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Strength testing for COPD & other respiratory conditions for pulmonary rehabilitation

Date requested: 29.6.2018
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SUMMARY
Systematic Reviews: (7)
RCTs: (1), (11), (15), (19), (20), (21), (23), (24), (25), (34), (39), (43), (44), (47)

A thorough patient-centred outcome assessment is considered a necessary component of a successful pulmonary rehabilitation programme. All tests should follow recommended procedures, including standard operating procedures for exercise testing.

The assessments, which vary widely across centres usually include measures of exercise performance, peripheral muscle strength, health-related quality of life, and anxiety and depression. Other aspects of outcome assessment that may be measured include functional performance, physical activity, and knowledge/self-efficacy. (28)

- Only one article specifically mentioned “strength testing” (15)
- Lower Limb Resistance Training - Compared with routine PR guidance, home-based LLRT can improve not only the muscle strength and exercise endurance but also the lower limb functional status. Relevance to clinical practice: Our developed home-based LLRT intervention is simple, safe and feasible in stable COPD patients and could hence be promoted in clinical practice (1)
A high-intensity whole-body endurance-and-strength program improved quality of life, functional status, exercise capacity and muscle force. (39)

Fatigue was associated with dyspnea and health status. Respiratory muscle strength was related to peripheral muscle strength and health status, but not to fatigue, peripheral muscle endurance or exercise capacity. These findings may provide insight for outcome measures for pulmonary rehabilitation programs for patients with bronchiectasis (37)

Pulmonary rehabilitation (PR) improves outcomes in patients with chronic obstructive pulmonary disease (COPD). Optimal assessment includes cardiopulmonary exercise testing (CPET), but consultations are limited. Field tests could be used to individualize PR instead of CPET. The six-minute stepper test (6MST) is easy to set up and its sensitivity and reproducibility have previously been reported in patients with COPD (3)

The 6MST appears to be as responsive as the 6MWT in assessing functional improvement during PR in patients with COPD. The 6MST is a low-cost assessment and requires limited space (14)

Adding a second walk to the 6-min walk test significantly improves its performance in measuring response to a therapeutic intervention, improves the validity of COPD clinical trials, and would result in a 14% to 33% reduction in sample size requirements. Hence, it should be strongly considered by clinicians and researchers as an outcome measure for therapeutic interventions in patients with COPD (34)

A practice walk test improves outcomes (5)

One-legged cycling was successfully implemented into a "real-life" pulmonary rehabilitation program, demonstrating improvements in cardiorespiratory fitness with associated improvement in function for patients with moderate/severe COPD. One-legged cycling should be recommended in professional pulmonary rehabilitation guidelines as an option for exercise training and be available in other pulmonary rehabilitation programs. (17)

Ground walk training increased endurance walking capacity more than cycle training and was similar to cycle training in improving peak walking capacity, peak and endurance cycle capacity and quality of life. This study provides evidence for ground walking as a mode of exercise training in pulmonary rehabilitation programs (43)

The Manual Diaphragm Release Technique improves diaphragmatic mobility, exercise capacity and inspiratory capacity in people with chronic obstructive pulmonary disease. This technique could be considered in the management of people with chronic obstructive pulmonary disease. (19)

Chronic Disease Self Management Programme produced a small statistically significant increase in 6MWD (21)

Activity Monitor Armbands - Changes in physical activity following pulmonary rehabilitation are best measured for 4 weekdays, including only days with at least 8 h of wearing time (during waking hours) and considering the difference in daylight time as a covariate in the analysis. (24)

Incremental Shuttle Walk Tests - The increase in walk distance when a second ISWT was performed at zero and three months indicates the need to perform two ISWTs when participants are naive to the test and at the three-month reassessment during a 12-month maintenance exercise program (29), (46)

5Repitition Sit To Stand Test - The 5STS is reliable, valid and responsive in patients with COPD with an estimated MCID of 1.7 s. It is a practical functional outcome measure suitable for use in most healthcare settings (32)

Levels of daily activity may be vulnerable to seasonal variations and this should be considered when examining physical activity levels in patients with COPD (47)

Abstract: Aims and objectives: This study aimed to determine the effect of home-based lower limb resistance training (LLRT) in patients with stable COPD. Background: Pulmonary rehabilitation (PR) in COPD patients has been substantially investigated, but the rehabilitation components differ among studies. Few works have focused on home-based LLRT. Furthermore, few studies have assessed muscle strength and functional status by isokinetic/isometric extensor muscle peak torque (PT) and five-repetition sit-to-stand test (FTSST), respectively. Design: A randomised controlled design was adopted. Methods: (i) The home-based LLRT consisted of six sets of lower limb training cycles by self-gravity resistance and Thera-band resistance at 8-12RM, 20-30 min/session and 3 sessions/week for 12 weeks. (ii) The intervention group (n=25) received routine PR guidance and home-based LLRT, whereas the control group (n=22) received routine PR guidance only. The muscle strengths, FTSST durations, 6-min walking distances (6MWDs) and COPD assessment test results at enrolment and week 12 were compared. Results: Relative to the baseline findings, all the indexes of muscle strength (isometric extensor muscle PT, isometric extensor muscle PT to body weight ratio [PT/BW], isokinetic extensor muscle PT and isokinetic extensor muscle PT/BW) did not significantly change in the intervention group. Meanwhile, no significant intragroup difference was noted among the indexes of muscle strength (except for isometric extensor muscle PT) in the control group. The FTSST decrease was significant between and within groups. By contrast, the 6MWD significantly increased within both groups, but not between the groups. The COPD assessment tool score decreased significantly within the intervention group. Conclusions: Compared with routine PR guidance, home-based LLRT can improve not only the muscle strength and exercise endurance but also the lower limb functional status. Relevance to clinical practice: Our developed home-based LLRT intervention is simple, safe and feasible in stable COPD patients and could hence be promoted in clinical practice.


Abstract: Pulmonary rehabilitation (PR) is established as an effective intervention in optimising function and quality of life in patients with chronic obstructive pulmonary disease (COPD). However, there are very limited data on the effectiveness of PR in older patients with COPD. We reviewed all patients attending an 8-week outpatient programme. Patients were divided into two groups; Group A (n = 202), below 70 years, and Group B (n = 122), above 70 years of age. Outcomes in both patient subgroups were compared using FEV(1), Incremental Shuttle Walk Test (ISWT), Endurance Shuttle Walk Test (ESWT), Grip Strength, St. George's Respiratory Questionnaire (SGRQ), Hospital Anxiety and Depression Score (HADS), and COPD Assessment Test (CAT) score. Statistical analysis was conducted using Mann-Whitney non-parametric testing and chi-square testing for comparison of clinically relevant improvements between groups. There was no significant difference in PR outcomes between Group A and Group B using absolute values. Mean changes in ISWT for Groups A and B 39.7 m vs. 32.8 m (p = 0.63), respectively, SGRQ -2.5 vs. -2.8 (p = 0.95), HADS anxiety score -0.83 vs. -0.57 (p = 0.43) and HADS depression score -0.69 vs. -0.39 (p = 0.48), respectively. There was no difference in the proportion of patients who achieved the minimal clinically significant improvement in Group A versus Group B for parameters ISWT (38.6% vs 42.7%), SGRQ (27.8% vs 21.3%), and HADS total score (20.5% vs 28.1%). These data suggest that benefits of PR in COPD are not age dependent. Age should not be a barrier to enrolling patients with COPD in PR programmes.
Although the change in ISWD and 6MWD with PR was lower in the practice walk test group, 6MWD, 34.8 m (95% CI 24.7 to 44.9) was 2.2 times (95% CI 1.34) more likely to enroll and 17% (95% CI 1.03-1.34) more likely to complete PR. The six-minute stepper test (6MST) is easy to set up and its sensitivity and reproducibility have previously been reported in patients with COPD. The aim of this study was to develop a prediction equation to set intensity in patients attending PR, based on the 6MST. The following relationships were analyzed: mean heart rate (HR) during the first (HR1-3) and last (HR4-6) 3 minutes of the 6MST and HR at the ventilatory threshold (HRvt) from CPET; step count at the end of the 6MST and workload at the Ventilatory threshold (VT) (Wvt); and forced expiratory volume in 1 second and step count during the 6MST. This retrospective study included patients with COPD referred for PR who underwent CPET, pulmonary function evaluations and the 6MST. Twenty-four patients were included. Prediction equations were HRvt = 0.7887 x HR1-3 + 20.83 and HRvt = 0.6180 x HR4-6 + 30.77. There was a strong correlation between HR1-3 and HR4-6 and HRvt (r = 0.69, p < 0.001 and r = 0.57, p < 0.01 respectively). A significant correlation was also found between step count and LogWvt (r = 0.63, p < 0.01). The prediction equation was LogWvt = 0.001722 x step count + 1.248. The 6MST could be used to individualize aerobic training in patients with COPD. Further prospective studies are needed to confirm these results.


