Original research

Efficacy of unsupervised exercise in adults with obstructive lung disease: a systematic review and meta-analysis

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ABSTRACT

Introduction The benefits of unsupervised exercise programmes in obstructive lung disease are unclear. The aim of this systematic review was to synthesise evidence regarding the efficacy of unsupervised exercise versus non-exercise-based usual care in patients with obstructive lung disease.

Methods Electronic databases (MEDLINE, CINAHL, Embase, Allied and Complementary Medicine Database, Web of Science, Cochrane Central Register of Controlled Trials and Physiotherapy Evidence Database) and trial registers (ClinicalTrials.gov, Current Controlled Trials, UK Clinical Trials Gateway and WHO International Clinical Trials Registry Platform) were searched from inception to April 2020 for randomised trials comparing unsupervised exercise programmes with non-exercise-based usual care in adults with chronic obstructive pulmonary disease (COPD), non-cystic fibrosis bronchiectasis or asthma. Primary outcomes were exercise capacity, quality of life, mortality, exacerbations and respiratory cause hospitalisations.

Results Sixteen trials (13 COPD, 2 asthma, 1 chronic bronchitis: 1184 patients) met the inclusion criteria. Only data on COPD populations were available for meta-analysis. Unsupervised exercise resulted in a statistically but not clinically significant improvement in the 6-Minute Walk Test (n=5, MD=22.0 m, 95% CI 4.4 to 39.6 m, p=0.01). However, unsupervised exercise did lead to statistically significant and clinically meaningful improvements in St. George's Respiratory Questionnaire (n=4, MD=−11.8 points, 95% CI −21.2 to −2.3 points, p=0.01) and Chronic Respiratory Disease Questionnaire domains (dyspnoea: n=4, MD=0.5 points, 95% CI 0.1 to 0.8 points, p<0.01; fatigue: n=4, MD=0.7 points, 95% CI 0.4 to 1.0 points, p<0.01; emotion: n=4, MD=0.5 points, 95% CI 0.2 to 0.7 points, p<0.01; mastery: unable to perform meta-analysis) compared with non-exercise-based usual care.

Discussion This review demonstrates clinical benefits of unsupervised exercise interventions on health-related quality of life in patients with COPD. High-quality randomised trials are needed to examine the effectiveness of prescription methods.

Key messages

What is the key question?

► Are unsupervised exercise interventions effective for inducing improvements in exercise capacity, quality of life and healthcare use outcomes?

What is the bottom line?

► Unsupervised exercise interventions are effective at improving St. George's Respiratory Questionnaire and Chronic Respiratory Disease Questionnaire domain scores, but do not result in clinically meaningful improvements in the 6-Minute Walk Test.

Why read on?

► This systematic review provides a wealth of information on interventions used to date, as well as synthesised data on commonly used clinical outcomes in relation to unsupervised exercise.

INTRODUCTION

There is a strong evidence base showing the effectiveness of supervised exercise interventions, such as traditional centre-based pulmonary rehabilitation, for the management of obstructive lung disease as demonstrated by improvements in symptoms, exercise capacity and quality of life outcomes.[1–3] When delivered following acute exacerbations of chronic obstructive pulmonary disease (COPD), such supervised interventions also reduce hospitalisations.[4] Despite these points, relatively few people with obstructive lung disease have access to such programmes or may find it difficult to engage with, or adhere to, face-to-face exercise programmes delivered in a supervised setting.[5 6] Barriers to access and long-term adherence include time requirements, travel constraints and the use of specialist equipment, which may not be available in the home setting.[7 8]

With the clear benefits of exercise interventions and the issues surrounding compliance, it is important to adapt programmes to various patient needs. One approach to addressing common barriers with supervised exercise programmes, such as time requirements and travel constraints (for both the healthcare professionals and patients), is to tailor programmes to be delivered in the patient's home in an unsupervised manner. Some studies have compared supervised exercise programmes to unsupervised programmes[9 10] and suggest unsupervised interventions might be able to offer time, space and/

or cost-effective ways to improve exercise adherence, fitness and symptoms. While there have been systematic reviews examining the efficacy of exercise interventions for patients with COPD across different settings, they have not specifically examined the efficacy of unsupervised exercise versus usual care.[11] There is a lack of clarity in the way unsupervised exercise interventions are defined (eg, home rehabilitation, telerehabilitation or self-management programmes), and to the best of our knowledge, there are no reviews to date which have compiled all of the available evidence on unsupervised exercise interventions across multiple obstructive lung diseases. Such evidence would provide valuable information to healthcare providers in the management of obstructive lung disease, particularly in settings where resources are limited for delivering supervised exercise interventions.

The objectives of this systematic review were to establish an up-to-date synthesis of available evidence from randomised controlled trials and to derive estimates of effect for unsupervised exercise interventions on functional exercise capacity, quality of life and healthcare use outcomes for people with obstructive lung disease.

METHODS

The protocol for this study (CRD42018092273) was registered in advance on PROSPERO (International Prospective Register of Systematic Reviews, www.crd.york. ac.uk/PROSPERO/).

Participants/population

Adults (ie, >18 years) with a clinical diagnosis of COPD, non-cystic fibrosis bronchiectasis or asthma, as defined by the authors of included studies, were included.

