JAMDA 15 (2014) 655–664

JAMDA

journal homepage: www.jamda.com

Original Study

Maintenance of a Physically Active Lifestyle After Pulmonary Rehabilitation in Patients With COPD: A Qualitative Study Toward Motivational Factors

Kelly F.J. Stewart MSc[a,*], Jessie J.M. Meis MSc[b], Coby van de Bool MSc[a,c], Daisy J.A. Janssen PhD[c], Stef P.J. Kremers PhD[b], Annemie M.W.J. Schols PhD[a]

[a] *Department of Respiratory Medicine, NUTRIM School for Nutrition, Toxicology and Metabolism, Maastricht University Medical Center+, Maastricht, The Netherlands*
[b] *Department of Health Promotion, NUTRIM School for Nutrition, Toxicology and Metabolism, Maastricht University Medical Center+, Maastricht, The Netherlands*
[c] *Department of Research and Education, CIRO+, Center of Expertise for Chronic Organ Failure, Horn, The Netherlands*

Keywords:
Chronic obstructive pulmonary disease
pulmonary rehabilitation
behavior maintenance
autonomous motivation

ABSTRACT

Objectives: To explore determinants of behavior change maintenance of a physically active lifestyle in patients with chronic obstructive pulmonary disease (COPD) 8–11 months after completion of a 4-month outpatient pulmonary rehabilitation program.
Design: A qualitative descriptive study of semistructured interviews.
Setting: Pulmonary rehabilitation assessment center.
Participants: Patients with COPD.
Measurements: Semistructured interviews until data saturation, coded by 2 independent researchers. Patients were classified as responder (maintenance or improvement) or nonresponder (relapse or decrease), based on 3 quantitative variables reflecting exercise capacity (Constant Work Rate Test), health-related quality of life (Short-Form health survey [SF-36]), and self-management abilities (Self-Management Ability Scale [SMAS-30/Version 2]).
Results: Mean (SD) forced expiratory volume in the first second (FEV_1) among interviewees was 52.5% (14.4%) predicted and the mean age was 63.5 years (range: 45–78). The group consisted of 15 responders and 7 nonresponders. Physical limitations reduced competence to engage in an active lifestyle and responders appeared to experience higher levels of perceived competence. Social support was found important and the experienced understanding from fellow patients made exercising together enjoyable. Particularly, responders expressed autonomous motivation and said they exercised because of the benefits they gain from it. Unexpectedly, only responders also experienced controlled motivation.
Conclusion: Perceived competence and autonomous motivation are important determinants for maintenance of an active lifestyle in patients with COPD. In contrast to common theoretical assumptions, a certain threshold level of controlled motivation may remain important in maintaining a physically active lifestyle after a pulmonary rehabilitation program.

Pulmonary rehabilitation is an individually tailored multidisciplinary program to improve physical and social performance and autonomy of patients with a chronic respiratory disease. It is known to improve exercise tolerance, quality of life, self-efficacy, and physical and psychological symptoms.[1–6] The cornerstone of pulmonary rehabilitation is exercise training and patient education, combined with nutritional intervention, occupational therapy, and psychosocial support on indication, with behavior change being an important overall goal.[7]

Part of the rehabilitation program is to prepare patients for maintaining this behavior change at home. It is a common problem that the benefits achieved during rehabilitation tend to decline in the months after the program in absence of any maintenance strategy.[8] Therefore, it is vital that determinants of both behavior change and behavior maintenance in pulmonary rehabilitation are well understood and considered when designing and executing a rehabilitation program.

One theory often applied when studying sustained maintenance of behavior change is Self-Determination Theory (SDT).[9] According to SDT,

---

The authors declare no conflicts of interest.

[*] Address correspondence to Kelly F.J. Stewart, MSc, Department of Respiratory Medicine, NUTRIM School for Nutrition, Toxicology, and Metabolism, Maastricht University Medical Center+, PO Box 616, 6200 MD, Maastricht, The Netherlands.
E-mail address: k.stewart@maastrichtuniversity.nl (K.F.J. Stewart).

1525-8610/$ - see front matter © 2014 AMDA – The Society for Post-Acute and Long-Term Care Medicine.
http://dx.doi.org/10.1016/j.jamda.2014.05.003

the patient needs to internalize values and skills for change, leading to autonomously regulated motivation, as opposed to externalized or controlled forms of motivational regulation. This in turn is assumed to lead to better maintenance of behavior change.[10,11] Furthermore, the theory argues that the patient's fulfillment of the 3 basic psychological needs (ie, autonomy, relatedness, and competence) is essential for internalization of the motivational regulation of behavior.[9,12]

Determinants of behavior change during pulmonary rehabilitation and maintenance of an active lifestyle after pulmonary rehabilitation have recently been studied with qualitative research designs.[13,14] Meis et al[13] showed that patients with COPD became more confident in exercising and in managing their daily life activities, gained knowledge, and acquired new self-management skills during rehabilitation in a clinical setting. Hogg et al[14] found that feelings of belonging were an important aspect for attendance of sessions during and after rehabilitation. Also, they found an increase in patients' confidence to exercise, mainly when professionals and/or peers were present at exercise sessions. So, from a theoretical point of view, Hogg et al[14] have shown the potential impact of relatedness and competence in maintenance of an active lifestyle after pulmonary rehabilitation. However, the importance of the type of motivation in behavior maintenance is still unclear. Furthermore, no previous qualitative studies have distinguished long-term treatment responders from nonresponders. Therefore, it remains unclear which motivational factors are primarily responsible for sustained treatment success.

In a previous study, we have shown the need for long-term effectiveness of intervention among patients with less severe airway obstruction and low muscle mass.[15] Therefore, the current study aims to investigate maintenance of a physically active lifestyle after a 4-month outpatient pulmonary rehabilitation program in clinically stable patients with moderate COPD. To explain the differences between patients who do and do not show a long-term response to pulmonary rehabilitation, the 3 basic psychological needs and motivational regulations, based on the tenets of SDT, have been studied to suggest future directions for research.

Methods

A qualitative descriptive method was used to address the research question.

Study Population

The study population consisted of 22 clinically stable patients with COPD 8 to 11 months after completion of a 4-month outpatient pulmonary rehabilitation program, selected by means of convenience sampling. The study was incorporated in the ongoing NUTRAIN trial investigating the efficacy of nutritional supplementation during 4 months of supervised exercise training on physical performance and cardio-metabolic risk, in a placebo-controlled design. Two patients declined participation, stating they were not willing to participate in additional research.

Data Collection

The interviews for the current study took place at the assessment center or at the patient's home, depending on the interviewee's preference. To capture the patients' personal experiences and opinions, semistructured interviews were conducted individually using a theory- and evidence-based interview guide (Table 1). Topics for the interview guide were derived from the self-determination and self-regulation literature,[16,17] and included perceived behavior change, barriers/facilitators, satisfaction/frustration of basic psychological needs, motivation, dealing with and accepting of disease and limitations, and goal setting.

To attain consistency in data gathering, all interviews were conducted by the same researcher, who was blinded to whether the interviewee was a responder or nonresponder. Interviews were held 12 to 15 months after the start of rehabilitation and were conducted in Dutch. Interviews were audiotaped to allow verbatim transcription and subsequent analysis of the data, and notes were taken on social interactions and nonverbal expressions. Collection of data continued until data saturation was considered to be achieved, which occurred after 22 interviews.

