

Title	Outcomes of pulmonary rehabilitation for COPD in older patients: a comparative study
Authors	Bennett, Deirdre;Bowen, Bernadette;McCarthy, Padriac;Subramaniam, Abi;O'Connor, Michael;Henry, Michael T.
Publication date	2016-12-20
Original Citation	Bennett, D., Bowen, B., McCarthy, P., Subramaniam, A., O'Connor, M. and Henry, M. T. (2016) 'Outcomes of Pulmonary Rehabilitation for COPD in Older Patients: A Comparative Study', COPD: Journal of Chronic Obstructive Pulmonary Disease, pp. 1-6.
Type of publication	Article (peer-reviewed)
Link to publisher's version	10.1080/15412555.2016.1258051
Rights	© 2016 Taylor & Francis Group, LLC. http://www.tandfonline.com/10.1080/15412555.2016.1258051
Download date	2023-09-30 20:06:01
Item downloaded from	https://hdl.handle.net/10468/3536



UCC

University College Cork, Ireland
Coláiste na hOllscoile Corcaigh



Outcomes of pulmonary rehabilitation for COPD in older patients: A comparative study.

Journal:	<i>COPD: Journal Of Chronic Obstructive Pulmonary Disease</i>
Manuscript ID	Draft
Manuscript Type:	Original Paper
Date Submitted by the Author:	n/a
Complete List of Authors:	Bowen, Bernadette ; Cork University Hospital Group, Respiratory Medicine Bennett, Deirdre; University College Cork National University of Ireland, Medical Education Unit McCarthy, Padriac; University College Cork National University of Ireland, Respiratory Medicine Subramaniam, Abi; Cork University Hospital Group, Respiratory Medicine O'Connor, Michael; Cork University Hospital Group, Dept Of Medicine for the Elderly Henry, Michael; University College Cork National University of Ireland, Respiratory Medicine; Cork University Hospital Group, Respiratory Medicine
Keywords:	COPD, Pulmonary Rehabilitation, Older patients, exercise

SCHOLARONE™
Manuscripts

1
2
3 **Outcomes of pulmonary rehabilitation for COPD in older patients: A comparative**
4
5 **study.**
6

7 Authors: Bowen B¹, Bennett DM³, Subramaniam A¹, McCarthy P², O'Connor M^{2,4}, Henry
8 MT^{1,2}
9
10

- 11
12
13
14 1. Department of Respiratory Medicine, Cork University Hospital, Cork, Ireland
15
16 2. Department of Medicine, University College Cork, Cork, Ireland.
17
18 3. Medical Education Unit, University College Cork, Ireland
19
20 4. Department of Medicine for the Elderly, Cork University Hospital, Cork, Ireland
21
22

23
24
25 Email addresses:
26

27 Bowen. B Bernadette.bowen@hse.ie

28 Bennett DM d.bennett@ucc.ie

29 Subramaniam A dr.abisubra@gmail.com

30 McCarthy P pmmccarthy1992@gmail.com

31 O'Connor M Michael.oconnor1@hse.ie

32 Henry MT Michael.henry@hse.ie
33
34
35
36
37
38
39
40
41
42
43
44

45 CORRESPONDENCE TO: Michael T Henry, MD, Department of Respiratory Medicine,
46
47 Cork University Hospital and Department of Medicine, University College Cork, Wilton,
48
49 Cork, Ireland. e-mail: michael.henry@hse.ie
50

51
52 Tel: 00 353 21 4920169 Fax: 00 353 21 4920168
53

54 **Running head:** Pulmonary Rehabilitation for COPD in older patients
55

56 **Keywords:** Pulmonary Rehabilitation, COPD, older patients, exercise
57
58
59
60

Abstract

Pulmonary rehabilitation (PR) is established as an effective intervention in optimising function and quality of life in patients with COPD. However, there is limited data on the effectiveness of PR in older patients with COPD.

We reviewed all patients attending an 8 week outpatient programme. Patients were divided into two groups; Group A (n=202), below 70 years and Group B (n=122), above 70 years of age. Outcomes in both patient subgroups were compared using FEV₁, Incremental Shuttle Walk Test (ISWT), Endurance Shuttle Walk Test (ESWT), Grip Strength, St. George's Respiratory Questionnaire (SGRQ), Hospital Anxiety and Depression Score (HADS), and COPD Assessment Test (CAT) score. Statistical analysis was conducted using Mann-Whitney non-parametric testing and Chi-squared testing for comparison of clinically relevant improvements between groups.