Intervention

Studies were included if patients were randomised to an unsupervised exercise training intervention. For the purposes of this review, exercise was defined as 'physical activity consisting of planned, structured and repetitive bodily movement done to improve and/or maintain one or more components of physical fitness'.[12] The following criteria were applied for an unsupervised exercise intervention to be considered for inclusion: includes aerobic and/or resistance-based exercises; evidence of prescription to participants (ie, frequency, intensity, time and type of exercise (FITT) principles); a baseline assessment of exercise performance (if assessing exercise capacity as an outcome); can run alongside a supervised or unsupervised education programme; can include an introductory supervised 'run in' period of up to 2 weeks, which is for the purposes of demonstration, instruction or familiarisation, but not a formal supervised programme (eg, pulmonary rehabilitation); and can include remote contact with healthcare professionals using technologies such as telephones or tablet/smart devices, as long as this does not take place during exercise (ie, real-time instruction/coaching).

Comparator

The comparator was any concurrent control group that did not receive an exercise intervention (including referral to pulmonary rehabilitation in the study period). Any study that had a control arm/usual care of non-exercise-based interventions (eg, education, counselling and breathing/relaxation/airway clearance therapy) was still included if the intervention arm also received these treatments.

Outcomes

Primary outcomes were exercise performance/capacity (eg, 6-Minute Walk Test (6MWT), Incremental Shuttle Walk Test (ISWT) and Endurance Shuttle Walk Test (ESWT)), health-related quality of life (HRQoL) (eg, St. George's Respiratory Questionnaire (SGRQ), Chronic Respiratory Disease Questionnaire (CRQ), Hospital Anxiety and Depression Score and Asthma Control Questionnaire), disease impact (Chronic Obstructive Pulmonary Disease Assessment Tool (CAT)), all-cause mortality, exacerbations and respiratory cause hospitalisations.

Secondary outcome measures were all-cause hospitalisations, length of hospital stay, emergency department visits, outpatient visits, general practitioner visits, adverse events, aerobic fitness/capacity, peripheral muscle strength, physical activity levels (PALs) and activities of daily living.

Study design

Studies were considered for inclusion if they adopted a randomised controlled trial design with randomisation of participants at an individual or cluster level or quasi-randomised method. Randomised cross-over trials, up to the point of cross-over, were also eligible.

Search strategy

To identify any relevant ongoing or published systematic reviews, searches were conducted using Database of Abstracts of Reviews of Effects, PROSPERO and the Cochrane Database of Systematic Reviews.

The following bibliographic databases, platforms and trial registers were searched: MEDLINE, CINAHL, Embase, Web of Science Core Collection, Cochrane Central Register of Controlled Trials, Physiotherapy Evidence Database, Allied and Complementary Medicine Database, ClinicalTrials.gov, Current Controlled Trials, UK Clinical Trials Gateway and WHO International Clinical Trials Registry Platform. Searches were completed within each source from inception to April 2020 with no limits set on language. Attempts were made to translate any relevant non-English language texts. These searches were supplemented with internet searches (ie, Google Scholar), Conference Proceedings Index (Web of Science), forward and backward citation tracking from included studies, review articles and contact with study authors.

Search terms were structured around the population (eg, "Lung Diseases, Obstructive"), intervention (eg, "Exercise") and study type (eg, "randomised"). An example of a full search strategy is presented in online supplemental table S1.

Search results were compiled using EndNote referencing software (Clarivate Analytics, Philadelphia, Pennsylvania, USA). Following removal of duplicate citations, two reviewers screened titles and abstracts independently. For studies that were not excluded based on title/abstract, full-text papers were requested and independently assessed by two reviewers for eligibility. Any discrepancies in decisions of study eligibility were resolved through discussion, and, if required, a third reviewer.

Data extraction and quality appraisal

Data extraction was completed using an adapted form on Microsoft Excel based on the Cochrane Data Extraction Template. The characteristics and data extracted are listed in online supplemental table S2. One reviewer undertook data extraction for each study, with the accuracy of this extraction cross-checked by a second reviewer.

Risk of bias (quality) assessment

Two reviewers independently assessed the risk of bias within the included studies using the Cochrane Tool for Risk of Bias, in accordance with the Cochrane Handbook. The domains evaluated were selection bias, performance bias, detection bias, attrition bias, reporting bias and other bias.[13] Each of these domains were categorised as having high, low or unclear risk of bias, with the overall risk of bias for each study then determined as high (more than two 'unclear' domains or more than one 'high'-risk domain), moderate (two unclear domains or one high-risk domain) or low (no unclear or high-risk domains). Any disagreements in risk of bias assessments were resolved through further discussion and, if required, the input of a third reviewer.

Strategy for data synthesis

All meta-analyses were performed using Review Manager V.5.4 and in accordance with Cochrane guidance.[13] We contacted study authors to obtain any missing numerical outcome data. In very few cases, where all methods to obtain data had been exhausted, estimates of effect for individual studies were extracted from previous systematic reviews and guideline documents. Measures of effect were mean differences for all continuous outcomes. We focused on changes from baseline to end of intervention period for continuous outcomes as this was the method of reporting that was most common across studies and to help remove between-person variability from the analysis. For individual studies where SD of changes was not available, we calculated using other reported parameters (eg, 95% CIs), imputed using correlation coefficients derived from other studies in the same meta-analysis or assuming a conservative correlation coefficient of 0.5, or (for unstandardised mean difference estimates only) opted to use post-intervention values only in the analysis. Risk ratios were used for dichotomous outcomes. Individual study data for continuous and dichotomous outcomes were combined statistically using an inverse random-effects method. Statistical heterogeneity in all meta-analyses was interpreted by the I^2 value. In meta-analyses where the I^2 statistic was greater than 40%, potential sources of the statistical heterogeneity were explored. We prespecified subgroup analysis to explore heterogeneity in the primary outcomes according to the following clinical and methodological factors: diagnosis (COPD, bronchiectasis and asthma) and severity of disease; exercise intervention characteristics (FITT principles, methods of delivery or support, including run-in period); comparator (no intervention or non-exercise-based intervention); outcome measures (generic or disease-specific, objective or self-reported); and study design (allocation method/duration of follow-up). There was only one primary outcome where the I^2 statistic was greater than 40% and could be resolved by our prespecified subgroups. For this meta-analysis (SGRQ), heterogeneity was best explained by exercise intervention characteristics. We did not perform subgroup analyses on any other primary outcomes. We also planned to perform sensitivity analysis by excluding studies with a moderate or high risk of bias, but this was not possible due to a lack of studies with a low risk of bias.