Data were obtained on demographics, lung function, dyspnea (Medical Research Council [MRC] dyspnea scale[18]), and body composition (dual-energy x-ray absorptiometry) to describe the study population. Additional quantitative data were used to distinguish whether patients managed to maintain or improve their mental and physical health (responders) or declined in mental and physical health (nonresponders) in the 8 months after pulmonary rehabilitation. To provide an adequate and balanced reflection of the patient's physical and mental health, 3 variables were used to categorize patients based on the minimally clinically important difference (MCID): exercise capacity (constant work rate test [CWRT]), Health-Related Quality of Life (HRQoL; Short-Form health survey [SF-36][19]), and self-management abilities (SMAS-30/version 2[20]). The latter was specifically included because improving self-management is an important aspect of pulmonary rehabilitation.[7]

An MCID was available from literature for the CWRT and SF-36. The MCID for the SMAS-30/version 2 was calculated through a distribution-based method using the SD[21] from a larger data sample from the NUTRAIN study. When the change in outcome, determined as the difference between 12 and 4 months after initiation of pulmonary rehabilitation, occurred in the undesired direction and was more deviant than the MCID, the patient was categorized as nonresponding for that variable, and otherwise as responding. Accelerometry data were obtained to translate the 3 used variables into an objective behavioral measure of physical activity in both groups, measured at 8 months after completion of pulmonary rehabilitation. A patient responding on a minimum of 2 of the 3 variables was considered a responder (Table 2).

Data Analysis

Qualitative content analysis was applied for analysis of the interviews, using qualitative analysis software (NVivo 9.2; QSR

Table 1
Interview Guide

Topics Addressed	Questions
Perceived behavior change, barriers/facilitators, satisfaction/frustration of basic psychological needs, motivation, dealing with and accepting of disease and limitations, and goal setting	-How did you experience the rehabilitation program? -How were you prepared for managing your lifestyle at home after rehabilitation by health care professionals? -How did the first weeks at home go? -How are things going now? -Do you feel capable of engaging in an active lifestyle? -Did you experience support from other people? -What makes it difficult or easier to be physically active? -What motivates you to stay physically active? -What guidance or facilities do you wish for at this moment to aid behavior maintenance?

Table 2
Minimal Clinically Important Differences Used for Categorization as Responder or Nonresponder

Measurement Variable	Measurement Method or Questionnaire	MCID
Exercise capacity	CWRT at 75% of peak work rate	100 seconds[33]
HRQoL	SF-36	5 points[34]
Self-management ability	SMAS-30/version 2	0.5 SD = 5.79 points*

CWRT, Constant Work Rate Test; HRQoL, health-related quality of life; MCID, Minimal Clinically Important Difference; SF-36, Short-Form health survey; SMAS, Self-Management Ability Scale.

*The SD was determined from a larger sample of patients from the NUTRAIN study.

International, Doncaster, Victoria, Australia). After verbatim transcription, the transcripts were coded by using a predeveloped coding system, which was modified and extended during the course of analysis to ensure the best fit to the data. Patterns and irregularities were discerned by further categorizing and counting of responses. Coding was performed by 2 researchers independently and different viewpoints were discussed until agreement was achieved.

Table 3
Demographic Characteristics of the Study Population, Measured at Start of Rehabilitation Unless Otherwise Defined

	Patients With COPD, n = 22
Gender	
Male, n (%)	14 (63.6)
Female, n (%)	8 (36.4)
Age, y, at date of interview	
Mean (SD)	63.5 (7.8)
Range	45–78
Educational level*	
Low, n (%)	11 (50.0)
Medium, n (%)	8 (36.4)
High, n (%)	3 (13.6)
Marital status	
Married or living together with a partner, n (%)	17 (77.3)
Divorced/living separately, n (%)	1 (4.5)
Widow/widower, n (%)	2 (9.1)
Single, n (%)	2 (9.1)
No. of years since being diagnosed with COPD	
Mean (SD)	5.0 (3.9)
Range	0–13
No. of times participated in pulmonary rehabilitation program	
First rehabilitation	17 (77.3)
1 previous rehabilitation	5 (22.7)
Pulmonary function: FEV_1, %pred.	
Mean (SD)	52.5 (14.4)
Range	25–90
GOLD classification of COPD	
GOLD grade I, n (%)	1 (4.5)
GOLD grade II, n (%)	12 (54.5)
GOLD grade III, n (%)	7 (31.8)
GOLD grade IV, n (%)	2 (9.1)
BMI (kg/m^2)	
Mean (SD)	22.7 (2.1)
Range	18.9–26.9
FFMI (kg/m^2)	
Mean (SD)	16.3 (1.5)
Range	14.3–18.4
MRC dyspnea scale[18] (12 months after start of rehabilitation)†	
Mean (SD)	2.9 (1.3)
Range	1–5

BMI, body mass index (kg/m^2); COPD, chronic obstructive pulmonary disease; FEV_1, forced expiratory volume in the first second; FFMI, Fat Free Mass Index; GOLD, Global Initiative for Chronic Obstructive Pulmonary Disease; MRC, Medical Research Council; %pred, percent predicted.

*Low educational level = no education, primary or lower vocational education; Medium educational level = secondary education, secondary vocational education; High educational level = higher professional education or university.

†On a 1–5 scale; a higher score represents a higher experience of dyspnea.

Ethical Considerations

The study was part of the larger NUTRAIN trial. The clinical trial was approved by the Medical Ethics Committee of the University Hospital Maastricht and Maastricht University (File no. 11-3-004). Participants were informed that all information they provided would be treated confidentially and would only be used anonymously for research purposes. All participants provided written informed consent to take part in the study.

Results

Out of 22 interviewees, 14 were men and ages ranged from 45 to 78 years. Most patients were categorized as Global Initiative for Chronic Obstructive Lung Disease grade 2 (54.5%). The mean (SD) forced expiratory volume in the first second (FEV_1) was 52.5% (14.4%) of the predicted value for a person of similar height, weight, and age (Table 3). Dividing patients based on the MCIDs yielded a group of 15 responders and 7 nonresponders. The mean values of each variable, as well as the average activity count per day from accelerometry, can be found in Table 4 for both groups separately. The results were significantly higher for responders than for nonresponders on the SF-36 ($P = .002$) and the SMAS-30 ($P = .012$), but not for exercise capacity ($P = .360$). The results for accelerometry (physical activity level) tended toward significance ($P = .092$).

At the time of the interview, patients engaged in several different forms of activity. Most patients visited physiotherapy 2 to 3 times a week, often in addition to walking, cycling, swimming, or visiting a gym. Some patients received physiotherapy in a group, whereas others received it individually. Furthermore, patients performed household tasks, such as vacuum cleaning, window cleaning, grocery shopping, and gardening, although not all patients were still capable of performing these tasks.

