Respiratory Medicine (2013) 107, 401–407

Available online at www.sciencedirect.com

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Barriers to pulmonary rehabilitation: Characteristics that predict patient attendance and adherence

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Received 20 September 2012; accepted 23 November 2012
Available online 19 December 2012

KEYWORDS
Pulmonary rehabilitation;
Attendance;
Adherence;
Smoking;
Barriers

Summary
Background: Pulmonary rehabilitation (PR) is efficacious in chronic obstructive pulmonary disease (COPD). As completion rates of PR are poor, we wished to assess predictors of attendance and adherence.
Methods: We performed a retrospective analysis of 711 patients with COPD, who were invited to attend PR. Data were compared to allow predictors (gender, smoking status, attending partner, referral route, employment status, body mass index, forced expiratory volume in 1 s (FEV_1), oxygen therapy (LTOT), oxygen saturations, chronic respiratory questionnaire (CRQ), shuttle walk distance, travel distance and time) of attendance (0 or >0 attendance) and adherence (< or >63% attendance) to be identified.
Results: 31.8% of patients referred for PR did not attend and a further 29.1% were non-adherent. Predictors of non-attendance were female gender, current smoker, and living alone. Predictors of non-adherence were extremes of age, current smoking, LTOT use, FEV_1, CRQ score and travelling distance. Multiple logistic regression revealed that LTOT and living alone were independent predictors of poor attendance and current smoking, poor shuttle walking distance and hospitalisations were independent predictors of poor adherence.
Conclusion: Smoking status, availability of social support and markers of disease severity were predictors of attendance and adherence to PR.

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http://dx.doi.org/10.1016/j.rmed.2012.11.016

Introduction

Chronic Obstructive Pulmonary Disease (COPD) is a major cause of morbidity. It accounts for 1.4 million GP consultations and 1 million bed days per year in UK hospitals with an annual NHS cost of £810 to £930 million.[1] Pulmonary rehabilitation (PR) is a non-pharmacological intervention designed for patients with chronic respiratory disease. It is a multidisciplinary programme involving exercise training, disease education and behavioural interventions, which has been shown to significantly improve symptoms of dyspnoea and exercise capacity in patients with COPD.[2] There is evidence that PR is a cost effective method of improving health-related quality of life in patients with COPD who are functionally disabled by breathlessness and it is recommended in national guidelines.[2–4]

Uptake for PR is poor with attendance reported as being as low as 50%.[5] In addition 23–31% of patients who start the course fail to complete.[6,7] The cost of completion of a PR programme in the UK has been estimated at £199 to £249 per person,[8] and, although the cost of PR varies considerably between countries, there are tangible financial implications when patients fail to attend. Given the importance of reducing inefficiency within health services, there is an acute need to understand the factors that predict non-attendance and non-adherence to PR with a view to improving uptake.

Several qualitative and small quantitative studies have investigated factors which may influence attendance and adherence at PR. Commonly identified barriers included travel issues, competing commitments such as work and caring, as well as fears that PR would have little benefit or be detrimental to health.[5,9] Other factors which appear to influence attendance are smoking history,[5,6,10,11] degree of breathlessness[11] and available social support.[6,10] Decisions to attend PR may also be influenced by the amount of information and enthusiasm of the referring physician.[12,13] There is conflicting information about influence of depression, with a meta-analysis suggesting patients with depression predict non-completion[5] but a large study contradicting this.[14]

Understanding in this area is limited by small sample sizes in the most part, and most of the studies tend to examine either attendance or adherence exclusively rather than both issues in the same population, despite both outcomes being important in maximizing completion of PR courses. The aim of this study is to quantitatively examine the role of a wide range of demographic and disease related factors on both attendance and adherence to PR amongst a large sample of patients in order to identify methods of improving completion of these programmes.

Methods

We performed a retrospective analysis of a research database of 711 patients with a diagnosis of COPD who where were invited to attend outpatient PR at a community hospital in Norwich, UK. We used this database to evaluate factors which were associated with attendance (attended the first PR session) or non-attendance (referred but did not attend any sessions) in addition to factors associated with adherence (attended six or more sessions) or non-adherence (attended between 1 and 5 sessions). A 6 week cut-off for adherence was used as national guidelines suggest that this is the minimum number of sessions required for patients to gain benefit from PR.[3]

