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Changes in personal control as a predictor of quality of life after pulmonary rehabilitation

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Abstract

Objective: Perceptions of mastery and self-efficacy may be related to better outcomes in pulmonary rehabilitation in patients with chronic obstructive pulmonary disease (COPD). This study examined (1) whether patients with COPD improved during a rehabilitation programme with respect to quality of life (QoL) and perceptions of self-efficacy and mastery, and (2) whether increased perceptions of mastery and self-efficacy contributed to a higher QoL after rehabilitation.

Methods: Thirty-nine consecutive COPD patients (aged 60.5 ± 9.0) were included from a rehabilitation centre and completed self-report questionnaires assessing symptoms, QoL, and perceptions of personal control.

Results: COPD patients improved during rehabilitation in overall QoL and self-efficacy, although no significant changes were found in QoL domains and mastery. Changes in self-efficacy during rehabilitation contributed to the explanation of the social and psychological functioning QoL domains.

Conclusion: Even in seriously impaired COPD patients in advanced stages of illness, positive changes in self-efficacy and overall well-being can be established during rehabilitation. Changes in self-efficacy were related to a better QoL, suggesting the importance of personal control in the adjustment to COPD.

Practice implications: Focussing more explicitly on the enhancement of perceptions of personal control in COPD patients may be an important aim of pulmonary rehabilitation.

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Keywords: Chronic obstructive pulmonary disease; Quality of life; Health status; Personal control; Self-efficacy

1. Introduction

Chronic obstructive pulmonary disease (COPD) is one of the main causes of disability in persons over 40 [1]. COPD is characterised by airflow limitation and a loss of pulmonary function that is not fully reversible by pharmacological treatment [2,3]. This airflow obstruction is usually progressive and is associated with an abnormal inflammatory response of the lungs to particles or gases [2,4]. Most patients with COPD experience symptoms such as a chronic cough, dyspnoea and the production of sputum [5]. The diagnosis of COPD includes patients with chronic bronchitis, characterised by a fixed obstruction of the airways, and pulmonary emphysema, caused by a decreased elasticity of the lung tissue. COPD has a serious impact on the quality of life (QoL) of patients [6], for example, most patients with

COPD experience physical limitations as well as psychological problems, such as feelings of anxiety or depression [7].

Since COPD is an incurable disease, the treatment of patients with COPD is mainly aimed at effective disease management focussed on the prevention of disease progression and on improvements with respect to symptoms and exercise tolerance [2]. In addition to pharmacological treatment, in the more severely affected patients pulmonary rehabilitation is recommended to support the management of COPD [1]. A comprehensive rehabilitation programme should consist of exercise training, nutrition counselling, and education [2]. Patients at all stages of COPD may benefit from exercise training (aerobic exercise and respiratory muscle strength training) during rehabilitation, leading to improvements in exercise tolerance and symptoms of dyspnoea and fatigue [8–10]. Pulmonary rehabilitation is particularly indicated in the more severely impaired patients with COPD, given the multidisciplinary approach of the programmes targeted at both pulmonary and non-pulmonary problems, and the improvement of QoL [2].

Part of the effects of the treatment of COPD patients depends on their efforts to engage in certain healthy behaviours, like stopping smoking or doing more physical exercise. Mostly, these are unhealthy behaviours the patients have engaged in for many years and therefore these behaviours are resistant to change. For example, smoking is the most important contributing factor in the development and progression of COPD [5,11], which patients find hard to change. Therefore, it is very important for the patients to be motivated and committed to the rehabilitation programme to be able to accomplish changes in their behaviour. Many of these patients, however, face multiple and often complex problems, both physical and psycho-social [8]. Previous research has shown that COPD patients referred for rehabilitation had often lost their motivation to improve [12]. Moreover, repeated, failed efforts to change their behaviour may have resulted in decreases in their perceptions of personal control [13–15].

Personal control refers to individuals' belief about their capacity to exert control over their own lives [16,17] and can be divided into several forms of control. Mastery, which is the extent to which people feel in control of the forces that affect their lives [18], has been found to be negatively associated with functional decline [19]. Self-efficacy refers to the confidence people have in being able to execute actions that are required to deal with particular situations [20,21] and appears to be related to the effectiveness of rehabilitation [22]. Furthermore, self-efficacy has been associated with stopping smoking [14], adherence to medication [23] and to physical exercise [13], all important factors in the management of COPD [1].

Previous studies have shown that perceptions of personal control are important factors related to the outcomes of pulmonary rehabilitation [14,24–27], since these perceptions influence patients' motivation [20] to make the required efforts during rehabilitation. Due to the often multiple problems and the diminished sense of personal control of COPD patients, their treatment is rather difficult. Though a number of studies have reported the effects of rehabilitation on exercise tolerance and QoL [28], these effects often decrease in the long term [10,24,29,30]. Positive effects of rehabilitation are difficult to achieve and many patients experience relapse, even if they initially improved during rehabilitation [31,32]. As a result, patients with lower perceptions of personal control may fail to attain their goals during rehabilitation or may more easily relapse afterwards. Higher perceptions of personal control, however, may be related to better outcomes of pulmonary rehabilitation.

In this study, we first examined whether QoL and perceptions of mastery and self-efficacy improved in patients with COPD referred to a rehabilitation programme. Given the often multiple and complex problems patients with COPD have to face, and a decreased level of motivation to change their behaviour, these patients were in fairly poor psychological shape, rendering it unlikely that changes in their perceptions of personal control during rehabilitation could be expected. Moreover, the assessed patients with COPD were quite seriously ill with respect to their lung function parameters (stage III of the GOLD classification (global initiative for chronic obstructive lung disease) [2], indicating serious COPD). Consequently, on the basis of previous research [31], only modest changes in QoL during rehabilitation were expected. Second, we studied whether changes in mastery and self-efficacy were related to a higher QoL after rehabilitation.