Abstract: Pulmonary rehabilitation programs (PRPs) are most commonly provided in hospital settings which present barriers to attendance such as long distances or travel times. Community-based settings have been used in an attempt to alleviate the travel burden. This study evaluated the feasibility and outcomes of a network of community-based PRPs provided in non-healthcare facilities (CPRPs). The CPRPs were established in five venues and comprised two supervised group sessions each week for 8 weeks. Participant inclusion criteria and guidelines for exercise testing and training were developed to reduce the risk of adverse events. Outcome measures included 6-min walk distance (6MWD) and health-related quality of life (chronic respiratory questionnaire (CRQ)). Respiratory-related hospital admission data were collected in the 12 months prior to and following the program. Two hundred and fifty-one participants (79% with chronic obstructive pulmonary disease: mean +/- SD FEV1 49 +/- 21%predicted) entered a CPRP of which 166 (66%) completed. Improvements were demonstrated in 6MWD (mean difference (95% CI) 44 m (37-52)) and total CRQ score (0.5 points per item (0.4-0.7)). Fewer participants had a respiratory-related hospital admission following the program (12% vs. 37%, p < 0.0001). Pulmonary rehabilitation is safe, feasible and effective when conducted in community-based non-healthcare facilities.

PT - Observational Study


Abstract: Our aim was to evaluate the use and impact of the practice walk test on enrolment, completion, and clinical functional response to pulmonary rehabilitation (PR) using the 2015 UK National Chronic Obstructive Pulmonary Disease (COPD) Pulmonary Rehabilitation audit data. Patients were assessed according to whether a baseline practice walk test was performed or not. Study outcomes included use of the practice walk test, baseline and change in incremental shuttle walk test distance (ISWD) or 6-minute walk test distance (6MWD), and enrolment to and completion of PR program. Of 7,355 patients, only 1,666 (22.6%) had a baseline practice test. At baseline, the practice walk test group walked further as compared to the no practice walk test group: ISWD, 17.9 m [95% confidence interval (CI) 8.2-27.5 m] and 6MWD, 34.8 m (95% CI 24.7-44.9 m). The practice walk test group were 2.2 times (95% CI 1.8-2.6) more likely to enroll and 17% (95% CI 1.03-1.34) more likely to complete PR. Although the change in ISWD and 6MWD with PR was lower in the practice walk test group,
they walked further at discharge assessment. Only 22.6% of the patients in the 2015 National PR audit had a practice walk test at assessment. Those who did had better enrolment, completion, and better baseline walking distance, from which the prescription is set


Abstract: PURPOSE: Individuals with all forms of pulmonary disease are referred for pulmonary rehabilitation. This study examines pulmonary rehabilitation outcomes between individuals with chronic obstructive lung disease (COPD) and non-COPD disease and the impact of gender. METHODS: This is a retrospective study at a tertiary center. The primary endpoint was the difference in 6-min walk test distance. Secondary measurements included treadmill and NuStep minutes; biceps curls and front arm raises load; quality of life measured by the St George’s Respiratory Questionnaire; and University of California San Diego-Shortness of Breath Questionnaire (UCSD-SOBQ) scores. RESULTS: Eighty patients were included: 38 men (23 COPD, 15 non-COPD) and 42 women (31 COPD, 11 non-COPD). There was a statistically significant improvement in 6-min walk test distances pre- to post-pulmonary rehabilitation for all participants, *P* = .0003. Although both the COPD and non-COPD groups demonstrated overall improvement (*P* < .0004 and *P* = .02, respectively), subgroup analysis showed no statistically significant change in the non-COPD group when divided by gender. There was a significant statistical improvement in lower and upper extremity strength in all participants. Only women with COPD showed a statistically significant improvement with respect to overall quality of life as measured by St. George’s Respiratory Questionnaire, and University of California San Diego-Shortness of Breath Questionnaire, while only men with COPD showed any improvement in their sleep quality measured by the Pittsburgh Sleep Quality Index. CONCLUSIONS: Pulmonary rehabilitation results in different but improved outcomes regardless of gender or disease state


Abstract: OBJECTIVE: To evaluate the effectiveness of exercise training in patients with very severe chronic obstructive pulmonary disease (COPD). DESIGN: We searched MEDLINE, EMBASE, Cochrane Central Register of Controlled Trials, and Cumulative Index to Nursing and Allied Health Literature databases using the following as search terms: COPD, Chronic Obstructive Pulmonary Disease, Exercise, and Pulmonary Rehabilitation. We included randomized controlled trials (RCTs) of subjects with forced expiratory volume in the first second of less than 35% of the predicted normal value enrolled in in-patient, outpatient, or home- or community-based training programs lasting at least 4 weeks with respect to usual care. We included RCTs with outcome measures including the 6-minute walking test and/or health-related quality of life assessed by the St. George’s Respiratory Questionnaire (SGRQ). RESULTS: Of 580 articles screened, 10 were included. The programs' duration ranged from 4 to 52 weeks with 1 to 5 sessions per week lasting 15 to 40 minutes each. The intervention group improved in 6-minute walking test [weighted mean difference, 67.1 (95% confidence interval [CI], 37.897-98.927); standardized mean difference, 3.86 (95% CI, 2.04-5.67)], and St. George’s Respiratory Questionnaire [weighted mean difference, -8.041 (95% CI, -15.273 to -0.809); standardized mean difference, -1.23 (95% CI, -2.14 to -0.31)]. CONCLUSIONS: Exercise training improves exercise tolerance and health-related quality of life in patients with very severe COPD. However, because few studies on severely affected patients are available and the training programs are Highly heterogeneous, larger RCTs are needed

PT - Meta-Analysis
PT - Review

Abstract: BACKGROUND: The Glittre activities of daily living (ADL) test is supposed to evaluate the functional capacity of COPD patients. The physiological requirements of the test and the time taken to perform it by COPD patients in different disease stages are not well known. The objective of this work was to compare the metabolic, ventilatory, and cardiac requirements and the time taken to carry out the Glittre ADL test by COPD subjects with mild, moderate, and severe disease. METHODS: Spirometry, Medical Research Council questionnaire, cardiopulmonary exercise test, and 2 Glittre ADL tests were evaluated in 62 COPD subjects. Oxygen uptake (VO2), carbon dioxide production, pulmonary ventilation, breathing frequency, heart rate, SpO2, and dyspnea were analyzed before and at the end of the tests. Maximum voluntary ventilation, Glittre peak VO2/cardiopulmonary exercise test (CPET) peak VO2, Glittre VE/maximum voluntary ventilation, and Glittre peak heart rate/CPET peak heart rate ratios were calculated to analyze their reserves. RESULTS: Subjects carried out the Glittre ADL test with similar absolute metabolic, ventilatory, and cardiac requirements. Ventilatory reserve decreased progressively from mild to severe COPD subjects (P < .001 for Global Initiative for Chronic Obstructive Lung Disease [GOLD] 1 vs GOLD 2, P < .001 for GOLD 1 vs GOLD 3, and P < .001 for GOLD 2 vs GOLD 3). Severe subjects with COPD presented a significantly lower metabolic reserve than the mild and moderate subjects (P = .006 and P = .043, respectively) and significantly lower Glittre peak heart rate/CPET peak heart rate than mild subjects (P = .01). Time taken to carry out the Glittre ADL test was similar among the groups (P = .82 for GOLD 1 vs GOLD 2, P = .19 for GOLD 1 vs GOLD 3, and P = .45 for GOLD 2 vs GOLD 3). CONCLUSIONS: As the degree of air-flow obstruction progresses, the COPD subjects present significant lower ventilatory reserve to perform the Glittre ADL test. In addition, metabolic and cardiac reserves may differentiate the severe subjects. These variables may be better measures to differentiate functional performance than Glittre ADL time.

PT - Evaluation Studies


Abstract: BACKGROUND: Recent evidences show that Pulmonary Rehabilitation (PR) is effective in patients with Interstitial Lung Disease (ILD). It is still unclear whether disease severity and/or etiology might impact on the reported benefits. We designed this prospective study 1) to confirm the efficacy of rehabilitation in a population of patients with ILDs and 2) to investigate whether baseline exercise capacity, disease severity or ILD etiology might affect outcomes. METHODS: Forty-one patients (IPF 63%, age 66.9 +/− 11 ys) were enrolled in a standard PR course in two centers. Lung function, incremental and endurance cycloergometry, Six Minutes Walking Distance (6MWD), chronic dyspnea (Medical Research Council scale-MRC) and quality of life (St. George Respiratory Questionnaire-SGRQ) were recorded before and at the end of PR to measure any pre-to-post change. Correlation coefficients between the baseline level of Diffuse Lung Capacity for Carbon monoxide (DLCO), Forced Vital Capacity (FVC), 6MWD, power developed during incremental endurance test, GAP index (in IPF patients only) and etiology (IPF or non-IPF) with the functional improvement at the 6MWDT (meters), at the incremental and endurance cycloergometry (endurance time) and the HRQoL were assessed. RESULTS: Out of the 41 patients, 97% (n = 40) completed the PR course. Exercise performance (both at peak load and submaximal effort), symptoms (iso-time dyspnea and leg fatigue), SGRQ and MRC significantly improved after PR (p < .001). Patients with lower baseline 6MWD showed greater improvement in 6MWD (Spearman r score = -.359, p = .034) and symptoms relief at SGRQ (r = -.315, p = .025) regardless of underlying disease. CONCLUSION: Present study confirms that comprehensive rehabilitation is feasible and effective in patients with ILD of different severity and etiology. The baseline submaximal exercise capacity inversely correlates with both functional and symptom gains in this heterogeneous population.

