:589–595

Overview

- Pulmonary rehabilitation in 2023 guideline
- 2022 Cochrane review in pulmonary rehabilitation
- Pulmonary rehabilitation of COPD
- Pulmonary rehabilitation of ILD
- Pulmonary rehabilitation of COVID-19
- Pulmonary rehabilitation in Korea

EUROPEAN RESPIRATORY JOURNAL
ORIGINAL RESEARCH ARTICLE
M.A. MCNARRY ET AL.

Inspiratory muscle training enhances recovery post-COVID-19: a randomised controlled trial

Melitta A. McNarry[1], Ronan M.G. Berg[2,3], James Shelley[1], Joanne Hudson[1], Zoe L. Saynor[4], Jamie Duckers[5], Keir Lewis[6,7], Gwyneth A. Davies[7] and Kelly A. Mackintosh[1]

- To investigate the potential rehabilitative role of inspiratory muscle training (IMT)
  - Reductions in breathlessness and improvements in quality of life and functional capacity
- 281 adults (prior self-reported COVID-19 infection, primary symptom of breathlessness) were recruited through social media, online COVID-19 support groups or following hospital discharge

-> randomised 4:1 to an 8-week IMT or a "usual care" waitlist control arm

-> 148(IMT: n=111; controls: n=37) participants completed the post-intervention testing

- IMT
  - PrO2, a handheld inspiratory flow resistive device
  - Three unsupervised IMT sessions/week

Eur Respir J. 2022 Oct 6;60(4):2103101.