The text that follows is the result of qualitative content analysis. The words printed in italics are sentences or expressions as pronounced by the participants. The references to quotations in the following text consist of a letter followed by a number. The letter indicates by whom the quotation was expressed (R = responder; NR = nonresponder), with the first number indicating the participant number and the second number being a serial number (Table 5). The structure of the text is based on the main attributes of SDT, reflecting

Table 4
Variables Used in the Responder/Nonresponder Analysis, Measured at 12 Months After Start of Rehabilitation

	Responders, n = 15	Nonresponders, n = 7	P
Exercise capacity, s; CWRT at 75% of peak work rate			
Mean (SD)	510.1 (405.1)	329.5 (186.8)	.360
Range	136–1200	159–681	
SF-36*[,19]			
Mean (SD)	60.0 (15.4)	39.1 (9.5)	.002
Range	42–85	25–50	
SMAS-30/version 2†[,20]			
Mean (SD)	64.0 (9.1)	55.0 (7.64)	.012
Range	45–80	40–65	
Accelerometry, average activity count per day; Actigraph			
Mean (SD)	149,244.3 (83,863.3)	96,647.6 (37,115.2)	.092
Range	38,761.6–348,378.2	41,275.0–131,537.6	

CWRT, Constant Work Rate Test; SF-36, Short Form (36) health survey; SMAS-30, Self-Management Ability Scale.

Difference tested using independent samples *t*-test, 2 tailed.

*A higher score reflects lower disability (range 0–100).

†A higher score reflects better management skills (range 0–100).

Table 5
Quotations by Patients

Quotations from responders	
R1.1	I can’t cycle on a normal bicycle anymore. I’ve used this [electronic bicycle] for the past 5 years.
R1.2	[The most important motivation to exercise is] to gain condition, and for my lungs. To maintain this because you notice that when you’ve been ill for a few weeks and didn’t work out, your condition decreases.
R1.3	I think it’s important to have a connection with someone. To get to trust each other.
R1.4	I got a lot of support from my partner. And if it wasn’t him, it would be my children.
R1.5	If my husband wouldn’t have been here, I would’ve needed help at home because I couldn’t manage alone. He also stimulates me to exercise. And when I’m doing something, now and then he tells me to sit down and take a rest.
R1.6	I think it would be easier when the disease was visible. Most people say: “But you’re looking good…” But they don’t know that when you work or walk, breathing is difficult. People don’t understand. […] They know I’m ill but they don’t understand.
R1.7	When we get the chance we go for a walk every day, and we go cycling when the weather is good.
R1.8	[I need the physiotherapy as a motivation] because without this as a big stick, when I have to do 3 series of 8 exercises, after 2 series I think “that’s enough for now.”
R1.9	I’m in contact with the pulmonary nurse regularly. When there’s something wrong I can always telephone or send an e-mail. So that’s nice too.
R1.10	We created a group of fellow sufferers, with patients and pulmonary nurses. We have activities like barbecues together, and also lectures that are very interesting. And you can talk to other patients, “Do you feel breathless as well, do you feel this or that?”
R1.11	The group at physiotherapy is also nice. I think that’s important because when others aren’t nice, it isn’t nice for me either; you have to be able to joke a little. I like a group better than individually, but it has to be the same group, not different people all the time.
R2.1	[I can’t meet my friends often because of the snow]. Imagine losing all social contacts and feeling isolated. I’m basically a hermit now and that’s not my nature at all.
R2.2	My most important motivation is increasing the chances of survival. Or what you want to call it, fighting deterioration.
R2.3	[It is motivating to see improvement in measurements.] But you don’t expect to improve when you’re not in rehabilitation anymore. You shouldn’t expect that when you’re at home exercising 4 times a week for an hour. I’m happy maintaining it.
R2.4	I didn’t experience support, but I felt well at the time. […] During rehabilitation I managed everything myself.
R2.5	I really enjoyed exercising in groups during rehabilitation. And to be around people as well.
R2.6	I experienced some unresolved grief from my divorce during rehabilitation. I had some personal conversations with my physiotherapist and she noticed something was up as well.
R2.7	I would feel guilty toward myself if I wouldn’t [exercise] anymore.
R2.8	It really comes from within you.
R3.1	I don’t exercise if I don’t have to; I need a big stick so I go to the physiotherapy twice a week to exercise. That’s under supervision, more or less the same as we did at the rehabilitation. […] I don’t think things would have gone as well [without this guidance]. I’m not sure but I don’t think so.
R3.2	Some days I think “damn, I really don’t want to go” but I said I would so I go. I don’t have a reason not to go and not wanting to is not a reason. So I go anyway and when I’m finished I’m glad I have.
R3.3	No, [I don’t avoid things that make me short of breath] but I do things at a slower pace.
R3.4	I don’t know whether I can maintain [the exercising] but this motto: “If you can’t do it as you should, then you should just do it as you can.” I stick to that.
R4.1	Rehabilitation went well. It was hard at times, but generally it went quite well.
R4.2	First I didn’t exercise at all and now I have to exercise every day and that’s quite hard. Because I work full-time, I’m home at 5 PM, have to cook, clean, and then exercise. That’s not easy. But I still do it every day.
R4.3	I insist that I exercise every day. That’s just a sense of discipline.
R4.4	When I don’t feel well or days that I have a headache or other things, I think “Ah, do I have to exercise again?” Sometimes it gets too much.
R4.5	You can go outside in the winter, with this cold, but things are even harder because it’s cold and you tighten your body and that hurts your muscles and joints. Everything gets stuck. Then it’s good to have exercise equipment at home.
R4.6	I must keep on exercising because otherwise I won’t be able to do as much as I want to. I want to be able to do things at home.
R4.7	When I do my exercises well, I don’t get infections as quickly either. First I was sick often and now my immune system works much better because of the exercising. That stimulates a lot.
R4.8	They’ll have to accept that I can’t walk that quickly; they’ll have to adapt.
R4.9	At first my husband supported me a lot to really do the exercises but now I do it by myself. Sometimes when I don’t want to, he says that I should do it because otherwise I won’t do it anymore in the future. Nowadays he doesn’t have to say this anymore, I do it by myself.
R4.10	I keep in touch with one other patient from rehabilitation, but apart from that I don’t see others anymore.
R5.1	It’s getting busier at work now [so it’s harder to exercise enough]. That’s why the boss says that I have to go to physiotherapy on Monday and Friday, no matter what. If this wasn’t possible, you get home in the evening, really tired and you don’t want to go anymore.
R5.2	With aerobic exercise training, resistance training, and walking you’re able to stabilize the decline.
R5.3	In the winter it’s always hard to [exercise].
R5.4	I’m sure that exercise and physiotherapy does the same: it makes me feel better because you exercise more. Although I didn’t expect it to be such a difference.
R5.5	The whole family supported me. They would grab my laptop bag for me and took care of my pigeons.
R5.6	They know I can no longer do everything, and they accept it and are happy when you come at all.
R5.7	I do most of it myself. My wife tells me: “stop moaning and do it yourself.” She’s really easy with that.
R5.8	You meet other people who also have trouble with their lungs. You start to talk to them because they have the same issues as you do.
R5.9	Because you’re in a group, it’s nice to be able to work together in little groups.
R5.10	It is nicer when you’re with more people who also have a lung problem.
R5.11	I [exercise] with pleasure.
R5.12	I enjoy doing [physiotherapy] when it’s during working hours. If it would be in the evening after work, it would be a different story.
R5.13	That’s self-discipline. I must do this, I do it for myself.
R5.14	You have to be able to motivate yourself.
R6.1	Maintaining [my exercise routine] is getting more difficult. It’s becoming a rut.
R6.2	I’m 100% sure I’m able to pick it up again, because I recently managed to do so.
R6.3	It needed getting used to, that’s all.
R6.4	I expect to fall back into my fatigue. I’m tired now as well, but that’s from exercising. That’s a different kind of tiredness from what I used to feel.
R6.5	I realize that it won’t get any better than the level I’m at now. I exercise to maintain this and to avoid it declining. I don’t expect an improvement.
R6.6	With regard to exercise I know really well what I should do. [I received enough information during rehabilitation to do this by myself.]
R6.7	I had my own motivation […] There was no one telling me I should do this or that. They supported me but I didn’t need it as a big stick because I had enough motivation.
R6.8	I didn’t have help at home or in transportation. I managed pretty well; I’m still young for a COPD patient.
R6.9	I enjoy the social aspects of it. At a gym I work for myself. At the physiotherapy as well of course, but it’s easier to have a little fun there because others know what’s wrong with you and you know what’s wrong with them. You don’t have that at the gym.