PT - Multicenter Study

Abstract: Lymphangioleiomyomatosis (LAM) is a cystic lung disease frequently associated with reduced exercise capacity. The aim of this study was to assess safety and efficacy of pulmonary rehabilitation in LAM. This controlled clinical trial included 40 patients with LAM and a low physical activity level. The pulmonary rehabilitation programme comprised 24 aerobic and muscle strength training sessions and education. The primary outcome was exercise capacity (endurance time during a constant work rate exercise test). Secondary outcomes included health-related quality of life (St George’s Respiratory Questionnaire (SGRQ)), 6-min walking distance (6MWD), dyspnoea, peak oxygen consumption (VO2), daily physical activity (pedometer), symptoms of anxiety and depression, lung function and peripheral muscle strength (one-repetition maximum). The baseline characteristics were well balanced between the groups. The pulmonary rehabilitation programme exhibited improvements in the following outcomes versus controls: endurance time (median (interquartile range) 169 (2-303) s versus -33 (-129-39) s; p=0.001), SGRQ (median (interquartile range) -8 (-16-2) versus 2 (-4-5); p=0.002) and 6MWD (median (interquartile range) 59 (13-81) m versus 20 (-12-30) m; p=0.002). Dyspnoea, peak VO2, daily physical activity and muscle strength also improved significantly. No serious adverse events were observed. Pulmonary rehabilitation is a safe intervention and improves exercise capacity, dyspnoea, daily physical activity, quality of life and muscle strength in LAM.

(11) Cameron-Tucker HL, Wood-Baker R, Joseph L, Walters JA, Schuz N, Walters EH. A randomized controlled trial of telephone-mentoring with home-based walking preceding rehabilitation in COPD. Int J Chron Obstruct Pulmon Dis 2016; 11:1991-2000. Abstract: PURPOSE: With the limited reach of pulmonary rehabilitation (PR) and low levels of daily physical activity in chronic obstructive pulmonary disease (COPD), there is a need to increase daily exercise. This study evaluated telephone health-mentoring targeting home-based walking (tele-rehab) compared to usual waiting time (usual care) followed by group PR. PATIENTS AND METHODS: People with COPD were randomized to tele-rehab (intervention) or usual care (controls). Tele-rehab delivered by trained nurse health-mentors supported participants’ home-based walking over 8-12 weeks. PR, delivered to both groups simultaneously, included 8 weeks of once-weekly education and self-management skills, with separate supervised exercise. Data were collected at three time-points: baseline (TP1), before (TP2), and after (TP3) PR. The primary outcome was change in physical capacity measured by 6-minute walk distance (6MWD) with two tests performed at each time-point. Secondary outcomes included changes in self-reported home-based walking, health-related quality of life, and health behaviors. RESULTS: Of 65 recruits, 25 withdrew before completing PR. Forty attended a median of 6 (4) education sessions. Seventeen attended supervised exercise (5+-2 sessions). Between TP1 and TP2, there was a statistically significant increase in the median 6MWD of 12 (39.1) m in controls, but no change in the tele-rehab group. There were no significant changes in 6MWD between other time-points or groups, or significant change in any secondary outcomes. Participants attending supervised exercise showed a nonsignificant improvement in 6MWD, 12.3 (71) m, while others showed no change, 0 (33) m. The mean 6MWD was significantly greater, but not clinically meaningful, for the second test compared to the first at all time-points. CONCLUSION: Telephone-mentoring for home-based walking demonstrated no benefit to exercise capacity. Two 6-minute walking tests at each time-point may not be necessary. Supervised exercise seems essential in PR. The challenge of incorporating exercise into daily life in COPD is substantial.

PT - Randomized Controlled Trial

(12) Jacome C, Marques A. Short- and Long-term Effects of Pulmonary Rehabilitation in Patients With Mild COPD: A COMPARISON WITH PATIENTS WHO HAVE MODERATE TO SEVERE COPD. Journal of cardiopulmonary rehabilitation and prevention 2016; 36(6):445-453. Abstract: PURPOSE: Pulmonary rehabilitation (PR) is effective in patients with moderate to severe chronic obstructive pulmonary disease (COPD). However, the effects of PR in patients with mild COPD have not yet been established. Thus, this study investigated the short- and long-term effects of PR in patients with mild COPD in comparison with patients with moderate to severe disease. METHODS: A total of 32 patients with mild (group 1) and 29 with moderate to severe (group 2) COPD completed the study. Both groups participated in a 12-week PR program with exercise training and psychosocial support and education. Outcome measures...
at baseline, 3 (post-PR), 6, and 9 months later included 6-minute walk test (6MWT); Modified Medical Research Council Dyspnea Scale; 1-repetition maximum chest press and knee extension; a brief physical activity assessment; the number of exacerbations in the past 3 months and the St. George Respiratory Questionnaire (SGRQ). RESULTS: Improvements in the 6MWT, chest press, knee extension, and physical activity were observed post-PR (P < .001), with no differences between the 2 groups. Reduction in the number of exacerbations (P < .001) and improvements in the SGRQ total (P < .001) were also observed, however, with greater magnitude in group 2 (P = .029 and P < .001, respectively). Except for peripheral muscle strength (P < .002), all the achieved benefits were sustained at 6 and 9 months (P > .05). CONCLUSIONS: Pulmonary rehabilitation improves exercise tolerance, muscle strength, physical activity, and health-related quality of life and reduces exacerbations in patients with mild COPD as it does in patients with moderate to severe COPD. Moreover, most of these benefits were maintained at 9-month follow-up, suggesting that PR could be part of the management of mild COPD.


Abstract: PURPOSE: Various exercise tests have been used to assess the response to pulmonary rehabilitation (PR) in patients with chronic obstructive pulmonary disease (COPD). Few studies have compared exercise tests in the same subjects to determine the relative responsiveness of various tests. The goal of this pilot study was to examine the responsiveness of different exercise tests in patients with COPD completing PR. METHODS: Fifteen male patients with COPD underwent PR. All subjects completed 6-minute walk test (6MWT), incremental shuttle walk test (ISWT), endurance shuttle walk test (ESWT), maximal incremental exercise test (MIET), constant workload exercise test (CWET), and maximal arm ergometry tests before and after PR. The Chronic Respiratory Disease Questionnaire was also completed before and after PR. RESULTS: The number of participants who exceeded the minimal clinically important difference was similar for each of the different exercise tests. Effect sizes for the MIET and CWET were slightly higher, 0.82 and 0.97, respectively, than for the 6MWT, ISWT, and ESWT, 0.72, 0.65, and 0.60, respectively. Effect sizes were not significantly different between the 6MWT and the ESWT. The changes in exercise test results were not significantly correlated with the changes in quality of life. The improvement in laboratory cycling tests did not significantly correlate with the improvement in shuttle walk tests. CONCLUSIONS: On the basis of these data, all exercise measures were responsive to PR. Indices derived from cycling in the laboratory appeared more responsive than indices derived from walking in the field when assessed by effect size, but this finding and its possible clinical significance requires confirmation in a larger study.

MEDLINE®


Abstract: BACKGROUND: The validity and reproducibility of the 6-minute stepper test (6MST) have already been demonstrated in patients with chronic obstructive pulmonary disease (COPD). OBJECTIVES: The aim of this study was to evaluate the responsiveness of the 6MST to pulmonary rehabilitation (PR) in patients with COPD, to determine a minimal important difference (MID) for the 6MST, and to compare the 6MST and the 6-minute walk test (6MWT). METHODS: Sixty-two patients with COPD were included in a prospective experimental study. Participants underwent a 3-week inpatient PR program. The primary outcome was the change in the number of steps during the 6MST measured before and after PR. The secondary outcome included the change in the 6-minute walking distance (6MWD) pulse oximetry, heart rate, dyspnea, and leg discomfort during the tests measured before and after PR. MID was determined by anchor-based and distribution approaches. RESULTS: After PR, we observed a significant increase in the number of steps during the 6MST (22.5 steps; 95% CI 13.8-31.3; p < 0.0001) and in the 6MWD (26.6 m; 95% CI 17.6-35.5; p < 0.0001). The 6MST and 6MWT were improved by 10.1 and 6.5%, respectively. The number of steps during the 6MST was significantly correlated with the 6MWD before (r = 0.72; p < 0.0001) and after PR (r = 0.66; p < 0.0001). MID was estimated to be around 20 steps. CONCLUSION: The
6MST appears to be as responsive as the 6MWT in assessing functional improvement during PR in patients with COPD. The 6MST is a low-cost assessment and requires limited space.


Abstract: BACKGROUND: The combination of protein supplementation with exercise is successful in increasing weight and energy intake, as well as exercise capacity and health-related quality of life in sarcopenic patients diagnosed with chronic obstructive disease (COPD). However, the potential benefit of protein supplementation for non-sarcopenic patients with COPD has yet not previously been examined. AIM: The aim of this trial was to evaluate the effect of protein supplementation on quality of life, physical function, muscle strength and biochemical blood markers in patients diagnosed with COPD undergoing nine weeks of pulmonary rehabilitation. DESIGN: A prospective, parallel group randomised clinical trial. SETTING: Patients referred from their general practitioners to the COPD rehabilitation outpatient programme at the local community rehabilitation centre. POPULATION: Patients (N.=53) with stable moderate to severe COPD diagnosed with COPD, 40 years or older and with a BMI<30. METHOD: The participants were assigned to one of two groups to receive either twice daily protein supplementation (9.3 g of protein/566.4 KJ) plus exercise or exercise only. Before and after nine weeks of rehabilitation, mental state was measured by means of St George Respiratory Questionnaire, physical performance was evaluated by shuttle walking test and maximal muscle strength test, and fasting blood samples were analyzed. RESULTS: Supplementing exercise with protein had no additional effect on any of the outcome measures. However, shuttle walk time, St George total score and subscore for impact improved as effect of time. CONCLUSION: This trial was unable to provide evidence for the effect of protein supplementation on quality of life, physical function, and muscle strength in non-sarcopenic patients with moderate to severe COPD. CLINICAL REHABILITATION IMPACT: The role of protein supplementation in COPD-rehabilitation should focus on identifying patients to receive supplement with protein and from those who will not benefit.


