Non-pharmacologic Prevention of AECOPD

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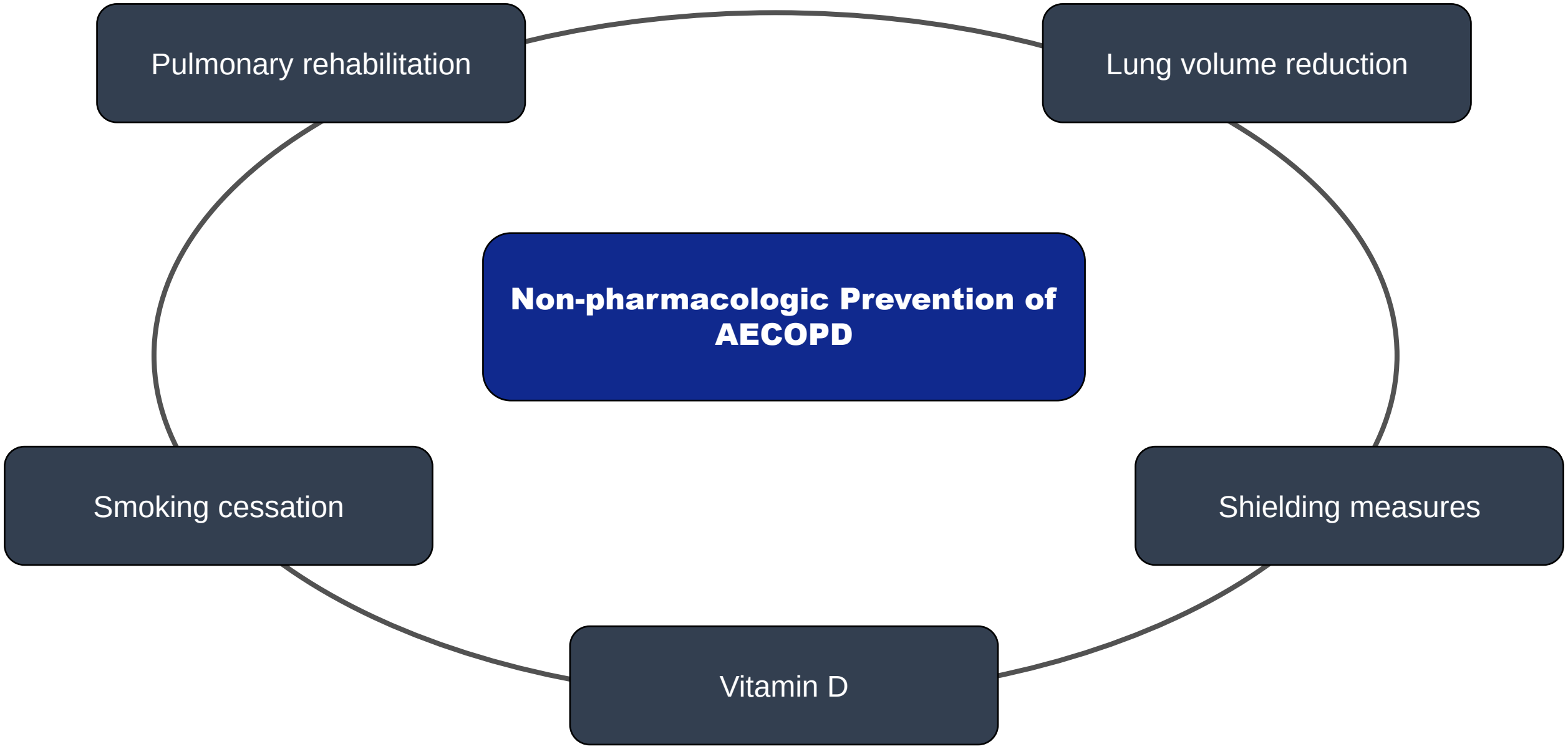
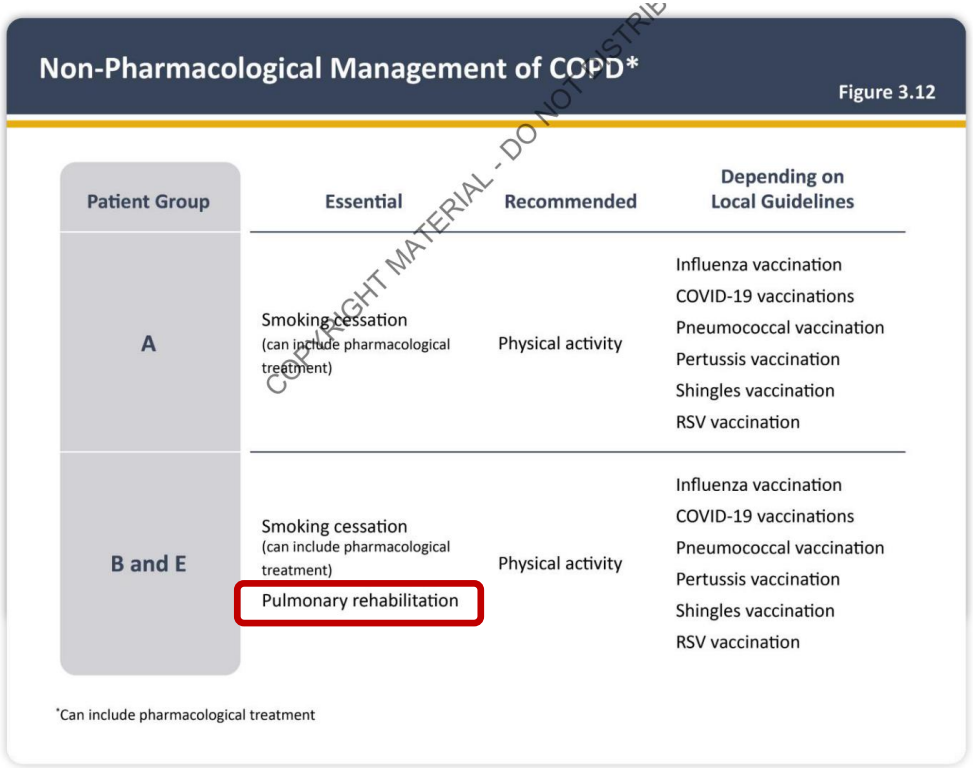
Interventions that reduce the frequency of AECOPD (GOLD 2024)

Intervention Class	Intervention
Bronchodilators	LABAs LAMAs LABA + LAMA
ICS-containing regimens	ICS + LABA ICS + LABA + LAMA
Anti-inflammatory (non-steroid)	Roflumilast
Anti-infectives	Vaccines Long Term Macrolides
Mucoregulators	N-acetylcysteine Carbocysteine, Erdosteine
Various others	Smoking Cessation Rehabilitation Lung Volume Reduction Vitamin D Shielding measures (e.g., mask wearing, minimizing social contact, frequent hand washing)

GOLD 2024


Pulmonary rehabilitation
Lung volume reduction
Non-pharmacologic Prevention of AECOPD
Smoking cessation
Shielding measures
Vitamin D

Recommendations of PR in current reports and guidelines



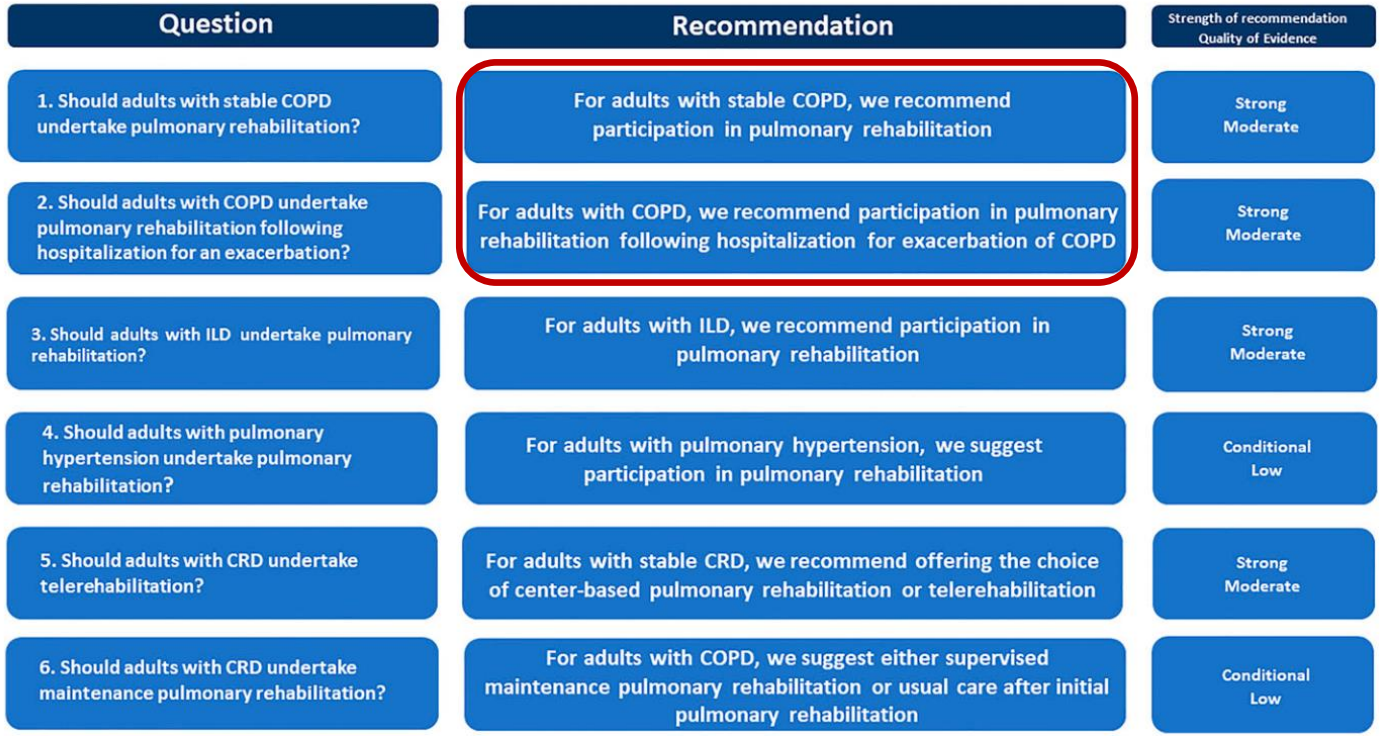
Non-Pharmacological Management of COPD*

Figure 3.12

Patient Group	Essential	Recommended	Depending on Local Guidelines
A	Smoking cessation (can include pharmacological treatment)	Physical activity	Influenza vaccination COVID-19 vaccinations Pneumococcal vaccination Pertussis vaccination Shingles vaccination RSV vaccination
B and E	Smoking cessation (can include pharmacological treatment) Pulmonary rehabilitation	Physical activity	Influenza vaccination COVID-19 vaccinations Pneumococcal vaccination Pertussis vaccination Shingles vaccination RSV vaccination

*Can include pharmacological treatment

GOLD 2024 reports



Question	Recommendation	Strength of recommendation Quality of Evidence
1. Should adults with stable COPD undertake pulmonary rehabilitation?	For adults with stable COPD, we recommend participation in pulmonary rehabilitation	Strong Moderate
2. Should adults with COPD undertake pulmonary rehabilitation following hospitalization for an exacerbation?	For adults with COPD, we recommend participation in pulmonary rehabilitation following hospitalization for exacerbation of COPD	Strong Moderate
3. Should adults with ILD undertake pulmonary rehabilitation?	For adults with ILD, we recommend participation in pulmonary rehabilitation	Strong Moderate
4. Should adults with pulmonary hypertension undertake pulmonary rehabilitation?	For adults with pulmonary hypertension, we suggest participation in pulmonary rehabilitation	Conditional Low
5. Should adults with CRD undertake telerehabilitation?	For adults with stable CRD, we recommend offering the choice of center-based pulmonary rehabilitation or telerehabilitation	Strong Moderate
6. Should adults with CRD undertake maintenance pulmonary rehabilitation?	For adults with COPD, we suggest either supervised maintenance pulmonary rehabilitation or usual care after initial pulmonary rehabilitation	Conditional Low

2023 ATS guideline for PR

GOLD 2024, Rochester et al. *AJRCCM. 2023;208(4):e7-e26.*

PR is associated with decreased AE & mortality

[COPD Original Research]

CHEST

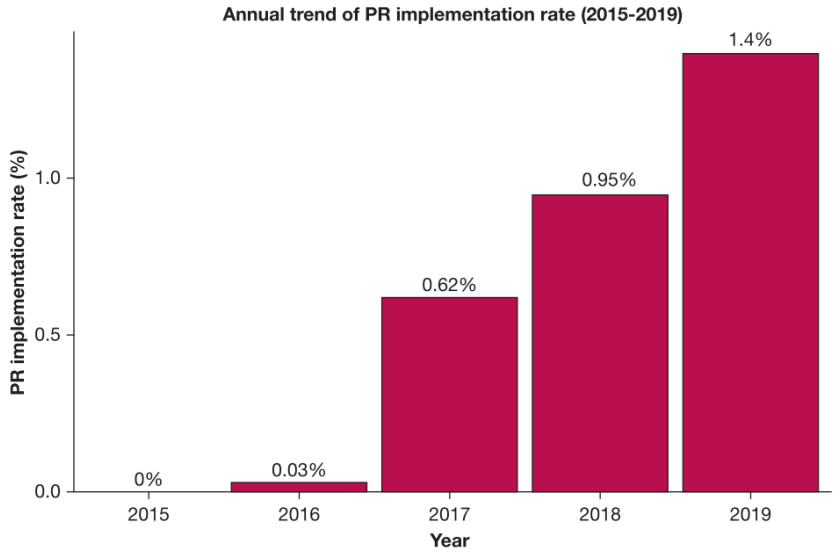
Pulmonary Rehabilitation Is Associated With Decreased Exacerbation and Mortality in Patients With COPD

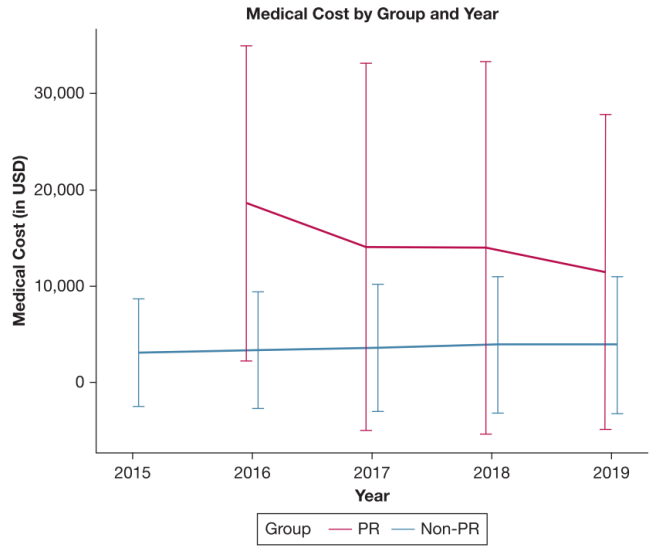
A Nationwide Korean Study

Check for updates

TABLE 1] General Characteristics of Study Participants

Characteristic	PR Group (n = 6,360; 1.43%)	Non-PR Group (n= 436,498; 98.56%)	*P* Value
Mean age, y	70.94 ± 9.04	70.61 ± 10.56	.004
Sex, male	5,082 (79.9)	296,862 (68.0)	< .001
Insurance type			
NHI	5,472 (86.0)	371,693 (85.2)	.049
Medical aid	888 (14.0)	64,805 (14.8)	
mCCI	2.03 ± 1.98	2.42 ± 2.14	< .001
Moderate-to-severe AE in previous year	0.73 ± 2.15	0.32 ± 1.81	< .001
Severe AE in previous year	0.56 ± 1.38	0.14 ± 0.62	< .001
COPD medication during 1 y			
LAMA	708 (11.1)	69,564 (15.9)	< .001
LABA + LAMA	2,855 (44.9)	89,601 (20.5)	< .001
ICS + LABA	1,397 (22.0)	122,851 (28.1)	< .001
ICS + LABA + LAMA	1,778 (28.0)	50,904 (11.7)	< .001
Death, 2016-2019	627 (9.9)	47,559 (10.9)	.008





Choi et al. *Chest. 2024;165(2):313-322.*

Exacerbations

TABLE 2] Effect of PR in COPD Exacerbation

Exacerbation Severity	No. (%) of Patients With Events (n = 6,360)		Crude OR (95% CI)	Adjusted OR (95% CI)
	Pre-PR	Post-PR		
Moderate-to-severe AE	1,759 (27.7)	543 (8.5)	0.218 (0.198-0.240)	0.585 (0.539-0.635)
Severe AE	1,635 (25.7)	496 (7.8)	0.213 (0.193-0.236)	0.550 (0.502-0.602)
Exacerbation Severity	Mean No. of Events/Year ± SD (n = 6,360)		Crude IRR (95% CI)	Adjusted IRR (95% CI)
	Pre-PR	Post-PR		
Moderate-to-severe AE	0.733 ± 2.151	0.220 ± 1.209	0.921 (0.917-0.925)	0.973 (0.965-0.980)
Severe AE	0.560 ± 1.382	0.171 ± 0.847	0.850 (0.840-0.860)	0.999 (0.983-1.017)

Covariates included the following: age, sex, type of insurance, mCCI, and previous moderate-to-severe exacerbation. AE = acute exacerbation; IRR = incidence rate ratio; mCCI = modified Charlson Comorbidity Index; PR = pulmonary rehabilitation.