(*continued on next page*)

Table 5 (*continued*)

R7.1	We've been to Prague before but you have to walk all day. I wouldn't do that anymore because I can't do it.
R7.2	I've never had a relapse so I'm not really sure what to expect.
R7.3	It just needed some getting used to. At first it was hard.
R7.4	We cycle together. I use the electric bicycle and my partner uses the normal one.
R7.5	In the summer we cycle a lot, but in the winter it just doesn't happen.
R7.6	Well, the main issue is my health. That I can keep what I have left as long as I can. That's the main issue and it stimulates me a lot.
R7.7	I expect to fall back slowly; to the level I had before rehabilitation. I think you just need [to exercise].
R7.8	My loved ones were supporting me a lot during rehabilitation and they still support me 100%.
R7.9	I learned a lot from the nurses, but it wasn't really support.
R7.10	I'll tell others why I'm not coming. And they understand.
R7.11	My partner has told me many times before to start doing more. But the starting is so difficult.
R7.12	I got the most support from my husband. It recurs on a daily basis.
R7.13	You get to know these people after a while and that makes a difference.
R7.14	Well… What's support? That's just normal, I don't know. They know me, they know what I'm like and they think it's normal too. I don't need much support.
R7.15	If I can manage without [oxygen], then I don't want to use it. […] Stopping using oxygen is something I pushed for myself. I didn't want to exercise with oxygen forever.
R7.16	It is too cold [to cycle or walk in the winter] and I just don't want to. I would exercise less [without the physiotherapy routine].
R7.17	I'll be a grandmother this year so I want to enjoy it. So that I maintain what I have left.
R7.18	I realized that exercising is something that's good for me. You grow into this.
R8.1	[Exercising is only more difficult] when it rains a lot. But I enjoy exercising, it makes me feel good. The cycling not so much, I do that because I have to, but the walking… I enjoy walking a lot. I don't need motivation to do that.
R8.2	Usually I'm not limited. Only when doing extreme things, like carrying things upstairs to the bathroom my husband was building, I'll get tired a little more quickly than others. But others get tired as well, only I reach that threshold quicker. And then I just wait a little and rest.
R8.3	I have always enjoyed [exercising]. Only the cycling I don't really enjoy, especially in the winter. But I realize now that particularly cycling means a lot to my physical condition and it would've been worse if I hadn't cycled. Sometimes I just want to get off the bike when it's windy, but I just keep on going. It's training.
R8.4	I don't need support, not with regard to exercise. I have enough motivation; I want to reach 120 years as well.
R8.5	[I'll recover by myself after relapse] because I have to get back on my bike [to go to work]. […] I don't have a choice, I must cycle.
R8.6	The best thing for me would be a mini-program, like we had in rehabilitation. Not just at a physiotherapist but more aimed at what we have built up at physiotherapy. […] I don't mind how provides it, but it needs to fit the rehabilitation better. And maybe twice a week, longer and in a group which will keep the costs a bit lower.
R9.1	I don't know whether I'd be able to get over a relapse.
R9.2	You get used to [having to exercise that much during rehabilitation].
R9.3	Monday and Wednesday I have to go to physiotherapy, but when I have to work on Monday and Tuesday I can just put the Monday therapy to the Friday. I'm able to shift it.
R9.4	[I exercise] to make sure that my lung muscles stay the same and I don't decline.
R9.5	You can just go [to the gym]. You can just do the exercises I'm doing now. Just do the same and try to increase a little.
R9.6	I bought a pulse-oximeter myself now, so I can measure myself now.
R9.7	They show their support, but they don't need to stimulate me.
R9.8	The maintenance of the house and administration are my jobs. My wife does the housekeeping.
R9.9	My wife didn't exercise so she comes along [to the physiotherapy] on Mondays now.
R9.10	When there's something you need to do to stay healthy I think that's something you should just do. Otherwise there is no point in going to a physician or someone else. I'll just do it.
R9.11	To me it was motivating to see [people who are in a worse state]. To think well, that's not what I want. You'll have to walk around with a walking frame and this oxygen thing. That's very limiting I think.
R9.12	It's something that must happen, right? And up until now I manage to keep it constant. I just do it.
R9.13	It is very important to get along well with your physiotherapist. If you don't, it won't work. Then it's demotivating. But that's the same with a physician or health care worker.
R10.1	I didn't like Monday mornings, when we had to play with a ball or overthrow cones. […] All those childish games, no, I didn't like that.
R10.2	I did the games when I could, but otherwise I stopped. I physically couldn't do it. It feels like there's something stuck [in my chest].
R10.3	I'm having trouble with my thumb, it doesn't work.
R10.4	When I see a bench, I sit down, even if it's only for 5 minutes.
R10.5	[I use my walking stick] when I go for a walk, when worst comes to worst.
R10.6	There's always a day that things don't go too well. It depends on the weather.
R10.7	Moving is for your health as well. Just keep going.
R10.8	No, I didn't have support from others. I'm usually on my own.
R10.9	I think exercising is great!
R10.10	[It was] no problem [to keep exercising because someone had told me to do so].
R11.1	I know enough [to start again after having quit for 6 months due to my rheumatism].
R11.2	I often can't go due to my rheumatism.
R11.3	I think I'll get really weak and my strength will decrease. And my airways will decrease as well I think.
R11.4	The energy you get from exercising. Because, well, the training is only 2 times a week for 1 hour, but you notice the difference.
R11.5	My husband supports me a lot with everything. As do other people.
R11.6	My husband's mother had asthma so he knows what it's like.
R11.7	You get to know people as well, I like it.
R11.8	There are a lot of people there that ask whether you are okay when you come off your bicycle and you need a rest. I like it there.
R11.9	I exercise because someone told me it's good for me] but I also do it for myself.
R11.10	I try to [maintain it]. I have a lot to look forward to. Four grandchildren, which makes me want to work.
R12.1	I had surgery on my shoulder and training properly isn't really possible. That's annoying […] and it does limit you.
R12.2	[My main motivation to keep exercising] is to be able to do things. Because when you stop exercising things will go worse and you'll have to stay at home. My wife and I enjoy going to outdoor festivals and you want to be able to continue that. […] So that's why I exercise. Though I would like to be able to do more in the garden as well.
R12.3	I would love to work in the garden, but with the weather being like this [that's difficult].
R12.4	[If I wouldn't exercise anymore] my physical condition will decrease, I'll be able to do less.
R12.5	[I would like] more facilities for lung patients, for exercising. Better organized, because there is guidance where I go but it's too little. At rehabilitation we were with 10 patients and 2 supervisors who were always with you.