Abstract: PURPOSE: The COPD Assessment Tool (CAT) has previously been shown to be a sensitive outcome measure for pulmonary rehabilitation (PR) in a stable population, but its utility in a postexacerbation PR population is unknown. The aim of this study was to investigate any differences in response to the CAT between stable and postexacerbation patients undertaking PR. METHODS: Patients attending a 7-week outpatient PR program completed a CAT questionnaire pre- and postrehabilitation. Patients referred for elective outpatient PR were compared with those who had been referred to PR following a hospital admission for an exacerbation. RESULTS: Two hundred consecutive patients completed the CAT questionnaire: 125 stable patients (74 male, mean age 71.1 +/- 8.9 years, forced expiratory volume in 1 second [FEV1] 1.39 L +/- 0.6, and body mass index [BMI] 28.5 +/- 6.7 kg/m) and 75 postexacerbation patients (23 male, mean age 70.6 +/- 8.6 years, FEV1 1.16 L +/- 0.5, and BMI 25.8 +/- 7.3 kg/m). A statistically significant difference between the stable and postexacerbation patient groups pre-PR CAT score (P = .05) was observed. There was no significant difference in post-PR CAT scores or change in CAT scores between the stable and postexacerbation groups. There was a significant difference in pre- and post-PR walking test results between the groups. The improvement in the Endurance Shuttle Walking Test (ESWT) in the stable group was greater (P < .05). CONCLUSIONS: Postexacerbation PR patients had a worse CAT score prior to PR when compared with a stable PR population, but both groups made improvements in CAT following completion of PR.


Abstract: RATIONALE: In patients with chronic obstructive pulmonary disease (COPD),
partitioned exercise training using one-legged cycling leads to greater improvements in peak oxygen uptake than conventional two-legged cycling. OBJECTIVES: We evaluated the feasibility of incorporating one-legged cycling as the principal aerobic training modality for pulmonary rehabilitation in COPD. METHODS: Physiotherapists underwent four teaching sessions about the principles and practical implementation of one-legged cycling training. Patients enrolled in a pulmonary rehabilitation program underwent 6-8 weeks of training in which one-legged cycling three times per week was the principal aerobic exercise activity. Participants cycled for 15 minutes with each leg, in each session. An incremental cardiopulmonary exercise test was completed before and after pulmonary rehabilitation along with standard pulmonary rehabilitation outcome measures. Participants and physiotherapists completed a satisfaction survey at the end of the program. MEASUREMENTS AND MAIN RESULTS: A total of 22 out of 32 participants (14 male; mean [SD] age, 66 [7] years; FEV1% predicted, 32 [17%]; median [interquartile range] Medical Research Council dyspnea scale, 3.5 [3.0-4.3]) completed pulmonary rehabilitation. Peak oxygen uptake increased 1.1 (0.4-1.7) ml.min(-1).kg(-1) (8%) from baseline (P<0.01). The mean (95% confidence interval) 6-minute-walk test distance improved by 72 (45-98) m (P<0.001). The change in the Chronic Respiratory Questionnaire total score of 1.6 (1.1-2.1; P<0.001) was achieved by improvement in all four domains above the clinically important difference. All the physiotherapists considered one-legged cycling safe and would continue to prescribe it; 75% of participants would recommend it to other patients. CONCLUSIONS: One-legged cycling was successfully implemented into a "real-life" pulmonary rehabilitation program, demonstrating improvements in cardiorespiratory fitness with associated improvement in function for patients with moderate/severe COPD. One-legged cycling should be recommended in professional pulmonary rehabilitation guidelines as an option for exercise training and be available in other pulmonary rehabilitation programs. Clinical trial registered with www.clinicaltrials.gov (NCT01930526)


Abstract: INTRODUCTION: Personalized, global pulmonary rehabilitation (PR) management of patients with COPD is effective, regardless of the place in which this rehabilitation is provided. The objective of this retrospective observational study was to study the long-term outcome of exercise capacity and quality of life during management of patients with COPD treated by home-based PR. METHODS: Home-based PR was administered to 211 patients with COPD (mean age, 62.3 +/- 11.1 years; mean forced expiratory volume in 1 second, 41.5% +/- 17.7%). Home-based PR was chosen because of the distance of the patient's home from the PR center and the patient's preference. Each patient was individually managed by a team member once a week for 8 weeks with unsupervised continuation of physical exercises on the other days of the week according to an individual action plan. Exercise conditioning, therapeutic patient education, and self-management were included in the PR program. The home assessment comprised evaluation of the patient's exercise capacity by a 6-minute stepper test, Timed Up and Go test, ten times sit-to-stand test, Hospital Anxiety and Depression score, and quality of life (Visual Simplified Respiratory Questionnaire, VQ11, Maugeri Respiratory Failure 28). RESULTS: No incidents or accidents were observed during the course of home-based PR. The 6-minute stepper test was significantly improved after completion of the program, at 6 months and 12 months, whereas the Timed Up and Go and ten times sit-to-stand test were improved after PR and at 6 months but not at 12 months. Hospital Anxiety and Depression and quality of life scores improved after PR, and this improvement persisted at 6 months and 12 months. CONCLUSION: Home-based PR for unselected patients with COPD is effective in the short term, and this effectiveness is maintained in the medium term (6 months) and long term (12 months). Home-based PR is an alternative to outpatient management provided all activities, such as exercise conditioning, therapeutic education, and self-management are performed.

PT - Observational Study

Abstract: Questions: In people with chronic obstructive pulmonary disease, does the Manual Diaphragm Release Technique improve diaphragmatic mobility after a single treatment, or cumulatively? Does the technique also improve exercise capacity, maximal respiratory pressures, and kinematics of the chest wall and abdomen? Design: Randomised, controlled trial with concealed allocation, intention-to-treat analysis, and blinding of participants and assessors. Participants: Twenty adults aged over 60 years with clinically stable chronic obstructive pulmonary disease. Intervention: The experimental group received six treatments with the Manual Diaphragm Release Technique on non-consecutive days within a 2-week period. The control group received sham treatments following the same regimen. Outcome measures: The primary outcome was diaphragmatic mobility, which was analysed using ultrasonography. The secondary outcomes were: the 6-minute walk test; maximal respiratory pressures; and abdominal and chest wall kinematics measured by optoelectronic plethysmography. Outcomes were measured before and after the first and sixth treatments. Results: The Manual Diaphragm Release Technique significantly improved diaphragmatic mobility over the course of treatments, with a between-group difference in cumulative improvement of 18 mm (95% CI 8 to 28). The technique also significantly improved the 6-minute walk distance over the treatment course, with a between-group difference in improvement of 22 m (95% CI 11 to 32). Maximal expiratory pressure and sniff nasal inspiratory pressure both showed significant acute benefits from the technique during the first and sixth treatments, but no cumulative benefit. Inspiratory capacity estimated by optoelectronic plethysmography showed significant cumulative benefit of 330 ml (95% CI 100 to 560). The effects on other outcomes were non-significant or small. Conclusion: The Manual Diaphragm Release Technique improves diaphragmatic mobility, exercise capacity and inspiratory capacity in people with chronic obstructive pulmonary disease. This technique could be considered in the management of people with chronic obstructive pulmonary disease. Trial registration: NCT02212184.


Abstract: OBJECTIVES: Pulmonary rehabilitation (PR) provides benefit for patients with chronic obstructive pulmonary disease (COPD) in terms of quality of life (QoL) and exercise capacity; however, the effects diminish over time. Our aim was to evaluate a maintenance programme for patients who had completed PR. SETTING: Primary and secondary care PR programmes in Norfolk. PARTICIPANTS: 148 patients with COPD who had completed at least 60% of a standard PR programme were randomised and data are available for 110 patients. Patients had greater than 20 pack year smoking history and less than 80% predicted forced expiratory volume in 1s but no other significant disease or recent respiratory tract infection. INTERVENTIONS: Patients were randomised to receive a maintenance programme or standard care. The maintenance programme consisted of 2h (1h individually tailored exercise training and 1h education programme) every 3 months for 1 year. PRIMARY AND SECONDARY OUTCOME MEASURES: The Chronic Respiratory Questionnaire (CRQ) (primary outcome), endurance shuttle walk test (ESWT), EuroQol (EQ5D), hospital anxiety and depression score (HADS), body mass index (BMI), body fat, activity levels (overall score and activity diary) and exacerbations were assessed before and after 12 months. RESULTS: There was no statistically significant difference between the groups for the change in CRQ dyspnoea score (primary end point) at 12 months which amounted to 0.19 (-0.26 to 0.64) units or other domains of the CRQ. There was no difference in the ESWT duration (-10.06 -191.16 to 171.03) seconds, BMI, body fat, EQ5D, MET-minutes, activity rating, HADS, exacerbations or admissions. CONCLUSIONS: A maintenance programme of three monthly 2h sessions does not improve outcomes in patients with COPD after 12 months. We do not recommend that our maintenance programme is adopted. Other methods of sustaining the benefits of PR are required. TRIAL REGISTRATION NUMBER: NCT00925171


Abstract: PURPOSE: Both exercise and self-management are advocated in pulmonary rehabilitation for people with chronic obstructive pulmonary disease (COPD). The widely used 6-week, group-based Chronic Disease Self-Management Program (CDSMP) increases self-reported exercise, despite supervised exercise not being a program component. This has been little explored in COPD. Whether adding supervised exercise to the CDSMP would add benefit is unknown. We investigated the CDSMP in COPD, with and without a formal supervised exercise component, to address this question. PATIENTS AND METHODS: Adult outpatients with COPD were randomized to the CDSMP with or without one hour of weekly supervised exercise over 6 weeks. The primary outcome measure was 6-minute walk test distance (6MWD). Secondary outcomes included self-reported exercise, exercise stage of change, exercise self-efficacy, breathlessness, quality of life, and self-management behaviors. Within- and between-group differences were analyzed on an intention-to-treat basis. RESULTS: Of 84 subjects recruited, 15 withdrew. 6MWD increased similarly in both groups: CDSMP-plus-exercise (intervention group) by 18.6±46.2 m; CDSMP-alone (control group) by 20.0±46.2 m. There was no significant difference for any secondary outcome. CONCLUSION: The CDSMP produced a small statistically significant increase in 6MWD. The addition of a single supervised exercise session did not further increase exercise capacity. Our findings confirm the efficacy of a behaviorally based intervention in COPD, but this would seem to be less than expected from conventional exercise-based pulmonary rehabilitation, raising the question of how, if at all, the small gains observed in this study may be augmented.


