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The effect of postrehabilitation programmes among individuals with chronic obstructive pulmonary disease

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The effect of postrehabilitation programmes among individuals with chronic obstructive pulmonary disease. D. Brooks, B. Krip, S. Mangovski-Alzamora, R.S. Goldstein. ©ERS Journals Ltd 2002.

ABSTRACT: The purpose of this study was to examine the effects of two postrehabilitation programmes on functional exercise tolerance and health-related quality of life in patients with chronic obstructive pulmonary disease (COPD).

Subjects with COPD (n=109) were randomised to receive either enhanced follow-up (EF) or conventional follow-up (CF). Subjects in the EF group attended a monthly support group and received a telephone call from a staff member at the midpoint (2 weeks) between their visits. Both groups had scheduled appointments with a physical therapist and physician at 3-monthly intervals after discharge.

Longitudinal data were recorded in 85 subjects (37 EF and 48 CF). Over the course of the study, there was no difference in distance walked in 6 min between the two groups but a significant difference for time and a group-time interaction. There was no difference in total chronic respiratory disease questionnaire score between groups at baseline or at any time interval despite a significant difference with time.

There was a clear deterioration in functional exercise capacity and health-related quality of life after completion of respiratory rehabilitation but no difference between the groups.

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Chronic obstructive pulmonary disease (COPD) is the fourth leading cause of morbidity and mortality in North America and Europe [1–3]. Its prevalence continues to rise, especially among females. COPD represents a global challenge, consuming substantial healthcare resources throughout the world to such an extent that many professional societies have published guidelines for the management of COPD [4, 5].

Pulmonary rehabilitation is an accepted therapeutic intervention which has been shown to result in important short-term benefits in exercise tolerance and health-related quality of life [6–8]. These benefits were evident irrespective of whether rehabilitation was delivered through inpatient, outpatient or community-based programmes [9–11].

Unfortunately, the improvements gained during rehabilitation tended to diminish following the intensive phase of the programme. REIS *et al.* [11] noted that the initial improvements in exercise tolerance diminished over the subsequent 18 months despite good community follow-up. Similarly, WEDZICHA *et al.* [12] reported that at 1 yr, no significant improvements in exercise tolerance or health status remained. FOGLIO *et al.* [13] noted that in patients with COPD after outpatient rehabilitation, there was a diminution in postprogramme exercise tolerance, respiratory muscle strength and dyspnoea scores at 12 months, with only 52% of patients still having a clinically-relevant improvement in their quality of life scores. GRIFFITHS *et al.* [14] attributed the loss of effect following rehabilitation to poor self-management practices and a lack of adherence to treatment protocols after discharge.

Patients with chronic conditions often fail to recall elements of potentially important medical advice and do not always adhere to advice that is recalled due to psychosocial or medical factors [15]. Poor adherence has a detrimental effect on morbidity, mortality and healthcare resources [16–18]. Therefore, approaches that encourage patients to maintain the improvements gained during the intensive phase of rehabilitation may have important implications to the patients, not only on their subsequent functional exercise capacity and health-related quality of life, but also on their subsequent health-resource utilisation. Using a nonrandomised design, VALE *et al.* [19] noted the absence of effects of a weekly exercise-maintenance

For editorial comments see page 4.

programme (19 subjects) compared with nonexercise maintenance (32 subjects) after outpatient rehabilitation. Functional exercise capacity and health-related quality of life increased by 25% and 35% respectively postrehabilitation but diminished by 11% and 8% respectively at 11±6 months (mean±SEM), with no significant differences between the two groups. Greater declines were noted among those with lower baseline (prerehabilitation) walking distances [19].

Compliance enhancement with healthcare interventions usually involves regular contact with healthcare professionals who supervise and encourage patients to continue with their programme of care. Programmes vary in their postrehabilitation follow-up [20, 21] including regular visits to the rehabilitation centre, graduated discharge with decreasing visits over several months and self-help groups. Information evaluating approaches to programme adherence is very limited. A small pilot study showed no benefits from weekly or monthly postprogramme home visits [9]. This study was undertaken to compare the effects of two postrehabilitation programmes on functional exercise capacity and health-related quality of life among patients with COPD who had completed respiratory rehabilitation.

Methods

Approval was obtained from the human ethics committees of the University of Toronto and West Park Healthcare Centre. Informed consent was obtained from each subject.

Programme description

The rehabilitation programme was typical of many reported in randomised-controlled trials to result in improved health-related quality of life and functional exercise capacity among patients with COPD [6–8]. The programme consisted of patient education, psychosocial support and supervised exercises, of which breathing exercises, interval training, upper extremity training, leisure walking and treadmill or cycle exercise comprised the main components. Group and individual lectures, relaxation therapy and occupational therapy constituted the main educational and psychosocial supports. Inpatients exercised five times a week under daily supervision for 6 weeks. Outpatients exercised three times a week at the centre and at home for 8 weeks. Patients enrolled in the programme were prescribed a home-training routine which they practiced before discharge. The home routine included the main exercise components of the programme (breathing exercises, upper extremity exercises, walking and interval training) taught and practiced during the intensive phase.