There was no significant difference in PR outcomes between Group A and Group B using absolute values. Mean changes for ISWT in Group A and B 39.7m vs. 32.8m (p=0.63) respectively, SGRQ -2.5 vs. -2.8 (p=0.95), HADS anxiety score -0.83 vs. -0.57 (p=0.43) and HADS depression score -0.69 vs. -0.39 (p=0.48) respectively. There was no difference in the proportion of patients who achieved the minimally clinically significant improvement in Group A versus Group B in for parameters ISWT (38.6% vs 42.7%), SGRQ (27.8% vs 21.3%), HADS total score (20.5% vs 28.1%).

These data suggest that benefits of PR in COPD are not age dependent. Age should not be a barrier to enrolling patients with COPD in PR programmes.

1
2
3 ABBREVIATIONS: COPD=chronic obstructive pulmonary disease, PR = pulmonary
4 rehabilitation, BMI = body mass index, FEV₁ = forced expiratory volume in one second,
5
6
7 ISWT= incremental shuttle walk test, ESWT = endurance shuttle walk test, SGRQ = St.
8
9 George's Respiratory Questionnaire, HADS = hospital anxiety and depression score, CAT =
10
11 COPD assessment test, HRQoL = health related quality of life, mMRC = Modified Medical
12
13 Research Council score, MCID = minimal clinically important difference, ADL = activities
14
15 of daily living.
16
17
18
19

20 21 **Introduction**

22
23 Chronic Obstructive Pulmonary Disease (COPD) is associated with increased morbidity and
24
25 mortality worldwide. It is the fourth leading cause of death worldwide and is predicted to be
26
27 the third most common cause of death by 2020 [1]. In Ireland, COPD has an estimated
28
29 prevalence of 400,000 people from a population of 4.58 million and according to the
30
31 INHALE report [2]. The prevalence of COPD is increasing in older age groups [3]. In the
32
33 context of an ageing population, it is evident that health burden of COPD and its co-
34
35 morbidities will continue to increase and exert a major impact on health services
36
37 internationally [2,4]. Pulmonary rehabilitation (PR) plays a crucial role in the care of COPD
38
39 patients and has been shown to reduce improve exercise and functional capacity and reduce
40
41 exacerbations [1,5,6,7]. Many studies have established the effectiveness of PR in improving
42
43 exercise tolerance, health related quality of life (HRQoL) as well as reducing dyspnoea,
44
45 exacerbations and hospitalisations [8-11]. The effectiveness of PR in older patients with
46
47 COPD has been examined in a number of small studies however, it has not been convincingly
48
49 demonstrated that older patients respond as well to PR as younger patients [12-15]. The aim
50
51 of this study was to compare the efficacy of PR in a large cohort of COPD patients above and
52
53 below the age of seventy years.
54
55
56
57
58
59
60

Methods

A retrospective review was performed on all patients with a confirmed diagnosis of COPD, who completed a 8 week, 16 session, outpatient PR programme over 6 years between 2008 and 2014. This was an outpatient programme based in a local community hospital with gym and educational facilities. Patients were referred to the PR programme through the outpatient service of the Department of Respiratory Medicine, Cork University Hospital by the lead physician for COPD and PR (MTH). Patients were only excluded if they could not access the facility for logistical reasons or were deemed neurologically or cardiologically unsuitable for an outpatient PR programme. Individually prescribed exercise programmes were designed for patients by an experienced COPD physiotherapist and nurse specialist. Full physiological assessments took place before and immediately after completion of the PR programme. Sixteen educational sessions were provided by the consultant respiratory physician, respiratory physiotherapist and COPD nurse specialist, social worker, professional smoking cessation counsellor and clinical psychologist.

