



## Factors associated with adherence to pulmonary rehabilitation in patients with COPD in family health centers and hospitals in Chile from the perspective of professionals: A cross-sectional study

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### ABSTRACT

**Background/objective:** Pulmonary rehabilitation (PR) is a central component in the treatment of chronic obstructive pulmonary disease (COPD), although it is not widely used and between 40 and 60% of patients do not adhere. Low adherence has been associated with clinical and sociodemographic factors. However, no factors associated with adherence have been described in Chile. Therefore, we aimed to determine factors associated with adherence to pulmonary rehabilitation in patients with COPD in family health centers and hospitals in Chile.

**Methods:** A quantitative, observational, analytical and cross-sectional study was designed considering PR programs conducted in 2019. A non-probabilistic sample was obtained by convenience. Characteristics of the centers, perceived influence of clinical/sociodemographic variables on adherence to PR were determined and, subsequently, the estimated value of clinical variables in PR adherents and non-adherents by center were determined, using a questionnaire designed, validated in this study and sent by email.

**Results:** Twenty-nine responses were obtained (8.7%). Professionals indicated that 45% of patients adhere to PR and, from their perspective, age, dyspnea, cardiorespiratory capacity, tobacco use, exacerbations, travel time, access to transportation and level of education are factors that influence adherence. When values of clinical variables estimated by professionals in adherent and non-adherent patients are analyzed, the frequency of smokers was the only factor associated with adherence (OR 0.96, 95% CI 0.93–0.99).

**Conclusions:** The factors found by the present study may be useful in the development of strategies aimed at improving adherence to PR, for example, by supporting smoking cessation.

### 1. Introduction

Pulmonary rehabilitation (PR) is a comprehensive intervention designed to improve physical and psychological condition of people with chronic respiratory disease, and it seeks to promote long-term adherence to healthy behaviors.<sup>1</sup> It is a central component of therapeutic strategies for chronic obstructive pulmonary disease (COPD) because it improves maximal and functional exercise capacity, health status, anxiety and depression, peripheral muscle function and

health-related quality of life.<sup>2–4</sup> In addition, it allows to modify systemic manifestations of COPD.<sup>2,4</sup> It is relevant to mention that improving quality of life of patients living with COPD by non-pharmacological therapies, such as PR, has been a major area of focus in the last three decades. In this sense, PR could modify quality of life by its effectiveness in mental health issues and by controlling symptoms.<sup>5</sup> This may be even extrapolated to effectiveness of PR in diseases such as COVID.

Although it shows effectiveness, PR is not widely used, and a percentage of patients do not adhere to treatment.<sup>3,6–8</sup> It has recently been

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reported in the UK that a 6% of patients with COPD are referred to PR and 40–60% complete it.<sup>8</sup> In Chile, the participation rate of COPD patients in PR is 2–3%, and the completion rate is 26–37% between 2014 and 2016.<sup>9</sup>

Studies show that factors associated with low patient adherence to PR are related to insufficient funding and resources, lack of awareness and knowledge about PR, and barriers related to patients.<sup>10</sup> In Canada, the main reasons for PR dropping out are respiratory exacerbation (85% of centers) and low satisfaction with the program (12% of centers).<sup>6</sup> In the UK, the factors associated with low adherence are socioeconomic aspects, higher symptoms and lower performance in enrollment tests.<sup>3</sup> Predictors of low attendance included: current smoker, hospital admission within the last year, higher dyspnea score and prolonged transfer time.<sup>11</sup> In Argentina, the factors associated with adherence to PR were medical insurance, travel time to the hospital of less than 60 min, and available income.<sup>12</sup> Knowledge about the factors associated with adherence to PR could allow to health care teams to focus their efforts on reducing the gaps. However, in Chile these factors have not been described. Therefore, we asked what factors were associated with adherence to pulmonary rehabilitation in Chile. We aimed to determine factors associated with adherence to PR in COPD patients in family health centers and hospitals in Chile.

## 2. Methods

### 2.1. Study design

A quantitative, observational, analytical and cross-sectional study was designed, following the STROBE guidelines, which was approved for one year, from October 26, 2020, by the Ethical-Scientific Committee of Universidad de las Américas with code CEC\_FP\_2020006. All participants signed online informed consent.

### 2.2. Participants

PR programs of family health centers and hospitals in Chile. Based on 553 PR programs in Chile, including 371 family health centers and 182 hospitals,<sup>13</sup> estimating one annual PR program in each center, a population of 332 programs was considered, given that an unpublished preliminary study by our team found that 60% of the centers perform PR. The inclusion criteria were to be a PR program in any region of Chile and to have been initiated in the period September 2020 to September 2021. For hospitals, programs developed in high, medium and low complexity hospitals were considered. Cardiopulmonary rehabilitation or physical activity programs were excluded.