Subjects

Patients from both inpatient and outpatient programmes were recruited. Eligibility criteria included: 1) severe stable COPD (forced expiratory volume in one second (FEV_1) <40% predicted, FEV_1/forced vital capacity <0.70); 2) completion of inpatient or outpatient rehabilitation; 3) nonsmoker for a minimum of 6 months; 4) aged 49–85 yrs. Exclusion criteria included: 1) coexisting conditions that might limit exercise tolerance or cognitive functioning; 2) noncompliance with respiratory rehabilitation; 3) mechanical ventilatory support for any part of the day; 4) inability to communicate in English; 5) living too far away to participate.

Protocol. Subjects were screened during the middle weeks of the programme. During the last week they were contacted and the study was explained to them. Upon programme completion, all subjects received a written home prescription plus log sheets from their physical therapist, with standardised instructions regarding exercise.

Subjects entered the study within 2 weeks of programme completion. Baseline measurements of exercise and quality of life were made after which subjects were stratified according to their level of disability (baseline 6-min walk distance >350 m) and then randomised to control or study groups, using a random numbers table.

Subjects allocated to enhanced follow-up (EF) were invited to attend monthly 2-h group sessions, led by a physical therapist. The first hour was spent discussing any concerns they had regarding their home-maintenance programme and in the second hour subjects performed components of their home programme (choice of the patient) under the therapist's supervision. Between visits (2 weeks after the group session), subjects received a phone call from a different physical therapist who asked standardised questions regarding adherence to their programme and discussed any of their concerns. During visits to the centre and during telephone conversations, subjects were encouraged to continue their exercises as well as their general health habits. The enhanced follow-up programme was continued for 12 months.

Subjects randomised to conventional follow-up (CF) visited the physical therapist every 3 months for a year. During these follow-up sessions, they were asked standardised questions regarding illnesses or hospitalisations. They were asked about their exercise programme and encouraged to comply with it. They were encouraged to identify any concerns to their therapist. If any parts of the programme had been discontinued, they were encouraged to resume them.

Both groups received the same medical follow-up, being seen by their respiratory specialist, who was unaware of their group allocation, at 3-monthly intervals.

Subjects requiring medical attention for respiratory exacerbations or any other reason were seen by their family physician or appropriate specialist who had no investment in the results of the trial and was not aware of the group allocations. Scheduled measurements were postponed for up to 2 weeks if patients were experiencing an exacerbation.

Measures

Measurements were made at baseline, 3, 6, 9 and 12 months by research staff blinded to the group allocation of the subjects.

Primary outcome measures. Functional exercise capacity: 6-min walk test. The 6-min walk (6MW) test was administered in the same quiet corridor for each measure. Subjects were required to walk as far as they could in 6 min. Encouragement was standardised [22]. The distance walked was recorded. Subjects were familiar with the test having completed several as part of their rehabilitation programme.

The chronic respiratory disease questionnaire. The chronic respiratory disease questionnaire (CRDQ) was an interviewer-administered questionnaire which comprised of four domains (dyspnoea, fatigue, emotional function and mastery), and required ~20 min for completion. It has been found to be valid, reproducible and responsive in patients with COPD [23, 24] and has been used in many clinical trials [6, 7].

Secondary outcome measures. Medical outcomes survey: short-form 36. This general questionnaire has eight health concepts: limitations in physical activity, limitations in social activities, bodily pain, general mental health, limitations in usual role activities, energy and fatigue and general health perceptions. The short-form (SF)-36 required 5–10 min for self-administration [25, 26].

St. George's respiratory disease questionnaire. The St. George's respiratory disease questionnaire (SGRQ) is a disease-specific questionnaire which evaluates symptoms, activities and the psychosocial impact of the respiratory condition. The psychometric properties of this test are well known [26, 27].

Subject compliance. Compliance was ascertained from a series of standardised questions asked by the physical therapist who was unaware of the group allocations, at each follow-up visit. Compliance was established for each of the four groups of exercises: aerobic exercise, breathing exercises, upper-extremity training and interval training. Compliance for each type of exercise was arbitrarily defined as performing at least 50% of prescribed sessions. When subjects indicated noncompliance, they were asked to provide their reasons for it from a list of possible reasons that included "chest infection", "weather", "psychosocial reasons" (*e.g.* stress due to family situation, feeling depressed) and "lack of motivation" (*e.g.* too busy, lack of interest). The number of group sessions attended at the institution for the EF group were noted (maximum of 12 and a minimum of 0).

Pulmonary function tests. Pulmonary function testing was performed according to accepted standards [28]. This included conventional measures of lung volumes, flow rates, diffusing capacity and respiratory muscle strength.

Statistical analysis

Mean±SEM were calculated for each outcome measure. Repeated measures two-way analysis of variance (ANOVA) was used to test the difference over time and between groups. *Post hoc* analysis was performed using the Student Newman-Keuls test. The software used for the repeated measures ANOVA handled missing data such that the repeated measure analysis was specific to each subject. All available data was considered in the analysis. Proportions were compared using Chi-squared statistics. Compliance responses were coded and categorised for each time interval. The percentage of subjects in each category was compared between groups and for different types of exercises using two-way ANOVA.