RESULTS

After duplicates were removed, searches identified 6240 records for screening, of which 4362 records were excluded based on title and 1602 on abstract. Full texts were obtained for the remaining 276 records, of which 16 studies met the inclusion criteria (figure 1).

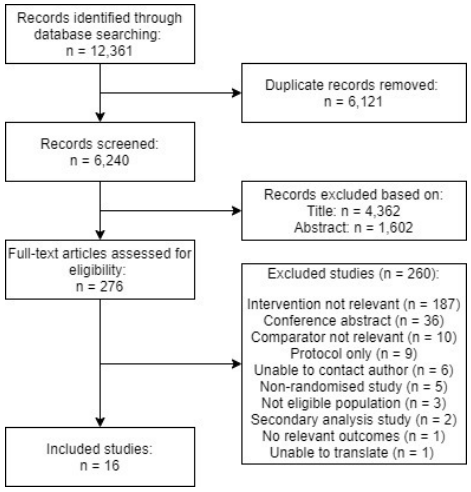

Figure 1 Flow diagram of the study selection.

Characteristics of included studies

The 16 included studies were published between 1977 and 2020 (online supplemental table S3). Of the included studies, 13 focused on COPD[14–26]; 2 focused on asthma[27 28]; and 1 focused on chronic bronchitis[29] as an obstructive lung disease. A total of 1184 patients with obstructive lung disease (1055 COPD, 105 asthma and 24 chronic bronchitis) were randomised, of which 59% were men. Study sample sizes varied in size between 16 and 191 patients. COPD disease severity varied from mild to very severe, and asthma varied from mild to moderate.

All studies were randomised controlled trials, which allocated patients to either a control group (usual care) or to an intervention, including unsupervised exercise. The control group in some studies received educational support,[22 24 25] telephone calls[22 25 26] and clinic follow-ups,[19 29] in addition to usual care. The unsupervised exercise interventions lasted between 6 weeks and 1 year. Exercise sessions varied in session frequency, from 2 days a week to daily exercise. Desired exercise intensity was not reported in all studies, but of those which reported set exercise intensity, there was variation with exercise programmes ranging from moderate to high intensity.[16 18–22 24 26] The designed exercise programmes covered aerobic, resistance and strength training. The characteristics of included studies which were used in the meta-analysis are summarised in table 1. A detailed overview of the characteristics of all eligible studies is shown in online supplemental table S3.

The risk of bias assessment was hindered by poor study reporting (online supplemental table S4).

Primary outcomes

Exercise capacity

6-Minute Walk Test

Meta-analysis of five trials[17 18 22 25 26] in patients with COPD demonstrated a statistically significant improvement in 6MWT performed with unsupervised exercise (MD=22.0 m, 95% CI 4.4 to 39.6 m, p=0.01) (figure 2A). Statistical heterogeneity was not apparent (I^2=0%). However, the magnitude of effect did not meet the threshold of 30 m for clinically important improvement.[30] Four further trials reported 6MWT as an outcome[14–16 20] in a COPD population, but data could not be obtained from one study,[16] and in three other studies,[14 15 20] data could only be retrieved from previous systematic reviews.[1 30 31] Extraction of trial data from previous reviews is not a widely accepted approach, but analysis with the three additional studies is