Pulmonary rehabilitation programme

The data were obtained from two PR programmes; one organised by a secondary-care team (covering a population of 800,000 and area of 2700 km^2) the other run by a primary-care team (population 200,000, area 1000 km^2). Both programmes were identical and took place in the same gymnasium and followed the same protocol,[15] consisting of 8 weekly supervised exercise training sessions. These high intensity sessions included an hour of strength and endurance training including walking, cycling, standing from sitting, arm exercises using dumbbells and step-ups. Prior to or following each exercise training session patients attended an educational session for 1 h. This is in the form of seminar and included the following topics: relaxation, physiology, medication, emotions, nutrition, coping skills, social services and maintenance techniques. In addition patients undertook endurance exercises every day, and strength exercises 2 more times a week at home as this has been shown to be as beneficial as twice weekly supervised sessions.[16] The secondary-care programme was designed to receive patients under hospital follow-up while the primary-care programme primarily received patients from general practice and a community respiratory clinic. Referral to the programmes was from hospital and community nurse and medical practitioners.

Patients

The database included all the patients that attended at least one session of the PR programme organised by the primary-care team between 1/1/2005 and 31/7/2010 and every patient referred to the secondary-care programme in the same time period, including those that did not attend. Patients were excluded if they did not have a physician labelled diagnosis of COPD with evidence of airflow obstruction (forced expiratory volume in 1 s/forced vital capacity <0.7) and a past or present smoking history, or died between referral and attendance or before completion of the course.

Database

The database included socio-demographic (age, gender, smoking, marital & employment status, and postcode) and disease-related (body mass index, spirometry, oxygen saturations and use of long term oxygen therapy (LTOT)) information which were provided by the referring practitioner. Smoking, marital and employment status were self-reported. In addition, for patients who attended an assessment prior to the PR programme, details of the incremental shuttle walk test (ISWT),[17] hospital anxiety and depression score (HADS),[18] chronic respiratory questionnaire (CRQ)[19] and lung information needs questionnaire (LINQ)[20] were recorded. Information regarding hospital admissions in the preceding 12 months were obtained from

hospital records. The travel time and distance from the patients' home postcode to the PR centre was calculated using the Geographical Information System (GIS) package ArcGIS v9.3. A digital representation of the road network was constructed using the Ordnance Survey Meridian data[21] and network routing algorithms were used in the GIS to identify the most direct route along the road network from each patient's home to the PR centre, and to calculate the total travel time and distance for that route. All calculations assumed car travel. As a measure of neighbourhood material deprivation, the Index of Multiple Deprivation (IMD) score,[22] was calculated for each individual based on the Census Lower Super Output Area zone that their postcode was allocated to. Where documented in the medical notes, the reasons for non-attendance and non-adherence were captured in a blinded fashion and added to the database. Data for attendance/non-attendance was only available for patients referred for the secondary-care programme, while data for adherence/non-adherence was available for both programmes.

The study was approved by Cambridgeshire Central Research Ethics Committee (11/EE/0382).

Statistical analysis

The distribution of the variables from the primary-care and secondary-care programmes were compared using a *T*-test. Factors predictive of attendance or adherence were identified by a univariate logistic regression analysis. Then a multivariable model was constructed using forward selection to identify the factors which were independently associated with attendance. HADS and LINQ data were not included within the multivariable analysis due to the number of patients with incomplete data. For both of the above analyses, continuous variables were categorised into quartiles. The residuals from the regression models were examined to ensure that that the assumptions associated with the analysis were not violated. Analysis was undertaken using Stata 11.2/SE (Austin, Texas) and a p value of <0.05 was considered significant.

Results

The database consisted of 711 (417 male) patients with a mean (standard deviation) age of 69.0 (9.0) years, smoking history of 50.7 (28.7) pack-years and FEV_1 of 1.06 (0.48) litres. The characteristics of the patients attending the primary or secondary-care programmes are shown in Table 1. There were no statistically significant differences between the two groups, although patients attending secondary care were more likely to be referred by a physician and live further from the centre than those in primary care. The adherence for patients referred via primary care was 71.4% and that referred from secondary care was 71.8% ($p = 0.92$).

Attendance

Of the 498 patients referred for the secondary-care PR programme, four patients died prior to attendance and were excluded. Of the remaining patients, 157 (31.8%) failed to attend a single session of the PR course.

In univariate analysis, patients were significantly less likely to attend if they were female (62.8% attendance vs. 72.1% male attendance), current smokers (56.6% attendance vs. 74.9% ex-smoker attendance) or lived alone (61.4% attendance vs 73.7% cohabitant attendance) (Online material – Table 1). There was no significant difference for any of the other characteristics in the proportion of patients attending.