The patients were divided into two groups; Group A below the age of 70 and Group B, above 70 years. Patient demographics and PR outcomes were collected from the programme database. Outcome measures analysed were forced expiratory volume in one second (FEV_1), Incremental Shuttle Walk Test (ISWT) distance, Endurance Shuttle Walk Test (ESWT) time, Grip Strength, St. George's Respiratory Questionnaire (SGRQ) and Hospital Anxiety and Depression Score (HADS), Modified Medical Research Council (mMRC) and CAT (COPD assessment test) scores. Data was analysed using SPSS V.21. The efficacy of PR was assessed by comparing the differences in the evaluated parameters between the two groups. Mann-Whitney U test and Chi-squared test were used to evaluate changes in parameters post-programme by age group in three ways, in keeping with

1
2
3 approaches used in previous studies; change in mean raw measures as illustrated in **table 2**,
4
5 mean % change from baseline in **table 3** and proportion of patients achieving minimally
6
7 clinical significant improvement. For some parameters the dataset was incomplete and this
8
9 is reflected in the results tables below. Both Mann-Whitney U and Chi –squared testing were
10
11 also used to determine whether there was a significant difference between groups defined by
12
13 clinically significant change [16] in ISWT, SGRQ, HADS and CAT corrected for their
14
15 baseline mean BMI, (dividing the patient cohort into those with BMI < 20 versus those \leq 20),
16
17 FEV₁ (those < 1 L/s versus those \geq 1 L/s) and CAT score (those with CAT score < 20 versus
18
19 those with a score \geq 20). P-values of less than 0.05 were considered statistically significant
20
21 throughout. This study was approved by the clinical research ethics committee (CREC) of the
22
23 Cork University Hospitals.
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Results

A total of 324 COPD patients attending the PR programme were analysed, of whom 122 patients were 70 years of age or above. In Group A, the mean (SD) age was 61 (3.79) years while in Group B was 75 (6.9) years. Patients' mean baseline characteristics are shown in Table 1. Table 2 shows the mean change in raw measures post PR programme by age group. Mann Whitney U testing showed that there was no significant differences in the changes achieved between the younger Group A patients and the older Group B patients. Table 3 illustrates the % change in parameters post-programme in order to take into account the differences in baseline parameters between the groups. Again, no significant differences between age groups were found.

We also compared the proportion of patients achieving clinically significant improvement in parameters between age groups using a Chi squared test. Parameters examined were ISWT – (MCID 47.5M) [17], total SGRQ score (MCID -4) [18], total HADS score (MCID 1.5) [19] and CAT score (MCID 2). There is no universally accepted MCID for grip strength.

38.6% of patients in group A and 42.7% of patients in group B achieved a MCID in ISWT distance walked post PR programme. This difference was not significant between groups. 27.8% of patients in group A and 21.3% in group B achieved MCID in SGRQ score post programme. This difference was not significant between groups. 20.5% of patients in group A and 28.1% of patients in group B achieved a MCID in HAD score post PR programme. This difference was not significant between groups. Finally, 26.5% of group A patients and 25.9% of patients in group B achieved MCID in CAT scores post PR programme and again there was no significant difference between groups. Overall taking into account all 3

1
2
3 parameters, 56.2% patients in Group A and 51.4% of patients in Group B achieved an MCID
4
5 in at least one of the 3 parameters measured and there was no significant difference between
6
7 groups.
8
9

10
11 When we attempted to control for patient cohort baseline FEV₁, CAT score and BMI to
12
13 determine if these baseline parameters were associated with better outcomes from PR across
14
15 the group (**table 4**) as a whole and in both the younger and older patient cohorts we found the
16
17 following: The numbers with low BMI (<18.5) were very small (n=8) and thus the data was
18
19 insufficient for comparison. Using both Mann U Whitney (p=0.007) and Chi squared
20
21 analysis (p=0.003), a lower FEV₁ (<1 L/s) pre-programme (at baseline) was associated with
22
23 a clinically significant improvement in HADS score across the whole population over the
24
25 course of the PR program. Those with lower FEV₁ were found to be most likely to gain
26
27 improvement in both anxiety and depression scores. This relationship was found to be age
28
29 independent, baseline FEV₁ <1 L/s versus HADS improvement in Group A (p=0.011) was
30
31 matched by the improvement in HADS in the low FEV₁ in Group B (P=0.017).
32
33
34
35

36 In contrast in Group A, under 70 year old COPD patients, those who achieved with a
37
38 clinically significant improvement of >2 points in CAT score had a higher FEV₁ at baseline
39
40 (≥ 1 L/s), (p=0.01). Looking at baseline CATS scores to define predictors of response we
41
42 found the following: A lower baseline CAT is linked to clinically significant change in CAT
43
44 across age groups. A lower baseline CAT (<20) was linked to clinically significant change in
45
46 ISWT in Group B (>70 years) but not in Group A, however, a lower baseline CAT (<20) was
47
48 linked to clinically significant change in SGRQ Group A but not in Group B.
49
50

51 Those who achieved a clinically significant improvement in ISWT had a lower CAT score
52
53 (<20) at baseline in Group B (p=0.007, Mann U Whitney, p=0.014 Chi squared). In Group
54
55
56
57
58
59
60

1
2
3 A, this relationship was significant using comparison of means ($p=0.01$) but not by Chi
4
5 squared test.

