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ORIGINAL RESEARCH

Insufficient Pulmonary Rehabilitation Uptake After Severe Exacerbation of COPD: A Multicentre Study in the South West Region of France

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Purpose: Pulmonary rehabilitation (PR) is a type of multidisciplinary care strongly recommended after severe exacerbation of chronic obstructive pulmonary disease (COPD). Recently, a national French study reported a very low rate of PR uptake (8.6%); however, important clinical data were missing. Here, we aimed to identify the main factors associated with insufficient PR uptake after hospitalisation for COPD exacerbation.

Patients and Methods: This multicentre retrospective study included patients hospitalised with COPD exacerbation between 1 January 2017 and 31 December 2018, as identified by both coding and a detailed review of medical records. PR was defined as inpatient care in a specialised centre or unit within 90 days of discharge. Multivariate logistic regression was used to identify associations between PR uptake and patient characteristics, such as comorbidities, non-invasive ventilation (NIV), inhaled treatment, and forced expiratory volume in 1 second (FEV1).

Results: Among the 325 patients admitted for severe COPD exacerbation, 92 (28.3%) underwent PR within 90 days of discharge. In univariate analysis, relative to those who underwent PR, patients without PR had significantly more comorbidities, were less often treated with triple bronchodilator therapy or NIV, and had a higher FEV1. In multivariate analysis, variables independently associated with the lack of PR uptake were the presence of comorbidities (adjusted odds ratio (aOR) = 1.28 [1.10–1.53], p = 0.003) and a higher FEV1 (aOR = 1.04 [1.02–1.06], p < 0.001). There was no significant correlation between PR uptake and departmental PR centre capacity (notably, some departments had no PR facilities).

Conclusion: These data highlight the lack of PR in the early stages of COPD. Collaboration among all healthcare providers involved in patient management is crucial for improved PR uptake.

Plain Language Summary: Pulmonary rehabilitation (PR) is multidisciplinary care strongly recommended after severe exacerbation of chronic obstructive pulmonary disease (COPD); however, referral remains very low in France. We have shown, in three French centres, that early-stage COPD and associated comorbidities are the main factors contributing to insufficient PR after hospitalisation for exacerbation. Collaboration among all healthcare providers involved in patient management is crucial to improve PR uptake in the years ahead because physical medicine and rehabilitation professionals play key roles in the promotion and early initiation of PR programs.

Keywords: COPD, comorbidities, healthcare resources, pulmonary rehabilitation

Introduction

Pulmonary rehabilitation (PR) is a multidisciplinary approach that includes exercise training, therapeutic education, nutrition management, and mental health issues, with the goal of achieving long-term behavioural changes.[1,2] Chronic obstructive

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pulmonary disease (COPD) is characterised by acute exacerbation with worsening symptoms, quality of life (QoL) deterioration, and an increased risk of mortality, particularly in patients requiring hospitalisation.[3,4] Guidelines strongly recommend PR for patients with COPD after severe exacerbation[1,5] with proven benefits to exercise capacity, health-related QoL, reduced readmission, and mortality.[6,7] The Global Initiative for Chronic Obstructive Lung Disease (GOLD) report recommends PR initiation within 4 weeks of discharge;[1] some studies have shown that early PR significantly improves exercise capacity and QoL.[8,9] Later initiation within 90 days after discharge also leads to reduced risks of rehospitalisation and mortality, as demonstrated in large cohorts.[7,10] However, PR uptake rates remain very low, ranging from 1.9% to 9.6% in carefully selected populations; fewer than 10% of patients complete a program.[10–12] In France, a recent nationwide population study showed only 8.6% PR uptake after severe COPD exacerbation; additionally, patients with a lower PR uptake rate tended to be younger, had fewer comorbidities, and lacked non-invasive ventilation (NIV) or oxygen therapy.[13] The barriers to referral and uptake are complex and multi-factorial.[14] Important geographical disparities have been identified at the national level, especially in the correlation between PR uptake and PR facilities.[13] Moreover, comorbidities present major obstacles to COPD management by increasing symptoms, worsening disability, and impairing patient QoL; they also tend to make treatment more complex, leading to reduced treatment adherence and diminished PR uptake.[12,15]

The previous national study was based on an analysis of the health insurance database without access to individualised medical records. The current study focuses on a large South West region of France, specifically Aquitaine; it considers data from both the Programme de Médicalisation des Systèmes d'Information (PMSI) database and exhaustive clinical data from patient records, such as smoking status and pulmonary functional tests (PFTs). Similarly, a more precise geographical analysis was conducted at the departmental level.

