Rehabilitation in COPD –
in stable phase, following exacerbation
and as maintenance treatment –
in primary and hospital care

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Limitations in COPD

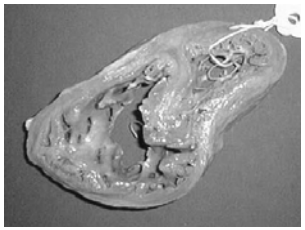
- Ventilatory limitations
- Cardiovascular limitations
- Skeletal muscle dysfunction
- Co-morbidities
  - Cardiac disease
  - Malnutrition
  - Osteoporosis
  - Depression, anxiety
  - Systemic inflammation
- Increased dyspnea
- Decreased physical capacity
- Decreased quality of life

Limitations - ventilatory

- Increased airway resistance
- Gas exchange deficiency
- Hyperinflation, static and dynamic
- Changed lung mechanics
- Breathing muscle dysfunction
- Increased work of breathing

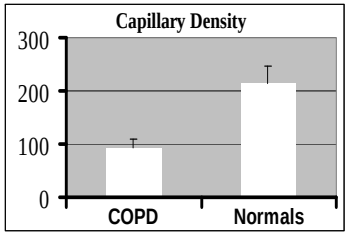
Limitations - cardiovascular

•Hypoxic vasoconstriction
•Polycytemia
•Structural changes in pulmonary vessels
•Increased pulmonary vascular resistance
• Increased right ventricular pressure
•Cor Pulmonale

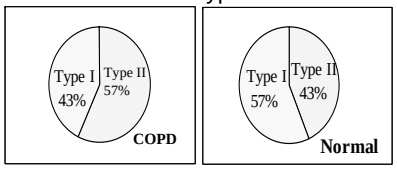


Dilated right ventricle in COPD patient

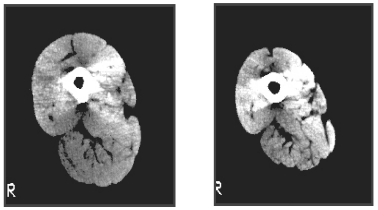
Limitations – skeletal muscle



Fiber type



Normal **COPD**



Area: 118.5 cm^2 Area: 79.6 cm^2

Changed mitochondrial function and excessive production of reactive oxygen species

Jobin J, et al. *J Cardiopulmonary Rehab* 1998.
Bernard et al. *AJRCCM* 1998.
Puente-Maestu et al. *ERJ* 2009.

Respiratory Medicine (2006) 100, 1451–1457
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Thigh muscle strength and endurance in patients with COPD compared with healthy controls

Tania Janaudis-Ferreira, Karin Wadell, Gunnevi Sundelin*, Britta Lindström

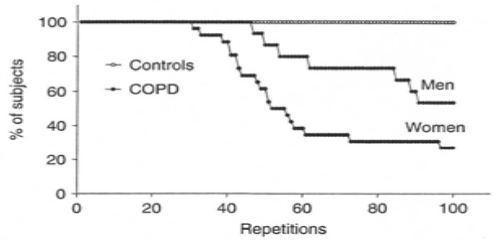
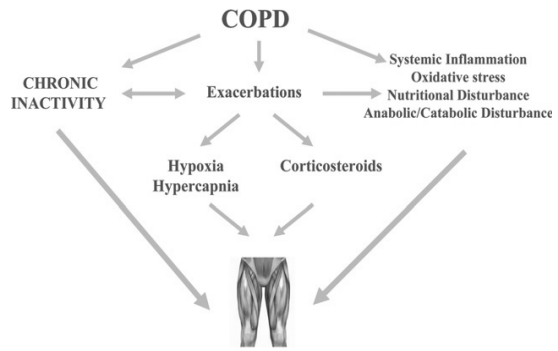


Figure 1 Percentage (%) of subjects succeeding different numbers of repetitions in the endurance test for controls and COPD (men and women).

