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## Home rehabilitation in patients with chronic obstructive pulmonary disease the short- term and long-term effects

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*Document Version*

Publisher's PDF, also known as Version of record

*Publication date:*

1995

[Link to publication in University of Groningen/UMCG research database](#)

*Citation for published version (APA):*

Wijkstra, P. J. (1995). *Home rehabilitation in patients with chronic obstructive pulmonary disease the short-term and long-term effects*. s.n.

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### SUMMARY

The presented studies in this thesis show the benefits of rehabilitation at home in patients with Chronic Obstructive Pulmonary Disease (COPD). In the past, rehabilitation programmes have been carried out by several investigators in different settings and have been designed to improve functional capacity and to alleviate symptoms. In contrast to inpatient programmes rehabilitation at home is more convenient for the patients, because they stay in touch with their families and apply their training in daily practice. Furthermore, a home care programme is possibly cheaper as compared to an inpatient programme. In this respect it is remarkable that most studies have investigated effects of inpatient rehabilitation only.

In **chapter 1** a review is given with respect to the effects of rehabilitation on impairment, disability and handicap as published up to the time this thesis was prepared. It is clear that rehabilitation has a number of benefits, like improved exercise tolerance and reduction of symptoms. However, most rehabilitation programmes have investigated short-term effects without including a control group. Therefore, the aim of our study was to assess both short-term and long-term effects of rehabilitation at home in a controlled study on subjective and objective variables. In addition, we investigated the validity and reliability of the Chronic Respiratory Questionnaire to assess quality of life. Finally, we investigated the validity of peak inspiratory mouth pressure to assess inspiratory muscle strength, because the latter may give additional information about the impairment in COPD.

The patients and methods of the study are described in **chapter 2**. All patients showed severe airways obstruction (mean  $FEV_1$  44% of predicted, mean  $FEV_1/IVC$  37%) and low reversibility (mean increase in  $FEV_1$  of 0.15 L, 5% of predicted  $FEV_1$ ). After stratified randomization the patients were allocated to one of the 3 groups, consisting of 15 patients each. Two groups (A and B) started a rehabilitation programme for 1.5 year, while 1 group formed the control group (C), which received no rehabilitation at all. Patients were supervised by a multidisciplinary team during their rehabilitation programme at home, consisting of a pulmonologist, a local physiotherapist, a local nurse, and

a general practitioner. During the first 12 weeks both rehabilitation groups (A+B) visited a local physiotherapist twice a week. Thereafter, group A visited the same physiotherapist once a week, while group B received a follow-up of once a month. Both groups visited the general practitioner once a month during the first 3 months, while the local nurse was visited by both groups once a month during 18 months.

We used peak inspiratory mouth pressure (P.PImax) to assess inspiratory muscle strength. Because the validity of P.PImax is not known, we investigated in **chapter 3** whether P.PImax is a valid assessment of inspiratory muscle strength by comparing it with the maximal oesophageal pressure during a sniff manoeuvre (sniff Poes) in patients with COPD. In addition we investigated the discriminating capacity of P.PImax. P.PImax showed no learning effect, while the intra-individual coefficient of variation was acceptable. Measures of agreement showed no significant discrepancies between the mean P.PImax and mean sniff Poes. Moreover, P.PImax was significantly lower in both male and female COPD patients compared with healthy males and healthy females of comparable age. Our conclusion is that P.PImax is a valid assessment of inspiratory muscle strength. In addition, it is a non-invasive method and it requires little time to assess inspiratory muscle strength. Therefore, it can be easily used in clinical practice.

Quality of life is an important outcome variable in rehabilitation research. In our study we assessed quality of life by the Chronic Respiratory Questionnaire (CRQ) which contains 4 dimensions: dyspnoea, fatigue, emotion, and mastery. In **chapter 4** we investigated the reliability and validity of the CRQ, because no research was done so far on the psychometric qualities of the CRQ. The items of the dimensions fatigue, emotion, and mastery showed a high internal consistency reliability as well as a high test re-test reliability. In addition, these three dimensions correlated significantly with dimensions which cover the same domains in the SCL-90. The latter is a valid questionnaire containing dimensions, like anxiety, depression, sleeping disturbances, and somatization. The items of the dimension dyspnoea showed a low internal consistency reliability and a moderate test re-test reliability. We concluded that the dimensions fatigue, emotion, and mastery of the CRQ are valid and reliable to

assess quality of life in patients with COPD. We suggest not to include this dimension in the overall score of the CRQ in comparative research, because the items of the dimension dyspnoea showed to be less reliable. Nevertheless, this dimension can be used for intra-individual comparison.

Several studies have investigated the relationship between either objective variables or subjective variables on the one hand with exercise tolerance on the other hand. In **chapter 5** we investigated the predictive value of both objective (lung function and inspiratory muscle strength) and subjective (quality of life and dyspnoea) variables on exercise tolerance. Regression analyses showed that the transfer factor for carbonmonoxide ( $T_{LCO}$ ) and maximal oesophageal inspiratory pressure (PImax Pes) were the best predictors of both Wmax and 6-minute walking distance (6MD); the explained variance was 69% and 54%, respectively. We therefore concluded that objective variables are better predictors of exercise tolerance in patients with COPD than subjective variables.