Results

Sample. A total of 109 subjects were enrolled in the study (50 EF and 59 CF) groups. There were 24 subjects who did not return for follow-up appointments after the baseline evaluation (fig. 1). Therefore, 85 subjects participated in the study. Their baseline characteristics are summarised in table 1. There were no significant differences between subjects who dropped out and those included in the study. There were no significant differences at baseline between those entering the EF (37) and the CF (48) groups (table 1) ($p>0.1$). Only a few subjects dropped out of the study in the first 6 months (fig. 1). However, a large number of drop-outs occurred between 6–9 months. Forty-one subjects (18 EF and 23 CF) completed the study (fig. 1).

Primary outcome measures. Figure 2 summarises the results of the 6MW test over the year of follow-up for the EF and CF groups. At baseline, the groups were similar (CF 375±14 m, EF 395±15 m, $p=0.34$). Using time and group as factors, there was no difference in the distance walked in 6 min between the two groups (two-way ANOVA, $p=0.3$), but a significant difference for time ($p<0.001$) and interaction between time and group ($p=0.03$). *Post hoc* analysis revealed that for the control group, distances walked at 6, 9 and 12 months were less than the distance at baseline ($p<0.04$). For the EF group, distance walked at 12 months was less than all other measures ($p<0.001$).

Given the apparent trend in the data and the decrease in sample size after 6 months, the data were analysed taking into account values from the first 6 months. This analysis revealed a difference between groups, with greater distance in the EF group ($p=0.04$).

Figure 3 shows the changes in the domains of the CRDQ for the two groups. There was no difference in total CRDQ score between groups despite a significant difference over time (two-way ANOVA, $p=0.32$ for group, $p<0.001$ for time). *Post hoc* analysis revealed that the quality of life scores at 12 months were lower (worse) than at other times. For the individual domains of the CRDQ, the categories of dyspnoea, fatigue, and mastery showed a difference with time ($p \leqslant 0.002$), but no difference between

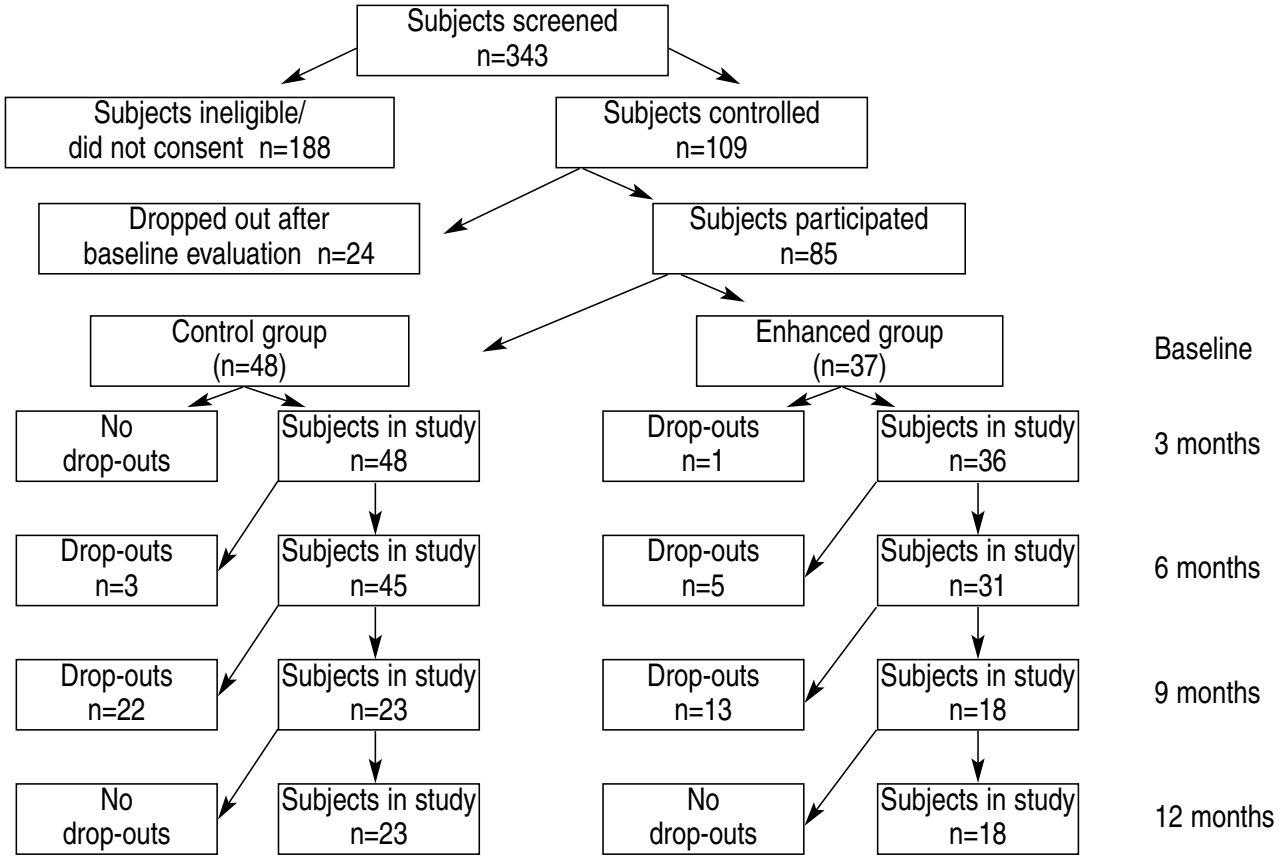

Fig. 1. – Flow chart demonstrating the subjects who dropped out or withdrew from the study and those who remained.

groups (p>0.1). The category of emotion showed no difference over time or between groups (p>0.1). No significant differences in CRDQ scores were found between groups at 6 months.