A non-probabilistic sample was obtained by convenience from a sampling frame composed of family health centers and hospitals where contact email address of PR manager was provided, according to the definition and characteristics of a sampling frame following the literature.<sup>14</sup> In addition, we considered centers and hospitals for which we did not have direct email addresses of the PR manager, but which were contacted through the respiratory health coordinators of Health Services where the centers and hospitals belong, with the aim of broadening the dissemination and achieving a larger sampling frame to reduce biases. For this purpose, a register of emails of PR managers of family health centers and hospitals, and of respiratory health coordinators was prepared, which were previously obtained, as part of the study, through a request on the website of each Health Service, in the link "Solicitud de información, Ley de Transparencia". This allows access to Chilean public information. In total, the sampling frame was composed of 295 contacts of PR managers and 56 contacts of respiratory health coordinators.

### 2.3. Recruitment

After obtaining authorization of the Ethics Committee of Universidad de las Américas, the PR managers were contacted through email to

inform about the study, detail the inclusion and exclusion criteria, and provide an online informed consent form. The respiratory health coordinators were also contacted through email, attaching all the information about the study, but they were asked to disseminate this information among their PR managers. After reviewing the consent form, if PR managers agreed to participate, they were asked to click "I accept" to enter the study and access the data collection instrument.

### 2.4. Variables

The following variables were measured: type of center, region, type of program, participation in PR, percentage of adherence to PR, perceived influence of clinical/sociodemographic variables (age between 55 and 74 years, dyspnea <4 in mMRC, FEV1 >80%, distance >350 m in Six-minute Walking Test (6MWT), greater number of repetitions in 1-min Sit-to-Stand test (1MINSTS), smoking cessation, lower number of exacerbations, travel time to health center <60 min, good accessibility to transportation and higher level of education) on adherence to PR. In addition, the estimated value of age, dyspnea, FEV1, cardiorespiratory capacity, frequency of smoking patients and frequency of exacerbations of adherent and non-adherent patients was determined for each center.

### 2.5. Instrument

The variables were measured using the "Questionnaire of factors associated with adherence to pulmonary rehabilitation of users with COPD", which was created based on the literature<sup>3,6,11,12</sup> and validated by professionals with experience in PR. Selection criteria for the validating professionals were: to have at least 3 years of experience in PR and to have completed a diploma or master's degree in respiratory diseases. Five validators were contacted and characterized prior to validation: three had a master's degree and one a PhD, the median of years of experience was 12 years, the degree of knowledge on a scale of 0–10 was rated as 8, and the most influential source of information on PR knowledge was practical experience, followed by self-knowledge. Subsequently, the coefficient of expert competence (K) was determined.<sup>15</sup> Only those experts whose K coefficient was  $\geq 0.8$  were considered.<sup>16</sup> Therefore, the number of validators was four.

The questionnaire was validated for face validity and content validity.<sup>17</sup> To determine face validity, comprehension was evaluated, and to determine content validity, the relevance of each question was evaluated, both of them by a form given to each validator. This form also included a section of open-ended questions to ascertain the opinion of each validator about the instrument, specifically, on the fulfillment of objectives, redaction, number and formulation of questions, and suggestions or observations.

The final version of the questionnaire consisted of 21 questions, distributed in the following sections: characteristics of the center and the PR program (section A), factors associated with adherence to PR from the perspective of the professional (section B), estimation of the factors associated with adherence to PR by health center (section C). Section A contained multiple-choice answers, section B presented dichotomic answers (yes or no), and section C asked to estimate each variable value for adherent and non-adherent patients. The questionnaire was digitized using the SurveyMonkey® platform, USA.

### 2.6. Data collection

Data was collected between November 2021–December 2021 by research team members J.Z., M.D., S.M. and F.O. The questionnaire was sent online, providing an access link. The questionnaire was sent three times, separated by two weeks. The information was obtained in Excel xlsx format.

2.7. Statistical analysis

Sample size was obtained by calculating the sample size for the estimation of a proportion, considering a population of 332 programs, with a confidence level of 95%, precision of 9% and precision of 9%<sup>18</sup> and an expected PR adherence ratio of 26%.<sup>8</sup> Thus, a sample size of 72 PR programs was obtained.

Quantitative variables were described using median and inter-quartile range. Categorical variables were described using proportions. For all variables, the percentage of missing values was calculated. For hypothesis testing, the effect of the independent variables age, dyspnea, FEV1, cardiorespiratory capacity, cigarette consumption and frequency of exacerbations on adherence, using the estimated value for each center, was determined using binary logistic regression. The results were expressed as odds ratio and 95% confidence interval. Model fit was determined by the Hosmer-Lemeshow goodness-of-fit test.  $p < 0.05$  was considered statistically significant. STATA 14.2 software (StataCorp, USA) was used in all analyses.

