# Pulmonary Rehabilitation among Chronic Obstructive Pulmonary Disease (COPD) Patients at Pulmonary Hospital Tirana

**Ledi Neçaj, Ervin Marku, Zamir Damani**
Faculty of Technical Medical Sciences, Medical University of Tirana, Albania

## Abstract

**Background:** Pulmonary rehabilitation (PR) in COPD patients from different studies has shown a great impact on the quality of life among patients.
**Aim:** Our aim was evaluation of pulmonary rehabilitation with exercise training among COPD patients treated at Pulmonary Hospital in Tirana.
**Methods:** For our purpose, we included 13 patients. An inclusive criterion for our study was that all patients in the analysis must be with COPD. The length of study was 12 week. This time was based in our experience and was also was similar to other studies The mean age and SD was 67±13 years and forced expiratory volume was found to be on average 71±25.2% as predicted. The pulmonary rehabilitation exercise training was performed in following comprised endurance and strength. The functional balance assessment was done before and after PR and was based on Timed up and Go (TUG) test. The strength of quadriceps muscle was assessed as well as (10 repetition maximum) exercise tolerance (6-minuts walking) was taking into account for PR. In order to assess the quality of life a self administrated questioner was given to all participants. The questioner was based on St George's Respiratory Questionnaire.
**Results:** *Tug* score before and after as changed -1.7 ±1.8 sec, p=0.001, effect size 1.17.
Out of 13 patients 3 (23.1%) before, and 2 (15.4%) after PR, the TUG performance was worse than average. The St George's Respiratory Questionnaire symptoms score (p=0.012), quadriceps muscle strength (p=0.001), and exercise tolerance (p=0.001) were improved.
**Conclusions:** Our results show that PR associated with exercise training program had a great impact in improving the quality of life among patient with COPD
**KEYWORDS:** COPD, PR, patients, quality of life

## INTRODUCTION

Patients with chronic obstructive pulmonary disease (COPD) present impairments in exercise tolerance, muscle strength in both upper and lower extremities, self-reported functioning, and also in balance (1). Moreover, recent studies suggest that these patients fall frequently (2,3).
Evidence has shown that the risk of falling in older adults is multifactorial, and balance (2) and postural control (4) impairments are important predictors of falls (5). Thus, multicomponent interventions including walking, balance, and strength training have been recommended (6). Pulmonary rehabilitation (PR) is an effective intervention for COPD, which includes exercise training and psychosocial support and education for patients to achieve maximal independence and function in the community (7). However, this recommended standard of care is mainly focused on training periph-eral muscles through endurance and strength training and does not include a specific component of balance training. Although exercise has been shown to improve balance and decrease fall risk in older adults, (8) when the effect of PR on balance in patients with COPD was

studied, only minor improvements on balance were found (9). The primary aim of this study was to assess the effects of a PR program, including a specific component of balance training, on functional balance of patients with COPD.

## PATIENTS AND METHODS

A single group, pretest-posttest design was used. The study received full approval from the Institutional Ethics Committee. A convenience sample of outpatients with COPD was recruited in 1 primary care center. Inclusion criteria were diagnosis of COPD according to the Global Initiative for Chronic Obstructive Lung Disease, (10) ≥18 years, and clinical stability for 1 month prior to the study (ie, no hospital admissions or exacerbations). Patients were excluded if they presented with severe psychiatric, neurologic, or musculoskeletal conditions and/or unstable cardio-vascular disease. Eligible patients were informed about the study by general practitioners, and 13 patients were contacted by the researchers. Before data collection, written informed consent was obtained.

### Data Collection

Data on sociodemographic, fall history, and lung function were obtained to characterize the sample. Fall history was assessed with a standardized question "Have you had any falls in the last 12 months?" Lung function was assessed with spirometry and the COPD grade was determined (10). To assess the effects of the PR program, activities limitation resulting from breath-lessness and health-related quality of life (HRQOL) were collected, followed by the assessment of quadri-ceps muscle strength, exercise tolerance, and functional balance. All questionnaires and tests were administered before and after the PR program.

### Intervention

The PR program was conducted for 12 weeks and included 2 main components—exercise training (3 times a week for 60 minutes each session) and psychosocial support and education (once a week for 90 minutes). The exercise training component comprised the following:

1. A warm-up of 5 to 10 minutes including range of motion, stretching, low-intensity aerobic exercises, and breathing techniques, such as pursed lips breathing, body positions, diaphragmatic breathing, and airway clearance techniques.

2. Endurance training (walking) for 20 minutes at 60% to 80% of the average speed achieved during the 6-minute walk test (6MWT). Training intensity was adjusted according to patient symptoms of fatigue and dyspnea (Modified Borg Scale) (7).

