Experiences in responders and non-responders to pulmonary rehabilitation among people with chronic obstructive pulmonary disease
a clinical study with convergent mixed analysis

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Abstract

Purpose: This study aims to investigate the experienced and measured development in physical capacity in people with Chronic Obstructive Pulmonary Disease (COPD) undergoing a standard pulmonary rehabilitation programme with a focus on the diverging experiences of responders and non-responders.

Methods: Twenty-one participants in standard pulmonary rehabilitation were included in the study. We measured the participants’ change in the six-minute walk test (6MWT) during rehabilitation participation. We investigated their experiences of the changes in their physical capacity by combined participant observations and interviews. A convergent mixed analysis was conducted of the coherent data.

Results: Standard pulmonary rehabilitation had a different physical impact on people with COPD. Responders were delighted by a positive physical change, which improved their daily functioning and capability of fulfilling personal priorities. However, non-responders experienced decreased capacity and a lack of trust in their future. All participants found it
challenging to exercise and achieve sustainable exercise habits.

**Conclusion:** In this qualitative study, we found that absence of expected improvement to pulmonary rehabilitation seems to confer distress and feelings of hopelessness. The achievement of sustainable change in daily exercise behaviour appears yet to be insufficient. Thus, new and more individualized models of physiotherapists’ guidance in exercise are imperative.

**Keywords:** Chronic obstructive pulmonary disease; Empirical research; Personal Narratives as Topic; Rehabilitation Outcome.

**Introduction**

There is substantial evidence that pulmonary rehabilitation improves exercise capacity, health-related quality of life, and well-being in people with Chronic Obstructive Pulmonary Disease (COPD) [1,2]. The effect is primarily believed to be mediated by physical exercise training [1,3,4]. Physical exercise positively influences the vicious spiral of COPD-related symptoms, including, e.g., dyspnea, fatigue, muscle-skeletal dysfunction, as well as emotional and social discomfort [1,5]. Furthermore, the improved exercise capacity following pulmonary rehabilitation is associated with decreased morbidity and mortality [6]. The six-minute walk test (6MWT) is recommended as a gold-standard field test to determine development in physical capacity and thus evaluate treatment response from COPD rehabilitation programmes [7,8].
Even though the mean improvement of pulmonary rehabilitation is unequivocal, this average is the result of very individual response with a span from no change or even worsening to immense improvement in physical capacity [9–11]. Yet, little is known about the lived experiences of people with COPD within these varieties.

Improved knowledge of the psycho-emotional consequences of participating in pulmonary rehabilitation programmes is needed to tailor individualized exercise training programmes [7,8,11]. This includes gaining insight into the experiences of both people who respond and do not respond with a positive clinically important change in physical capacity from the current pulmonary rehabilitation programmes [7,8,11].

Hence this paper presents knowledge concerning the diverging experiences of responders and non-responders in physical capacity among people with chronic obstructive pulmonary disease undergoing a standard outpatient pulmonary rehabilitation programme.

Materials and Methods

Design

Mixed method data were collected with qualitative ethnographic-inspired participant observations combined with in-depth interviews and measurement of the development in 6MWT. With the use of a convergent mixed-method analysis, a phenomenological-hermeneutic interpretation of the experiences of the responders and non-responders from 6MWT was conducted.
Participants

Participants from a standard outpatient pulmonary rehabilitation programme at Slagelse Hospital, Denmark were invited to participate in the study.

Inclusion criteria were: a doctor's diagnosis of COPD, a modified Medical Research Council dyspnea scale of ≥2 (measures symptom severity, scoring from lowest symptoms, 0, to highest symptoms, 4), referred by a general practitioner or hospital physician for pulmonary rehabilitation, and fluent in Danish. The presence of comorbidities was no exclusion criterion.

Twenty-seven patients were invited from three different but similar rehabilitation courses running between August 2016 and March 2017. Six persons declined participation due to a lack of energy. In total, 19 (10 women) accepted study participation and completed tests (Table 1). Spirometry was performed either at the hospital or by the general practitioner. COPD Assessment Test (CAT) score was completed at inclusion and after the finalisation of the rehabilitation programme.