3. Results

3.1. Proportion of responses. Characteristics of the centers and programs

Out of 351 questionnaires sent, of which 295 were sent to managers and 56 were sent to coordinators, 29 responses were obtained (8.7% of responses regarding the population), of which 24 (82.76%) were family health centers and 5 (17.24%) hospitals, from different regions of Chile. Most of the centers performed outpatient programs (86.21%) (Table S1).

3.2. Participation and adherence to PR

The number of patients admitted to PR in the study period was 9 (5–12) patients, and the percentage of PR adherence was 45% (5–66%) (Table 1).

3.3. Association of clinical and sociodemographic variables with adherence to PR

From the perspective of the professionals, being 55–74 years old (72.41%), having a dyspnea score lower than 4 points in mMRC (68.97%), traveling a distance higher than 350 m in 6MWT (55.17%), having stopped smoking (68.97%), having fewer exacerbations (79.31%), traveling less than 60 min to the health center (93.10%), having good accessibility to transportation (86.66%) and having a higher level of education (68.97%) influence greater adherence to PR. On the other hand, having an FEV1 higher than 80% and performing a greater number of repetitions in 1MINSTS did not influence greater adherence to PR (Table 2).

When clinical variables were estimated by the professionals, the analysis of the association between age, dyspnea, FEV1, cardiorespiratory capacity, frequency of smoking patients and frequency of exacerbations in COPD patients, and adherence to PR, the only variable that showed a statistically significant association by binary logistic regression was the frequency of smoking patients (6% of smokers among adherent patients and 28% among non-adherent patients, OR 0.96, 95% CI 0.93–0.99) (Table 3).

**Table 1**  
Participation and adherence to PR.

Variables	Median (IR)
Number of patients admitted to PR <sup>a</sup>	9(5–12)
Percentage of adherence to PR <sup>a</sup>	45(5–66)

<sup>a</sup> Frequency of answers for both variables: 29(100.00%).

**Table 2**  
Perceived influence of clinical/sociodemographic variables in adherence to PR from the perspective of the professional.

Variables	Categories	N(%) <sup>a</sup>
Age between 55 and 74 years	Yes	21(72.41)
	No	6(20.69)
	No answer	2(6.90)
Dyspnea <4 in mMRC	Yes	20(68.97)
	No	7(24.14)
	No answer	2(6.90)
FEV1 >80%	Yes	13(44.83)
	No	14(48.28)
	No answer	2(6.90)
Distance >350 m in 6MWT	Yes	16(55.17)
	No	11(37.93)
	No answer	2(6.90)
Greater number of repetitions in 1MINSTS	Yes	11(37.93)
	No	16(55.17)
	No answer	2(6.90)
Smoking cessation	Yes	20(68.97)
	No	7(24.14)
	No answer	2(6.90)
Lower number of exacerbations	Yes	23(79.31)
	No	4(13.79)
	No answer	2(6.90)
Travel time to health center <60 min	Yes	27(93.10)
	No	0(0.00)
	No answer	2(6.90)
Good accessibility to transportation	Yes	26(86.66)
	No	1(3.45)
	No answer	2(6.90)
Higher level of education	Yes	20(68.97)
	No	7(24.14)
	No answer	2(6.90)

<sup>a</sup> Percentages calculated for n = 29.

**Table 3**  
Association of clinical and sociodemographic variables with adherence to PR by center, from the perspective of the professionals.

Variables	Adherence to PR		Odds ratio (95% CI) <sup>b</sup>	p-value
	Adherent	Non-adherent		
	Median (IR)	Median (IR)		
Age (years)	68(61–70)	60 (52.5–67.5)	1.07 (0.96–1.18)	0.18
Dyspnea (score of mMRC)	2(2–3)	2(1–3)	0.69 (0.20–2.29)	0.55
FEV1 (% of predicted value)	60(59–67)	65(47–75)	0.99 (0.96–1.03)	0.92
Cardiorespiratory capacity (m in 6MWT)	340 (256–400)	306 (250–400)	1.00 (0.99–1.00)	0.95
Frequency of smokers (%)	6(0–19)	28(0–90)	0.96 (0.93–0.99)	0.03 <sup>a</sup>
Frequency of exacerbations (average of exacerbations in the last 12 months)	2(1–6)	1.5(0.5–3)	1.03 (0.97–1.09)	0.31

<sup>a</sup> Statistically significant.

<sup>b</sup> Goodness-of-fit test p-value = 0.59.

4. Discussion

This is the first study that determines factors associated with adherence to PR in Chile. The only variable that showed association with adherence was the frequency of smoking patients.