6
7 A low CAT score at baseline did not predict improvement of SGRQ scores in Group B, but
8
9 did predict improvement in SQRG in the younger Group A ($p=0.01$ Mann U Whitney, $p=0.05$
10
11 Chi squared)
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

For Peer Review Only

Discussion

The efficacy of PR is well recognised as a therapeutic intervention in COPD patients; however, the benefits amongst older patients remain unclear. Our data suggest that COPD patients over the age of 70 years benefit from a comprehensive outpatient PR programme to a similar extent to their younger counterparts under 70 years.

COPD is a growing problem in the older patients and is often undertreated. [20] Some previous PR studies, have excluded patients over the age of seventy. [21,22] It is apparent PR has sometimes been considered inappropriate for older patients because of the physiological effects of ageing which would limit their ability to take part or improve their exercise capacity. The justification for age exclusion remains ambiguous, nevertheless patients over the age of 70 years are frequently excluded along with patients with other co-morbidities such as ischaemic heart disease, heart failure or and arthritis. [22,23] Furthermore, clinical trials commonly use the age seventy as the lower limit for patient recruitment based on the consideration that those between the age of 65 and 70 years have a general health status that is good enough to benefit from therapeutic interventions that are often used in younger patients. [24] We chose a threshold of seventy years for our study to test the hypothesis that age should not be a barrier to the benefits of PR in COPD. There are data in the literature that older patients and older patients with severe COPD benefit from PR. Couser *et al* compared the effects of inpatient and outpatient pulmonary rehabilitation on old older patients COPD patients (aged 75 years or over) and younger subjects.[12] The data from this study suggest that 6-month comprehensive outpatient PR programmes are as beneficial in

1
2
3 older patients with severe or very severe COPD as they are in younger. The authors suggested
4
5 that patients with seriously impaired lung function and major exercise limitation (n=150
6
7 patients, 17 patients over age 75 years with severe COPD) could benefit from a 6-month
8
9 ambulatory multidisciplinary PR programme, although they often have significant co-
10
11 morbidities. Adherence levels and benefits of older patients with COPD to this long duration
12
13 comprehensive programme were in the same range as those seen younger patients.
14
15

16
17
18 One of the strengths of our study was the large sample size of 324 patients and the long time
19
20 frame of 6 years over which the data was compiled compared to other studies conducted in
21
22 similar area. Katsura demonstrated that Pulmonary rehabilitation is an effective treatment in
23
24 terms of improving dyspnoea, exercise capacity and HRQoL in older COPD patients, and the
25
26 benefits are almost comparable for young-older patients and old-older patients patients.
27
28 However, this was a small study (n=59) and a 2 week programme. [13] Our study involves a
29
30 much larger cohort over 8 weeks and with patient numbers in both groups, allowing for a
31
32 high quality analysis to be carried out. Roomi *et al* assessed the effects of incremental
33
34 pulmonary rehabilitation for 12 weeks on older patients COPD patients over 70 years of age.
35
36 In a limited small cohort, they showed a significant increase in exercise capacity on the
37
38 6MWD. [25] Our study, which has the largest described cohort to date of older patients,
39
40 showed that both patient groups demonstrate comparable improvements in functional and
41
42 quality of life scores, with a majority of patients exceeding MCID thresholds in measured
43
44 clinical parameters in both groups.
45
46
47
48
49

50
51
52 The main limitation in this study is that it is retrospective and we do not have extensive
53
54 follow up data on long term patient outcomes and compliance with exercise post programme.
55
56 We have a large patient cohort and an 8 week, 16 session programme, however the data
57
58
59
60

1
2
3 collection though comprehensive, was not complete. Some baseline parameters, such as the
4
5 body mass index, blood pressure and other co-morbidities were not measured. These details
6
7 could have made the study more informative; to assess their impact on patients' performance
8
9 post PR. Interviewer bias should also be taken into consideration. Apart from that, there was
10
11 no control for both groups, but it would have been unethical to refuse PR to these COPD
12
13 patients who remain symptomatic.
14
15