Abstract: Abstract: Objective: Patients with chronic obstructive pulmonary disease (COPD) appear to have impaired cardiac autonomic modulation with depressed heart rate variability (HRV). Pulmonary rehabilitation (PR) is recommended as an integral part of the management. However, the effect of PR on HRV at peak exercise remains unclear. Methods: Sixty-four patients with COPD participated in a 12-week, 2 sessions-per-week, hospital-based PR program. Baseline and post-PR status were evaluated by spirometry, HRV, health-related quality of life (HRQL, St. George’s Respiratory Questionnaire, SGRQ), cardiopulmonary exercise test, respiratory muscle strength, and dyspnea Borg’s scale. Results: After PR, there were significant improvements in the time and frequency domains of HRV with increased standard deviation of the normal R-R intervals, difference between adjacent normal R-R intervals within a given time minus one, high-frequency and decreased low-frequency, as well as concurrent improvements in HRQL, exercise capacity, dyspnea score, and respiratory muscle strength (all p < 0.05). Conclusions: PR results in significant improvements in autonomic function, with concurrent improvements in HRQL and exercise capacity.


Abstract: PURPOSE: Aerobic exercise training is a recognized approach for improving functional capacity in COPD. People with greater disease severity often have difficulty achieving higher aerobic exercise training intensity. The effects of resistance training prior to aerobic training were examined to determine if this sequential approach was associated with greater gains in functional status than aerobic training alone or concurrent aerobic and resistance training. METHODS: Patients were randomized to: 1) sequential resistance then aerobic training (RT-then-AT) (8 weeks resistance training followed by 8 weeks aerobic exercise training), 2) control group (CE-then-AT + RT) (8 weeks of 'sham' training followed by 8 weeks concurrent aerobic and resistance training), 3) control group (CE-then-AT) (8 weeks 'sham' training followed by 8 weeks aerobic training). Outcomes were assessed at study entry, after week 8, and after week 16: aerobic exercise performance; muscle strength and endurance. RESULTS: 75 patients completed training: FEV1 %predicted 40 +/- 10, V O2(peak) %predicted, 71 +/- 22, fat-free mass index 19.5 +/- 3.1. RT-then-AT had greater acquisition of peripheral muscle endurance than CE-then-AT + RT and CE-then-AT, but improvements in aerobic exercise performance were similar. Improvements in muscle strength were similar.
between RT-then-AT and CE-then-AT + RT. Sarcopenia was associated with poorer attendance, and lower aerobic and resistance training volumes. CONCLUSION: Although the sequential approach to resistance and aerobic training yielded a greater increase in muscle endurance and higher resistance training volume compared to concurrent resistance and aerobic training, other training outcomes were similar between the two groups, thus the sequential approach is not clearly superior to the concurrent approach in severe COPD.

ClinicalTrials.gov Identifier: NCT01058213
PT - Randomized Controlled Trial

Abstract: BACKGROUND: There is a wide variability in measurement methodology of physical activity. This study investigated the effect of different analysis techniques on the statistical power of physical activity outcomes after pulmonary rehabilitation. METHODS: Physical activity was measured with an activity monitor armband in 57 patients with COPD (mean +/- SD age, 66 +/- 7 years; FEV1, 46 +/- 17% predicted) before and after 3 months of pulmonary rehabilitation. The choice of the outcome (daily number of steps [STEPS], time spent in at least moderate physical activity [TMA], mean metabolic equivalents of task level [METS], and activity time [ACT]), impact of weekends, number of days of assessment, postprocessing techniques, and influence of duration of daylight time (DT) on the sample size to achieve a power of 0.8 were investigated. RESULTS: The STEPS and ACT (1.6-2.3 metabolic equivalents of task) were the most sensitive outcomes. Excluding weekends decreased the sample size for STEPS (83 vs 56), TMA (160 vs 148), and METS (251 vs 207). Using 4 weekdays (STEPS and TMA) or 5 weekdays (METS) rendered the lowest sample size. Excluding days with < 8 h wearing time reduced the sample size for STEPS (56 vs 51). Differences in DT were an important confounder. CONCLUSIONS: Changes in physical activity following pulmonary rehabilitation are best measured for 4 weekdays, including only days with at least 8 h of wearing time (during waking hours) and considering the difference in DT as a covariate in the analysis. TRIAL REGISTRY: ClinicalTrials.gov; No.: NCT00948623; URL: www.clinicaltrials.gov
PT - Multicenter Study
PT - Randomized Controlled Trial

Abstract: Objective: The current study evaluated the costs and benefits of a simple aerobic walking program for patients with chronic obstructive pulmonary disease (COPD). Method: This was a blinded randomized controlled clinical trial that recruited 72 patients diagnosed with COPD, 40 of whom were included in the study and divided into two groups [control group (CG) and pulmonary rehabilitation group (GPR)]. We assessed pulmonary function, distance covered during the 6-minute walk test (6MWT), respiratory and peripheral muscle strength, health-related quality of life (HRQOL), body composition, and level of activities of daily living (ADLs) before and after an 8-week walking program. The financial costs were calculated according to the pricing table of the Brazilian Unified Health System (SUS). Results: Only 34 of the 40 patients remained in the final sample; 16 in the CG and 18 in the GPR (FEV1: 50.9±14% predicted and FEV1: 56±0.5% predicted, respectively). The intervention group exhibited improvements in the 6MWT, sensation of dyspnea and fatigue, work performed, BODE index (p<0.01), HRQOL, ADL level (p<0.001), and lower limb strength (p<0.05). The final mean cost per patient for the GPR was R$ 148.75 (~US$ 75.00) and no patient significantly exceeded this value. However, 2 patients in the CG did exceed this value, incurring a cost of R$ 689.15 (~US$ 345.00). Conclusion: Aerobic walking demonstrated significant clinical benefits in a cost-efficient manner in patients with COPD

Abstract: BACKGROUND: Pulmonary rehabilitation (PR) is a core component of the management of patients with moderate-to-very-severe COPD. However, as impairments in quadriceps muscle strength and health-related quality of life (HRQOL) are already present in patients with mild COPD, there is a need to investigate whether PR could also be beneficial to these patients. Thus, this study assessed the impact of PR on patients with mild COPD.

METHODS: A quasi-experimental study was conducted. Twenty-six participants (67.8 ± 10.3 years old; FEV1 83.8 ± 6.4% of predicted) enrolled in a 12-week PR program with exercise training and psychoeducation. Lung function was assessed by spirometry, dyspnea with the Modified Medical Research Council questionnaire, functional balance with the Timed Up and Go test, muscle strength with 10-repetition maximum testing, exercise tolerance with the 6-min walk test, emotional state with the Depression Anxiety Stress Scales, and HRQOL with the St George Respiratory Questionnaire (SGRQ). RESULTS: Significant effects were observed on participants' dyspnea (P = .003, effect size [ES] = 0.7), functional balance (P < .001, ES = 0.8), shoulder flexor/knee extensor strength (P < .001, ES = 1.2-1.3), and exercise tolerance (P < .001, ES = 0.5). With the exception of the SGRQ impact score, the symptom (P < .001, ES = 0.6), activity (P = .02, ES = 0.4), and total (P = .005, ES = 0.3) scores improved significantly after PR. The PR program had no significant effect on participants' lung function and emotional state. CONCLUSIONS: Patients with mild COPD benefit from PR and could therefore be routinely included in these programs. Studies with more robust designs and with long-term follow-ups are needed to inform guidelines for PR in mild COPD.