The applicable rehabilitation was an 8-week, group-based programme, with two weekly (total=16) one-hour sessions of physiotherapist guided endurance and strength exercises. Participants were encouraged to do home exercises during the programme. The outline of the programme is shown in Table 2. Furthermore, the participants were offered individual consultations with the healthcare professionals on an as-needed basis [12].

Table 1 + Table 2 about here.

Data collection

Data were collected from August 2016 to March 2017.
Measurement of functional exercise capacity: Before and after the rehabilitation programme, the participants performed one 6MWT in accordance with the European Respiratory Society guideline to determine whether there was a clinically meaningful change in functional exercise capacity using a minimal important difference (MCID) of walking distance capacity being ≥ 30.0 meters [7]. Heart rate and oxygen saturation were monitored, and the participants rated their perception of dyspnea on the Borg CR-10 dyspnea scale before and after 6MWT [7]. Both baseline and 8-weeks follow-up tests were performed in a 30 m hospital corridor.

Participant observations: Guided by the ethnographic methods of Hammersley & Atkinson and Spradley, [13–15] 48 observations were conducted of the sessions of the rehabilitation. All three courses were followed from start to end. Here we aimed to get insight into the participants' experiences of their development in physical capacity. Accordingly, it was initially investigated how they, along with the rehabilitation programme, managed and responded to the exercise and expressed perception about their physical condition. This gave important data on what actually went on and how the participants developed during the rehabilitation. Additionally, it qualified the basis for the following interviews. The observations lasted for 1½ - 4 hours and ranged from the researchers’ full participation in what took place in the rehabilitation sessions to full observation, where the researcher distanced from the interaction. These positions were carefully selected to gain access to various aspects of what was said and expressed about the physical state of being along the course of the rehabilitation [13-15]. On occasions, informal conversations with the participants were conducted to deepen insight into what was observed [14]. Notes and quotations were written in a notebook during the observations. Accurate field notes were
made immediately after the sessions ended [16]. Here the following issues were described: Room/the physical surroundings, Participants, Activity (what persons do), Objectives (materials), Actions, Events (over time), Time, Purpose (what someone tries to achieve), and Feelings (expressed) [15]. Moreover, it was clarified what was, quotations, summaries, or non-verbal communication, and memos or commentaries of the researcher were written [16]. Continuously, reflections on the field notes guided the focus of the observations [13].

**Interviews:** With inspiration from Kvale & Brinkmann and Foghs’ methods [17,18], all participants were interviewed after rehabilitation completion. Using a semi-structured interview guide, the interviewer encouraged the participants to talk about *how in physical terms they perceived their life with illness and what it had meant to participate in the rehabilitation programme*. The participants were also invited to elaborate on reactions or remarks from the observations during the interviews. As preferred by the participants, the interviews were conducted either in a hospital room (12), in their private homes (5), or by telephone (2). The interviews lasted for 20-60 minutes. They were audio-recorded and transcribed verbatim.

**Ethics**

The Ethical Committee (SJ-559) and the Danish Data Agency (J. Nr. REG-071-2016) approved this study. Their guidelines were followed. In addition, the ethical principles of the Declaration of Helsinki were followed [19].

The participants received oral and written information about the study and had at least two days to consider participation before informed consent was obtained. All participants were
informed about guaranteed anonymity, that they could withdraw consent at any time, and data handling according to current standards would be kept confidential.

Data analysis

Data material consisted of measurements from 6MWT and a 313-paged text of field notes and transcribed interviews. Guided by a convergent design, the qualitative analysis, and the measured responses were combined in various ways to identify inter-related patterns [20].

Participants were categorized as responders if they had a minimum clinically important difference (MCID) being ≥ 30.0 meters [7]. Accordingly, participants were categorized as non-responders if their 6MWT changed by < 30.0 meters (including deteriorated 6MWT distance). Since an interesting pattern occurred within the variations of the responders' and the non-responders' experiences, we decided to investigate this. This pattern was new to us and reflected both similarities and differences concerning how the participants were affected by the physical aspects.

