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Review article

Non-pharmacological and non-invasive interventions for chronic pain in people with chronic obstructive pulmonary disease: A systematic review without meta-analysis

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ABSTRACT

Objectives: Chronic Obstructive Pulmonary Disease (COPD) is complicated by chronic pain. People with COPD report higher pain prevalence than the general population. Despite this, chronic pain management is not reflected in current COPD clinical guidelines and pharmacological treatments are often ineffective. We conducted a systematic review that aimed to establish the efficacy of existing non-pharmacological and non-invasive interventions on pain and identify behaviour change techniques (BCTs) associated with effective pain management.

Methods: A systematic review was conducted with reference to Preferred Reporting Items for Systematic Review (PRISMA) [1], Systematic review without Meta analysis (SWIM) standards [2] and Grading of Recommendations Assessment, Development and Evaluation (GRADE) guidelines [3]. We searched 14 electronic databases for controlled trials of non-pharmacological and non-invasive interventions where the outcome measure assessed pain or contained a pain subscale.

Results: Twenty-nine studies were identified involving 3,228 participants. Seven interventions reported a minimally important clinical difference in pain outcomes, although only two of these reached statistical significance ($p < 0.05$). A third study reported statistically significant outcomes, but this was not clinically significant ($p = 0.0273$). Issues with intervention reporting prevented identification of active intervention ingredients (i.e., BCTs).

Conclusions: Pain appears to be a meaningful issue for many individuals with COPD. However, intervention heterogeneity and issues with methodological quality limit certainty about the effectiveness of currently available non-pharmacological interventions. An improvement in reporting is required to enable identification of active intervention ingredients associated with effective pain management.

1. Introduction

Prevalence of chronic pain in people with Chronic Obstructive Pulmonary Disease (COPD) is reported to be between 32 and 66% [4,5]. This is comparable to, or higher than, that reported in the general population (20% worldwide estimates, 33–50% in the UK) and similar to people with other chronic health conditions (up to 52%) [4–8].

As well as impacting negatively on quality of life [9–11] and health status [12,13], chronic pain has been associated with reduced exercise capacity [11], functional limitations [14], reduced physical activity levels [10,15], poor balance and an increased risk of falls in people with COPD [16]).

Despite accumulating evidence supporting the high prevalence of pain in people with COPD, management of chronic pain in COPD is not included in national and international clinical guidelines [17–20]. Pulmonary Rehabilitation (PR) is considered the most effective treatment currently available to reduce breathlessness for people with COPD. It has shown to improve prognosis, quality of life and ability to self-manage [18,21] but chronic pain has also been cited as a negatively influencing factor in PR programme uptake and completion [22]. A few studies have reported PR to be ineffective in relieving chronic pain, despite eliciting significant benefits in exercise capacity, muscle strength

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and psychological symptoms [23–25]. As these were single studies, we considered a collective approach may provide clearer evidence for developing future interventions and guidance.

Pharmacological management of chronic pain is often the prescribed approach [5,7,8] yet in people with COPD and other chronic pain populations this has been shown to be ineffective. People with COPD report a higher level of pain medication usage than people with other long-term conditions, yet still report experiencing pain [8]. Pharmacological approaches to chronic pain management are associated with adverse risk of abuse, overdose, dependency, death, myocardial infarction, fractures [26], and other side effects including, constipation, sedation, dizziness, nausea, and respiratory difficulties. For these reasons, non-pharmacological and non-invasive interventions for pain management are now recommended in other populations [27–30].

The aim of our systematic review was to assess the efficacy of non-pharmacological and non-invasive interventions for the management of chronic pain in people with COPD. The interventions we expected to find included physical therapies; exercise therapy; electrotherapy; psychological therapies or combined approaches. These therapies would likely be delivered during the stable phases of the disease and post exacerbation, so the review examined these stages of clinical treatment.

A secondary aim was to identify the active ingredients of effective interventions using the Behaviour Change Taxonomy v1 (BCTv1) [31]. This taxonomy is a method of categorising the active ingredients of interventions to improve the effectiveness of intervention reporting into a standardised definition. This enables identification of the effective techniques, permits the accurate description of the intervention enabling more accurate appraisal of the evidence, enables understanding of how interventions work and enables effective translation from research trials to clinical protocols [31].

2. Materials and methods

2.1. Study design

This systematic review followed a published protocol (CRD42020172626) and adhered to the Preferred Reporting Items for Systematic Review (PRISMA) [1], and Grading of Recommendations Assessment, Development and Evaluation (GRADE) guidelines [3]. Meta-analysis was not possible therefore Systematic review without Meta analysis (SWIM) guidance [2] was followed.

2.2. Data sources

The following fourteen databases were searched: Web of Science, EBSCOhost, Medline, AMED, PsycArticles, Psychology and Behavioural Sciences Collection, PsycInfo and CINAHL, Cochrane Library online, EMBASE, Scopus, PubMed, clinicaltrials.gov, and dissertations indexed with ProQuest Dissertations and Theses Global and EthOS. The search strategy was verified by a medical librarian. It was developed using a combination of MeSH terms and keywords. An initial scoping search was run in Medline (Supplementary Appendix A) and then adapted to suit each database (available from the authors). Hand-searching of end reference lists and citation searching of included articles was undertaken. Grey literature was searched via Open Grey (www.opengrey.eu). Online records of the European Respiratory Society, American Thoracic Society and British Thoracic Society were hand searched for any relevant submissions. The initial searches were run May to June 2020 and updated May to August 2022.

2.3. Inclusion criteria

2.3.1. English language studies

Population: Individuals with a confirmed diagnosis of stable COPD (GOLD stages (1–4)), managed in any setting. This includes people post exacerbation when rehabilitation would be appropriate.

Interventions: Any non-pharmacological, non-invasive intervention-based study. Randomised and non-randomised controlled trial (RCT/non-RCT) designs were eligible for inclusion. Non-pharmacological refers to "interventions that do not involve prescribed, over the counter or herbal drugs, however administered (orally, or via intradermal, subcutaneous, or intramuscular injections)". Non-invasive refers to "interventions that do not require the insertion of instruments into the body" [32].

Comparisons: Standard or usual care.

Outcomes: Outcome measures assessing pain (e.g., The Brief Pain Inventory- [33] or outcome measures including a pain subscale (e.g., for example the SF – 36 quality of life scale - [34]. Pain outcome measures would need to

- Assess pain over time [35].
- Measure pain, not confound it with other somatic symptoms [36].
- Be valid, reliable, and responsive to changes in pain.
- Have been verified against a recognised existing pain measurement tool.
- Measure pain magnitude as well as impact [36].

The definition of chronic pain for the purpose of this systematic review was pain which had occurred for three months or more and had no underlying tissue damage in its etiology [35,37].

2.4. Exclusion criteria

Palliative approaches to COPD care, end of life care, intensive care interventions and people currently suffering from an exacerbation.

2.5. Study selection

The lead author ran the searches, and the results were uploaded into Endnote X9 to undergo a process of de-duplication. Two reviewers independently screened 20% of potentially relevant articles against eligibility criteria based on titles and abstracts (JRM and JR). An inter-rater reliability threshold of 80% was set using percentage of positive agreement, which was achieved. The remaining articles were screened by one reviewer (JRM). All full text articles were assessed by the same two reviewers (JRM and JR). At both stage 1 and 2 of selection, consensus for inclusion was achieved without the need of a third reviewer. Reference lists of included studies were searched, and a citation search of included studies was conducted (by JRM).

2.6. Risk of bias in studies

Methodological quality was assessed independently by two reviewers (JRM and JR) using the standardised Critical Appraisal Tools for RCT and non-RCT designs [38]. The GRADE process was used to report on the quality of evidence [3,39]. This included risk of bias assessment, inconsistency, indirectness, imprecision, and study power.