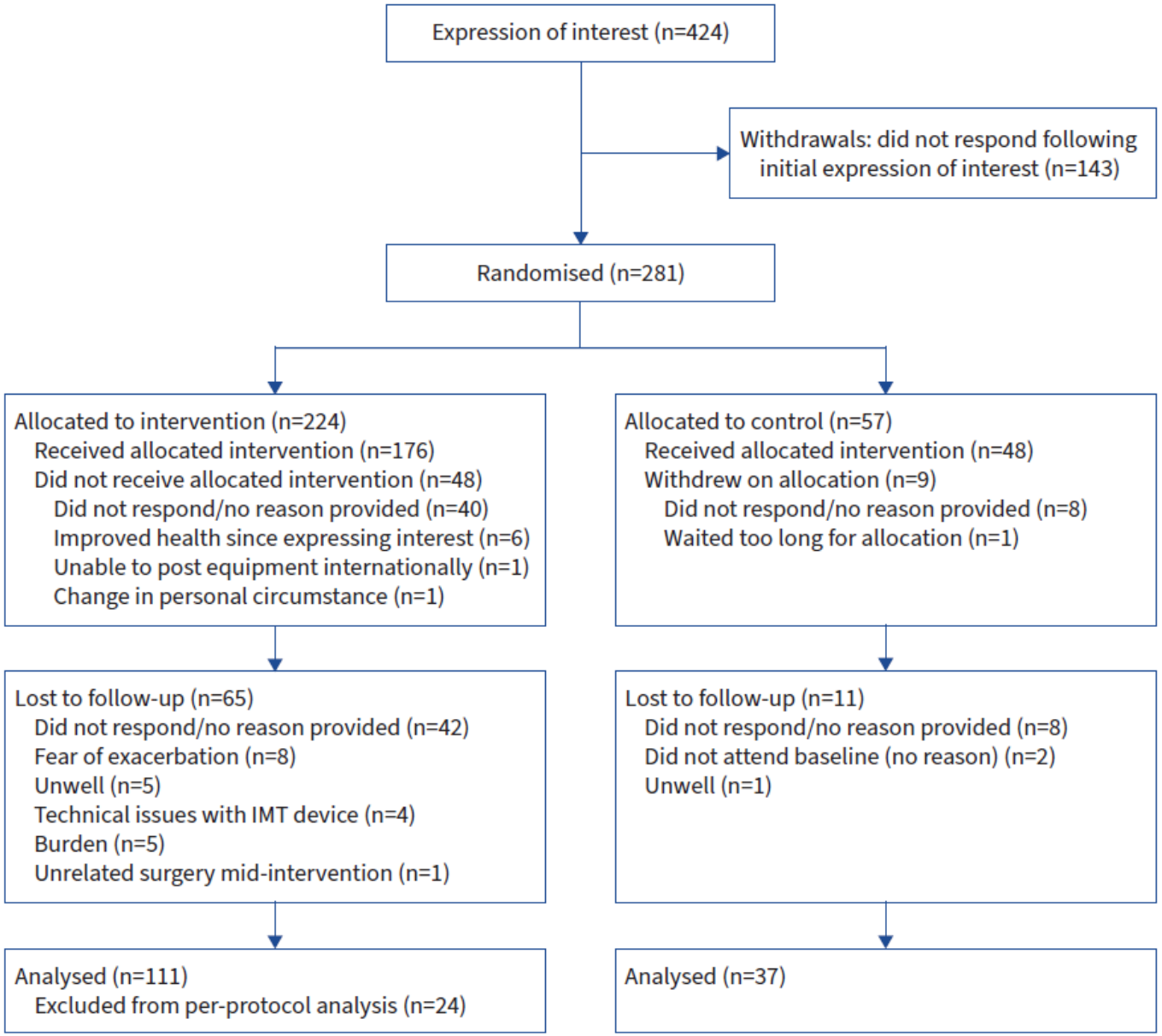

FIGURE 1 CONSORT (Consolidated Standards of Reporting Trials) flow diagram. IMT: inspiratory muscle training.

Eur Respir J. 2022 Oct 6;60(4):2103101.

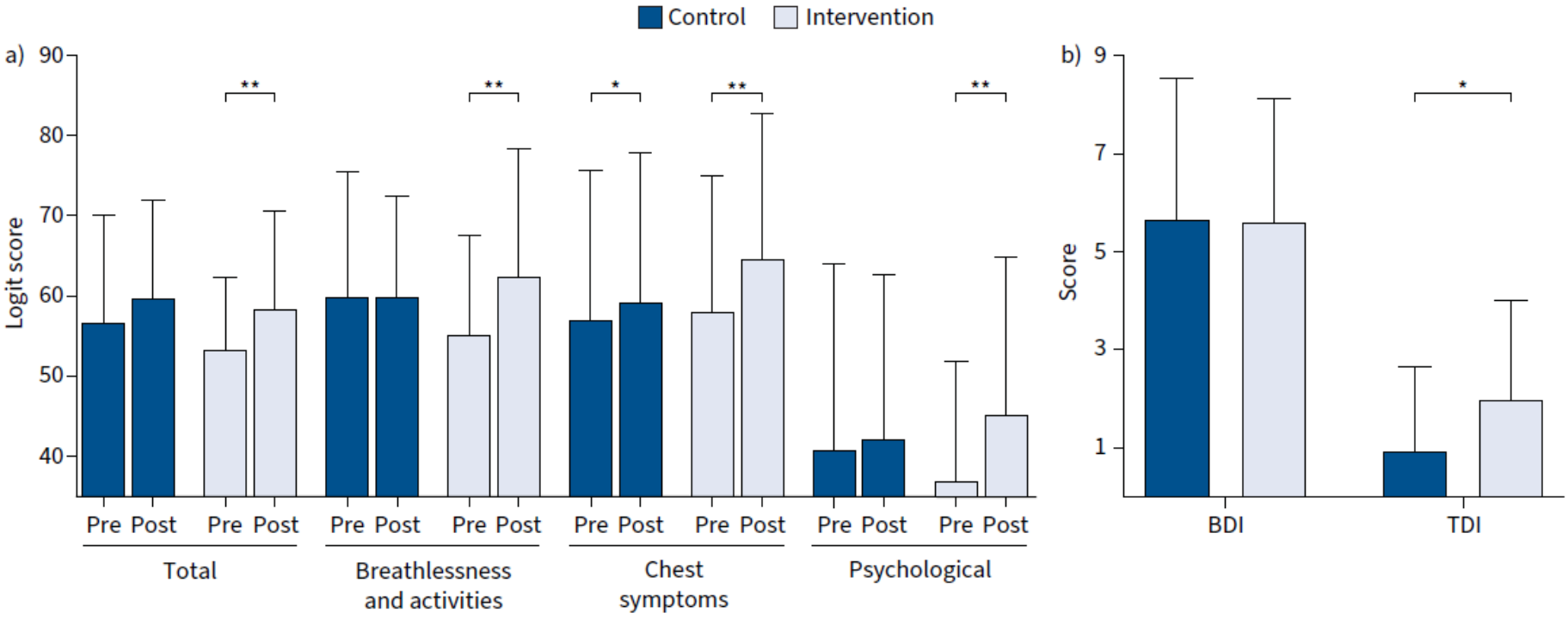

FIGURE 2 Pre- and post-intervention self-reported health and breathlessness according to a) King's Brief Interstitial Lung Disease (K-BILD) questionnaire, and b) Baseline Dyspnoea Index (BDI) and Transition Dyspnoea Index (TDI). *: $p<0.05$; **: $p<0.01$.