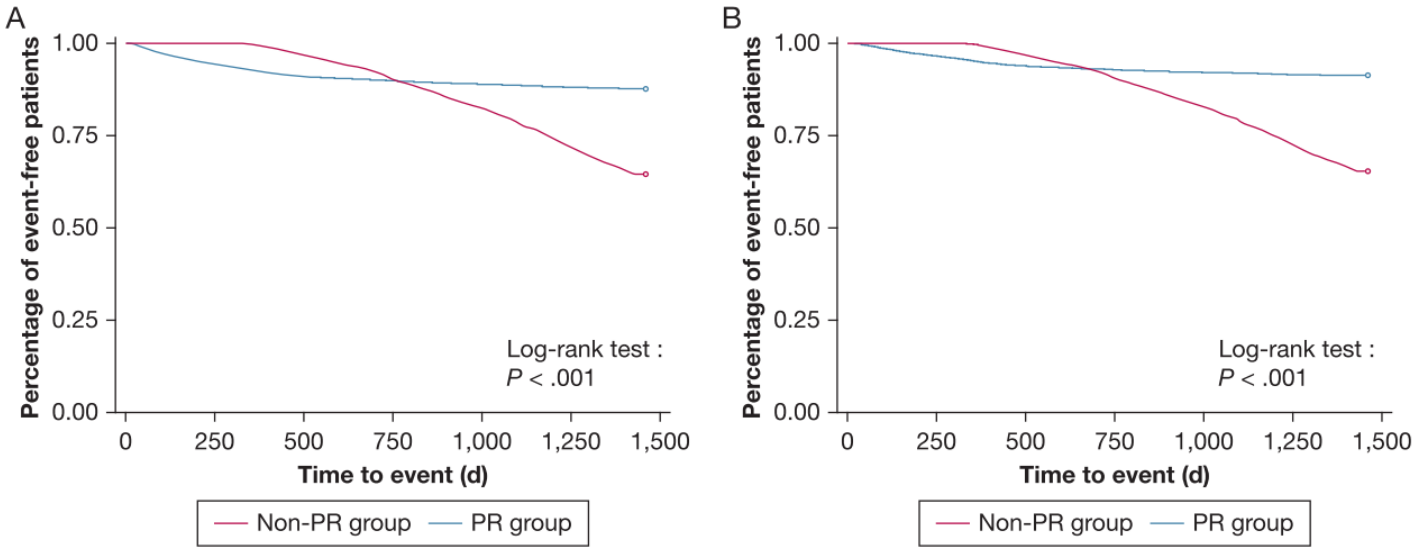


Figure 3 – *A, B, Time to first exacerbation: (A) moderate-to-severe exacerbation and (B) severe exacerbation.*

Choi et al. *Chest. 2024;165(2):313-322.*

Mortality

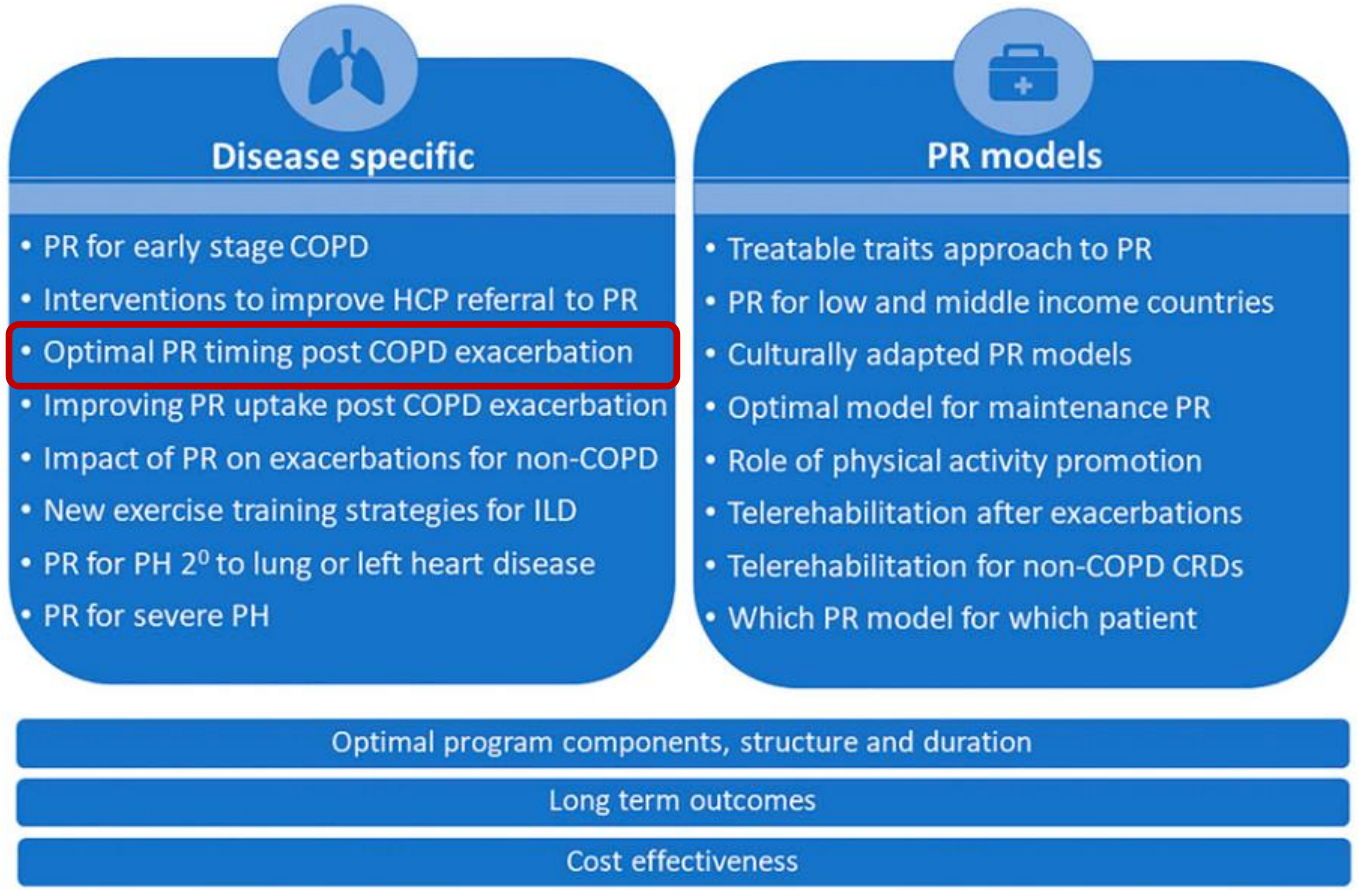
TABLE 3] Differences of Mortality Between the PR and Non-PR Groups

Variables	Hazard Ratio	95% CI	*P* Value
Age categories, y			
40-49	1 (reference)	…	…
50-59	0.925	(0.846-1.011)	.085
60-69	1.166	(1.073-1.266)	< .001
≥ 70	3.075	(2.839-3.331)	< .001
Sex, male	1.568	(1.535-1.602)	< .001
Type of insurance			
NHI	1 (reference)	…	…
Medical aid	1.096	(1.070-1.122)	< .001
mCCI	1.151	(1.146-1.155)	< .001
Previous exacerbation	2.210	(2.165-2.255)	< .001
PR (vs non-PR)	0.671	(0.620-0.727)	< .001

mCCI = modified Charlson Comorbidity Index; NHI = National Health Insurance; PR = pulmonary rehabilitation.

Choi et al. *Chest. 2024;165(2):313-322.*

Research needs in pulmonary rehabilitation



Rochester et al. *AJRCCM. 2023;208(4):e7-e26.*

PR after AECOPD

Rehabilitation

Original research

Do pulmonary rehabilitation programmes improve outcomes in patients with COPD posthospital discharge for exacerbation: a systematic review and meta-analysis

Jenkins et al. *Thorax. 2024;79(5):438-447.*

PR after AECOPD

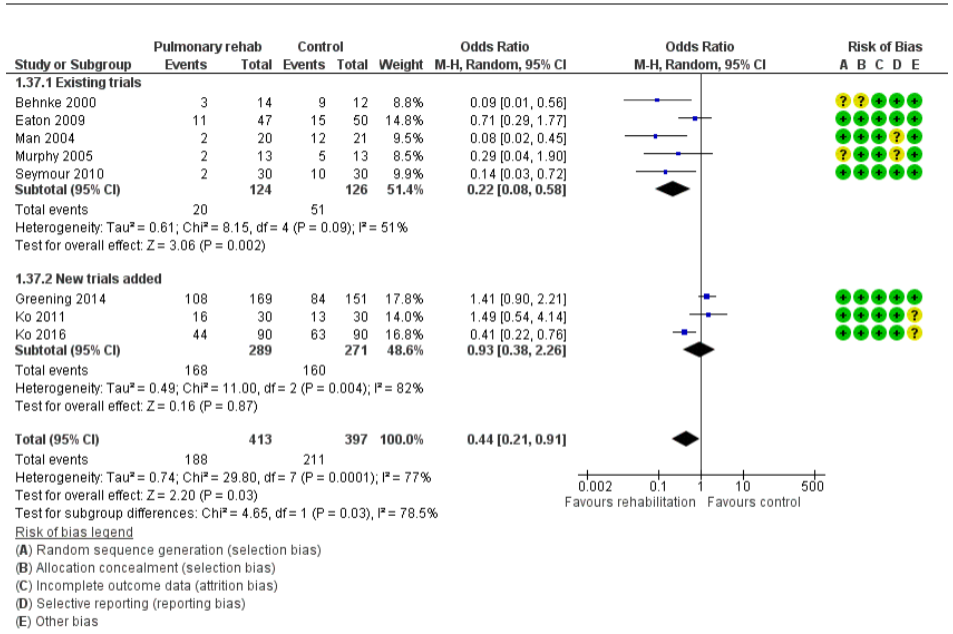
Cochrane Database of Systematic Reviews | Review - Intervention

Pulmonary rehabilitation following exacerbations of chronic obstructive pulmonary disease

Milo A Puhan, Elena Gimeno-Santos, Christopher J Cates, Thierry Troosters Authors' declarations of interest

Version published: 08 December 2016 Version history

https://doi.org/10.1002/14651858.CD005305.pub4



Hospital readmission

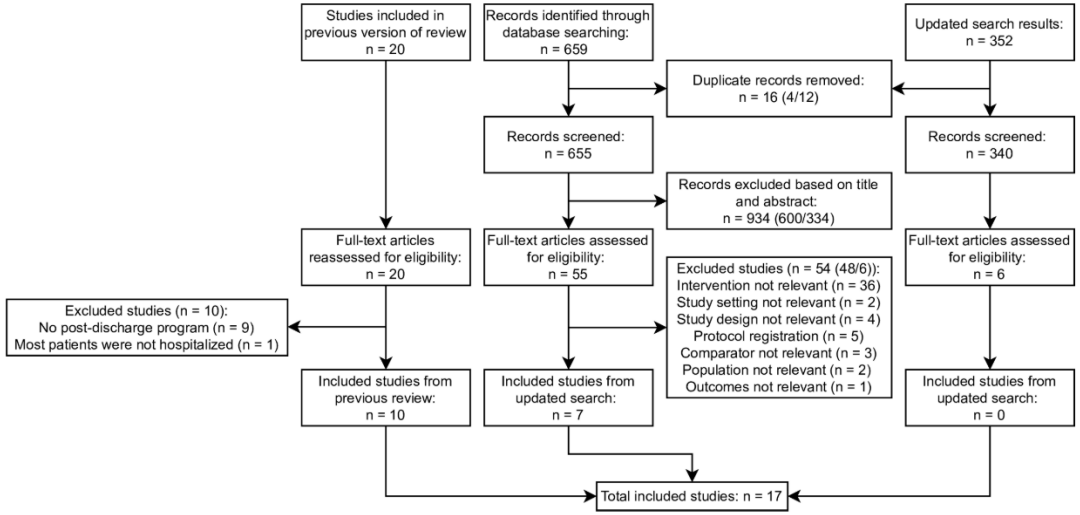
Puhan et al. *Cochrane Database Syst Rev. 2016;12(12):Cd005305.*

PR after AECOPD

Rehabilitation

Original research

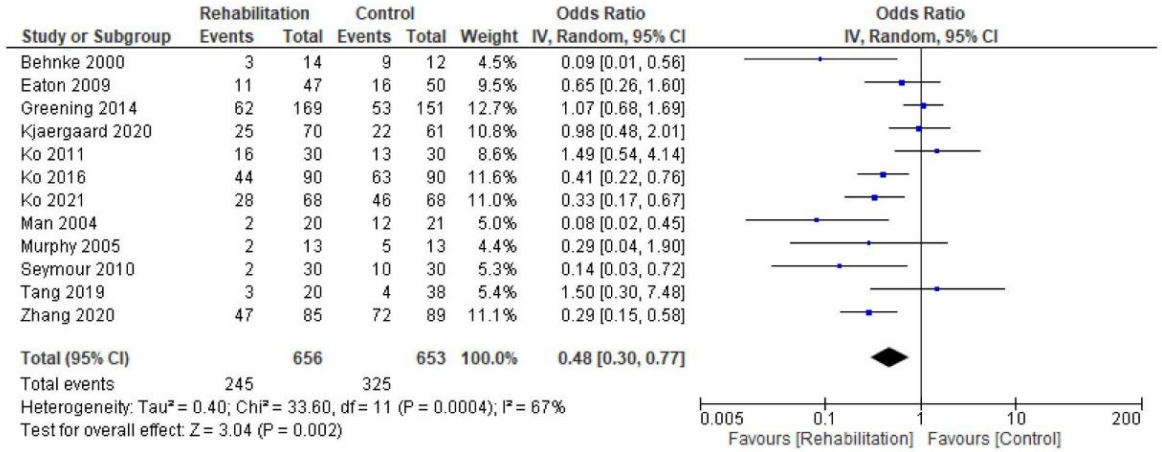
Do pulmonary rehabilitation programmes improve outcomes in patients with COPD posthospital discharge for exacerbation: a systematic review and meta-analysis



- An update of a previous Cochrane review
- Searches were conducted from 2015.10-2023.8
- Studies that initiated PR< 3 wks of hospital discharge.
- Studies assessing the impact of solely inpatient PR were excluded.

Jenkins et al. *Thorax. 2024;79(5):438-447.*

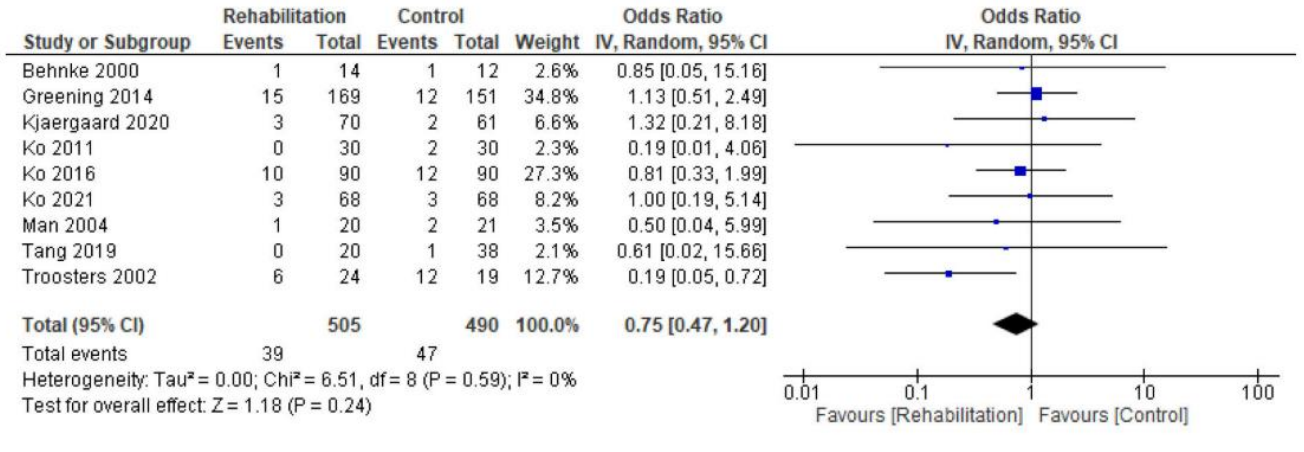
PR after AECOPD



Study or Subgroup	Rehabilitation Events	Rehabilitation Total	Control Events	Control Total	Weight	Odds Ratio IV, Random, 95% CI
Behnke 2000	3	14	9	12	4.5%	0.09 [0.01, 0.56]
Eaton 2009	11	47	16	50	9.5%	0.65 [0.26, 1.60]
Greening 2014	62	169	53	151	12.7%	1.07 [0.68, 1.69]
Kjaergaard 2020	25	70	22	61	10.8%	0.98 [0.48, 2.01]
Ko 2011	16	30	13	30	8.6%	1.49 [0.54, 4.14]
Ko 2016	44	90	63	90	11.6%	0.41 [0.22, 0.76]
Ko 2021	28	68	46	68	11.0%	0.33 [0.17, 0.67]
Man 2004	2	20	12	21	5.0%	0.08 [0.02, 0.45]
Murphy 2005	2	13	5	13	4.4%	0.29 [0.04, 1.90]
Seymour 2010	2	30	10	30	5.3%	0.14 [0.03, 0.72]
Tang 2019	3	20	4	38	5.4%	1.50 [0.30, 7.48]
Zhang 2020	47	85	72	89	11.1%	0.29 [0.15, 0.58]
Total (95% CI)		**656**		**653**	**100.0%**	**0.48 [0.30, 0.77]**
Total events	245		325			

Heterogeneity: Tau² = 0.40; Chi² = 33.60, df = 11 (P = 0.0004); I² = 67%
Test for overall effect: Z = 3.04 (P = 0.002)

Hospital readmission



Study or Subgroup	Rehabilitation Events	Rehabilitation Total	Control Events	Control Total	Weight	Odds Ratio IV, Random, 95% CI
Behnke 2000	1	14	1	12	2.6%	0.85 [0.05, 15.16]
Greening 2014	15	169	12	151	34.8%	1.13 [0.51, 2.49]
Kjaergaard 2020	3	70	2	61	6.6%	1.32 [0.21, 8.18]
Ko 2011	0	30	2	30	2.3%	0.19 [0.01, 4.06]
Ko 2016	10	90	12	90	27.3%	0.81 [0.33, 1.99]
Ko 2021	3	68	3	68	8.2%	1.00 [0.19, 5.14]
Man 2004	1	20	2	21	3.5%	0.50 [0.04, 5.99]
Tang 2019	0	20	1	38	2.1%	0.61 [0.02, 15.66]
Troosters 2002	6	24	12	19	12.7%	0.19 [0.05, 0.72]
Total (95% CI)		**505**		**490**	**100.0%**	**0.75 [0.47, 1.20]**
Total events	39		47			

Heterogeneity: Tau² = 0.00; Chi² = 6.51, df = 8 (P = 0.59); I² = 0%
Test for overall effect: Z = 1.18 (P = 0.24)

Mortality

Jenkins et al. *Thorax. 2024;79(5):438-447.*

6MWT

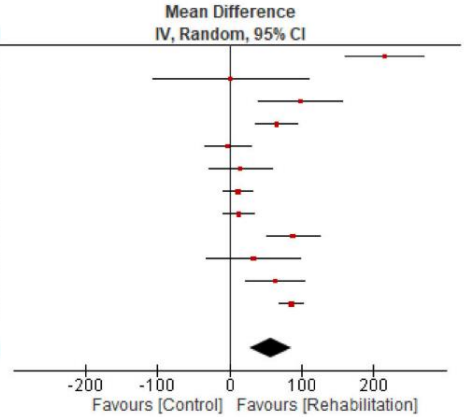
Incremental shuttle walk test

Endurance shuttle walk test

A

Study or Subgroup	Mean Difference	SE	Weight	Mean Difference IV, Random, 95% CI
Behnke 2000	215	28	7.5%	215.00 [160.12, 269.88]
Cox 2018	1.5	54.9276	4.2%	1.50 [-106.16, 109.16]
Daabis 2017	98.5	29.4529	7.3%	98.50 [40.77, 156.23]
Deepak 2014	66	15	9.4%	66.00 [36.60, 95.40]
Eaton 2009	-2	16	9.3%	-2.00 [-33.36, 29.36]
Ko 2011	15.54	22.7441	8.3%	15.54 [-29.04, 60.12]
Ko 2016	12.5	10.44	9.9%	12.50 [-7.96, 32.96]
Ko 2021	12.77	10.796	9.8%	12.77 [-8.39, 33.93]
Lu 2020	88.5	19.0658	8.8%	88.50 [51.13, 125.87]
Tang 2019	33.6	33.5	6.7%	33.60 [-32.06, 99.26]
Troosters 2002	64	21	8.6%	64.00 [22.84, 105.16]
Zhang 2020	85.7	8.6217	10.0%	85.70 [68.80, 102.60]
Total (95% CI)			**100.0%**	**57.49 [28.68, 86.29]**

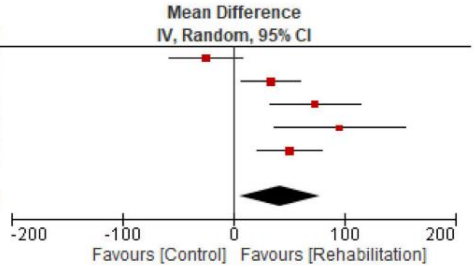
Heterogeneity: Tau² = 2078.12; Chi² = 98.91, df = 11 (P < 0.00001); I² = 89%
Test for overall effect: Z = 3.91 (P < 0.0001)



B

Study or Subgroup	Mean Difference	SE	Weight	Mean Difference IV, Random, 95% CI
Greening 2014	-24.44	16.89	21.1%	-24.44 [-57.54, 8.66]
Kjaergaard 2020	33.9	13.435	22.5%	33.90 [7.57, 60.23]
Man 2004	74	21	19.2%	74.00 [32.84, 115.16]
Murphy 2005	96	30	15.3%	96.00 [37.20, 154.80]
Seymour 2010	51	15	21.9%	51.00 [21.60, 80.40]
Total (95% CI)			**100.0%**	**42.55 [6.29, 78.82]**

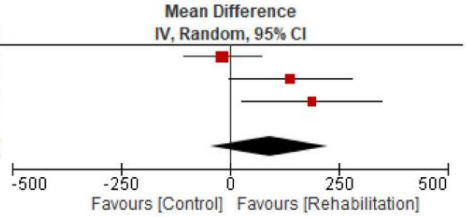
Heterogeneity: Tau² = 1339.14; Chi² = 21.10, df = 4 (P = 0.0003); I² = 81%
Test for overall effect: Z = 2.30 (P = 0.02)



C

Study or Subgroup	Mean Difference	SE	Weight	Mean Difference IV, Random, 95% CI
Greening 2014	-16.63	45.24	40.0%	-16.63 [-105.30, 72.04]
Kjaergaard 2020	140	72.4503	31.4%	140.00 [-2.00, 282.00]
Seymour 2010	189	82.1444	28.6%	189.00 [28.00, 350.00]
Total (95% CI)			**100.0%**	**91.35 [-43.01, 225.70]**