Secondary outcome measures. There was no difference between group or with time in the SF-36 for the domains of: social activities, pain, mental health, role activities and general health (p>0.05). There was a

Table 1. – Characteristics of subjects who dropped-out and those who completed the study

	Dropped-out or withdrawn	Completed study		
		Total sample	CF	EF
Subjects n	24	85	48	37
Control/enhanced	11/13	48/37		
Sex F:M	6:18	35:50	20:28	15:22
Post inpatient/outpatient	15/9	51/34	27/21	24/13
Oxygen at rest	6	15	7	8
Oxygen on exercise only	1	2	1	1
Age yrs	69±1.92	68±0.8	68±1.1	68±1.1
Baseline 6-min walk m	315±34	382±10	383±14	381±16
FEV_1 L	0.77±0.07	0.70±0.03	0.67±0.04	0.71±0.04
FEV_1 % pred	31±2.4	32±1.3	32±1.6	32±1.9
FEV_1/FVC	33.1±1.1	36.8±1.1	35.6±1.4	38.1±1.7
V_{50} % pred	9±0.8	10±0.5	9±0.5	10±0.9
$D_{L,CO}$ % pred	40±3.1	42±2.5	41±3.6	43±3.5
TLC_{pleth} % pred	134±6.0	137±3.4	137±3.0	136±6.2
TLC_{He} % pred	78±4.5	77±1.8	78±2.4	76±2.6
MIP cmH_2O	-40±8.5	-36±5.2	-40±3.1	-34±11.4
MEP cmH_2O	83±17.7	77±3.9	76±5.6	78±5.5

Data are presented as mean±SEM. CF: conventional follow-up; EF: enhanced follow-up; FEV_1: forced expiratory volume in one second; FVC: forced vital capacity; V_{50}: flow at 50% of VC; $D_{L,CO}$: carbon monoxide diffusing capacity; TLC_{pleth}: total lung capacity by plethysmography; TLC_{He}: total lung capacity by helium dilution; MIP: maximum inspiratory pressure; MEP: maximum expiratory pressure.

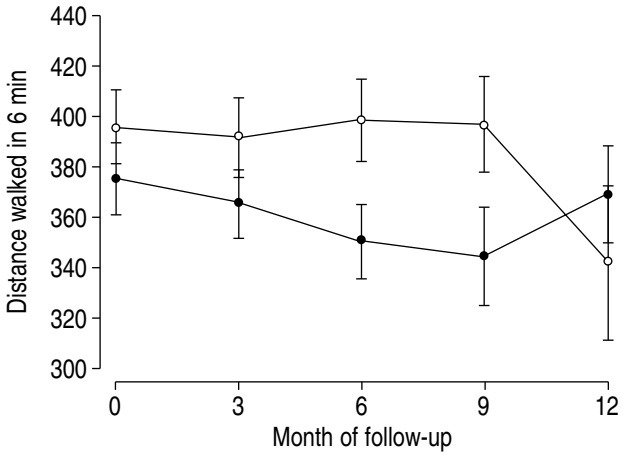

Fig. 2. – Change in the 6-min walk with time in the two groups. ●: control group; ○: enhanced follow-up group. Sample sizes: 37, 35, 28, 17 and 21 for 0, 3, 6, 9 and 12 months respectively for the enhanced follow-up group; 48, 48, 44, 22, 18 for 0, 3, 6, 9 and 12 months respectively for the control group.

significant effect of time on the domains of physical function and fatigue ($p<0.001$). *Post hoc* analysis revealed that physical function values at 12 months were lower than at other times ($p<0.01$) (fig. 4). For fatigue, baseline values were higher than those at 6 and 9 months ($p<0.02$). The SGRQ also showed an effect for time ($p=0.002$) with no group effect ($p=0.9$) (fig. 5).

There was no difference in the number of respiratory exacerbations between the groups (33 in CF and 35 episodes in EF). Pulmonary function did not change between groups or with time.

The number of subjects who reported performing their exercises did not differ between the two groups (Chi-squared, $p=0.08$) but deteriorated over time ($p<0.001$) (fig. 6). The main reasons for noncompliance were respiratory exacerbations, stated by 60% (CF), 43% (EF) subjects at 3 months and 78% (CF), 80% (EF) subjects at 9 months (table 2). The distribution of subject compliance differed with the modality of exercise (aerobic exercise, breathing exercise, upper-arm strengthening and interval training). No group effect was noted ($p=0.2$) but there was a significant effect of type of exercise ($p<0.001$) with a higher percentage of subjects performing breathing exercises and aerobic training than those performing interval training or muscle strengthening ($p<0.003$) (fig. 7). Subjects in the EF group attended on average 4.3±0.7 (39%) out of a maximum of 12 session (minimum 0, maximum 12; median, 4). There was no correlation between the number of sessions attended and the change in distance walked ($r=0.08$, $p=0.2$).

