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Out-patient rehabilitation improves activities of daily living, quality of life and exercise tolerance in chronic obstructive pulmonary disease

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Out-patient rehabilitation improves activities of daily living, quality of life and exercise tolerance in chronic obstructive pulmonary disease. K.E. Bendstrup, J. Ingemann Jensen, S. Holm, B. Bengtsson. ©ERS Journals Ltd 1997.

ABSTRACT: The purpose of this study was to investigate the effects on activities of daily living, quality of life, and exercise tolerance of a comprehensive out-patient rehabilitation programme for patients with moderate-to-severe chronic obstructive pulmonary disease.

In this randomized and controlled trial, the main outcome measures were Activities of Daily Living (ADL) score, York Quality of Life Questionnaire (YQLQ) score, Chronic Respiratory Disease Questionnaire (CRDQ) score, 6 min walking distance (6MWD), forced expiratory volume in one second (FEV_1), and forced vital capacity (FVC). The rehabilitation programme included physical training, occupational therapy, education, and smoking cessation therapy, and lasted for 12 weeks. The patients were evaluated at entry, halfway through, and at the end of the programme. Follow-up was at 24 weeks.

Forty seven patients were recruited, and 16 in each group completed the trial. There were significant differences in the improvements in ADL and CRDQ between the control and the treatment groups at 12 and 24 weeks, and at 24 weeks, respectively. At 6, 12 and 24 weeks, improvements in the 6MWD were 21.6 *versus* 79.8, 36.1 *versus* 113.1 and 21.4 *versus* 96.2 for control and treatment groups, respectively ($p<0.004$). A correlation matrix showed only ADL and 6MWD to be significantly correlated; the matrix was also used to validate the translated questionnaires. The programme required 124 staff-hours in total.

An inexpensive, comprehensive out-patient rehabilitation programme can produce long-term improvement in activities of daily living, quality of life, and exercise tolerance in patients with moderate-to-severe chronic obstructive pulmonary disease.

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Rehabilitation programmes for patients with chronic obstructive pulmonary disease (COPD) have been shown to have a number of benefits, such as fewer hospital admissions, reduced dyspnoea, improved work tolerance, improved self-esteem, improved sense of well-being, and greater freedom in the activities of daily living. These improvements have largely been achieved with no change in pulmonary function [1–11].

Only a few of these studies have included a control group, many were in-patient programmes, and nearly all have focused mainly on a specific aspect of pulmonary rehabilitation: exercise training (respiratory muscle training, upper limb, lower limb, or combination training), education, occupational therapy, or cessation of smoking.

The purpose of this study was to set-up and evaluate, using a controlled, randomized design, a comprehensive out-patient programme for patients with COPD, with emphasis upon improvements in activities of daily living, quality of life, and exercise tolerance. The programme was specifically designed to require the modest and economic resources available at most community hospitals.

Methods

Patients

From hospital records of the last 5 yrs, 140 patients diagnosed with either chronic obstructive bronchitis or emphysema were invited for evaluation. Eighty five were interviewed and 47 were found to satisfy the following inclusion criteria: 1) forced expiratory volume in one second (FEV_1) between 25% and 55% of the predicted value for age, gender, and height [12]; 2) Tiffenau index (FEV_1/forced vital capacity (FVC) ratio) less than 70% [12]; and 3) stable condition for at least 4 weeks: no change in exercise status, sputum colour

and quantity, or changes in medication. The exclusion criteria were: 1) heart disease (moderate or severe ischaemic heart disease, acute myocardial infarction within 3 months, cardiomyopathy, and valvular heart disease); 2) musculoskeletal disease limiting exercise; and 3) intermittent claudication limiting exercise. The study was approved by the regional Ethics Committee, and informed signed consent was obtained from all patients.

The patients were randomly allocated to either an intervention or a control group. The patients in the control group were told at inclusion that they would be offered an active programme at the end of the study, if the study showed significant effect. For both groups, the study did not interfere with the patients' usual follow-up pattern. Exacerbations were, thus, cared for by the primary physician; no exacerbation was severe enough to cause interruption of the training.

Intervention

The intervention programme lasted 12 weeks. The programme consisted of the following components.

