World Journal of Respirology

Online Submissions: http://www.wjgnet.com/esps/
wjrespirol@wjgnet.com
doi:10.5320/wjr.v3.i2.29

World J Respirol 2013 July 28; 3(2): 29-37
ISSN 2218-6255 (online)

BRIEF ARTICLE

Seasonal variation and living alone are related to pulmonary rehabilitation non-completion

James R Walsh, Zoe J McKeough, Norman R Morris, Stephanie T Yerkovich, Michelle E Wood, Jenny D Paratz

James R Walsh, Norman R Morris, Stephanie T Yerkovich, Queensland Lung Transplant Service, The Prince Charles Hospital, Queensland 4032, Australia
James R Walsh, Stephanie T Yerkovich, Jenny D Paratz, School of Medicine, University of Queensland, Queensland 4072, Australia
Zoe J McKeough, Discipline of Physiotherapy, University of Sydney, Sydney, NSW 2141, Australia
Norman R Morris, School of Rehabilitation Sciences and Griffith Health Institute, Griffith University, Gold Coast 4215, Australia
Michelle E Wood, Adult Cystic Fibrosis Centre, Prince Charles Hospital, Queensland 4032, Australia
Author contributions: Walsh JR was responsible for the study design, primary analysis and interpretation of the data, and drafting the manuscript; McKeough ZJ, Morris NR and Paratz JD contributed to study conception and revision of the manuscript; Yerkovich ST contributed to the data analysis and revision of the manuscript; Wood ME contributed to the data acquisition and revision of the manuscript.
Supported by The Prince Charles Hospital Foundation and the Queensland Health's Health Practitioner Research Scheme
Correspondence to: Mr. James Walsh, Queensland Lung Transplant Service, The Prince Charles Hospital, Rode Road, Chermside 4032, Queensland, Australia. james_walsh@health.qld.gov.au
Telephone: + 61-73-1394443 Fax: + 61-73-1394082
Received: January 4, 2013 Revised: April 28, 2013
Accepted: June 8, 2013
Published online: July 28, 2013

Abstract

AIM: To identify baseline characteristics that independently predict pulmonary rehabilitation non-completion and compare these findings against the participant's reasons for non-completion.

METHODS: Participants with chronic obstructive pulmonary disease (COPD) who attended a standardised twice weekly, eight week pulmonary rehabilitation program (located in the sub-tropics, latitude 27°29′ South) between 2010 and 2012 were recruited. The baseline characteristics of program completers and non-completers were compared in a case-controlled design. Participants who attended < 12/16 sessions were classified as a non-completer. Non-completers (those who missed > 4 sessions of the program) were asked by one independent investigator to participate in a survey about their pulmonary rehabilitation experience. Baseline characteristics were assessed for differences between program completers and non-completers. The baseline characteristics included disease severity, exercise capacity, smoking history, participant's social support and the season when each participant commenced rehabilitation. Non-completers that agreed to participate in the survey were asked to indicate what personal factors or external factors contributed to their program non-completion. Comparisons of completers and non-completers baseline characteristics were performed using cross-tabulations and t-tests, with significant measures analysed in a multivariate binary logistic regression model. Non-completers survey responses were compared to the identified independent predictors using cross-tabulations.

RESULTS: Twenty-six participants (23.4%) of the 111 participants with COPD [(mean ± SD) age was 67.4 ± 9.2 years and FEV1 54.6% ± 22.3%)], were classified as non-completers. Forty-five participants (40.5%) commenced pulmonary rehabilitation during winter. Thirty-six participants (32.4%) were living alone at program commencement. In the multivariate analysis (n = 111), only programs that commenced in winter (Exp B: 0.255, 95%CI: 0.090-0.727, P = 0.011) and participants that lived alone (Exp B: 2.925, 95%CI: 1.039-8.229, P = 0.042) were identified as independent predictors of program non-completion. Twenty participants of the twenty-six non-completers agreed to participate in the survey about their pulmonary rehabilitation experience. The reasons given for non-completion were grouped into: medical reasons (75%), other personal reasons (30%) and external barriers (45%), with ten non-completers reporting more than one reason.

No participant reported living alone or that the program commenced during winter as a reason for non-completion. There was no relationship between illness being the participant's reason for non-completion and the programs that commenced in winter (P = 0.135).

CONCLUSION: Despite winter commencing programs and participants who lived alone being independent predictors of program non-completion, neither measure was reported by participants as a reason for non-completion.

Key words: Chronic obstructive pulmonary disease; Pulmonary rehabilitation; Predictive factors; Program completion; Program non-completion

Core tip: The study's purpose was to identify baseline characteristics that independently predict pulmonary rehabilitation non-completion and compare these findings against the participant's reasons for non-completion. Twenty-six of the 111 participants with chronic obstructive pulmonary disease were classified as non-completers. Only programs that commenced in winter (P = 0.011) and participants that lived alone (P = 0.042) were identified as independent predictors of program non-completion. Twenty non-completers were interviewed about their pulmonary rehabilitation experience with their reasons grouped into: medical reasons (75%), other personal reasons (30%) and external barriers (45%). No participant reported living alone or that the program commenced during winter as a reason for non-completion.