This study aimed to identify the factors associated with insufficient PR uptake after hospitalisation for COPD exacerbation in a large French population.

Methods

Data Sources

This retrospective multicentre study included patients hospitalised for COPD exacerbation between 1 January 2017 and 31 December 2018 at the University Hospital of Bordeaux and both Bayonne and Libourne public hospitals. The patients were identified using PMSI codes and were not restricted to the pulmonology department. The PMSI system corresponds to the French national hospital discharge database, which includes hospital diagnoses and medical procedures performed during each hospital stay at a French public hospital. Individual data were then extracted from hospital medical records.

Study Population

Our study included patients aged ≥ 40 years who were hospitalised for at least one night for COPD exacerbation. They were identified by a principal diagnosis (PD) of COPD or PD of acute respiratory failure, respiratory infection, influenza, acute heart failure, or pneumothorax and a second associated diagnosis of COPD. Exacerbation was defined as the acute worsening of respiratory symptoms that resulted in additional treatment[1] from the physician examining the patient, as confirmed by review of hospital admission records. We excluded patients with no confirmed forced expiratory volume in 1 second/forced ventilatory capacity (FEV1/FVC) ratio < 0.70 on PFTs prior to admission or at the pulmonologist follow-up visit for inaugural COPD diagnosis, other diagnoses than COPD, or COPD without exacerbation criteria. Moreover, to focus on individuals eligible for PR, other exclusion criteria were applied as follows: patients who died within 90 days; patients either hospitalised for more than one night within 90 days after discharge or transferred to another acute care facility, hospice, or long-term care facility; patients with active dementia; and bedridden patients (Figure 1).

Outcome

PR was defined as a stay in a medical unit or centre dedicated to PR programs initiated within 90 days of hospital discharge. In France, most PR programs are carried out in dedicated centres over a 3–6-week period, even if ambulatory care is increasing. They are multidisciplinary, including aerobic physical exercise and muscular strength exercises, as well as therapeutic education, help with smoking cessation, nutritional management and anxiety management.[16] The