Table 1 Characteristics of included studies in the meta-analysis

	Bourbeau *et al* 2003[15] (Canada)	Chen *et al* 2018[17] (China)	Elçi *et al* 2008[18] (Turkey)	Hernández *et al* 2000[19] (Spain)	Ho *et al* 2012[21] (Taiwan)	Lahham *et al* 2020[22] (Australia)	Mitchell *et al* 2014[23] (UK)	Moore *et al* 2009[24] (UK)	Nguyen *et al* 2013[25] (USA)	Pradella *et al* 2015[26] (Brazil)
Respiratory diagnosis and disease severity	COPD Stable, moderate–severe	COPD Stable, moderate–very severe	COPD GOLD stages I–IV	COPD Stable, moderate	COPD Stable, mild–very severe	COPD Stable, mild	COPD Stable, mild–very severe	COPD Stable, moderate–severe	COPD Stable, mild–very severe	COPD Stable, mild–very severe
Intervention description and duration	Home-based exercise intervention for 1 year	Home-based lower-limb exercise intervention for 12 weeks	Home-based PR programme targeting lower (walking) and upper limbs (weights) with 24 sessions over 3 months	Home/outdoor-based walking exercise programme for 12 weeks	Home-based walking exercise programme paced to music for 12 weeks	Home-based aerobic (walking) and resistance (upper and lower limb) exercise training for 8 weeks	Home-based manual incorporating education and exercise programme (walking, upper and lower limb resistance training using weights) for 6 weeks	Home-based high intensity interval exercise video/DVD for 6 weeks	Self-management programme incorporating exercise intervention (online or face-to-face) for 12 months	Home-based walking PR programme for 24 sessions
Exercise frequency	3 days/week	3 days/week	2 days/week	6 days/week	5 days/week	5 days/week	Daily (walking), 3 days/week (upper and lower limb training)	4 days/week	4 days/week	3 days/week
Exercise intensity	Guided by Borg score	Best effort, not exceeding Borg score of 5	75% of 6MWT speed (walking)	≥70% of max speed of ISWT	80% VO_2peak initially, increased gradually each month based on ISWT	80% of walking speed from 6MWT Intensity gauged by Borg scale	Not reported	High intensity	Gauged by Borg score	60%–70% HRmax
Exercise time (min)	30–45	20–30	90	60	30	30	30 min (walking), not reported (resistance)	30	30	40
Exercise type	Aerobic and resistance	Resistance	Aerobic and resistance	Aerobic	Aerobic	Aerobic and resistance	Aerobic and resistance	Aerobic and resistance	Aerobic and resistance	Aerobic
Intervention run-in period	Supervised session at home	One study visit	One supervised session	Home visit	One research visit	Home visit	One study visit	One study visit	Home visit	1 week run-in at rehab centre
Additional support	Living well with COPD booklet (supervised education component) Monthly telephone calls	Exercise supervised by family member	Exercise supervised by family member and weekly telephone calls	2-week reviews at hospital	Monthly reviews and progression	Weekly motivational interviewing Better living with COPD booklet	Biweekly phone calls using motivational interviewing	Education material	Biweekly reinforcement and feedback with motivational interviewing	Educational booklet and weekly phone call
Comparator	Same level of care without add-on management programme	Usual care	Usual care	Usual care and 2-week reviews at hospital	Usual care	Usual care and weekly phone calls. Better living with COPD booklet	Usual care	Usual care and education booklet	Usual care, biweekly phone calls and education	Usual care and weekly phone call

COPD, chronic obstructive pulmonary disease; GOLD, Global Initiative for Chronic Obstructive Lung Disease; HRmax, maximum heart rate; ISWT, Incremental Shuttle Walk Test; 6MWT, 6-Minute Walk Test; PR, pulmonary rehabilitation; VO_2peak, peak oxygen consumption.

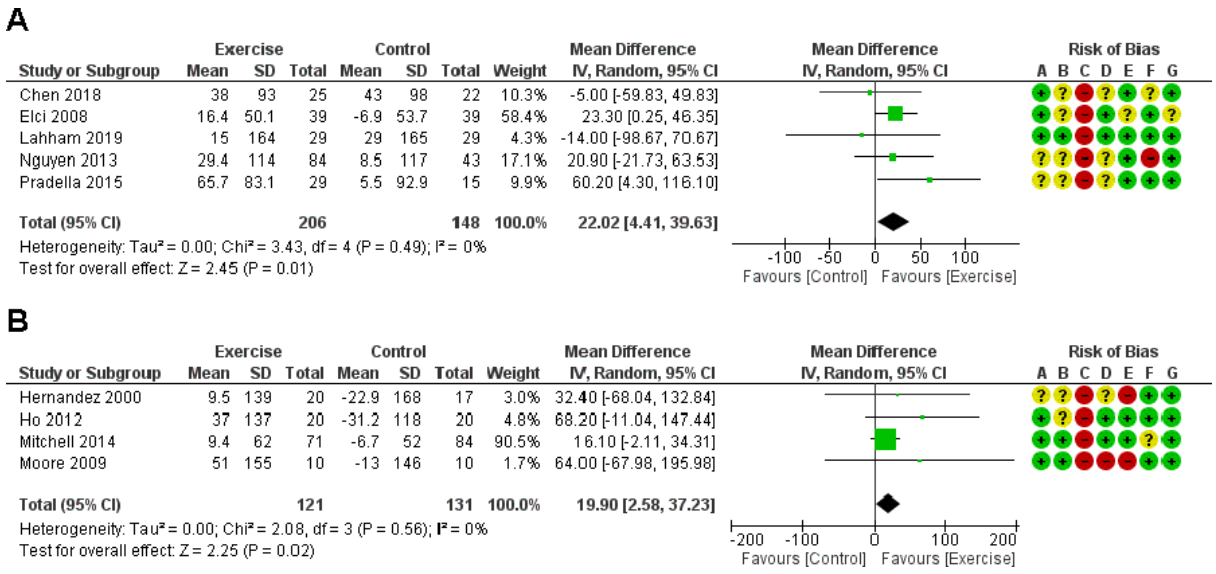

Figure 2 Trial-level data, effect estimates and forest plot of comparison for change in 6MWT distance following an unsupervised exercise intervention versus usual care in studies reporting 6MWT for which data were able to be obtained (A), and for change in ISWT following an unsupervised exercise intervention versus usual care (B). Risk of bias legend: A, random sequence generation (selection bias); B, allocation concealment (selection bias); C, blinding of participants and personnel (performance bias); D, blinding of outcome assessment (detection bias); E, incomplete outcome data (attrition bias); F, selective reporting (reporting bias); G, other bias. 6MWT, 6-Minute Walk Test; ISWT, Incremental Shuttle Walk Test; IV, inverse variance.

provided in online supplemental figure S1. Data from the three studies had a minimal effect on the overall magnitude of effect of unsupervised exercise interventions (MD=25.3 m, 95% CI −1.0 to 51.5 m, p=0.06), but their inclusion led to substantial heterogeneity (I^2=71%).