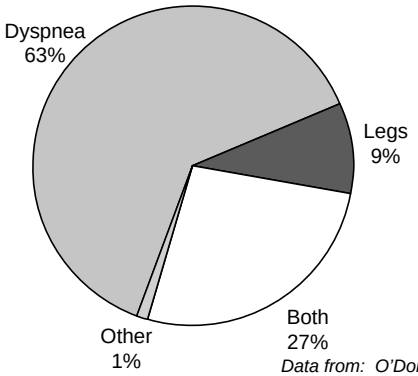


COPD Skeletal Muscle Disease

Man et al, 2009

Reasons for stopping exercise in COPD

Constant-Load Cycle Exercise (n=403)



Data from: O'Donnell et al. AJRCCM 2001.
O'Donnell et al. ERJ 2004.
Maltais et al. Chest 2006.

PR- definition by ATS/ERS

Joint ACCP/AACVPR Evidence-Based Clinical Practice Guidelines 2007

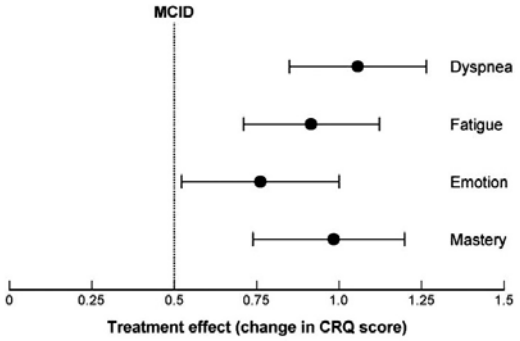
- An evidence-based, multidiciplinary, and comprehensive intervention for patients with chronic respiratory diseases who are symptomatic and often have decreased daily life activities. PR is designed to reduce symptoms, optimize functional status, increase participation in daily work and social activities, and reduce health care costs through stabilizing or reversing systemic manifestations of the disease.

Important features of successful rehabilitation

Joint ACCP/AACVPR Evidence-Based Clinical Practice Guidelines 2007

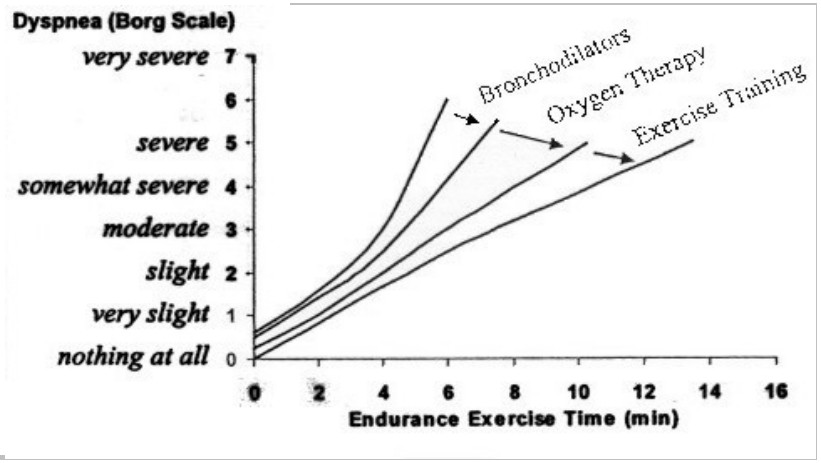
- Multidisciplinary – expertise from various health care disciplines integrated in a comprehensive and cohesive program
- Individual – the program is designed to meet realistic individual goals
- Focus on physical and psychological health and social function

