The Effect of Pulmonary Rehabilitation on Non-chronic Obstructive Pulmonary Disease Patients

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ABSTRACT: Background: Pulmonary rehabilitation has shown significant benefit for patients with chronic obstructive pulmonary disease (COPD). The effect on non-COPD pulmonary patients is less well established.

Objectives: To determine whether pulmonary rehabilitation is also beneficial for non-COPD pulmonary patients.

Methods: Clinical and demographic data on non-COPD pulmonary patients who participated in our institutional pulmonary rehabilitation program between January 2009 and December 2016 were collected. Participants engaged in a 60-minute, twice-weekly, ambulatory hospital-based program lasting 12 to 24 sessions. Sessions included both endurance and muscle training as well as healthy lifestyle educational activities. The six-minute walk test (6MWT) and the St. George’s Respiratory Questionnaire (SGRQ) were conducted before and after the rehabilitation program.

Result: We recruited 214 non-COPD patients, of whom 153 completed at least 12 sessions. Of these, 59 presented with interstitial lung disease (ILD), 18 with non-ILD restrictive lung defects, 25 with asthma, 30 with lung cancer, and 21 with other conditions (e.g., pulmonary hypertension, bronchiectasis). The groups demonstrated significant improvement in 6MWT and in SGRQ scores. Non-COPD patients gained a 61.9 meter (19%) improvement in the 6MWT (P < 0.0001) and 8.3 point reduction in their SGRQ score (P < 0.0001).

Conclusions: Pulmonary rehabilitation is effective in non-COPD pulmonary patients. As such, it should be an integral part of the treatment armament provided to the vast majority of those suffering from chronic respiratory disease.

KEY WORDS: interstitial lung disease (ILD), non-chronic obstructive pulmonary disease (COPD), pulmonary rehabilitation, six-minute walk test (6MWT), St. George’s Respiratory Questionnaire (SGRQ)

Pulmonary rehabilitation in chronic obstructive pulmonary disease (COPD) patients is an integral therapeutic component, as stated by various guidelines [1–3]. The advantages among COPD subjects are well established [4–6]. In contrast, the effect of pulmonary rehabilitation in non-COPD patients has not been studied in depth. Limited data exist regarding the role of pulmonary rehabilitation in interstitial lung disease (ILD) [7–9]. A recent Cochrane review graded the quality of evidence as low to moderate [10]. Pulmonary rehabilitation is also a potential treatment option for those presenting with non-ILD restrictive lung disease [11], asthma [12], lung cancer [13], bronchiectasis [14], and pulmonary hypertension [15]. It is also a treatment used before and after thoracic surgery [16]. Nevertheless, as of yet, pulmonary rehabilitation has not been implemented as a common treatment modality for non-COPD pulmonary disease patients. Furthermore, pulmonary rehabilitation in Israel is reimbursed by the health funds only in severe COPD patients with forced expiratory volume (FEV1) below 50% predicted.

Exercise capacity in patients with chronic lung diseases is impaired. The limitation of exercise is complex. The causes of dyspnea are usually multifactorial, reflecting peripheral muscle dysfunction, defective gas exchange, increased respiratory load and physical deconditioning. Aging and co-morbidities are potential aggravating factors.

The decline in physical activity may lead to depletion of muscle mass, reduction of the amount of muscle blood capillaries, decrease in aerobic enzymes, and decrease in the number mitochondria [17,18]. Exercise training is one of the best ways to improve muscle function in respiratory diseases. Physical activity augments muscle mass, increases the number of capillaries, improves aerobic enzymes, and adds to the number of mitochondria in the peripheral muscles [19]. Improvement in skeletal muscle function leads to gain in exercise capacity, even in the absence of changes in pulmonary function. Improved capacity and efficiency of the skeletal muscles results in reduction in the ventilatory requirement for the same work load. This process culminates in a diminished sense of exertional dyspnea. These outcomes provide the patho-physiologic rational behind this treatment modality. Similar effects would be expected in non-COPD pulmonary diseases. Nevertheless, few studies have explored this assumption [20].

In the present study we explored the outcomes of pulmonary rehabilitation in non-COPD pulmonary patients as carried out in real-world clinical scenario.

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PATIENTS AND METHODS
The Shaare Zedek Medical Center pulmonary rehabilitation program was inaugurated in 2008. The program is directed by a certified physiotherapist under the supervision of a board certified pulmonologist. All patients are referred to the program by a pulmonologist and the majority of them present with COPD. All participants are initially assessed by a multi-disciplinary team consisting of a pulmonologist, physiotherapist, dietician, and social worker. In the present study, clinical and demographic data were collected and each participant was required to complete a six-minute walk test (6MWT) and a St. George’s Respiratory Questionnaire (SGRQ) before entering the rehabilitation program, as well as at completion.