Walsh JR, McKeough ZJ, Morris NR, Yerkovich ST, Wood ME, Paratz JD. Seasonal variation and living alone are related to pulmonary rehabilitation non-completion. *World J Respirol* 2013; 3(2): 29-37 Available from: URL: http://www.wjgnet.com/2218-6255/full/v3/i2/29.htm DOI: http://dx.doi.org/10.5320/wjr.v3.i2.29

INTRODUCTION

Pulmonary rehabilitation is an effective intervention in managing chronic obstructive pulmonary disease (COPD), with level one evidence demonstrating that these programs can improve participant's exercise capacity, quality of life and breathlessness[1,2]. Despite these benefits, recent studies have reported non-completion rates for pulmonary rehabilitation programs between 20%-30%[3-6]. Additionally, poor pulmonary rehabilitation attendance has been associated with less improvement in quality of life and exercise capacity[7,8]. With less than 1.5% of individuals with COPD estimated to be able to access pulmonary rehabilitation each year[9-11], it is important to improve the understanding of factors associated with program non-completion to ensure optimal use of this limited health care resource.

Previous studies have described common themes related to pulmonary rehabilitation non-completion including illness[4,12], transport difficulties[12], and a lack of social support at home[13]. A number of participant factors have been associated with non-completion including decreased quadriceps strength[5], smoking status[3,14], depression[5,15], living alone[3] and having a greater distance to travel[15]. The weather was also described by participants as a reason for non-completion[4], with seasonal variation shown to affect COPD patient's physical activity[16]. However, it is unclear if programs located in different climates have the same influence on non-completion. In a recent systematic review, Keating *et al*[17] suggested that the best model for predicting pulmonary rehabilitation non-completion included quadriceps weakness, depression and smoking but this model only explained 45% of the variation[5]. Conversely, there is considerable variation in the demographic and clinical factors associated with predicting non-completion[3,4,14,15]. Possible reasons for this variability, include the inconsistency in defining non-completion[3,4,14] and differences in the program length[3,4,15]. Furthermore, only the study by Fischer *et al*[3] has compared, in the same dataset, the independent factors associated with pulmonary rehabilitation program non-completion against the participant's described reasons for non-completion. This study suggested that no baseline socio-demographic, clinical or psychological variables predicted program non-completion[3]. However, the pulmonary rehabilitation programs investigated by Fischer *et al*[3] were ⩾ three supervised days per week for a twelve week period which may be more intensive than the typical pulmonary rehabilitation program[18,19].

Given that the models used to date to assess non-completion have explained so little of the variance, further investigation of factors affecting non-completion in a standardised pulmonary rehabilitation program is warranted. Hence the purpose of this study was to compare the independent factors associated with non-completion in a standardised eight week program against the participant's reasons for non-completion. The factors investigated include measures of disease severity, comorbidities, exercise capacity, quadriceps strength, quality of life, self-efficacy, smoking history, social support and the season when each participant commenced rehabilitation. Of these factors, the influence of comorbidities and the Body-mass-index, Airflow Obstruction, Dyspnea, and Exercise Capacity (BODE) index[20] on non-completion is not known. Therefore, the study aims were to identify participant characteristics at baseline assessment that independently predict pulmonary rehabilitation program non-completion; and to compare these characteristics against the participant's reported reasons for non-completion. We hypothesized that the reasons for program non-completion, including medical reasons and external barriers, would be related to the participant's baseline characteristics identified.

MATERIALS AND METHODS

Participants with COPD who attended the tertiary hospital's pulmonary rehabilitation program (located in the sub-tropics, latitude 27° 29' South), between 2010 and 2012 were considered for inclusion. All participants with COPD who completed the pulmonary rehabilitation program's baseline assessment were included in the study. Participants who declined to participate in the survey or were unable to be contacted by telephone were excluded from the survey component of the study. The characteristics of program completers and non-completers were compared in a case-controlled design using the baseline measures from a concurrent study. There is no clear consensus in classifying program non-completion with criteria ranging between: participant were classified as "poor attenders" with < 67% attendance of the total sessions[14], and participants being classified as a non-completer if one session was missed[15] or by participants not completing the final program assessment[3]. Therefore for the purpose of this study, a non-completer was arbitrarily classified as a participant who attended < 12/16 of the program's sessions. Once an individual missed > 4 sessions, the participants were contacted as soon as possible by a single investigator (who was independent of the pulmonary rehabilitation program) to ask them to take part in a survey about their pulmonary rehabilitation experience. Institutional ethics committee approval (HREC/08/QPCH/116-EC28116 and 2009000403) and each participant's informed consent were obtained prior to study commencement.

Measurements

Demographic information including social support and medical history were collected for each participant. The season when each participant commenced pulmonary rehabilitation was recorded. Lung function was measured pre-program according to standard methods[21]. The participant's comorbidities were classified into the categories of musculoskeletal, cardiac and metabolic diseases as described previously by Crisafulli *et al*[22] The influence of multiple comorbidities was assessed with the number of participant's comorbidities categorised into: zero (no associated comorbidity), one, two or three comorbidity categories and by using the Charlson Comorbidity index[23]. The BODE index was used as an indicator of disease severity[20]. Six minute walk distance (6MWD) assessed exercise capacity as per the recognised guidelines[24]. Quadriceps strength was assessed using hand-held dynamometry (the Lafayette Manual Muscle Test System) as previously described[25], with an adjustable strap added to ensure an isometric contraction. In order to compare between participants, quadriceps strength [adding together the participant's best attempt on each leg (kilograms)] was divided by the participant's body weight to calculate a percentage. Quality of life was assessed using the Chronic respiratory questionnaire (CRQ) and its four domains of dyspnea, fatigue, emotional function and mastery[26,27]. Participant's self-efficacy was measured using the COPD self-efficacy scale[28] and calculated by dividing the aggregate score by the number of questions answered[5].