Incremental Shuttle Walk Test

Meta-analysis of four trials[19 21 23 24] in patients with COPD demonstrated a statistically significant improvement in ISWT performance with unsupervised exercise (MD=19.9 m, 95% CI 2.6 to 37.2 m, p=0.02) (figure 2B). Statistical heterogeneity was not apparent (I^2=0%). However, the intervention effect was heavily weighted towards one trial.[26]

Other reported outcomes

Single trials reported ESWT,[23] Endurance Treadmill Test[26] and 12-Minute Walking Distance [29] as outcome measures in COPD populations; therefore, meta-analyses could not be performed.

HRQoL and disease impact

St. George's Respiratory Questionnaire

Meta-analysis of four trials[15 18 21 26] in patients with COPD showed a statistically significant effect on SGRQ-Total (MD=−11.8 points, 95% CI −21.2 to −2.3 points, p=0.01) and SGRQ-Impact (MD=−12.0 points, 95% CI −19.7 to −4.2 points, p<0.01) scores with unsupervised exercise and favoured intervention effects which were not statistically significant for SGRQ-Symptoms (MD=−6.2 points, 95% CI −14.5 to −2.1 points, p=0.14) and SGRQ-Activity (MD=−12.8 points, 95% CI −25.9 to −0.3 points, p=0.06) scores. However, there was substantial heterogeneity within each domain analysis (SGRQ-Total, I^2=85%, p<0.01; SGRQ-Impact, I^2=74%, p<0.01; SGRQ-Symptoms, I^2=67%, p=0.03; SGRQ-Activity, I^2=89%, p<0.01).

SGRQ (subgroup analysis)

Prespecified subgroup analysis according to intervention period (short term ≤12 weeks vs long term >12 weeks) demonstrated a greater magnitude of effect with short-term intervention for SGRQ (SGRQ-Total, MD=−15.5 points, 95% CI −21.9 to −9.2 points, p<0.01; SGRQ-Impact, MD=−15.4 points, −21.6 to −9.1 points, p<0.01; SGRQ-Symptoms, MD=−9.7 points, 95% CI −18.4 to −0.9 points, p=0.03; SGRQ-Activity, MD=−18.8 points, 95% CI −24.9 to −12.7 points, p<0.01). Heterogeneity was reduced to levels deemed to be unimportant for SGRQ-Total (I^2=33%), SGRQ-Impact (I^2=25%) and SGRQ-Activity (I^2=4%). Heterogeneity was only reduced to moderate levels with SGRQ-Symptoms (I^2=44%) (figure 3A–D). One further trial reported SGRQ as an outcome[28] in asthma patients, but data could not be obtained for meta-analysis.

Chronic Respiratory Disease Questionnaire

Meta-analysis of four trials[19 22–24] in patients with COPD showed a statistically significant improvement on CRQ-Dyspnoea (MD=0.5 points, 95% CI 0.1 to 0.8 points, p<0.01), CRQ-Fatigue (MD=0.7 points, 95% CI 0.4 to 1.0 points, p<0.01) and CRQ-Emotion (MD=0.5 points, 95% CI 0.2 to 0.7 points, p<0.01) scores with unsupervised exercise. Levels of heterogeneity were considered to be unimportant (CRQ-Dyspnoea, I^2=36%; CRQ-Fatigue, I^2=37%; CRQ-Emotion, I^2=0%) (figure 4A–C). There was substantial heterogeneity for CRQ-Mastery scores (I^2=93%, p<0.01). This could not be explained by any prespecified clinical or methodological factors; hence, meta-analysis was deemed inappropriate. One further trial reported CRQ as an outcome[25] in a COPD population, but domain data could not be obtained for meta-analysis.

Medical Research Council (MRC) Dyspnoea Scale

Meta-analysis of three trials[18 19 22] in patients with COPD showed a statistically significant improvement in MRC breathlessness