The 6MWT was conducted according to the American Thoracic Society guidelines from 2002. During the test, the patient walked in a corridor for six minutes as fast as possible. The 6MWT is well accepted for evaluation of the physical ability. The SGRQ (http://www.healthstatus.gsu.ac.uk/SGRQ_download) is one of the most accepted questionnaires to evaluate the quality of life among patients with respiratory diseases. All data obtained were recorded in the patient’s medical chart. The 6MWT and the SGRQ were routinely conducted by the same physiotherapists who treated the patient.

Participants took part in a twice-weekly, 60-minute, group sessions (six patients per group). The basic program included 12 to 24 sessions. Both aerobic and strength-building exercises for the upper and lower limbs were conducted. We used a standard treadmill and fitness bike. The exact composition and intensity of the activities were individually tailored based on the participant’s capabilities and limitations. Heart rate and blood pressure were recorded before and after activity while oxygen pulse oximetry was monitored throughout the session. Those demonstrating a drop in oxygen saturation were provided supplemental oxygen to maintain the saturation at or above 90%.

Healthy lifestyle promotion activities, social support service, and dietician consultation were provided. Every patient was encouraged to engage in independent intense physical activity of at least 1 hour every week. All smokers were advised to stop smoking.

A retrospective chart review between January 2009 and December 2016 was conducted following approval of the institutional review board. The same physiotherapist was responsible for the program during those years. Only patients without COPD who completed at least 12 sessions were included in the study. Those with co-existing COPD and other pulmonary disease were excluded (e.g., lung cancer and COPD, pulmonary fibrosis and COPD). We did not include these patients due to the potential bias resulting from the proven beneficial effects of pulmonary rehabilitation among COPD patients.

Paired one-way Student’s t test was used to evaluate differences in continuous variables (6MWT and SGRQ) before and after participation in the pulmonary rehabilitation program. P ≤ 0.05 was considered statistically significant.

RESULTS
Between January 2009 and December 2016, 214 non-COPD patients participated in the rehabilitation program. Among these patients, only 153 completed at least 12 sessions and thus were eligible for inclusion in the present study. Reasons for dropout included lack of interest, lack of time, difficulty in mobility, exacerbation of the pulmonary disease, and lack of funding by the health maintenance organizations. Pre- and post-participation 6MWT results were available for 150 patients, and 55 patients completed the SGRQ. The average patient age was 65.8 ± 13.5 years, with a majority being male (54.9%). Seventy-six patients (49.7%) never smoked, 63 (41.2%) were former smokers, and 14 (9.1%) were active smokers. The total non-COPD cohort consisted of 59 ILD, 18 non-ILD restrictive lung disease, 25 asthma, 30 lung cancer, and 21 others (e.g., pulmonary hypertension, bronchiectasis, surgery). The 6MWT and the SGRQ were repeated after at least 12 sessions. On average, the evaluations were administered after 21.5 sessions. Thirty-eight patients extended their participation period beyond the standard 24 sessions.

All non-COPD patient groups, excluding those with pulmonary hypertension, showed a clinically, as well as statistically significant, increment in 6MWT distance [Figure 1] and reduction of SGRQ score [Figure 2]. Patients presenting with pulmonary hypertension achieved a 45-meter (14.6%)
improvement in their 6MWT (P = 0.1) and a non-significant trend for improvement in their SGRQ score (3.5 points).

The combined cohort of non-COPD patients demonstrated a 61.9 ± 57.8 meter (19%) improvement in the 6MWT (P < 0.0001) and 8.3 ± 7.9 point reduction in their SGRQ score (P < 0.0001). Results of the 6MWT and SGRQ are presented in Figures 1 and 2, respectively.

Thirty-eight patients returned to the pulmonary rehabilitation department for a second program. The improvement achieved after the second session was similar to improvement after the first session. Patients with an extended participation period (n=38) showed no additional improvement in the 6MWT or SGRQ outcomes, but they maintained their improvement for a longer period of time.

**DISCUSSION**

Pulmonary rehabilitation is recognized as a basic treatment for COPD patients and is reimbursed by health funds in Israel for patients with FEV1 < 50% predicted. The effect in non-COPD patients is less well established and as such this treatment modality is less frequently offered to this patient population.