The short-term effects of rehabilitation at home are described in **chapter 6 and 7**. In **chapter 6** we assessed the effects of rehabilitation on quality of life. After 12 weeks the rehabilitation group had a significantly improved quality of life compared to the control group. Although the rehabilitation group showed an improved Wmax as well, the extend of exercise tolerance improvement was not significantly correlated with the level of improvement in quality of life. In **chapter 7** we investigated the effects of rehabilitation on dyspnoea and physiological variables, i.e  $VO_2$ max (symptom limited), maximal lactate level and Tension Time Index (TTI). The rehabilitation group showed a significant decrease in dyspnoea, lactate, and TTI, next to a significantly higher Wmax, 6MD, and  $VO_2$ max compared to the control group. We concluded that rehabilitation at home provides short-term improvements in both objective variables (Wmax and 6MD) and subjective variables, like quality of life. The finding that after 12 weeks of rehabilitation lactate, dyspnoea and TTI at the maximal exercise effort were not significantly different between the rehabilitation group and the control group is likely due to the fact that these parameters were measured at a significantly higher Wmax in the rehabilitation group than in the control group.

In **chapter 8 and 9** we investigated the long-term effects of rehabilitation at home. In **chapter 8** we showed that quality of life improves in both rehabilitation groups (A, weekly follow-up and B, monthly follow-up) over 18 months of follow-up, being significant in group B when quality of life after 3, 6, 12, and 18 months was compared to baseline level in quality of life. Moreover, group B showed a significantly higher quality of life compared to the control group C at 3 and 12 months. Both rehabilitation groups did not improve their Wmax and 6-minute walking distance during 18 months, whereas control group C showed a gradual decline in Wmax and 6MD, being significant at 12 and 18 months compared to their baseline value (**chapter 9**). In addition, group A improved their inspiratory muscle function and dyspnoea score at Wmax at 18 months, both compared to baseline. The dyspnoea at Wmax in group A was also significantly improved compared to control group C. Therefore, we conclude that weekly follow-up of physiotherapy is necessary to improve dyspnoea at Wmax, while monthly follow-up of physiotherapy is sufficient to sustain an initially improved quality of life.

## CONCLUSIONS

The following conclusions can be drawn from our study, in which we included COPD patients with severe airways obstruction (inclusion criteria : 1)  $FEV_1 < 60\%$  predicted, and 2)  $FEV_1/IVC < 50\%$ , both after bronchodilation).

- 1) Rehabilitation at home in patients with COPD provides both short- and long-term improvements in quality of life.
- 2) Rehabilitation at home in patients with COPD provides short-term improvements in exercise tolerance, inspiratory muscle strength and endurance capacity of the inspiratory muscles. Furthermore, after 12 weeks of rehabilitation at home there is a trend in decreasing the workload of the inspiratory muscles (Tension Time Index) and a reduction of the maximal lactate level at Wmax.
- 3) Weekly follow-up of physiotherapy after an initial comprehensive rehabilitation programme at home in patients with COPD shows a trend in improving inspiratory muscle function.



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- 4) Weekly follow-up of physiotherapy after an initial comprehensive rehabilitation programme at home in patients with COPD decreases dyspnoea during maximal exercise.
- 5) Monthly follow-up of physiotherapy after an initial comprehensive rehabilitation programme at home in patients with COPD is sufficient to sustain an initially improved quality of life.
- 6) Peak inspiratory mouth pressure is a valid assessment of inspiratory muscle strength.
- 7) The items of the Chronic Respiratory Questionnaire relating to the dimensions fatigue, emotion, and mastery are reliable and valid and can generally be used to assess quality of life.
- 8) Diffusion capacity and inspiratory muscle strength are the best predictors of exercise tolerance in COPD patients with severe airways obstruction.

## DIRECTIONS FOR FUTURE RESEARCH

Rehabilitation programmes have shown to be beneficial in patients with COPD. There remain, however, several questions.

- 1) Our multidisciplinary rehabilitation programme showed to be beneficial in the treatment of patients with COPD, which is in agreement with other studies. However, until now the effects of specific parts of this comprehensive programme on impairment, disability, and handicap are not known. Therefore, further rehabilitation studies should focus on the question how specific treatment modalities can improve particular elements in patients with COPD.
- 2) The combination of an improved inspiratory muscle function at rest and an improved dyspnoea during exercise after rehabilitation suggests a relation between both variables. Further studies should be carried out to investigate the effects of inspiratory muscle training on functional variables, like exercise tolerance, dyspnoea, and ADL.
- 3) Our study shows a decrease in the workload of the inspiratory muscles as assessed by the Tension Time Index (TTI) after rehabilitation. Therefore, we advocate to incorporate the assessment of TTI in exercise tests in patients

- with COPD in order to find possible specific training effects on the inspiratory muscles after rehabilitation. In addition, a decrease of the TTI may cause also a decrease of dyspnoea and in this way the TTI may be helpful in the understanding of dyspnoea during exercise.
- 4) Our study is the first study to show a decline in exercise tolerance in the control group in contrast to other previous studies in which no control group was included. Therefore, further long-term studies must include a control group to investigate whether rehabilitation improves exercise tolerance or prevents a decline of it.
  - 5) An important question in rehabilitation studies is whether long-term rehabilitation programmes decrease the number of exacerbations and hospitalizations. To be able to answer this question it is important that the patients are stratified for the number of exacerbations and hospitalizations they had before the study, because lung function or exercise tolerance cannot predict the exacerbation rate nor the hospitalization rate.
  - 6) Although it is clear that rehabilitation has a number of benefits, an important point of further investigation should be a cost-benefit analysis. In this analysis one has to compare on the one hand the benefits of rehabilitation, like a decrease in dyspnoea, improved quality of life, an increased life span and on the other hand the costs of a rehabilitation programme.