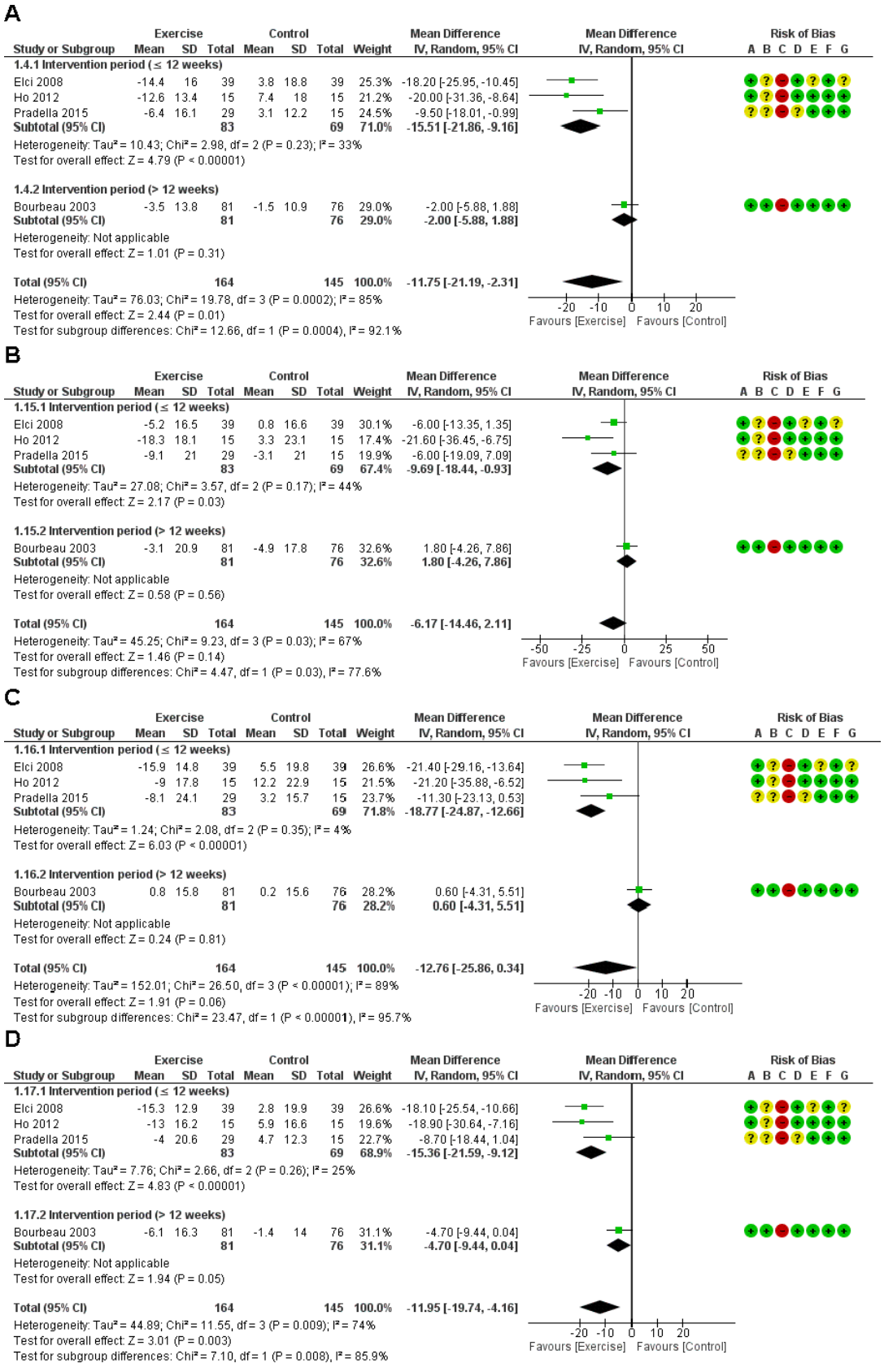

Figure 3 Trial-level data, effect estimates and forest plot of comparison for change in SGRQ-Total (A), SGRQ-Symptoms (B), SGRQ-Activity (C) and SGRQ-Impact (D) scores following an unsupervised exercise intervention versus usual care in all studies reporting SGRQ-Total and domain scores with prespecified subgroup analysis according to duration of interventions. Risk of bias legend: A, random sequence generation (selection bias); B, allocation concealment (selection bias); C, blinding of participants and personnel (performance bias); D, blinding of outcome assessment (detection bias); E, incomplete outcome data (attrition bias); F, selective reporting (reporting bias); G, other bias. IV, inverse variance; SGRQ, St. George's Respiratory Questionnaire.