16
17
18 From a functional aspect, both patient groups in this study had a negligible difference in their
19
20 lung function after PR. There was a relatively equal mean improvement seen across all
21
22 parameters in both groups following rehabilitation, with the exception of FEV₁. This is
23
24 similar to other studies which have shown that PR does not have a discernible effect on the
25
26 FEV₁ [8,10] confirming that that the benefits of PR are in improvements in patients' quality
27
28 of life and functionality rather than demonstrable improvements in pulmonary physiology.
29
30
31

32
33
34 The ISWT distance increased by 25% (39.7m) in Group A and 43% (32.8) in Group B albeit
35
36 from a lower baseline after PR. The older patients group did not attain an improvement that
37
38 would indicate a significant clinical response. However, as ISWT reflects the domestic
39
40 functional capacity of an individual, any positive change in exercise performance should be
41
42 considered as beneficial to the patient. [17] The same improvement in walk distance gain can
43
44 have a very different clinical meaning depending upon the baseline performance: a 70-m gain
45
46 may in fact provide either a negligible or substantial effect of the functional improvement
47
48 depending upon whether baseline walk distance was 250m or 100 m. Indeed, there is a strong
49
50 association between the walk distance and the level of independence in basic and
51
52 instrumental activities of daily living (ADLs). A comprehensive 12-week outpatient PR
53
54 programme has been shown to increase both 6 minute walk distance and activities of daily
55
56
57
58
59
60

1
2
3 living. [26] Relatively small improvements in walk distance in older patients who naturally
4 have a lower baseline walk distance may correspond to very clinically relevant improvements
5 in ADLs and personal independence, even allowing for modest real improvements as in the
6 case in our study. Similarly, a severe limitation in physical capabilities should not be a reason
7 for excluding older patients COPD patients from a PR programme; rather these patients may
8 achieve the greatest benefit. [15]
9

10
11 A strength of this study is that we recorded both ISWT and ESWT in our patient cohort.
12 Pepin et al validated the ESWR in terms of improvements perceived by patients. A change in
13 endurance shuttle walking performance of 45 - 85 s (or 60-115m) after bronchodilation is
14 likely to be perceived by patients. [27] Improvements of 78s and 68s in Groups A and B
15 respectively are almost certainly going to be perceived as beneficial in our study. Again there
16 was no significant difference between groups and the same argument likely applies as to why
17 there is a slightly smaller improvement in the older group who had a lower baseline. This
18 should not detract the very significant clinically important that both groups achieved after PR
19 with older patients performing as well as their younger counterparts. In the field of COPD
20 research, MID values have usually been reported as fixed values, expressed in the unit of the
21 instrument. When one takes age into account, perhaps MID estimates should be expressed as
22 a fraction of the baseline values. [28,29]
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44

45 We have no MCID for grip strength from literature. Our PR program spent considerable time
46 with patients working on upper limb strength and flexibility. This was reflected in
47 improvements in grip strength in both right and left hands in both group A and B. In our
48 cohort improvement in grip strength also showed no statistically significant difference
49 between the groups. However it is notable that the relative improvements are larger in the
50 older group who again, not unsurprisingly, started from a lower baseline. The improvement
51
52
53
54
55
56
57
58
59
60

1
2
3 was slightly higher in the right hand which is most likely accounted by the fact that a higher
4
5 proportion of people favour their right hand.
6
7

8
9
10 PR has also been shown to improve patients' HRQoL and we analysed this using the SGRQ
11 and HADS scores. A reduction of 4 units in SGRQ is considered to be the MCID. [16,18]
12
13 Reductions in SGRQ were similar between the two groups, 2.5 in Group A and 2.8 in Group
14
15 B. As for the HADS total score (MCID -1.5 units), Group A attained a larger reduction of
16
17 0.8, in comparison to Group B with 0.5 reduction. [19] Nonetheless, there was no statistically
18
19 significant difference between the outcomes in both groups. When the HADS domains were
20
21 assessed individually, depression scores dropped more than the anxiety scores in both groups.
22
23 This is consistent with earlier studies. [9,10] This may be explained by the improved
24
25 functional capacity that uplifts one's spirits and changes their outlook on life. The social
26
27 aspect of the programme also builds healthy interactions and motivations that may contribute
28
29 to this positive outcome. It is interesting that in both groups, those with a lower baseline
30
31 FEV₁ benefitted most in terms of improvement in HADS score with PR, suggesting that in
32
33 fact regardless of age, those with more severe COPD may derive most benefit in mood and
34
35 disease related anxiety. Similarly those with more severe disease reflected by a low
36
37 programme CAT score derived the most significant improvement in CAT score with PR
38
39 indicating again that regardless of age, disease severity should not be a barrier to participation
40
41 in a comprehensive PR programme.
42
43
44
45
46
47
48
49
50
51