A survey consisting of both closed response and open-ended questions was developed by the study's investigators, the pulmonary rehabilitation program's clinical staff and from the previous literature. Prior to study commencement, the face and content validity of the questionnaire was tested on participants from two pulmonary rehabilitation courses at program completion. The participants were asked to indicate possible factors that affected program completion and feedback was sought regarding the readability of the survey. The final version of the survey included specific questions asking if personal factors (illness, musculoskeletal injury, family commitments, and other commitments) or external factors (the weather, transport difficulties, and program location) contributed to program non-completion. Other possible reasons for program non-completion, such as lack of social support at home[13], were incorporated into more generic questions asking if there was any other personal reason affecting program completion or if there was any other external factors affecting program completion. To better interpret all questions related to non-completion, participants were also asked to provide additional comments explaining any reported reasons that affected non-completion. Participants were also asked for: general comments about the program, if the participant believed that the program could help manage their lung condition and if the participants noticed any benefits from their program. The survey also asked participants if they liked the program's assessment, education and exercise sessions.

Pulmonary rehabilitation program

The pulmonary rehabilitation program was a standardised twice weekly, eight week program[18,19], with five separate programs completed each year. Participants were referred to the program by respiratory physicians, respiratory nurses, or allied health professionals. Car parking was available for a fee (approximately $15/session). The program consisted of one hour each of multi-disciplinary education and exercise per session. Staff ratio during the exercise training sessions was two to three staff to supervise twelve to fifteen enrolled participants with the same staff supervising all programs. The supervised one hour exercise sessions consisted of lower limb endurance training which was individualised for intensity[19] and an upper and lower limb strengthening program. The training intensity of the participant's walking program was commenced at 80% of the average six minute walk test speed[19] and the cycle ergometry program was determined from 80% of the 6MWD as per the published protocol[29]. The lower limb endurance training intensity was progressed as tolerated for each participant throughout the program. All participants were encouraged to complete at least one additional unsupervised exercise session of lower limb endurance and strength training each week[18].

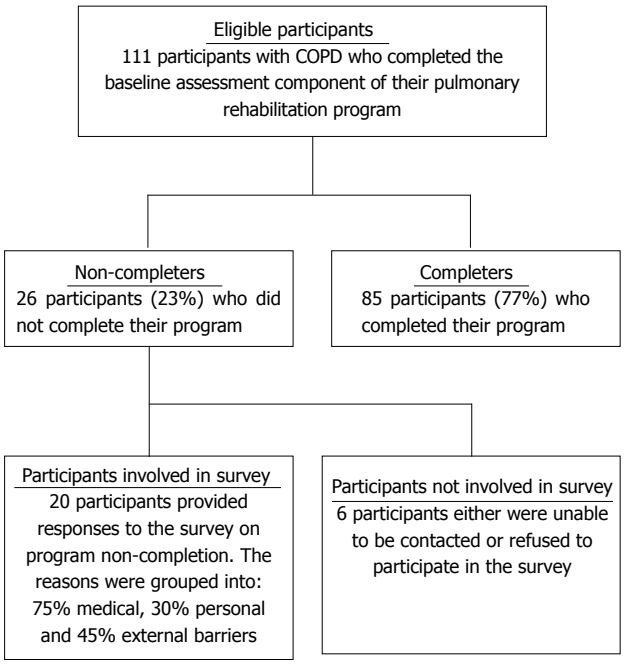

Figure 1 Study flow chart. COPD: Chronic obstructive pulmonary disease.

Statistical analysis

Comparisons of completers and non-completers baseline characteristics were performed using cross-tabulations and *t*-tests. Participant's baseline characteristics including respiratory function, Charlson Comorbidity index, BODE index, CRQ, six minute walk distance, quadriceps strength, self-efficacy, smoking history, if a participant lived alone and the season when each participant commenced rehabilitation were analysed in a univariate model to determine measures that were associated with non-completion. Significant measures ($P < 0.1$) were further analysed using a multivariate binary logistic regression model to identify independent predictors of non-completion. The non-completers survey responses used descriptive statistics to group individual responses and the responses were compared to the identified independent predictors using cross-tabulations.

RESULTS

One hundred and eleven pulmonary rehabilitation participants with COPD, (mean ± SD) age was 67.4 ± 9.2 years and FEV_1 54.6% ± 22.3%, were included in the study. Twenty-six of the participants (23.4%) were classified as a non-completer (attended < 12/16 sessions) with none of this group completing the end of program assessment (Figure 1). Seventy-one participants (64.0%) were categorised with ≥ one comorbid category. Thirty-three participants were categorised with musculoskeletal disease, 29 participants were categorised with cardiac disease and 36 participants were categorised with metabolic disease. Participants from eleven separate programs were included in this study, with four programs commenced during winter, three during summer, and two each during autumn and spring. Forty-five participants (40.5%) commenced pulmonary rehabilitation during winter. Thirty-six participants (32.4%) were living alone at program commencement and the remaining participants were living with their partner (*n* = 59), other family member (*n* = 15) or a friend (*n* = 1).