Within a phenomenological-hermeneutic approach, the interpretation of the text took inspiration from the French Philosopher Paul Ricoeur's' theory of narrative and interpretation, which consists of naïve reading, structural analysis, and critical interpretation [21,22]. In the structural analysis themes were identified of how the participants experienced their physical capacity throughout the rehabilitation course. These themes are described in the section of results with the inclusion of selected field notes and quotes from interviews. The theory of embodiment by the German philosopher Martin Heidegger [23] is included in the discussion as well as empirical studies with regards to rehabilitation and exercise for people with COPD.
Results

*Development in measured functional exercise capacity*

At baseline, the median 6MWT distance was 270 [range: 160-510] meters, increasing to 326 [150-487] meters at follow-up. The (median change was 20 [range -120-184] meters), covering substantial variations between the participants. Nine participants were classified as responders (median change 63 [range 30-184] meters), and ten participants were classified as non-responders (median change -25 [range -120-20] meters). Table 1 and 3 and Figure 1 depict the variable outcome of attending rehabilitation and change in 6MWT distance. Table 3 depicting between-group differences were insignificant in non-parametric testing. The group of responders attended a median of 13 sessions and the non-responders a median of 14 sessions.

*Table 3 and Figure 1 about here*

*The participants' experiences of the development in their physical condition*

As illustrated in Figure 2, we identified three themes within the revealed patterns of the coherent data material. The themes are unfolded in the following. The presented quotes refer to interviews, (I), or field notes, (FN) and the specific participants (n), (cf. Table 1).

*Figure 2 about here.*
Between physical improvements and aggravations

The observations and interviews covered that the responders experienced raised physical functioning during rehabilitation that had a widely positive impact on their daily lives. One female, who improved her 6MWT distance by 30 meters, after the rehabilitation programme ended she explained: "I feel that I have more power than I had before. When I walk the dog, I do not get as tired as I used to. And the walks keep on getting longer and longer." (I, P7).

Another female that improved her 6MWT distance with 86 meters said: “It’s an excellent bodily experience. Doing exercise made me feel better and better, and more capable of doing things." (I, P10). These statements reflect how those people felt that they had gained more surplus of energy. Activities in daily living, like shopping, keeping the house, enjoying nature and doing hobbies, became accordingly more accessible for them. Another female that improved the 6MWT with 31 meters described:

I am now able to participate in the confirmation ceremony of my grandchild and also the party that follows. This is because I took this programme. Before this, I did not have the air for such things. It has changed my life."(I, P16).

This statement illustrates how the responders in general felt released from disease oppression with an appreciated impact that was beyond the mere bodily perception. They described it as "Providing more well-being and happiness" (I P4 improving the 6MWT with 135 meters) and "Giving rise to a positive prospect" (P18 improving the 6MWT with 112 meters), indicating that they experienced having an improved capability to be in charge of their everyday life activities because of the gains from the exercise. Accordingly, physical improvement
influenced the participants' perception of life in a far-reaching positive way.

Predominantly physically burdened, the non-responders experienced an overall negative perception of life. With a thin and fragile voice a non-responding male participant, who managed to walk 10 meters longer in the 6MWT after the rehabilitation, disclosed it this way in his last session of exercise in the programme: "Unfortunately, my breath hasn't become better. My expectations have faded. I've somehow lost my hopes for getting better due to the disease." (FN, P13). This quote exemplifies that those who did not achieve a positive significant clinical change perceived the disease to become even more burdening during the rehabilitation. Being confronted with this decline caused increased despair, demotivation, and diminished hope in the future.

Some of the non-responders blamed the rehabilitation programme for being offered to them too late or not addressing their needs to exercise appropriately. Accordingly, the rehabilitation programme was experienced not helpful and even disappointing to non-responders as one female, who declined by 40 meters in the 6MWT after the rehabilitation ended, described it:

"Honestly, it did not live up to my expectations. I have not become better." (I, P3).

The non-responders who momentarily perceived physical progress during the rehabilitation were prone to consider their rehabilitation participation a failure.

**Box 1 about here.**

*Discovering that doing physical exercise is beneficial*

When starting the rehabilitation course, it was a common perception among all participants that they needed to avoid becoming overstrained. One male participant stated it in this way: "I
am worried that I cannot exercise because I know that it will make me lose my breath." (FN, P8). This statement covers that the symptoms stipulated a restrained approach to exercise from the participants. However, many came to new insights as the rehabilitation went on because they realized that exercise was rewarding to them. Their acts and statements reflected that it was a surprise to them that exercising could improve their physical capacity and reduce COPD symptoms.