Effects of PR on health related quality of life in COPD



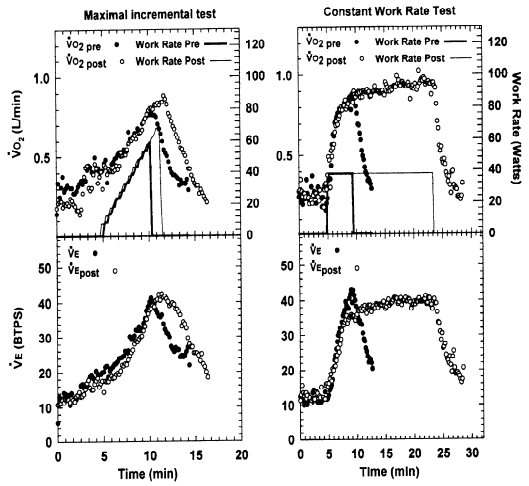
Lacasse et al, 2006

Effect of different interventions regarding dyspnea



O'Donnell, 1998

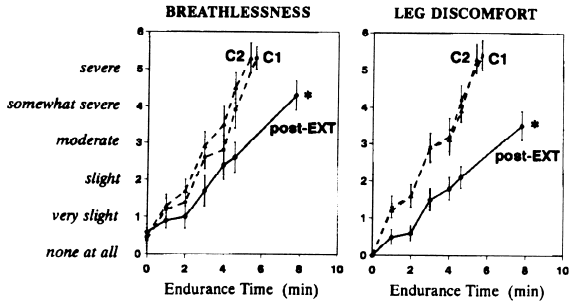
Effect of aerobic training



Response (VO_2, WR and VE) at maximal and constant work rate test before and after training.

Porszasz et al, 2005

Effect of exercise training



Response in dyspnea and leg discomfort at constant work rate test before and after training.

O'Donnell et al, 1998

Results of aerobic training in PR

- Increased VO_2 (max)
- Decreased VO_2,VE, HR at isotime
- Decreased lactate levels
- Decreased dynamic hyperinflation
- Improved muscle fiber ratio, mitochondrial activity, capillarization and enzyme activity.
- Improved maximal and sub-maximal exercise capacity

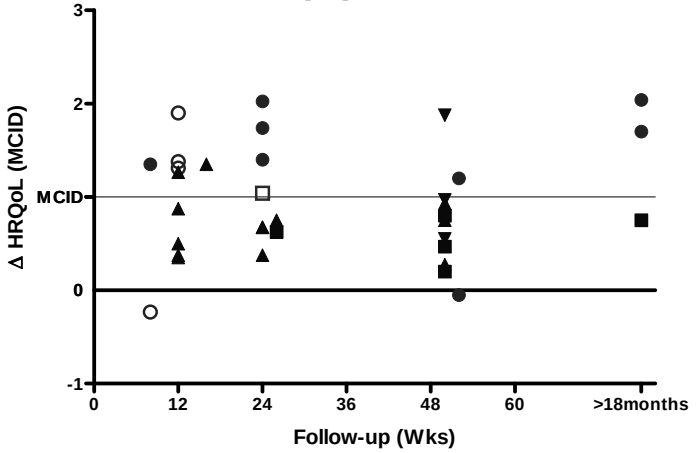
Results of strength training in PR

- Increased muscle strength
- Increased cross sectional area
- Structural and functional adaptation
- Improved functional capacity

Effects of PR

- Exercise training is, after smoking sessation, the single most important component in pulmonary rehabilitation (Cote et al, 2005)
- A higher level of physical activity reduces the number of hospital admissions as well as mortality (Garcia-Aymerich 2006, Pitta 2006)
- PR reduce health care resource use (Gallefoss et al, 1999, Griffiths et al, 2001, Hailey D et al, 2010)

Effects of PR compared to pharmacological treatment in COPD



Troosters, 2005

PR design

- There are no differences in major patient-related outcomes of PR between nonhospital-(community or home sites) or hospital-based sites. It is strongly recommended that all COPD patients have access to PR programs regardless of program site. (1A)
- It is recommended that longer PR programs, beyond six to eight weeks duration, be provided for COPD patients. (2B)

(Marciniuk D et al. Can Respir J, 2010)

PR design

- Aerobic training + resistance training is more effective than aerobic training alone in improving endurance and functional ability.