Heterogeneity: Tau² = 9700.63; Chi² = 6.54, df = 2 (P = 0.04); I² = 69%
Test for overall effect: Z = 1.33 (P = 0.18)

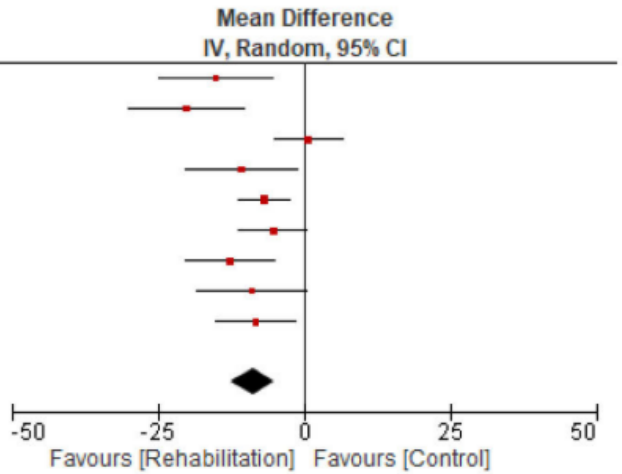


Jenkins et al. *Thorax. 2024;79(5):438-447.*

SGRQ

Study or Subgroup	Mean Difference	SE	Weight	Mean Difference IV, Random, 95% CI
Daabis 2017	-15.1	4.9368	8.6%	-15.10 [-24.78, -5.42]
Deepak 2014	-20.06	5.07	8.3%	-20.06 [-30.00, -10.12]
Greening 2014	0.78	2.96	13.6%	0.78 [-5.02, 6.58]
Ko 2011	-10.68	4.9413	8.6%	-10.68 [-20.36, -1.00]
Ko 2016	-6.8	2.26	15.7%	-6.80 [-11.23, -2.37]
Ko 2021	-5.21	2.9847	13.5%	-5.21 [-11.06, 0.64]
Man 2004	-12.7	3.93	10.9%	-12.70 [-20.40, -5.00]
Murphy 2005	-8.8	4.82	8.8%	-8.80 [-18.25, 0.65]
Seymour 2010	-8.2	3.52	12.0%	-8.20 [-15.10, -1.30]
Total (95% CI)			**100.0%**	**-8.70 [-12.45, -4.94]**

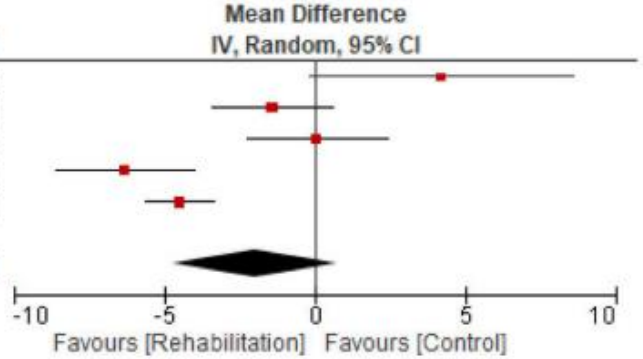
Heterogeneity: Tau² = 18.20; Chi² = 19.29, df = 8 (P = 0.01); I² = 59%
Test for overall effect: Z = 4.54 (P < 0.00001)



CAT

Study or Subgroup	Mean Difference	SE	Weight	Mean Difference IV, Random, 95% CI
Cox 2018	4.2	2.2408	14.8%	4.20 [-0.19, 8.59]
Kjaergaard 2020	-1.4	1.0204	21.2%	-1.40 [-3.40, 0.60]
Ko 2021	0.07	1.1909	20.4%	0.07 [-2.26, 2.40]
Lu 2020	-6.3	1.1609	20.6%	-6.30 [-8.58, -4.02]
Zhang 2020	-4.5	0.5849	23.0%	-4.50 [-5.65, -3.35]
Total (95% CI)			**100.0%**	**-1.99 [-4.73, 0.75]**

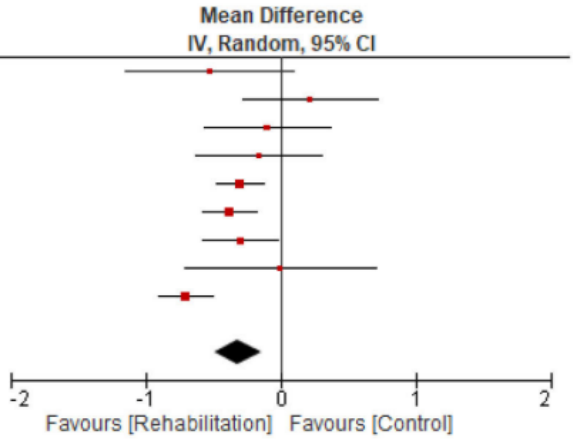
Heterogeneity: Tau² = 8.16; Chi² = 33.56, df = 4 (P < 0.00001); I² = 88%
Test for overall effect: Z = 1.42 (P = 0.15)



mMRC

Study or Subgroup	Mean Difference	SE	Weight	Mean Difference IV, Random, 95% CI
Cox 2018	-0.525	0.3164	5.6%	-0.53 [-1.15, 0.10]
Daabis 2017	0.22	0.2571	7.5%	0.22 [-0.28, 0.72]
Eaton 2009	-0.1	0.2384	8.3%	-0.10 [-0.57, 0.37]
Ko 2011	-0.16	0.2382	8.3%	-0.16 [-0.63, 0.31]
Ko 2016	-0.3	0.0894	17.8%	-0.30 [-0.48, -0.12]
Ko 2021	-0.38	0.1012	16.9%	-0.38 [-0.58, -0.18]
Lu 2020	-0.3	0.1414	13.9%	-0.30 [-0.58, -0.02]
Murphy 2005	0	0.3609	4.6%	0.00 [-0.71, 0.71]
Zhang 2020	-0.7	0.1007	17.0%	-0.70 [-0.90, -0.50]
Total (95% CI)			**100.0%**	**-0.31 [-0.48, -0.14]**

Heterogeneity: Tau² = 0.03; Chi² = 20.21, df = 8 (P = 0.010); I² = 60%
Test for overall effect: Z = 3.59 (P = 0.0003)



Jenkins et al. *Thorax. 2024;79(5):438-447.*

PR during hospitalization

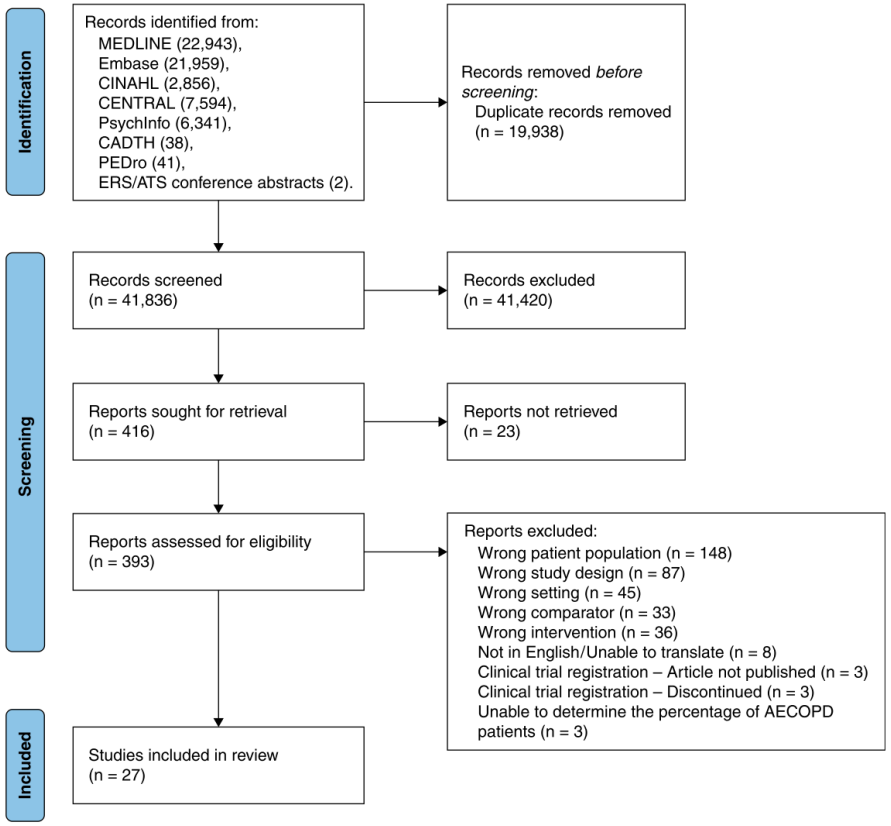
SYSTEMATIC REVIEW

Safety and Efficacy of Inpatient Pulmonary Rehabilitation for Patients Hospitalized with an Acute Exacerbation of Chronic Obstructive Pulmonary Disease

Systematic Review and Meta-analyses

Débora Petry Moecke[1,2], Kai Zhu[1,2], Jagdeep Gill[1,2], Shanjot Brar[1,2], Polina Petlitsyna[1], Ashley Kirkham[1], Mirha Girt[3], Joel Chen[4], Hannah Peters[1], Holly Denson-Camp[1], Stephanie Crosbie[1], and Pat G. Camp[1,2]

- Searched up to August 2022
- Searched RCTs that compared in-hospital PR with usual care.
- **Safety** and efficacy of PR during the hospitalization phase for individuals with AECOPD.



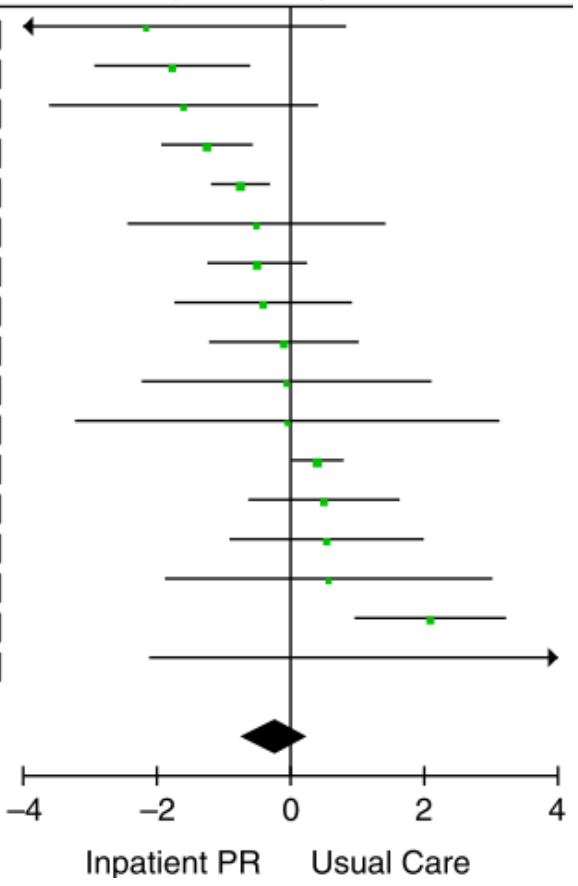
Moecke et al. *Ann Am Thorac Soc. 2023;20(2):307-319.*

Length of stay (LOS)

Study or Subgroup	Inpatient PR Mean	SD	Total	Usual Care Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
Lopez-Lopez 2021 a	8.84	3.54	27	11	5.29	15	2.3%	−2.16 [−5.15, 0.83]
Knaut 2020	5.6	1.49	13	7.37	1.6	14	7.0%	−1.77 [−2.94, −0.60]
Borges 2014	8	2.2	15	9.6	3.2	14	4.1%	−1.60 [−3.61, 0.41]
Troosters 2010	8.25	0.25	17	9.5	1.5	19	9.3%	−1.25 [−1.93, −0.57]
Mirza 2020	7	0.5	16	7.75	0.75	16	10.3%	−0.75 [−1.19, −0.31]
Liao 2021	12.96	4.7	34	13.47	3.4	36	4.3%	−0.51 [−2.44, 1.42]
Leonardi 2022	5.5	0.9	10	6	0.8	10	9.0%	−0.50 [−1.25, 0.25]
Lopez-Lopez 2021 b	9.24	1.89	32	9.65	2.36	16	6.3%	−0.41 [−1.74, 0.92]
Torres-Sánchez 2016	8.7	2	24	8.8	2	25	7.3%	−0.10 [−1.22, 1.02]
Lopez-Lopez 2020	9.45	3.02	22	9.51	4.22	22	3.7%	−0.06 [−2.23, 2.11]
Greulich 2014	8.58	3.81	20	8.63	6.16	20	2.1%	−0.05 [−3.22, 3.12]
Lu 2020	9.3	0.8	36	8.9	0.9	36	10.4%	0.40 [0.01, 0.79]
Greening 2014	11	5.33	169	10.5	5	151	7.2%	0.50 [−0.63, 1.63]
Torres-Sánchez 2018	9.75	3.57	60	9.21	3.18	30	5.9%	0.54 [−0.91, 1.99]
Lopez-Lopez 2018	9.78	3.56	23	9.21	3.18	10	3.1%	0.57 [−1.88, 3.02]
Torres-Sánchez 2017	12.47	1.9	29	10.38	2.47	29	7.2%	2.09 [0.96, 3.22]
Nava 1998	38.1	14.3	48	33.2	11.7	16	0.5%	4.90 [−2.12, 11.92]
Total (95% CI)			**595**			**479**	**100.0%**	**−0.23 [−0.74, 0.28]**

Heterogeneity: $Tau^2 = 0.61$; $Chi^2 = 55.74$, df = 16 ($P < 0.00001$); $I^2 = 71\%$

Test for overall effect: Z = 0.90 (P = 0.37)



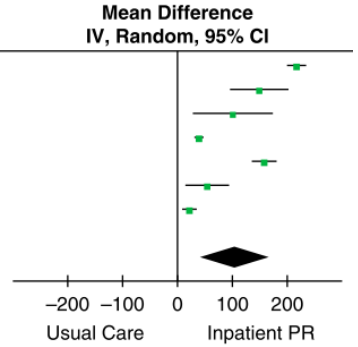
Moecke et al. *Ann Am Thorac Soc. 2023;20(2):307-319.*

6MWD

Study or Subgroup	Inpatient PR Mean	SD	Total	Usual Care Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
Behnke 2000	225	29.7	15	8	17.5	15	14.9%	217.00 [199.55, 234.45]
Borges 2014	160	61	15	11	83	14	13.6%	149.00 [95.68, 202.32]
Greulich 2014	95.55	120.84	20	−5.34	114.41	20	12.5%	100.89 [27.96, 173.82]
He 2015	49	14.82	66	9.8	20.39	28	15.0%	39.20 [30.84, 47.56]
Kirsten 1998	183	35.69	14	25	25.07	15	14.8%	158.00 [135.41, 180.59]
Lu 2020	67.2	93.79	36	13	77.96	36	14.2%	54.20 [14.36, 94.04]
Troosters 2010	35.75	11.75	19	14	25.75	17	15.0%	21.75 [8.42, 35.08]
Total (95% CI)			**185**			**145**	**100.0%**	**105.41 [42.80, 168.03]**

Heterogeneity: $Tau^2 = 6{,}770.95$; $Chi^2 = 443.11$, df = 6 ($P < 0.00001$); $I^2 = 99\%$

Test for overall effect: Z = 3.30 (P = 0.0010)

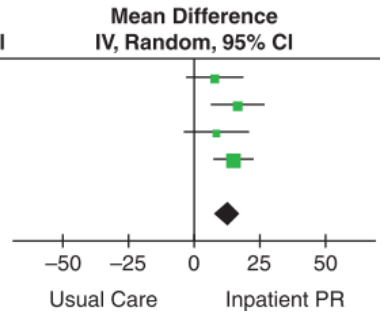


EQ-5D-5L

Study or Subgroup	Inpatient PR Mean	SD	Total	Usual Care Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
Lopez-Lopez 2020	17.45	19.98	44	9.63	22.01	22	20.3%	7.82 [−3.11, 18.75]
Lopez-Lopez 2021 a	29.03	12.37	27	12.47	18.05	15	23.1%	16.56 [6.30, 26.82]
Torres-Sánchez 2016	17.45	23.51	24	9	20.87	25	15.6%	8.45 [−4.02, 20.92]
Torres-Sánchez 2018	28.72	13.09	60	13.77	19.39	30	41.0%	14.95 [7.26, 22.64]
Total (95% CI)			**155**			**92**	**100.0%**	**12.86 [7.93, 17.78]**

Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 2.08$, df = 3 ($P = 0.56$); $I^2 = 0\%$

Test for overall effect: Z = 5.12 (P < 0.00001)

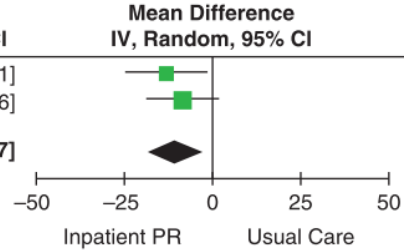


SGRQ

Study or Subgroup	Inpatient PR Mean	SD	Total	Usual Care Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
Borges 2014	−2.4	19.6	15	10.7	11.8	14	43.9%	−13.10 [−24.79, −1.41]
Greulich 2014	−6.43	16.68	20	2.05	16.67	20	56.1%	−8.48 [−18.82, 1.86]
Total (95% CI)			**35**			**34**	**100.0%**	**−10.51 [−18.25, −2.77]**

Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 0.34$, df = 1 ($P = 0.56$); $I^2 = 0\%$

Test for overall effect: Z = 2.66 (P = 0.008)



Moecke et al. *Ann Am Thorac Soc. 2023;20(2):307-319.*

PR during hospitalization

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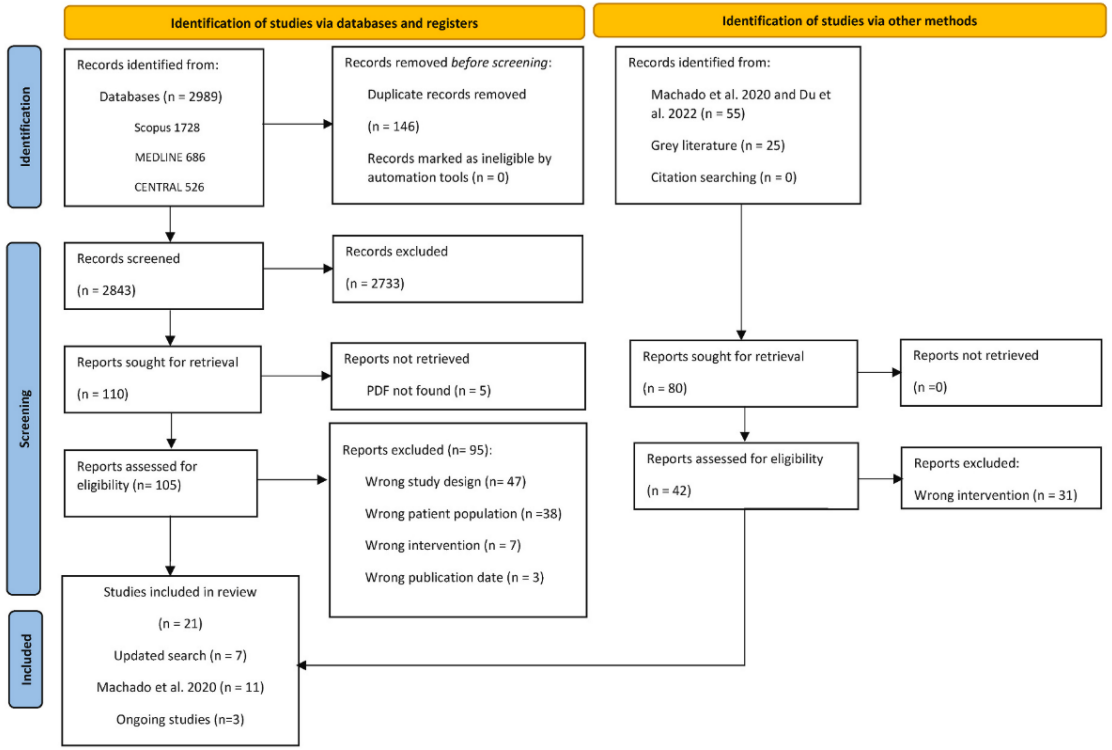
Original Research

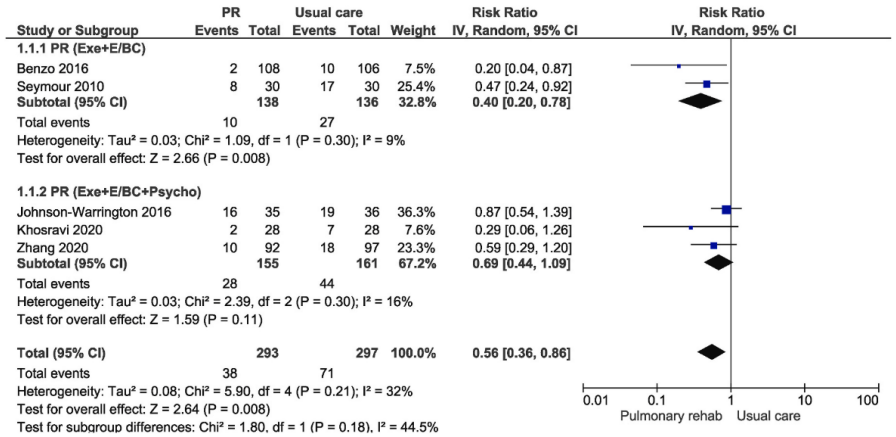
Pulmonary rehabilitation for acute exacerbations of COPD: A systematic review

- Searched from 2020 to 2022
- Searched RCTs that compared in-hospital PR with usual care.
- **Benefits and Harms** of PR during the hospitalization phase for individuals with AECOPD.