A male responder who improved the walking distance by 135 meters after finalizing the programme, put it this way:

   I have learned that it brings more well-being. I feel more joy and that everything is in a brighter light. The body realizes that you can manage exercising. So now I see that it is not a good idea to withdraw on the sofa saying, “don’t do anything because it will make you lose your breath”. (I, P4).

Hence, appropriate exercising during the rehabilitation programme assisted, especially the responders, in understanding that this could amend their physical capacity in a remarkably positive way. However, some non-responders also recognized that exercising was rewarding to them. But unfortunately, the non-responders tended to abandon the idea of exercising when they did not perceive progress. A non-responding female that had a decline in her 6MWT distance by 120 meters described in the following way how it felt overwhelming to participate in the rehabilitation exercises:

   I was totally done when returning from every single rehabilitation session. I was not able to have any plans for anything else. I came home, had a small meal, a cup of
Experiences like this made non-responders feel incapable of enduring the exercise and occupied with the impression that they needed to give up working on this. These situations made them even sadder and more vexed than before starting rehabilitation.

**Box 2 about here.**

*Challenged in learning to exercise*

As expected, it was demanding for both responders and non-responders to perform the exercise appropriately in the rehabilitation. When introduced to the exercises, the participants appeared both insecure and reluctant. Frequently, they needed to withdraw from the activity. They took resting positions while fighting for lowering high respiratory frequency or other symptoms to decrease. The observation and interview material revealed in many ways how especially the non-responders were challenged. In one example, where the participants had accomplished endurance exercises by long-distance walking, and 15-minute interval rides on exercise bikes, the following was observed:

“The physiotherapist asks if it is hard to manage the breathing techniques during exercise. Some respond that the challenge of the breathing techniques becomes accentuated concerning the increasing exercise intensity. A non-responding male that ended up reducing his 6 minutes’ walk distance by 42 meters (P15) says: “*I feel the opposite. Initially, I feel muscle pain. I need to pass this unpleasant stage before I can continue.*” (FN). This episode illustrates how the non-responders’ difficulties in performing exercise were accentuated due to a challenge of muscle soreness.
The observations moreover reflected that all participants were challenged to comply with the recommendations from the physiotherapist. However, intensive individualized instructions by the physiotherapist were, in many cases, experienced as useful, especially to the responders. “On the bikes, P19, who improves the 6MWT with 46 meters after the rehabilitation ended, makes several stops. The physiotherapist instructs her to slow down. ‘Do not stop. Continue cautiously and carefully.’” He emphasizes that she should perform the breathing techniques and demonstrates this. She follows his guidance and is capable of continuing for 12 minutes. She manages to coordinate speeding up and slowing down with her breathing.”(FN). This situation covers how the responders were prone to improve their exercise performance when intensively encouraged and guided. It was uplifting to them to discover that they could manage more than they had expected. However, notably how much help they needed from physiotherapists.

Moreover, both responders and non-responders were encouraged by exercising with peer participants. Nevertheless, some stated that they longed for an adequate level of exercise. Those participants considered a lack of possibility to exercise in a genuinely competitive milieu as a deficiency in the rehabilitation. To responders, this meant that they were in need of a higher pace. Meanwhile, some non-responders longed for a higher pace to be motivated to work harder, and other non-responders missed the competition at a slower pace to avoid overstraining. Trying to keep up with a too high level made some non-responders give up the exercises.

In a notable way, it turned out to be stressful for the people with COPD to incorporate new exercise habits within two months, as explained by a female responder improving her 6MWT
distance with 30 meters in this way: “I would have liked it if I was able to try the techniques out at home and then have the chance to come here and ask, ‘how am I supposed to do this and that.’” (I, P7). This statement also covers how the participants tended to miss guidance for exercises at home during the programme. Another responder (improving 6MWT distance with 135 meters) described the experience of the timespan in this way: “I would have preferred a longer-lasting programme. You can say that we are only half-way up the tilt. And then suddenly... bump... the tilt has turned downside again.” (I, P4).