2.7. Data extraction and synthesis

Standardised data extraction tools [40] were used by one reviewer (JRM) and checked by a second (JR). Intervention characteristics were extracted with reference to the Template for Intervention Description and Replication (TiDeR) framework [41].

Data extracted included the following study characteristics: Country of origin; aims, design, setting; outcomes targeted (pain, quality of life); eligibility criteria; participant recruitment, sample size; participant details, people responsible for delivering the intervention, dyspnoea, capacity for exercise/activities, COPD health status and results (effect sizes, between and within group differences, significance) and intervention details (e.g., mode of delivery, duration, intensity). These data were chosen to enable potential synthesis of the data in outcomes

relevant to this population as recommended by the SWIM guidelines. The timepoint selected was immediately post intervention as defined by each study.

For studies that reported an improvement in pain outcomes, intervention descriptions were coded with reference to the included behaviour change techniques (BCTs) (by JRM) using the Behaviour Change Taxonomy v1 [31]. We extracted BCTs included in interventions to change behaviours and not outcomes of behaviours directly.

3. Results

In total 95,302 potentially relevant studies were identified (Fig. 1). Following deduplication 36,254 records were screened and 36,031 excluded. A total of 223 full text studies were assessed for eligibility. Twenty-nine studies met the eligibility criteria (N = 3,228 participants).

3.1. Data synthesis

Heterogeneity of interventions precluded the use of meta-analysis. Consequently, data were synthesised by grouping the studies based on intervention type and study design to facilitate understanding of the interventions following SWIM guidelines [2]. These were developed following data extraction rather than in advance, as an initial review of data was needed to enable clear similarities between studies to become evident. Counting of effective studies [2] was used due to the lack of studies with statistically significant results. Attempts were made to contact 58 corresponding authors of shortlisted studies to request missing or additional data. Responses were received from authors of 11

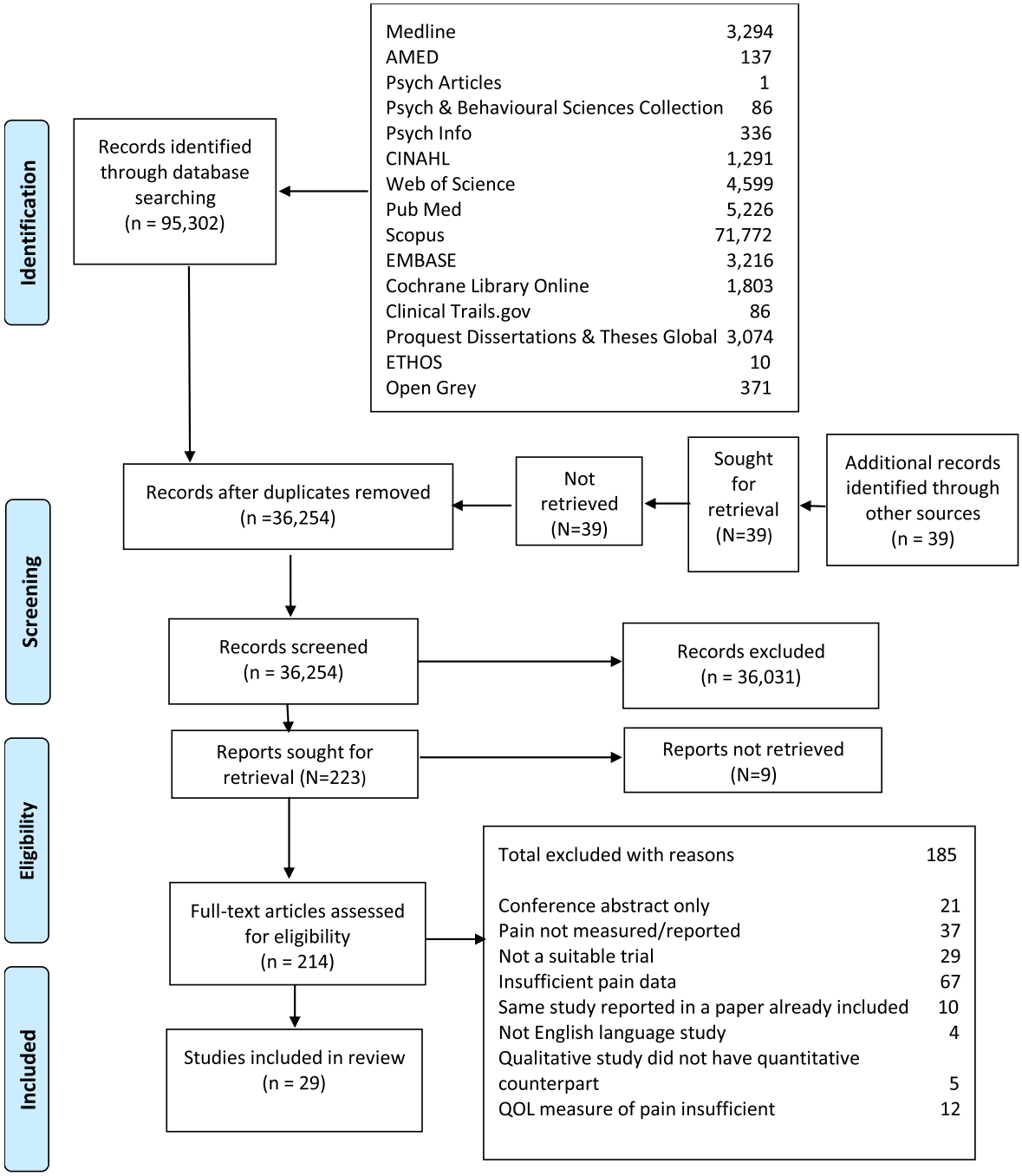

Fig. 1. Prisma flow diagram [1].

studies which resulted in 3 studies being included in the final review. The remaining studies were excluded as pain data could not be accurately quantified without author input.

COPD-specific minimal clinically important differences (MCID) for changes in pain and the other selected outcomes were used [42–44]. Pre-intervention pain scores for both the intervention and control/comparator groups were converted to weighted averages to assess the range and weighted means of pain levels in the full COPD sample across the studies (where data were available in this format). Mean data of the pain, PCS and MCS scores were calculated using Microsoft Excel version 2301 to establish the mean and range of scores in the study group populations for comparison to other similar population groups in existing literature.

We extracted the BCT information from any studies reporting a MCID of more than 1, whether significant or not. This decision was taken to increase the likelihood that those BCTs extracted were likely to be associated with changes in behaviours that subsequently led to changes in outcomes of behaviours (i.e., pain).

3.2. Study characteristics

Summaries of the 29 studies are presented in Tables 1 and 2. Twenty-five included studies were an RCT design (including three pilot RCTs), four were non-RCT designs. One study adopted a mixed methods approach [45]; a pilot online section of a randomised, controlled trial with semi-structured interviews and thematic analysis.

3.2.1. Effect of interventions on pain outcomes

A summary of studies according to intervention type and the target outcomes of the interventions is provided in Table 2. Pre and post intervention data for each of the included studies is provided in Supplementary Appendix B.

A wide range of interventions were reported. They included PR, education, various forms of exercise, breathing management techniques, self-management, and psychotherapeutic interventions (for detail see Table 2). Most of the interventions were not targeted specifically at pain. One study [70] reported using an intervention that involved pain education or management as part of the intervention. It used a North American Nursing Diagnosis Association system to diagnosis complications caused by the disease, including pain, that were then targeted by a follow up nursing intervention. This appeared, from the limited description, to be a form of enhanced follow up to help people with COPD manage their symptoms. One study [66] specifically looked for pain as a primary outcome.