2. Methods

2.1. Participants

Consecutive patients with COPD who participated in a pulmonary rehabilitation programme were included between January 2001 and April 2002. In order to facilitate the interpretation of the data of these patients, we provided baseline data of a reference group, included during the same period, of consecutive outpatients who received standard care in a general hospital. Standard care consists of regular visits to a pulmonologist in order to monitor symptoms of COPD, to adjust medication therapy accordingly, and to prevent or manage exacerbations [2]. Patients in both groups were eligible for inclusion if they were (1) diagnosed as suffering from COPD, (2) aged between 40 and 80 years, (3) registered with a forced expiratory volume in 1 s (FEV_1) of less than 70% of the predicted value, (4) fluent in the Dutch language, (5) free from other pulmonary disease, (6) free from other serious non-pulmonary disease (such as heart disease or cancer), and (7) free from psychiatric problems in the previous year. Pulmonologists selected the patients who were suitable for participation in the study, and asked them

verbally (rehabilitation) or by mail (reference group) whether they gave permission to the researcher to inform them about the study. Patients received written information about the study and an informed consent form, requesting their permission to take part in the study. The Medical Ethics Committee of both centres approved the study.

2.2. Study design

This study consisted of two assessments collected by means of self-report questionnaires. Patients filled in questionnaires at the beginning (T1) and at the end (T2) of the rehabilitation programme. The length of the rehabilitation programme varied, with the average duration being 20 weeks (S.D. = 11.2). Incomplete questionnaires were returned, and patients were asked to complete the missing items.

2.3. Pulmonary rehabilitation

Pulmonary rehabilitation involves several types of health professionals and consists of exercise training, nutrition counselling, and education [2]. The multidisciplinary pulmonary rehabilitation programme in our study may differ to a certain extent from other programmes in this respect that it has a longer duration and a higher intensity [33]. The basic part of the rehabilitation programme in our study concerns physical support, consisting of pharmacological treatment (optimalisation of medication by a pulmonologist, mostly consisting of bronchodilator therapy), strength and endurance training, breathing retraining, and dietary interventions.

Apart from physical exercise, psycho-social interventions are aimed at psycho-education and self-management of the patients. Psycho-education addresses psycho-social problems related to the disorder by means of Kübler–Ross's theory of the stages of grief (shock, denial, depression, anger and adaptation) [34]. Self-management modules focus at compliance and maintaining a good physical condition after rehabilitation. By means of a self-medication scheme, patients are taught how to interpret their symptoms and the severity of the airflow obstruction, and to administer their medications accordingly. Self-management modules support the patients to implement the health behaviours learnt during rehabilitation (such as physical exercise) in their daily lives, in order to remain physically active and to prevent them from relapse after rehabilitation.

Physical therapy and psycho-social interventions are divided into several modules, which mostly are administered in group sessions, although some additional individual modules are offered when indicated, such as psychotherapy or a smoking cessation module. The programme covers 3 days a week (several modules a day) in the first 10 weeks of the programme, and 2 days a week in the next 6–10 weeks of the programme. Patients are referred for rehabilitation when in stage II, III or IV according to the GOLD classification [2]

and, consistent with the ICF model [35], when they experience limitations in activity and participation or if environmental or personal factors exist, which influence their disability. Patients are not admitted for rehabilitation when serious psychiatric or medical co-morbidity exists or when patients are addicted to alcohol or drugs (about 5% of the patients referred were not admitted). Most patients participated in rehabilitation as outpatients, although patients were also able to participate as inpatients if they needed intensive nursing care or the travel time to the rehabilitation centre was too long.

2.4. Assessments

2.4.1. Clinical characteristics

Data concerning case history and clinical characteristics were collected from the patients' medical records. Lung function parameters (forced expiratory volume (FEV_1) in litres, FEV_1 % pred and forced vital capacity (FVC) in litres) of the patients in rehabilitation were measured at the beginning of the rehabilitation programme. For the reference group, the most recent assessment of these measures during a regular visit to the outpatient clinic, within 1–3 months before T1, was used. Previous studies have shown that the annual rate of decline in FEV_1 for patients with COPD varies from 47 to 60 ml/year [36], although FEV_1 assessments within 3–6 months do not tend to fluctuate very much [37]. Furthermore, information on the number of pack-years ((number of years patients have smoked × number of cigarettes a day)/20) and the lung disease duration was collected.

2.4.2. Symptoms of COPD

A short questionnaire measured dyspnoea during rest and exercise, sputum production and coughing during the last week [38]. The total scale consists of the average of the four items with a range from 0 to 6. Higher scores indicate more symptoms.

2.4.3. Quality of life

Three subscales of the Rand 36-item health survey [39,40] were selected for the assessment of QoL, covering the three major domains of QoL: *physical functioning* (10 items), *psychological functioning* (five items), and *social functioning* (two items). Physical functioning measures the extent to which health interferes with daily activities such as climbing stairs. Psychological functioning measures mood, including feelings of depression or tension. Social functioning assesses interference of health with normal social activities such as visiting friends or relatives. All subscales vary between 0 and 100; higher scores indicate better functioning.

Overall QoL was measured on Cantril's ladder [41], a scale ranging from 0 to 10, with higher scores indicating a higher overall QoL. Patients answered the question: 'Here is a picture of a ladder. Suppose the top of the ladder represents the best possible life for you and the bottom represents the

worst possible life for you. Where on the ladder do you feel you personally stand at the present time?'

2.4.4. Perceptions of personal control

The Mastery scale of Pearlin and Schooler [42] measures the extent to which people feel they are in control of their own lives in general. Examples of items are: 'I have little control over the things that happen to me' or 'I can do just about anything I really set my mind to do'. This scale is composed of five positively formulated items and two negatively formulated items; the latter must be reversed. All items add up to a total score (range 7–35); higher scores indicate higher levels of mastery.