These statements underline how the responders experienced the timeframe to be inappropriately short. Accordingly, finishing the rehabilitation programme was typically connected with feelings of being left to oneself with a struggle for finding proper ways and places to maintain exercising. This was even worse for the non-responders which one male, that walked 20 meters longer in the follow-up test, described in the following way:

I am searching high and low. I am not keen on going to the local gym. Because I need someone to keep an eye on me. Sometimes I get dizzy when I exercise, and in those centers, you just go down there using your member card and go in there just taking care of yourself. (I, P20).

The quotation highlights how the non-responding people felt left in limbo without the comfort and courage to continue exercising in daily life. It moreover covers how the non-responders had troubles managing the transition to what they experienced as insecure and chaotic offers in the primary health care sector and the remaining community.
Discussion

The findings from this qualitative study highlight the fact that a substantial proportion of people with COPD do not improve their physical capacity during a seemingly successful pulmonary rehabilitation programme regardless of a slightly higher exercise attendance than those who achieve an important positive clinical change in 6MWT distance. The findings underline the complexity in response to exercise [9,11]. Furthermore, it implies that the eight-week long evidence-based standard pulmonary rehabilitation programme offered in Denmark does not seem an optimal intervention to a subgroup of people with COPD. To our knowledge, the presented insight into these non-responders’ experiences is a crucial new tribute [24].

Notably, the development in physical capacity has a far-reaching influence on the participants’ perception of life. Heidegger claims that one’s body is in each case perceived by the individual as “my body.”[23](p 86). Understood this way, the body refers to perceptions and feelings as they are lived with the body: To one’s experience of oneself - one’s existence. Furthermore, Heidegger emphasizes that one’s being is determined by the constant changes in the reach of one’s physical state-of-being [23]. In line of this thinking, physical perceptions are intertwined with the participants’ understanding of their existence. As this study shows, the development in physical capacity becomes a matter of reconsidering one’s existence, either positively as the responders’ experience or negatively as perceived by the non-responders. Besides, it highlights how sensitive COPD patients are to their physical status. To reduce the unfortunate despondency found in this study, all non-responders should be
encouraged intensively to exercise in an individually appropriate way. This might contribute to raising motivation for exercise and accordingly, a positive mindset for leading a more healthy life as found necessary by Sigurgeirsdotir et al. [25]. Furthermore, it can target the unmet needs of people with COPD to find new methods to perform activities in everyday life [26].

Moreover the finding that the physical perceptions are crucial to the participants’ self-understanding can give new light to the various factors that are shown to influence engagement in exercise among people with COPD. For example, it highlights the motivational power of social support and experiencing understanding from fellow patients during exercise [27]; along with the importance of exercising being fun and a pleasure as well as leading to happiness and satisfaction [28]. Furthermore, it apprehends that living with a physically active partner has a positive motivational influence [29]. Bringing this light to the field, the individual’s sensitivity to rehabilitation’s challenging factors seems even more critical. Overall, it emphasizes the suggestion by Troosters et al. that a personalised flexible approach in pulmonary rehabilitation is preferable, along with more long-lasting programmes up to three to six months [30].

It is crucial to acknowledge that regular exercise for people with COPD has several beneficial effects, such as fewer symptoms and improved exercise capacity [1,31–33]. As shown in this study, the participants must realize that they can benefit from exercising, with significant improvements or maintaining their physical exercise capacity at a higher level than otherwise. This should be highlighted during exercise guidance. The majority of our cohort had a FEV1 below 50% of expected, so limited improvement in physical capacity may not be a surprise.
The shown challenges in muscle soreness for the non-responders during exercising is likely due to a deficient fitness level and was experienced as almost intolerably acute increases in their known symptoms. These findings might in part explain the lacking positive rehabilitation outcomes for some people with COPD [4,6,9]. Of particular importance, consideration should be given to the discovery that the non-responders have a tendency to feel despondent and demotivated by the rehabilitation participation when they fail in enduring the exercises. To refine evidence-based clinical practice, pulmonary rehabilitation should be designed to address individual needs [6,34]. This study highlights that exercise guidance needs careful coordination with every individual’s development in physical capacity and exercise habits during and after rehabilitation.