Notes: [Full text maybe available with NHS OpenAthens]


Abstract: Usual gait speed is a consistent predictor of adverse outcomes in community-dwelling elderly people. The reliability and validity of the 4-m gait speed (4MGS) has recently been demonstrated in patients with chronic obstructive pulmonary disease (COPD). The aims of this study were to assess the responsiveness of the 4MGS and to estimate the minimal clinically important difference (MCID). In 301 COPD patients, 4MGS and incremental shuttle walk (ISW) were measured before and after pulmonary rehabilitation. 4MGS and ISW were also measured at baseline and 1 year later in a separate cohort of 162 COPD patients. The MCID of 4MGS was estimated using distribution and anchor-based methods. 4MGS improved significantly with pulmonary rehabilitation (mean change 0.08 m.s⁻¹, p<0.001). The minimal detectable change at 95% confidence was 0.11 m.s⁻¹. The MCID was estimated at 0.11 m.s⁻¹ (anchored against ISW) and 0.08 m.s⁻¹ (anchored against self-reported improvement). The effect size for 4MGS was greatest in frail individuals. After 12 months, mean 4MGS declined by 0.04 m.s⁻¹. When anchored against a decline of more than the MCID for ISW, change in 4MGS was -0.11 m.s⁻¹. The 4MGS is responsive to pulmonary rehabilitation and longitudinal change in COPD, and has potential as a simple functional assessment tool in COPD. The 4MGS may be particularly useful in frail individuals with COPD.


Abstract: A comprehensive assessment is the foundation of a successful pulmonary rehabilitation programme. There is a broad selection of outcome measures that tend to be categorized into measures of exercise performance (including measures of strength) quality of life (health status), psychological well-being, nutritional status and more recently knowledge and self-efficacy. There is a growing interest in the measurement of physical activity too, although this is a current line of research activity. A sophisticated suite of outcomes allows the rehabilitation program to be personalised to the individual and deliver effective rehabilitation.

(29) Spencer LM, Alison JA, McKeough ZJ. Evaluating the need for two incremental shuttle walk tests during a maintenance exercise program in people with COPD. *Physiotherapy* 2014; 100(2):123-127.

Abstract: OBJECTIVE: To determine if there was an increase in walk distance when two
incremental shuttle walk tests (ISWTs) were performed at the commencement of a maintenance exercise program (0 month) and at three, six and 12-month assessments. DESIGN: A prospective, longitudinal, repeated measures study in COPD. SETTING: Single site, hospital outpatient physiotherapy department. PARTICIPANTS: Forty-eight participants (22 males) with COPD participated in the study: [baseline characteristics: mean (SD): FEV1 59 (19) % predicted; age 65 (8) years; BMI 26 (6) (kg/m(2))]. INTERVENTION: Participants completed two ISWTs at zero, three, six and twelve months. OUTCOMES: Incremental shuttle walk distance (ISWD). RESULTS: There was a significant increase in walk distance between two ISWTs at zero month (17 metres (95% CI: 7 to 26) and three months (18 metres (95% CI: 6 to 30), but not at six or 12 months. CONCLUSION: The increase in walk distance when a second ISWT was performed at zero and three months indicates the need to perform two ISWTs when participants are naive to the test and at the three-month reassessment during a 12-month maintenance exercise program

Abstract: BACKGROUND: Pulmonary rehabilitation (PR) is beneficial for patients with COPD, with improvement in exercise capacity and health-related quality of life. Despite these overall benefits, the responses to PR vary significantly among different individuals. It is not clear if PR is beneficial for patients with COPD and normal exercise capacity. We aimed to investigate the effects of PR in patients with normal exercise capacity on health-related quality of life and exercise capacity. METHODS: Twenty-six subjects with COPD and normal exercise capacity were studied. All subjects participated in 12-week, 2 sessions per week, hospital-based, out-patient PR. Baseline and post-PR status were evaluated by spirometry, the St George’s Respiratory Questionnaire, cardiopulmonary exercise test, respiratory muscle strength, and dyspnea scores. RESULTS: The mean FEV1 in the subjects was 1.29 ± 0.47 L/min, 64.8 ± 23.0% of predicted. After PR there was significant improvement in maximal oxygen uptake and work rate. Improvements in St George’s Respiratory Questionnaire scores of total, symptoms, activity, and impact were accompanied by improvements of exercise capacity, respiratory muscle strength, maximum oxygen pulse, and exertional dyspnea scores (all P < .05). There were no significant changes in pulmonary function test results (FEV1, FVC, and FEV1/FVC), minute ventilation, breathing frequency, or tidal volume at rest or exercise after PR. CONCLUSIONS: Exercise training can result in significant improvement in health-related quality of life, exercise capacity, respiratory muscle strength, and exertional dyspnea in subjects with COPD and normal exercise capacity. Exercise training is still indicated for patients with normal exercise capacity

Abstract: Pulmonary rehabilitation includes upper and lower extremity exercise training. While validated tests such as the six-minute walk distance (6MWD) and shuttle walk tests are available to evaluate the effectiveness of lower extremity training, the optimal method of evaluating the effectiveness of upper extremity training has not been determined. This study evaluates the potential utility of unsupported arm lifts (UALs) testing as an outcome measurement for pulmonary rehabilitation. Records of chronic obstructive pulmonary disease (COPD) patients who underwent outpatient pulmonary rehabilitation at our institution were reviewed. Outcomes assessed before and immediately after the intervention included 6MWD, the self-administered Chronic Respiratory Questionnaire (CRQ-SA), and UALs. For the latter, the patient repeatedly raises a wooden dowel from thigh to arm level, with the number of repetitions per minute used as the outcome. Changes in variables from pre- to post-pulmonary rehabilitation were analyzed using paired t test. Pearson correlation coefficients were used to evaluate associations. Of the 241 patients, 51% were male. Mean age was 69 +/- 9 years, body mass index was 28 +/- 7 kg/m(2), and forced expiratory volume in 1 second was 50 +/- 20 percent-predicted. All studied variables increased significantly post-pulmonary rehabilitation: the 6MWD by 45 +/- 50 m (effect size 0.49), the CRQ-SA total score by 0.84 +/- 0.86 units (effect size 0.89), and UAL by 12 +/- 13 lifts/minute (effect size 0.75; p < 0.0001 for all). As a measure of upper extremity exercise capacity, UAL appears to be responsive to the
comprehensive pulmonary rehabilitation intervention. Using effect sizes, the degree of improvement appears to be between that of 6MWD and CRQ-SA. UAL may be a useful outcome assessment for pulmonary rehabilitation in COPD patients.

(32) Jones SE, Kon SS, Canavan JL, Patel MS, Clark AL, Nolan CM et al. The five-repetition sit-to-stand test as a functional outcome measure in COPD. Thorax 2013; 68(11):1015-1020. Abstract: BACKGROUND: Moving from sitting to standing is a common activity of daily living. The five-repetition sit-to-stand test (5STS) is a test of lower limb function that measures the fastest time taken to stand five times from a chair with arms folded. The 5STS has been validated in healthy community-dwelling adults, but data in chronic obstructive pulmonary disease (COPD) populations are lacking. AIMS: To determine the reliability, validity and responsiveness of the 5STS in patients with COPD. METHODS: Test-retest and interobserver reliability of the 5STS was measured in 50 patients with COPD. To address construct validity we collected data on the 5STS, exercise capacity (incremental shuttle walk (ISW)), lower limb strength (quadriceps maximum voluntary contraction (QMVC)), health status (St George’s Respiratory Questionnaire (SGRQ)) and composite mortality indices (Age Dyspnoea Obstruction index (ADO), BODE index (iBODE)). Responsiveness was determined by measuring 5STS before and after outpatient pulmonary rehabilitation (PR) in 239 patients. Minimum clinically important difference (MCID) was estimated using anchor-based methods. RESULTS: Test-retest and interobserver intraclass correlation coefficients were 0.97 and 0.99, respectively. 5STS time correlated significantly with ISW, QMVC, SGRQ, ADO and iBODE ($r$= -0.59, -0.38, 0.35, 0.42 and 0.46, respectively; all $p<0.001$). Median (25th, 75th centiles) 5STS time decreased with PR (Pre: 14.1 (11.5, 21.3) vs Post: 12.4 (10.2, 16.3) s; $p<0.001$). Using different anchors, a conservative estimate for the MCID was 1.7 s. CONCLUSIONS: The 5STS is reliable, valid and responsive in patients with COPD with an estimated MCID of 1.7 s. It is a practical functional outcome measure suitable for use in most healthcare settings.

PT - Comparative Study

[Full text maybe available with NHS OpenAthens]

(33) Maltais F. Exercise and COPD: therapeutic responses, disease-related outcomes, and activity-promotion strategies. Phys Sportsmed 2013; 41(1):66-80. Abstract: Chronic obstructive pulmonary disease (COPD) reduces patients’ exercise capacities and their abilities to perform daily physical activities, thereby increasing morbidity and mortality rates. The cycle of dyspnea, deconditioning, and declining physical activity not only accelerates the progression of COPD but also increases the risk for developing or aggravating metabolic and cardiovascular diseases. Cardiovascular and metabolic comorbidities also limit physical function, and their disabling effects in combination with COPD may be greater than the effects of each disease alone. The impact of COPD and its treatment on the ability to exercise, and the degree of physical activity in daily life, can be measured by field-based tests (eg, the 6-minute walk test or incremental and endurance shuttle-walk test), laboratory-based tests (eg, incremental or constant work-rate treadmill and cycle-ergometer tests), and physical activity assessments (eg, questionnaires and accelerometers). Walking tests increase oxygen consumption and desaturation in patients with COPD more than cycling tests with similar work-rate profiles and may more closely resemble patients’ normal activities. Despite the questionable relevance of exercise testing to patients’ daily functionality, exercise parameters remain important predictors of survival in patients with COPD. Treatment of COPD (pharmacotherapy, pulmonary rehabilitation, or both) can increase exercise capacity and physical activity in daily life, which potentially slows the decline of lung function, reduces the frequencies of exacerbations and hospitalizations, decreases mortality, slows the progression of comorbidities, improves health-related quality of life, and increases the activity reserve for routine function. This article examines the interactions of reduced physical activity and decreased exercise capacity with the progression of COPD, comorbidities, and mortality. The article also describes the available exercise tests for patients with COPD and reviews the evidence indicating that treating COPD improves exercise capacity. Notably, it appears that even mild COPD reduces exercise capacity and daily physical activity, indicating the need for early intervention.