Seven studies [48,51,55,60,64,70,73] reported a clinically meaningful change in pain outcomes (a MCID of 1 or over) pre to post intervention. However, only two of these (Karasu & Okuyan, & Mozaffari) were statistically significant ($p < 0.001$). The Raphaely et al. study did not achieve a clinical meaningful improvement but did achieve statistical significance ($p = 0.0273$). The only mixed method study found [45] did not provide any additional qualitative data relating to pain.

3.2.2. Identification of behaviour change techniques associated with effectiveness

A lack of reporting of intervention description made extraction of BCTs difficult. Table 3 presents an overview of the BCTs identified within each 'effective' intervention. Where information about intervention content was reported, the most common BCTs reported were "instructions on how to perform the behaviour" and "goal setting (behaviour)".

It must be recognised that these studies were focussed on a range of interventions targeting a range of primary outcomes (see Table 2) which did not always include pain, but pain was one domain of one outcome that could be assessed and reported. The BCTs were therefore often targeting some increase in physical exercise, psychological state or other disease-based functionality, the side effect of which, could have improved the participants pain experiences, but in most cases did not.

Where information was reported on intervention content, all interventions reporting a clinically meaningful improvement in pain outcomes ($n = 7$ out of 29) provided a degree of instruction for study participants', and two of the three provided goal setting and feedback on behaviours.

3.2.3. Pain in COPD

Pain, PCS and MCS outcome measures taken at baseline were extracted from each intervention and control group in the studies or calculated from domain data where possible. The mean pain scores ranged from 8.15 to 77.50 with a weighted mean for the whole sample of 54.53. Excluding the outliers in the Ozturk [65] study (determined by observing box plots and extracting them from the sample) resulted in a range of 35.1–77.5 and a weighted mean pain score of 55.90. Weighted means for the PCS and MCS were 33.34 and 42.43 respectively.

3.3. Certainty of evidence and reporting biases

The quality of evidence reviewed was variable (see Tables 4 and 5 for RCT and non-RCT quality ratings respectively) with five RCT's indicating low risk of bias, eight indicating moderate risk of bias, twelve indicating high risk of bias and all four non-RCTs showing moderate risk of bias.

4. Discussion

To our knowledge, this is the first systematic review to investigate the effect of non-pharmacological and non-invasive interventions on chronic pain in individuals with COPD. There were three main findings: (1) non-pharmacological and non-invasive interventions trialled to date, have a limited positive effect on pain management in people with COPD. (2) A lack of reporting of detailed intervention methodology makes identification of active intervention ingredients problematic, therefore assessment of intervention ingredients associated with effectiveness could not be performed. (3) Pain appears to be an issue, but specific or broader pain measures are not commonly used in people with COPD.

4.1. Included interventions had a limited impact on pain

It is recognised that the interventions examined in this review were not primarily designed to target chronic pain in the COPD population but were developed to target more general symptoms of COPD. Only one had a treatment component that specifically targeted pain as part of the symptomology of the disease [70], and one [66] specifically looked for pain as a primary outcome. However, all included a QOL measure where pain was a factor in the domains being assessed. Although a meta-analysis was not conducted due to heterogeneity, the evidence suggests existing non-pharmacological and non-invasive interventions trialled to manage COPD do not currently improve chronic pain for people with COPD to a level that is clinically meaningful.

Despite PR [18] being recommended for people with COPD and having undisputable physical and psychosocial benefits it does not appear to improve pain. This is in line with recommendations from other published studies [23]. Research suggests that without a specific overt focus on pain assessment and management, people with COPD can be discouraged from raising pain as an issue and therefore it could be either missed as a comorbidity or unintentionally mismanaged as a result [7]. Furthermore, some health professionals report feeling apprehensive about their training and knowledge in this area [7].

The findings point to an unmet need in addressing pain within COPD management. Potential solutions may lie in incorporating best-practice non-pharmacological pain management to COPD through training and provision of supporting materials. Effective biopsychosocial interventions for chronic pain often include a range of factors common to

Table 1
Summary of included study characteristics showing study location, design, intervention details, control, delivery, participant age, male bias, COPD severity, N, setting and main outcomes. (Key at foot of table).

Study, Location & Design	Intervention	Control	Intervention Delivered by	Participants Age Mean (SD) years *	% Male	COPD severity **	N (at start)	Intervention Setting	Outcomes (Direction of effect between groups differences at post intervention, p value)
Pulmonary Rehabilitation									
[46]; UK; RCT	6-week multidisciplinary rehabilitation programme (18 visits). Educational activities - breathing, secretion clearance, nutrition, exercise, medications, and 30 min exercise aerobic and resistance, psychological issues - stress management and relaxation, mastery and control over illness, goal setting.	Standard medical management as outpatient.	Occupational therapy, physiotherapy, and dietetic staff, specialist respiratory nurse and a smoking-cessation counsellor	I 68·2 (8·2) C 68·3 (8·1)	60	Moderate to very severe	200	Outpatient pul rehab	Pain; + ns PCS; + p < 0.001 MCS; + p < 0.001 Dyspnoea; + M p < 0.001 Cap for Exe; + M p < 0.001 COPD health status; + M p < 0.001
[47]; Sweden; RCT	Pul rehab - multidisciplinary 2 × 1 h sessions per week for 12 weeks, exercise, aerobic and strength, nutritional advice, self-care and energy saving techniques, disease education, medications, exacerbation management, smoking cessation, breathing,	Usual care (undefined) - no rehab or care from professionals in those teams	Multidisciplinary, comprising a physiotherapist, dietician, occupational therapist and a nurse.	I 66 (6) C 64 (6)	50	Moderate to severe	30	Outpatient pul rehab	Pain; - ns PCS; - MCS; - Dyspnoea; NR Cap for Exe; + ns COPD health status; - ns
[48]; India; nRCT	Pul rehab 20 min of 3x exercise (60 min total) 3 weekly for 3 weeks - self management education specifically related to COPD and three different types of exercises: (i) walking; (ii) biking; and (iii) resistance exercises. Duration increased as walking time increased to max 20 min walking.	Usual care - kept under observation as an outpatient	Not stated	I 63.4 (7.31) C 63.8 (9.16)	80	Moderate to very severe	30	Hospital inpatients then discharged as outpatients	Pain; + M ns PCS; + M MCS; + M Dyspnoea; - ns Cap for Exe; + M p = 0.013 COPD health status; NR

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Table 1 (*continued*)

Study, Location & Design	Intervention	Control	Intervention Delivered by	Participants Age Mean (SD) years *	% Male	COPD severity **	N (at start)	Intervention Setting	Outcomes (Direction of effect between groups differences at post intervention, p value)
						Total		260	
Combined Exercise									
[49]; Australia; RCT	Adding supervised exercise to a Chronic Disease Self-Management Program (**CDSMP**). 6 weeks of a 1-h, weekly, supervised group exercise session of aerobic and strengthening exercises	6-week CDSMP only (usual care)	Physiotherapist –investigator (Intervention) and Physiotherapy assistant (control)	I 64.5 (9.13), C 67.1(9.41)	54	Mild to severe	81	Pulmonary rehabilitation referrals at local hospital	Pain; + ns PCS; + ns MCS; - ns Dyspnoea; + Cap for Exe; 0 ns COPD health status; NR
[50]; Japan; RCT	12 weeks of aerobic combined with strength training (**AERO + ST**) or combined with recreational activities (**AERO + RA**) and a control group. AERO = 3 weekly 20-min walking exercise sessions; ST = 3 × 10 repetitions of 4 exercises, 60-min relaxation and breathing exercises; **RA** = training using exercise balls	No exercise program	Not noted	ST 69.0 (8.7) RA 68.1 (4.4) C 69.9 (7.1)	No details	Moderate to very severe	60	Outpatient clinic at university institute	**AERO + ST** Pain; + % changes only listed - starting point not known ns PCS; NR MCS; NR Dyspnoea; - ns Cap for Exe; + $p < 0.05$ COPD health status; NR **AERO + RA** Pain; - % changes only listed - starting point not known ns PCS; NR MCS; NR Dyspnoea; - ns Cap for Exe; + M $p < 0.05$ COPD health status; NR
[51]; Portugal; nRCT	Combined group CG - combined training (aerobic and strength) (**COMB**), and aerobic group (**AG**). 3 × 30 min sessions/week over 10 weeks	Respiratory physiotherapy RP group - breathing control and bronchial clearance techniques 46 ± 17.1 min per session	Not noted	AG 63.0 (1.7) ComG 64.5(2.5), RP (control) 63.0 (4.3)	100	Moderate to severe	100	National Health Service centres - primary care based	**COMB** Pain; + M ns PCS; + M MCS; + Dyspnoea; NR Cap for Exe; NR COPD health status; + M $p < 0.05$ **AG** Pain; + ns PCS; + M MCS; + Dyspnoea; NR Cap for Exe; NR