Self-efficacy was measured by the self-efficacy scale of Sullivan et al. [22,43], which consists of items assessing behaviours related to health. This scale consists of the subscales *control symptoms* and *maintain function*. The *control symptoms* subscale was measured by six items (range 0–24), such as 'How confident are you that you can control your breathlessness by taking your medications?' The *maintain function* subscale consisted of three items (range 0–12), such as, 'How confident are you that you can get regular exercise?' Items for each scale add up to a total score; higher scores indicate higher levels of self-efficacy.

2.4.5. Socio-demographic variables

Age, gender, marital status and educational level were assessed. Educational level was assessed according to the

International Standard Classification of Education [44,45], which has six categories that were recoded into four categories, ranging from lower educated to higher educated.

2.5. Statistics

The data were checked for normality (by means of the Kolmogorov–Smirnov test), and since the distributions of the variables were not significantly different from the normal distribution, parametric tests were used for the analyses. First, t-tests, Chi-square tests, and analyses of (co)variance were performed in order to compare the patients in rehabilitation with the reference group with respect to demographic and clinical characteristics, QoL, symptoms, and personal control (corrected for age-differences between the groups). Second, paired-samples t-tests were carried out to study changes to QoL, symptoms and personal control during rehabilitation. Effect sizes were calculated as mean baseline scores minus mean follow-up scores, divided by the pooled standard deviation [46]. According to Cohen, these scores can be divided into trivial (ES < .20), small (.20 ≥ ES < .50), medium (.50 ≥ ES < .80) and large (ES ≥ .80) effects [47]. Third, bi-variate correlation analyses were performed to study the associations of personal control at T1 with QoL at T2. In addition, multiple regression analyses of QoL at T2 on personal control at T1 were performed, and regression analyses of QoL at T2 on changes in personal control between T1 and T2, both
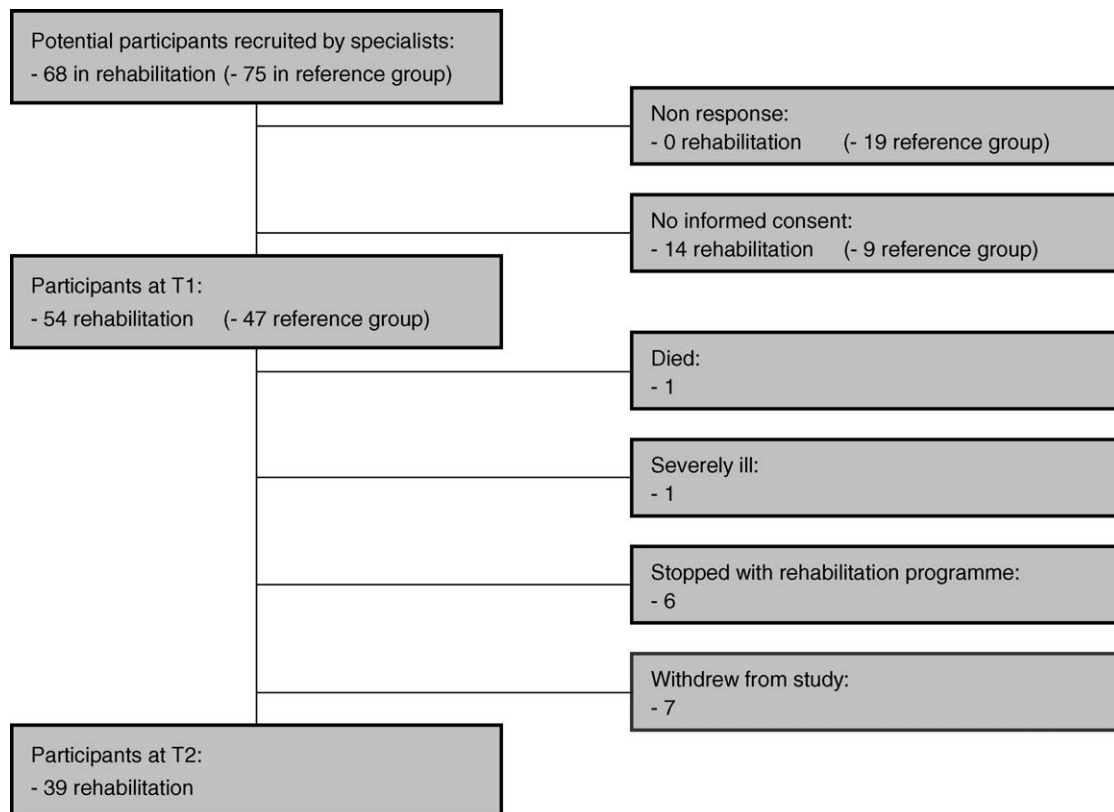

Fig. 1. Flow diagram of participants.

adjusted for QoL at T1, age, and gender. The same QoL domains were measured at both T1 and at T2. The value of each QoL domain at T2 was used as a dependent variable in the regression analysis and was corrected for the initial value of the same QoL domain at T1.

3. Results

3.1. Patient groups

Fig. 1 shows the numbers of patients in the study. Patients who refused to participate did not differ significantly from the respondents with respect to age and gender. In rehabilitation, 54 patients were included (response rate was 79%) and 39 patients participated in both assessments. Patients who dropped out during the study scored significantly lower than the respondents in terms of vital capacity and physical and social functioning at T1; no significant differences were found with respect to demographic characteristics and perceptions of personal control.

3.2. Socio-demographic variables

Table 1 shows that patients referred for rehabilitation were on average about 7 years younger ($p < .001$) than the patients in the reference group. Other socio-demographic parameters did not differ significantly between the groups.

3.3. Comparison with reference group: QoL, symptoms, and personal control

Table 2 shows that patients in rehabilitation scored significantly lower in self-reported physical functioning compared with the patients in the reference group, after correction for age-differences between the groups. Further-

more, patients in rehabilitation scored significantly lower in overall QoL than the reference group. No significant differences in personal control were found between the groups.