3. Strength training (15 minutes) included 7 exercises (2 sets of 10 repetitions) of the major upper and lower limb muscle groups using elastic bands, free weights, and ankle weights. The amount of weight was between 50% and 85% of the 10 repetition maximum (10-RM) (7). The training load was increased when the patient performed 2 additional repetitions with a given load on 2 consecutive sessions. The training intensity was adjusted as de-scribed in the endurance training.

4. Balance training for 5 minutes consisted of static and dynamic exercises using mainly upright positions. Balance exercises were organized in the following 4 levels (6): (1) postures that gradually reduced the base of support; (2) dynamic movements that perturbed the center of gravity; (3) stressing postural muscle groups; and (4) dynamic movements while performing a secondary task individually or in groups, with a progressively narrowed base of sup-port. In this component, patients were also trained on how to lie down and get up from the floor.
5. A cool down of 10 minutes included similar exercises to the warm-up.

The psychosocial support and education component provided information about COPD; healthy lifestyles; falls and fall prevention strategies; emotion-management strategies; problem solving techniques, and community resources.

**Functional Balance**

The primary outcome measure was *functional balance*, defined as the ability to maintain equilibrium in dynamic situations required for daily activities. The Timed Up and Go (TUG) test was used to assess functional balance, as recent research has suggested that assessment of balance under multitask conditions may be a more sensitive indicator of balance problems and falls than assessment of balance in a single-task con-text (11). The test requires the patient to rise from a standard chair, walk 3 m, turn around, walk back to the chair, and sit down. Patients were instructed to walk quickly, but as safely as possible. Two TUG tests were performed and the best performance was recorded. This test has been shown to predict falls in community-dwelling older adults, (11) and normative reference scores are available (12).

**Secondary Outcome Measures**

Activities limitation resulting from breathlessness was assessed by patients selecting the statement from the modified British Medical Research Council questionnaire that best described their limitation. Health-related quality of life was assessed using the St George's Respiratory Questionnaire (SGRQ), and a change of 4 units was considered clinically relevant (13). Quadriceps muscle strength was assessed using the 10-RM with ankle weights. Exercise tolerance was measured using the 6MWT. Two tests were performed and the best performance was recorded.

**Statistical Analysis**

Descriptive statistics were used to describe the sample. Measurements collected before and after the PR program were compared using paired *t* tests for normally distributed data, the Wilcoxon signed-rank test for non normally distributed data and ordinal data, and the McNemar test for dichotomous categorical data. Correlations between functional balance changes and changes in SGRQ total score, SGRQ symptoms score, quadriceps muscle strength, and 6MWT were analyzed with the Pearson or Spearman correlation coefficient. All statistical analyzes were performed using PASW Statistics version 18.0 for Windows (SPSS Inc, Chicago, IL), and graphs were created using Graph Pad Software 5.0 (La Jolla, CA). Effect sizes (ES) were also determined to explore the degree to which the PR program was responsible for changes in activities limitation resulting from breathlessness, HRQOL, muscle strength, exercise tolerance, and functional balance. ESs were calculated as the mean difference in values before and after PR

divided by the mean standard deviation (ie, mean ± SD before and after PR) using G*Power Software 3.1.1 (Kiel, Germany). The magnitudes of the ES were interpreted as ≥0.2 small effect, ≥0.5 medium effect, and ≥0.8 large effect (14). The level of significance considered was 0.05.

## RESULTS

A total of 13 patients enrolled in the study. Regarding COPD severity, 9 patients had mild, 8 moderate, and 5 severe to very severe COPD. Almost half of the participants (n = 10; 45.5%) reported at least 1 fall in the preceding year. Table 1 provides the socio demographic and clinical characteristics of the participants.

**Table. 1 • Socio demographic and Clinical Characteristics of the Participants (n = 22)[a]**

| Characteristics | Results |
|---|---|
| | |
| Age, yrs | 67.0 ± 13 |
| Male | 13 (100%) |
| BMI, $kg/m^2$ | 28.4 ± 6.0 |
| $FEV_1$, % predicted | 71 ± 25.2 |
| GOLD classification | |
| Mild | 9 (69.2%) |
| Moderate | 8 (61.5%) |
| Severe to very severe | 5 (38.5%) |
| Fall history | 10 (76.9%) |

Abbreviations: BMI, body mass index; $FEV_1$, forced expiratory volume in 1 second; GOLD, Global Initiative for Chronic Obstructive Lung Disease. [a]Values are mean ± SD or n (%).