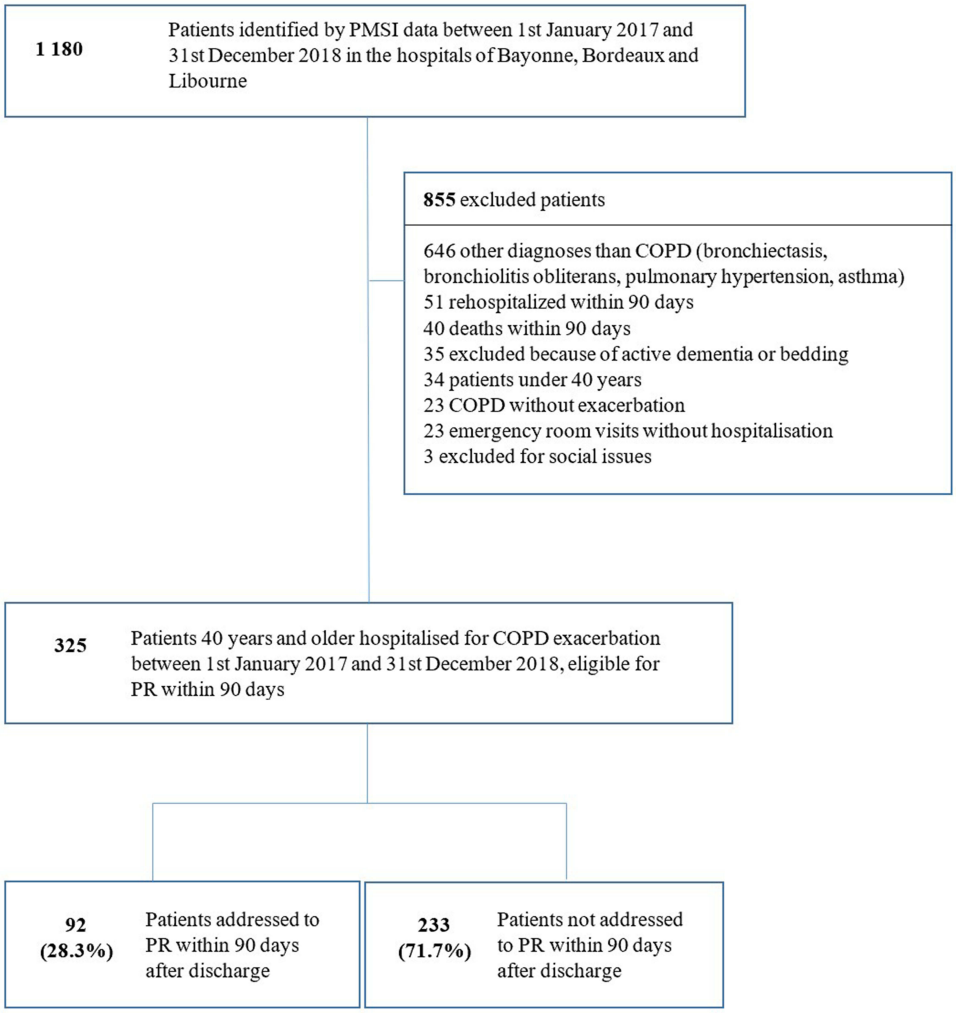

Figure 1 Flow chart.
Abbreviations: PR, pulmonary rehabilitation; PMSI, Programme de Médicalisation des Systèmes d'Information.

precise content may vary from one centre to another, but there are common guidelines.[15] A combination of endurance training (three to five sessions of 20 to 60 minutes per week at an intensity of 60% of maximum work), high-intensity training with intervals of 30 seconds to 1 minute, and resistance (3 sets of 8 to 12 repetitions at 60 to 70% of maximum load) is proposed. In addition, some programs incorporate neuromuscular electrical stimulation and respiratory muscle training.[17] Based on previous studies, a delay of 90 days was selected.[7,10,13] Only the first stay was analysed for patients with several stays.

Features and Healthcare Consumption

The Charlson index was used to estimate the weights of comorbidities.[18,19] To facilitate the analyses, the Charlson principal components were grouped into the following major categories: diseases of the circulatory system, including myocardial infarction, heart failure, cerebrovascular diseases, and peripheral vascular diseases; diabetes, including diabetes with or without complications; and cancer, including cancer with or without metastasis, as previously described.[20] Healthcare consumption was described by medications, such as inhaled long-acting beta2 agonists (LABA), long-acting muscarinic antagonists (LAMA), inhaled corticosteroids (ICS), oxygen, or NIV, as well as PR before the time of index hospitalisation for COPD exacerbation. Each patient's city of residence was used to estimate their access to PR. Additionally, socio-professional categories defined by the French National Institute for Statistical and Economic Studies were applied.

Ethic and Statistical Analyses

According to French Law,[21] this anonymous retrospective observational database study did not require approval by an ethics committee or informed signed consent from included patients. This work complies with the protection of personal health data and privacy, with the framework of application provided for by Article 65–2 of the Amended Data Protection Act and general data protection regulations. Additionally, this study was designed in accordance with Strengthening the Reporting of Observational Studies in Epidemiology guidelines.

Categorical variables were compared using the chi-square test or Fisher's exact test. Continuous variables were summarised as means ± standard deviations and were compared using Student's *t*-test. Factors associated with PR initiation after severe exacerbation of COPD were estimated using a multivariate logistic regression model and quantified by adjusted odds ratios (aORs) with 95% confidence intervals (CIs). The threshold for statistical significance was set to $p < 0.05$. Potential confounding factors were identified in the literature. Data concerning PR centres were obtained from the Système d'Information Interrégional en Santé. The distance between the city of residence and PR was measured using Google Maps (Google, Menlo Park, CA, USA). We used R software (v4.2.0; R Foundation for Statistical Computing, Vienna, Austria) with the 'stats' package (v4.2.0) to perform multivariate analysis. Other analyses were performed using Microsoft Excel (Microsoft Corp., Redmond, WA, USA) and GraphPad Prism software (GraphPad Software, La Jolla, CA, USA).