The participant's baseline characteristics were assessed for differences between program completers and non-completers. Non-completers had a lower baseline 6MWD ($P = 0.030$), lower total CRQ score ($P = 0.012$), and more non-completers lived alone ($P = 0.015$) when compared to program completers (Table 1). A higher percentage of non-completers also commenced pulmonary rehabilitation during winter when compared to program completers ($P = 0.006$). There was no relationship between program non-completion and participants with musculoskeletal ($P = 0.469$), cardiac ($P = 0.205$), metabolic disease ($P = 0.238$), the participant's number of comorbidity categories ($P = 0.257$) or any other participant characteristics.

In order to identify independent predictors of non-completion, the baseline participant characteristics were evaluated using univariate and multivariate logistic regression models (*n* = 111) with non-completers (Yes = 1, No = 0) as the dependent variable. In the univariate analysis, the significant factors associated with non-completion were lower baseline 6MWD, lower CRQ total score, and a greater percentage of people who lived alone and commenced pulmonary rehabilitation in winter. In the multivariate analysis, only programs that commenced in winter (Exp B: 0.255, 95%CI: 0.090-0.727, $P = 0.011$) and participants that lived alone (Exp B: 2.925, 95%CI: 1.039-8.229, $P = 0.042$) were identified as independent predictors of non-completion (Table 2).

Twenty-six participants were identified as non-completers. Six individuals either could not be contacted despite multiple attempts (*n* = 4) or refused to participate in the survey (*n* = 2). Therefore, the following survey results were from the remaining twenty participants (20/26) classified as non-completers. Most of the participants provided positive general comments, liked the program structure and reported benefits from the program despite non-completion (Table 3). The reported benefits included improved understanding of the lung condition (*n* = 6), given an exercise program (*n* = 4) and improved breathing control (*n* = 3).

From the survey results, the participant's reasons for non-completion were grouped into: 75% medical reasons (illness, musculoskeletal injury, medical investigations and slow to recover after illness), 30% other personal factors (family commitments, work commitments and hard to motivate themselves to leave the house), and 45% external factors (transport difficulties, the weather and program location, Table 4). Ten non-completers (50%) reported more than one reason for non-completion. Although, programs that commenced in winter was identified as independent predictors of non-completion, only the heat and/or humidity (*n* = 3) and air pollution (*n*

Table 1 Participant's baseline demographic data *n* (%)

	Completers (*n* = 85)	Non-completers (*n* = 26)	*P* vaule
Age (yr)	67.4 ± 9.1	67.2 ± 9.5	0.93
Sex (female)	36 (42.3)	12 (46.2)	0.822
Social support (living alone)	22 (25.9)	14 (53.8)	0.015
Currently smoking	6 (7.1)	4 (15.4)	0.24
Programs commencing in Winter	28 (32.9)	17 (65.4)	0.006
FEV1% predicted	55.4 ± 22.4	51.4 ± 22.5	0.452
FVC% predicted	76.8 ± 18.5	71.4 ± 19.5	0.243
Charlson Co-morbidity index	1.9 ± 1.1	1.9 ± 1.0	0.851
BODE index	2.6 ± 1.9	3.1 ± 2.1	0.256
BMI (kg/m^2)	27.6 ± 5.2	26.6 ± 4.2	0.383
Quadriceps strength (%)	62.3 ± 22.5	60.1 ± 21.8	0.681
6MWD (m)	406 ± 107	350 ± 134	0.03
COPD self-efficacy score (mean score/question)	2.8 ± 0.8	2.8 ± 0.8	0.924
Chronic respiratory Questionnaire	86.7 ± 21.5	73.2 ± 29.9	0.012
CRQ-dyspnea domain (mean score/question)	4.2 ± 1.4	3.9 ± 1.3	0.279
CRQ -fatigue domain (mean score/question)	3.6 ± 1.3	3.1 ± 1.0	0.064
CRQ-emotional domain (mean score/question)	4.6 ± 1.2	4.3 ± 1.3	0.179
CRQ-mastery domain (mean score/question)	4.7 ± 1.3	4.4 ± 1.4	0.456

Continuous data expressed as the mean ± SD. FEV1: Forced expiratory volume in one second; FVC: Forced expiratory volume; BODE: Body-mass-index, Airflow Obstruction, Dyspnea, and Exercise Capacity; BMI: Body mass index; 6MWD: Six minute walk distance; COPD: Chronic obstructive pulmonary disease; CRQ: Chronic respiratory questionnaire.

= 1) were the reasons given. There was no relationship between illness being the participant's reason for non-completion during the programs commenced in winter [70% (7/10)] when compared to programs commenced during the remaining seasons [60% (6/10); P = 0.135]. Transport barriers in attending the program, including parking costs (n = 10), limited disabled parking (n = 3) and limited public transport (n = 1), were discussed by thirteen non-completers (65%) including 70% (7/10) of the non-completers who lived alone. However, despite transport being a barrier, only seven participants indicated that transport difficulties was a reason for program non-completion with four of these seven respondents living alone.