In the present study we showed that a twice-weekly, short-term pulmonary rehabilitation program provides substantial benefits both in functional capacity (6MWT) and quality of life (SGRQ) among patients with non-COPD lung diseases. We described a real-life scenario of pulmonary rehabilitation among non-COPD pulmonary patients. The largest group of participants presented with ILD. The improvement in the 6MW test among these patients was similar to the findings in small previous studies [7-9]. The Cochrane review [10] found an improvement of 44.3 meters in the 6MW test among 86 ILD patients participating in different rehabilitation programs. In our study the improvement among 59 ILD patients was 61.9 meters. The quality of life among ILD patients, as measured by SGRQ, showed a significant improvement of 7 points. These results were similar to the results reported by Vainshelboim and colleagues [7], which showed a significant reduction of 9.7 points, while Tonelli and co-authors [9] found a reduction of 12.1 points.

In our study, 18 patients presented with non-ILD restrictive lung disease. They showed a 68.7 meter improvement in the 6MW test. Similar results were achieved in a study by Salhi [11], which found a 64 meter improvement after 12 weeks and a 81 meter improvement after 24 weeks. The quality of life improved significantly among asthma patients as shown by a significant reduction of 9.4 points in the SGRQ. Mendes et al. [12] also demonstrated improved quality of life among asthma patients after rehabilitation. In that study, the quality of life was evaluated by the health-related quality of life (HRQoL) measure. The patients demonstrated significant improvement (P < 0.001) in most parameters. We enrolled 30 patients presenting with lung cancer without evidence of COPD. These patients had significant improvement in the 6MWT (460 meters) and in SGRQ (−10.7 points). Jones [13] showed a significant improvement of 49 meters in 6MWT among patients with lung cancer.

Our findings among different groups of non-COPD patient are consistent with the evidence shown in the literature. Even though the evidence shows significant benefit, the number of studies and the number of patients in the studies is low, thus pulmonary rehabilitation is not considered a routine treatment in patients with non-COPD pulmonary disease. We assume that many patients who could benefit from the treatment were not addressed at all. This is the first study showing that a heterogeneous group of non-COPD pulmonary patients who participated in a short-term pulmonary rehabilitation program, gained significant improvement of both in functional capacity (6MWT) and quality of life (SGRQ).

Those results are consistent with the evidence in the literature regarding the benefits of physical activity among the vast majority of patients [21,22]. In the present study, 38 patients with non-COPD lung disease had an extended participation period. We failed to show any significant additional improvement in the 6MWT or SGRQ score. The fact that repeated sessions did not achieve further improvement does not mean that the treatment was futile. The repeated sessions maintained the positive effect for a longer period. Among COPD patients it has been shown that the benefits of pulmonary rehabilitation diminish after 6 to 12 months [23] and that achievement lost can be regained with repeated pulmonary rehabilitation sessions. We believe that the same is true among non-COPD pulmonary patients. Therefore it is plausible that a more prolonged rehabilitation program maintained the positive effects gained by our non-COPD participants for a longer time then would be expected otherwise.
LIMITATIONS
The study had no control group and therefore the relative placebo effect and the Hawthorn effect could not be measured. Nevertheless, being a real world scenario study, it is the patient’s beneficial gains that are important and as such the outcomes are indisputable.

Another limitation is the partial response rate (33%) regarding the pre- and post- SGRQ. Despite the relatively small number of completed questionnaires, the magnitude of change (8.3 points) in the quality of life as represented by the SGRQ (P < 0.001) is substantial when compared to the frequently quoted seminal COPD studies (TORCH and UPLIFT), which showed a 2 to 4 point improvement with the use of inhalers with COPD patients [24,25]. Furthermore as responders and non-responders did not differ in their clinical or demographic characteristics one may assume that the results represent the group as a whole. Last, the results of the small number of participants diagnosed with bronchiectasis or pulmonary hypertension, or who underwent thoracic surgery are less robust.

CONCLUSIONS
Pulmonary rehabilitation provides significant beneficial effects in both quality of life and functional capacity to most patients presenting with non-COPD pulmonary diseases. We believe that pulmonary rehabilitation should be offered to the majority of patients with chronic respiratory disease.

Future research should be conducted to further validate the current results among larger patient groups as well as provide answers to the many unanswered questions such as: what is the optimal program length? How long does the positive effect of pulmonary rehabilitation last? How often should a repeat refresher session be offered to patients?

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References

“Nothing happens quite by chance. It’s a question of accretion of information and experience”
Jonas Salk (1914-1998), American medical researcher and virologist, discovered and developed one of the first successful polio vaccines.