Data Availability

The data associated with the paper are not publicly available but can be obtained from the corresponding author upon reasonable request.

Results

Patient Characteristics

From the selected PMSI codes, we identified 1180 patients with in-hospital stays between 1 January 2017 and 31 December 2018 (Figure 1). In total, 855 patients were excluded after detailed analysis of the medical records, mainly because they had a diagnosis other than COPD (eg, bronchiectasis, bronchiolitis obliterans, pulmonary hypertension, or asthma). At the time of index hospitalisation, of the remaining eligible 325 patients admitted for severe acute exacerbation of COPD, 284 (87.4%) had a PD of COPD. The characteristics of the participants are presented in Table 1. Briefly, 247 (76.0%) patients were diagnosed with COPD before hospitalisation. The mean age was 68.0 ± 9.8 years; most patients were men (59.7%) and current (48.3%) or former (48.3%) smokers; and the mortality rate at 12 months after hospital discharge was 4.6%. The mean Charlson index was 2.3 ± 1.9; the main comorbidities were diseases of the circulatory system, followed by diabetes mellitus, cancers, and renal diseases, corresponding to 40.0%, 19.1%, 13.2%, and 4.3% of patients, respectively (Tables S1 and S2). The mean FEV1 was 44.5 ± 16.1%. Regarding inhaled treatments, most patients received a dual combination of LABA + LAMA (33.2%) or a triple combination of LABA + LAMA + ICS (31.4%). However, 13.9% of the patients did not receive any inhaled treatment at admission. Additionally, 91 patients (28.0%) had undergone PR. Finally, 30.2% of the patients received home oxygen therapy, and 16.0% were treated with NIV. Despite missing data, we found that < 30% of patients had received influenza and/or pneumococcal vaccines (Table 1).

Main Outcome

Among 325 patients admitted for severe acute exacerbation of COPD, only 92 (28.3%) underwent PR within 90 days after discharge (Figure 1). Sixty-five patients (70.7%) were directly transferred from the hospital to the PR centre, whereas 4 (4.4%) underwent PR within 7 days and 10 (10.8%) underwent PR within 7 to 30 days. The median distance between home and PR was 33.5 km [20.1; 49.8] (Table S3).

Factors Associated with Insufficient Pulmonary Rehabilitation (PR) Uptake

In univariate analysis, there were no significant differences between age and sex (Table 2). Patients who did not undergo PR had more comorbidities according to the Charlson index (2.5 ± 2.1 vs 1.8 ± 1.3, $p = 0.0002$). They also had a higher

Table 1 Characteristics of Patients Hospitalised for Severe Exacerbation of COPD in Bayonne, Bordeaux, and Libourne Between 1 January 2017 and 31 December 2018

Patient Characteristics (N = 325)	N	%
Principal diagnosis		
COPD	284	87.4
Sex		
Male	194	59.7
Age (years)		
Mean ± SD	68 ± 9.8	
Charlson index		
Mean ± SD	2.3 ±1.9	
Oxygen therapy	98	30.2
NIV	52	16.0
Baseline treatment		
No treatment	45	13.9
LABA or LAMA alone	22	6.7
LABA + LAMA	108	33.2
LABA + ICS	44	13.6
LABA + LAMA + ICS	102	31.4
Flu vaccination[a]	95	29.2
Pneumococcal vaccination[b]	77	23.7
Pulmonary function tests (mean ± SD)		
FEV1 (%)	44.5 ± 16.1	
TLC[c] (%)	110.6 ± 25.8	
GOLD stage		
1	6	1.9
2	112	34.5
3	139	42.8
4	63	19.4
Frequent exacerbator*	24	7.4
Smoking		
Never smoker	6	1.9
Former smoker (> 3 months)	157	48.3
Current smoker	157	48.3
Profession		
Unemployment or retirement	234	72.0
Disability	43	13.2
Current professional activity	23	7.1
Previous PR[d]	91	28.0
PR admission within 90 days	92	28.3
Rehospitalisation rate at 12 months for COPD	53	16.3
Death 12 months after discharge	15	4.6

Notes: [a]36% missing data, [b]29% missing data, [c]23% missing data, [d]20% missing data. *Frequent exacerbator is defined by two moderate exacerbations during the past 12 months or at least one severe exacerbation.