Eur Respir J. 2022 Oct 6;60(4):2103101.

TABLE 3 Pre- and post-intervention health-related quality of life, respiratory muscle strength, estimated physical fitness, physical activity, sleep levels, and mental health and wellbeing in the per-protocol population (n=124)

	Pre-intervention		Post-intervention	
	Control (n=37)	IMT (n=87)	Control (n=37)	IMT (n=37)
K-BILD				
Total	59.7±15.8	56.8±12.4	59.8±12.6	67.8±14.4[#,¶]
Breathlessness and activities	40.6±23.3	36.7±13.1	41.9±20.7	49.7±19.5[#]
Psychological	56.9±18.7	60.4±17.4	59.2±18.7[#]	70.1±16.9[#,¶]
Chest symptoms	56.6±13.5	54.0±7.8	59.5±12.4	60.7±10.8[#]
Respiratory muscle strength				
MIP (cmH_2O)	82.8±38.5	73.3±28.7	90.5±42.1	112.6±42.9[#,¶]
FIT (AU)	20.5±13.7	19.7±14.7	22.0±27.6	24.9±14.0[#]
SMIP (PTU)	475.1±218.3	445.3±183.9	464.2±226.8	587.7±215.0[#,¶]
Physical fitness				
Estimated V'_{O_2max} ($mL \cdot kg^{-1} \cdot min^{-1}$)	37.9±12.4	37.5±15.6	36.8±4.8	43.4±17.5[#]
Device-based physical activity				
Sedentary time (min)	757.8±105.0	766.2±89.9	774.6±72.9	742.8±95.5
LPA (min)	125.2±62.05	117.7±58.9	120.2±44.7	124.2±42.3
MPA (min)	64.8±36.6	70.9±36.2	69.8±32.3	87.0±40.0[#]
VPA (min)	2.6±5.4	0.96±1.6	2.5±6.3	2.5±6.3
Most active 60 min (*mg*)	107.8±60.3	99.6±29.6	107.1±42.5	115.6±33.7[#]
Most active 30 min (*mg*)	150.8±90.7	132.8±37.3	156.2±105.5	158.1±59.4[#]
Intensity gradient	−3.2±0.4	−3.4±0.4	−3.3±0.4	−3.3±0.4
Device-based sleep				
Sleep duration (min)	413.3±81.6	398.3±84.9	399.8±62.5	412.5±73.9
Sleep efficiency (%)	85±11	84±14	85±9	85±10
Perceived Competence Scale	14.1±9.3	15.1±7.7	16.7±8.9[#]	16.5±7.8
Basic Needs Satisfaction Scale				
Autonomy	4.6±0.9	4.6±0.9	4.8±0.7	4.7±0.8
Competence	4.8±1.0	4.9±1.1	4.9±0.9	5.0±1.0
Relatedness	5.8±0.8	5.7±0.9	5.8±0.7	5.7±1.0
Treatment Self-Regulation Questionnaire				
Amotivation	5.4±3.0	5.1±2.2	5.4±2.2	5.7±2.6
External regulation	7.4±3.5	8.0±4.5	8.0±3.8	8.2±3.7
Introjected regulation	7.4±3.1	7.0±3.5	6.9±3.7	6.9±3.3
Autonomous motivation	36.6±6.2	35.2±6.6	36.6±5.2	33.8±6.9

PR of COPD: Effectiveness of a lung-term home-based exercise training program in patients with COPD after PR

- Conclusion
  - IMT elicited clinically meaningful reductions in the severity of dyspnea and chest-related symptoms, as well as improved respiratory muscle strength and aerobic fitness
  - IMT may be an efficacious home-based rehabilitation strategy during recovery from COVID-19

Overview

- Pulmonary rehabilitation in 2023 guideline
- 2022 Cochrane review in pulmonary rehabilitation
- Pulmonary rehabilitation of COPD
- Pulmonary rehabilitation of ILD
- Pulmonary rehabilitation of COVID-19
- Pulmonary rehabilitation in Korea

2022 Oct 14;101(41):e31085.

YONSEI UNIVERSITY

Observational Study

Medicine

OPEN

Current status and trends of pulmonary rehabilitation in South Korea

National level data analysis using Health Insurance Review and Assessment Service (HIRA) database from 2016 to 2018

Hyo-Jung Kim, MD[a], Hee-Eun Choi, MD[b,*], Hang-Jea Jang, MD[a], Hyun-Kuk Kim, MD[a], Jin-Han Park, MD[a], Jae-Ha Lee, MD[a], Tae-Hoon Kim, MD[b]

- To evaluate the national trends of PR and the annual changes in the number and patterns of prescriptions of pulmonary rehabilitation before and after the insurance coverage
- Using the data of 24,380 patients during the 3-year period from 2016 to 2018 that were archived by the National Health Information Database of the Health Insurance Review and Assessment Service in South Korea

Table 1

Baseline characteristics of evaluated patients.