DISCUSSION

The current study assessed significant differences in the baseline characteristics between pulmonary rehabilitation program completers and non-completers. Non-completers were shown at baseline to have reduced exercise capacity, decreased quality of life, and increased fatigue in the CRQ domain, and a greater percentage of non-completers were living alone and commenced the program in winter. However of these factors, living alone and programs that commenced in winter were the only baseline characteristics shown to independently predict non-completion. Participant's baseline characteristics of smoking status (self-reported), lung function, quadriceps strength, the Charlson Comorbidity index, BODE index, and self-efficacy were also not related to non-completion. Interestingly, neither living alone nor programs that commenced in winter were reported by participants in the survey responses as a reason for program non-completion. The survey results showed that medical reasons were the most common participant reasons for program non-completion. In addition, non-completers reported other barriers to program non-completion including personal factors of work and family commitments and external factors including transport difficulties and the weather.

Participants who lived alone or participants that commenced pulmonary rehabilitation in winter were identified, from baseline assessment measures, as the only independent predictors of program non-completion. Despite, no surveyed participant directly indicating that living alone was a reason for program non-completion, living alone has been previously related to participants with poorer motivation and an increased challenge of getting to the pulmonary rehabilitation program[3,4]. In the present study, this relationship is also relevant, with 70% of the non-completers who lived alone indicating that there were transport difficulties in attending the program. Programs that commenced in winter (4/11 programs) accounted for 65.4% (17/26) of the participants who were classified as non-completers. Although programs commencing in winter was identified as an independent predictor, the heat and/or humidity (n = 3) and air pollution (n = 1) were the only weather related reasons reported by the participants for non-completion. Furthermore, our result of programs commencing in winter being an independent predictor was somewhat surprising considering the program's location has a relatively mild winter (most winter days are sunny with an average temperature of around 17 ℃) when compared to other parts of the world. Despite illness being more commonly reported as a reason for program non-completion during winter (70%) when compared to the remaining seasons (60%), this findings was not statistically significant (P = 0.135). It is possible that there are other factors, including the

Table 2 Binary logistic regression model for a non-completer in pulmonary rehabilitation

	β	SE	Wald χ^2	*P*	Odds ratio (Exp β)	95%CI for Exp β
Univariate analysis						
Six minutes walk distance	-0.004	0.002	4.435	0.035	0.996	0.992–1.000
CRQ fatigue domain	-0.351	0.192	3.357	0.067	0.704	0.483-1.025
CRQ total score	-0.024	0.01	5.662	0.017	0.976	0.957-0.996
Social support-lives alone	1.19	0.465	6.548	0.01	3.288	1.321-8.182
Programs commenced in Winter	-1.347	0.472	8.127	0.004	0.260	0.103-0.656
Multivariate analysis						
Social support-lives alone	1.073	0.528	4.134	0.042	2.925	1.039-8.229
Programs commenced in Winter	-1.366	0.534	6.541	0.011	0.255	0.090-0.727

Only variables with $P < 0.1$ are shown in the table. There was a strong correlation between the chronic respiratory questionnaire (CRQ) total score and the CRQ fatigue domain ($r = 0.783$), therefore only the CRQ total score was assessed in the multivariate analysis.

Table 3 Non-completers responses about their pulmonary rehabilitation experience

	Yes	No	Undecided/no comment
Did you like the initial assessment?	15	2	3
Did you like the education sessions?	18	0	2
Did you like the exercise sessions?	12	2	6
Did you notice any benefits from participating in the program?	16	1	3
Do you believe pulmonary rehabilitation can help you manage your condition?	17	0	3

presence of depression as a comorbidity, not investigated during the current study that may have influenced this relationship between winter programs and non-completion. However, both hot and cold weather have been reported previously as barriers to program completion[4]. Further investigation is needed to determine if seasonal variation in different climates also affects pulmonary rehabilitation program non-completion.

The non-completion rate of 23% in the present study was similar to the published findings in other pulmonary rehabilitation programs[3-6]. Using a similar criteria for non-completion as the current study, Garrod *et al*[5] reported that 31% of participants were non-completers of a twice weekly seven week pulmonary rehabilitation program. Although the present study's criteria [< 75% (< 12/16) attendance] was arbitrary, no participant who attended < 75% of the sessions completed the final program assessment.

In the present study, participants personal and disease related characteristics, with the exception of living alone, did not discriminate between individuals who may or may not complete pulmonary rehabilitation. In our cohort, non-completers who were still smoking at program commencement (15.4%) were not significantly different to the completers group (7.1%, $P = 0.240$). While smoking status has been previously associated with non-completion, our study had a lower rate of participants still smoking at program commencement (9.0%), when compared to the previous studies (14%-17%)[3,14]. The smaller cohort of current smokers in our study may explain why smoking status was not an independent predictor. Baseline quadriceps strength was not significantly different between completers and non-completers ($P = 0.681$) in our results despite being previously shown to be an independent predictor of non-completion[5]. Our results also suggest that self-efficacy, CRQ and its domains of dyspnea, self-mastery and emotional function do not identify participants likely to have poorer program completion. Furthermore, we have shown that there are multiple reasons for non-completion, including medical reasons, other personal factors and external barriers. In the current study, 75% of surveyed non-completers reported a medical reason, including illness and musculoskeletal injury, as the most common reason for program non-completion reflecting the findings of Fischer *et al*[3]. The study by Fischer *et al*[3] also found that program non-completion was not related to medical and psychosocial variables, including illness perception.