3.4. Changes in QoL, symptoms and personal control during rehabilitation

Table 2 also reports that COPD patients in rehabilitation showed significant improvements between T1 and T2 in overall QoL (ES = .43) and in the self-efficacy subscale *control symptoms* (ES = .62), whereas no significant changes were found in QoL domains, symptoms of COPD, and mastery.

Although on average patients in rehabilitation did not change significantly on QoL domains, further analyses of individual patients showed that a subgroup of patients did improve with respect to physical functioning: 36% of the patients showed improvements in physical functioning. Only a small number of patients improved with respect to social and psychological functioning.

3.5. Relationships between personal control and QoL domains

Table 3 contains the Pearson's correlation coefficients for the relationships between QoL domains, mastery, and self-efficacy. We found significant relationships between each QoL domain at T1 and the same QoL domain at T2. Perceptions of personal control at T1 were not significantly related to QoL at T2. Changes in self-efficacy *maintain function* were significantly related to social and psychological functioning at T2 ($r = .50$, $p < .01$ and $r = .35$, $p < .05$).

Correlation analyses at T1 and T2 revealed the following results (additional information, which is not displayed in the

Table 1
Demographic variables and clinical characteristics of COPD patients in rehabilitation and reference group

	Rehabilitation (N = 39)		Reference group (N = 44)		Difference between groups
	Mean	S.D.	Mean	S.D.	*p*-value
Age (years)	60.5	9.0	68.0	8.2	.001[a]
Gender (% female)	41.0		34.1		n.s.
Educational level (%)					n.s.
Primary	28.3		45.4		
Lower vocational	35.9		27.3		
Secondary/intermediate vocational	17.9		18.2		
Higher vocational/university	17.9		9.1		
Marital status (% with partner)	84.6		88.4		n.s.
FEV_1 (litres)	1.2	0.6	1.4	0.7	n.s.
FEV_1 % pred	40.7	21.1	46.9	16.1	n.s.
FVC (litres)	3.2	0.9	3.3	0.9	n.s.
Pack-years (years)	41.5	29.4	33.7	21.2	n.s.
Illness duration (years)	8.6	8.4	11.7	12.0	n.s.

n.s. = not significant.

[a] *t*-value = 4.0.

Table 2

QoL and perceptions of personal control (ranges in parentheses) for patients with COPD in rehabilitation and reference group

	Rehabilitation						Reference group	
	T1		T2		T2–T1		T1	
	Mean[a]	S.D.	Mean[a]	S.D.	p-value[b]	ES	Mean[a]	S.D.
Quality of life								
Physical functioning (range 0–100)	30.0[c]	19.7	35.0[d]	21.4	n.s.	.24	41.1	28.9
Social functioning (0–100)	51.3	25.3	59.0	25.5	n.s.	.30	65.1	29.0
Psychological functioning (0–100)	66.3	18.8	68.2	20.9	n.s.	.10	72.2	19.6
COPD specific symptoms (0–6)	3.0	1.0	2.9	1.1	n.s.	.11	2.7	1.1
Overall QoL (0–10)	5.3[e]	1.4	5.9	1.7	.03[f]	.43	6.1	1.5
Personal control								
Mastery (7–35)	22.6	5.1	21.2	4.7	n.s.	.28	23.1	4.2
Self-efficacy control symptoms (0–24)	17.8	3.2	19.7	2.9	.002[g]	.62	19.2	3.3
Self-efficacy maintain function (0–12)	7.2	2.4	8.0	2.6	n.s.	.30	7.3	1.9

n.s. = not significant.

[a] Unadjusted means (uncorrected for age differences between groups).

[b] Adjusted p-values.

[c] Analysis of variance between groups vs. reference group F-value = 5.6, p = .02.

[d] Analysis of variance between groups vs. reference group F-value = 4.0, p = .05.

[e] Analysis of variance between groups vs. reference group F-value = 3.9, p = .05.

[f] Paired t-tests within group (T2–T1) t-value = −2.2.

[g] Paired t-tests within group (T2–T1) t-value = −3.3.

table): self-efficacy *maintain function* at T1 was significantly related to social functioning ($r = .40$, $p < .05$) and marginally significantly related to psychological functioning ($r = .31$, $p = .058$) and physical functioning ($r = .31$, $p = .059$). Self-efficacy *control symptoms* was only significantly related to psychological functioning ($r = .41$, $p < .05$). Mastery was related to psychological functioning ($r = .40$, $p < .05$) and overall QoL ($r = .39$, $p < .05$), and marginally significantly related to physical functioning ($r = .31$, $p = .057$). At T2, self-efficacy *maintain function* was significantly related to all QoL domains and overall QoL ($r = .44$–$.65$, $p < .01$), whereas self-efficacy *control*

symptoms was not significantly related to any of the domains and overall QoL. Mastery was significantly related to overall QoL ($r = .34$, $p < .05$) and marginally significantly related to physical functioning ($r = .31$, $p = .067$).