Discussion

In this study, enhanced follow-up, designed to promote programme adherence, did not influence

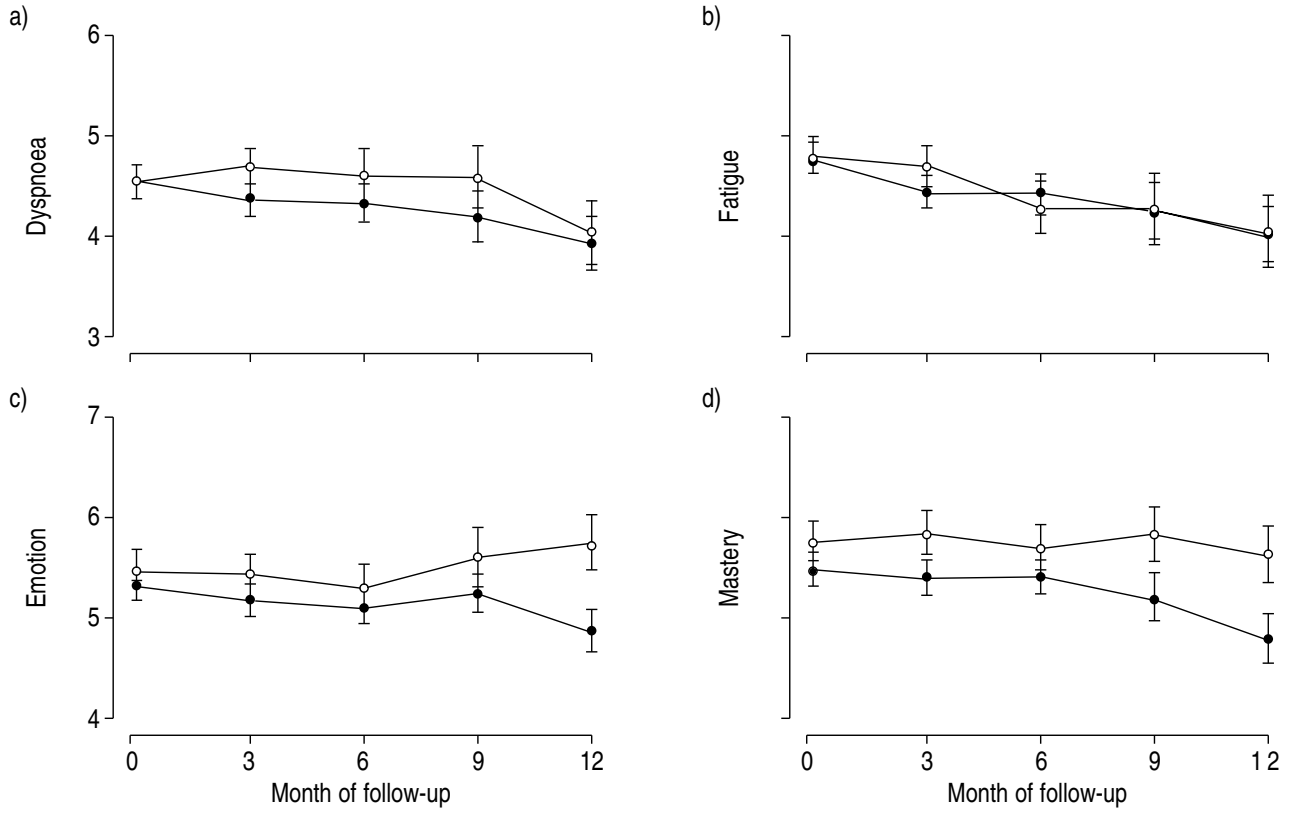

Fig. 3. – Changes in chronic respiratory disease questionnaire a) dysponea, b) fatigue c) emotion d) mastery) with time in subjects receiving enhanced follow-up (○) and in control subjects (●). Sample sizes: 37, 18, 31, 18, 17 for 0, 3, 6, 9 and 12 months respectively for the enhanced follow-up group; 48, 48, 44, 23, 23 for 0, 3, 6, 9 and 12 months respectively for the control group.