Exercise training. The patients trained together at the hospital for 1 h, three times a week for 12 weeks. The sessions were conducted by a physiotherapist with support from an auxilliary nurse. Strength training, both of upper and lower limbs and back muscles, was accomplished using tubular latex bands (length 1.5 m, diameter 1 cm). For the stronger participants the bands were doubled. Backwards walking, crossed/uncrossed sideways walking, and running forwards and backwards were used to improve co-ordination and balance. Stair climbing was used for endurance training. A few patients trained with a skipping rope. Stretching constituted an additional part of the programme. The physiotherapist individualized the training, according to the needs and resources of each patient. The participants were strongly encouraged to reach their maximum tolerable exercise level. Except for the elastic bands, the training required no special equipment. The patients were encouraged to train at home and to continue training after the intervention period.

Occupational therapy. Groups of four to five patients with similar Activities of Daily Living (ADL) scores (see below) at inclusion were formed. An occupational therapist had two lessons with each group, teaching techniques to overcome impairment of the everyday tasks listed by the ADL questionnaire.

Education. During 12 sessions, the patients were taught the anatomy of the lungs, pathophysiology and complications of COPD, and treatment modalities, with special emphasis upon the proper administration, dosage and side-effects of the normally used drugs. Special consideration was given to correct inhalation techniques, and how to cope with acute dyspnoea. A psychologist told the participants about psychological problems associated with COPD, a social worker informed about socioeconomic problems, and a dietician taught about nutrition (one lesson each).

Smoking cessation. Participants wishing to stop smoking were offered free transdermal nicotine patches, according to established recommendations [13, 14]. Benefits and problems of smoking cessation were taught at the beginning of the programme, with two reinforcement sessions halfway through the programme. A folder with advice was also available. A physician and an occupational therapist were in charge of sessions, the latter offering practical alternatives to smoking.

Assessment

Assessments were performed at inclusion and after 6, 12 and 24 weeks (12 weeks after the end of the programme). All assessments were performed in the late afternoons. The questionnaires were translated into Danish.

Activities of Daily Living score. A questionnaire specifically designed for patients with chronic pulmonary diseases was used [15]. It consisted of 41 questions covering: eating, personal care, dressing, bathing, going to the toilet, preparing meals, cleaning, washing clothes, shopping, social activities and work. Except at inclusion, the patients answered this questionnaire at the hospital, with the investigators available for help.

Chronic Respiratory Disease Questionnaire (CRDQ) score [16]. This questionnaire measures: dyspnoea, fatigue, emotional function, and mastery of the disease and its effects. [16]. The questionnaire was administered as a structured interview, and all interviews were performed by the same investigator. Previous scores were available to the patient at each interview.

The York Quality of Life Questionnaire (YQLQ) score [17]. This questionnaire measures quality of life on a scale from 0 (dead) to 1 (perfect health), allowing calculation of quality-of-life adjusted years. The questionnaire is self-explanatory and was answered at the hospital. The investigators were available for help.

Further assessments. During the 6 min walking distance (6MWD) along a flat hospital corridor (50 m), each patient was paced to cover the maximum possible distance, pausing for breath if necessary. No training sessions were included. Blood pressure, pulse rate, and arterial blood tensions were measured before and after 12 weeks. At 6 and 24 weeks, pulse oximetry (Pulsox 8; Minolta Camera Co. Ltd, Japan) was performed before, during and after exercise.

To monitor the success of smoking cessation therapy, the patients were asked to exhale through a carbon monoxide analyser (Mini Smokerlyzer; Bedfont Technical Instruments Ltd, UK). Their tobacco consumption was also recorded.

FEV_1 and FVC were recorded from the best of three forced volume-time curves (Vitalograph®; Vitalograph Ltd, UK). Most patients needed to use bronchodilators in order to get to the hospital; all tests within an individual patient were standardized, whether performed pre- or postbronchodilator. The patients measured peak expiratory flow (PEF) with a mini peak flow meter (Vitalograph®), twice daily. Patient attendance was monitored at each session. The number of staff working hours was recorded.

Statistical analysis

Statistical analysis was performed using StatView for MacIntosh and BMDP for PC (1987 edition). All continuous data were analysed using the unpaired t-test on the difference between the baseline value at entry into the study and the value at a given later time. All discrete data were analysed using the Chi-squared test. The level of significance was set at 5%.