Independent predictors of attendance were the use of long term oxygen therapy (odds ratio (OR) 0.45 (0.22,0.96), $p = 0.038$) and co-habiting (OR 1.82 (1.02,3.24), $p = 0.042$).

Adherence

Out of 557 patients (337 from primary care and 220 from secondary care) that attended the PR programme three patients died during the course of the programme and so were excluded from the final analysis. 393 (70.9%) patients attended at least 63% of sessions in the PR course and were included in the "adherence" group. 161 (29.1%) patients were included in the "non-adherence" group.

Age was a significant predictor of adherence with patients in the youngest and oldest quartiles of age least likely to complete PR. Patients were also less likely to complete PR if they were current smokers (44.9% adherence vs. 79.9% ex-smoker adherence) or used LTOT (59.3% adherence vs. 73.0% adherence in non-LTOT users). Adherence to PR was also associated with higher forced expiratory volume in 1 s (FEV_1), greater incremental shuttle walk distance and higher CRQ scores in the mastery and emotion categories. Time taken to travel to the PR centre also predicted adherence with patients travelling for a maximum of 7 min least likely to complete the course. There was no significant difference with any of the other variables (Online material – Table 2).

Independent predictors of adherence were smoking status, shuttle walk distance and hospital admissions with ex-smokers, patients with good exercise tolerance and patients without previous hospitalization most likely to complete the PR course (Table 2).

Reasons for non-attendance/adherence

Reasons for non-attendance and non-adherence were available for 99 and 54 patients respectively (Fig. 1). The most common reported reasons for patients not attending were transport problems (25%), and patients believing that their disease was too mild (24%) or too severe (23%) to benefit from PR (Fig. 1). Patients who felt their disease was too severe had a higher mean (SD) pack year smoking history (71 (46) pack-years) than those who felt their disease was too mild (51 (20) pack-years) but there was no difference in terms of age, gender, FEV_1 or use of LTOT. Patients who complained of transport problems lived further away (13.5 (8.4) miles) and had longer to travel (26.0 (12.8) minutes) than the average (9.6 (7.7) miles, 19.9 (12.1) minutes).

The most common reason for non-adherence was a COPD exacerbation (22%) or development of another medical condition (20%). Patients who did not complete the course

Table 1 Patient characteristics.

Variable		Primary care	*N*	Secondary care	*N*
		Mean (SD)		Mean (SD)	
Age (yrs)		69.9 ± 9.1	217	68.3 ± 9.1	494
Male		138 (59.2%)	217	287 (58.1%)	494
Current smoker		65 (27.9%)	217	129 (26.1%)	480
Pack-years (yrs)		52.0 ± 32.4	131	50.5 ± 27.5	399
Co-habitation		141 (66.2%)	213	335 (69.8%)	480
In current employment		15 (7.6%)	198	35 (8%)	474
Travel distance (miles)		4.4 ± 3.9	217	9.4 ± 7.7	494
Travel time (min)		11.4 ± 6.5	217	19.7 ± 12.0	494
Body mass index (kg^2/m^2)		27.4 ± 6.1	153	27.0 ± 6.1	356
FEV_1 (l)		1.06 ± 0.46	215	1.07 ± 0.50	471
FEV_1 % predicted		42.7 ± 15.9	210	43.2 ± 17.2	398
Oxygen saturations at rest (%)		94.9 ± 2.5	217	94.7 ± 2.5	452
LTOT user		7 (3.2%)	217	77 (15.8%)	488
Hospital admissions		0.27 ± 0.88	217	0.78 ± 1.08	494
Role of referring health care professional	Physician	76 (35.4%)	215	343 (70.5%)	488
	Nurse	139 (64.6%)		128 (26.2%)	
	Other	0 (0.0%)		16 (3.3%)	
Chronic respiratory questionnaire (CRQ) score (1–7)	Dyspnoea	2.79 ± 1.26	122	2.38 ± 0.98	327
	Fatigue	3.66 ± 1.23		3.12 ± 1.25	
	Emotion	4.55 ± 1.32		3.92 ± 1.31	
	Mastery	4.56 ± 1.41		4.02 ± 1.37	
Lung information needs questionnaire (Linq) score	Disease knowledge (0–4)	1.42 ± 1.11	173	1.33 ± 0.95	68
	Medicines (0–5)	0.74 ± 0.91	172	0.41 ± 0.70	
	Self-management (0–6)	3.13 ± 1.72	170	2.39 ± 1.30	
	Exercise (0–5)	2.32 ± 1.37		1.41 ± 1.19	
	Diet (0–2)	1.53 ± 0.74		1.18 ± 0.68	
	Smoking (0–3)	0.32 ± 0.58	159	0.22 ± 0.42	
	Total (0–25)	9.42 ± 3.55	170	6.94 ± 3.06	
Hospital anxiety and depression score (0–21)	Anxiety	6.7 ± 4.4	171	6.7 ± 4.6	32
	Depression	6.3 ± 3.4		5.6 ± 3.3	
ISWT (m)		180 ± 117	215	162 ± 110	324

Table 2 Independent predictors of adherence.