Abbreviations: COPD, chronic obstructive pulmonary disease; NIV, non-invasive ventilation; LABA, long-acting beta2-agonists; LAMA, long-acting muscarinic antagonists; ICS, inhaled corticosteroids; FEV1, forced expiratory volume in one second; TLC, total lung capacity; SD, standard deviation; PR, pulmonary rehabilitation.

Table 2 Comparison of Patients Undergoing PR or Not, After Severe Acute Exacerbation, in Bayonne, Bordeaux, and Libourne

	PR		No PR		p-value
	N	%	N	%	
Sex					
Male	54	58.7	140	60.1	0.82
Age (years)					
Mean ± SD	68.9 ± 9.9		67.6 ± 9.8		0.33
Charlson index					
Mean ± SD	1.8 ± 1.3		2.5 ± 2.1		0.0002
Oxygen therapy	33	40.2	65	27.9	0.16
NIV	23	25.0	29	12.5	0.0054
Baseline treatment					
No treatment	10	10.9	35	15.0	0.33
LABA or LAMA alone	3	3.3	19	8.2	0.11
LABA + LAMA	29	31.5	79	33.9	0.68
LABA + ICS	13	14.1	31	13.3	0.84
LABA + LAMA + ICS	37	40.2	65	27.9	0.03
Flu vaccination[a]	26	28.3	69	29.6	0.67
Pneumococcal vaccination[b]	23	25.0	54	23.1	0.57
Pulmonary function tests (mean ± SD)					
FEV1 (%)	37.2 ± 13.8		47.3 ± 16.0		< 0.0001
TLC (%)[c]	111.4 ± 27.5		110.4 ±25.2		< 0.0001
GOLD stage					
1	1	1.1	5	2.2	1.00
2	16	17.4	96	41.2	< 0.0001
3	44	47.8	95	40.1	0.18
4	28	30.4	35	15.0	0.0010
Frequent exacerbator	10	10.9	14	6.0	0.13
Smoking					
Never smoker	0	0.0	6	2.6	0.19
Former smoker (> 3 months)	49	53.3	108	46.4	0.18
Current smoker	40	43.5	117	50.2	0.36
Profession					
Unemployment or retirement	71	77.2	163	69.9	0.47
Disability	12	13.0	31	13.3	0.82
Current professional activity	5	5.4	18	7.7	0.48
Previous pulmonary rehabilitation[d]	36	39.1	55	23.6	0.01
Number of patients rehospitalised at 12 months for COPD	17	18.5	36	15.5	0.50
Death 12 months after discharge	6	6.5	9	3.9	0.30
Distance between living city and PR centre[e]					
Mean ± SD	48.4 ± 86.4		57.8 ± 122.1		0.37
≤ 10 km	12	13.0	20	8.6	0.22
11–30 km	29	31.5	94	40.3	0.16
31–50 km	29	31.5	77	33.1	0.89
> 50 km	21	22.8	42	18.0	0.44

Notes: [a]36% missing data, [b]29% missing data, [c]23% missing data, [d]20% missing data, [e]0.3% missing data. For patients without PR uptake, the distance between their city of residence and the nearest centre was considered.

Abbreviations: PR, pulmonary rehabilitation; NIV, non-invasive ventilation; LABA, long-acting beta2-agonists; LAMA, long-acting muscarinic antagonists; ICS, inhaled corticosteroids; FEV1, forced expiratory volume in one second; TLC, total lung capacity; SD, standard deviation.

Table 3 Multivariate Analysis Model by Logistic Regression of Association Between Patient Characteristics and the Absence of PR Uptake in Bayonne, Bordeaux, and Libourne

Multivariate Analysis (N = 320)	aOR (95% CI)	p-value
Charlson index	1.28 (1.10–1.53)	0.003
NIV	0.61 (0.31–1.21)	0.20
LABA + LAMA +ICS	0.69 (0.40–1.20)	0.20
FEV1	1.04 (1.02–1.06)	< 0.001

Abbreviations: PR, pulmonary rehabilitation; NIV, non-invasive ventilation; LABA, long-acting beta2-agonists; LAMA, long-acting muscarinic receptor antagonists; ICS, inhaled corticosteroids; FEV1, forced expiratory volume in one second; aOR, adjusted odds ratio; CI, confidence interval.