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Table 1 (*continued*)

Study, Location & Design	Intervention	Control	Intervention Delivered by	Participants Age Mean (SD) years *	% Male	COPD severity **	N (at start)	Intervention Setting	Outcomes (Direction of effect between groups differences at post intervention, p value)
									COPD health status; + M ns
						Total	241		
Interval/HIIT/Resistance Training									
[52]; Sweden; RCT	Interval training - 3 min interval training - Training sessions were twice a week for 16 weeks, session duration approximately 90 min. A criterion for fulfilling the training was participation in at least 24 of the 32 sessions	Continuous training -group cycled for 27 min each session at target load	Physiotherapist	I 65 (7) C 64 (8),	15% of completers (not reported for whole sample)	Moderate to severe	100	Outpatients' physio unit	Pain; + ns PCS; + MCS; + Dyspnoea; - ns Cap for Exe; - ns COPD health status; NR
[53]; USA; RCT	Resistance (weight) training increased weights single set of 5 exercises during 13 of the 16 PR sessions for less than 10 min	Pul rehab 16 20–40 min sessions 2 x a week for 8 weeks (also included weights but not increased during the session)	Supervising staff (undefined)	I 71.0 (3.7) C 69.9 (6.3)	26	Severe	19	Hospital based PR programme	Pain; - ns PCS; 0 MCS; 0 Dyspnoea; NR Cap for Exe; - ns COPD health status; NR
[54]; Sweden; RCT	8 weeks of Resistance training using elastic bands 3 × 1 h/week with patient education (4 x) COPD specific anatomy, causes, mechanisms, and treatments	Education only	Physiotherapists	I 69(5) C 68 (6)	50	Moderate to very severe	44	Not noted in paper	Pain; - ns PCS; - ns MCS; + ns Dyspnoea; NR Cap for Exe; + M P = 0.005 COPD health status; + M ns
[55]; Sweden; nRCT	High intensity physical group training in water (**W**) and on land (**L**), aerobic & strength component for 45 min, 3x a week for 12 weeks.	usual care - no intervention	Physiotherapists	W 65 (4), L 65 (7), C 63 (7)	37	Moderate to severe	43	Outpatients	Water Pain; + M ns PCS; + ns MCS; 0 ns Dyspnoea; NR Cap for Exe; + M ns COPD health status; - ns Land Pain; - ns PCS; 0 ns MCS; 0 ns Dyspnoea; NR Cap for Exe; + M p = 0.008 COPD health status; - ns
						Total	206		
Inspiratory muscle training/breathing									
[56]; USA; RCT	Exercise plus harmonica playing - says is pul rehab but no	Says is pul rehab but no detail given apart from exercise. No other	A member of the PR staff (e.g., registered nurse, respiratory	I 71.9 (8.4) C 69.0 (9.6)	Not reported but states groups were homogeneous.	Severe	45	Outpatient PR programme	Pain; - ns PCS; NR MCS; NR

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Table 1 (*continued*)

Study, Location & Design	Intervention	Control	Intervention Delivered by	Participants Age Mean (SD) years *	% Male	COPD severity **	N (at start)	Intervention Setting	Outcomes (Direction of effect between groups differences at post intervention, p value)
	detail given apart from exercise. No other education or counselling. Patients were given practice exercises to perform for at least 5 min, but not exceeding 20 min twice/day, 5 days/week. Exercise conditioning was conducted twice a week for 8–10 weeks or a total of 16 sessions. Aerobic and resistance exercise.	education or counselling.	therapist, or exercise physiologist).						Dyspnoea; + ns Cap for Exe; + M ns COPD health status; NR
[57]; UK; RCT	7 -week, home-based inspiratory muscle training programme using POWERbreathe inspiratory muscle trainer, 2 sessions per day, 1 in the am and 1 in the pm (5 h apart), 6 days/. Each session a minimum of 30 breaths in the device	Sham procedure shown to have no effect	physiotherapist	I 70.1 (8.4) C 71.1 (9.6)	64	Moderate to severe	68	Respiratory outpatient clinics, GP practices and British Lung Foundation Breathe Easy groups	Pain; + ns PCS; NR MCS; NR Dyspnoea; + ns Cap for Exe; + ns COPD health status; NR
[45]; UK; RCT (pilot)	12, once weekly, hour long, singing and breathing exercise sessions, physical warm up, breathing exercises, vocal warms ups, songs and a cool down. Daily practice encouraged.	Usual care – no intervention	Professional singing teacher	I 72.1 (9.65) C 69.89 (9.36)	50% but groups unbalanced	Not reported	18	Online	Pain; + ns PCS; - ns MCS; + ns Dyspnoea; + ns Cap for Exe; - ns COPD health status; - ns
						Total	131		
Yoga									
[58]; Japan; RCT (pilot)	10 min of laughter yoga before each PR training session including deep breathing with laughter and hand clapping	Usual care - 2 weeks pul rehab without laughter yoga - 5x education sessions over 2 weeks, medication, and nutrition education where necessary.	Nurse	75.5(6.4)	88	Moderate	8	Hospital outpatients enrolled in pul rehab	Pain; - ns PCS; + MCS; + Dyspnoea; + ns Cap for Exe; - ns COPD health status; + ns
						Total	8		
CBT/MI Studies									
[59]; USA; RCT	Coping Skills training (CST) cognitive-behavioural	COPD Education (COPD-ED) −12 weekly and 2 biweekly	I - clinical psychologists C - health educator	66.1 (8.3)	61	Moderate to very severe	326	University medical centres	Pain; 0 ns PCS; - MCS; - Dyspnoea; +

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Table 1 (*continued*)