In previous studies a lack of perceived benefit from pulmonary rehabilitation programs has been associated with poor adherence and non-completion[12,30]. However, despite the multiple reported challenges to program non-completion, the majority of the surveyed non-completers expressed favourable comments about the program, reported benefits from the program and believed that pulmonary rehabilitation could help manage their lung condition. When considering the participants reasons for non-completion, these positive responses from the participants could suggest that program non-completion was largely unexpected due to unforeseen circumstances on program commencement. This may reflect why it remains difficult to identify participants' characteristics which identify likely program non-completion. However, it is important to note that transport barriers in attending pulmonary rehabilitation were discussed by thirteen of the surveyed non-completers with seven of these participants indicating that transport difficulties were a reason for non-completion. Participants with greater resources such as social and emotional support have previously been shown to have better adherence[5], with increased

Table 4 Reasons given for pulmonary rehabilitation non-completion

	Yes	No	Undecided/no comment
Personal factors			
Did an illness affect you completing the program?	13	5	2
Did an injury affect you completing the program?	3	16	1
Did family commitments affect you completing the program?	3	15	2
Did other commitments affect you completing the program?	5	13	2
Did any other personal factors affect you completing the program?	3	15	2
External factors			
Did the weather affect you completing the program?	4	15	1
Did transport difficulties affect you completing the program?	7	12	1
Did the program location affect you completing the program?	1	18	1
Did any other factor affect you completing the program?	0	19	1

The other commitments affecting program completion were: work (n = 3) and medical investigations (n = 2). The other personal factors affecting program completion were: hard to motivate self to leave the house (n = 2) and slow to recover after being hospitalised (n = 1).

social support probably assisting participants to overcome the reported challenges such as transport difficulties and poor motivation required to complete a pulmonary rehabilitation program. Therefore, better recognition and support for participants who are living alone may reduce the reported challenges of transport difficulties and poor motivation, and increase program adherence[31]. Further research needs to investigate different strategies to increase support for participants living alone and to minimise other barriers to non-completion.

Study limitation

Some study limitations need to be acknowledged. While living alone was identified as an independent predictor of program non-completion, there was no corresponding question in the survey tool that specifically asked participants if living alone affected their program completion. However, participants were able to discuss if living alone was a reason for non-completion in the more generic questions that asked if there was any other personal reason affecting program completion. Similarly, the present study did not assess the influence of psychological factors, such as depression or anxiety, on program non-completion despite these comorbidities being prevalent in people with COPD. Therefore it is unknown what influence these psychological factors have on the current study's findings. However, there was no significant difference between program completers and non-completers in the other psychological measures including self-efficacy, self-mastery and emotional function. Lastly, while the sample size in the present study is relatively small (n = 111), it is similar to previous studies by Garrod *et al*[5] (n = 74) and Steele *et al*[6] (n = 146). However, it is possible that with a larger sample size there may be a relationship between program non-completion in winter and illness as the reason reported for non-completion.

Despite programs commencing in winter and participants who lived alone being identified as characteristics that independently predicted program non-completion, neither measure was reported by participants as a reason for non-completion. More support provided to people who live alone may limit the number of participants who do not complete pulmonary rehabilitation programs.

COMMENTS

Background

Pulmonary rehabilitation is an effective intervention in managing chronic obstructive pulmonary disease (COPD). However, non-completion rates have been reported between 20%-30%. With less than 1.5% of individuals with COPD estimated to be able to access pulmonary rehabilitation each year, it is important to improve the understanding of factors associated with program non-completion to ensure optimal use of this limited health care resource.

Research frontiers

Previous studies have reported considerable variation in the demographic and clinical factors associated with predicting pulmonary rehabilitation non-completion due in part to differences in program structure. Given that the models used to date to assess non-completion have explained so little of the variance, further investigation of factors affecting non-completion in a standardised pulmonary rehabilitation program is warranted. Therefore, the purpose of this study was to compare the independent factors associated with non-completion in a standardised eight week program against the participant's reasons for non-completion.

Innovations and breakthroughs

Prior to this study, there was only one study that compared, in the same dataset, the independent factors associated with pulmonary rehabilitation program non-completion against the participant's described reasons for non-completion. In the current study, participants who lived alone or participants that commenced pulmonary rehabilitation in winter were the only baseline characteristics that independently predicted program non-completion. However, no surveyed participant indicated that living alone or that program commenced during winter was a reason for non-completion. The surveyed non-completers reported a medical reason, including illness and musculoskeletal injury, as the most common reason for program non-completion. Furthermore, there was no relationship between illness being the participant's reason for non-completion and the programs that commenced in winter (P = 0.135).

Applications

The study investigated pulmonary rehabilitation program non-completion in a tertiary hospital's clinical program located in a sub-tropical climate. Non-completers reported many barriers as the reasons for non-completion including medical reasons (*e.g.,* illness or musculoskeletal injury), other personal factors (*e.g.,* work or family commitments, poor motivation) and external barriers (*e.g.,* transport difficulties, weather). Although programs commencing in winter was identified as an independent predictor, the heat and/or humidity (n = 3) and air pollution (n = 1) were the only weather related reasons reported by the participants for non-completion. Further investigation is needed to determine

if seasonal variation in different climates also affects pulmonary rehabilitation program non-completion. Despite participants who lived alone being an independent predictor of program non-completion, no surveyed participant indicated that living alone was a reason for program non-completion. Better recognition and support for participants living alone may assist these individuals to overcome the reported challenges such as transport difficulties and poor motivation required to complete a pulmonary rehabilitation program.