To the well-known concern that it is challenging for people to establish new exercise habits subsequently of rehabilitation [30,35,36], this study adds new knowledge. Not only do the participants experience learning to exercise as a massive stumbling block during rehabilitation, they feel poorly supported to be able to continue sustainable exercise habits when ending the programme. Especially the non-responders are prone to feeling insufficiently guided to exercise during rehabilitation. Also, it is highlighted that not even responders find the timeframe on eight weeks of exercise practice to be long enough. Other studies recommend adjustment and readjustment of training modalities, i.e., intensity, frequency, duration, location [1,4,30,37]. The present study adds that exercise milieus concerning the need for competition at either high or low pace must be considered in rehabilitation. Moreover, guidance in finding proper and safe exercise solutions; subsequently, the hospital programme is required, especially to non-responders.
Our study highlights that it is a complex challenge to guide people with COPD to exercise. It appears pivotal to address the individual motivation, and to make access to pulmonary rehabilitation easier. In earlier studies, we have shown that group-based telerehabilitation with individual goals appears promising but large-scale studies on efficacy is still missing [38,39].

**Strengths and limitations**

In this qualitative, clinical study with convergent mixed analysis, it is a strength that patterns could be identified [20] within both the response and the non-response regarding the 6MWT and the lived experiences of the development in physical capacity among people with COPD. Further investigation regarding the participants' exercise capacity could have given more useful information to the study and is recommended for future research. Nevertheless, the identified patterns are novel and, therefore, a significant tribute to the complex task of identifying response to pulmonary rehabilitation [11]. The combination of participant observations and interviews gave rich and detailed data, which allowed in-depth insight and internal validation within the interpretation [22]. Nevertheless, additional interviews and 6MWT conducted six months after the rehabilitation programme ended, could have shed further light on this particular post-rehabilitation period. Moreover, as a guideline, recommending the best out of two performed 6MWT could have been used at both baseline and eight weeks follow-up to reduce the learning effect, which could bias the 6MWT [7]. The use of only one variable to categorize participants into responders and non-responders, can be considered a limitation. However, we chose an objective measure (6MWT) of the rehabilitation effect. One might argue that a patient-reported outcome could be a more
relevant variable to categorize participants upon. However, post-protocol analysis has shown that the change in CAT-score from baseline to follow-up was not related to patient experiences in this small group of patients. Nevertheless, data on comorbidities, health status, and the scope of exacerbations could have led to improved insight, and is thus a major limitation of this study. Another limitation to the quantitative observations is the small sample of responders and non-responders, and the lack of a control group, which could have validated if the observed changes from baseline were related to the rehabilitation programme. Also, a ceiling effect from the baseline of the 6MWT can blur the results. Thus, the measured changes should be interpreted with caution, and more extensive studies are needed to provide more solid knowledge on the different experiences of responders and non-responders.

**Conclusion**

This study finds a standard pulmonary rehabilitation programme efficacious in improving physical capacity to nine people with COPD who experience improved well-being and far-reaching satisfaction in daily living. However, ten people did not respond, which is associated with demotivation and loss of hope in the future. Thus, both improvement and aggravation in physical conditions influence people with COPD in an existential manner. Nevertheless, all participants are challenged in learning to exercise and thus in need of extensive physiotherapeutic guidance in exercise. Moreover, the variated exercise experiences of responders and non-responders underline that more individualized guidance is warranted. Especially non-responders require support to cope with muscle soreness during exercise and establish action plans for regular training when rehabilitation ends. More research is needed to
tailor evidence-based, efficacious interventions to both responders and non-responders.

Declaration of Interest

The authors report no conflicts of interest.