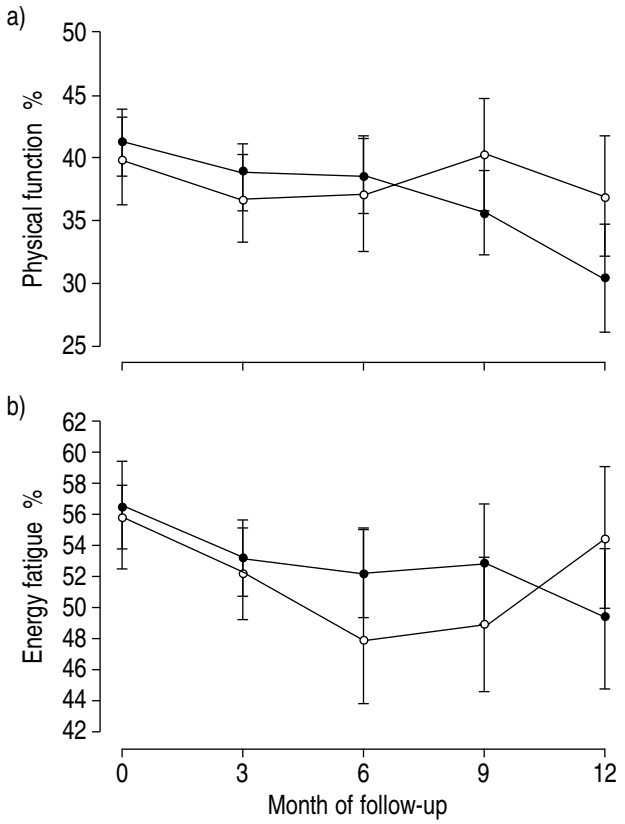

Fig. 4. – a) Physical function and b) energy domains of the short-form 36 with time in enhanced follow-up (○) and control (●) groups. Sample sizes: 37, 36, 31, 18, 18 for 0, 3, 6, 9 and 12 months respectively for the enhanced follow-up group; 48, 48, 45, 23, 23 for 0, 3, 6, 9 and 12 months respectively for the control group.

functional exercise capacity or health-related quality of life 12 months postpulmonary rehabilitation. Although the walking distances improved among the study group at 6 months, health-related quality of life did not and by 1 yr, the groups did not differ in either outcome.

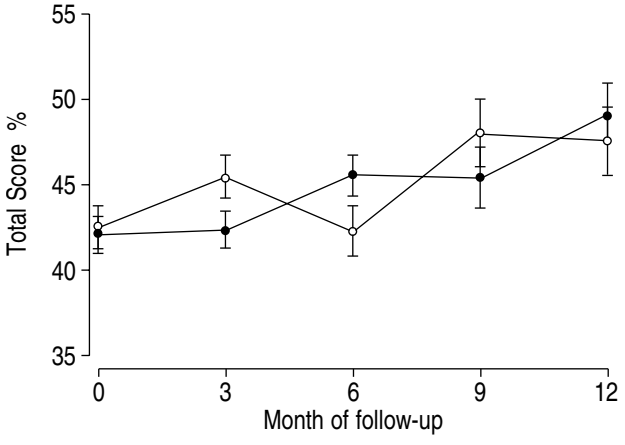

Fig. 5. – Change in the total score of the St. George's respiratory disease questionnaire in the enhanced follow-up (○) and control (●) groups. Sample sizes: 37, 36, 31, 18, 18 for 0, 3, 6, 9 and 12 months respectively for the enhanced follow-up group; 48, 48, 45, 23, 24 for 0, 3, 6, 9 and 12 months respectively for the control group. A higher value represents a worse score.

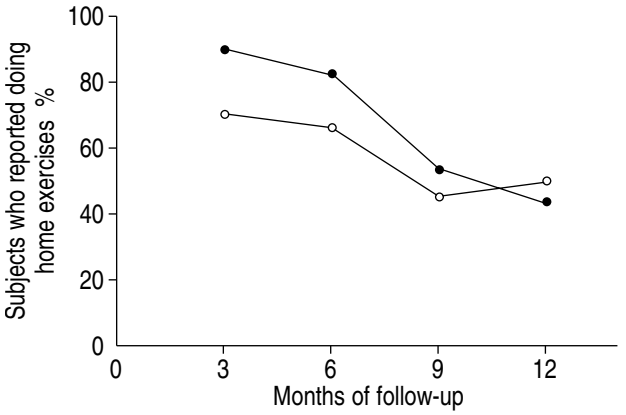

Fig. 6. – Percentage of control (●) and enhanced follow-up (○) subjects who self-reported performing regular exercises at home.

In a meta-analysis of patient education, MAZZUCA [29] concluded that although education was of value in altering compliance efforts to improve health through knowledge alone was rarely successful. Behaviourally-oriented programmes, such as those in which exercises were practiced under supervision, were more consistently successful in improving the clinical course of a chronic disease. It was therefore reasoned that an approach to maintenance that included frequent contact with health professionals through regular group visits and individual telephone calls might improve programme compliance when compared with a simple 3-monthly follow-up schedule.

Methodological issues in this study were typical of studies in which severely impaired and disabled individuals are screened for enrolment and followed for many months. Subjects screened (n=343) exceeded those enrolled (n=109) by just over three-fold. There were substantial drop-outs distributed similarly between the two groups, such that only 45 out of the original 85 subjects completed all follow-up measures. Those who dropped-out were similar to those who completed all follow-up measures, with the exception of a lower baseline walking distance among the drop-outs (315 *versus* 382 m, p=0.06), suggesting that they may have represented a more disabled group. Despite the drop-outs, sufficient power remained to detect relevant differences over time.