3.6. Independent associations between personal control and QoL domains

Table 4 shows the contribution of personal control to QoL domains after rehabilitation. The first regression analysis yielded no significant associations between either mastery or self-efficacy subscale *control symptoms* at T1 and any of the

Table 3

Pearson's correlation coefficients of QoL (Rand-36) and perceptions of personal control (mastery and self-efficacy) for patients with COPD in rehabilitation ($n = 39$)

	T2			
	Physical functioning	Social functioning	Psychological functioning	Overall QoL
T1 QoL				
Physical functioning	.42*	−.01	−.24	−.10
Social functioning	.40*	.51**	.45**	.33
Psychological functioning	.40*	.52***	.71***	.46**
T1 Overall QoL	.27	.27	.38*	.30
T1 Personal control				
Mastery	.16	.12	.19	.06
Self-efficacy control symptoms	−.06	.08	.29	.06
Self-efficacy maintain function	.25	.09	.14	.29
ΔPersonal control				
Mastery	.12	.15	.07	.24
Self-efficacy control symptoms	−.00	.16	−.04	.15
Self-efficacy maintain function	.18	.50**	.35*	.19

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Table 4
Regression of QoL domains at T2 on perceptions of personal control at T1 for COPD patients in rehabilitation ($n = 39$)

Predictors	Physical functioning T2			Social functioning T2			Psychological functioning T2			Overall QoL T2		
	B	β	ΔR^2	B	β	ΔR^2	B	β	ΔR^2	B	β	ΔR^2
Analysis 1[a]												
QoL domain T1	.33	.31		.50	.49[**]		.96	.86[***]		.29	.23	
Mastery T1	−.39	−.09		−.42	−.08		−.55	−.13		−.04	−.13	
Self-efficacy *control symptoms* T1	.27	.04		.80	.10		−.04	−.01		.02	.03	
Self-efficacy *maintain function* T1	1.83	.22		.47	.05		−1.13	−.13		.22	.32[b]	
			.17			.27			.54			.17
Analysis 2[c]												
QoL domain T1	.46	.45[**]		.40	.42[**]		.84	.75[***]		.49	.38[*]	
ΔMastery	1.01	.27[d]		.98	.21		.73	.18		.11	.33[e]	
ΔSelf-efficacy *control symptoms*	−.15	−.03		1.00	.14		.39	.06		.13	.25	
ΔSelf-efficacy *maintain function*	1.88	.26		4.12	.48[***]		2.92	.39[**]		.16	.27	
			.24			.49			.66			.27

[a] Regression analyses of QoL domains at T2 on control variables at T1. Regression analyses were corrected for age, gender, and the level of the specific QoL domain at T1.

[b] $p = .073$.

[c] Regression analyses of QoL domains at T2 on changes in personal control (T2–T1). Regression analyses were corrected for age, gender, and the level of the specific QoL domain at T1.

[d] $p = .085$.

[e] $p = .054$.

[*] $p < .05$.

[**] $p < .01$.

[***] $p < .001$.

QoL measures at T2. Self-efficacy subscale *maintain function* was only marginally significantly related to overall QoL at T2 ($\beta = .32$, $p = .073$).

The second regression analysis showed that changes during rehabilitation in self-efficacy *maintain function* contributed significantly to the explanation of changes in social functioning ($\beta = .48$, $p < .001$) and psychological functioning ($\beta = .39$, $p < .01$). Changes in self-efficacy subscale *control symptoms* were neither significantly related to any of the QoL domains nor to overall QoL. Changes in mastery were only marginally significantly related to the explanation of changes in physical functioning ($\beta = .27$, $p = .085$) and overall QoL ($\beta = .33$, $p = .054$).

4. Discussion and conclusion

4.1. Discussion

Patients with COPD improved with respect to overall QoL and self-efficacy during the rehabilitation programme. In addition, changes during rehabilitation in self-efficacy contributed to the explanation of the social and psychological QoL domains after rehabilitation, which is consistent with earlier findings reported by Lox and Freehill [13] and McCathie et al. [27].

4.1.1. Quality of life

In general, the physical domain of QoL tends to decrease with age [40]. Consequently, the result that the patients in rehabilitation showed a worse physical functioning than the slightly older reference group indicates that the rehabilitation group indeed had a serious condition. However, on average both groups scored much lower than healthy people of the same age (healthy people 64.8 (S.D. 26.4) [40]; rehabilitation group 30.0 (S.D. 19.7), reference group 41.1 (S.D. 28.9)). Considering their FEV_1, patients in both groups in this study are in stage III according to the GOLD guidelines [2], indicating that both groups of patients with COPD are extensively impaired and in need of careful management.

No significant improvement in physical functioning was found at group level during rehabilitation. Previous research did report significant improvements in physical functioning measured by the SF-36 [48,49], thereby demonstrating the sensitivity of this measure to assess changes in QoL during rehabilitation. The COPD patients in this study were in advanced stages of their illnesses and therefore, the possibilities for improvement with respect to physical aspects of QoL were probably limited [31]. Previous research has shown that during the course of their illness, COPD patients gradually decline with respect to pulmonary function and with respect to physical and other domains of QoL [37,50]. This process of deterioration can only be retarded, with medication for instance, but not stopped [36]. This may also explain the fact that significant improvements in self-reported physical functioning during rehabilitation were not found at group level. Although the physical condition of the COPD patients in rehabilitation was rather poor, psycho-social adjustment to the illness is still possible, which is supported by our result that

COPD patients improved during rehabilitation with respect to their overall QoL.

4.1.2. Personal control

The finding that COPD patients in rehabilitation reported significant changes in self-efficacy is consistent with earlier findings [10,13,51]. However, the COPD patients in this study were seriously ill, illustrated by the result that no improvements with respect to QoL domains were found. Furthermore, these patients were rather impaired with respect to personal control (mastery scores for healthy people 24.7 (S.D. 5.3) [19]; rehabilitation 22.6 (S.D. 5.1), reference group 23.1 (S.D. 4.2)). Moreover, in order to realise positive rehabilitation effects, the patients are required to change certain unhealthy behaviours, which is rather difficult for patients often suffering from multiple psycho-social problems and demotivation [8,12]. Consequently, the results of this study, showing a significant improvement in self-efficacy during rehabilitation, are rather remarkable. Only a few other studies have assessed perceptions of personal control in patients with COPD [15,52–55] and, therefore, this study contributes to the existing literature.

After rehabilitation, patients reported more confidence in their ability to exert control over their symptoms. Self-efficacy theory assumes that perceptions of personal efficacy are based on previous experiences of successful performance or learning experiences [20,56], hence, exercise training may lead to higher perceptions of self-efficacy [57]. Since pulmonary rehabilitation is tailored to the abilities of individual patients, the individual goals of the programme are readily achievable, which probably results in an improvement in perceptions of self-efficacy. The result that no improvements in mastery were found during rehabilitation shows that the changes in personal control during rehabilitation are specific rather than general.