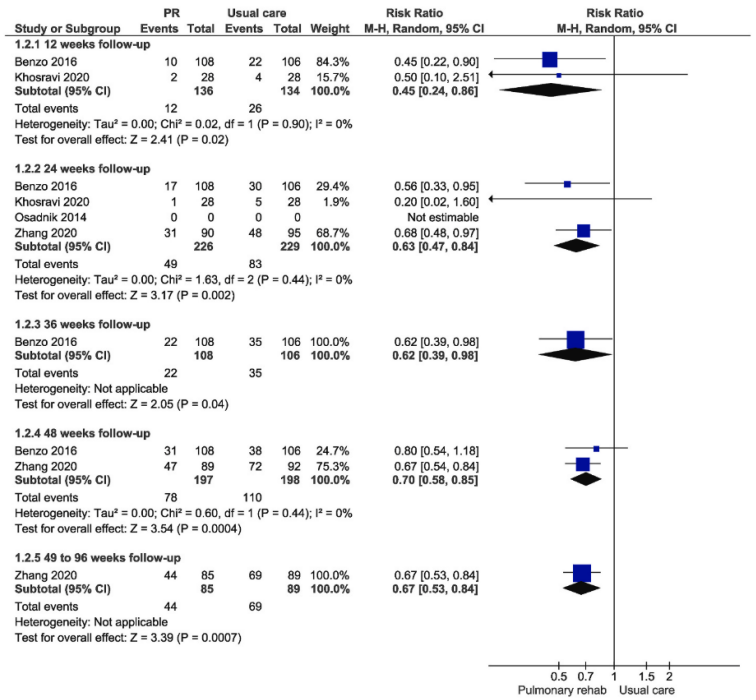


Meneses-Echavez et al. *Respir Med. 2023;219:107425.*

AECOPD-related hospitalization (4-12 weeks)

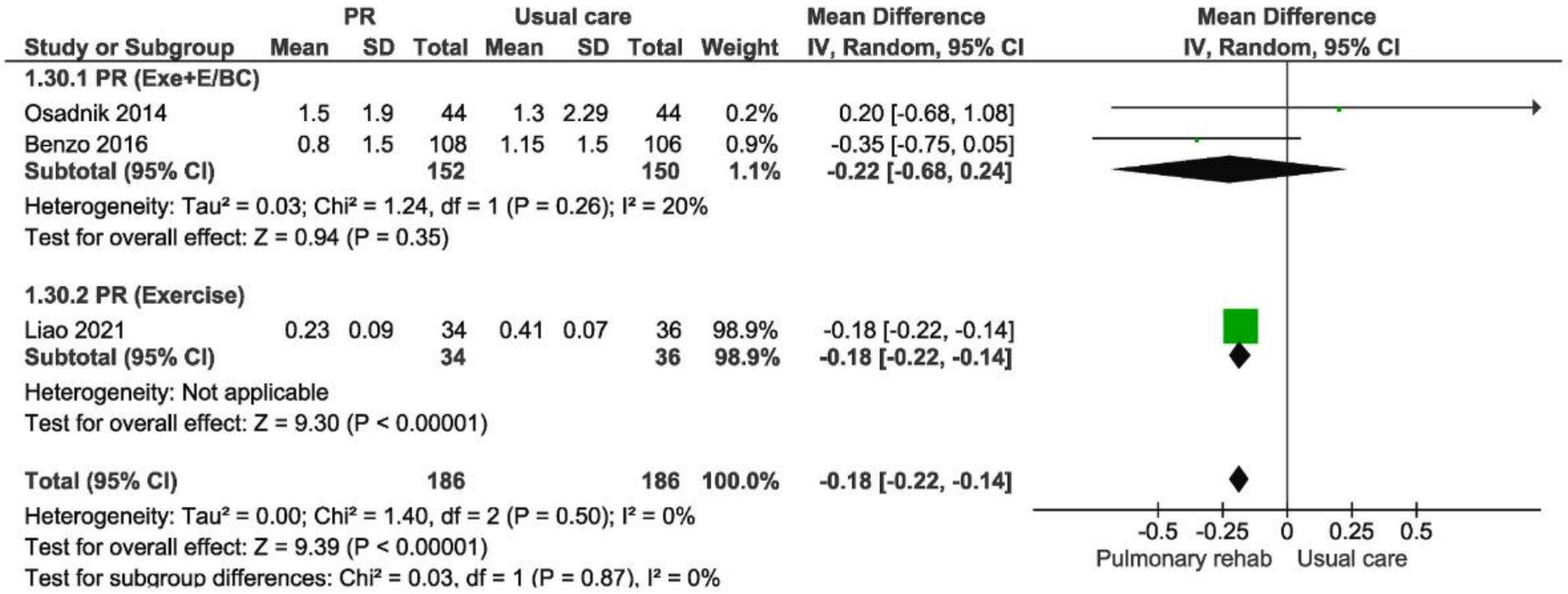


AECOPD-related hospitalization (12-96 weeks)



Meneses-Echavez et al. *Respir Med. 2023;219:107425.*

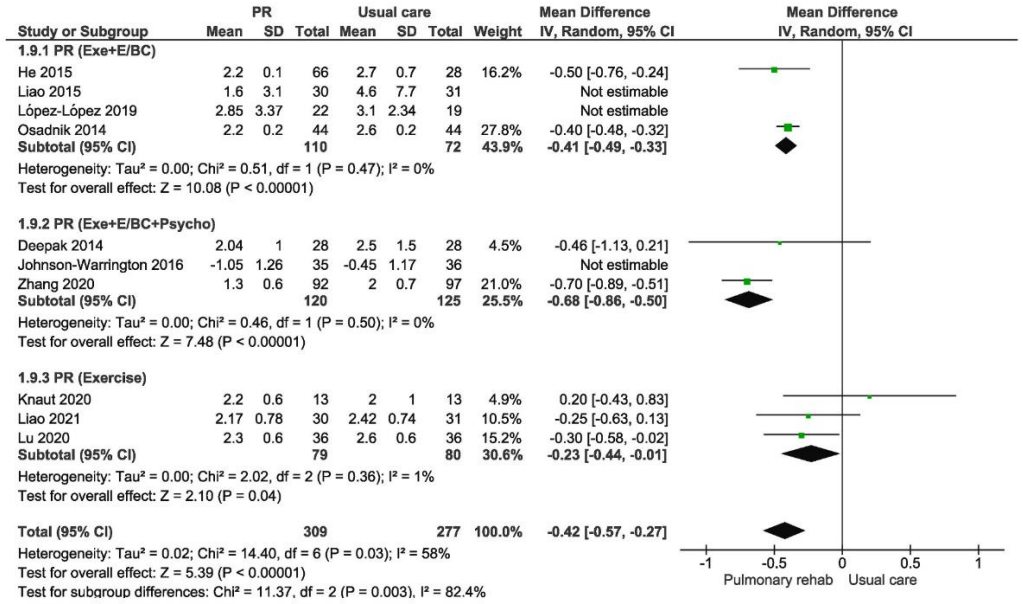
Re-exacerbation



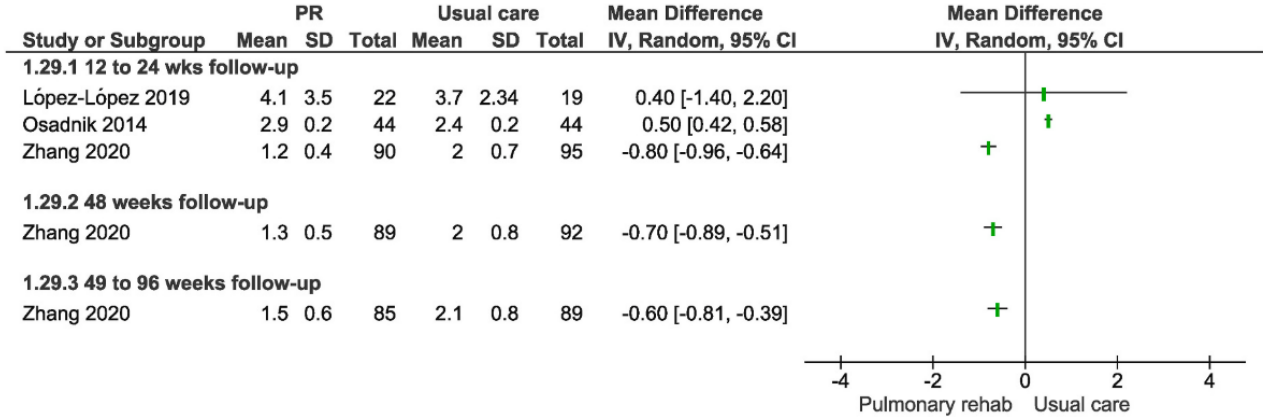
Study or Subgroup	PR Mean	PR SD	PR Total	Usual care Mean	Usual care SD	Usual care Total	Weight	Mean Difference IV, Random, 95% CI
1.30.1 PR (Exe+E/BC)								
Osadnik 2014	1.5	1.9	44	1.3	2.29	44	0.2%	0.20 [-0.68, 1.08]
Benzo 2016	0.8	1.5	108	1.15	1.5	106	0.9%	-0.35 [-0.75, 0.05]
Subtotal (95% CI)			**152**			**150**	**1.1%**	**-0.22 [-0.68, 0.24]**
Heterogeneity: Tau² = 0.03; Chi² = 1.24, df = 1 (P = 0.26); I² = 20%								
Test for overall effect: Z = 0.94 (P = 0.35)								
1.30.2 PR (Exercise)								
Liao 2021	0.23	0.09	34	0.41	0.07	36	98.9%	-0.18 [-0.22, -0.14]
Subtotal (95% CI)			**34**			**36**	**98.9%**	**-0.18 [-0.22, -0.14]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 9.30 (P < 0.00001)								
Total (95% CI)			**186**			**186**	**100.0%**	**-0.18 [-0.22, -0.14]**
Heterogeneity: Tau² = 0.00; Chi² = 1.40, df = 2 (P = 0.50); I² = 0%								
Test for overall effect: Z = 9.39 (P < 0.00001)								
Test for subgroup differences: Chi² = 0.03, df = 1 (P = 0.87), I² = 0%								

Meneses-Echavez et al. *Respir Med. 2023;219:107425.*

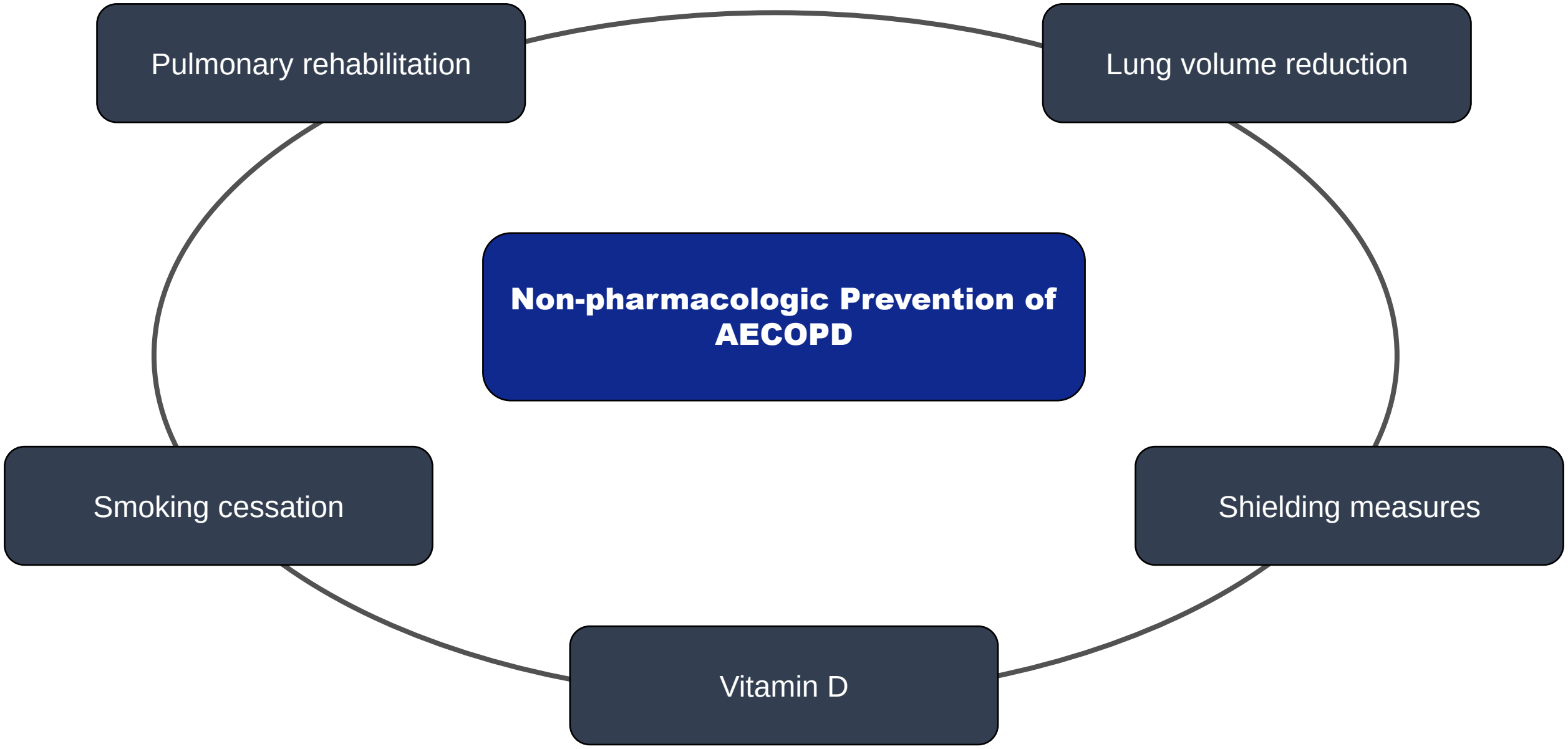
Dyspnea (at the end of intervention)



Dyspnea (long term)



Meneses-Echavez et al. *Respir Med. 2023;219:107425.*


Pulmonary rehabilitation
Lung volume reduction
Non-pharmacologic Prevention of AECOPD
Smoking cessation
Shielding measures
Vitamin D

LVRS reduces COPD exacerbation risks

The Effect of Lung Volume Reduction Surgery on Chronic Obstructive Pulmonary Disease Exacerbations

George R. Washko[1], Vincent S. Fan[2,3], Scott D. Ramsey[2,4], Zab Mohsenifar[5], Fernando Martinez[6], Barry J. Make[7], Frank C. Sciurba[8], Gerald J. Criner[9], Omar Minai[10], Malcolm M. DeCamp[11], and John J. Reilly[1], for the National Emphysema Treatment Trial Research Group*

- Enrollment criteria
  - FEV1 < 45% predicted
  - bilateral emphysema on chest CT

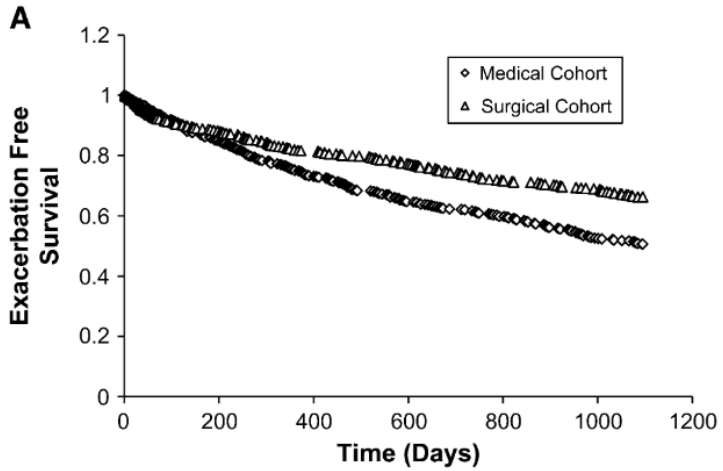
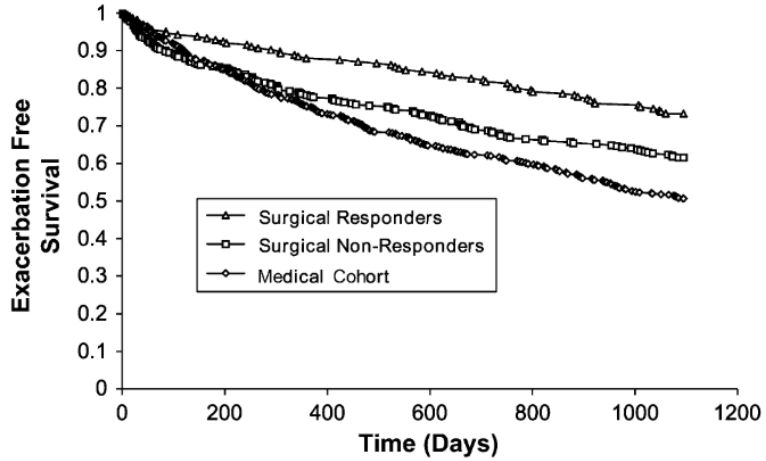


TABLE 3. RESULTS OF MULTIVARIATE COX REGRESSION ANALYSIS TO PREDICT TIME TO FIRST EXACERBATION BASED ON 6-MONTH CHANGE IN PHYSIOLOGIC VARIABLES AMONG SURGICAL PATIENTS

Variable*	Hazard Ratio	*P* Value
ΔFEV_1 (10 ml)	3.2	0.002
Δ Slow VC (10 ml)	1.13	0.28
ΔRV (10 ml)	1.02	0.33
ΔFRC (10 ml)	1.01	0.59
Δ Maximal work (1 W)	1.00	0.40
ΔPa_{O_2} (1 mm Hg)	1.01	0.33
ΔPa_{CO_2} (1 mm Hg)	1.01	0.79
ΔMEP (1 cm H_2O)	1.00	0.73



Surgical cohort experienced an approximate 30% reduction in exacerbation frequency

Surgical responders :
improvement in FEV1>200ml / 6mo

Washko et al. *Am J Respir Crit Care Med. 2008;177(2):164-169.*

EBV reduces COPD exacerbation risks

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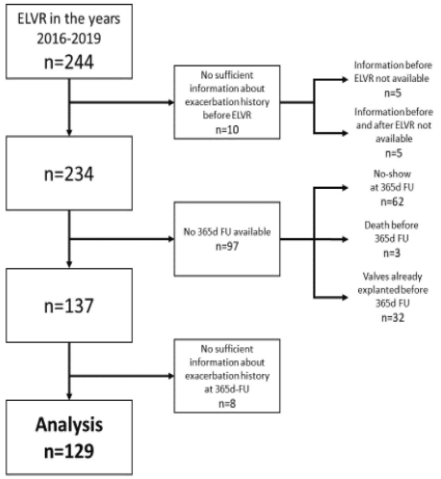
Original Research

Endobronchial lung volume reduction with valves reduces exacerbations in severe emphysema patients

- A single-center retrospective analysis of severe emphysema patients with EBV implantation.
- The number of exacerbations before and after ELVR was compared.
- The primary endpoint of the study was the number of exacerbations one year after ELVR compared to one year before ELVR.