Peer review

This is an interesting study to explore the reasons why some participants who joined an 8-wk pulmonary rehabilitation program could not complete the course. Authors investigate a total 111 COPD patients and analyzed baseline characteristics. Authors concluded that despite winter commencing programs and participants who lived alone being independent predictors of program non-completion, neither measure was reported by participants as a reason for non-completion.

REFERENCES

1 Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease (revised 2011). Available from: URL: http://www.goldcopd.org

2 **Ries AL**, Bauldoff GS, Carlin BW, Casaburi R, Emery CF, Mahler DA, Make B, Rochester CL, Zuwallack R, Herrerias C. Pulmonary Rehabilitation: Joint ACCP/AACVPR Evidence-Based Clinical Practice Guidelines. *Chest* 2007; **131**: 4S-42S [PMID: 17494825 DOI: 10.1378/chest.06-2418]

3 **Fischer MJ**, Scharloo M, Abbink JJ, van 't Hul AJ, van Ranst D, Rudolphus A, Weinman J, Rabe KF, Kaptein AA. Drop-out and attendance in pulmonary rehabilitation: the role of clinical and psychosocial variables. *Respir Med* 2009; **103**: 1564-1571 [PMID: 19481919 DOI: 10.1016/j.rmed.2008.11.020]

4 **O'Shea SD**, Taylor NF, Paratz JD. But watch out for the weather: factors affecting adherence to progressive resistance exercise for persons with COPD. *J Cardiopulm Rehabil Prev* 2007; **27**: 166-174; quiz 175-176 [PMID: 17558200]

5 **Garrod R**, Marshall J, Barley E, Jones PW. Predictors of success and failure in pulmonary rehabilitation. *Eur Respir J* 2006; **27**: 788-794 [PMID: 16481381 DOI: 10.1183/09031936.06.00130605]

6 **Steele BG**, Belza B, Cain K, Coppersmith J, Howard J, Lakshminarayan S, Haselkorn J. The impact of chronic obstructive pulmonary disease exacerbation on pulmonary rehabilitation participation and functional outcomes. *J Cardiopulm Rehabil Prev* 2010; **30**: 53-60 [PMID: 20068424]

7 **Nishiyama O**, Taniguchi H, Kondoh Y, Kimura T, Ogawa T, Watanabe F, Arizono S. Factors in maintaining long-term improvements in health-related quality of life after pulmonary rehabilitation for COPD. *Qual Life Res* 2005; **14**: 2315-2321 [PMID: 16328910 DOI: 10.1007/s11136-005-7710-y]

8 **Troosters T**, Gosselink R, Decramer M. Exercise training in COPD: how to distinguish responders from nonresponders. *J Cardiopulm Rehabil* 2001; **21**: 10-17 [PMID: 11271652 DOI: 10.1097/00008483-200101000-00004]

9 **Frith P,** Alison J, Burdon J, McKenzie D, Markos J, Peters M, Pierce R, Richmond R, Snell G, Walker P, Young I. Case Statement: Chronic Obstructive Pulmonary Disease (COPD): The Australian Lung Foundation (2001). Available from: URL: http://www.lungfoundation.com.au/images/stories/docs/COPD_Case_Statement-web-small.pdf

10 **Brooks D**, Sottana R, Bell B, Hanna M, Laframboise L, Selvanayagarajah S, Goldstein R. Characterization of pulmonary rehabilitation programs in Canada in 2005. *Can Respir J* 2007; **14**: 87-92 [PMID: 17372635]

11 **Yohannes AM**, Connolly MJ. Pulmonary rehabilitation programmes in the UK: a national representative survey. *Clin Rehabil* 2004; **18**: 444-449 [PMID: 15180129 DOI: 10.1191/0269215504cr736oa]

12 **Keating A**, Lee AL, Holland AE. Lack of perceived benefit and inadequate transport influence uptake and completion of pulmonary rehabilitation in people with chronic obstructive pulmonary disease: a qualitative study. *J Physiother* 2011; **57**: 183-190 [PMID: 21843834 DOI: 10.1016/S1836-9553(11)70040-6]

13 **Arnold E**, Bruton A, Ellis-Hill C. Adherence to pulmonary rehabilitation: A qualitative study. *Respir Med* 2006; **100**: 1716-1723 [PMID: 16554147 DOI: 10.1016/j.rmed.2006.02.007]

14 **Sabit R**, Griffiths TL, Watkins AJ, Evans W, Bolton CE, Shale DJ, Lewis KE. Predictors of poor attendance at an outpatient pulmonary rehabilitation programme. *Respir Med* 2008; **102**: 819-824 [PMID: 18337077 DOI: 10.1016/j.rmed.2008.01.019]

15 **Fan VS**, Giardino ND, Blough DK, Kaplan RM, Ramsey SD. Costs of pulmonary rehabilitation and predictors of adherence in the National Emphysema Treatment Trial. *COPD* 2008; **5**: 105-116 [PMID: 18415809 DOI: 10.1080/15412550801941190]

16 **Sewell L**, Singh SJ, Williams JE, Morgan MD. Seasonal variations affect physical activity and pulmonary rehabilitation outcomes. *J Cardiopulm Rehabil Prev* 2010; **30**: 329-333 [PMID: 20551827]