(*continued on next page*)

Table 5 (*continued*)

R13.1	I think I can maintain my current level if nothing intervenes. What I worry about is getting a cold.
R13.2	In the gym you pay for going 4 to 5 times a week, while you work 3 days a week [and can't go to the gym]. I wouldn't do that. Now you could say it's wrong to do so, but you have to be able to afford it.
R13.3	I decided by myself to walk more. It wasn't like someone had to stimulate me.
R13.4	They're looking at you, "How is it possible he can't play sports? You can't see anything about the guy." Those are the things; people need a year to accept you like this, because you used to be different.
R13.5	Now my wife has to carry the shopping bags up the stairs.
R13.6	The whole family supported me.
R13.7	You get a connection with the other patients; you're all in the same boat.
R13.8	There's one fellow patient who lives close by that I still have a connection with.
R13.9	What can you do, what can the other person do? And you take that into account.
R13.10	I'm happy now to be able to retire next year and do things with the grandchildren. But I can't do everything I wanted to do. I can't do football.
R14.1	What's motivation? You just want to keep going; you want to return to where you were before. That's natural. Right, I know it's not possible [to reach that] but I'd rather live well for 5 years than poorly for 10 years. And that's motivation to do things. […] So the primary motivation is to be able to have fun.
R14.2	[If you wouldn't exercise] you would be in a worse state. Your physical condition, endurance, time of recovery all decreases…
R14.3	You shouldn't fool yourself. When you agree to do 3 series of 10 exercises, you should do that. […] And don't say I'll only do 3 series of 8. You fool yourself but you don't get to know your limits either. […] You just have the proof that by doing the exercises you're pushing your limits to a higher level.
R14.4	[Reaching my limits] is what I wanted myself because I used to exercise when I was young. […] Keep on pushing your limits. […] I want more and more in weights, walking faster and longer distances. That just remains.
R14.5	I hope [to maintain this exercising]. If it were up to me, that is. [I may not manage] if I get another lung infection. All right, you just get yourself together and start rebuilding. Try to at least.
R14.6	I didn't want to accept [the diagnosis] at first. Now I more or less do. But you still run in to little things. That you hear or see negative things. […] Maybe those people experienced something. Like when I had an appointment at the hospital, I saw this man in a wheelchair with an IV and a big bottle of oxygen. He had put the bottle aside and was smoking a cigarette. That's not a positive image and probably those other people have seen negative things like this and take that with them.
R14.7	You don't [deal with your disease] by yourself. You do that with everyone around you, with people guiding you. Especially your partner, in my case my wife.
R14.8	I received a lot of support [from people around me]. Mostly them, those closest to me, they were dealing with it in a really positive way. They just considered it normal.
R15.1	I tried to postpone it as much as possible but recently I applied for a mobility scooter. So at least I can travel a little farther. I can travel [to the shops] now, but you always need a car and you then have trouble parking.
R15.2	To be honest, I just don't have the energy anymore to exercise.
R15.3	I try to do as many things as possible, but I have too little energy and breath nowadays. It depends on the weather a lot. Some days I feel fine, like 2 weeks ago when we went to Germany and I walked all afternoon, which went well. And some days I want to bring out the rubbish and I can hardly do it.
R15.4	[My main motivation to keep going is] that you notice your physical condition getting better and that you bond with other people.
R15.5	Of course it's not nice to [use a mobility scooter]. The worst thing is, people can't see what's wrong with us. So they can easily think we're exaggerating. Those who know what [COPD] means, respond to me in a different manner. It is possible to explain it.
R15.6	I tried to keep up as long as possible, at work as well. They tried all sorts of things to spare me but I just couldn't manage anymore.
R15.7	I really enjoyed attending rehabilitation at the hospital here. Being together with other patients and everyone knows what's wrong with the other. That was nice. And there was a little sense of competition as well. It was a very free atmosphere and I miss that in gyms. If I could start rehabilitation again tomorrow, I would.
R15.8	We got exercises for our intercostal muscles and I try to maintain doing them as good as possible at home. I have a list of them here. […] I must say, you notice it's good for you. When you skip a week, you know it.
Quotations from nonresponders	
NR1.1	I think I can [exercise enough by myself when the weather changes for the better].
NR1.2	The winter has put me down on this couch. […] [I can't go out to the supermarket] due to the cold. [In the summer] I can.
NR1.3	Now I'm happy I've bought an electric bicycle. It's a lot easier to cycle.
NR1.4	I always just stop [to take a rest]. Recover a little.
NR1.5	If the weather would've been good, you would've cycled more.
NR1.6	People in my environment didn't play a big role for me.
NR1.7	My son just walks slower if I can't keep up.
NR1.8	One woman from the rehabilitation group lives close by. I've been to visit her before.
NR1.9	There's not much wrong with me, so I managed pretty well. Just the issue that my knee always hurts.
NR1.10	I've been at the inpatient pulmonary rehabilitation center and this really motivated me; when you see these people walking around with oxygen bottles and walking frames. That gave me the strength to take measures.
NR1.11	And my grandson, that motivates me as well. I want to do a lot of things with him.
NR2.1	If nothing changes legally, I'm quitting everything.
NR2.2	Some days you use the weights [at home], like you learned at the trainings.
NR2.3	I've searched the Internet as well for different training schedules.
NR2.4	I get a lot of support from my partner and son. That's all really good.
NR2.5	And [during the rehabilitation] it was a lot of fun with others as well.
NR2.6	I won't give up exercising quickly because I enjoy it so much.
NR3.1	There hasn't been a moment that I thought, "O God, I have to use a walking frame now." I was happy enough that the physiotherapist came and said, go walk in the corridor. […] It's a great thing. When I'm tired I just sit down.
NR3.2	I have to use a taxi to go to physiotherapy because I don't cycle or drive my scooter because of my illness.
NR3.3	As soon as you hand over control to me, [things go wrong]. I need structure.
NR3.4	[The main reason for exercising] is that things will function better in your body.
NR3.5	[If I wouldn't exercise anymore] life is over. If you just sit down, nothing will happen […] and you create your own death. […] But I don't even think about that, the motivation [to keep exercising] is right within me.
NR3.6	I never thought about [not being able to do things anymore]. […] As long as I can do things at my own pace, it's all right.
NR3.7	I don't know [if I can maintain this exercise habit]. That depends on what will happen around me.
NR4.1	[Exercising is difficult] when I feel short of breath. I do very little then. And if I need to go to physiotherapy, I tell him and he adjusts the exercises.
NR4.2	Right now it's too cold so I won't go by foot anyway.
NR4.3	In the summer I try to take the bicycle. […] We're basically good-weather cyclists.
NR4.4	If we manage 25 kilometers, we cycle 25 kilometers. If it's 40, then it's 40.