4.1.3. Contribution of self-efficacy to QoL domains

Improvements in the self-efficacy subscale *maintain function* were related to improved social and psychological functioning after rehabilitation, while changes in self-efficacy *control symptoms* were not related to QoL after rehabilitation. Improvements in self-efficacy *control symptoms* probably do not lead to a better QoL as actual control over the symptoms patients experience is limited. Self-efficacy *maintain function* concerns the confidence patients have in being able to engage in physical activities. As a result of low perceptions of self-efficacy, COPD patients may refrain from the activities of daily life [58]. Increased perceptions of self-efficacy *maintain function* may encourage patients to engage in social activities more often, which in turn may enhance their feelings of well-being.

4.1.4. Study limitations

This study has a few limitations. First, since we did not perform a randomised controlled study, we cannot determine whether the changes in self-efficacy during rehabilitation can be attributed to the rehabilitation programme. However, our aim was to study changes in QoL and perceptions of personal control during rehabilitation, and we did not question whether rehabilitation per se was effective or not. An advantage of our design is that we did not apply extensive selection criteria for the patients to be included in the study, and therefore, these patients are likely to be rather representative of the COPD patients seen in pulmonary rehabilitation.

Second, our 20-week rehabilitation programme may be longer than that in many other rehabilitation centres. This makes our programme less comparable to other rehabilitation programmes, although some other studies have investigated longer rehabilitation programmes [59,60]. Previous studies have found support for the notion that longer programmes appear to be more successful than shorter programmes [2,60].

Third, unfortunately a reasonably large number of patients in rehabilitation dropped out during the study, mainly due to their leaving the programme. Although the patients who dropped out scored significantly lower than the participants on a few variables in the study, no significant differences have been found with respect to perceptions of personal control and, therefore, the amount of drop-out probably did not affect our results.

4.2. Conclusion

COPD patients improved with respect to overall QoL and personal control during a rehabilitation programme. Furthermore, this study revealed a relationship between changes during rehabilitation in perceptions of self-efficacy with QoL, suggesting that perceptions of personal control, and self-efficacy in particular, play an important part in the adjustment to COPD. These results show that even in seriously impaired COPD patients in advanced stages of illness, positive changes in self-efficacy and overall well-being can be established during rehabilitation.

The results of pulmonary rehabilitation, however, are often not maintained for a long period [10,31]. Previous studies have argued that perceptions of personal control influence patients' motivation [20] to exert effort for certain activities, and have been associated with lifestyle changes, such as physical exercise and smoking cessation [13,14]. Consequently, the role of self-efficacy may be very important in maintaining the effects of rehabilitation. It would thus be of interest to study whether the changes in self-efficacy are maintained after the end of the rehabilitation programme and whether this is associated with enduring changes in lifestyle factors.

4.3. Practice implications

A finding of interest for health care professionals is that the patients in rehabilitation and the reference group did not

differ with respect to pulmonary function, while the patients in rehabilitation functioned significantly worse with respect to self-reported physical functioning. This suggests that patients are more often referred for rehabilitation on the basis of their limitations in daily physical activities than on the basis of pulmonary function. Furthermore, these results suggest a discrepancy between pulmonary function and perceptions of limitations in physical functioning, which is in line with earlier studies that have showed discrepancies between self-reported and more objectively assessed physical functioning [61,62].

An important result of this study is that the patients improved during rehabilitation with respect to self-efficacy. In the treatment of patients with COPD, aside from improving physical functioning, enhancing health promoting behaviours is important as these behaviours promote better disease management. Higher levels of self-efficacy are associated with healthy behaviours, such as smoking cessation [14], more physical exercise, and higher training achievements [63]. Therefore, interventions for patients with COPD should not only focus on improving physical functioning but also on enhancing perceptions of self-efficacy. In patients with COPD in particular, strengthening perceptions of personal control is very important, since these perceptions of control in turn affect the motivation to engage in healthy behaviours [20]. To date, strengthening the control beliefs of COPD patients is only an implicit goal of rehabilitation, although rehabilitation programmes are appropriate interventions to enhance both self-efficacy and physical functioning [13]. Therefore, enhancing perceptions of self-efficacy is suggested as being an important aim in the treatment of patients with COPD.

Acknowledgements

References

[1] Pauwels RA, Buist AS, Ma P, Jenkins CR, Hurd SS. Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease. National Heart, Lung, and Blood Institute and World Health Organization Global Initiative for Chronic Obstructive Lung Disease (GOLD): executive summary. Respir Care 2001;46: 798–825.

[2] Global Initiative for Chronic Obstructive Lung Disease. Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease. Executive Summary (Updated 2004). National Heart, Lung and Blood Institute, July 1, 2003 [cited January 14, 2005]. Available from: http://www.goldcopd.com.

[3] American Thoracic Society. Standards for the diagnosis and care of patients with chronic obstructive pulmonary disease. Am J Respir Crit Care Med 1995;152:S77–S121.

[4] Mannino DM. COPD: epidemiology, prevalence, morbidity and mortality, and disease heterogeneity. Chest 2002;121:121S–6S.

[5] Rennard SI. COPD: overview of definitions, epidemiology, and factors influencing its development. Chest 1998;113:235S–41S.

[6] Stavem K, Lossius MI, Kvien TK, Guldvog B. The health-related quality of life of patients with epilepsy compared with angina pectoris, rheumatoid arthritis, asthma and chronic obstructive pulmonary disease. Qual Life Res 2000;9:865–71.

[7] Yohannes AM, Baldwin RC, Connolly MJ. Depression and anxiety in elderly outpatients with chronic obstructive pulmonary disease: prevalence, and validation of the BASDEC screening questionnaire. Int J Geriatr Psych 2000;15:1090–6.