Variable	OR (95% CI)	*p*-Value
Smoking		
Current	1	
Ex	7.59 (3.93,14.64)	<0.001
ISWT		0.0002
1	1	
2	2.68 (1.2,5.98)	0.016
3	4.93 (2.18,11.14)	<0.001
4	5.5 (2.24,13.54)	<0.001
Hospital admissions		0.0165
0	1	
1	0.53 (0.27,1.03)	0.06
2 (or more)	0.3 (0.12,0.73)	0.008

Results of forward selection model, variables predictive of adherence. (Analysis excluded lung information needs (LINQ) and hospital anxiety and depression score (HADS) data).

due to COPD exacerbations had higher HADS anxiety (10.7 (8.4) units) and depression (11.7 (5.9) units) than the average (7.6 (4.7), 6.6 (3.7) respectively). Again, patients reporting transport problems as a cause for their non-adherence lived further away (9.7 (9.7) miles) and had longer journey times (19.1 (15.2) minutes) than the average (6.5 (7.7) miles, 14.9 (12.1) minutes).

Discussion

It has previously been suggested that disease severity does not influence attendance or adherence at PR,[5,6,10,11] however this study suggests that it does play a significant role. The use of long term oxygen therapy, a marker of progressive disease, was associated with both non-attendance and non-adherence, while measures of lung function (FEV_1), quality of life (CRQ) and exercise tolerance (ISWT) were all lower in patients who failed to complete the course. Independent predictors of non-adherence included previous hospital admissions and minimal shuttle walk distance. Due to the nature of the disease, patients with COPD are prone to exacerbations, the frequency of

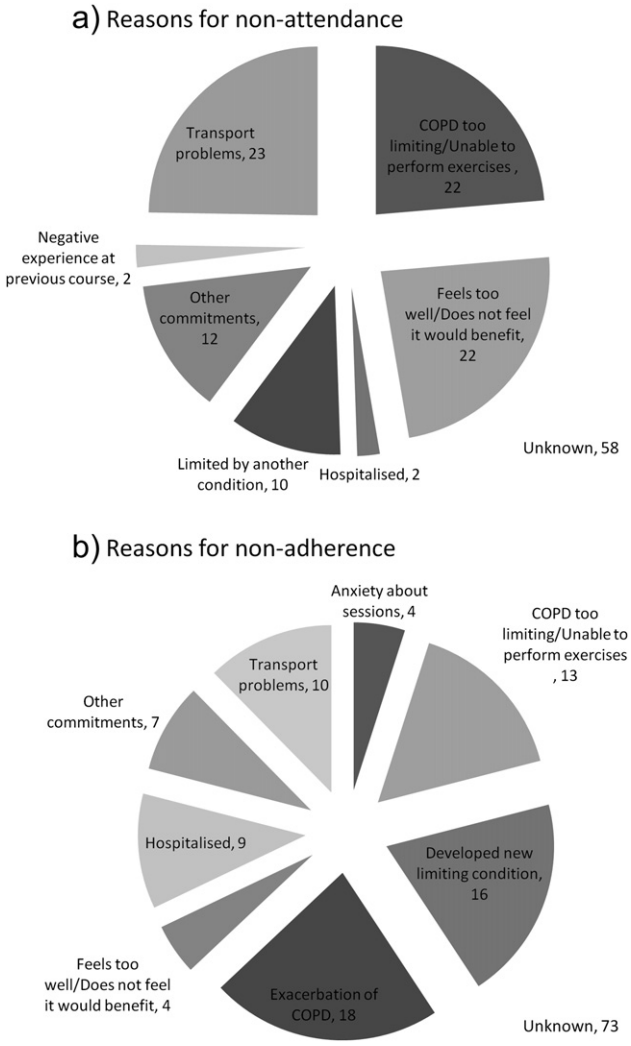

Figure 1 The reasons for patients (a) not attending (referred but did not attend any sessions) pulmonary rehabilitation or (b) not adhering (attended less than 60% of sessions) to pulmonary rehabilitation course.

which tends to increase with severity of the disease. Exacerbations are an important cause of drop-out from PR, and this was the case with 37% of those who failed to adhere to the course in this study. Short of maximising medical therapy, there may be little that can be done to reduce the impact of exacerbations on adherence to PR. Exacerbations of COPD are most frequently seen in the winter months, and one might suggest that avoiding this period when planning a PR programme may improve adherence, although we found no association between time of year and completion of the course.

