

Online supplement

Methods: Pulmonary rehabilitation

Pulmonary rehabilitation (PR) was an eight-week outpatient exercise and multidisciplinary education programme. It comprised two supervised sessions of exercise and education, and at least one additional home-based exercise session per week. Each supervised session involved 60 minutes of supervised exercise and 45 to 60 minutes of education.

Respiratory physiotherapists supervised the exercise sessions which involved progressive, individually tailored aerobic and resistance training. Initial walking speed was prescribed at 80% of predicted peak oxygen consumption based on the incremental shuttle walk test (ISW) performance with the aim of patients exercising for 15 minutes continuously. Initial endurance cycling was set at a workload to achieve level 3 to 4 on the Borg Dyspnoea Scale with the aim of patients completing 15 minutes of continuous training. Lower limb resistance training was based on the American College of Sport's Medicine resistance training guidelines with an initial prescription of 2 to 4 sets of 8 to 12 repetitions for strength and 1 to 2 sets of 15 to 20 repetitions for endurance training based on 60% of a one-repetition maximum on a leg press or knee extension weights machine, as well as sit-to-stand, knee extension, hip flexion and hip abduction exercises with appropriate free weights and ankle weights. Upper limb resistance training comprised biceps curls, shoulder press and upright row with free weights. Participants with a prescription for supplemental oxygen performed the exercises using oxygen; exercise was stopped if SpO₂ dropped below 80% in line with international safety guidelines (1). Patients received an individualised, written home exercise programme during pulmonary rehabilitation and an individualised structured, written plan for on-going exercise maintenance on completion of pulmonary rehabilitation.

A multidisciplinary team, including physiotherapists, psychologists, dieticians, nurses, doctors, occupational therapists, dieticians, social workers, speech and language therapists and expert patients, all with expertise in chronic respiratory disease, delivered the education sessions. They aimed to develop patients' understanding and holistic management of their disease, and topics included psychological wellbeing (described below), physical activity and exercise, medication use, diet, smoking cessation as well as managing infections through early recognition,

rescue medication and appropriate general practice/hospital presentation. Patients received a booklet of the topics covered in these sessions.

The one-hour psychological wellbeing session was delivered by a clinical psychologist with expertise in chronic respiratory disease. It was delivered using blended education methods and involved a short didactic talk, group activities and reflective practices that followed the principles of cognitive behavioural therapy. The topics included:

- Adjusting to life with long-term lung condition
- Breathlessness and anxiety:
- Causes including the vicious cycle of anxiety
 - Physical effects of anxiety
 - Management of breathlessness and anxiety: breathing control, distraction techniques, managing unhelpful thoughts, relaxation, adopting a low stress way of living.

Reference

1. Holland AE, Spruit MA, Troosters T, Puhan MA, Pepin V, Saey D, et al. An official European respiratory society/American thoracic society technical standard: Field walking tests in chronic respiratory disease. *European Respiratory Journal*. 2014 Dec 1;44(6):1428–46.

Results

Table 1. Baseline characteristic according to HADS-A categorisation

Variable	HADS-A ≤7 (n=154)	HADS-A 8-10 (n=44)	HADS-A ≥11 (n=37)	p-value
Sex (male: n (%))	108 (70%)	29 (66%)	26 (70%)	0.86
Age (years)	73 (9)	72 (11)	72 (10)	0.64
FVC (L)	2.24 (0.79)	2.19 (0.89)	1.96 (0.67)	0.16
FVC (% predicted)	70.9 (21.6)	67.0 (58.0, 86.0)	58.9 (16.3)	<0.01
FEV ₁ /FVC	0.81 (0.08)	0.82 (0.08)	0.80 (0.71, 0.85)	0.12
MRC	3 (2, 4)	3 (2, 4)	4 (3, 5)	<0.001
BMI (kg/m ²)	27.1 (4.8)	26.4 (5.2)	28.3 (24.2, 31.5)	0.19
Ischaemic heart disease (n (%))	21 (14%)	9 (21%)	4 (11%)	0.42
Pulmonary hypertension (n (%))	10 (7%)	6 (14%)	1 (3%)	0.14
Prescribed antifibrotic therapy (n (%))	19 (12%)	4 (9%)	3 (8%)	0.69
Prescribed medication for anxiety (n (%))	1 (0.6)	0 (0%)	0 (0%)	0.77
Prescribed medication for depression (n (%))	7 (4.5%)	2 (4.5%)	1 (2.7%)	0.89
Long-term oxygen therapy (n (%))	22 (14%)	5 (11%)	1 (3%)	0.15
Ambulatory oxygen therapy (n (%))	25 (16%)	8 (18%)	1 (3%)	0.08
HADS-A	3.1 (2.2)	9.0 (8.0, 10.0)	13.7 (2.3)	<0.01
ISW (m)	251 (172)	228 (155)	140 (50, 260)	0.02
CRQ-Dyspnoea	16.3 (6.1)	15.3 (6.0)	12.5 (5.7)	<0.01
CRQ-Mastery	19.9 (5.3)	17.5 (5.4)	12.2 (5.6)	<0.01
CRQ-Fatigue	14.9 (5.4)	13.3 (5.2)	9.7 (4.3)	<0.01
CRQ-Emotion	34.4 (8.4)	30.0 (8.2)	24.0 (14.5, 29.0)	<0.01
CRQ-Total	85.4 (21.1)	76.5 (21.1)	53.5 (40.0, 72.8)	<0.01
KBILD-Psychological	60.1 (16.7)	49.1 (42.5, 60.8)	45.1 (35.5, 50.5)	<0.01
KBILD-Breathlessness and Symptoms	41.9 (33.1, 52.5)	36.7 (13.7)	31.6 (15.2)	<0.01
KBILD-Chest	68.6 (18.2)	63.7 (44.0, 73.4)	48.0 (23.5)	<0.01
KBILD-Total	57.4 (10.7)	52.2 (9.1)	48.0 (42.8, 54.8)	<0.01