[8] Lareau SC, ZuWallack R, Carlin B, Celli B, Fahy B, Gosselink R, et al. Pulmonary rehabilitation-1999. American Thoracic Society. Am J Respir Crit Care Med 1999;159:1666–82.

[9] Berry MJ, Rejeski WJ, Adair NE, Zaccaro D. Exercise rehabilitation and chronic obstructive pulmonary disease stage. Am J Respir Crit Care Med 1999;160:1248–53.

[10] Ries AL, Kaplan RM, Limberg TM, Prewitt LM. Effects of pulmonary rehabilitation on physiologic and psycho-social outcomes in patients with chronic obstructive pulmonary disease. Ann Intern Med 1995;122:823–32.

[11] Anthonisen NR, Connett JE, Murray RP. Smoking and lung function of lung health study participants after 11 years. Am J Respir Crit Care Med 2002;166:675–9.

[12] Büchi S, Wolf C, Schwarz F, Villiger B, Buddeberg C. Sind stationäre Rehabilitationsbehandlungen bei Patienten mit chronisch obstruktiver Lungenkrankheit (COLK) sinnvoll? Ergebnisse einer prospektiven 1-Jahres-Verlaufsstudie. Psychother Psychosom Med Psychol 1996;46:423–9.

[13] Lox CL, Freehill AJ. Impact of pulmonary rehabilitation on self-efficacy, quality of life, and exercise tolerance. Rehabil Psychol 1999;44:208–21.

[14] Meland E, Maeland JG, Laerum E. The importance of self-efficacy in cardiovascular risk factor change. Scand J Public Health 1999;27: 11–7.

[15] Toshima MT, Kaplan RM, Ries AL. Self-efficacy expectancies in chronic obstructive pulmonary disease rehabilitation. In: Schwarzer R, editor. Self-efficacy: thought control of action. Washington, DC, USA: Hemisphere Publishing Corp.; 1992. p. 325–54.

[16] Skinner EA. A guide to constructs of control. J Pers Soc Psychol 1996;71:549–70.

[17] Gurin P, Gurin G, Morrison BM. Personal and ideological aspects of internal and external control. Soc Psychol 1978;41:275–96.

[18] Pearlin LI, Lieberman MA, Menaghan EG, Mullan JT. The stress process. J Health Soc Behav 1981;22:337–56.

[19] Kempen GIJM, Sanderman R, Miedema I, Meyboom-de Jong B, Ormel J. Functional decline after congestive heart failure and acute myocardial infarction and the impact of psychological attributes. A prospective study. Qual Life Res 2000;9:439–50.

[20] Bandura A. Self-efficacy: toward a unifying theory of behavioral change. Psychol Rev 1977;84:191–215.

[21] Carver C, Harris S, Lehman J, Durel L, Antoni M, Spencer S, et al. How important is the perception of personal control? Studies of early stage breast cancer patients. Pers Soc Psychol Bull 2000;26:139–49.

[22] Berkhuysen MA, Nieuwland W, Buunk BP, Sanderman R, Rispens P. Change in self-efficacy during cardiac rehabilitation and the role of perceived overprotectiveness. Patient Educ Couns 1999;38:21–32.

[23] Gifford AL, Bormann JE, Shively MJ, Wright BC, Richman DD, Bozzette SA. Predictors of self-reported adherence and plasma HIV concentrations in patients on multidrug antiretroviral regimens. J Acq Immun Def Synd 2000;23:386–95.

[24] Büchi S, Villiger B, Sensky T, Schwarz F, Wolf C, Buddeberg C. Psycho-social predictors of long-term success of in-patient pulmonary rehabilitation of patients with COPD. Eur Respir J 1997;10:1272–7.

[25] Lorig KR, Sobel DS, Stewart AL, Brown B-WJ, Bandura A, Ritter P, et al. Evidence suggesting that a chronic disease self-management

program can improve health status while reducing hospitalization: a randomized trial. Med Care 1999;37:5–14.

[26] Ketelaars CA, Schlosser MA, Mostert R, Huyer-Abu-Saad H, Halfens RJ, Wouters EF. Determinants of health-related quality of life in patients with chronic obstructive pulmonary disease. Thorax 1996;51:39–43.

[27] McCathie H-CF, Spence SH, Tate RL. Adjustment to chronic obstructive pulmonary disease: the importance of psychological factors. Eur Respir J 2002;19:47–53.

[28] Goldstein RS, Gort EH, Stubbing D, Avendano MA, Guyatt GH. Randomised controlled trial of respiratory rehabilitation. Lancet 1994;344:1394–7.

[29] Griffiths TL, Burr ML, Campbell IA, Lewis-Jenkins V, Mullins J, Shiels K, et al. Results at 1 year of outpatient multidisciplinary pulmonary rehabilitation: a randomised controlled trial. Lancet 2000;355:362–8.

[30] Strijbos JH, Postma DS, van Altena R, Gimeno F, Koeter GH. A comparison between an outpatient hospital-based pulmonary rehabilitation program and a home-care pulmonary rehabilitation program in patients with COPD. A follow-up of 18 months. Chest 1996;109:366–72.

[31] Ketelaars CA, Abu-Saad HH, Schlosser MA, Mostert R, Wouters EF. Long-term outcome of pulmonary rehabilitation in patients with COPD. Chest 1997;363–9.

[32] Wempe JB, Wijkstra PJ. The influence of rehabilitation on behaviour modification in COPD. Patient Educ Couns 2004;52:237–41.

[33] Lacasse Y, Wong E, Guyatt GH, King D, Cook DJ, Goldstein RS. Meta-analysis of respiratory rehabilitation in chronic obstructive pulmonary disease. Lancet 1996;348:1115–9.

[34] Kübler-Ross E. On death and dying. New York: Macmillan, 1969.