(*continued on next page*)

Table 5 (*continued*)

NR4.5	I [exercise] for my health and to be able to do things. I've seen people sitting in wheelchairs or walking with crutches. I don't want that yet so my health is more of an issue to me.
NR4.6	[If I wouldn't exercise] I wouldn't be what I'm now. I'd be sitting in this chair puffing. I wouldn't be able to do things. But because I go to physiotherapy every week I profit from it.
NR4.7	[I exercise] to stay healthy.
NR4.8	If I can't do it, we'll find a solution. Phone our daughter or the neighbor. They're here for me straight away.
NR4.9	When we go visit other people they open the doors and smoke on the balcony. I've told them as well; otherwise I just won't come over.
NR4.10	We walk together and now that the weather is getting better again we'll cycle when we get the chance.
NR4.11	What do you mean, support? We don't need support; we know each other through and through. It's a natural thing.
NR4.12	A good group is important. And I'm still in touch with people from rehabilitation. We phone on a regular basis and they also still go to physiotherapy.
NR4.13	At physiotherapy with other COPD patients, you can always talk about what happens to you as a COPD patient. And there was one guy who wanted to do things but couldn't. We, as a group, stimulated this guy.
NR4.14	We had a good instructor, which makes a difference too.
NR4.15	My physiotherapist is a good person to work with. And that's what you need, otherwise it won't work.
NR4.16	If you don't have a nice group, I would have quit a long time ago. Or I'd want to go to a different group.
NR4.17	[We cycle with a group of friends]. It's a nice group. We go for the fun of it, we don't have to.
NR4.18	I do it for myself. As I said, not for my wife because she's more capable of doing things than I am. I do it for my own health; so that I can do things as well. I'll be 72 and I want to be able to do things at my age.
NR5.1	The supermarket is really close but I have to use the car or walking frame, otherwise I won't make it. When I use the walking frame, I stop in between and I sit down on it to rest.
NR5.2	Certain things I couldn't do because I have dystrophy [in my arm. This was very limiting.]
NR5.3	Rainy weather, the cold, oh, horrible! [...] Especially the wind. The cold is not too bad but the wind that comes with it; I can't breathe then.
NR5.4	I won't get off the couch anymore.
NR5.5	My daughters clean the windows, so I don't have to. My husband carries the heavy things.
NR5.6	I didn't get much emotional support, but I didn't experience problems emotionally either.
NR5.7	Last week the occupational therapist came to explain how I'm supposed to do things.
NR5.8	I lost my friends because of my disease.
NR5.9	One should have a goal. I want to be able to do things. I want to go for a walk with my grandchild later as well.
NR6.1	We do it our own way nowadays. If not today, we'll do it tomorrow.
NR6.2	[Despite fluctuations in my health] I would like to keep going. If I don't, things might get even worse.
NR6.3	I really look forward to [exercising]!
NR6.4	I like what I'm doing now. Two times per week [physiotherapy]. I get to meet people who have the same issues as me. You get the chance to talk about that sort of thing.
NR7.1	I just go. I grab my mobility scooter and go to the physiotherapy.
NR7.2	Usually I use a walking frame. When I walk the street and I'm tired, I put the thing on the side of the street and sit down for a while.
NR7.3	When there's a lot of snow [it is hard to exercise]. But rain is not good for lung patients either. [...]And cycling, that's too cold for me. [...] No wind, as long as there's no wind. It's too heavy for my legs [to cycle].
NR7.4	There are set times for therapy at the practice I go to, so I don't need to be stimulated to go.
NR7.5	When we get tired, we sit down. We just adapt, otherwise you'll become a hermit having to stay at home all day.
NR7.6	People don't believe that the weather is such an influence, but it is!
NR7.7	When I said to my son I quit smoking, he said: "Clear the ashtrays, no more smoking inside." Now he smokes outside.
NR7.8	No one smokes inside, everyone goes outside. And when people can't smoke inside anymore, they won't visit.
NR7.9	We're still in touch but don't exercise together because everybody lives in different places. We telephone and get together for birthdays or so.
NR7.10	I must keep on exercising, if I don't, I'll feel the consequences. I'll have a relapse because my condition will decrease.
NR7.11	We had a lot of fun and that's most important.
NR7.12	[When physiotherapy would've been farther away this would not be a barrier.] It just has to happen. It's something you do for yourself. Not for the physiotherapist, for me.

the basic needs (ie, competence, relatedness, autonomy) and motivational regulation.

Competence

Both pulmonary problems [R10.1, R15.2, NR3.2, NR4.1] and comorbidities [R4.4, R10.3, R11.2, R12.1, NR1.9, NR5.2] may limit patients in their ability to exercise and perform activities of daily living. To deal with limitations, patients mentioned to perform activities at their *own pace* [R3.3, R8.2, R10.4, NR1.4, NR3.6, NR4.4, NR5.1, NR6.1] or make use of devices such as an electric bicycle or a mobility scooter [R7.4, R10.5, R15.1, NR1.3, NR3.1, NR5.1, NR7.1, NR7.2]. However, as a result of their limitations, several patients mentioned being *unable to walk to the shops* [R15.1, NR5.1], *cycle* [R1.1], or *go on holidays* [R7.1] and also mostly avoided attempting the behavior. Seemingly in contrast, many patients felt confident at exercising, and responders expressed that, although at first they *needed to get used to exercising* or found it *hard,* they indicated that it *got better* after these initial difficulties [R4.1, R6.3, R7.3, R9.2]. Mostly responders indicated that they are *confident to be able to recover by themselves* after relapse or to maintain their exercise behavior [R6.2, R8.5, R11.1, R13.1, R14.5, NR1.1] but this was not true for all patients [R3.4, R6.1, R7.2, R9.1, R13.1, NR2.1, NR3.7].

Relatedness

Patients expressed they experience a sense of relatedness, or absence thereof, during exercise. Several patients expressed they exercise with their partner, family, or friends [R1.7, R7.4, R9.9, NR4.10]. Activities were walking, cycling, or attending a gym or physiotherapy together and they indicated they enjoy the company [R9.9, NR4.17]. During rehabilitation and often at physiotherapy, patients exercise in a group. They indicated this to be *favorable and motivating to keep exercising* [R1.11, R2.5, R5.9, R6.9, R7.13, R8.6, R11.7, R15.4, NR2.5, NR4.16, NR7.11]. They *stimulate* and *help* each other and *understand each other's limitations* [R5.10, R6.9, R11.8, R13.7, R15.7, NR4.13, NR6.4]. Many patients indicated that health care providers have also taught, helped, and stimulated them [R1.9, R2.6, R7.9, NR4.14, NR5.7] but that it is a *prerequisite that there is a bond between them and the health care provider* [R1.3, R9.13, NR4.15].

Besides social support during or with regard to exercise, patients experienced a lot of understanding toward their limitations from other people close to them, such as their partner, family, and friends, as well as other people with limitations [R4.8, R5.6, R7.10, R11.6, R13.9, NR1.7, NR4.8, NR7.5, NR7.7]. For patients who were married or living together with a partner, the primary source of support came from their partner [R1.4, R11.5, R14.7, NR2.4, NR4.11], for example by *helping taking care of housework and shopping* [R1.5, R7.12, R9.8, R13.5, NR5.5] or *stimulating to exercise or do other activities* [R1.5, R4.9, R5.7, R7.11]. Family and friends offered support as well [R1.4, R7.8, R13.6, R14.8, NR2.4] and they helped *in and around the home* [R5.5, NR5.5] or they would *not smoke in presence of the patient* [NR4.9]. However, some friendships have also ended as a result of the patient's illness [NR5.8, NR7.8] and patients mentioned that there is a lack of understanding in others [R1.6, R13.4, R14.6, R15.5, NR7.6]. Several patients *still meet or telephone with other patients* [R1.10, R4.10, R13.8, NR1.8, NR4.12, NR7.9] who they met during rehabilitation and they can talk about the problems they all encounter [R1.10, R5.8]. Finally, whereas most patients really valued and needed the support they received, particularly responders indicated that although their partner, family, or friends support them or are there for them, they do not experience or need social support, as they *did not experience any problems* [R2.4, R6.8, R7.14, R9.7, R10.8, R13.3, NR1.6, NR5.6].