A matrix of overall (0th order) and 4th order partial correlations between all six main outcomes was calculated. The purpose of including partial correlations was to arrive at the true bivariate (*i.e.* corrected for the simultaneous correlations with other variables) correlations between FEV_1, FVC, CRDQ, YQLQ, ADL and 6MWD. It also provided information regarding the validity of the Danish translations of the questionnaires.

Results

The 47 eligible patients were randomized. Five patients failed to attend and did not provide a reason, leaving 22 and 20 patients in the control and the intervention group, respectively. Ten patients did not complete the programme. Of the four patients in the intervention group who did not complete the programme, one died in her home (as far as could be ascertained the cause of death was unrelated to the rehabilitation programme; no autopsy was performed), one was admitted for acute abdominal surgery and two elected to drop out. In the control group: one patient was excluded due to myocardial infarction and five patients elected to drop out.

Therefore, 16 patients in each group completed the programme. The average attendance rate for the intervention group was 78%.

Table 1 presents the demographic data for the patients studied. There were no significant differences between the two groups for any of the variables listed.

The ADL score improved only in the intervention group, and the difference in improvements between the two groups reached statistical significance at 12 and 24 weeks (table 2). The improvements for the intervention group fell mainly in the following areas: personal care, house cleaning, and shopping.

The CRDQ score for the control group changed little during the programme. The scores for the intervention group showed a trend towards improvement with time, and the difference between the two groups was statistically significant on follow-up (table 3) at 24 weeks.

YQLQ score improved in the intervention group, but not in the control group. The difference between the two groups approached significance (p=0.064) only at follow-up (24 weeks) (table 4).

The 6MWD improved in both groups at all evaluations, but significantly more so for the intervention group than for the control group (table 5). For the latter, the improvement at 24 weeks was not statistically different from zero (p=0.11).

None of the changes in the respiratory or circulatory variables approached significance. There were no significant changes in tobacco consumption or in the expired carbon monoxide levels in either group. Six of the eight smoking patients in the intervention group wished to stop smoking, but none of them succeeded. The average number of exacerbations per patient was similar: intervention group 1.3 and control group 1.5.

Table 1. – Demographic data of the subjects

	Treatment	Control
Sex F/M	7/9	7/9
Age yrs	64±3	65±2
Smokers/nonsmokers	9/7	7/9
FEV_1 $L \cdot min^{-1}$	1.02±0.06	1.04±0.07
FVC L	2.05±0.12	2.08±0.15
P_{a,O_2} kPa	10.78±0.41	10.06±0.49
P_{a,CO_2} kPa	5.23±0.15	5.16±0.21
S_{a,O_2} %	95±0.6	94±1.0
6MWD m	316±33.7	339±27.9
CRDQ score	86±4.9	83±3.3
YQLQ score	0.94±0.02	0.96±0.01
ADL score	127.6±9.5	135.0±6.2

Values are presented as mean±SEM. F: female; M: male; FEV_1: forced expiratory volume in one second; FVC: forced vital capacity; P_{a,O_2}: arterial oxygen tension; P_{a,CO_2}: arterial carbon dioxide tension; S_{a,O_2}: arterial oxygen saturation; 6MWD: 6 min walking distance; CRDQ: Chronic Respiratory Disease Questionnaire; YQLQ: York Quality of Life Questionnaire; ADL: Activities of Daily Living.

Table 2. – Improvement in the Activities of Daily Living (ADL) score in the two groups studied

	ADL score		
	Week 6	Week 12	Week 24
Control group	-7.4±10.6	-4.4±4.1	-9.8±6.7
Treatment group	6.2±2.8	17.7±5.6	14.4±4.7
p-value	0.086	0.004	0.007

Values are presented as mean±SEM.

Table 3. – Improvement in the Chronic Respiratory Disease Questionnaire (CRDQ) score in the two groups studied

	CRDQ score		
	Week 6	Week 12	Week 24
Control group	-0.2±3.8	0.6±3.8	-5.8±4.9
Treatment group	6.6±3.1	8.6±3.5	11.1±4.5
p-value	0.174	0.133	0.018

Values are presented as mean±SEM.