Study, Location & Design	Intervention	Control	Intervention Delivered by	Participants Age Mean (SD) years *	% Male	COPD severity **	N (at start)	Intervention Setting	Outcomes (Direction of effect between groups differences at post intervention, p value)
	coping skills over the telephone by clinical psychologists 30 min weekly for 12 weeks and biweekly for 1 month (14 sessions total over 16 weeks). 1) education about stress and pulmonary health; 2) training in a variety of coping skills (e.g., relaxation, problem solving, cognitive restructuring); 3) promotion of physical activity with individualized activity prescription and 4) maintenance and generalization.	telephone calls from a health educator covering pulmonary physiology, medication usage, nutrition, and symptom management.							Cap for Exe; + $p < 0.05$ COPD health status; + ns
[60]; Netherlands; RCT	Pul rehab plus motivational interviewing lifestyle physical activity counselling program with feedback of a pedometer. 4 × 30 min counselling sessions over 7 weeks of the rehab programme	Pul rehab alone - exercise training, dietary intervention, and psycho-educational modules	physical therapists and counsellors	I 65.7 (10.4), C 62.5 (12.3)	43	Moderate to very severe	21	Patients entering pul rehab at University Centre for Rehabilitation	Pain; + M ns PCS; NR MCS; NR Dyspnoea; NR Cap for Exe; + ns COPD health status; - ns
[61]; USA; RCT	One 2 h session of group CBT with specific components including relaxation training, cognitive interventions, and graduated practice, followed by homework and weekly calls for 6 weeks. interventions with demonstrated success for reducing symptoms of anxiety, with specific components addressing education, relaxation, cognitive	COPD 2 h education and weekly calls	I - board-certified geropsychiatrist C - Board-certified internist	71.3 (5.9)	83	Moderate to very severe	53	Veterans Affairs Hospital	Pain; - ns PCS; 0 MCS; + Dyspnoea; NR Cap for Exe; + ns COPD health status; NR

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Table 1 (*continued*)

Study, Location & Design	Intervention	Control	Intervention Delivered by	Participants Age Mean (SD) years *	% Male	COPD severity **	N (at start)	Intervention Setting	Outcomes (Direction of effect between groups differences at post intervention, p value)
	interventions, and graduated practice via workbooks and audiotapes. Weekly calls - opportunity to ask questions, monitor compliance and increase the probability of continued practice.								
[62]; USA; RCT	8 sessions of group CBT 1-h each, (1) education and awareness training focused on anxiety, depression and associated physiological, cognitive and behavioural symptoms (session 1); (2) relaxation training (session 2); (3) increasing pleasurable activity and decreasing anxiety-related avoidance (sessions 2–3); (4) cognitive therapy (alternative thoughts, encouraging self-statements, and thought-stopping) (sessions 4 and 5); (5) problem-solving techniques (session 6); (6) sleep management skills (session 7); and (7) skills review and planning for maintenance of gains (session 8). Each session began with group discussion and review of symptoms, practice exercises and motivational interviewing techniques, instruction and practice in a new skill were provided. Finally, additional home-practice exercises were assigned.	8 sessions of group COPD education 1-h each (45-min lectures/15-min discussions, designed to control for contact time and group social support), breathing strategies and airway management, pathophysiology of lung disease, medications, use of oxygen, avoidance of environmental irritants, nutrition, exercise, smoking cessation and end-of-life planning	Psychology interns and postdoctoral fellows with significant experience in CBT for anxiety and depression for both I & C groups.	I 66.1 (10.1) C 66.5 (10.4)	96	Moderate to very severe	238	Veterans Affairs care facility patients and community	Pain; + ns PCS; 0 MCS; + ns Dyspnoea; 0 ns Cap for Exe; + ns COPD health status; - $p < 0.05$

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Table 1 (*continued*)

Study, Location & Design	Intervention	Control	Intervention Delivered by	Participants Age Mean (SD) years *	% Male	COPD severity **	N (at start)	Intervention Setting	Outcomes (Direction of effect between groups differences at post intervention, p value)
[63]; Australia; nRCT	Mentoring for self-management, based on motivational interviewing, 12 months, regular visits/tel calls, no. of visits/calls or duration not specified, goals setting, action planning. combined with daily diary symptom monitoring	Usual care (Undefined)	Community health nurses	I 66.5 (9.5) C 69.7 (9.4)	43	Severe to very severe	101	Post exacerbation admissions to hospital	Pain; + ns PCS; + MCS; error in data reported Dyspnoea; + ns Cap for Exe; NR COPD health status; NR
						Total	739		
Self-Management interventions									
[64]; Australia; RCT	2 interventions - nurse assisted medical management (**MM**) and nurse assisted collaborative management (**CM**). Initial contact in pts home then once a month by telephone - review of symptoms and medications; education about COPD, symptoms, and medications; smoking cessation; a written action plan for worsening symptoms; and completion of a letter to their primary care physician describing the patient's status and, if indicated, suggestions for modifying management to be consistent with GOLD guidelines. CM included additional focus of collaborative care - patient centred and intended to facilitate the adoption of healthy behaviours including lifestyle and self-management skills	Usual care - given 2 educational booklets and advised to follow advise of physician.	Nurses	(At follow up) 69.0 (8.2)	43	Moderate to severe	217	Primary care clinics	**MM** Pain; + ns PCS; + MCS; 0 Dyspnoea; NR Cap for Exe; NR COPD health status; + M **CM** Pain; + M ns PCS; + MCS; + Dyspnoea; NR Cap for Exe; NR COPD health status; + M
					89		80		Pain; + ns

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Table 1 (*continued*)

Study, Location & Design	Intervention	Control	Intervention Delivered by	Participants Age Mean (SD) years *	% Male	COPD severity **	N (at start)	Intervention Setting	Outcomes (Direction of effect between groups differences at post intervention, p value)
[65]; Turkey; RCT	Multidisciplinary self-management training and biweekly phone counselling included physical activity, chest physiotherapy, motivational sentences, action planning, meds, nutrition, psychological information. Chest disease specialist: Normal lung function and COPD pathophysiology, Proper use of medicines, Inhaler device training, Oxygen therapy, Smoking cessation attempt, Prevention of attacks and early treatment Indications for referral to health facilities. Physiotherapist: Maintaining the benefits of exercise and physical activity, Respiratory manoeuvres, Placement of a motion pattern in the thoraco-abdominal region, Diaphragmatic respiration, Slow and deep breathing, Respiratory control, Respiratory training to reduce the dynamic hyperinflation of the rib cage, Lip breathing, Relaxation exercises, Bronchial hygiene techniques, Effective coughing, Huffing Postural drainage, Energy saving and daily work simplification techniques, Strengthening and endurance exercises to	Standard care (undefined)	Multidisciplinary team - Chest disease specialist, Physio, Psychologist, Dietician	I 64.55 (8.21) C 60.93 (8.59)		Moderate to severe		Outpatient Pul rehab clinics	PCS; 0 MCS; + Dyspnoea; + M Cap for Exe; NR COPD health status; + $p < 0.001$

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Table 1 (*continued*)

Study, Location & Design	Intervention	Control	Intervention Delivered by	Participants Age Mean (SD) years *	% Male	COPD severity **	N (at start)	Intervention Setting	Outcomes (Direction of effect between groups differences at post intervention, p value)
	increase exercise capacity, Psychologist: Psychological assessment, To cope with chronic illness, Evaluation of leisure time, Directing the necessary events to the Mental Health Support Unit. Dietitian: Nutritional training in COPD								
[66]; USA; RCT	Retrospective secondary analysis based on RCTs. Physical activity intervention consisting of a pedometer plus a self-management website that provides goal setting, feedback, motivational messages, educational content, and social support.	usual care and usual care of pedometer only - assessing the impact of the online web based self-management platform	Online	I 69 (8) C 71 (8)	98	Not reported	373	Veterans' hospital clinics	Pain; + p < 0.05 PCS; NR MCS; NR Dyspnoea; NR Cap for Exe; + ns COPD health status; NR
[67]; Australia; RCT	Regular calls to manage illness issues and health behaviours −16 × 30 min over 12 months, with increasing time between calls Smoking, Nutrition, Alcohol, Physical activity, Psychosocial well-being and Symptom management - (1) Psychoeducation about common psychological reactions to COPD diagnosis and treatment; (2) self-management skills training, including goal setting, action planning and problem solving skills to manage setbacks; (3) cognitive coping skills training to identify and challenge negative COPD-related cognitions that	GP care plus non-interventional brief monthly phone calls.	I - community health nurses C - usual care from GP	I 68.2 (7.9) C 67.3 (7.6)	52	Moderate to severe	182	General practice across urban and rural areas	Pain; - ns PCS; + ns MCS; 0 ns Dyspnoea; NR Cap for Exe; NR COPD health status; + ns