Several published studies have noted that the gains made during the intensive phase of rehabilitation diminish with time [9–11, 14]. Contributing factors may include programme duration and location, both of which may influence subsequent compliance. Programmes that reported extended benefits [30, 31] continued for 6 months in contrast with the usual programme duration of several weeks [20, 21]. In a study by TROOSTERS *et al.* [31], outpatients trained for 6 months experienced improvements in walking distance and in quality of life that exceeded the minimal clinically-important difference 18 months postprogramme. In a study by STRIJBOS *et al.* [32], both outpatients and home-based patients received rehabilitation for 3 months. Continued benefits were noted 15 months later among the home-based group compared with those who received an outpatient

Table 2. – Self-reported reasons for not exercising in conventional follow-up (CF) and enhanced follow-up (EF) groups

Time months	CF		EF	
	Reason	Cases %	Reason	Cases %
3	Chest infection	60	Chest infection	43
	Weather	13	Psychosocial reasons	28
	Psychosocial reasons	27	Lack of motivation	43
6	Chest infection	60	Chest infection	38
	Psychosocial reasons	27	Psychosocial reasons	13
	Weather	13	Weather	13
	Lack of motivation	7	Lack of motivation	36
9	Chest infection	78	Chest infection	80
	Family situation	11	Weather	20
	Weather	11		
12	Chest infection	40	Chest infection	75
	Family situation	10	Weather	25
	Psychosocial reasons	30	Lack of motivation	25
	Weather	20		

Note that the total·cell^{-1} may add up to >100% as subjects may have chosen more than one reason; Psychosocial reasons included stress due to family situation or death in the family or feeling depressed; Lack of motivation included being too busy or lacking interest.

institutionally-based programme, suggesting that a programme learned at home or in a community-based facility may be better integrated into a patient's daily routine.

Patients with chronic conditions frequently fail to follow important medical advice. It may be that they fail to recall exactly what was recommended to them by their healthcare professionals, or their failure to follow advice may relate to psychosocial factors such as lack of motivation or medical factors such as respiratory exacerbations. GRIFFITHS *et al.* [14] noted that only 25% of the 200 patients who completed 3 months of outpatient rehabilitation attended a weekly, postprogramme, self-help group.

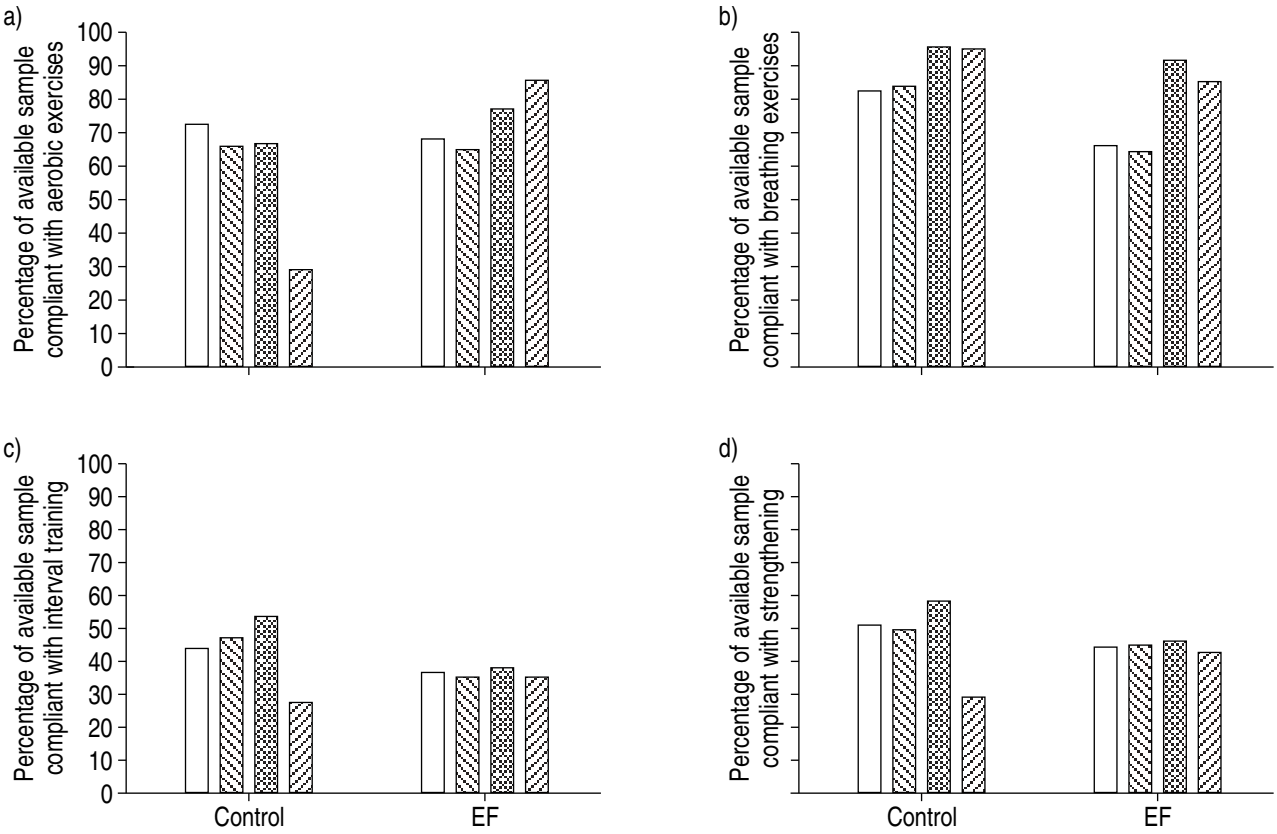

Fig. 7. – Percentage of available sample in control and enhanced follow-up subjects who were compliant with a) aerobic exercises (mainly walking) b) breathing exercises, c) interval training and d) strengthening. □: 3 months; ▨: 6 months; ▩: 9 months; ▨: 12 months.