  While aerobic training is the foundation of PR, it is recommended that both aerobic and resistance training be prescribed to COPD patients. (2B)

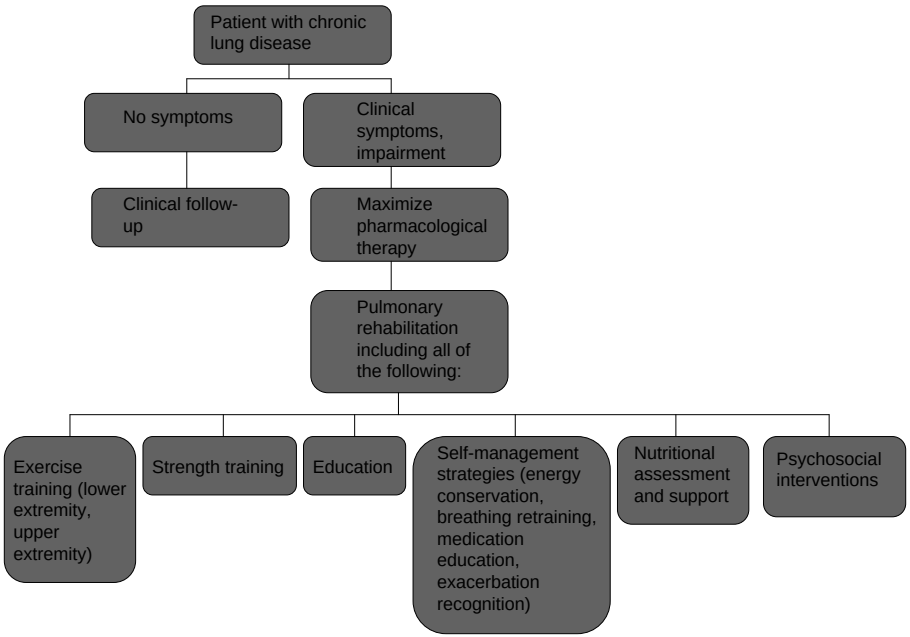
(Marciniuk D et al. Can Respir J, 2010)

PR design

- The longer program the better effect (Troosters et al, 2005)
- The higher intensity the better effect on physiological parameters (Varga et al, 2007)
- Lower intensity training may be of benefit regarding compliance to training (Carlin, 2009)
- Addition of arm strength training improves arm function, and arm muscle strength (Janaudis Ferreira et al, 2010)
- 25 recommendations regarding PR (Ries A et al, 2007)

PR, for whom?

- The benefits of PR are realized by both women and men. It is strongly recommended that both women and men be referred to for PR. (1C)
- It is strongly recommended that patients with moderate, severe and very severe COPD participate in PR. (1C)
- Currently there are insufficient data to make a recommendation regarding patients with mild COPD. (Marciniuk et al 2010)
- Pulmonary rehabilitation is successful for COPD irrespective of MRC dyspnea grade (Evans RA et al, 2009)
- Different stages of disease severity according to GOLD criteria do not present differences regarding daily physical activity (Pitta et al 2008)



Modified from Carlin, 2009

What happens during an AECOPD?

- Acutely reduced lung function
- Significant skeletal muscle weakness
  - Systemic inflammation
  - Negative nutritional balance
  - Administration of corticosteroids (Spruit et al, 2003)
- Inactivity; only a limited time in weight-bearing activities (Pitta et al, 2006)
- Is exercise training safe and feasible during/following an AECOPD?

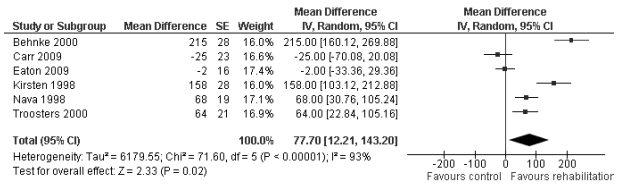
Evidence for PR during and after AECOPD

- PR can start already at the inpatient stage
- Daily sessions are most often used
- Resistance training can be conducted safely and is successful in preventing the deleterious impact of exacerbations on muscle function

  (Troosters, 2010)
- No adverse events have been reported (Behnke 2000, Man 2004)
- Also mechanically ventilated patients have positive effects of PR following AECOPD (Nava, 1998)