This study has shown that smoking status is a strong predictor of both attendance and adherence to PR. This is an observation that has been consistently shown in a number of similar studies.[5,6,10,11] Smokers tend to be less inclined to adopt health promoting behaviours and smoking is associated with non-adherence with medical treatments and cardiac rehabilitation.[23,24] Currently patients that smoke are not excluded from taking part in PR and it has been shown that current smokers gain equal benefits from PR as ex-smokers.[25] Education sessions about the effects of smoking on the lungs and the benefits of cessation are delivered as part of the PR course, although formal smoking cessation is only offered at about 50% of PR courses.[26] It has been suggested that attendance at PR can help to reinforce smoking cessation,[27] but there has been no research into whether smoking cessation prior or parallel to PR improves adherence and attendance at the course. Exclusion of smokers from PR remains a contentious issue, however it has been suggested that if it is not a pre-requisite for attendance then smoking cessation must be offered within the programme.[28] We did not find any association between length of pack year history and risk of drop-out as has previously been suggested.[7]

In our study we found that patients who lived alone were less likely to attend PR. Women without social support in this cohort may be less likely to be car drivers and thus less likely to attend. Social support has been shown to have a positive influence on attendance in a number of studies.[6,10] Patients with COPD are often left isolated by symptoms of breathlessness which may inhibit their ability to partake in social activities and patients who lack social support are likely to be those who would benefit most from PR. Concerted effort should therefore be made to increase up-take in these patients. There is anecdotal evidence to suggest that "buddy" schemes, in which new patients are paired with patients who have previously completed the course, improve adherence, but there have been no studies to validate this theory.[29]

Qualitative research has suggested that transport difficulties may provide a barrier to attendance and adherence to PR.[5,9,30] Graves et al.,[31] found that patients living further than 25 min from a PR centre were less likely to attend an information session about PR, while patients were more likely to adhere to a PR programme as part of the National Emphysema Treatment Trial if they lived closer to the PR centre.[32] We assessed both distance and travel time to a PR centre on both attendance and adherence to a PR programme. We found no statistical association between either measure and attendance at the programme although in terms of the effect size the odds ratio shows the lowest attendance in the group living furthest away. Interestingly, we found that patients that had to travel for less than 7 min were less likely to remain in the programme than patients travelling for longer periods of time. This was an unexpected finding. It has been shown previously that living in socially deprived areas reduces uptake to health services, an issue which is compounded by travel distance.[33] Patients living further away from the PR centre tended to live in more affluent areas, which goes some way to explain why adherence improved with travel time requirements. Patients who cited travel issues as a reason for not attending or adhering tended to live further away suggesting that distance to the PR centre is a factor for at least some individuals.

We assumed in this study that patients would for the most part be travelling by car, as this is the mode of transport that the majority of patients use to attend hospital,[34] and travel distance and time were calculated accordingly. In reality a proportion of patients, particularly those who lived closer to the PR centre, may have been travelling via public transport, ambulance/hospital

transport or on-foot. This study took place in a small city in a rural county, where transport links may be limited and therefore access problems may be different from PR undertaken in large cities. In order to fully appreciate the impact of transport on attendance and adherence to PR, a more in depth analysis of the mode and availability of transport needs to be made.

We accept that this was a retrospective study and as such there may be some reporting bias. The reason for non-attendance or adherence was not available for a sizable proportion of patients; however the data for predictors was complete for the majority of variables except the HADS and LINQ. The reasons for non-attendance or adherence were only available for a small number of patients and provide exploratory information only but the findings are compatible with the main analysis.

In conclusion, we have found that in this large retrospective study smoking status, availability of social support and markers of disease severity, in particular use of long term oxygen therapy, were strong predictors of attendance and adherence to PR. We suggest that maximising medical therapy, providing concomitant smoking cessation service if appropriate and using a "buddy" scheme may improve completion of PR programmes, but further studies are needed.

Conflict of interest

None of the authors have a conflict of interest to declare.

Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.rmed.2012.11.016.

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