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Table 1 (*continued*)

Study, Location & Design	Intervention	Control	Intervention Delivered by	Participants Age Mean (SD) years *	% Male	COPD severity **	N (at start)	Intervention Setting	Outcomes (Direction of effect between groups differences at post intervention, p value)
	impede self-management; (4) communication skills to facilitate discussion between the health mentor (HM) and the patient; and (5) promoting self-efficacy to manage chronic illness.								
						Total	852		
Enhanced Follow Up									
[68]; Canada; RCT	Pul rehab with enhanced follow up - education, psychosocial support and supervised exercises and breathing 5x a week for 6 weeks. Follow up monthly 2 h sessions of discussing concerns and practising home programme. Follow up phone call alternative 2 weeks. 12 months of follow up.	Pul rehab - education, psychosocial support and supervised exercises and breathing 5x a week for 6 weeks. Visit to physio every 3 months. Asked standardised questions.	Not stated	I 68 (1.1) C 68 (1.1)	58	Severe	85	Unclear but post rehab programme and ethics granted by university and healthcare centre	Pain; no data ns PCS; NR MCS; NR Dyspnoea; NR Cap for Exe; NR COPD health status; NR ns
[69]; UK; RCT	Pul rehab with follow up - scripted tel call at monthly intervals for 6 months then at 9-, 12- and 15-months post rehab to encourage exercise	Pul rehab 2 x weekly 2 h sessions for 6 weeks. Exercise - aerobic and strength and multidisciplinary education - relaxation, symptom recognition, energy conservation, the disease process and therapies.	Delivered by senior physiotherapist and an assistant. study personnel at assistant physiologist level made the follow up calls.	Com rehab 68.7 (8.3), hosp rehab 69.1 (7.5)	53	Moderate to very severe	326	2x2 community and hospital settings with or without follow up	Pain; ns long term follow-up data not recorded for SF 36 domains only by location PCS; 0 ns MCS; 0 ns Dyspnoea; - ns Cap for Exe; + ns COPD health status; - M ns
[70]; Turkey; RCT	Nursing care delivered during 4 x home visits. "Nursing interventions" were applied for the diagnoses. The patient was told how to adapt to physical and psychological changes caused by COPD and to possible problems. Intervention included pain management	No nursing care until after trial	The researcher	I 60.72 ± 4.73 C 61.95 ± 2.60	74	Mild to Very severe	84	Community - home based	Pain; + M p < 0.05 PCS; + MCS; + Dyspnoea; NR Cap for Exe; NR COPD health status; NR

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Table 1 (*continued*)

Study, Location & Design	Intervention	Control	Intervention Delivered by	Participants Age Mean (SD) years *	% Male	COPD severity **	N (at start)	Intervention Setting	Outcomes (Direction of effect between groups differences at post intervention, p value)
[71]; New Zealand; RCT	Chronic disease management programme - enhanced care/ follow up on top of existing pulmonary rehabilitation programme – implemented by the usual GP and practice nurse with support from a respiratory physician and a respiratory nurse specialist to put in place a care plan to undertake regular maintenance checks and set achievable goals for lifestyle changes. Symptoms management advise, smoking cessation education medication and inhaler use, annual flu vaccine. Monthly reviews and enhanced input if symptoms worsened	Usual care including pulmonary rehab, but no care plan or specialist follow up	Existing primary care team, with support from a respiratory nurse specialist and respiratory specialist physician	mean 68 years, range: 44–84 years	41.5	Not reported	135	Primary care from 51 GP practices	Pain; + ns PCS; + MCS; 0 Dyspnoea; + ns Cap for Exe; + ns COPD health status; NR
						Total	630		
Telephone monitoring									
[72]; Netherlands; RCT (pilot)	A regular outpatient visit by the pulmonologist at baseline and after 6 months. bi weekly telephone monitoring and follow up if signs of exacerbation are present. brief introductory conversation followed by administration of CCQ. if score exceeded MCID of 0.4 points, pulmonologists were notified immediately to contact the patient. The pulmonologist then inquired about signs and	A regular outpatient visit at baseline and after 6 months by the pulmonologist. Interim outpatient visits were planned at 2 and 4 months with a pulmonary nurse practitioner.	Registered nurses	I 68 (9) C 68 (9),	67	Severe	101	Outpatients dept	Pain; + ns PCS; NR MCS; NR Dyspnoea; NR Cap for Exe; NR COPD health status; - ns

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Table 1 (*continued*)

Study, Location & Design	Intervention	Control	Intervention Delivered by	Participants Age Mean (SD) years *	% Male	COPD severity **	N (at start)	Intervention Setting	Outcomes (Direction of effect between groups differences at post intervention, p value)
	symptoms of an exacerbation.								
						Total	101		
Education [73]; Iran; RCT	3 sessions educational intervention of 60–90 min over 6 weeks and 2 sessions of follow-up intervention intervals of 2 weeks over 5 weeks - 1. Review of chest anatomy, the causes of COPD, aggravating factors, mitigating factors, and complications, lifestyle (including physical activities, staying away from dust, etc.) 2. Definition of healthy lifestyle and the relationship between lifestyle and disease attacks and the number of hospitalization and quality of education 3. Awareness, attitude, and function to participate in care and treatment procedures. Follow up visit - continuing the care program and engaging the patients, project evaluation.	Not defined	Nurse	Not reported	77	Not reported	60	Teaching hospital affiliated with university	Pain; + M − p > 0.001 PCS; + MCS; + Dyspnoea; NR Cap for Exe; NR COPD health status; NR
						Total	60		

*I = Intervention; C = Control; ** COPD severity not recorded in the study was calculated with reference to the Graduation of Severity of Airflow Obstruction Chart (NICE, 2018) where possible; RCT = Randomised controlled trials; nRCT = non-randomised/other forms of trials; '+', favourable or positive change; '− ', unfavourable or negative change; 'ns', not significant between group difference; M = improvement of greater than one minimal clinically important difference unit of the outcome scale used; NR = not reported; 0 = no change; Cap for Exe = Capacity for exercise; Pul rehab = pulmonary rehabilitation; PCS = SF 36 Physical Component Score; MCS = SF 36 Mental Component score; CBT = cognitive behavioural therapy; CCQ = Clinical COPD Questionnaire; mins = minutes; hr = hour. Significance noted where reported in study.

PR [30]. For non-COPD populations they are recommended to include pain education, exercise, and psychological components to increase motivation to change and reduce pain salience and fear around pain preventing sufferers living valued lives [28,74–78]. Some of these intervention components are already part of PR programmes (see Fig. 2). Where PR already includes tools to manage disease symptomology, encourage exercise, good nutrition and is mindful of people's emotional status, additional training in up-to-date pain management information or pain neuroscience education may be required to make PR programmes more effective in managing pain.

Evidence suggests that pain, anxiety, and dyspnoea may activate similar neural networks [79,80]. Whilst some pain may be caused by biological factors of the COPD disease, some elements of the pain may be due to the pain system "going chronic" and therefore be characteristic of

Table 2
A summary of intervention types reported and intervention targets within included studies and the study designs and outcome measure used.