Effect of PR following AECOPD

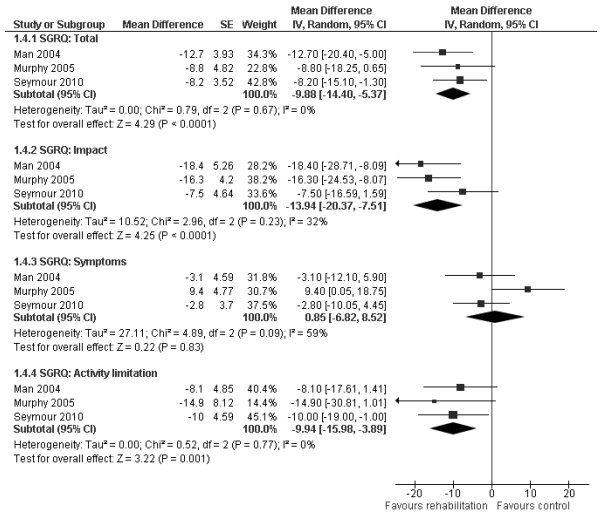
Walking distance (6MWD)



Puhan et al, 2010

Effect of PR following AECOPD

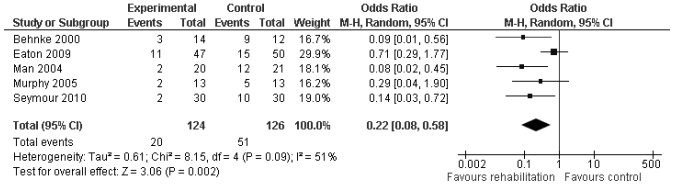
Health related quality of life (SGRQ)



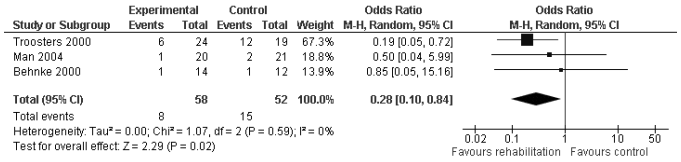
Puhan et al, 2010

Effect of PR following AECOPD

Hospital admission



Mortality



Puhan et al, 2010

Evidence for PR following AECOPD

- PR improved recovery
  - Exercise tolerance
  - Dyspnea
  - Quality of life
  - Reduced hospital readmission rate
  - Reduced re-exacerbation events
  - Reduced mortality

(Marciniuk et al. 2010, Puhan et al. 2010)

Evidence for PR in primary care for patients with COPD

- Today most of the long-term management of COPD patients are done in primary care settings. They are therefore left to create PR programs in the community
- Not much evidence in the literature so far
- Recommendations are similar as for general PR (inpatient, outpatient or home-based settings) (Carlin, 2009)
- Self-management interventions during and after PR have been suggested to promote better long-term involvement in physical activity (Bourbeau, 2010)
- Maintenance is the key

Maintenance

- Large variation in results of studies evaluating maintenance programs.
- Once-weekly supervised high intensity maintenance exercise program is advised (Troosters, 2005)
- Home-based walking program has been found to be effective maintenance training. (du Moulin, 2009)
- Improved walking distance, quality of life and lower number of hospital admissions were maintained up to 18 months after discharge with supervised home training program. (Behnke, 2003)

Maintenance

- Exercise self-efficacy and changes in self-efficacy are predictors of exercise adherence in elderly (Brassington et al, 2002, McAuley et al 1993)
- Self-management interventions have shown reduced health care utilization (Adams et al 2007, Effing et al 2007)
- Engagement in physical training of their own choice was most effective regarding maintenance effects in patients with chronic heart failure (Beckers et al, 2010)

Challenges

- Access to pulmonary rehabilitation
  - 1.2 % of the COPD population in Canada have access to pulmonary rehabilitation. (Brooks et al, 2006)
  - Less than 1 % of the COPD population in Northern Sweden have access to pulmonary rehabilitation (Ahrnquist et al, Bachelor thesis, 2008)
- Behavioral change
  - Significant improvements in a variety of outcomes after 3 months of multidiciplinary PR did not translate into more time spent walking in daily life (Pitta et al, 2008)
- Maintenance – call for research (Nici et al, 2009)