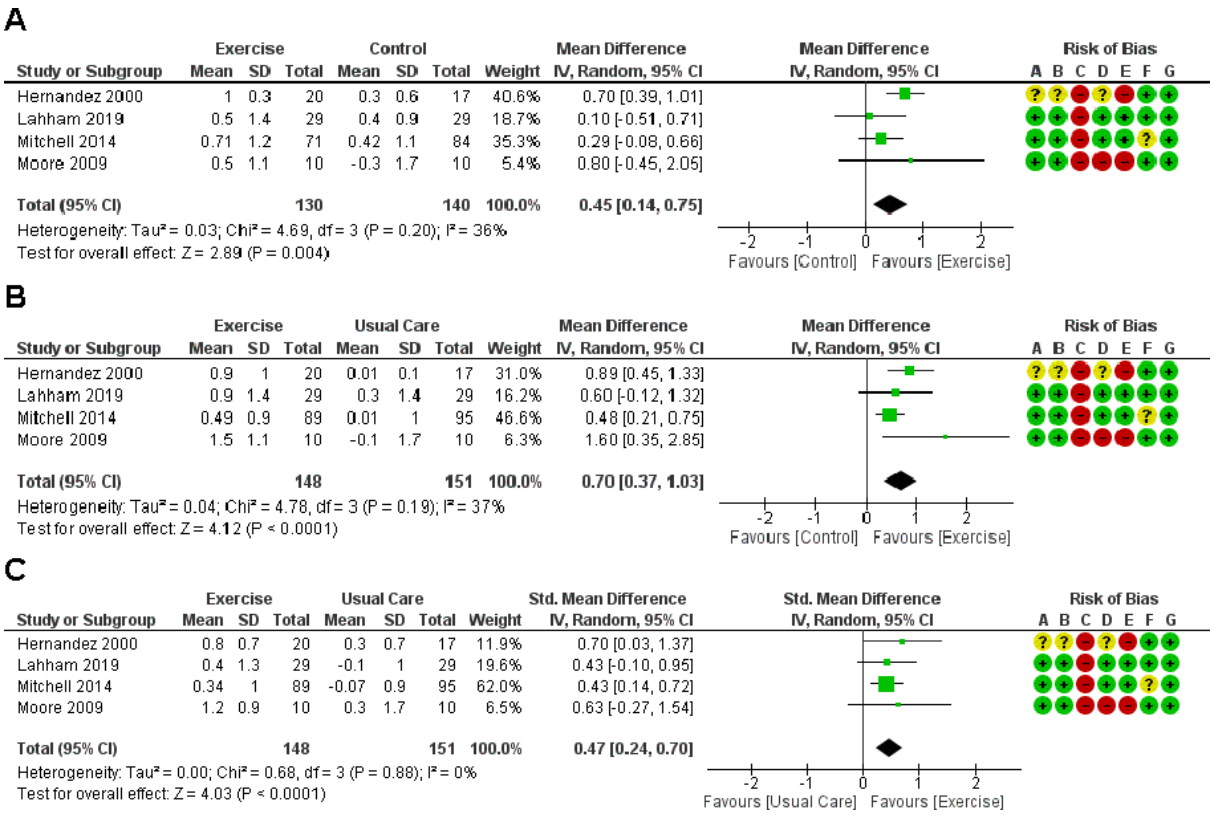

Figure 4 Trial-level data, effect estimates and forest plot of comparison for change in CRQ-Dyspnoea (A), CRQ-Fatigue (B) and CRQ-Emotion (C) scores following an unsupervised exercise intervention versus usual care in all studies reporting CRQ domain scores. CRQ-Mastery scores were not meta-analysed due to substantial unexplained heterogeneity. Risk of bias legend: A, random sequence generation (selection bias); B, allocation concealment (selection bias); C, blinding of participants and personnel (performance bias); D, blinding of outcome assessment (detection bias); E, incomplete outcome data (attrition bias); F, selective reporting (reporting bias), (G) other bias. CRQ, Chronic Respiratory Disease Questionnaire; IV, inverse variance.

score with unsupervised exercise (MD=−0.3 points, 95% CI −0.5 to −0.1 points, p<0.01) (figure 5). Statistical heterogeneity was not apparent (I^2=0%). One further trial[19] reported on dyspnoea using Baseline Dyspnoea Index (BDI) / Transition Dyspnoea Index (TDI) in patients with COPD and therefore was not included in the meta-analysis.

Other reported outcomes

Anxiety and depression in patients with COPD,[14 18 23] asthma control,[27 28] CAT[16 17] and 36-Item Short Form Health Survey in patients with COPD[18 25] were reported as outcomes, but the use of a mixture of different measurement tools and/or being unable to obtain suitable data deemed meta-analysis inappropriate.

Healthcare use

Hospitalisations (respiratory cause), mortality and exacerbations

One trial presented data on respiratory cause hospital admissions, mortality and exacerbations[15]; therefore, a meta-analysis could not be performed for these outcomes. A further trial presented data on respiratory cause hospitalisations,[21] but data could not be obtained for meta-analysis.

Secondary outcomes

Hospitalisations (all cause)

One trial presented data on all-cause hospitalisations[21]; therefore, a meta-analysis could not be performed for these outcomes.

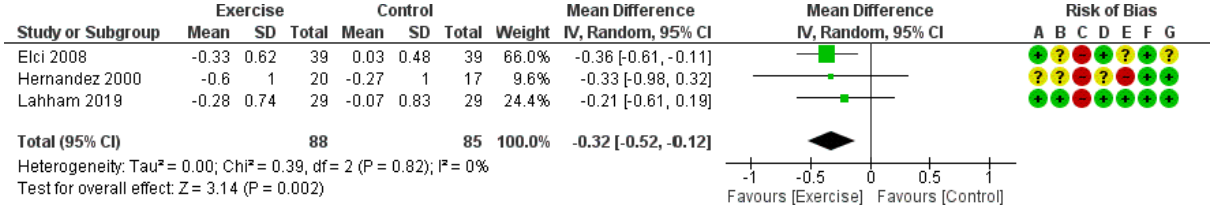

Figure 5 Trial-level data, effect estimates and forest plot of comparison for change in MRC score following an unsupervised exercise intervention versus usual care. Risk of bias legend: A, random sequence generation (selection bias); B, allocation concealment (selection bias); C, blinding of participants and personnel (performance bias); D, blinding of outcome assessment (detection bias); E, incomplete outcome data (attrition bias); F, selective reporting (reporting bias); G, other bias. IV, inverse variance; MRC, Medical Research Council.

Other reported outcomes

Hospital length of stay in patients with COPD,[21] emergency department visits in patients with COPD,[15 21] outpatient visits in patients with COPD,[15] aerobic fitness in either COPD or asthma populations,[19 25 27–29] muscle strength in either COPD or asthma populations,[17 25 28] and PALs in patients with COPD[16 22] were reported as outcomes, but the use of different measurement tools and outcome measurements, or not being able to obtain data across studies meant these outcomes could not be meta-analysed. All trials reporting relevant outcomes which could not be included in meta-analyses are narratively summarised in online supplemental table S5.

DISCUSSION

Summary of main findings

To our knowledge, this is the first review to have synthesised data from randomised trials assessing the effect of unsupervised exercise interventions on functional exercise capacity, quality of life and healthcare use of people with obstructive lung disease in comparison to non-exercise based usual care. This systematic review provides evidence that unsupervised exercise interventions, in addition to non-exercise usual care, can improve the disease-specific quality of life of people with COPD by clinically meaningful amounts, but this is not seen with exercise capacity outcomes. Unfortunately, data were unavailable for meta-analyses from included studies of other obstructive lung diseases such as asthma, so the findings presented are only applicable to that of COPD. No studies of patients with bronchiectasis met the inclusion criteria for this review.

Interpretation of the results

6MWT was the most commonly reported measure of exercise capacity.[14 15 17 18 20 22 25 26] Based on a minimal clinically important difference (MCID) of 30 m,[32] the 22 m 6MWT improvement with unsupervised exercise cannot be considered clinically meaningful for people with COPD. This is in contrast to established literature demonstrating that supervised exercise interventions are effective at increasing exercise capacity,[1] which may indicate the importance of a supervision element.

While data synthesis from four trials[19 21 23 24] suggests that unsupervised exercise may improve ISWT performance by a statistically significant amount, this effect fell below the MCID for COPD (47.5 m),[33] echoing the findings observed with 6MWT. The meta-analysis for ISWT performance was heavily weighted by one large study which incorporated unsupervised exercise as part of a self-management programme,[23] with a 'light touch' approach for prescribing exercise and ensuring adherence, which may limit intervention effects. The larger estimate of effect seen in other included studies, which included a more formalised prescription, perhaps suggests that the lack of clinically meaningful improvement in ISWT with unsupervised exercise should be viewed with some caution.