52 **Conclusion**

53
54 In summary, our study suggests that PR is beneficial in both young and older patients COPD
55
56 patients, although trending slightly better in the younger cohort. Thus, age alone should not
57
58
59
60

1
2
3 be a limiting factor to participate in a PR programme as any improvement should be patients
4
5 of all age groups should be encouraged to enrol in this programme as it does have a role in
6
7 improving health outcomes.
8

9 10 **ACKNOWLEDGMENTS**

11 **Author contributions:** MTH is the senior author, conceived the project and is the guarantor
12
13 for the whole content of the manuscript. DBM reviewed the data, conducted the statistical
14
15 analysis and edited drafts of the paper. BB performed the PR and collected the data. PM and
16
17 AS collected data and performed initials analysis and wrote the first draft. MOC reviewed the
18
19 data and contributed to the final draft.
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Conflict of interest statement

FUNDING / SUPPORT: This research did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sector.

None of the authors report any conflict of interests.

The authors alone are responsible for the content and writing of the paper.

Reference:

1. GOLD. Global Strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease 2011 [updated January 2014]. Available from: http://www.goldcopd.org/uploads/users/files/GOLD_Report2014_Feb07.pdf.
2. Brennan N, McCormack S, O' Connor TM. Ireland needs healthier lungs - the evidence. INHALE Report 2nd Edition. 2008
3. Mannino DM, Gagnon RC, Petty TL, Lydick E. Obstructive lung disease and low lung function in adults in the United States. Data form the National Health and Nutrition Examination survey, 1988-94. Arch Intern Med 2000; 160: 1683-9
4. Lazano R. et al. Global and regional mortality from 235 causes of death for 20 age groups from 1990 and 2010: a systemic analysis for the global burden of disease study 2010. Lancet 2012; 380:2095-2128.
5. National Institute for Health and Care Excellence (NICE). Chronic obstructive pulmonary disease. Management of chronic obstructive pulmonary disease in adults in primary and secondary care (partial update). 2010.

- 1
2
3 6. Bolton CE, Bevan-Smith EF, Blakey JD, Crowe P, Elkin SL, Garrod R, et al. British
4
5 Thoracic Society guideline on pulmonary rehabilitation in adults. *Thorax*. 2013;68
6
7 Suppl 2:ii1-30
8
9
- 10
11 7. O'Donnell DE, Aaron S, Bourbeau J, Hernandez P, Marciniuk DD, Balter M, et al.
12
13 Canadian Thoracic Society recommendations for management of chronic obstructive
14
15 pulmonary disease - 2007 update. *Canadian Resp Journal* 2007;14 Suppl B:5b-32b.
16
17
- 18
19 8. Lacasse Y, Goldstein R, Lasserson TJ, Martin S. Pulmonary rehabilitation for chronic
20
21 obstructive pulmonary disease. *The Cochrane database of systematic reviews*.
22
23 2006(4):Cd003793.
24
25
26
27
- 28
29 9. Lacasse Y, Martin S, Lasserson TJ, Goldstein RS. Meta-analysis of respiratory
30
31 rehabilitation in chronic obstructive pulmonary disease. *A Cochrane systematic*
32
33 review. *Europa Medicophysica*. 2007;43(4):475-85.
34
35
36
37
- 38
39 10. Griffiths TL, Burr ML, Campbell IA, Lewis-Jenkins V, Mullins J, Shiels K, et al.
40
41 Results at 1 year of outpatient multidisciplinary pulmonary rehabilitation: a
42
43 randomised controlled trial. *Lancet*. 2000;355(9201):362-8.
44
45
46
- 47
48 11. Garrod R, Marshall J, Barley E, Jones PW. Predictors of success and failure in
49
50 pulmonary rehabilitation. *Eur Respir J* 2006;27(4):788-94.
51
52
- 53
54 12. Couser JJ, Guthmann R, Hamadeh MA, Kane CS. Pulmonary Rehabilitation improves
55
56 exercise capacity in older COPD patients with COPD. *Chest* 1995; 107: 730-734
57
58
59
60