A comparison of measures before and after PR is presented in Table 2. After the PR program, the activities limitation resulting from breathlessness was significantly reduced (mean change = −0.5; p=0.025; ES = 0.466). The SGRQ total score did not change significantly (mean change = −4.3 units; *p*=0.089; ES =0.391), although the change reached clinically relevance (13). There was a significant improvement of the SGRQ symptoms score (mean change = −12.2 units; p=0.012; ES=0.604), quadriceps muscle strength (mean change = 3.1 kg; *p*=0.001; ES = 1.475), and exercise tolerance (mean change = 35.7 m; *p*=0.001; ES =1.027).
Regarding the effect of PR on functional balance, the TUG score showed a significant improvement (Figure 1) (mean change = −1.7 seconds; *p*=0.001; ES=1.249). Before PR, approximately half of the sample (n = 9; 46.2%) and after PR only 1 participant (7.7%) (*p*=0.008) had a TUG score worse than the average of age-matched healthy peers (12).

There were no statistically significant correlations between change in functional balance and change in SGRQ total score (*r*=0.171), SGRQ symptoms score (*r* = −0.018), quadriceps muscle strength (*r*=0.207), or 6MWT distance (*r* = −0.060).

**Table 2 • Effect of Pulmonary Rehabilitation on the Activity Limitation Resulting From Breathlessness, Health-Related Quality of Life, Quadriceps Muscle Strength, Exercise Tolerance, and Functional Balance (n = 22)[a]**

| Variable | Pre-PR | | PostPR | | Mean Change (95% CI) | | | *P* Value | ES |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| mMRC, score | 2.6 | ± 1.0 | 2.2 | ± 0.80 | −0.5 | ± 0.9 | (−0.8, −0.1) | 0.025[b] | 0.466 |
| SGRQ, total score | 43.5 | ± 19.5 | 39.2 | ± 17.8 | −4.3 | ± 11.0 (−9.3, 0.7) | | 0.089 | 0.391 |
| 10-RM quadriceps | 3.2 | ± 1.7 | 6.3 | ± 2.2 | 3.1 | ± 2.1 | (2.2, 4.0) | 0.001[b] | 1.475 |
| strength, kg | | | | | | | | | |
| 6MWD, m | 375.8 | ± 94.9 | 411.4 | ± 97.0 | 35.7 | ± 34.7 (20.2, 51.0) | | 0.001[b] | 1.027 |
| TUG score, s | 8.9 | ± 2.3 | 7.2 | ± 1.7 | −1.7 | ± 1.4 | (−2.3, −1.1) | 0.001[b] | 1.249 |

Abbreviations: 6MWD, 6-minute walking distance; ES, effect size; mMRC, Modified British Medical Research Council questionnaire; RM, repetition maximum; SGRQ, St George's Respiratory Questionnaire; TUG, Timed Up and Go.
[a]Values are mean ± SD. Mean change: Post-PR minus Pre-PR. [b]Significant at $P<0.05$

## DISCUSSION

The main finding of this study was that a PR program with a specific component of balance training had a large effect on functional balance improvements in patients with COPD.

Similar to other studies, which have assessed the effects of PR on patients with COPD, significant improvements on activities limitation resulting from breathlessness, HRQOL, muscle strength, and exercise tolerance were found. This shows that the implemented program was, overall, at least as effective as it has been previously reported. Regarding the effect of the program on patient functional balance, a change of −1.63 ± 1.8 seconds in TUG score was found. This result is slightly higher than the value obtained by Beauchamp et al (9) −1.5 ± 2.4 seconds). In our study, the ES for TUG test was much larger (ES=1.249) than in theirs (ES=0.625), indicating that PR with a specific component of balance training may contribute to greater functional balance improvements than standard PR. However, this comparison must be considered with caution because the 2 studies included patients with different grades of the disease (forced expiratory volume in 1 second =71.± 25.2% predicted in the present study vs 46.3 ± 22.3% predicted in Beauchamp et al (9) and employed different TUG protocols.

Even with the uncertainty that PR programming with balance training improves patient functional balance to a greater extent than standard PR, our findings clearly demonstrate that most participants with a TUG score worse than the average of their age-matched healthy peers at baseline (12) achieve a normal TUG performance after the program. As TUG assesses balance under multitask conditions and this is similar to the performance of activities of daily living, (11) this finding suggests a lessening of overall fall risk in

these patients.