Data reported as mean (standard deviation), median (25th, 75th centile), number (percent).

Abbreviations: BMI: Body Mass Index; CRQ: Chronic Respiratory Questionnaire; FEV₁: Forced Expiratory Volume in 1 Second; FVC (L): Forced Vital Capacity; HADS-A: Hospital Anxiety and Depression Scale – Anxiety; HADS-D: Hospital Anxiety and Depression Scale – Depression; ISW: Incremental Shuttle Walk; KBILD: King's Brief Interstitial Lung Disease; MRC: Medical Research Council.

Table 2. Baseline characteristic according to HADS-D categorisation

Variable	HADS-D ≤7 (n=149)	HADS-D 8-10 (n=47)	HADS-D ≥11 (n=39)	p-value
Sex (male: n (%))	104 (70%)	33 (70%)	26 (67%)	0.92
Age (years)	73 (9)	74 (8)	70 (11)	0.49
FVC (L)	2.24 (0.80)	2.20 (0.80)	1.92 (1.42, 2.23)	0.10
FVC (% predicted)	72.1 (23.0)	68.5 (57.0, 75.5)	56.8 (17.3)	<0.01
FEV ₁ /FVC	0.81 (0.08)	0.80 (0.77, 0.86)	0.78 (0.10)	0.32
MRC	3 (2, 4)	4 (3, 5)	4 (3, 5)	<0.001
BMI (kg/m ²)	27.1 (4.9)	27.3 (25.3, 31.2)	27.1 (23.5, 30.6)	0.66
Ischaemic heart disease (n (%))	23 (15%)	5 (11%)	6 (15%)	0.71
Pulmonary hypertension (n (%))	9 (6%)	3 (6%)	5 (3%)	0.34
Prescribed antifibrotic therapy (n (%))	18 (12%)	2 (4%)	6 (15%)	0.21
Prescribed medication for anxiety (n (%))	1 (0.7%)	0 (0%)	0 (0%)	0.75
Prescribed medication for depression (n (%))	8 (5.4%)	2 (4.3%)	0 (0%)	0.34
Long-term oxygen therapy (n (%))	23 (15%)	4 (9%)	1 (3%)	0.06
Ambulatory oxygen therapy (n (%))	26 (17%)	6 (13%)	2 (5%)	0.14
HADS-D	4.0 (1.9)	9.0 (8.0, 9.0)	13.0 (2.3)	<0.01
ISW (m)	255 (171)	190 (100, 370)	156 (132)	<0.01
CRQ-Dyspnoea	16.7 (6.4)	14.7 (4.7)	11.0 (8.0, 14.0)	<0.01
CRQ-Mastery	20.8 (4.7)	15.9 (5.1)	11.0 (4.4)	<0.01
CRQ-Fatigue	15.6 (5.4)	12.3 (3.5)	8.0 (6.0, 11.0)	<0.01
CRQ-Emotion	36.4 (7.1)	26.2 (5.7)	19.7 (6.1)	<0.01
CRQ-Total	89.4 (19.6)	69.2 (14.1)	50.6 (15.0)	0.00
KBILD-Psychological	61.5 (16.1)	46.4 (41.2, 54.8)	40.6 (12.3)	<0.01
KBILD-Breathlessness and Symptoms	42.9 (33.7, 50.2)	34.7 (14.4)	30.1 (15.3)	<0.01
KBILD-Chest	69.1 (18.1)	56.4 (16.4)	45.5 (26.7)	<0.01
KBILD-Total	58.1 (10.0)	50.0 (7.7)	45.0 (13.3)	<0.01

Data reported as mean (standard deviation), median (25th, 50th, 75th centile), number (percent).

Abbreviations: BMI: Body Mass Index; CRQ: Chronic Respiratory Questionnaire; FEV₁: Forced Expiratory Volume in 1 Second; FVC (L): Forced Vital Capacity; HADS-A: Hospital Anxiety and Depression Scale – Anxiety; HADS-D: Hospital Anxiety and Depression Scale – Depression; ISW: Incremental Shuttle Walk; KBILD: King's Brief Interstitial Lung Disease; MRC: Medical Research Council.