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List of Tables, Figures, and Boxes

Table 1. Baseline characteristics, and characterization as responder ($\geq 30$-meter change in 6MWT distance) or non-responder ($<30$-meter change) after rehabilitation.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Gender</th>
<th>Age</th>
<th>FEV1 (% predicted)</th>
<th>mMRC (score)</th>
<th>CAT score</th>
<th>6MWT distance</th>
<th>6MWT distance</th>
<th>6MWT change</th>
<th>Attended sessions</th>
<th>Responder (+ or -)</th>
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<td>78</td>
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<td>3</td>
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<td>84</td>
<td>45</td>
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<td>45</td>
<td>3</td>
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<td>13</td>
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<td>61</td>
<td>3</td>
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<td>2</td>
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<td>316</td>
<td>274</td>
<td>-42</td>
<td>16</td>
<td>-</td>
</tr>
<tr>
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<td>79</td>
<td>4</td>
<td>30</td>
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<td>31</td>
<td>9</td>
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<td>15</td>
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<td>-120</td>
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<td>112</td>
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<td>4</td>
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<td>46</td>
<td>14</td>
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<td>3</td>
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<td>160</td>
<td>180</td>
<td>20</td>
<td>16</td>
<td>-</td>
</tr>
<tr>
<td>P21</td>
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<td>26</td>
<td>510</td>
<td>487</td>
<td>-23</td>
<td>16</td>
<td>-</td>
</tr>
</tbody>
</table>

FEV1: Forced Expiratory Volume in 1 second; mMRC: modified Medical Research Council dyspnea scale. CAT score: COPD Assessment Test score. 6MWT: 6-Minute Walk Test.

* Unable to complete the eight weeks follow-up test due to illness and were excluded from data analysis.

** Hospital admission during rehabilitation due to COPD-related issues as pneumonia, exacerbation, or dyspnea.
Table 2. Outline of the pulmonary rehabilitation programme

<table>
<thead>
<tr>
<th>Content</th>
<th>Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Exercise-based sessions</strong></td>
<td>Each exercise session consists of 10-15 minutes of warm-up activities followed by varied strength and endurance exercises. The exercises consist of e.g., cycling, Nordic walking, ball, and elastic band exercises. The patients are instructed by the physiotherapist during the exercises, either group-based or individually. Each session ends with 5-10 minutes of warm-down with relaxation and stretching exercises. The patients often ask the physiotherapist questions about their illness during this part of the session. Every second week the exercising activities also include a 30 minutes session with the occupational therapist focusing on daily activities and energy saving principles.</td>
</tr>
</tbody>
</table>
| **Education sessions**           | **1st session was held in week 1:**  
12 pm - 14 pm – by a nurse  
Physiological and anatomical factors related to COPD and psychosocial reactions.  
14 pm - 15 pm: - by an occupational therapist  
Strategies in order to prevent or minimize respiratory stress during activities.  
**2nd session was held in week 3:**  
12 pm -13 pm: - by a nurse  
Medicine and inhalation techniques  
13 pm -14 pm: - by a physiotherapist  
Exercise principles and respiratory techniques exempli gratia positive expiratory pressure (PEP), Pursed Lip Breathing (PLB), coughing techniques and how to manage the symptoms and become physically active in daily life.  
14 pm -15 pm: - by a dietitian  
Nutrition and risk factors related to COPD.  

The patients are offered individual consultations with the healthcare professionals if deemed relevant.  

The programme is in line with the Danish National Guidelines for pulmonary rehabilitation [12]. It is free of charge to the patients, and if needed, cost-free transport to the hospital is possible.
Table 3. Differences in baseline variables, attended sessions and changes in PROMs in responders and non-responders to pulmonary rehabilitation

<table>
<thead>
<tr>
<th></th>
<th>Responders</th>
<th>Non-responders</th>
<th>P-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female, n (%)</td>
<td>6 (67)</td>
<td>4 (40)</td>
<td>0.37</td>
</tr>
<tr>
<td>Age, median [range]</td>
<td>71 (64-80)</td>
<td>71 (55-82)</td>
<td>0.97</td>
</tr>
<tr>
<td>FEV₁ predicted, median [range]</td>
<td>46 (32-81)</td>
<td>43 (26-66)</td>
<td>0.21</td>
</tr>
<tr>
<td>mMRC, median [range]</td>
<td>2 (0-4)</td>
<td>3 (0-3)</td>
<td>0.91</td>
</tr>
<tr>
<td>CAT-score, median [range]</td>
<td>22 (11-30)</td>
<td>22 (9-29)</td>
<td>0.94</td>
</tr>
<tr>
<td>Baseline 6MWT, meters, median [range]</td>
<td>236 (165-390)</td>
<td>293 (160-510)</td>
<td>0.55</td>
</tr>
</tbody>
</table>