Table 4. – Improvement in the York Quality of Life Questionnaire (YQLQ) score in the two groups studied

	YQLQ score		
	Week 6	Week 12	Week 24
Control group	-7.8±9.3	-4.1±9.2	-10.5±11.8
Treatment group	-4.7±13.1	26.4±17.3	18.0±8.7
p-value	0.458	0.171	0.064

Values are presented as mean±SEM.

Table 5. – Improvement in 6 min walking distance in the two groups studied

	6 min walking distance m		
	Week 6	Week 12	Week 24
Control group	21.6±9.9	36.1±10.4	21.4±13.4
Treatment group	79.8±15.5	113.1±17.8	96.2±16.1
p-value	0.004	0.001	0.001

Values are presented as mean±SEM.

Table 6. – Correlation matrix for the six main outcomes studied

Variable	FEV_1	FVC	6MWD	ADL	CRDQ	YQLQ
FEV_1	-	0.391	0.234	0.162	0.047	-0.300
FVC	0.308	-	0.301	0.012	0.142	0.125
6MWD	0.008	0.391	-	0.720**	0.430	0.414
ADL	0.318	-0.316	0.636**	-	0.376	0.563*
CRDQ	0.169	-0.000	0.180	0.062	-	0.549*
YQLQ	-0.484	-0.031	-0.002	0.439	0.000	-

Values in the lower left triangle of the table are the partial correlation coefficients of 4th order, whilst those in the upper right triangle are the overall or 0th order correlation coefficients. FEV_1: forced expiratory volume in one second; FVC: forced vital capacity; 6MWD: 6 min walking distance; ADL: Activities of Daily Living score; CRDQ: Chronic Respiratory Disease Questionnaire score; YQLQ: York Quality of Life Questionnaire score. *: $p<0.05$; **: $p<0.01$.

A total of 124 staff-hours were required, as follows: physician 16 h (teaching); nurse 9 h (teaching); physiotherapist 42 h; auxilliary nurse 42 h; occupational therapist 12 h; psychologist 1 h; dietician 1 h; social worker 1 h.

From the correlation matrix, only ADL and 6MWD showed significant partial correlation, while the correlation between FEV_1 and YQLQ came close to significance. ADL and 6MWD, ADL and YQLQ, and YQLQ and CRDQ showed significant overall correlation (table 6).

Discussion

The main outcome variables of the present study were activities of daily living, quality of life, exercise tolerance and spirometry. Positive effects of the rehabilitation programme were found in the first three variables.

The ADL questionnaire was specifically designed for patients with COPD [15]. The improvements in ADL score are likely to be associated with the improvement of exercise tolerance, as the improvements were mainly in the more strenuous tasks (cleaning, shopping and personal care), and significant partial correlation was found between ADL and 6MWD (table 6). Further improvements are, therefore, unlikely to be obtained by upgrading the occupational therapy component of the programme. DEKHUIJZEN *et al*. [18] found that the ADL score improved in the training group, and that it correlated to well-being. The present results show that this correlation may be the product of simultaneous covariations with other variables (provided that the YQLQ score reflects general well-being) (table 6). Reduced anxiety and depression and improved psychological well-being, as reflected in the improved CRDQ score, might also have contributed to the positive effect of the rehabilitation programme on the ADL score [18, 19].

The CRDQ has been shown to be a responsive and valid measure of quality of life for patients with COPD [20], following rehabilitation programmes [21]. WIJKSTRA *et al*. [22] found that the dyspnoea quality of CRDQ had a low internal consistency but, in keeping with the other three qualities, dyspnoea also showed significant test/retest reliability. In a study design like the present, test/retest reliability is more important than internal consistency.

WIJKSTRA *et al*. [22] also sought to validate their use of the CRDQ in a Dutch population by comparing it to the Symptoms Check List (SCL-90), a score having nine qualities, each scored on a five point scale.

They found significant correlation between the qualities of the CRDQ and some of those of the SCL-90. Culturally and socioeconomically, Dutch and Danish populations might be very similar, but we nevertheless sought to validate the use of the translated questionnaires in a Danish population by calculating the correlations between the outcome measures, as shown in table 6. Like JONES *et al*. [23], we did not find any correlation between 6MWD, quality of life and spirometry, thus confirming a common clinical observation. The 6MWD and ADL score showed the largest partial correlation, indicating that these two variables measure related aspects of daily functioning.