[35] WHO. International classification of functioning, disability and health: ICF, 1st ed. Geneva: WHO, 2001.

[36] Sutherland ER, Allmers H, Ayas NT, Venn AJ, Martin RJ. Inhaled corticosteroids reduce the progression of airflow limitation in chronic obstructive pulmonary disease: a meta-analysis. Thorax 2003;58:937–41.

[37] Burge PS, Calverley PM, Jones PW, Spencer S, Anderson JA, Maslen TK. Randomised, double blind, placebo controlled study of fluticasone propionate in patients with moderate to severe chronic obstructive pulmonary disease: the ISOLDE trial. Brit Med J 2000;320:1297–303.

[38] Van der Molen T, Willemse BMW, Schokker S, Ten Hacken NHT, Postma D, Juniper EF. Development validity and responsiveness of the Clinical COPD Questionnaire. Health Qual Life Outcomes [serial online] April 28, 2003 [cited August 5, 2003] [10 screens]. Available from: URL: http://www.hqlo.com/content/1/1/13.

[39] Ware JE, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. Med Care 1992;30:473–83.

[40] Van der Zee K, Sanderman R, Heyink JW, De Haes H. Psychometric qualities of the RAND 36-item health survey 1.0: a multidimensional measure of general health status. Int J Behav Med 1996;3:104–22.

[41] Cantril H. Discovering people's aspirations: the method used. In: Cantril H, editor. The pattern of human concerns. New Brunswick, NJ: Rutgers University Press; 1965. p. 21–9.

[42] Pearlin LI, Schooler C. The structure of coping. J Health Soc Behav 1978;19:2–21.

[43] Sullivan MD, LaCroix AZ, Russo J, Katon WJ. Self-efficacy and self-reported functional status in coronary heart disease: a 6-month prospective study. Psychosom Med 1998;60:473–8.

[44] United Nations Educational Scientific and Cultural Organization. International Standard Classification of Education (ISCED). Paris, France: UNESCO, 1976.

[45] Ranchor AV, Bouma J, Sanderman R. Vulnerability and social class: differential patterns of personality and social support over the social class. Pers Indiv Differ 1996;20:229–37.

[46] Middel B, Van Sonderen FLP. Statistical significant change versus relevant or important change in (quasi) experimental design: some conceptual and methodological problems in estimating magnitude of intervention-related change in health services. Int J Integr Care 2002;2:1–22.

[47] Cohen J. Statistical power analysis for the behavioural sciences. New York: Academic Press, 1977.

[48] Boueri FMV, Bucher-Bartelson BL, Glenn KA, Make BJ. Quality of life measured with a generic instrument (Short Form-36) improves following pulmonary rehabilitation in patients with COPD. Chest 2001;119:77–84.

[49] Ward JA, Akers G, Ward DG, Pinnuck M, Williams S, Trott J, et al. Feasibility and effectiveness of a pulmonary rehabilitation programme in a community hospital setting. Brit J Gen Pract 2002;52:539–42.

[50] Spencer S, Calverley PM, Sherwood-Burge P, Jones PW. Health status deterioration in patients with chronic obstructive pulmonary disease. Am J Respir Crit Care Med 2001;163:122–8.

[51] Zimmerman BW, Brown ST, Bowman JM. A self-management program for chronic obstructive pulmonary disease: relationship to dyspnea and self-efficacy. Rehabil Nurs 1996;21:253–7.

[52] Van der Palen J, Klein J, Seydel E. Are high generalized and asthma-specific self-efficacy predictive of adequate self-management behaviour among adult asthma patients? Patient Educ Couns 1997;32:S35–41.

[53] Kohler CL, Fish L, Greene PG. The relationship of perceived self-efficacy to quality of life in chronic obstructive pulmonary disease. Health Psychol 2002;21:610–4.

[54] Scherer YK, Schmieder LE. The effect of a pulmonary rehabilitation program on self-efficacy, perception of dyspnea, and physical endurance. Heart Lung 1997;26:15–22.

[55] Kaplan RM, Ries AL, Prewitt LM, Eakin E. Self-efficacy expectations predict survival for patients with chronic obstructive pulmonary disease. Health Psychol 1994;13:366–8.

[56] Holman HR, Lorig K. Perceived self-efficacy in self-management of chronic disease. In: Schwarzer R, editor. Self-efficacy: thought control of action. Washington, DC, USA: Hemisphere Publishing Corp.; 1992 p. 305–23.

[57] Stewart KJ, Kelemen MH, Ewart CK. Relationships between self-efficacy and mood before and after exercise training. J Cardiopul Rehabil 1994;14:35–42.

[58] Wigal JK, Creer TL, Kotses H. The COPD self-efficacy scale. Chest 1991;99:1193–6.

[59] Troosters T, Gosselink R, Decramer M. Short- and long-term effects of outpatient rehabilitation in patients with chronic obstructive pulmonary disease: a randomized trial. Am J Med 2000;109:207–12.

[60] Spruit MA, Troosters T, Trappenburg JCA. Decramer M, Gosselink R. Exercise training during rehabilitation of patients with COPD: a current perspective. Patient Educ Couns 2004;52:243–8.

[61] Singh SJ, Sodergren SC, Hyland ME, Williams J, Morgan MD. A comparison of three disease-specific and two generic health-status measures to evaluate the outcome of pulmonary rehabilitation in COPD. Respir Med 2001;95:71–7.

[62] Wijnhoven HA, Kriegsman DM, Hesselink AE, Penninx BW, de Haan M. Determinants of different dimensions of disease severity in asthma and COPD: pulmonary function and health-related quality of life. Chest 2001;119:1034–42.

[63] Ewart CK. Role of physical self-efficacy in recovery from heart attack. In: Schwarzer R, editor. Self-efficacy: thought control of action. Washington, DC, USA: Hemisphere Publishing Corp.; 1992 p. 287–304.