17 **Keating A**, Lee A, Holland AE. What prevents people with chronic obstructive pulmonary disease from attending pulmonary rehabilitation? A systematic review. *Chron Respir Dis* 2011; **8**: 89-99 [PMID: 21596892]

18 **Nici L**, Donner C, Wouters E, Zuwallack R, Ambrosino N, Bourbeau J, Carone M, Celli B, Engelen M, Fahy B, Garvey C, Goldstein R, Gosselink R, Lareau S, MacIntyre N, Maltais F, Morgan M, O'Donnell D, Prefault C, Reardon J, Rochester C, Schols A, Singh S, Troosters T. American Thoracic Society/European Respiratory Society statement on pulmonary rehabilitation. *Am J Respir Crit Care Med* 2006; **173**: 1390-1413 [PMID: 16760357 DOI: 10.1164/rccm.200508-1211ST]

19 **Alison J,** Barrack C, Cafarella P, Frith P, Hanna C, Hill C. The Pulmonary Rehabilitation Toolkit on behalf of The Australian Lung Foundation(2009).Available from: URL: http://www.pulmonaryrehab.com.au/welcome.asp

20 **Celli BR**, Cote CG, Marin JM, Casanova C, Montes de Oca M, Mendez RA, Pinto Plata V, Cabral HJ. The body-mass index, airflow obstruction, dyspnea, and exercise capacity index in chronic obstructive pulmonary disease. *N Engl J Med* 2004; **350**: 1005-1012 [PMID: 14999112 DOI: 10.1056/NEJMoa021322]

21 **Wanger J**, Clausen JL, Coates A, Pedersen OF, Brusasco V, Burgos F, Casaburi R, Crapo R, Enright P, van der Grinten CP, Gustafsson P, Hankinson J, Jensen R, Johnson D, Macintyre N, McKay R, Miller MR, Navajas D, Pellegrino R, Viegi G. Standardisation of the measurement of lung volumes. *Eur Respir J* 2005; **26**: 511-522 [PMID: 16135736 DOI: 10.1183/09031936.05.00035005]

22 **Crisafulli E**, Costi S, Luppi F, Cirelli G, Cilione C, Coletti O, Fabbri LM, Clini EM. Role of comorbidities in a cohort of patients with COPD undergoing pulmonary rehabilitation. *Thorax* 2008; **63**: 487-492 [PMID: 18203818 DOI: 10.1136/thx.2007.086371]

23 **Charlson ME**, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis* 1987; **40**: 373-383 [PMID: 3558716 DOI: 10.1016/0021-9681(87)90171-8]

24 **ATS Committee on Proficiency Standards for Clinical Pulmonary Function Laboratories.** ATS statement: guidelines for the six-minute walk test. *Am J Respir Crit Care Med* 2002; **166**: 111-117 [PMID: 12091180 DOI: 10.1164/ajrccm.166.1.at1102]

25 **O'Shea SD**, Taylor NF, Paratz JD. Measuring muscle strength for people with chronic obstructive pulmonary disease: retest reliability of hand-held dynamometry. *Arch Phys Med Rehabil* 2007; **88**: 32-36 [PMID: 17207672 DOI: 10.1016/

j.apmr.2006.10.002]
26 **Guyatt G,** Schunemann H. Chronic Respiratory Questionnaire: Self Administered Standardised Format Hamilton. Canada: McMaster University, 2001
27 **Williams JE**, Singh SJ, Sewell L, Guyatt GH, Morgan MD. Development of a self-reported Chronic Respiratory Questionnaire (CRQ-SR). *Thorax* 2001; **56**: 954-959 [PMID: 11713359 DOI: 10.1136/thorax.56.12.954]
28 **Wigal JK**, Creer TL, Kotses H. The COPD Self-Efficacy Scale. *Chest* 1991; **99**: 1193-1196 [PMID: 2019177 DOI: 10.1378/chest.99.5.1193]
29 **Luxton N**, Alison JA, Wu J, Mackey MG. Relationship between field walking tests and incremental cycle ergometry in COPD. *Respirology* 2008; **13**: 856-862 [PMID: 18811884 DOI: 10.1111/j.1440-1843.2008.01355.x]
30 **Fischer MJ**, Scharloo M, Abbink JJ, Thijs-Van A, Rudolphus A, Snoei L, Weinman JA, Kaptein AA. Participation and drop-out in pulmonary rehabilitation: a qualitative analysis of the patient's perspective. *Clin Rehabil* 2007; **21**: 212-221 [PMID: 17329278 DOI: 10.1177/0269215506070783]
31 **Bourbeau J**, Bartlett SJ. Patient adherence in COPD. *Thorax* 2008; **63**: 831-838 [PMID: 18728206 DOI: 10.1136/thx.2007.086041]

P- Reviewers Chen YH, Dimopoulos S, Lin MC
S- Editor Zhai HH **L- Editor** A **E- Editor** Lu YJ

Published by **Baishideng Publishing Group Co., Limited**
Flat C, 23/F., Lucky Plaza,
315-321 Lockhart Road, Wan Chai, Hong Kong, China
Fax: +852-65557188
Telephone: +852-31779906
E-mail: bpgoffice@wjgnet.com
http://www.wjgnet.com