FEV1 (47.3% ± 16.0 vs 37.2% ± 13.8, p < 0.0001), were less often at GOLD stage 4 (p = 0.001), and were treated with a triple combination of LABA + LAMA + ICS (27.9% vs 40.2%, p = 0.03). Patients required less often NIV (p = 0.005), whereas oxygen therapy did not significantly differ. Finally, more patients who underwent PR had already participated in the PR program at some point (39.1% vs 23.6%, p = 0.01).

In the multivariate analysis (Table 3), patients who did not undergo PR had more comorbidities, according to the Charlson index (aOR = 1.28 [1.10–1.53], p = 0.003). Patients with COPD had more preserved lung function with a higher FEV1 (aOR = 1.04 [1.02–1.06], p < 0.001). However, there were no significant associations of PR with NIV (aOR = 0.61 [0.31–1.21]) or triple inhalation therapy (aOR = 0.69 [0.40–1.20]).

Geographic Analyses of PR Disparities

We noticed important regional disparities in PR uptake. Based on the patient's living department, PR uptake varied from 17.4% in the Dordogne department to 40.0% in the Lot-et-Garonne department (Figure 2A). There was no correlation between PR uptake and PR centre capacity in individual departments (Figure 2C and D); however, some patients had no PR bed (Figure 2B). PR uptake was not significantly associated with distance between the city of residence and PR centre (48.4 ± 86.4 km vs 57.8 ± 122.1 km, p = 0.37).

Social Outcomes

Regarding socio-professional issues, 234 patients (72%) were unemployed or retired. Employees and workers were the two main socio-professional categories, representing 16.0% and 24.3% of patients, respectively. There were no significant differences between the groups (Table S4).

Finally, in univariate analysis, no significant difference was found between patients who underwent PR or not regarding the rehospitalisation rate at 12 months (18.5% vs 15.5%, p = 0.50). Similar Results were obtained regarding the mortality rate at 12 months after adjustments for age, comorbidities, and FEV1 (p = 0.29) (Figure S1).

Discussion

This study is the first to describe the socioeconomic and clinical factors associated with insufficient PR uptake in the French region. Among 325 patients, only 92 (28.3%) underwent PR within 90 days of hospitalisation for severe COPD exacerbation. This rate was higher than the national admission rate (8.6%)[13] and those of several previous studies,[12,22,23] but it remains insufficient. This difference may be partly explained by our stringent selection criteria, including the need to confirm an FEV1/FVC ratio < 0.7 on PFTs. Additionally, almost all patients came from respiratory care departments that commonly collaborated with nearby PR centres.

Regarding the delay in PR uptake, the GOLD report recommends admission within 30 days of discharge.[1] In our study, the largest number of patients underwent PR within 30 days (81.0%) or 7 days (75.0%) of discharge.