Autonomy

Rehabilitation is strongly regulated with preplanned activities at set times. After pulmonary rehabilitation, many patients followed physiotherapy programs that stimulated them to exercise [R1.8, R3.1, NR7.4]. However, several patients also indicated that they wished physiotherapy would resemble rehabilitation more [R8.6, R12.5, R15.7]. To some, it is an autonomous decision to hand over control [NR3.3], but many patients said they know well what they should do with regard to exercising and chose to exercise without guidance or regulation [R6.6, R9.5, R9.6, R15.8, NR2.2, NR2.3].

For some patients, their autonomy is compromised by barriers they experience, particularly the weather. However, whereas *cold, humid, and windy weather* makes it harder to be physically active outdoors [R2.1, R4.5, R5.3, R7.5, R8.1, R10.6, R12.3, NR1.2, NR4.2, NR5.3, R15.3, NR7.3], good weather conditions can also facilitate exercise for patients [R7.5, NR1.5, NR4.3]. Furthermore, maintaining a regular exercise routine while working full-time is considered *difficult* [R4.2, R5.12, R13.2, R15.6], although this depends on the flexibility of the employer and physiotherapist [R5.1, R9.3].

Motivational Regulation

Autonomous motivation

Most patients expressed experiencing autonomous motivation. Particularly responders said they were able to *motivate themselves* [R2.8, R4.9, R5.14, R6.7, R8.4, R13.3, R14.4, NR3.5] and to exercise *for themselves, not for someone else* [R5.13, R11.9, R14.3, NR4.18, NR7.12]. Intrinsic motivation can be seen from patients who expressed to *like exercising* [R5.11, R8.1, R10.9, NR2.6, NR6.3]. Identified regulation was observed predominantly in responders. For example, by maintaining an active lifestyle, patients expect or want to *gain or maintain health, fitness, and strength* [R1.2, R2.3, R4.7, R5.2, R6.5, R7.6, R8.3, R9.4, R10.7, R11.3, R12.4, R14.1, R14.2, R15.4, NR4.7, NR6.2, NR7.10]; *to increase their chances of survival* [R2.2, NR3.5]; to have *more energy, capacity, or feel better* [R4.6, R5.4, R6.4, R7.7, R11.4, R12.2, NR3.4, NR4.6]; and to *not need a wheelchair, crutches, or oxygen* [R7.15, R9.11, NR1.10, NR4.5, NR5.4]. Several also indicated that they feel a strong motivation to keep exercising to *be able to do things with their grandchildren*, now or in the future [R7.17, R11.10, R13.10, NR1.11, NR5.9]. Integrated regulation was not expressed by patients.

Controlled motivation

Controlled motivation was observed exclusively in responders. Introjected regulation was expressed by only one patient, who mentioned he would *feel guilty toward himself if he would not exercise* [R2.7]. External regulation was observed in patients who felt that *exercising just has to happen* [R3.2, R4.3, R7.18, R9.12] and because *someone had told them to exercise* [R9.10, R10.10, R11.9]. To several patients, physiotherapy served as *a big stick* to exercise enough [R1.8, R7.16].

Amotivation

Finally, one nonresponder expressed feeling no motivation to maintain a healthy lifestyle because of great financial and legal issues [NR2.1].

Discussion

This study explored determinants that may be important for maintenance of lifestyle changes in patients with COPD after pulmonary rehabilitation. A feeling of perceived competence to be physically active, as well as exercising with fellow patients, seemed to facilitate exercise. Furthermore, a certain threshold level of controlled motivation in addition to autonomous motivation seemed to promote exercise adherence.

Confidence to Perform Activities of Daily Living

Although in general patients felt confident to exercise, which particularly grew during rehabilitation, and to recover after relapse, many were not able to perform activities of daily living to their satisfaction. Therefore, professional guidance in increasing confidence to be physically active in other settings may have great potential to enable patients to do their own shopping, transportation, or maintaining social contacts. Being able to perform activities of daily living is an important component of HRQoL,[22] which in itself is a focus point of pulmonary rehabilitation[7]. Facilitating devices, such as an electric bicycle or mobility scooter, may support the performance of activities of daily living.

Feeling of Understanding

Most patients experience support from their partner, family, and friends, with some mentioning that this was very important to them. However, mainly responders also indicated that "other people," such as their partner, friends, their boss, or strangers, do not understand their disease and the limitations they themselves experience. This feeling of lack of understanding from others may jeopardize the feeling of relatedness. In contrast, patients enjoyed exercising with other patients, as they were all in a similar situation so they understand what the other person is going through and could bond. Moreover, exercising in a group stimulated exercising for many patients, and they indicated a wish to be able to continue exercising in a (COPD) group as they did during rehabilitation. Unfortunately, to many patients this was not available, and they received physiotherapy on an individual basis. Also, comparable to findings from Hogg et al,[14] attending a gym was not considered an option by most, because of higher costs and because of having to exercise along with fit and healthy people. Organization of training groups for patients is recommended to facilitate maintenance of an exercise routine.

Controlled Motivation in Addition to Autonomous Motivation

The current study revealed that particularly responders experienced autonomous types of motivation. Meis et al[13] found that during pulmonary rehabilitation many patients' motivation shifted from a more controlled motivation to a more autonomous motivation and that the patients had started to like exercising. It is a positive finding that this autonomous motivation is maintained. The fact that this was observed predominantly in responders highlights its potential importance.

Unexpectedly, only responders experienced controlled types of motivation, in addition to autonomous types of motivation. Although a negative association was found between controlled motivation and mental health in a previous meta-analysis,[23] high levels of controlled motivation may not be detrimental when they co-occur with high levels of autonomous motivation. This so-called high-quantity cluster has been observed previously[24,25] and this group does not appear to do worse than those who experience high autonomous motivation together with low controlled motivation. The effect of a high-quantity cluster may explain the apparent controversy in the current study. It indicates the need to stimulate autonomous motivation in patients, but not necessarily to discourage controlled motivation. A certain threshold level of controlled motivation may be required for patients with a chronic disease.

Future Development and Improvement of Maintenance Interventions

Previous intervention studies have shown that the effect of pulmonary rehabilitation is generally not sustained in the long-term, even when maintenance programs were included.[26–28] This effect may be because of a low compliance rate, as dropout rates were high, at up to 73% in one study.[29] Studies that explored determinants of sustained effect found that lower initial health status and adherence to maintenance programs were significant predictors of sustained effect of pulmonary rehabilitation.[30,31] Taking this together, when designing a maintenance intervention program, one should consider methods to reduce attrition rates to obtain the maximum benefits of maintenance interventions. Based on the findings of the current study, autonomy supportive coaching,[32] possibly in addition to remaining above a certain threshold level of controlled motivation, could play an important role in this.

Methodological Considerations

Several limitations should be considered when interpreting the results. First, a limitation of the methodology is that it could be sensitive to socially desirable answers. However, due to assurance of confidentiality and anonymity, as well as the fact that the patient and the researcher conducting the interview had no previous connection, it is unlikely to have been an issue. Patients of both the intervention group and the control group of the NUTRAIN study have been included in this study. This could be considered a limitation, as the intervention group has undergone a different treatment (ie, additional nutritional supplementation and counseling), but no clear difference was observed in opinions and expressions of patients from both groups during analysis. Finally, although the exploration of the differences between responders and nonresponders yielded some interesting findings, qualitative research is not suited to test differences between groups. However, in the current study, this analysis was done to explore future directions for research, not to determine the significance of a relationship. Therefore, future research may focus on exploring the differences between responders and nonresponders in motivational regulation and satisfaction of the 3 basic psychological needs in a quantitative study design.