- 1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
13. Katsura H, Kanemaru A, Yamada K, Motegi T, Wakabayashi R, Kida K. Long term effectiveness of an inpatient pulmonary rehabilitation program for older patients: Comparison between young-older patients and old-older patients groups. *Respirology* 2004; 9: 230-236.
 14. Baltzan M, Kamel H, Alter A, *Can Respir J* 2004; 11: 407-413 Pulmonary rehabilitation improves functional capacity in patients 80 years and older..
 15. Di Meo F, Pedone C, Lubich S, Pizzou C, Trallesi M, Incalzi RA. Age does not hamper the response to pulmonary rehabilitation of COPD patients. *Age and Ageing* 2008; 37: 530-535.
 16. Juniper EF, Guyatt GH, Willan A, et al. Determining a minimal important change in a disease specific Quality of Life Questionnaire. *J Clin Epidemiology* 1994; 47:81-7
 17. Singh SJ, Jones PW, Evans R, Morgan MDL. Minimum clinically important improvement for the incremental shuttle walk test. *Thorax* 2008;63:775-777
 18. Jones PW. St George's Respiratory Questionnaire: MCID. *COPD* 2005; 2(1):75-9
 19. Puhan MA, Frey M, Buchi S, Schunemann HJ. The minimal important difference of the hospital anxiety and depression scale in patients with chronic obstructive pulmonary disease. *Health and quality of life outcomes* 2008; 6:46

- 1
2
3 20. Takahashi T, Ichinose M, Inoue H, Shirato K, Hattori T, Takishima T.
4
5 Underdiagnosis and undertreatment of COPD in primary care settings. *Respirology*.
6
7 2003;8(4):504-8.
8
9
10
11
12 21. McGavin CR, Gupta SP, Lloyd EL, McHardy GJ. Physical rehabilitation for the
13
14 chronic bronchitic: results of a controlled trial of exercises in the home. *Thorax*.
15
16 1977;32(3):307-11.
17
18
19
20
21 22. Tydeman DE, Chandler AR, Graveling BM, Culot A, Harrison BD. An investigation
22
23 into the effects of exercise tolerance training on patients with chronic airways
24
25 obstruction. *Physiotherapy*. 1984;70(7):261-4.
26
27
28
29
30 23. Selzler AM, Simmonds L, Rodgers WM, Wong EY, Stickland MK. Pulmonary
31
32 rehabilitation in chronic obstructive pulmonary disease: predictors of program
33
34 completion and success. *COPD*. 2012;9(5):538-45.
35
36
37
38
39 24. Balducci L. Geriatric oncology: challenge for the new century. *Eur J Cancer*.
40
41 2000;36:1741-1754.
42
43
44
45
46 25. Roomi J, Johnson MM, Waters K, Yohannes A, Helm A, Connolly MJ. Respiratory
47
48 rehabilitation, exercise capacity and quality of life in chronic airways disease in old
49
50 age. *Age Ageing* 1996; 25: 12–16.
51
52
53
54
55
56
57
58
59
60

- 1
2
3 26. Bendstrup KE, Ingemann JJ, Holm S *et al.* Out-patient rehabilitation improves
4 activities of daily living, quality of life and exercise tolerance in chronic obstructive
5 pulmonary disease. *Eur Respir J* 1997; 10: 2801–6.
6
7
8
9
10
11 27. Pepin V, Laviolette L, Brouilliard L, Sewell L, Singh SJ, Revill SM, Lacasse Y,
12 Maltais F. *Thorax* 2011;66:115e120. doi:10.1136/thx.2010.146159
13
14
15
16
17
18
19
20 28. Redelmeier DA, Bayoumi AM, Goldstein RS, et al. Interpreting small differences in
21 functional status: the six minute walk test in chronic lung disease patients. *Am J*
22 *Respir Crit Care Med* 1997;155:1278e82.
23
24
25
26
27
28
29 29. Redelmeier DA, Guyatt GH, Goldstein RS. Assessing the minimal important
30 difference in symptoms: a comparison of two techniques. *J Clin Epidemiol*
31 1996;49:1215e19.
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