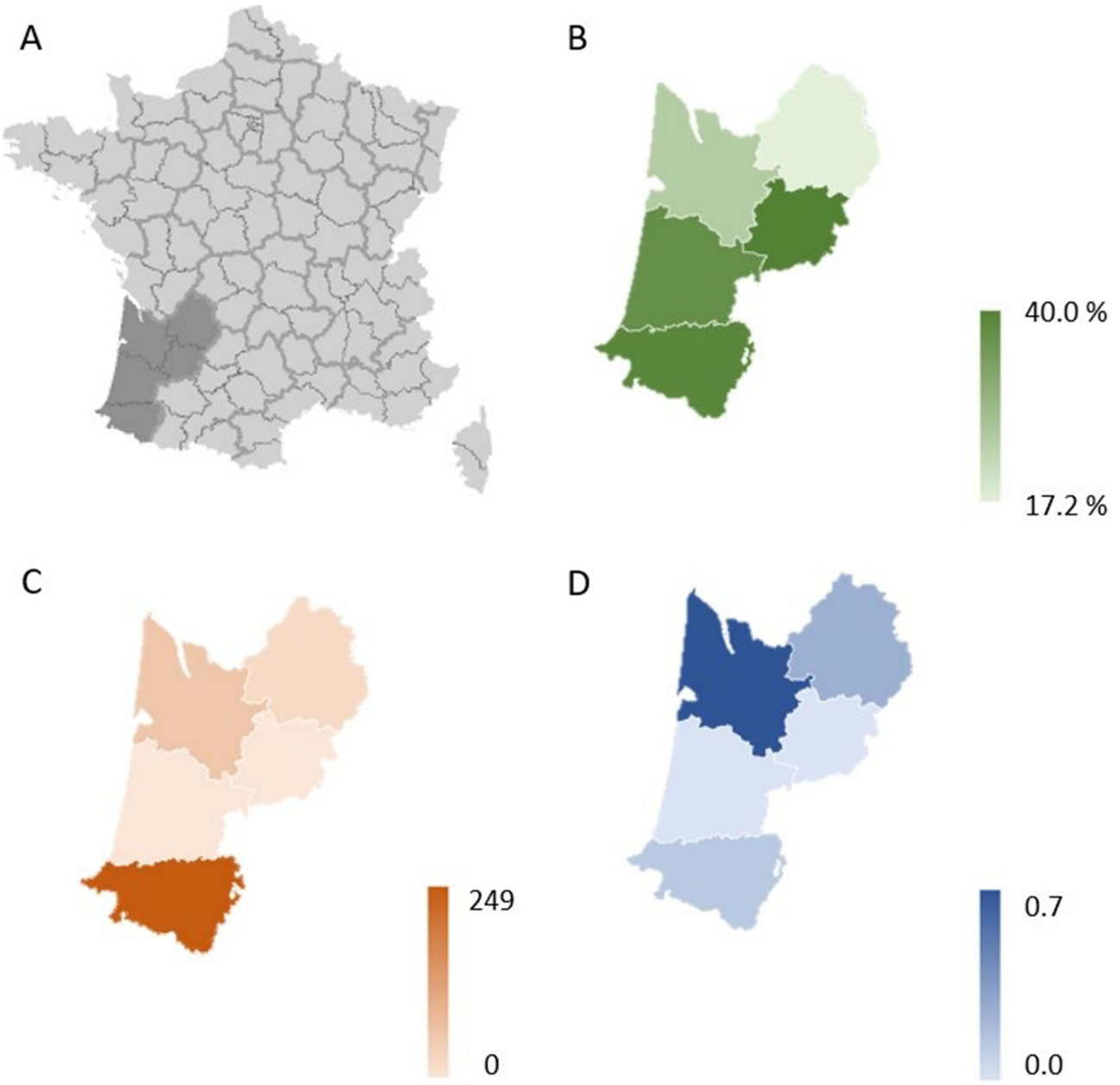

Figure 2 Pulmonary rehabilitation disparities according to department. (**A**) Region of interest. (**B**) PR uptake, (**C**) Number of PR beds by department, (**D**) Ratio of number of patients admitted to PR and number of bed available).
Abbreviation: PR, pulmonary rehabilitation.

Features Related to Insufficient PR Uptake

In our study, patients with preserved lung function were less likely to undergo PR. However, Halpin et al[24] showed that the mean annual decline in FEV1 increased after a single moderate-to-severe exacerbation compared with the decline before exacerbation (FEV1 76.5 vs 39.1 mL/year, p = 0.003), confirming the need to refer patients with both preserved and impaired lung function in PR after exacerbation. Additionally, comorbidities should not be an obstacle to PR uptake. Grosbois et al[25] showed significant improvements in exercise capacity, QoL, and anxiety/depression rate after PR, regardless of cardiovascular and metabolic comorbidities. Similarly, Crisafulli et al[26] observed significant improvements in all PR Outcomes tested among 45% of patients with comorbidities (hypertension, dyslipidemia, coronary artery disease, and diabetes were most common).