In the current study, a substantial diminution in programme compliance (adherence to the recommendations of the multidisciplinary rehabilitation team) was observed. This issue of adherence is relevant to many aspects of healthcare [33], with wide ranges of adherence (15–94%) having been reported for a variety of programmes and diagnostic categories [34, 35]. Among those with respiratory conditions, BOSLEY *et al.* [36] noted that >50% of asthmatics did not take their medications regularly and that low adherence correlated with reduced health-related quality of life. Patients with COPD have exhibited underadherence with medications and smoking cessation [37], over-adherence by excessive use of some medications [38] and ineffective adherence by incorrect inhaler technique, which compromises the effectiveness of the medications [39]. Adherence with healthcare activities is influenced by many factors including patient age, sex, socioeconomic status, anxiety, self-efficacy and personal beliefs [18]. Practitioner factors include their level of involvement in selecting the treatment regimen, and the availability of written instructions [18]. Regimen factors include the length and degree of difficulty of an exercise (dosage), as well as the required frequency and the type of exercise (treatment) itself [34]. Lastly, there are external factors such as the setting and the available social supports.

The authors′ assessment of compliance with the home rehabilitation programme relied on self-reports from the patients enrolled. This approach assumed that the patients provided accurate information to the therapists. Self-reports sometimes overestimate the rate of adherence with healthcare recommendations [40, 41]. There was a dramatic decrease in the number of patients (in both groups) who continued with the recommended exercise programme. Adherence decreased to nearly 50% 9 months after the end of the intensive rehabilitation phase (fig. 6), irrespective of whether subjects were in EF or CF group. Subject compliance varied with the type of exercise. Breathing exercises and walking were more likely to be continued than interval training or muscle strengthening. Presumably, the former two exercises could more easily be incorporated into daily routines or the subjects were more readily aware of their benefits compared with the latter two exercises. To the best of the authors′ knowledge these differences have not been previously reported, but they are relevant in the selection of a home prescription which is more likely to be accepted if it is brief, relevant and associated with a sense of well being.

Exacerbations were clearly a major contributor to the functional deterioration over the 12 months following rehabilitation, although it is not possible to know whether the observed changes related to the exacerbation itself or to its effect on subsequent compliance. It was likely a combination of both mechanisms. Although most patients identified exacerbations as being responsible for their reduced compliance, other factors such as psychosocial or environmental were also identified. In patients with moderate or severe COPD, frequent exacerbators scored worse in a disease-specific measure of health-related quality of life (SGRQ) than infrequent exacerbators [42]. In a cohort of 101 patients with COPD (forced expiratory volume in one second 42% predicted), an exacerbation frequency of $2.4 \cdot \text{patient}^{-1} \cdot \text{yr}^{-1}$ was reported [42]. These respiratory exacerbations were associated with symptomatic and physiological deteriorations, which returned to baseline pre-exacerbation levels after 7 (range 4–14) days for dyspnoea and 6 (1–14) days for peak expiratory flows. However, recovery to baseline was complete in only 72% of exacerbations at 35 days and for 7% of exacerbations, recovery of peak expiratory flow had not occurred by 91 days. The authors are not aware of the relationship between compliance with rehabilitation and respiratory exacerbations having been reported previously. An abbreviated rehabilitation phase immediately following a respiratory exacerbation or the implementation of compliance-enhancing interventions at that time may assist patients with COPD to maintain their optimal level of functioning.

Other reasons for the deterioration postrehabilitation include the progressive nature of the condition (COPD) and recurrent infections that result in deconditioning that is difficult to reverse [14]. KETELAARS *et al.* [43] used a hierarchical cluster analysis to define patients in whom long-term benefits were maintained at 9 months. Baseline patient characteristics were the same between two subgroups: 1) those with moderate health-related quality of life scores on admission who improved substantially following 10–12 weeks of inpatient rehabilitation, but subsequently experienced a significant deterioration in health-related quality of life; and 2) those with poor health-related quality of life scores on admission who exhibited little improvement with rehabilitation and remained severely impaired at 9 months [43]. The authors recommended that a multidisciplinary aftercare programme would be warranted for those who showed a substantial improvement with rehabilitation. For those with little or no improvement, limited home care, with little expectations of further improvement, might be sufficient to sustain them at home. Of note, BOWEN *et al.* [44] reported a 73% survival at 4 yrs among 149 patients (89% COPD) who underwent rehabilitation. A higher postrehabilitation functional-status questionnaire score and a greater 6-min walking distance were strong predictors of survival. This study emphasises the potential importance of maintaining the benefits of a rehabilitation programme.

To conclude, this study showed a clear deterioration in functional exercise capacity and health-related quality of life over 12 months after completion of respiratory rehabilitation. This deterioration was most likely associated with poor postprogramme compliance, which was not influenced by an enhanced programme that provided more frequent contact with health professionals both through visits to the institution and by telephone at home. Alternative approaches that focus on reversing the dysfunction associated with respiratory exacerbations might help maintain functional exercise capacity and health-related quality of life postrehabilitation among patients with severe chronic obstructive pulmonary disease.

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