Although the percentage of responses obtained by this study is lower than that reported in the literature, which reaches 18% in studies with online collection of data,<sup>19</sup> a previous unpublished study conducted by our team in Chile showed that 48 centers had performed PR out of a total of 80 centers that participated in the study. Given that the present study

used the same health center contact base, it is possible that the maximum number of centers that could have reported factors associated with adherence had been 48, of which the responses in the current study represent 60.4%.

Adherence in the present study was considered as the completion of more than 85% of the sessions.<sup>20</sup> The percentage of adherence to PR reported by the PR managers in the present study is less than half of the patients admitted to PR. This value is analogous to that reported in the literature,<sup>8</sup> and slightly higher than that previously reported in a Chilean study based on ministerial statistical data.<sup>9</sup> This percentage suggests the need to implement strategies aimed at improving adherence in COPD patients.

The factors associated with adherence to PR in the present study were determined through the perspective of the professionals, in contrast to other previously published studies; however, the current results show similarities with those studies. Respiratory exacerbation, greater dyspnea, lower cardiorespiratory capacity, current smoking, low socioeconomic status, and long transfer time have been associated with low adherence,<sup>3,11,12,21</sup> as it was perceived by the professionals in the present study. Similarly, FEV1 was not perceived as a variable associated with adherence, analogous to what has been shown previously.<sup>11</sup>

Respiratory exacerbations are an important factor that determines low adherence to PR. In this regard, a study showed that severe exacerbations are those associated with treatment drop out.<sup>22</sup> Also, a greater number of exacerbations, along with greater dyspnea and lower cardiorespiratory capacity are associated with greater disease severity, therefore they are targets for therapeutic action of PR to reduce hospitalizations and costs.<sup>23</sup> The present study suggests that they should be considered in strategies that seek to increase adherence to PR, for example through education and preventive management, so that patients can be benefited with PR. Similarly, patient barriers, such as the cost of travel to health centers or travel time, need to be considered, for example, by actions that provide greater flexibility or that bring the places where PR is performed closer to the patients.

The quantification of the association between clinical variables and adherence to PR, only the frequency of smoking patients in the centers was associated with adherence. This is relevant for actions that can be taken to increase adherence to PR since smokers would be less likely to adopt healthy behaviors.<sup>21</sup> In this sense, one study showed that support for tobacco cessation would encourage adherence to PR, from the perspective of patients.<sup>20</sup>

The limitations of this study are related to the population studied, which are health centers rather than patients. However, this strategy allowed us to have an overview of different centers and regions of the country, since access to individual patient data is restricted in most of the centers in the country. Additionally, there are biases related to the collection method, which was online. However, this allowed to reach health centers in different regions of the country. On the other hand, the number of responses in the present study is low; however, the proportion of Chilean centers performing PR is also low, and the methodology of the study would have allowed to survey a significant percentage of centers that performed PR in the period of the study. Finally, although the prevalence of depressive symptoms in COPD is higher than normal population (24.6% vs 11.7%),<sup>24</sup> this variable was not included as a factor that affects the adherence to PR, but it should be considered in further studies.

In conclusion, the proportion of smoker patients is associated with adherence to PR in Chilean health centers. Future studies in individuals would be required to elucidate the association of sociodemographic factors. Even so, the factors found by the present study may be useful in the development of strategies aimed at improving adherence to PR, for example, by supporting smoking cessation.

#### Author contributions

Macarena Díaz: Conceptualization; Data curation; Formal analysis;

Investigation; Methodology; Supervision; Validation; Roles/Writing - original draft; Writing - review and editing, Sebastián Muñoz: Conceptualization; Data curation; Formal analysis; Investigation; Methodology; Supervision; Validation; Roles/Writing - original draft; Writing - review and editing, Felipe Osorio: Conceptualization; Data curation; Formal analysis; Investigation; Methodology; Supervision; Validation; Roles/Writing - original draft; Writing - review and editing, Juan Zapata: Conceptualization; Data curation; Formal analysis; Investigation; Methodology; Supervision; Validation; Roles/Writing - original draft; Writing - review and editing, Carlos Nieto: Data curation; Formal analysis; Methodology; Software; Supervision; Roles/Writing - original draft; Writing - review and editing, Darwin Morales: Conceptualization; Formal analysis; Investigation; Methodology; Supervision; Validation; Writing - review and editing, Gonzalo Hidalgo: Data curation; Formal analysis; Methodology; Software; Supervision; Roles/Writing - original draft; Writing - review and editing, Andrea Méndez: Conceptualization; Formal analysis; Funding acquisition; Investigation; Methodology; Project administration; Resources; Software; Supervision; Validation; Visualization; Roles/Writing - original draft; Writing - review and editing.

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#### Data availability

The data that support the findings of this study are available from the corresponding author, AM, upon reasonable request.

#### Declaration of competing interest

None.

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#### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.cegh.2022.101153>.

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