In terms of quality of life outcomes, synthesised data suggest that unsupervised exercise leads to statistical and clinically meaningful improvements in total scoring of SGRQ[15 18 21 26] and domain scoring of CRQ.[19 22–24] Unsupervised exercise also improved MRC breathlessness score by −0.3 points,[18 19 22] but this fell short of the MCID of −1 point.[34] These findings are in keeping with those of a previous review which included supervised exercise training in people with COPD.[35] It is important to note, however, that due to unexplained heterogeneity, the effects of unsupervised exercise on the mastery domain of the CRQ are still unclear. Furthermore, there was evidence of heterogeneity in estimates of intervention effect on SGRQ. It would appear that the study of Bourbeau *et al*[15] may have been a key contributor to the significant heterogeneity, whereby a 12-month intervention was implemented. Despite reporting significant treatment effects at 4 months, this was not apparent at 12 months, casting doubt on the longer-term impact of unsupervised interventions.[15] It could be that the lack of formal prescription and adherence monitoring may have contributed to this lack of observed effect at the end of the intervention.[15] Given the relative lack of eligible studies over 12 weeks long, further high-quality research is needed to establish the longer-term benefits of unsupervised exercise.

There was a paucity of evidence reporting outcomes related to healthcare use, meaning meta-analysis was not possible. Considering the importance of healthcare use to the future health outcomes of all patients with obstructive lung disease,[36] it is imperative that more trials are conducted which examine the potential benefit of unsupervised exercise interventions on these outcomes.

A key strength of this review is that it is the first to have comprehensively searched for and synthesised data from randomised controlled trials of unsupervised exercise interventions across all obstructive lung diseases. This is the first systematic review to report significant and clinically meaningful improvements in disease-specific quality of life in these patients. In doing so, this review followed a preplanned and publicly available protocol. It is important to highlight that raw study data were obtained to increase the amount of studies in our analyses.

A limitation of our review is that, when writing the protocol, we did not expect such disparity between included trials in terms of how unsupervised exercise was defined, prescribed, monitored and reported. It is clear that the levels of heterogeneity seen across a number of reported outcomes may well be due to the diversity in methods of exercise prescription and support. Despite having success in requesting data for analyses, there were studies presenting relevant outcomes, which could not be obtained for meta-analysis, two of which were asthma focused,[27 28] meaning the findings of our meta-analysis are purely COPD focused. However, a narrative summary of the reported effects within individual studies for which data could not be obtained has been tabulated to supplement the meta-analyses presented. Similarly, our searches were current as of April 2020, and there are ongoing studies which may have been eligible for inclusion had they been completed prior to this date. For example, Zanaboni *et al*[37] are conducting a large multicentre randomised controlled trial with patients with COPD to examine the effects of a longer-term unsupervised exercise intervention on healthcare use, quality of life and exercise capacity. This study will be an important contribution to the area.

Implications to practice

Given the likely lower cost and time requirements with unsupervised exercise interventions, our review supports their potential use as part of the COPD treatment pathway. Supervised elements may need to be considered if the intervention is intended to maximise changes in exercise capacity, but further head-to-head evidence of supervised versus unsupervised programmes (as done in Holland *et al*[9] and Horton *et al*[10]) would be required to investigate this.

While substantial diversity among the specific interventions existed, the current data would suggest that

incorporating formal prescription relating to basic programming principles (ie, frequency, intensity, time and type) and facilitating compliance should be key considerations for practitioners. However, given the lack of consistency in how these factors have been included in research to date, it is not possible to provide further clarity on how to best integrate these aspects of unsupervised exercise prescription for patients with obstructive lung disease.

Implications to research

The quality of evidence presented within this review and meta-analysis is generally low. The poor reporting that was generally observed across the included studies in this review suggests future randomised controlled trials should work according to Consolidated Standards of Reporting Trials guidelines.

Despite the apparent benefits of unsupervised exercise for people with COPD, higher-quality large-scale randomised controlled trials are needed to examine the relative effectiveness of different approaches to prescription. The impact of further research on the existing evidence base can be highlighted by the CIs of our point estimates. Although we report the overall magnitude of effects in some outcome measures to be clinically meaningful, the majority of the CIs for these point estimates include between-group differences, which would not meet MCIDs. At the same time, the available evidence does not currently favour a clinically meaningful effect of unsupervised exercise on 6MWT, but the CI does contain a change that would surpass the MCID. To build on the existing evidence and for comparison against supervised exercise, it would be advantageous for future studies to incorporate the most common assessments of functional exercise capacity (6MWT and ISWT) and disease-specific quality of life (ie, SGRQ and CRQ), in addition to hospitalisation and exacerbation data.

In order to maximise the translation of findings to applied practice, more studies should examine unsupervised exercise interventions for obstructive lung diseases beyond COPD, across a wider range of disease severity, and should follow up patients over longer periods of time (ie, >12 weeks).

CONCLUSION

In conclusion, our systematic review and meta-analysis provides evidence that unsupervised exercise interventions result in improvements in HRQoL, but not necessarily exercise capacity. However, further higher-quality randomised trials are likely to have an important impact on our confidence in the estimates of effect, particularly to what extent these improvements are clinically meaningful. Despite our intentions to review the evidence in asthma and bronchiectasis, there remains a lack of trials to quantify the benefit of unsupervised exercise in these populations.

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