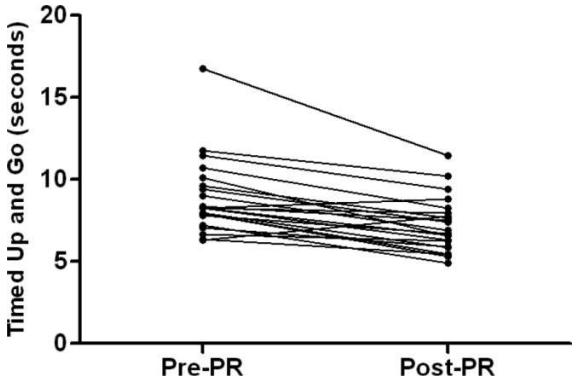


**Figure 1.Timed Up and Go score of the participants before and after the pulmonary rehabilitation (PR) program.**

Currently, it is not possible to determine whether the TUG score improvement found in this study has clinical relevance, as TUG minimal detectable change (MDC) has not been determined for COPD. The MDC is the smallest amount of difference in individual scores between 2 points in time that represents a true statistical change. Therefore, we cannot firmly state that including a 5-minute component of balance training in PR programs is sufficient to promote clinically relevant functional balance improvements in patients with COPD. Nevertheless, in our study, balance training was implemented with the recommended frequency (3 times per week) (15) and incorporated static and dynamic exercises similar to everyday activities. Leung et al (16) assessed the effect of Short-form Sun-style Tai Chi compared with no exercise training on balance in patients with COPD. The intervention was 12 weeks, twice a week, for 60 minutes. It was observed that the Tai Chi group had a significant improvement in functional reach distance, compared with the control group (ES=1.45) (16). The distinctly different dose trainings in our study and Leung et al (6) demonstrate the urgent need for guidelines addressing the optimal dose-response ratio of balance training.

**References**

1. Eisner M, Blanc P, Yelin E, et al. COPD as a systemic disease: impact on physical functional limitations. *Am J Med*. 2008;121:789-796.

2. Beauchamp M, Hill K, Goldstein R, Janaudis-Ferreira T, Brooks D. Impairments in balance discriminate fallers from non-fallers in COPD. *Respir Med*. 2009;103:1885-1891.

3. Roig M, Eng J, MacIntyre D, et al. Falls in people with chronic obstructive pulmonary disease: an observational cohort study. *Respir Med*. 2011;105:461-469.

4. Roig M, Eng J, Macintyre D, Road J, Reid W. Postural control is impaired in people with COPD: an observational study. *Physiother Can*. 2011;63:423-431.

5. Muir S, Berg K, Chesworth B, Klar N, Speechley M. Balance impairment as a risk factor for falls in community-dwelling older adults who are high functioning: a

prospective study. *Phys Ther*. 2010;90:338-347.

6. Chodzko-Zajko WJ, Proctor DN, Fiatarone Singh MA, et al. Exercise and physical activity for older adults. *Med Sci Sports Exerc*. 2009;41:1510-1530.

7. Nici L, Donner C, Wounters E, et al. American Thoracic Society/ European Respiratory Society statement on pulmonary reha-bilitation. *Am J Respir Crit Care Med*. 2006;173:1390-1413.

8. Gillespie L, Robertson M, Gillespie W, et al. Interventions for preventing falls in older people living in the community. *Cochrane Database Syst Rev*. 2012;9:CD007146.

9. Beauchamp M, O'Hoski S, Goldstein R, Brooks D. Effect of pulmonary rehabilitation on balance in persons with chronic obstructive pulmonary disease . *Arch Phys Med Rehabil*. 2010;91:1460-1465.

10. Global Initiative for Chronic Obstructive Lung Disease (GOLD). Global strategy for the diagnosis, management and prevention of COPD. Published 2013. http://www.goldcopd.org./. Accessed March 28, 2013.

11. Shumway-Cook A, Brauer S, Woollacott M. Predicting the prob-ability for falls in community-dwelling older adults using the Timed Up & Go Test . *Phys Ther*. 2000;80:896-903.

12. Bohannon RW. Reference values for the timed up and go test: a descriptive meta-analysis. *J Geriatr Phys Ther*. 2006;29:64-68.

13. Jones PW. St. George's Respiratory Questionnaire: MCID. *COPD*. 2005;2:75-79.

14. Cohen J. A power primer. *Psychol Bull*. 1992;112:155-159.

15. Garber CE, Blissmer B, Deschenes MR, et al. American College of Sports Medicine position stand. Quantity and quality of exer-cise for developing and maintaining cardiorespiratory, muscu-loskeletal, and neuromotor fitness in apparently healthy adults: guidance for prescribing exercise. *Med Sci Sports Exerc*. 2011;43:1334-1359.

16. Leung RWM, McKeough ZJ, Peters MJ, Alison JA. Short-form Sun-style tai chi as an exercise training modality in people with COPD. *Eur Respir J*. 2013;41:1051-1057.

17. Cote CG, Celli BR. Pulmonary rehabilitation and the BODE index in COPD. *Eur Respir J*. 2005;26:630-636.

18. Selzler A-M, Simmonds L, Rodgers WM, Wong EYL, Stickland MK. Pulmonary rehabilitation in chronic obstructive pulmonary disease: predictors of program completion and success. *J COPD*. 2012;9:538-545.