Conclusion

The current study has contributed to insights in successful behavior change maintenance after pulmonary rehabilitation. Perceived competence and relatedness may be of great importance in both an exercise setting as well as during activities of daily living. Furthermore, a certain threshold level of controlled motivation, in addition to autonomous motivation, may be important in ensuring the continuous engagement in physical activity by patients with COPD. These findings can be used to optimize effective aftercare programs, based on an individualized approach.

Acknowledgments

This study was financially supported by Nutricia Research and Lung Foundation Netherlands (3.4.09.003).

References

1. Lacasse Y, Martin S, Lasserson T, et al. Meta-analysis of respiratory rehabilitation in chronic obstructive pulmonary disease. A Cochrane systematic review. Eura Medicophys 2007;43:475–485.
2. Costi S, Crisafulli E, Degli Antoni F, et al. Effects of unsupported upper extremity exercise training in patients with COPD. A randomized clinical trial. Chest 2009;136:387–395.
3. Harrison S, Greening N, Williams J, et al. Have we underestimated the efficacy of pulmonary rehabilitation in improving mood? Respir Med 2012;106:838–844.
4. Pitta F, Troosters T, Probst VS, et al. Are patients with COPD more active after pulmonary rehabilitation? Chest 2008;134:273–280.
5. Krall Scherer Y, Schmieder LE. The effect of a pulmonary rehabilitation program on self-efficacy, perception of dyspnea, and physical endurance. Heart Lung 1997;26:15–22.
6. Yoshimi K, Ueki J, Seyama K, et al. Pulmonary rehabilitation program including respiratory conditioning for chronic obstructive pulmonary disease (COPD): Improved hyperinflation and expiratory flow during tidal breathing. J Thorac Dis 2012;4:259–264.
7. Spruit MA, Singh SJ, Garvey C, et al. An official American Thoracic Society/European Respiratory Society statement: Key concepts and advances in pulmonary rehabilitation. Am J Respir Crit Care Med 2013;188:e13–e64.
8. Coultas D, McKinley J. Update on pulmonary rehabilitation for COPD. Clin Pulm Med 2009;16:183–188.
9. Ryan RM, Patrick H, Deci EL, et al. Facilitating health behaviour change and its maintenance: Interventions based on self-determination theory. Health Psychol Rev 2008;10:2–5.
10. Patrick H, Williams GC. Self-determination theory: Its application to health behavior and complementarity with motivational interviewing. Int J Behav Nutr Phys Act 2012;9:18.
11. Teixeira PJ, Carraca EV, Markland D, et al. Exercise, physical activity, and self-determination theory: A systematic review. Int J Behav Nutr Phys Act 2012; 9:78.
12. Hagger M, Chatzisarantis N, Nikos L. Intrinsic Motivation and Self-Determination in Exercise and Sport. Champaign, IL: Human Kinetics; 2007.
13. Meis JJ, Bosma CB, Spruit MA, et al. A qualitative assessment of COPD patients' experiences of pulmonary rehabilitation and guidance by healthcare professionals. Respir Med 2014;108:500–510.
14. Hogg L, Grant A, Garrod R, et al. People with COPD perceive ongoing, structured and socially supportive exercise opportunities to be important for maintaining an active lifestyle following pulmonary rehabilitation: A qualitative study. J Physiother 2012;58:189–195.
15. van Wetering CR, Hoogendoorn M, Broekhuizen R, et al. Efficacy and costs of nutritional rehabilitation in muscle-wasted patients with chronic obstructive pulmonary disease in a community-based setting: A prespecified subgroup analysis of the INTERCOM Trial. J Am Med Dir Assoc 2010;11:179–187.
16. Deci EL, Ryan RM. Intrinsic Motivation and Self-Determination in Human Behavior. New York: Plenum Press; 1985.
17. Cameron LD, Leventhal H. The Self-Regulation of Health and Illness Behaviour. London: Routledge; 2003.
18. Bestall J, Paul E, Garrod R, et al. Usefulness of the Medical Research Council (MRC) dyspnoea scale as a measure of disability in patients with chronic obstructive pulmonary disease. Thorax 1999;54:581–586.
19. Mahler DA, Mackowiak JI. Evaluation of the short-form 36-item questionnaire to measure health-related quality of life in patients with COPD. Chest 1995; 107:1585–1589.
20. Schuurmans H, Steverink N, Frieswijk N, et al. How to measure self-management abilities in older people by self-report. The development of the SMAS-30. Qual Life Res 2005;14:2215–2228.
21. Copay AG, Subach BR, Glassman SD, et al. Understanding the minimum clinically important difference: A review of concepts and methods. Spine J 2007;7: 541–546.
22. Testa MA, Simonson DC. Assessment of quality-of-life outcomes. N Engl J Med 1996;334:835–840.
23. Ng JY, Ntoumanis N, Thøgersen-Ntoumani C, et al. Self-determination theory applied to health contexts: A meta-analysis. Perspect Psychol Sci 2012;7: 325–340.

24. Stephan Y, Boiché J, Scanff CL. Motivational and physical activity behaviors among older women: A self-determination perspective. Psychol Women Q 2010;34:339–348.
25. Vlachopoulos SP, Karageorghis CI, Terry PC. Motivation profiles in sport: A self-determination theory perspective. Res Q Exerc Sport 2000;71:387–397.
26. Beauchamp MK, Evans R, Janaudis-Ferreira T, et al. Systematic review of supervised exercise programs after pulmonary rehabilitation in individuals with COPD. Chest 2013;144:1124–1133.
27. Spencer L, Alison J, McKeough Z. Maintaining benefits following pulmonary rehabilitation: A randomised controlled trial. Eur Respir J 2010;35:571–577.
28. Busby AK, Reese RL, Simon SR. Pulmonary rehabilitation maintenance interventions: A systematic review. Am J Health Behav 2014;38:321–330.
29. Elliott M, Watson C, Wilkinson E, et al. Short- and long-term hospital and community exercise programmes for patients with chronic obstructive pulmonary disease. Respirology 2004;9:345–351.
30. Nishiyama O, Taniguchi H, Kondoh Y, et al. Factors in maintaining long-term improvements in health-related quality of life after pulmonary rehabilitation for COPD. Qual Life Res 2005;14:2315–2321.
31. Heerema-Poelman A, Stuive I, Wempe JB. Adherence to a maintenance exercise program 1 year after pulmonary rehabilitation: What are the predictors of dropout? J Cardiopulm Rehabil Prev 2013;33:419–426.
32. Vansteenkiste M, Williams GC, Resnicow K. Toward systematic integration between self-determination theory and motivational interviewing as examples of top-down and bottom-up intervention development: Autonomy or volition as a fundamental theoretical principle. Int J Behav Nutr Phys Act 2012;9:23.
33. Laviolette L, Bourbeau J, Bernard S, et al. Assessing the impact of pulmonary rehabilitation on functional status in COPD. Thorax 2008;63:115–121.
34. Bjorner JB, Wallenstein GV, Martin MC, et al. Interpreting score differences in the SF-36 Vitality scale: Using clinical conditions and functional outcomes to define the minimally important difference. Curr Med Res Opin 2007;23:731–739.