Baseline characteristics		Yr, no. (%) 2016	2017	2018
Total patients (n)		5936	7970	10,474
Male (%)		3783 (64)	5272 (66.1)	6825 (65.2)
Age (yrs)	Mean ± SD	65.90 ± 14.75	66.70 ± 14.08	67.03 ± 13.48
Age group (yrs)	<30	182 (3.1)	207 (2.6)	231 (2.2)
	30–39	180 (3.0)	232 (2.9)	208 (1.9)
	40–49	381 (6.4)	431 (5.4)	602 (5.7)
	50–59	949 (16.0)	1155 (14.5)	1528 (14.6)
	60–69	1430 (24.1)	2023 (25.4)	2774 (26.5)
	70–79	1836 (30.9)	2594 (32.5)	3360 (32.1)
	≥80	978 (16.5)	1328 (16.7)	1771 (16.9)
Insurance type	National Health Insurance	5335 (89.9)	7165 (89.9)	9465 (90.4)
	Medical aid	622 (10.5)	835 (10.5)	1033 (9.9)
	Veterans' insurance	21 (0.4)	22 (0.3)	23 (0.2)

Table 2

Annual number of pulmonary rehabilitation.

Prescription name (KCD code)	Number of times 2016	2017	2018
Rehabilitative breathing therapy (MM290)	16,253	14,363	15,198
Rehabilitation exercise for pulmonary disease (MM440)	293	10,283	16,757
Rehabilitative breathing therapy + rehabilitation exercise for pulmonary disease (MM290 + MM440)	52	514	688
Total	**16546**	**24646**	**31955**

Table 3

Type of institutions that performed pulmonary rehabilitation.

Medical institutions	Yr, no. (%)		
	2016	2017	2018
Total patients (n)	5936	7970	10,474
Private clinics	3 (0.1)	1 (0.0)	–
Secondary and general hospitals	1884 (31.7)	2061 (25.9)	3325 (31.7)
Tertiary hospitals	4122 (69.4)	6017 (75.5)	7256 (69.3)

Table 5

Top ten cause of primary diagnosis undergoing pulmonary rehabilitation.

	2016, no.		2017, no.		2018, no.	
1	Cerebral infarction	466	Lung cancer	965	Lung cancer	1677
2	Pneumonia	444	COPD	689	COPD	1025
3	Lung cancer	356	Pneumonia	599	Pneumonia	626
4	Paraplegia	354	Other interstitial pulmonary disease	571	Other interstitial pulmonary disease	610
5	ICH	325	Cerebral infarction	420	Cerebral infarction	443
6	COPD	203	Paraplegia	380	Paraplegia	351
7	Intracranial injury	187	Respiratory failure	277	Respiratory failure	269
8	Aspiration pneumonia	178	ICH	235	Bronchiectasis	261
9	Bronchiectasis	160	Bronchiectasis	190	ICH	248
10	Spinal muscular atrophy and related syndrome	159	Intracranial injury	182	Intracranial injury	194

COPD = chronic obstructive pulmonary disease, ICH = intracerebral hemorrhage.

Medicine (Baltimore). 2022 Oct 14;101(41):e31085.

Summary

- PR in GOLD guideline 2023
- 2022 Cochrane review in pulmonary rehabilitation
  - Assess the effect of inspiratory muscle training (IMT) on COPD
  - Evaluate the effectiveness of PR compared to usual care in adult asthma
- PR of COPD
  - Effectiveness of a long-term Home-based exercise training program after PR in COPD
  - Alternative training modality (Singing) within PR for COPD
  - Clustering of COPD patients with their response to PR
- PR of ILD
  - PR in IPF and COPD
  - Survivial after PR in fibrotic ILD patients
- PR of COVID-19
  - IMT enhances recovery post-COVID-19
- PR in Korea
  - Current status and trends of PR in Korea (HIRA database)

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