PT - Review
and six months, regardless of program completion. RESULTS: In IPF, greater improvements in disease severity and response to pulmonary rehabilitation were assessed after eight weeks of pulmonary rehabilitation. Relationships between disease aetiology, including idiopathic pulmonary fibrosis (IPF), and other interstitial lung diseases (ILDs), however, there is marked variation in outcomes between individuals. The aim of this study was to establish the impact of the BMI categories (all p < 0.001). The majority of patients with COPD were overweight associated with a lower walking capacity. A walking-based PR programme was comparably effective across the BMI spectrum. Patients with COPD should be referred for standard PR, independent of BMI.

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in 6-minute walk distance (6MWD) immediately following pulmonary rehabilitation were associated with larger forced vital capacity \((r = 0.49, p = 0.01)\), less exercise-induced oxyhaemoglobin desaturation \((r(S) = 0.43, p = 0.04)\) and lower right ventricular systolic pressure \((r = -0.47, p = 0.1)\). In participants with other ILDs there was no relationship between change in 6MWD and baseline variables. Less exercise-induced oxyhaemoglobin desaturation at baseline independently predicted a larger improvement in 6MWD at six month follow-up. Fewer participants with IPF had clinically important reductions in dyspnoea at six months compared to those with other ILDs \((25\% \text{ vs } 56\%, p = 0.04)\). More severe dyspnoea at baseline and diagnosis other than IPF predicted greater improvement in dyspnoea at six months. CONCLUSIONS: Patients with IPF attain greater and more sustained benefits from pulmonary rehabilitation when disease is mild, whereas those with other ILDs achieve benefits regardless of disease severity. Early referral to pulmonary rehabilitation should be considered in IPF.

PT - Evaluation Studies


Abstract: BACKGROUND: There are limited number of studies investigating extrapulmonary manifestations of bronchiectasis. The purpose of this study was to compare peripheral muscle function, exercise capacity, fatigue, and health status between patients with bronchiectasis and healthy subjects in order to provide documented differences in these characteristics for individuals with and without bronchiectasis. METHODS: Twenty patients with bronchiectasis \((43.5 \pm 14.1 \text{ years})\) and 20 healthy subjects \((43.0 \pm 10.9 \text{ years})\) participated in the study. Pulmonary function, respiratory muscle strength (maximal expiratory pressure - MIP and maximal expiratory pressure - MEP), and dyspnea perception using the Modified Medical Research Council Dyspnea Scale (MMRC) were determined. A six-minute walk test (6MWT) was performed. Quadriceps muscle, shoulder abductor, and hand grip strength (QMS, SAS, and HGS, respectively) using a hand held dynamometer and peripheral muscle endurance by a squat test were measured. Fatigue perception and health status were determined using the Fatigue Severity Scale (FSS) and the Leicester Cough Questionnaire (LCQ), respectively. RESULTS: Number of squats, 6MWT distance, and LCQ scores as well as lung function testing values and respiratory muscle strength were significantly lower and MMRC and FSS scores were significantly higher in patients with bronchiectasis than those of healthy subjects \((p<0.05)\). In bronchiectasis patients, QMS was significantly associated with HGS, MIP and MEP \((p<0.05)\). The 6MWT distance was significantly correlated to LCQ psychological score \((p<0.05)\). The FSS score was significantly associated with LCQ physical and total and MMRC scores \((p<0.05)\). The LCQ psychological score was significantly associated with MEP and 6MWT distance \((p<0.05)\).

CONCLUSIONS: Peripheral muscle endurance, exercise capacity, fatigue and health status were adversely affected by the presence of bronchiectasis. Fatigue was associated with dyspnea and health status. Respiratory muscle strength was related to peripheral muscle strength and health status, but not to fatigue, peripheral muscle endurance or exercise capacity. These findings may provide insight for outcome measures for pulmonary rehabilitation programs for patients with bronchiectasis.

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Abstract: There is limited information about the benefits of pulmonary rehabilitation (PR) in patients with bronchiectasis. This study aimed to evaluate the effects of an out-patient PR program in patients with a primary diagnosis of bronchiectasis and to compare them with a matched COPD group who completed the same PR program. A retrospective review was conducted of patients with bronchiectasis or COPD who completed 6 to 8 weeks of PR at two tertiary institutions. The outcome measures were the 6-minute walk distance (6MWD) and Chronic Respiratory Disease Questionnaire (CRQ). Ninety-five patients with bronchiectasis completed the PR \((48 \text{ male; } \text{FEV}(1) 63 [24\% \text{ predicted}; \text{age } 67 [10\] \text{ years})\). Significant improvements in 6MWD \((\text{mean change } 53.4 \text{ m, } 95\% \text{ CI } 45.0 \text{ to } 61.7)\) and CRQ total score
Holland AE, Hill CJ, Rasekaba T, Lee A, Naughton MT, McDonald CF. Updating the minimal PT may experience significant nocturnal desaturation oxygen saturation changes during a 6MWT is useful in helping to identify COPD patients who may experience significant nocturnal desaturation.

PT - Validation Studies

Further prospective RCTs are warranted to substantiate these findings.

[Full text maybe available with NHS OpenAthens]


Abstract: BACKGROUND: The effects of different exercise training programs on the level of physical activity in daily life in patients with COPD remain to be investigated. OBJECTIVE: In patients with COPD we compared the effects of 2 exercise/training regimens (a high-intensity whole-body endurance-and-strength program, and a low-intensity calisthenics-and-breathing-exercises program) on physical activity in daily life, exercise capacity, muscle force, health-related quality of life, and functional status. METHODS: We randomized 40 patients with COPD to perform either endurance-and-strength training (no. 20, mean ± SD FEV1 40 ± 13% of predicted) at 60-75% of maximum capacity, or calisthenics-and-breathing-exercises training (no. 20, mean ± SD FEV1 39 14% of predicted). Both groups underwent 3 sessions per week for 12 weeks. Before and after the training programs the patients underwent activity monitoring with motion sensors, incremental cycle-ergometry, 6-min walk test, and peripheral-muscle-force test, and responded to questionnaires on health-related quality of life and functional status (activities of daily living, pulmonary functional status, and dyspnea).

RESULTS: Time spent active and energy expenditure in daily life were not significantly altered in either group. Exercise capacity and muscle force significantly improved only in the endurance-and-strength group. Health-related quality of life and functional status improved significantly in both groups.

CONCLUSIONS: Neither training program significantly improved time spent active or energy expenditure in daily life. The training regimens similarly improved quality of life and functional status. Exercise capacity and muscle force significantly improved only in the high-intensity endurance-and-strength group.


Abstract: UNLABELLED: BACKGROUND OBJECTIVES: Patients with chronic obstructive pulmonary disease (COPD) may experience sleep disordered breathing with nocturnal desaturation. An exploratory study was performed to determine whether any commonly measured clinical parameters were useful in predicting nocturnal desaturation in patients with COPD. A validation study was subsequently performed to confirm the utility of the parameter identified in the exploratory study as most useful in this regard. METHODS: A total of 103 (exploratory cohort) and 200 (validation cohort) consecutive patients with COPD admitted for pulmonary rehabilitation were evaluated. Standard outcome measures including nocturnal oximetry and the 6 min walk test (6MWT) on room air with continuous pulse oximetry were assessed. Patients with sleep apnea or those undergoing long-term oxygen therapy were excluded. RESULTS: In the exploratory study, the mean (+/- SD) patient age was 70 +/- 9.9 years, with forced expiratory volume in 1 s of 0.76 +/- 0.34 L, which was 36 +/- 16% of predicted. Body mass index, arterial oxygen tension, oxygen saturation by pulse oximetry at rest and during the 6MWT all demonstrated significant correlations with percentage of time spent with a saturation <90%. When the lowest pulse oximetry during the 6MWT was <=88%, 10 of 21 patients demonstrated a saturation <90% for at least 30% of sleep time. This measure yielded a positive likelihood ratio of 3.77 (95% CI 1.87 to 7.62) compared with those who did not reach this threshold value. The validation study confirmed similar detection characteristics.

CONCLUSIONS: Results from the present study suggest that monitoring oxygen saturation changes during a 6MWT is useful in helping to identify COPD patients who may experience significant nocturnal desaturation.

(39) 

(40) 

(41)
Abstract: OBJECTIVE: To establish the minimal important difference (MID) for the six-minute walk distance (6MWD) in persons with chronic obstructive pulmonary disease (COPD).

DESIGN: Analysis of data from an observational study using distribution- and anchor-based methods to determine the MID in 6MWD.

SETTING: Outpatient pulmonary rehabilitation program at 2 teaching hospitals.

PARTICIPANTS: Seventy-five patients with COPD (44 men) in a stable clinical state with mean age 70 years (SD 9 y), forced expiratory volume in one second 52% (SD 21%) predicted and baseline walking distance 359 meters (SD 104 m).

INTERVENTIONS: Not applicable. MAIN OUTCOME MEASURES: Participants completed the six-minute walk test before and after a 7-week pulmonary rehabilitation program.