In the present study, the rehabilitation programme was associated with significant improvement of the CRDQ score at 24 weeks for the intervention group. Since the activities scored by the CRDQ and the ADL are those most severely affected by the disease, the effects of the rehabilitation programme on these scores substantiate its positive impact on everyday life for these patients.

This finding agrees with that of GOLDSTEIN *et al*. [24], who, in a controlled study in a patient population comparable to that of the present study, found improvement of three of the four qualities of the CRDQ. Unlike the present study, where the improvement at follow-up after 24 weeks supports the credibility of the improvements, their study did not evaluate any possible lasting effect of the rehabilitation. That programme was a combined in- and out-patient programme (8 weeks and 4 months, respectively) of a longer overall duration; thus, it must have been considerably more expensive and, as the benefits were similar, have a lower cost/benefit ratio than the present programme. WIJKSTRA *et al*. [25] studied the effects of a rehabilitation programme, in which the patients trained at home under the guidance of the primary care physician, a nurse and a physiotherapist. They found improvement in three of the qualities of the CRDQ, findings similar to those of GOLDSTEIN *et al*. [24] and the present study. The number of man-hours required for their rehabilitation programme was not reported, and, therefore, the cost/benefit ratio of their study and the present study cannot be compared.

The changes in the YQLQ score were all nonsignificant, with no significant differences between the treatment and control groups. Both patient groups, however, showed high values at inclusion, leaving little room for improvement. Such high values in patients with severe functional impairment are most likely due to the fact that the questionnaire includes many sedentary activities and

is thus insensitive for monitoring rehabilitation, as suggested by JONES *et al*. [23].

In previous studies, the 6MWD has been shown to be reproducible [1, 26] and sensitive to changes in functional status during rehabilitation [27]. Upon repeated testing, a learning effect can be found as the distance improved between the first and second trial only [27]. The lack of practice trials in the present study can explain the improvements of 6MWD in the control group (table 5), which were barely significant at 6 weeks (p= 0.05), significant at 12 weeks (p=0.04), and nonsignificant at 24 weeks (p=0.11). The improved 6MWD for the treatment group agrees with several earlier studies [4, 24, 25, 28]. The mean improvement in 6MWD in the present study is approximately 33%, which is larger than the improvements reported in other studies. The improvement declined progressively over 12 months in the study by SWERTS *et al*. [4], most likely because their patients discontinued the training at home, whilst the improvement in the study by TOSHIMA *et al*. [28] and the present study persisted after 6 and 3 months, respectively. Thus, the latter two programmes may have succeeded in motivating the patients to continue training at home, indicating an important long-term effect of the programmes. In the present study, further improvements were small after 6 weeks, suggesting that a shorter programme than used in this study would suffice, as recently suggested by the European Respiratory Society (ERS) Task Force Position Paper [29].

Our training programme included both upper and lower limb exercise, as previous opinion was that any training effect obtained was likely to be specific for the muscle group trained, with no cross-over benefit [30]. Evidence to the contrary has, however, appeared [31]. It has previously been postulated that the improved functional capacity following training in COPD patients could be due to improved co-ordination and economy of motion, as they might be unable to exercise strenuously enough to achieve a training effect [32, 33]. However, other studies have shown that training can raise the anaerobic threshold in these patients [34–36], and this, with or without an increase in the maximal oxygen consumption, might explain the improvement in 6MWD in the present study, as our training programme was intensive and took the patients to their current limits. Despite that, the programme was well-tolerated and had a low drop-out rate.

In conclusion, our study shows that an economical, comprehensive, and well-tolerated rehabilitation programme can improve activities of daily living, quality of life, and functional capacity in patients with moderate-to-severe chronic obstructive pulmonary disease. The positive effect was apparent as early as 6 weeks after the beginning of the programme and persisted throughout the study. The modest personnel and economic requirements of the programme make it suitable for the maj-ority of hospitals. All the elements of our programme are currently in the European Respiratory Society Task Force Position Paper [29], except for the occupational therapy sessions, which may have been an important factor in the improvement of the Activities of Daily Living scores reported in the present study and would therefore, in our opinion, be worth considering for inclusion, as recently recommended [37].

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