For Peer Review Only

Table 1: Baseline characteristics (mean value) of the two groups of COPD patients

	Mean pre-programme parameters (SD) by age group				Mann Whitney U Test
	<70 year (n=202)		>= 70 years (n=122)		
		n		n	
Total n=324	<70 year (n=202)		>= 70 years (n=122)		
Age	61.5 (6.9)	202	75.5 (3.9)	122	N
BMI	28.5 (6.6)	190	27.8 (6.2)	117	NS
FEV₁ (l/s)	1.37 (0.59)	196	1.24 (0.49)	117	NS
ISWT (m)	232.3 (132)	200	151 (108)	122	p<0.001
ESWT (s)	341 (321)	194	219 (225)	119	p<0.001
SGRQ Total	51.8 (16.6)	157	52.2 (15.5)	82	NS
HADS – A	8 (4.3)	198	6.3 (3.8)	122	p<0.001
HADS – D	5.9 (3.6)	198	5.3 (3.2)	122	NS
Right Grip (kg)	25.5 (10.6)	195	22.4 (9.8)	118	P<0.05
Left Grip (kg)	23.8 (10.1)	199	20.4 (8.9)	119	P<0.01
mMRC	1.47 (1.06)	123	1.39 (0.96)	71	NS
CAT	21.8 (7.6)	133	19.8 (7.7)	82	NS

Table 2 shows the mean change in raw measures post PR programme by age group. Mann Whitney U testing showed that there was no significant differences in the changes achieved between the younger Group A patients and the older Group B patients.

	Mean change in raw parameters (SD) by age group				Mann Whitney U Test
	< 70 years (n=202)	n	>70 years (n=122)	n	
FEV₁ (l/s)	-0.003(0.2)	123	0.003 (0.24)	82	NS
ISWT (m)	39.7 (71.7)	127	32.8 (62.4)	89	NS
ESWT (s)	78.4 (353)	123	68.4 (206.5)	87	NS
SGRQ Total	-2.5 (10.1)	97	-2.8 (10.5)	61	NS
HADS – A	-0.8 (2.6)	126	-0.5 (3.4)	89	NS
HADS – D	-0.6 (2.3)	126	-0.3 (2.4)	88	NS
Right Grip (kg)	1.6 (4)	129	1.2 (4.2)	86	NS
Left Grip (kg)	1.4 (4.2)	128	1.1 (3.6)	87	NS
mMRC	-0.2 (1.1)	77	-0.02 (1.4)	52	NS
CAT	-1.8 (6.0)	83	-1.7 (6.6)	58	NS

Table 3 illustrates the % change in parameters post-programme in order to take into account the differences in baseline parameters between the groups. Again, no significant differences between age groups were found.

	Mean % change in parameters (SD) by age group				Mann Whitney U Test
	< 70 years (n=202)	n	>70 years (n=122)	n	
FEV₁	0.5 (16)	123	-0.6 (15)	82	NS
ISWT	25.4 (51.5)	127	43.6 (100)	89	NS
ESWT	49.7 (106)	123	47.2 (97.6)	87	NS
SGRQ Total	-1 (34.6)	97	-6 (23.3)	61	NS
HADS – A	-0.36 (67.9)	126	13.1 (109)	85	NS
HADS – D	0.5 (73.2)	126	9.8 (73.4)	88	NS
Right Grip	11.9 (27.1)	129	22.7 (75.2)	86	NS
Left Grip	9.7 (28.5)	128	13 (48)	87	NS
mMRC	-0 (73)	77	16.9 (110.2)	51	NS
CAT	-4.4 (38.1)	83	-4.8 (43.3)	58	NS

Table 4: The association between baseline characteristics FEV₁ (Forced Expiratory Volume in 1 sec), BMI (Basal Metabolic Index) and CAT (COPD Assessment Test)

	Group A (<70 years)	Group B (>70 years)
Baseline BMI	Numbers too small for analysis	
Baseline FEV ₁	FEV ₁ <1L associated with: clinically significant change in HADS FEV ₁ > 1L associated with clinically significant change in CAT	FEV ₁ <1L associated with: clinically significant change in HADS
Baseline CAT	Lower baseline CAT associated with: clinically significant change in CAT clinically significant change in ISWT (Mann Whitney only) clinically significant change in SGRQ	Lower baseline CAT associated with: clinically significant change in CAT clinically significant change in ISWT