Study	Outcome Measures	Intervention target	Interventions used									
			Pulmonary rehabilitation	Exercise	Interval/ Resistance /HIIT	Inspiratory Muscle Training/ Breathing	Yoga	CBT/ MI	Self-Management	Enhanced follow up	Telephone or digital monitoring	Education
Griffiths, et al, 2000	SF36	Healthcare utilisation, exercise capacity, QOL, health status	x									
Theander, et al, 2009	SF36	Fatigue, functional status, performance and satisfaction, exercise capacity, grip strength, Health perception, QOL	x									
Ali, et al 2014	SF36	Exercise capacity, QOL	x									
Cameron-Tucker, et al, 2014	SF36	Exercise capacity, stage of change, self-efficacy, dyspnoea, QOL, self-management		x					x			
Nakamura, et al, 2016	SF36	Muscular strength, endurance, exercise capacity, QOL, respiratory muscle strength, pulmonary function		x	x							
Pereira, et al 2010	SF36	Health status, QOL		x	x	x						
Arnardottir, et al 2007	SF36	Exercise capacity, HRQOL, dyspnoea, mental health, physiological response, QOL			x							
Benton, & Wagner, 2013	SF36	Muscular strength, endurance, QOL	x		x							
Nyberg, et al, 2015	SF36	Exercise capacity, upper extremity functional capacity, QOL, muscular function, endurance, HRQOL, anxiety, depression, self-efficacy, dyspnoea, fatigue			x							x
Wadell, et al, 2004	SF36	Exercise capacity, HRQOL, QOL,		x	x							
Alexander & Wagner 2012	SF36	Respiratory status, QOL, Functional capacity, Exercise capacity		x		x						
Nikoletou, et al, 2016	SF36	Respiratory function and strength, exercise capacity, anxiety, depression, QOL				x						
Philip, et al, 2020	SF36	QOL, disease impact, dyspnoea, depression, anxiety, balance confidence, physical activity				x						
Fukuoka, et al 2016	SF36	QOL, HRQOL, depression, anxiety, exercise capacity, dyspnoea	x			x	x					
Blumenthal, et al, 2014	SF36	Psychological and somatic QOL, hospitalisation, mortality		x				x				
de Blok, et al, 2006	RAND	Daily activity, fitness, HRQOL, ADL, depression, self-efficacy, QOL	x					x				
Kunik, et al, 2001	SF36	Anxiety, depression, physical & mental function, QOL, treatment satisfaction						x		x		
Kunik, et al, 2008	SF36	Anxiety, depression, QOL, HRQOL, exercise capacity, healthcare utilisation						x				x
Wood-Baker, et al, 2012	SF36	Weight, lung function, QOL, anxiety, depression, comorbidity, exacerbations						x	x			
Coultas, et al, 2005	SF36	QOL, HRQOL, illness intrusiveness, healthcare utilisation							x			
Öztürk, et al, 2020	SF36	Lung function, dyspnoea, health status, HRQOL, QOL, anxiety, depression							x			
Raphaely, et al, 2021	RAND	Pain, physical activity, exercise capacity, pulmonary function, dyspnoea		x					x			
Walters, et al, 2013	SF36	HRQOL, QOL, self-management capacity, anxiety, depression, Trauma, satisfaction with life, hospital admissions							x			
Brooks, et al, 2002	SF36	Exercise tolerance, QOL	x							x		
Waterhouse, et al, 2010	SF36	Exercise capacity, QOL, healthcare utilisation	x							x		
Karasu & Okuyan 2021	SF36	Sexual experiences, QOL								x		
Rea, et al, 2004	SF36	Hospital admissions, QOL, lung function, exercise capacity, Heath status	x						x			
Berkhof, et al, 2015	SF36	Healthcare utilisation, health status, QOL									x	
Mozaffari, et al, 2018	SF36	QOL										x
Total number of studies using each intervention			9	7	6	5	1	5	5	4	1	3

Colour coding indicates Minimal Clinically Important Differences (MCID) or statistically significance levels achieved. Those studies shown in green (7 studies) achieved a minimal clinically important difference in pain improvement for the measure used. Mozaffari et al, 2018, Karasu & Okuyan, 2021 and Raphaely, et al, 2021 achieved statistical significance. Raphaely, et al, 2021, achieved a statistically significant positive impact on pain but at a level below MCID. SF- 36 = 36 Item Short form health survey; RAND = RAND corporation form of the SF- 36; RCT = Randomised controlled trials; nRCT = non-randomised/other forms of trials; HIIT = High Intensity Interval Training; CBT= Cognitive Behavioural Therapy; MI= Motivational Interviewing; QOL = quality of life measured by the SF 36 or RAND; HRQOL= health status or quality of life measured by a disease specific instrument.

other primary chronic pain [81–83]. Evidence suggests this form of pain, together with secondary pain conditions associated with some chronic diseases may be helped using psychosocial interventions [27]. A key element of this is the salience of the pain [80,83,84]. Evidence from qualitative and quantitative studies points to the salience of pain or dyspnoea being stronger for some people compared to others; this could be a differentiating factor in people's perceptions of pain and dyspnoea and therefore their rehabilitation attempts and motivations. This is an avenue in need of future research.

4.2. *Interventions need to be better described in research*

A lack of detail in reporting of intervention methodology made extraction of BCTs difficult. Without this information, we were not able to confidently assess the active ingredients delivered during interventions.

All interventions identified and reported on in this review aimed to change behaviours to improve health outcomes. It was envisaged that improving peoples' ability to exercise or other elements of their disease functionality may have led to improvements in mobility, and therefore pain management, as is evidenced in non-COPD populations (NICE, 2020). It is important to acknowledge that BCTs included within each study reporting improvements in pain were used to target/change behaviours that are known to be associated with pain reduction. Therefore, although those BCTs extracted are from studies where improvements in pain were reported, no definitive conclusions should be made between individual BCTs and improvements in pain. The BCT findings should be considered exploratory, and at best provide guidance in terms of what 'might' be considered useful to include in a future intervention.

Changing individuals' health behaviour requires them to have the capability, opportunity, and motivation to do so [85]. Understanding the evidence-informed theories and models, and how the constructs of these are influenced by each intervention, is therefore critically important to implementing evidence-informed healthcare [86]. Equally important is having sufficient detail of the intervention applied to enable analysis to determine the likely active ingredients that facilitated the behavioural change. The studies included in our systematic review were lacking in terms of theoretical basis and description of intervention methodology, highlighting the need to address this gap within the field.

4.3. *Pain prevalence and impact should be assessed more regularly in people with COPD*

Our review supports previously published literature which suggests pain is a meaningful problem for people with COPD [5,8,11,87]. Despite this review examining studies where pain is not the primary focus, comparing our results with other studies using SF 36 as a pain measure, further supports findings that COPD populations experience more pain than the general population and at similar levels to those with other chronic diseases such as incontinence, cancer, AIDS, fibromyalgia and hyperlipidaemia [88–91].

Despite this, the number of studies, and nature of outcome measures identified by our review, demonstrates that pain measures are not commonly used in this population. This suggests that those responsible for the care of people with COPD have limited awareness of pain as a potential issue in COPD management. Current guidelines do not recommend the assessment of pain in people with COPD [18].

Table 3
BCT analysis of studies suggesting a pain improvement of 1 MCID or more, or statistical significance in improvement (p value shown where study reached significance).