We showed that a previous stay in rehabilitation was significantly associated with higher PR uptake. This is consistent with published reports showing that previous PR experience is an enabler of PR uptake.[27,28]

Intriguingly, 78 patients (24.0%) had no previous COPD diagnosis; therefore, exacerbation was the first event that enabled diagnosis of COPD. Although there was no difference in PR uptake, this percentage highlights the importance of underdiagnosis in COPD. Among 5055 smokers in the COPD Gene cohort, Tran et al[29] showed that 1064 (21.0%) patients without diagnosed COPD had airflow obstruction. In a cohort of 95,288 patients in Denmark,[30] 32,518 (34%) were considered at risk for COPD (age ≥ 40 years with estimated smoking history of ≥ 10 pack-years). Of these, 3699 (11%) met the diagnostic criteria for COPD, whereas 2903 (78%) were undiagnosed and 2052 (71%) were symptomatic. General practitioners could be key contributors to limiting this underdiagnosis via simple tools such as adapted questionnaires or spirometry.[31]

Finally, we found that sex and age were not related to PR uptake, unlike previous studies that showed an association with older patients[13] or younger patients.[32] Controversial data concerning sex have also been published.[12,23] Nevertheless, the prevalence of COPD is increasing among women. Women experience greater activity-related dyspnoea, more severe hyperinflation, and more frequent exacerbations.[33] In the current study, the small sample size may explain the lack of sex and age differences.

Healthcare System and PR

In France, most PR programs are carried out in specialised centres or units over a 3–6-week period, even if ambulatory care is increasingly delivered. However, we found a clear heterogeneous inter-departmental distribution of rehabilitation beds; notably, two of the five departments had no PR facility. The distance between home and rehabilitation centres and the presence of transportation difficulties have been identified as barriers to PR.[28] Indeed, Hayton et al[34] showed that 25% of non-adherent PR patients had transportation problems and lived further away than those admitted for rehabilitation. In our study, there was no significant association between PR uptake and distance from the home. This could be explained by the fact that we only considered inpatient PR and that in France, most medical transportation is reimbursed. Additionally, scheduling conflicts with work and family activities may be barriers to rehabilitation.[28] We could not find any differences in our cohort because only 23 patients (7.1%) had current professional activities. Nevertheless, these data highlight the crucial importance of developing more flexible programs accessible to all patients, such as by integrating telerehabilitation sessions. These types of PR programs could not be included in our study because they were underdeveloped at that time considered for the study period; however, new studies incorporating them would be relevant.

Concerning rehospitalisations, Stefan et al[10] found that PR initiation within 90 days of discharge was associated with a lower risk of readmission at 12 months (HR = 0.83, [0.77–0.90]). We did not obtain similar results in our cohort; however, because of our study design, we only had access to rehospitalisations in the same centre. Thus, we may have missed a small number of rehospitalisations. Furthermore, unlike the results obtained by Lindenauer et al,[7] the mortality rate at 12 months did not significantly differ between the groups, probably due to the small sample size.

Strengths and Limitations

A strength of our study was the use of precise clinical data, such as PFT, treatment, and history of exacerbation, to better describe COPD severity. Moreover, the Bayonne, Bordeaux, and Libourne hospitals are the three main centres with a respiratory department in the South West region of France, which provides a good representation of the proportions and characteristics of COPD hospitalised patients. However, identification of the target population by PMSI coding makes the selection of patients dependent on the accuracy and discretion of the practitioners who treat them, leading to the exclusion of more than half of the population. This limitation was reduced by an individual and a detailed analysis of individual medical records. Additionally, we chose the delay of 90 days; we did not have any information about patients referred later or those referred elsewhere (eg, telerehabilitation or home- or community-based PR). Despite these limitations, the findings of our study highlight that the use of PR after severe COPD exacerbation remains unacceptably low and heterogeneous. Notably, our study only investigated inpatient PR; in the future, we hope to have additional data from the development of outpatient PR and telerehabilitation. Finally, a major limitation of our study was the lack of information about PR referral, refusal, and the reasons for refusal.

Conclusion

PR uptake after severe COPD exacerbation was less than one-third of the COPD population in the South West region of France. Insufficient PR uptake is associated with a higher number of comorbidities and preserved lung function. Additionally, inter-departmental disparities were observed. New strategies are needed to promote PR after exacerbation, regardless of COPD severity. Home-based programs and telerehabilitation, which are increasingly being developed under robust research efforts, could become key solutions for promoting greater availability and accessibility to PR.

Ethical Approval

According to French Law, this anonymous retrospective observational database study did not require approval by an ethics committee or informed signed consent from the patients.

Author Contributions

All authors made a significant contribution to the work reported, in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all of these areas; took part in drafting, revising, or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and have agreed to be accountable for all aspects of the work.

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Disclosure

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