Clinical and functional outcome 1 year after ELVR compared to baseline (n = 129).

	n (available data)	Baseline Mean ± SD and median (IQR)	365d FU Mean ± SD and median (IQR)	p-value
FEV_1 (l)	127	0.80 ± 0.25	0.86 ± 0.29	<0.001
FEV_1 (%)	127	30.38 ± 8.55	32.58 ± 11.24	0.002
RV (l)	126	5.31 ± 1.35	4.98 ± 1.29	<0.001
RV (%)	126	243.89 ± 55.11	225.84 ± 59.18	<0.001
VC (l)	127	2.29 ± 0.67	2.36 ± 0.72	0.192
VC (%)	127	69.63 ± 16.88	71.58 ± 19.13	0.197
TLC (l)	127	7.60 ± 1.45	7.40 ± 1.41	0.008
TLC (%)	127	133.69 ± 18.74	130.55 ± 21.31	0.036
DLCO SB (%)	96	34.14 ± 15.15	33.99 ± 11.60	0.905
DLCO/VA (%)	96	50.43 ± 22.24	52.32 ± 36.99	0.905
mMRC	106	2.91 ± 1.04	2.79 ± 1.17	0.285
CAT	38	26.18 ± 6.27	25.18 ± 6.70	0.050
6-MWD (m)	85	283.49 ± 89.07	289.27 ± 92.41	0.477
exacerbations 1 year before and 1 year after ELVR	129	2.5 ± 2.2 2.0 (1.0)	1.8 ± 2.2 1.0 (3)	0.009

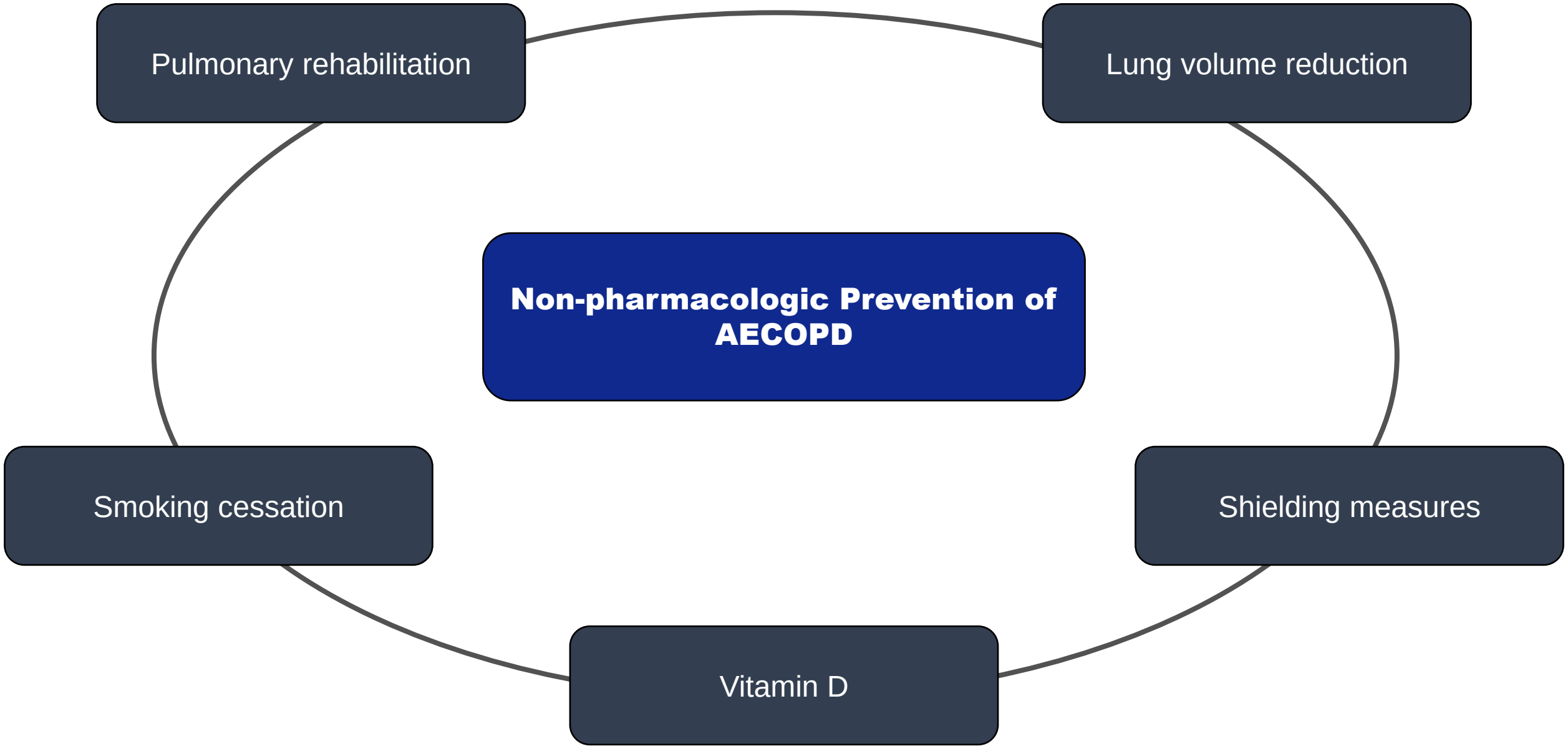
Brock et al. *Respir Med. 2023;218:107399.*

- The decline of exacerbation rate was positively associated with the development of complete lobar atelectasis at 365-day follow-up
- r = 0.228, p = 0.009

Subgroup-Analysis of patients with complete lobar atelectasis (n = 41).

	N	Mean ± SD baseline and Median (IQR)	Mean ± SD 365d FU and Median (IQR)	p-value
FEV_1 l	41	0.74 ± 0.17	0.88 ± 0.25	<0.001
FEV_1%	41	28.99 ± 6.85	33.95 ± 10.77	<0.001
RV l	41	5.51 ± 1.60	4.78 ± 1.58	<0.001
RV %	41	252.54 ± 58.00	217.89 ± 62.26	<0.001
VC l	41	2.19 ± 0.57	2.53 ± 0.62	<0.001
VC %	41	68.59 ± 15.86	79.53 ± 16.74	<0.001
TLC l	41	7.69 ± 1.64	7.33 ± 1.61	0.008
TLC %	41	136.76 ± 17.82	129.49 ± 17.20	0.006
DLCO SB %	32	35.35 ± 20.01	36.78 ± 12.38	0.682
DLCO/VA %	32	54.53 ± 31.76	60.99 ± 59.92	0.579
6-MWD m	29	271.34 ± 86.47	300.59 ± 81.24	0.012
mMRC	35	2.89 ± 1.11	2.94 ± 1.1	0.797
CAT	13	28.69 ± 6.46	27.62 ± 6.87	0.188
exacerbations 1 year before and 1 year after ELVR	41	2.8 ± 2.0 2.0 (3.5)	1.4 ± 1.8 1.0 (2.0)	<0.001

Brock et al. *Respir Med. 2023;218:107399.*


Pulmonary rehabilitation
Lung volume reduction
Non-pharmacologic Prevention of AECOPD
Smoking cessation
Shielding measures
Vitamin D

Smoking cessation is associated with reduced risk of AECOPD

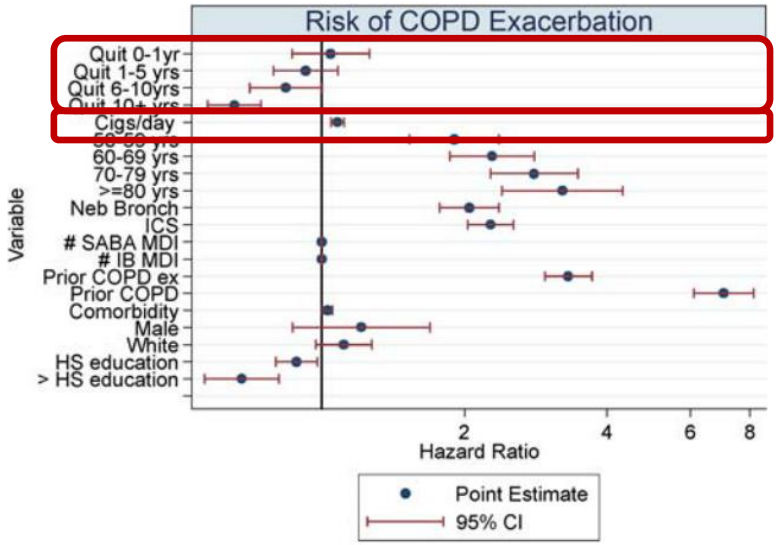
The Effects of Smoking Cessation on the Risk of Chronic Obstructive Pulmonary Disease Exacerbations

David H. Au, MD, MS[1,2], Christopher L. Bryson, MD, MPH[1,2], Jason W. Chien, MD, MS[2,3], Haili Sun, PhD[1], Edmunds M. Udris, MPH[1], Laura E. Evans, MD, MS[4], and Katharine A. Bradley, MD, MPH[1,2]

Smoking status	Total no.	No. events	Person-years	Rate (per 1000)	Hazard ratio-unadjusted	Hazard ratio-adjusted
Model 1						
Current smoker	8,067	723	26,365	27.4	Referent	Referent
Former smoker	15,904	1,208	52,959	22.8	0.84 (0.77, 0.93)	0.78 (0.75, 0.87)
Model 2						
Current smoker	8,067	723	26,365	27.4	Referent	Referent
Quit <1 year	1,301	153	4,046	37.8	1.35 (1.13, 1.61)	1.04 (0.87, 1.26)
Quit 1–5 years	2,321	258	7,542	34.2	1.26 (1.09, 1.45)	0.93 (0.79, 1.08)
Quit 6–10 years	2,119	190	7,010	27.1	1.00 (0.86, 1.18)	0.84 (0.70, 1.00)
Quit >10 years	10,163	607	34,361	17.7	0.66 (0.59, 0.73)	0.65 (0.58, 0.74)

Risk of AECOPD

- Data collected for ACQUIP
  - multi-center, randomized trial of a quality improvement intervention
- N=23,971



Sensitivity Analyses to Those Treated for COPD with Ipratropium Bromide

Au et al. *J Gen Intern Med. 2009;24(4):457-463.*

Table 3. Risk of COPD Exacerbations Associated with Previously Acknowledged COPD

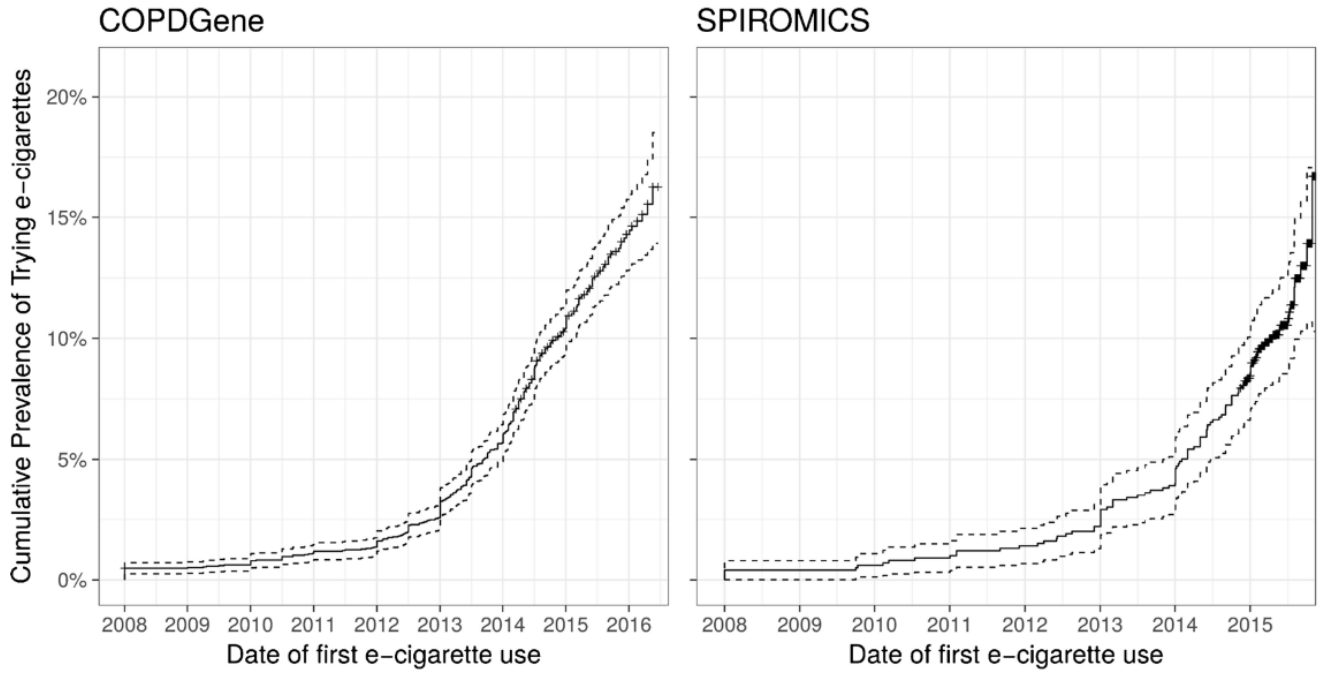
Smoking status	Total no.	No. Events	Person-years	Rate	Hazard ratio-unadjusted	Hazard ratio-adjusted
History of previous COPD						
Model 1						
Current smoker	2,817	603	8,099	74.5	Referent	Referent
Former smoker	4,292	1,038	11,950	86.9	1.16 (1.05, 1.29)	0.84 (0.75, 0.95)
Model 2						
Current smoker	2,817	603	8,099	74.5	Referent	Referent
Quit <1 year	460	137	1,184	115.7	1.50 (1.25, 1.81)	1.07 (0.87, 1.30)
Quit 1–5 years	827	227	2,254	100.7	1.34 (1.15, 1.56)	0.94 (0.80, 1.11)
Quit 6–10 years	643	168	1,779	94.4	1.27 (1.07, 1.51)	0.92 (0.76, 1.11)
Quit >10 years	2,362	506	6,733	75.2	1.01 (0.90, 1.14)	0.72 (0.63, 0.83)
No previous history of COPD						
Model 1						
Current smoker	5,250	120	18,266	6.6	Referent	Referent
Former smoker	11,612	170	41,009	4.1	0.64 (0.51, 0.81)	0.55 (0.41, 0.74)
Model 2						
Current smoker	5,250	120	18,266	6.6	Referent	Referent
Quit <1 year	841	16	2,862	5.6	0.84 (0.50, 1.42)	0.95 (0.54, 1.66)
Quit 1–5 years	1,494	31	5,288	5.9	0.90 (0.61, 1.34)	0.86 (0.56, 1.32)
Quit 6–10 years	1,476	22	5,231	4.2	0.65 (0.41, 1.02)	0.53 (0.32, 0.89)
Quit >10 years	7,801	101	27,629	3.7	0.56 (0.43, 0.74)	0.44 (0.31, 0.61)

Au et al. *J Gen Intern Med. 2009;24(4):457-463.*

Risks and benefits of E-cigarette

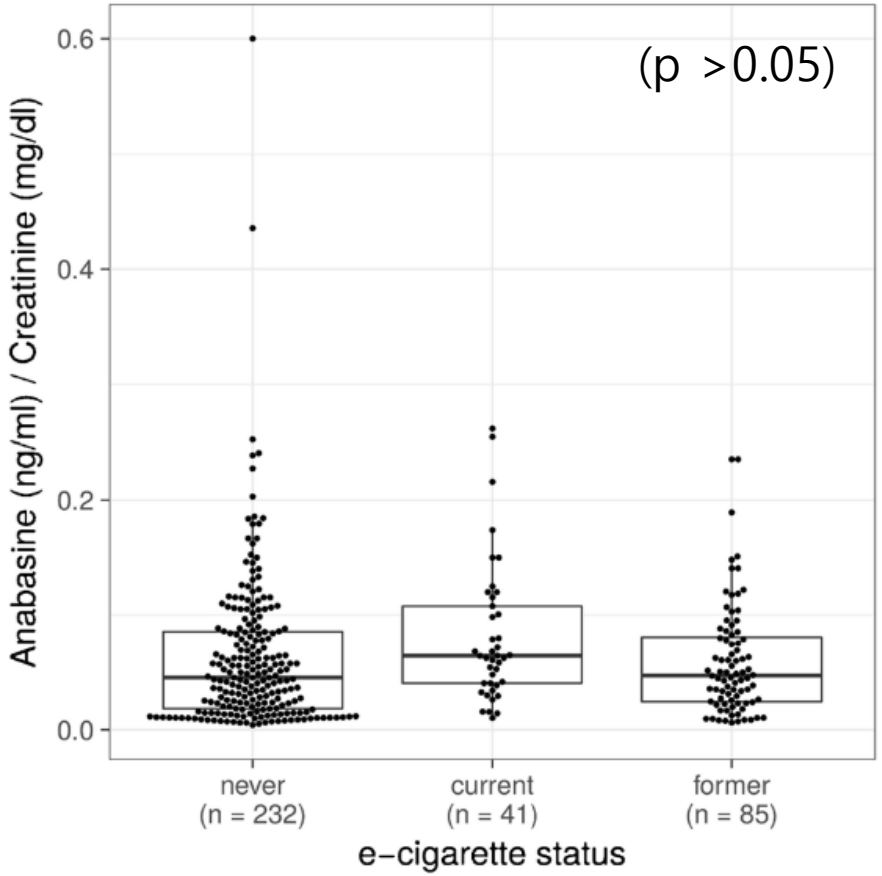
Electronic Cigarette Use in US Adults at Risk for or with COPD: Analysis from Two Observational Cohorts

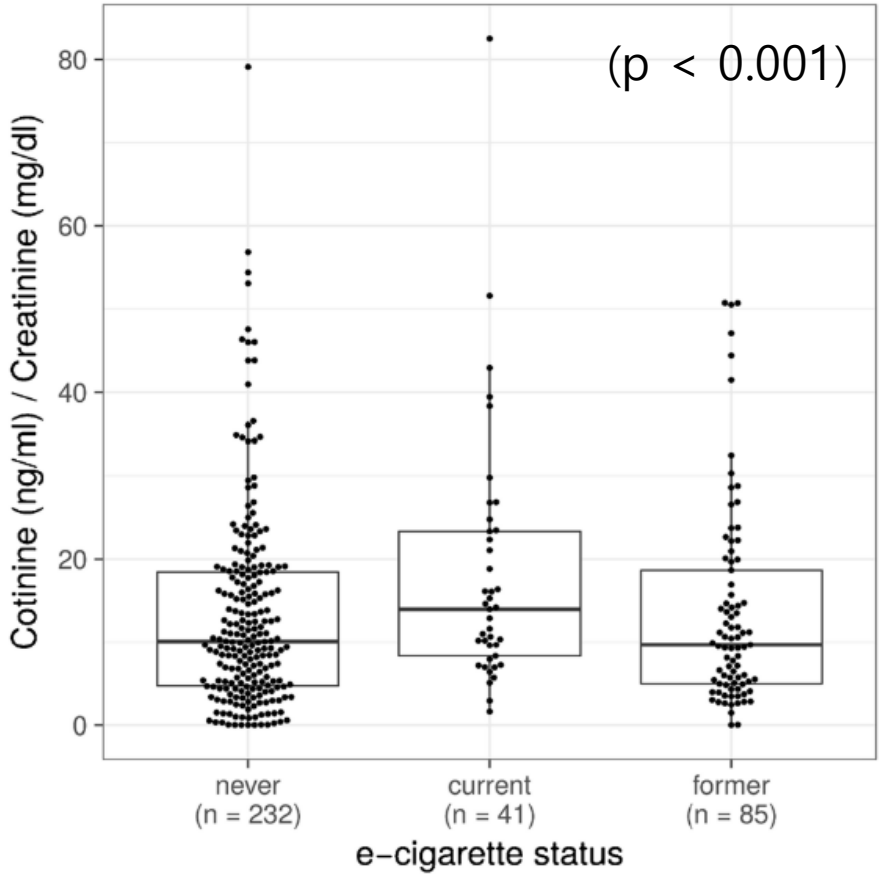
Russell P. Bowler, MD, PhD[1,2], Nadia N Hansel, MD[3], Sean Jacobson, BS[2], R. Graham Barr, MD[4], Barry J. Make, MD[2], MeiLan K. Han, MD[5,6], Wanda K O'Neal, PhD[7], Elizabeth C Oelsner, MD[4], Richard Casaburi, MD[8], Igor Barjaktarevic, MD[9], Chris Cooper, MD[9], Marilyn Foreman, MD[10], Robert A. Wise, MD[3], Dawn L. DeMeo, MD[11], Edwin K. Silverman, MD, PhD[11], William Bailey, MD[12], Kathleen F. Harrington, MD[12], Prescott G. Woodruff, MD[13], and M. Bradley Drummond, MD[7] for COPDGene and SPIROMICS Investigators