Study	Intervention	Pain Improvement (MCID and p where appropriate)	BCT Category														
			1.1	1.4	1.5	2.2	2.3	2.6	2.7	3.1	4.1	6.1	8.1	8.7	9.1	12.5	12.6
[48]	Pulmonary rehabilitation	+1.0 ns	x	x							x	x	x	x	x		x
[51]	Combined training (aerobic and strength),	+1.7 ns	x	x							x	x	x	x	x		x
[55]	High intensity physical group training in water	+1.6 ns	x	x							x	x	x	x	x		x
[60]	Pulmonary rehabilitation plus motivational interviewing	+1.1 ns	x	x	x		x	x		x	x	x	x	x	x		
[64]	Nurse assisted medical management (MM) and nurse assisted collaborative management (CM).	+1.0 ns		x					x		x						
[66]	Self-Management via website	+0.5 p > 0.005	x				x		x	x	x				x	x	
[70]	Enhanced Nursing Care Follow up	+1.3 p > 0.001	x						x		x						
[73]	Educational intervention	+2.0 p > 0.001				x					x	x					
Total			6	5	1	1	2	1	3	2	8	5	4	4	5	1	3
Count																	

1.1 Goal Setting (behaviour), 1.4 Action Planning, 1.5 Review behaviour goals, 2.2 Feedback on behaviour, 2.3 Self-monitoring of behaviour, 2.6 Biofeedback, 2.7 Feedback on outcomes of behaviours, 3.1 Social Support (unspecified), 4.1 Instructions how to perform the behaviour, 6.1 Demonstration of the behaviours, 8.1 Behavioural practice/rehearsal, 8.7 Graded tasks, 9.1 Credible source, 12.5 Adding objects to the environment, 12.6 Body changes. ns = non-significant; MCID = minimal clinical important differences.

Table 4
GRADE Quality of evidence for RCT studies.

Table 5
GRADE Quality of evidence for non-RCT studies.

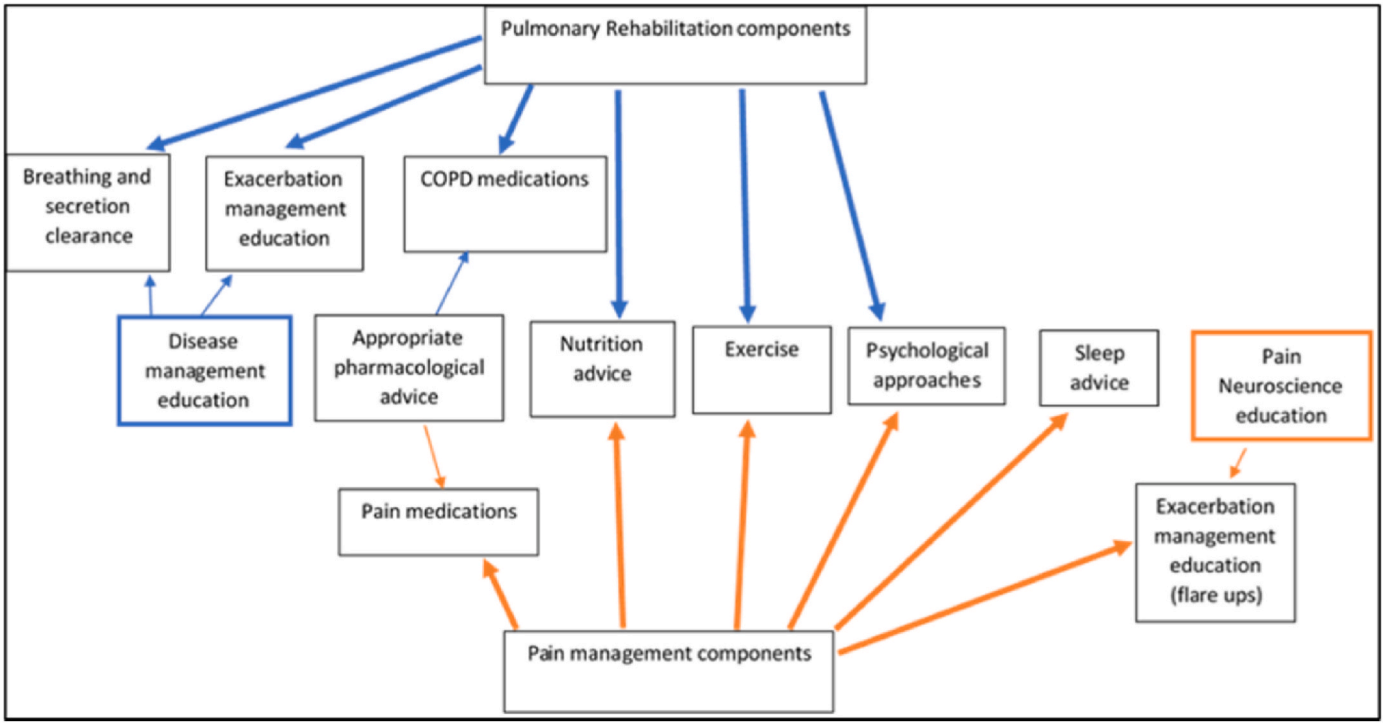

Fig. 2. Components of biopsychosocial pain interventions and the overlap with pulmonary rehabilitation components in COPD management.

4.4. Strengths and limitations

To our knowledge, this is the first systematic review to formally use quality-of-life measures capable of measuring pain outcomes to undertake a comprehensive exploration of the evidence for non-pharmacological interventions addressing pain in people with COPD. We followed a broad search strategy, involving fourteen bibliographic databases and grey literature and can have high confidence that we have identified all relevant studies meeting our eligibility criteria.

BCT protocols require that interventions are coded only where the BCT is explicitly reported in the intervention description. As such, this process was limited by the detail of intervention methodology reported within each study. Where interventions were listed, descriptions were typically brief (e.g., "pulmonary rehabilitation", "education") and the description of the theories/models and mechanisms for behaviour change were not specifically detailed. Many studies outlined the nature of the information conveyed to the participants but failed to note any supportive BCTs that may have been used by staff communicating this knowledge. For example, it is reasonable to assume that any PR process will involve forms of encouragement and support to the participants, but this was not reported by study authors and no taxonomies were used to facilitate intervention reporting/description. The actual content of PR, for example, is likely to vary between studies and provider.

4.5. Deviations from protocol

There were three main deviations from the published protocol (PROSPERO Protocol Registration number: CRD42020172626).

1. Heterogeneity in interventions reported prevented meta-analysis from taking place.
2. Only one mixed methods study was reported, based on a pilot RCT but with the qualitative element reflecting on a change in mode of delivery rather than a usual care comparator. This restricted the amount of possible relevant synthesis.
3. Fourteen databases were used rather than the stated 16 – the search capability of the 2 omitted were not compatible with the complex nature of the search strategies utilised.

4.6. Clinical implications and future direction

Pain is a significant issue for people with COPD, yet assessment and management are not recommended in current clinical guidelines for people within this population.

The focus on disease-specific outcomes means secondary disease complications are often neglected. Research and assessments should therefore be targeted at patient-centred needs and priorities. Research has suggested that people with COPD report higher levels of pain, despite being on high levels of pain medication [8,92] supporting the notion that currently pain management is sub-optimal and potentially too pharmacologically based. This may be because, as suggested by this review, non-pharmacological pain management options are not delivered in this field, and current treatment options are not effective at managing pain. Appropriate theory-informed interventions should be developed, with an accurate account/description of the intervention content used and reported to inform subsequent interventions. This should be an essential component of further research.

4.7. Conclusion

Pain appears to be a significant issue for individuals with COPD. However, intervention heterogeneity and methodological quality limit current knowledge about effectiveness of previously trialled non-pharmacological and non-invasive interventions on pain symptoms in people with COPD. Issues with a lack of detailed reporting prevents identification of intervention content associated with effective pain management. When pain was reduced, "providing instructions on how to perform the behaviour" and "goal setting" appear to be important intervention components but these were not specifically targeted at pain, instead other exercise, psychological or functionality goals. As it stands, the conduct of our systematic review does not enable us to recommend a specific intervention to improve pain in people with

COPD. There appears to be an element of "brain retraining" for pain management missing to make the intervention more effective. Future research should describe interventions in detail and more frequently assess pain in this population to inform the development of an intervention targeting pain management for people with COPD.

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Availability of other materials

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.rmed.2023.107191.

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