Participants and clinicians completed a global rating of change score while blinded to the change in 6MWD.

RESULTS: The mean change in 6MWD in participants who reported themselves to be unchanged was 17.7 meters, compared with 60.2 meters in those who reported small change and 78.4 meters in those who reported substantial change (P=.004).

Anchor-based methods identified an MID of 25 meters (95% confidence interval 20-61 m).

There was excellent agreement with distribution-based methods (25.5-26.5m, kappa=.95). A change in 6MWD of 14% compared with baseline also represented a clinically important effect; this threshold was less sensitive than for absolute change (sensitivity .70 vs .85).

CONCLUSIONS: The MID for 6MWD in COPD is 25 meters. Absolute change in 6MWD is a more sensitive indicator than percentage change from baseline. These data support the use of 6MWD as a patient-important outcome in research and clinical practice.

PT - Controlled Clinical Trial


Abstract: BACKGROUND AND OBJECTIVE: The six-minute walk test (6MWT) is widely used as an outcome measure in pulmonary rehabilitation programs (PRP). A learning effect for the test has been reported in COPD; however, limited data exist in patients with other respiratory diagnoses. The objectives of this study were to: (i) report the magnitude of change in 6MWD with test repetition in patients referred to an outpatient PRP, and (ii) compare the magnitude of change in 6MWD with test repetition in patients with COPD, interstitial lung disease (ILD), bronchiectasis and asthma.

METHODS: Retrospective study of 349 patients with stable COPD (n = 245), ILD (n = 21), bronchiectasis (n = 33) or asthma (n = 50) who performed two 6MWT at enrollment into a PRP.

RESULTS: 6MWD increased in all groups on the second test (all P < 0.001). At least 80% of patients in each diagnostic group walked further on their second 6MWT. The magnitude of change (mean, 95% CI) was greater (P < 0.05) in the COPD (37 m, 95% CI: 33-41 m) and ILD (41 m, 95% CI: 27-55 m) cohorts compared with the bronchiectasis (22 m, 95% CI: 14-31 m) and asthma (19 m, 95% CI: 11-27 m) cohorts.

CONCLUSIONS: Respiratory diagnosis influences the magnitude of the learning effect for the 6MWT. The findings support the recommendation of a practice 6MWT at baseline assessment in order to provide an accurate measure of the effects of rehabilitation on 6MWD.

Leung RWM, Alison JA, McKeough ZJ, Peters MJ. Ground walk training improves functional exercise capacity more than cycle training in people with chronic obstructive pulmonary disease (COPD): a randomised trial. Journal of Physiotherapy 2010; 56(2):105-112.

Abstract: QUESTIONS: Does an eight-week program of walk training improve endurance walking capacity in people with COPD compared to cycle training? Does walk training improve peak walking capacity, cycle capacity, and quality of life compared to cycle training? Is the endurance shuttle walk test (ESWT) responsive to change in walking capacity elicited by exercise training?

DESIGN: Randomised trial with concealed allocation, assessor blinding, and intention-to-treat analysis. PARTICIPANTS: 36 people with stable COPD recruited with four dropouts.

INTERVENTION: Participants were randomised into either a walk or cycle training group. Both groups trained indoors for 30 to 45 minutes per session, three times weekly over eight weeks at Concord Hospital.

Training intensities were based on baseline peak exercise tests and progressed as able.

OUTCOME MEASURES: The primary outcome was endurance walking capacity measured by the ESWT. Secondary outcomes included peak walking capacity, peak and endurance cycle capacity, and health-related quality of life.

Measures were taken at baseline (Week 0) and following training (Week 8).

RESULTS: The
walk training group increased their endurance walking time by 279 seconds (95% CI 70 to 483) more than the cycle training group. No significant differences between the groups were found for any other outcome. CONCLUSION: Ground walk training increased endurance walking capacity more than cycle training and was similar to cycle training in improving peak walking capacity, peak and endurance cycle capacity and quality of life. This study provides evidence for ground walking as a mode of exercise training in pulmonary rehabilitation programs.

Hospital Premium Collection

Abstract: OBJECTIVES: To compare the effectiveness of a once-weekly supervised pulmonary rehabilitation programme with a standard twice-weekly format. DESIGN: Randomised trial of equivalency. SETTING: Pulmonary rehabilitation service of a primary care trust delivered at two physiotherapy outpatient departments. PARTICIPANTS: Thirty patients with chronic obstructive pulmonary disease. OUTCOME MEASURES: Primary outcomes were the Incremental Shuttle Walking Test (ISWT), Endurance Shuttle Walking Test (ESWT) and St George's Respiratory Questionnaire (SGRQ), assessed at baseline and at completion of the supervised programme. Secondary outcomes were home-exercise activity, attendance levels and patient satisfaction with the programme. INTERVENTIONS: The once-weekly group (n=15) received one supervised rehabilitation session per week, and the twice-weekly group (n=15) received two sessions per week, both for 8 weeks, together with a home-exercise plan. RESULTS: After pulmonary rehabilitation, the groups showed similar improvements in exercise tolerance (median values: ISWT once-weekly 60 metres, twice-weekly 50 metres; ESWT once-weekly 226 seconds, twice-weekly 109 seconds). However, for health-related quality-of-life, the once-weekly group's score did not change (SGRQ 0), whereas an improvement was seen for the twice-weekly group (SGRQ 3.7). The number of home-exercise sessions and attendance levels were similar between the groups. Patient satisfaction with both formats was high and almost identical between the groups. CONCLUSIONS: This pilot provides data to inform a larger study and shows that once-weekly supervision may be capable of producing equivalent improvements in exercise tolerance as a twice-weekly programme, but the health-related quality-of-life outcome appeared to be poorer for once-weekly supervision.

Abstract: UK guidelines for domiciliary oxygen have suggested the six-minute walk test or shuttle walk tests as suitable functional measures for the clinical assessment of ambulatory oxygen (AO). To date, there is limited evidence that would support the use of shuttle walk tests as assessment tools for AO. The endurance shuttle walk test (ESWT) is used increasingly as an assessment tool within pulmonary rehabilitation (PR) but its potential as an investigative test for AO has not been explored. Using the same test for both PR and AO assessment is appealing since it would improve efficiency and act to standardise outcome measures in this patient population. The aim of this study was to examine the responsiveness and repeatability of the ESWT to AO and to compare the response with that of the six-minute walk test (6MWT). Twenty-three patients with chronic obstructive pulmonary disease (COPD) performed, in random order, the ESWT and the 6MWT on air and whilst breathing AO. Oxygen saturation and Borg ratings of breathlessness and perceived exertion were recorded. On a third day, eleven patients repeated the ESWT with AO in order to measure repeatability. There was a significantly greater change in the ESWT with oxygen than the change recorded from the 6MWT (66 [91] vs 6 [28] m respectively; P < .05). When repeated on a separate day, the mean difference (95% CI) between distances walked on the ESWT with AO was 0.91 (-47, 49) m. The ESWT was more responsive than the 6MWT for detecting improvements in walking endurance whilst breathing AO.

PT - Comparative Study
[Full text maybe available with NHS OpenAthens]

Abstract: BACKGROUND: The Incremental Shuttle Walking Test (ISWT) is used to assess exercise capacity in chronic obstructive pulmonary disease (COPD) and is employed as an outcome measure for pulmonary rehabilitation. We studied the value of this test in predicting survival in COPD patients enrolled in a rehabilitation program. METHODS: A total of 416 patients performed an ISWT before entering a 7-week outpatient pulmonary rehabilitation program. Their survival was observed over a mean period of 4.5 years (range = 1.2-7.2 years). RESULTS: During the observation period, 169 (40.6%) patients died. Univariate analyses showed that the ISWT as well as age, gender, present and previous tobacco smoking, forced expiratory volume in 1 second, body mass index, oxygen saturation at rest, long-term oxygen therapy, Medical Research Council dyspnea score, and treatment with oral corticosteroids were significantly associated with survival. Multivariate analysis, including relevant confounders, revealed that low ISWT was independently associated with poor survival (P = .001). The association was not linear and the risk of dying increased markedly when ISWT was lower than 170 m (RR = 2.84, 95% CI: 2.05-3.93). CONCLUSION: This study shows that the ISWT is a strong and independent predictor of survival in patients with COPD enrolled in a rehabilitation program.


Abstract: Seasonal differences may influence levels of physical activity and outcomes of a pulmonary rehabilitation (PR) program. This study examined the effect of seasonal variations upon baseline measures and outcomes of physical activity, exercise performance, and health status in PR. Stable patients (N = 95) with chronic obstructive pulmonary disease (COPD) were studied and placed into the seasonal group corresponding to when PR commenced: spring (n = 18), summer (n = 23), autumn (n = 34), winter (n = 20). Physical activity was measured by a uniaxial accelerometer, exercise performance by the Incremental Shuttle Walking Test (ISWT), and health status by the Chronic Respiratory Disease Questionnaire-Self Reported. Patients who commenced PR in the winter had lower levels of physical activity at baseline (P = .02) and attained the largest improvements when compared with any other seasonal group (P = .04). No seasonal variation was detected in ISWT scores or health status either prior to or upon completion of PR. The results of this study suggest that levels of daily activity may be vulnerable to seasonal variations and this should be considered when examining physical activity levels in patients with COPD.

PT - Randomized Controlled Trial

Databases searched: CINAHL, Cochrane, Hospital Premium Collection, Medline, NICE Evidence, PEDro, Pubmed, Google Scholar

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