Bowler et al. *J Gen Intern Med. 2017;32(12):1315-1322.*

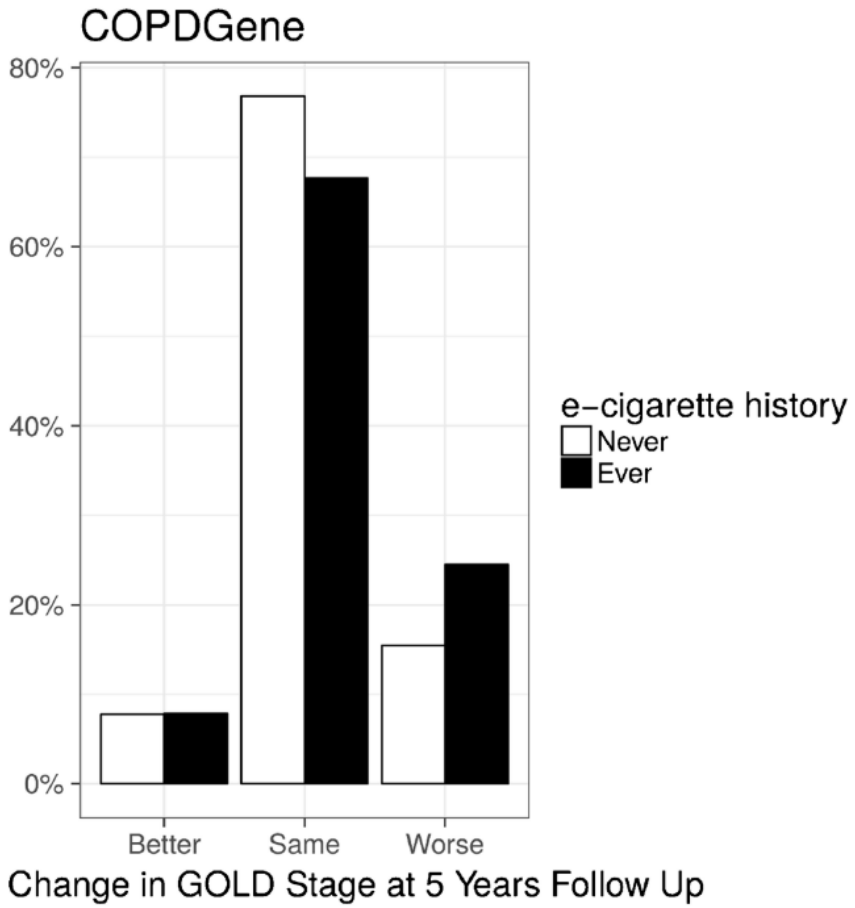
E-cigarette use is associated with higher nicotine consumption, but not lower tobacco consumption





Bowler et al. *J Gen Intern Med. 2017;32(12):1315-1322.*

E-cigarette use is associated with a higher percentage of worsening lung function



Bowler et al. *J Gen Intern Med. 2017;32(12):1315-1322.*

Outcomes of COPD smokers who switched to e-cigarettes

Polosa *et al. Respiratory Research* (2016) 17:166
DOI 10.1186/s12931-016-0481-x

Respiratory Research

RESEARCH Open Access

Evidence for harm reduction in COPD smokers who switch to electronic cigarettes

Riccardo Polosa[1,2,3†], Jaymin Bhagwanji Morjaria[4*†], Pasquale Caponnetto[1,2], Umberto Prosperini[5], Cristina Russo[6], Alfio Pennisi[7] and Cosimo Marcello Bruno[1,3]

Retrospective

International Journal of COPD

Dovepress
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Open Access Full Text Article

ORIGINAL RESEARCH

Health effects in COPD smokers who switch to electronic cigarettes: a retrospective-prospective 3-year follow-up

Prospective 3-yr

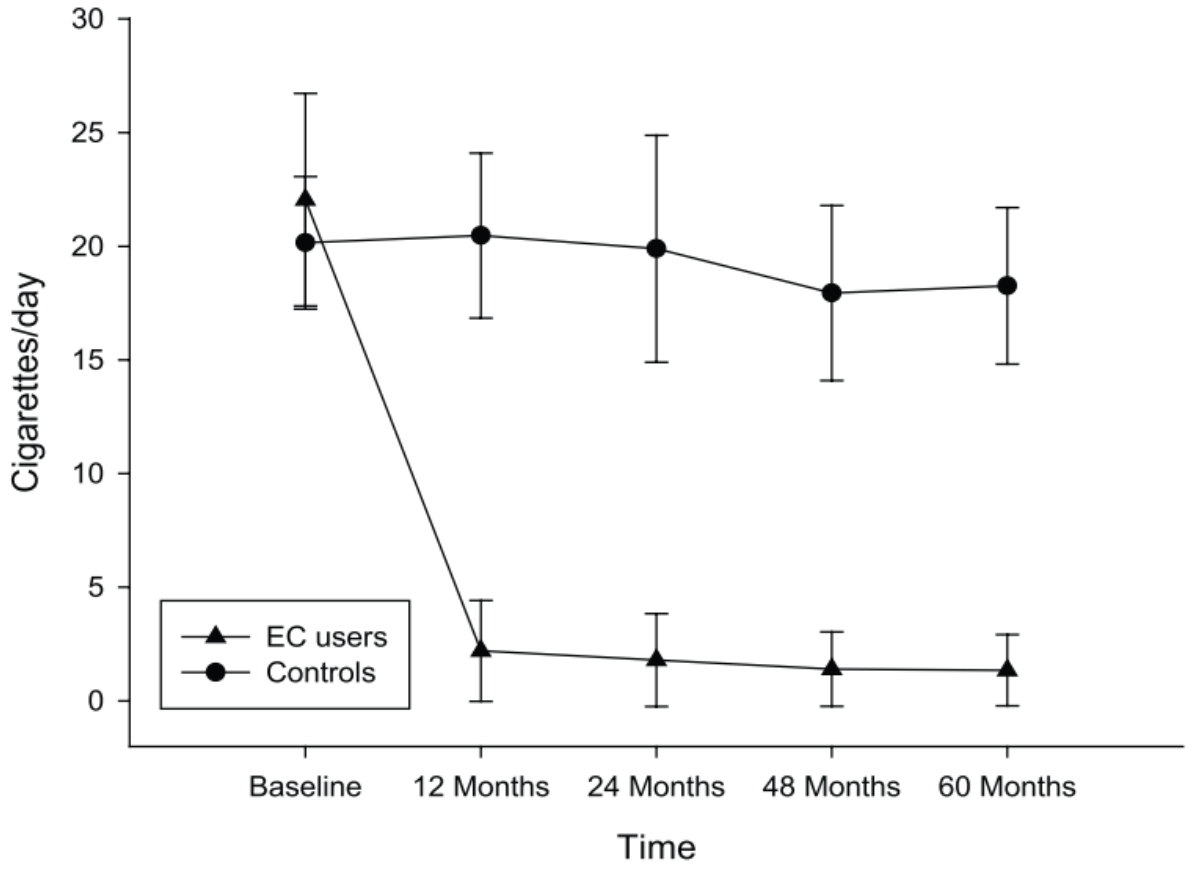
Therapeutic Advances in Chronic Disease

COPD smokers who switched to e-cigarettes: health outcomes at 5-year follow up

Ricardo Polosa*, Jaymin B Morjaria*, Umberto Prosperini, Barbara Busà, Alfio Pennisi, Mario Malerba, Marilena Maglia and Pasquale Caponnetto

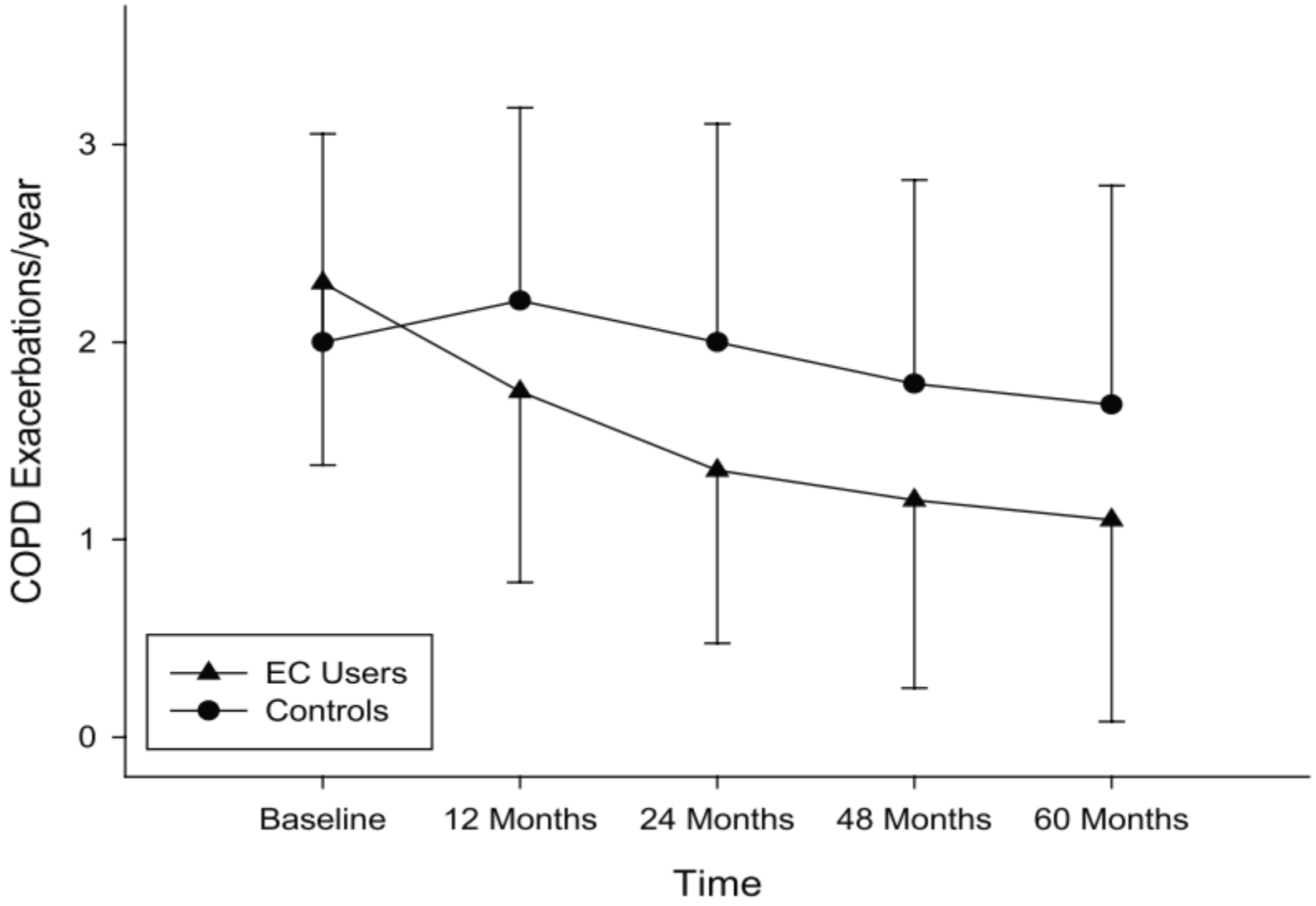
Prospective 5-yr

Polosa et al. *Respir Res. 2016;17(1):166.*
Polosa et al. *IJCOPD. 2018;13:2533-2542.*
Polosa et al.*Ther Adv Chronic Dis. 2020;11:2040622320961617.*

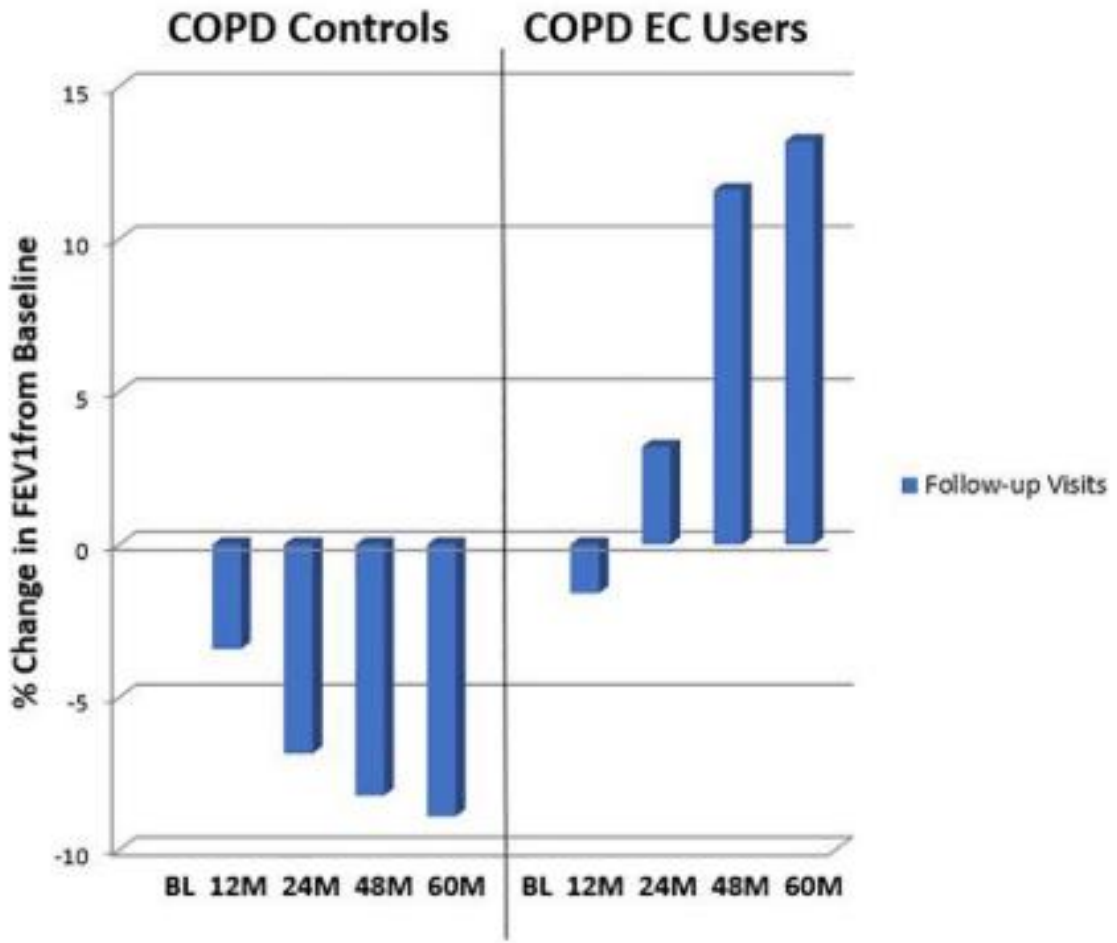


	Baseline	60-month follow-up	Within group *p* value *versus* baseline	Overall between group *p* value from baseline
COPD Controls (*n* = 19)				
post-BD FEV1* (l)	1.46 (1.19, 1.67)	1.33 (1.13, 1.53)	0.387	**0.004**
post-BD FVC* (l)	2.31 (2.10, 2.54)	2.34 (2.20, 2.58)	0.840	**0.016**
%FEV1/FVC	60.9 (±6.8)	57.9 (±9.1)	0.074	**0.038**
Cig/day¥	20.2 (±2.9)	18.3 (±3.4)	0.091	<**0.001**
CAT score*	20 (17, 24.5)	20 (17.5, 23.5)	0.962	0.158
COPD Exacerbations¥	2 (±1.1)	1.7 (±1.1)	0.331	**0.046**
6MWD*Σ (m)	285 (219.3, 361.8)	305 (243, 342.5)	0.722	**0.012**
COPD EC users (*n* = 20)				
post-BD FEV1* (l)	1.25 (0.98, 1.78)	1.42 (1.22, 1.95)	**0.001**	
post-BD FVC* (l)	2.49 (2.08, 2.65)	2.70 (2.17, 3.03)	**0.002**	
%FEV1/FVC¥	55.8 (±10.8)	58.2 (±9.2)	0.054	
Cig/day¥	22.1 (±4.7)	1.4 (±1.6)	<**0.001**	
CAT score*	21.0 (17, 25.3)	17 (14.8, 20.8)	**0.020**	
COPD exacerbations¥	2.3 (±0.9)	1.1 (±1.0)	<**0.001**	
6MWD*Σ (m)	278 (186, 313)	344.5 (239, 394.8)	**0.005**	

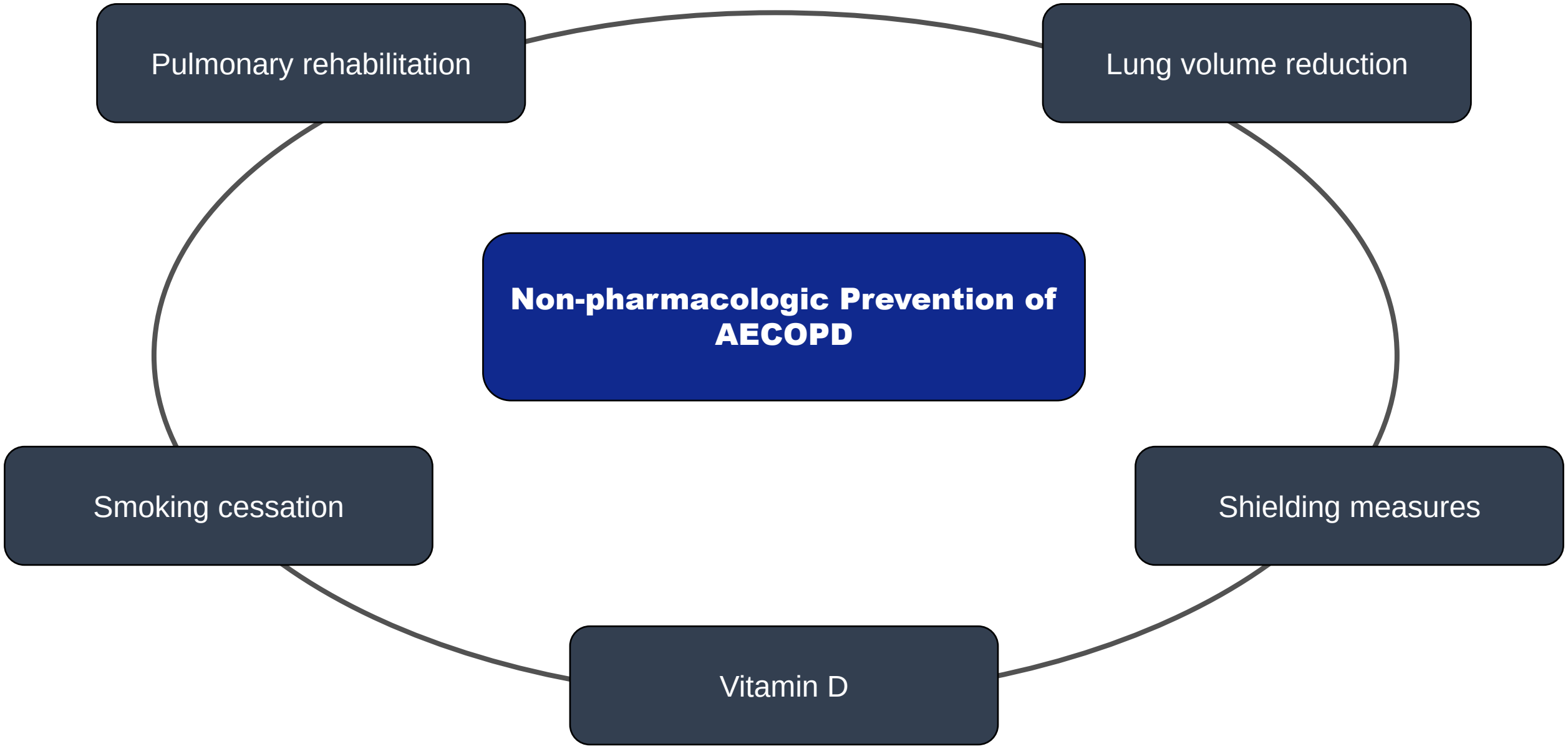
Polosa et al.*Ther Adv Chronic Dis. 2020;11:2040622320961617*