**After Pulmonary Rehabilitation:**

<table>
<thead>
<tr>
<th></th>
<th>Responders</th>
<th>Non-responders</th>
<th>P-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attended sessions, median [range]</td>
<td>13 (9-16)</td>
<td>14 (12-16)</td>
<td>0.38</td>
</tr>
<tr>
<td>Change in CAT, median [range]</td>
<td>0 (-8-8)</td>
<td>3.5 (-6-7)</td>
<td>0.68</td>
</tr>
<tr>
<td>Change in 6MWT, median [range]</td>
<td>63 (30-184)</td>
<td>-25 (-120-20)</td>
<td>0.00*</td>
</tr>
</tbody>
</table>

FEV₁: Forced Expiratory Volume in 1 second; mMRC: modified Medical Research Council dyspnea scale. CAT score: COPD Assessment Test score. 6MWT: 6-Minute Walk Test.

*: Categorical variables: Chi² test. Continuous variables: Mann-Whitney U-test
Figure 1.
An outline of responders and non-responders, based on 6MWT results

Participants’ 6MWT before and after rehabilitation measured in meters

Participants are sorted according to their baseline 6MWT result (lowest to highest).

* Responders. Classified by changes from baseline ≥ 30 meters.
The overall impression was that it was a struggle to all participants to achieve well-functioning exercise habits not only during but also subsequent to rehabilitation. Physiotherapist guidance seemed crucial and valued by the participants but also somehow insufficient. While the responders perceived surplus of energy and improved well-being, the non-responders seemed to experience despondency and demotivation not only in the rehabilitation but also in life as a whole.

Through a dialectic movement between understanding and explanation, themes are identified from the text. (20) The identified patterns within the coherent data material guided the formation of the three themes.

Box 1. Comprehensive understanding: Between physical improvements and aggravations

In a striking way, the participants’ developments in physical capacity included an overall change in perception of life as a whole, respectively positive or negative.

The responders experienced a positive raise in the overall perception of life. They were delighted by physical improvement, which both improved their daily functioning and capability of fulfilling personal priorities.

The non-responders tended to experience a proceeding physical aggravation. This caused demotivation, despondency and lack of hope in the future. To some it even occurred to provide a sense of defeat not being able to improve the physical capacity during rehabilitation.
Box 2. Comprehensive understanding: Discovering that doing physical exercise is beneficial

In a noteworthy way, the participants initially did not expect themselves to be able to exercise, nor to benefit from exercising. Clearly, well-performed exercising made the participants realize that they could improve their physical capacity. This was most prominent among the responders. They experienced a considerable improvement. However, some of the non-responders also came to this insight.

Nevertheless, some non-responders were prone to abandon the idea of exercising because they felt incapable of enduring this. This meant that participation in the rehabilitation made them feel more limited by their symptoms and thus increasingly sad.

Box 3. Comprehensive understanding: Challenged in learning to exercise

In sum, all the participants were clearly challenged in the process of learning to exercise. This was accentuated among the non-responders due to complex physically inabilities. Fortunately, responders experienced individualized in-action instructions by familiar physiotherapists to result in the acquisition of exercise techniques. Both responders and non-responders benefitted from exercising with peers. Nevertheless, both groups disclosed a desire for a more individually adjusted milieu of competition.

Typically, the participants experienced the rehabilitation programme to be inappropriately short and leaving them not sufficiently supported to implement appropriate exercise habits in everyday life. Especially the non-responders felt being left alone in a chaotic gap with no useful action plans for proper and safe everyday exercising when the hospital rehabilitation programme ended.
Implications for rehabilitation

- It is vital to acknowledge differential response to people with the chronic obstructive pulmonary disease following eight-week standard pulmonary rehabilitation.
- Especially noteworthy feelings of distress and hopelessness are prominent to non-responders because of the absence of the promised improvements.
- Both responders and non-responders require intensive physiotherapist guidance to exercise.
- It is recommended to ensure individualised support to people with chronic obstructive pulmonary disease in rehabilitation programmes.