Table 3. Relationship between baseline HADS-Anxiety and HADS-Depression with other outcome measures

Variable	HADS-A	HADS-D
HADS-A	N/A	0.63 (<0.01)
HADS-D	0.63 (<0.01)	NA
MRC	0.29 (<0.01)	0.40 (<0.01)
ISW (m)	-0.16 (<0.05)	-0.26 (<0.01)
CRQ-Dyspnoea	-0.20 (<0.01)	-0.38 (<0.01)
CRQ-Mastery	-0.47 (<0.01)	-0.71 (<0.01)
CRQ-Fatigue	-0.33 (<0.01)	-0.57 (<0.01)
CRQ-Emotion	-0.50 (<0.01)	-0.79 (<0.01)
CRQ-Total	-0.46 (<0.01)	-0.74 (<0.01)
KBILD-Psychological	-0.38 (<0.01)	-0.59 (<0.01)
KBILD-Breathlessness and Symptoms	-0.29 (<0.01)	-0.40 (<0.01)
KBILD-Chest	-0.35 (<0.01)	-0.50 (<0.01)
KBILD-Total	-0.36 (<0.01)	-0.56 (<0.01)
Number of PR sessions attended	-0.08 (0.214)	-0.02 (0.816)

Data reported as r-value (p-value).

Abbreviations: BMI: Body Mass Index; CRQ: Chronic Respiratory Questionnaire; HADS-A: Hospital Anxiety and Depression Scale – Anxiety; HADS-D: Hospital Anxiety and Depression Scale – Depression; ISW: Incremental Shuttle Walk; KBILD: King’s Brief Interstitial Lung Disease; MRC: Medical Research Council; NA: Not Applicable.

Table 4. Correlation between change in HADS-A and HADS-D with other outcome measures

Variable	Δ HADS-A	Δ HADS-D
Δ MRC	0.15 (0.06)	-0.36 (<0.01)
Δ ISW	0.08 (0.31)	-0.26 (<0.01)
Δ CRQ-D	-0.10 (0.21)	-0.31 (<0.01)
Δ CRQ-F	-0.02 (0.85)	-0.39 (<0.01)
Δ CRQ-E	-0.05 (0.51)	-0.38 (<0.01)
Δ CRQ-M	-0.13 (0.10)	-0.34 (<0.01)
Δ CRQ-T	-0.10 (0.24)	-0.46 (<0.01)
Δ KBILD-P	0.07 (0.48)	-0.32 (<0.01)
Δ KBILD-B	0.03 (0.80)	-0.18 (0.07)
Δ KBILD-C	-0.04 (0.71)	-0.20 (0.048)
Δ KBILD-T	0.05 (0.61)	-0.29 (<0.01)

Data are presented as r-value (p-value).

Abbreviations: Δ : Change with PR; CRQ: Chronic Respiratory Questionnaire; CRQ-D: CRQ Dyspnoea domain; CRQ-F: CRQ Fatigue; CRQ-E: CRQ Emotion domain; CRQ-M: CRQ-Mastery domain; CRQ-T: CRQ Total score; ISW: Incremental Shuttle Walk test; KBILD: Kings Brief Interstitial Lung Disease questionnaire; KBILD-P: KBILD Psychological domain; KBILD-B: KBILD – Breathlessness and activities; KBILD-C: KBILD Chest symptoms; KBILD-T: KBILD Total score; MRC: Medical Research Council Dyspnoea score; PR: Pulmonary Rehabilitation.

Table 5. HADS-D MID estimates

Anchor-based methods	MID estimate				
Linear regression					
• MRC	-1.2				
• CRQ-Dyspnoea	-0.7				
• CRQ-Fatigue	-1.0				
• CRQ-Emotion	-1.2				
• CRQ-Mastery	-1.2				
• CRQ-Total	-1.0				
• KBILD-Psychological	-0.6				
Receiver Operating Characteristic plot	AUC	p-value	MID estimate	Sensitivity	Specificity
• MRC	0.65	<0.01	-1.5	70	58
• CRQ-Dyspnoea	0.68	<0.001	-1.5	69	61
• CRQ-Fatigue	0.68	<0.001	-0.5	59	72
• CRQ-Emotion	0.72	<0.001	-1.5	66	65
• CRQ-Mastery	0.66	<0.001	-1.5	66	59
• CRQ-Total	0.71	<0.001	-1.5	72	64
• KBILD-Psychological	0.57	0.14	-1.5	59	53
Distribution-based methods	MID estimate				
0.5 * standard deviation	-1.5				
Standard error of measurement	-1.9				
Average MID (average of all MID estimates)	-1.2				

Abbreviation: AUC: Area Under the Curve; CRQ: Chronic Respiratory Questionnaire; HADS-D: Hospital Anxiety and Depression Scale- Depression; KBILD: King's Brief Interstitial Lung Disease; MID: Minimal Important Difference; MRC: Medical Research Council.