Polosa et al.*Ther Adv Chronic Dis. 2020;11:2040622320961617*



Polosa et al.*Ther Adv Chronic Dis. 2020;11:2040622320961617*


Pulmonary rehabilitation
Lung volume reduction
Non-pharmacologic Prevention of AECOPD
Smoking cessation
Shielding measures
Vitamin D

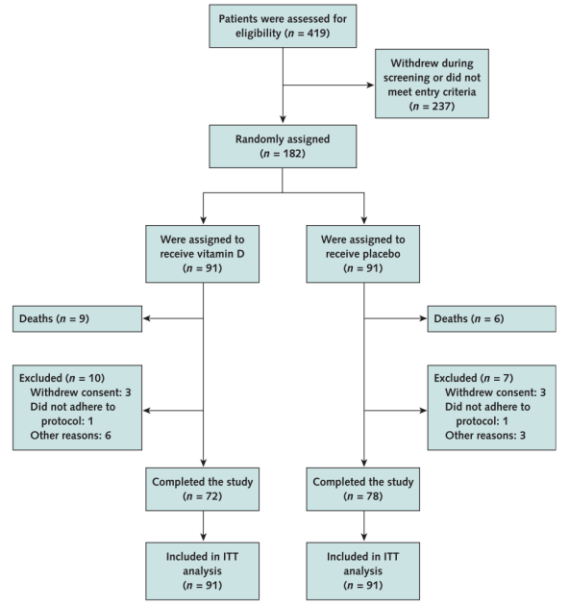
Effect of vitamin D supplements in AECOPD

Annals of Internal Medicine | ORIGINAL RESEARCH

High Doses of Vitamin D to Reduce Exacerbations in Chronic Obstructive Pulmonary Disease

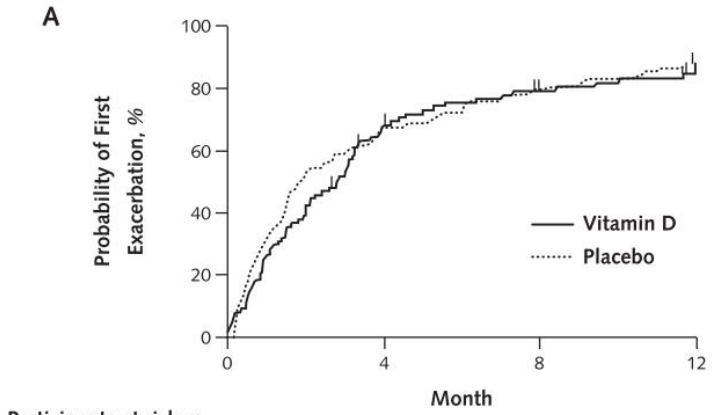
A Randomized Trial

An Lehouck, PhD; Chantal Mathieu, MD, PhD; Claudia Carremans, MS; Femke Baeke, PhD; Jan Verhaegen, MD, PhD; Johan Van Eldere, MD, PhD; Brigitte Decallonne, MD, PhD; Roger Bouillon, MD, PhD; Marc Decramer, MD, PhD; and Wim Janssens, MD, PhD



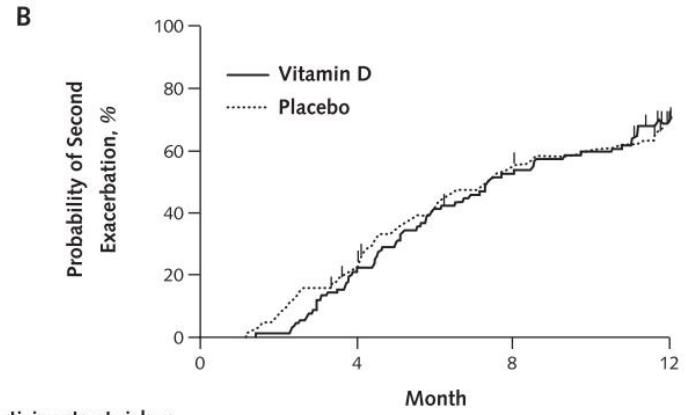
- Objective: To explore whether supplementation with high doses of vitamin D could reduce the incidence of AECOPD.
- Design: Single-center, double-blind RCT
- Setting: University Hospitals Leuven, Leuven, Belgium.
- Patients: 182 patients with moderate to very severe COPD and a history of recent exacerbations.
- Intervention: 100 000 IU of vitamin D supplementation or placebo every 4 weeks for 1 year.

Lehouck et al. *Ann Intern Med. 2012;156(2):105-114.*



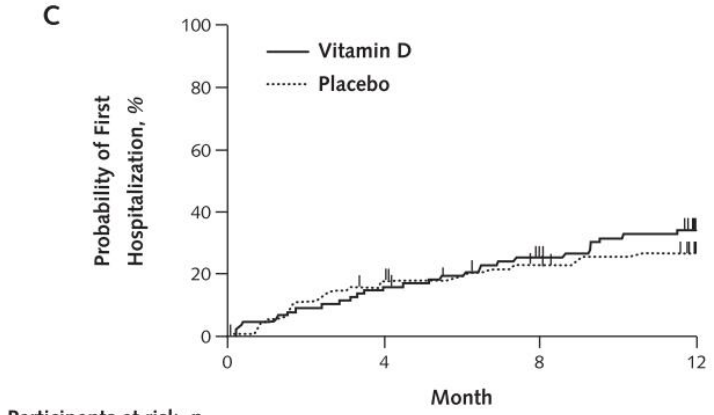
Participants at risk, *n*

Vitamin D	91	31	20	4
Placebo	91	30	19	9



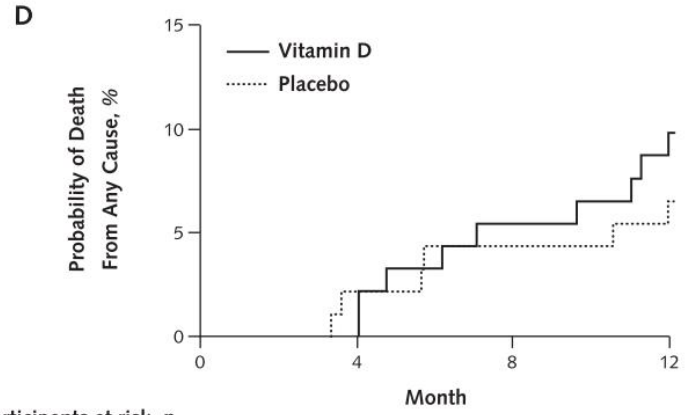
Participants at risk, *n*

Vitamin D	91	71	41	16
Placebo	91	68	38	13



Participants at risk, *n*

Vitamin D	91	74	60	37
Placebo	91	71	62	41



Participants at risk, *n*

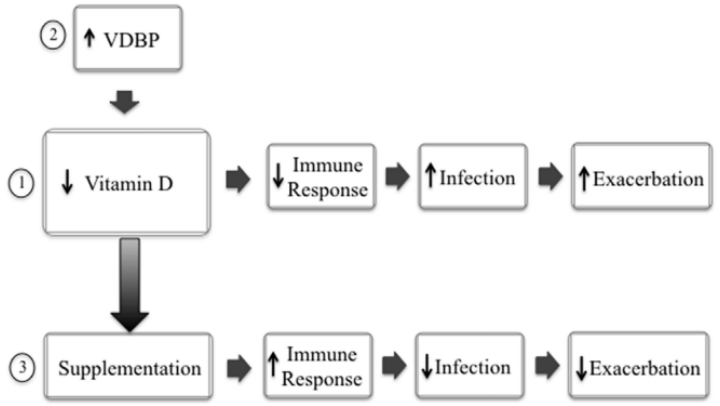
Vitamin D	91	91	87	82
Placebo	91	90	88	85

Lehouck et al. *Ann Intern Med. 2012;156(2):105-114.*

Effect of vitamin D supplements in AECOPD

C. Subgroup With Severe Vitamin D Deficiency

Variable	Vitamin D (*n* = 15)	Placebo (*n* = 15)	Difference or RR (95% CI)	*P* Value
Mean 25-(OH)D level (SD), *ng/mL*				
At baseline	8 (2)	7 (2)	0.57 (–1 to 2)	0.36
During study	50 (15)	12 (8)	38 (33 to 44)	<0.001
COPD exacerbations per patient-year, *n*	1.84	3.45	0.57 (0.33 to 0.98)	0.042



Severe vitamin D deficiency : serum 25-(OH)D levels <10 ng/mL

Lehouck et al. *Ann Intern Med. 2012;156(2):105-114.;* Ferrari et al. *Respir Med. 2018;139:34-38.*

Effect of vitamin D supplements in AECOPD

Chronic obstructive pulmonary disease

ORIGINAL ARTICLE

Vitamin D to prevent exacerbations of COPD: systematic review and meta-analysis of individual participant data from randomised controlled trials

David A Jolliffe,[1] Lauren Greenberg,[1] Richard L Hooper,[1] Carolien Mathyssen,[2] Rachida Rafiq,[3] Renate T de Jongh,[3] Carlos A Camargo,[4] Christopher J Griffiths,[1,5] Wim Janssens,[2] Adrian R Martineau[1,5]

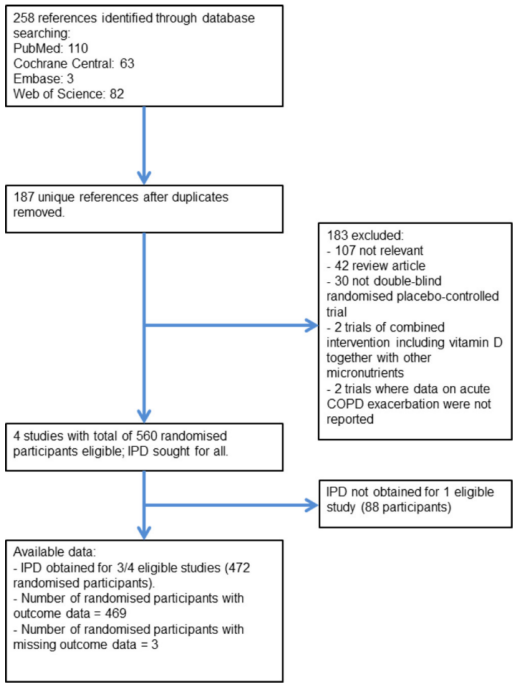
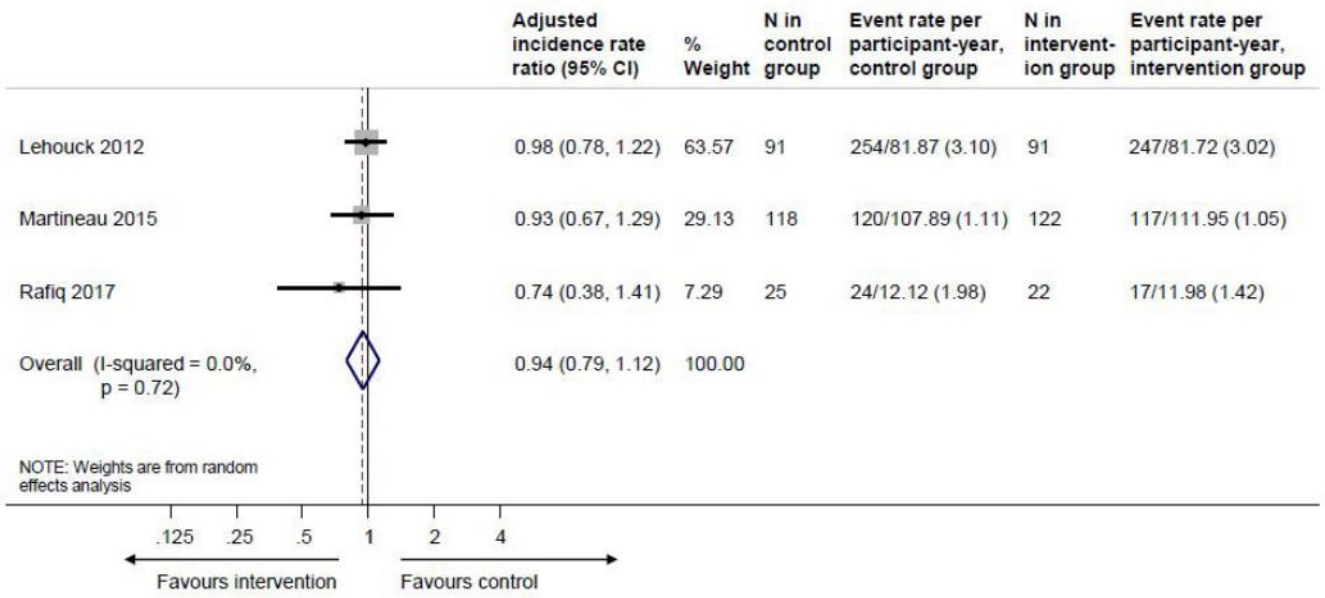


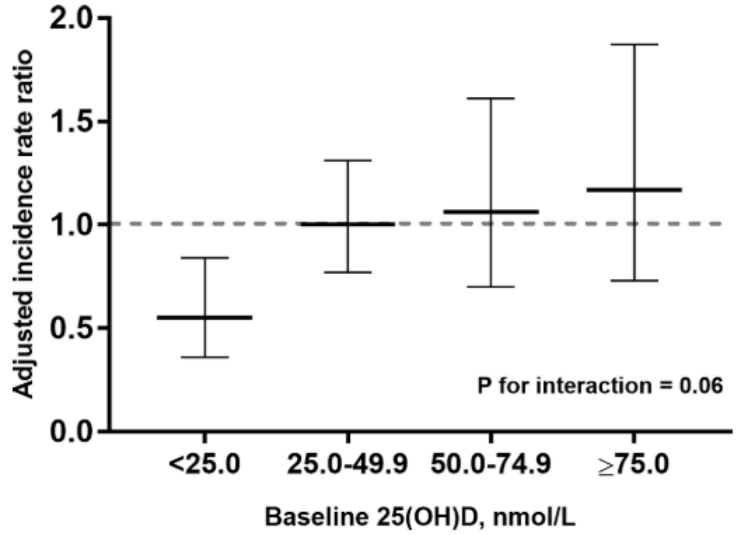
Table 1 Characteristics of trials and participants included in individual participant data meta-analysis

Study first author and year	Setting	Mean age, years (SD) [range]	Male:female	GOLD spirometric grade, N (%)	Ethnic origin	25(OH)D assay	Mean baseline 25(OH)D, nmol/L (SD) [range]	Baseline 25(OH)D <25 nmol/L (%)	Intervention: control, all participants (participants with baseline 25(OH)D <25 nmol/L)	Oral dose of vitamin D_3, intervention arm	Study duration	N with available outcome data/N randomised (%)
Lehouck 2012[13]	Secondary care, Belgium	67.9 (8.3) [48–86]	145:37	1: 2/182 (1.1). 2: 47/182 (25.8). 3: 91/182 (50.0). 4: 42/182 (23.1).	182/182 (100.0%) white European.	RIA	49.8 (29.2) [9.0–159.7]	31/182 (17.0)	91:91 (15:16)	2.5 mg (100 000 IU) bolus monthly*	12 months	182/182 (100.0)
Martineau 2015[14]	Primary and secondary care, UK	64.7 (8.5) [40–85]	144:96	1: 61/240 (25.4). 2: 113/240 (47.1). 3: 52/240 (21.7). 4: 14/240 (5.8).	227/240 (94.6%) white European†	LC-MS/MS	46.1 (25.7) [undetectable –160.0]	50/240 (20.8)	122:118 (29:21)	3 mg (120 000 IU) bolus once every 2 months‡	12 months	240/240 (100.0)
Rafiq 2017[15]	Secondary care, Netherlands	62.5 (5.6) [48–71]	26:24	1: 10/50 (20.0). 2: 22/50 (44.0). 3: 13/50 (26.0). 4: 5/50 (10.0).	49/50 (98.0%) white European§	LC-MS/MS	41.4 (16.0) [17.0–90.0]	6/50 (12.0)	24:26 (4:2)	30 µg (1200 IU) daily	6 months	47/50 (94.0)

Jolliffe et al. *Thorax. 2019;74(4):337-345*

Effect of vitamin D supplements in AECOPD



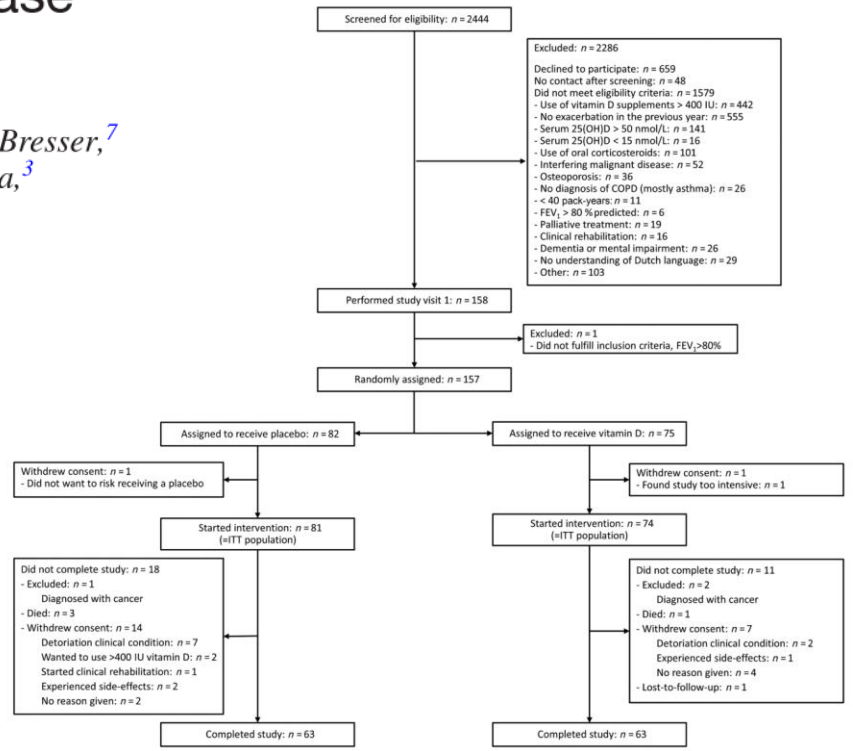


Jolliffe et al. *Thorax. 2019;74(4):337-345*

Effect of vitamin D supplements in AECOPD

Vitamin D supplementation in chronic obstructive pulmonary disease patients with low serum vitamin D: a randomized controlled trial

Rachida Rafiq,[1] Floor E Aleva,[2] Jasmijn A Schrumpf,[3] Johannes M Daniels,[4] Pierre M Bet,[5] Wim G Boersma,[6] Paul Bresser,[7] Michiel Spanbroek,[8] Paul Lips,[1] Tim J van den Broek,[9] Bart JF Keijser,[9] André JAM van der Ven,[10] Pieter S Hiemstra,[3] Martin den Heijer,[1] Renate T de Jongh,[1] and on behalf of the PRECOVID-study group[1]



- A multicenter, double-blind RCT.
- Eligible criteria
  - COPD patients with ≥1 exacerbations in the preceding year
  - a vitamin D deficiency (15–50 nmol/L)
- Randomly allocated in a 1:1 ratio
  - 16,800 IU vitamin D3 vs placebo/wk during 1 y.
- Primary outcome : annual exacerbation rate.

Rafiq et al. *Am J Clin Nutr. 2022;116(2):491-499.*

TABLE 2 Number of exacerbations of both study groups and IRR[1]

	Exacerbations, *n*			Unadjusted incidence rate, per person-year			
	Total	Placebo group	Vitamin D group	Placebo group	Vitamin D group	Adjusted IRR (95% CI)	*P* value
Intention-to-treat population ($n = 155$)	187	97	90	1.36	1.29	0.90 (0.67, 1.21)	0.47
Per-protocol analysis ($n = 135$)	158	86	72	1.40	1.21	0.84 (0.60, 1.17)	0.30
Subgroup ≤25 nmol/L ($n = 31$)	41	18	23	1.29	1.60	0.91 (0.43, 1.93)	0.80

[1]Results were based on negative binomial regression analyses. Adjusted analyses were corrected for stratification group and study center. IRR, incidence rate ratio; CI, confidence interval.

TABLE 3 Effect of vitamin D on time to first and second exacerbations and time to first hospitalization[1]

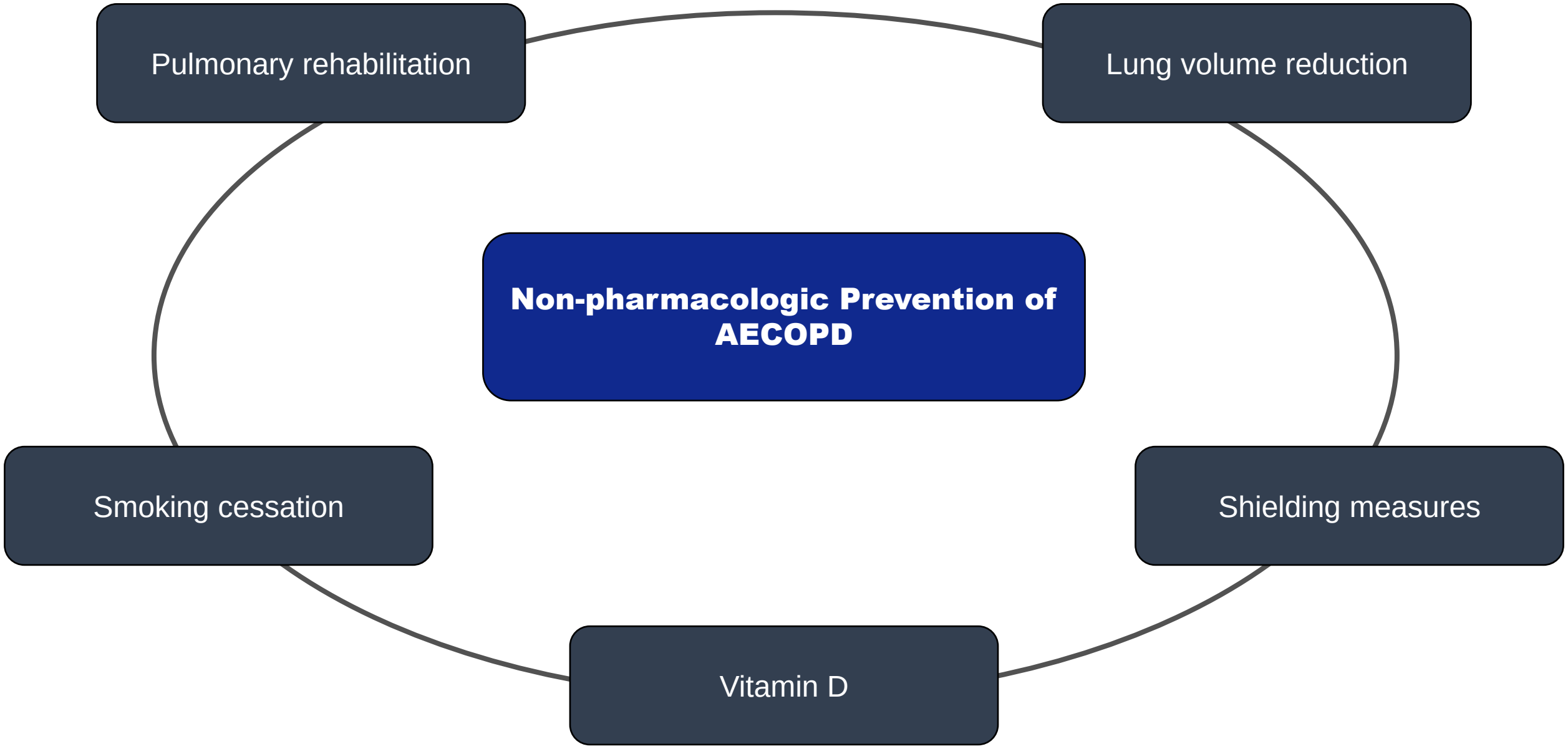
	HR (95% CI)	*P* value
Time to first exacerbation		
Intention-to-treat population ($n = 155$)	1.01 (0.67, 1.54)	0.93
Subgroup ≤25 nmol/L ($n = 31$)	0.55 (0.13, 2.30)	0.41
Time to second exacerbation		
Intention-to-treat population ($n = 155$)	0.80 (0.44, 1.43)	0.44
Subgroup ≤25 nmol/L ($n = 31$)	2.00 (0.24, 16.22)	0.52
Time to first hospitalization		
Intention-to-treat population ($n = 155$)	1.03 (0.51, 2.07)	0.93
Subgroup ≤25 nmol/L ($n = 31$)	1.09 (0.17, 7.01)	0.92

[1]Results were based on Cox regression analyses. All analyses were adjusted for stratification group and study center. HR, Hazard ratio; CI, confidence interval

TABLE 5 Effect of vitamin D supplementation on physical function and inflammatory markers[1]

	Mean/percentage difference (95% CI)	*P* value
Physical function ($n = 155$)		
6-min walking test, m	34 (−4, 71)	0.08
Handgrip strength, kg	1.15 (−1.20, 3.50)	0.34
Spirometry ($n = 154$)		
FEV_1, %predicted	− 0.91 (−6.15, 4.34)	0.73
FVC, %predicted	− 2.52 (−7.72, 2.67)	0.34
Maximal respiratory mouth pressures ($n = 150$)		
MIP, kPa	− 0.47 (−2.74, 1.79)	0.68
MEP, kPa	0.28 (−0.71, 1.27)	0.58
Inflammatory markers ($n = 152$)		
CRP, μg/mL	− 6.7 (−30.2, 24.1)	0.63
IL-6, pg/mL	− 13.3 (−30.6, 8.4)	0.21
LL-37, ng/mL	0.2 (−12.1, 14.3)	0.97

Rafiq et al. *Am J Clin Nutr. 2022;116(2):491-499.*


Pulmonary rehabilitation
Lung volume reduction
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Smoking cessation
Shielding measures
Vitamin D

Decrease in AECOPD in COVID-19 era

frontiers | Frontiers in Medicine

TYPE Original Research
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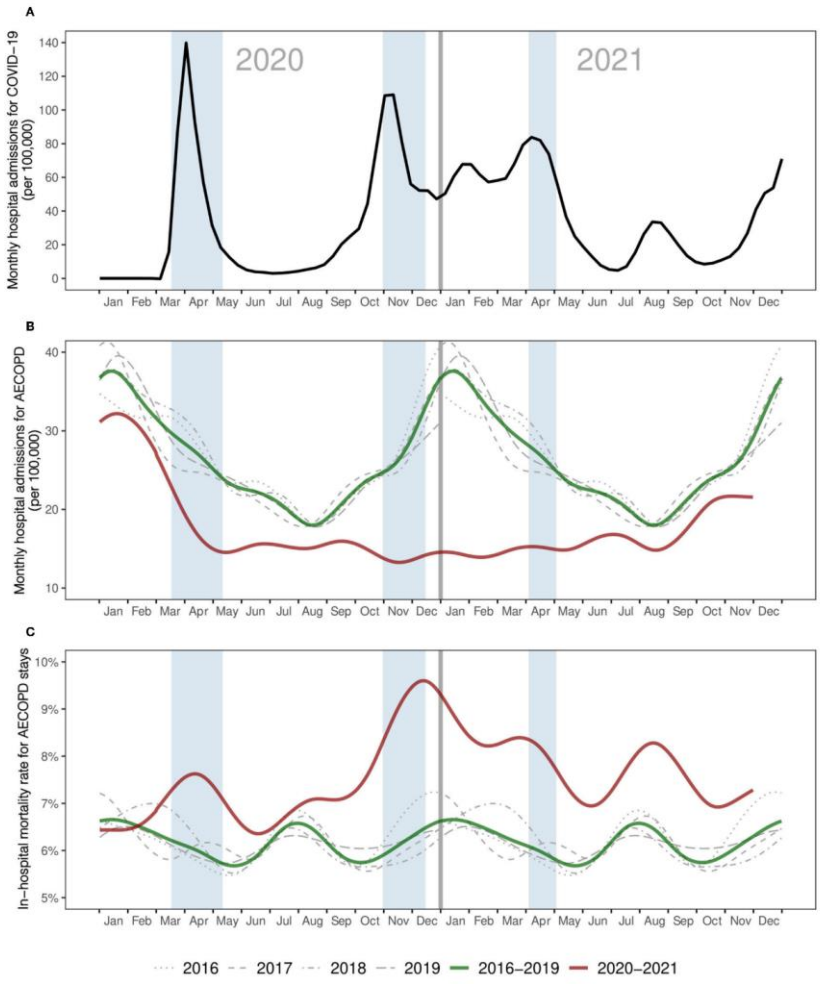
Hospital admissions and mortality for acute exacerbations of COPD during the COVID-19 pandemic: A nationwide study in France



Poucineau et al. *Front Med (Lausanne). 2022;9:995016.*

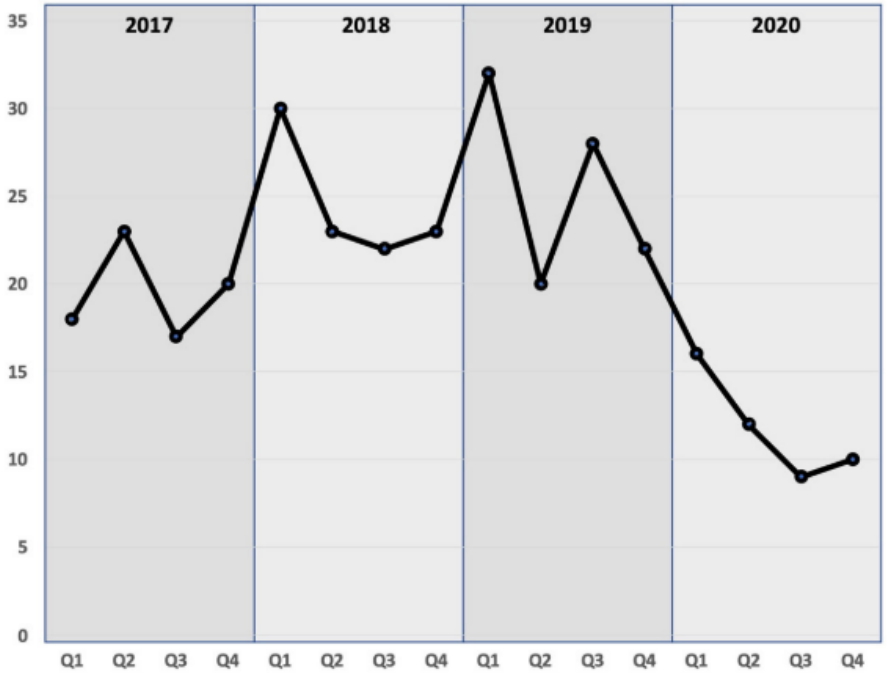
Decrease in AECOPD in COVID-19 era

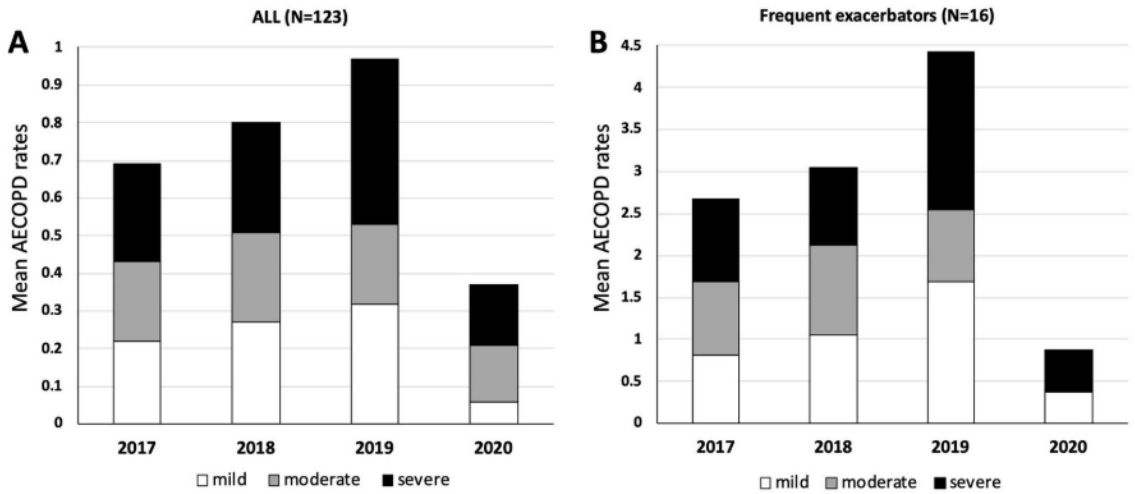
Chronic Obstructive Pulmonary Diseases:
Journal of the COPD Foundation®

Brief Communication

Decrease in Exacerbations During the Coronavirus Disease 2019 Pandemic in a Cohort of Veterans with COPD

Christian Trujillo, MD[1] Brian Garnet, MD[2,3] Ali Vaeli Zadeh, MD[2] Gisel Urdaneta, MD[2] Michael Campos, MD[2,3]





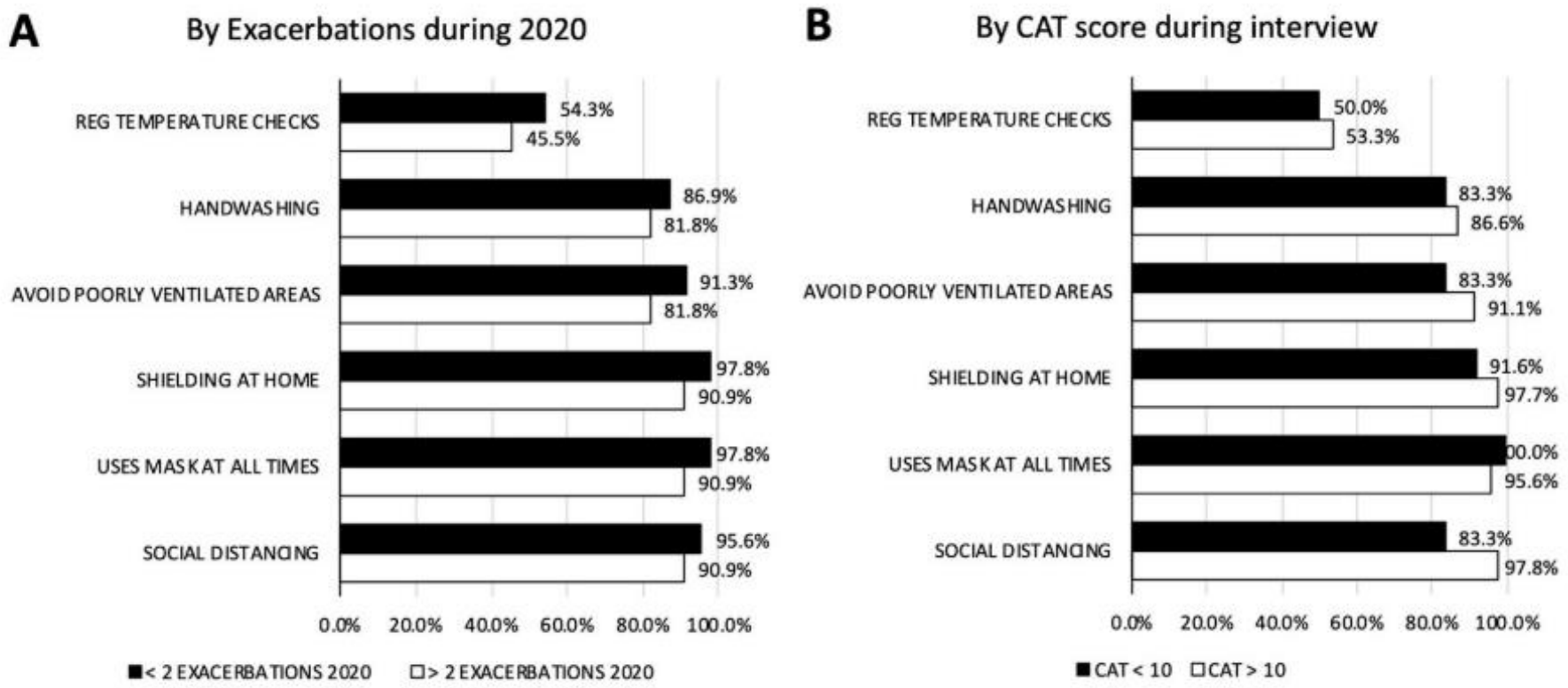
Trujillo et al. *Chronic Obstr Pulm Dis. 2021;8(4):572-579.*

Table 2. Summary of Studies on Acute Exacerbation of COPD During COVID-19 Pandemic

Name of the Study	Country	Methodology	Studied Epoch	% Reduction in 2020
Berghaus et al.[5]	Germany	Single center. Hospital data using ICD codes of exacerbated COPD	February 1 to May 1, 2020 and corresponding period in prior 2 years	55.23% reduction. From 105±8 (78-131) to 47±15 (45-92) median admissions per month
Chan et al.[6]	Hong Kong, China	Single center. Hospital data using ICD codes of AECOPD	January–March 2020 compared with average monthly AECOPD admission rates 2015-2019.	44.0% (36.4%-52.8%) reduction in monthly AECOPD admission rates
Sykes et al.[7]	United Kingdom	Two large hospital sites. Hospital data on admissions for asthma and COPD as primary diagnosis.	March 23 to June 1, 2020 compared with same periods in 2018 and 2019.	56.3% and 57.1% reduction in weekly exacerbation admissions rates compared to 2018 and 2019 respectively. From mean 15.7 to 36 and 36.6 per week.
Tan et al.[8]	Singapore	Single center. Hospital data using ICD codes of exacerbated COPD	February–July 2020 compared with pre-pandemic January 2018 to January 2019.	60.86% reduction in monthly AECOPD admissions. From 92 (SD 18) to 36 (SD 6).
Baum et al.[9]	United States of America	VA health system Corporate Data Warehouse for admissions due to COPD and other conditions using ICD-10 codes.	Compared January 29 to March 10, 2020 with March 11 to April 21, 2020.	48.4% total reduction in admissions with a principal diagnosis of COPD. From 1701 to 877 (IRR 0.51, CI 0.38-0.68).
McAuley et al.[10]	United Kingdom	Single center. Research database of COPD patients. N=160. Community and hospital AECOPD.	March 15 to April 30, 2020 compared with the same 6-week period in 2019.	21.42% total increase of AECOPD (126 vs 99). 38% increase in community AECOPD (121 vs 88). Severe AECOPD decreased 50%
Faria et al.[12]	Portugal	Single center. Patient cohort. N=286.	March to July 2020 compared to 2016-2019	73.4% reduction in average yearly rate of severe AECOPD.
Hu et al.[13]	Hubei, China	Research COPD cohort databse. N=307	December 2019 to March 2020 compared with October 2018 and March 2019 (not same patients).	62% reduction in AECOPD (from 52.2% to 19.8%). Admissions decreased 77.6% (from 29.3% to 6.5%).

Trujillo et al. *Chronic Obstr Pulm Dis. 2021;8(4):572-579.*

Compliances with COVID-19 preventive measures



Trujillo et al. *Chronic Obstr Pulm Dis. 2021;8(4):572-579.*

Conclusions

- Pulmonary rehabilitation is associated with decreased exacerbation risk and mortality
  - PR after AE COPD
  - PR during hospitalization
- LVRS and EBV is associated with decreased exacerbation risk
- Smoking cessation is essential. E-cigarette may be used as alternative with caution.
- Vitamin D may decrease exacerbation risk in deficient patients (<25ng/ml)
- Lesson from COVID-19 era : shielding measure is still important!


Thank you for your attention.