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Mortality-Reducing Effect of Rehabilitation for COPD: Observational Propensity-Matched Cohort Study Using a Nationwide Database

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BACKGROUND: In the course of therapy of patients with COPD, non-pharmacologic treatment, such as rehabilitation, plays an important role. Although some studies have provided concrete evidence of the effectiveness of rehabilitation in improving functional outcomes in subjects with COPD, evidence of its mortality-reducing effect has been insufficient. In the present study, we examined whether rehabilitation had positive effects on in-hospital mortality of subjects with COPD. METHODS: We used the Japanese Diagnosis Procedure Combination nationwide administrative claims database. This was a retrospective cohort study, and there were 18,037 eligible subjects with COPD from 1,055 hospitals. The main outcome was in-hospital mortality rates. A one-to-one propensity score matching method was used to compare hospital mortality rates after admission between rehabilitation and non-rehabilitation groups. RESULTS: A total of 3,356 pairs of subjects were selected from the rehabilitation and non-rehabilitation groups (*n* = 6,712). Subjects in the rehabilitation program showed a reduction in the odds of mortality (odds ratio = 0.80, 95% CI 0.65–1.00, *P* = .045). In the subgroup analyses, the rehabilitation group had a lower in-hospital mortality in the pre-obese subgroup (body mass index 25.0–29.9) than the non-rehabilitation group (*P* = .02). Although not significant, the rehabilitation group showed a relatively low in-hospital mortality in the Hugh-Jones dyspnea scale class 5 subgroup (*P* = .066). CONCLUSIONS: This large nationwide cohort study showed that rehabilitation indeed contributed to a reduction of in-hospital mortality. These findings underscore the importance of adopting rehabilitation as part of the treatment of COPD. *Key words: COPD; rehabilitation; mortality; propensity score; retrospective cohort study; diagnosis procedure combination.* [Respir Care 0;0(0):1–•. © 0 Daedalus Enterprises]

Introduction

COPD is a respiratory disease characterized by progressive persistent air-flow obstruction and difficulty in breathing, and it is associated with an increased chronic inflammatory reaction of the airways and lungs to harmful particles and gases.[1,2] According to research by the World Health Organization, COPD is the fourth-leading cause of death globally, and it is estimated that it will rank third by 2020.[3] Prevention and treatment of the disease has become an important public health issue, and the economic and social

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burden has grown accordingly.[4,5] COPD has been reported to cause a heavy financial burden. In the European Union, the direct cost associated with all respiratory diseases accounts for about 6% of the total amount of the budget dedicated to health care, 56% of which is estimated to account for COPD-related costs.[6] In the United States, the direct cost of COPD to the health care system is estimated to amount to 29.5 billion dollars, and the indirect cost is estimated to amount to 20.4 billion dollars.[7]

Rehabilitation provides ongoing support to patients so that they can live independently. The main objectives of rehabilitation are to help restore and maintain the respiratory function of patients with disorders caused by respiratory tract diseases, as well as to enhance the quality of life and revitalize physical and mental strength as far as possible in daily life.[8-10]

Studies have shown that rehabilitation is effective in terms of improving functional outcomes in subjects with COPD, and it is recommended by the American College of Chest Physicians/American Association of Cardiovascular and Pulmonary Rehabilitation (ACCP/AACVPR). The Global Initiative for Chronic Obstructive Lung Disease (GOLD) guidelines also reported that rehabilitation improves exercise capacity (level A) and health-related quality of life (level A). Meanwhile, several studies on the mortality-reducing effect of rehabilitation for subjects with COPD have been reported.[11-14] However, accumulation of more research data is needed. The GOLD guidelines based the mortality-reducing effect on level B evidence, and the ACCP/AACVPR guidelines concluded that there was insufficient evidence to confirm such an effect.

In the present study, we hypothesized that rehabilitation does, in fact, contribute to an improved survival rate in patients with COPD. To test this hypothesis, we conducted propensity-matched analysis with a large sample size using a nationwide in-patient database in Japan.

QUICK LOOK

Current knowledge

In the course of treatment of patients with COPD, nonpharmacological treatment, such as rehabilitation, plays an important role. Although some studies have provided concrete evidence of the effectiveness of rehabilitation in improving functional outcomes in subjects with COPD, evidence of its mortality-reducing effect has been insufficient.

What this paper contributes to our knowledge

This large nationwide cohort study showed that rehabilitation indeed contributed to a reduction of in-hospital mortality. In the pre-obese subgroup, whose BMI by itself was a factor that positively contributes to reducing mortality, rehabilitation interventions led to a further decrease in the in-hospital mortality rate.

Methods

Data Source

This study was a retrospective cohort study using a nationwide discharge abstract and administrative claims database. For the present study, we used the Japanese Diagnosis Procedure Combination (DPC) database.[15-17] All 82 university hospitals in Japan are obliged to adopt the DPC system, although adoption by community hospitals is voluntary. The database includes the following data: unique hospital identifier; patients' age and sex; diagnoses, comorbidities at admission, and complications after admission recorded in accordance with the International Classification of Diseases, 10th Revision (ICD-10) codes and as text data in Japanese; and information coded using original Japanese codes, such as the Hugh-Jones classification, smoking index, and discharge status (mortality data were collected from the discharge status listed as "death").

Complications that occurred after admission are clearly differentiated from comorbidities that were already present at admission. To optimize accuracy, the responsible physicians are obliged to record diagnoses with reference to medical charts. In 2011, 7 million patients were included in the DPC system, which accounted for approximately 45% of all in-patient admissions to acute care hospitals in Japan that year.

This study was based on a secondary analysis of the administrative claims data. The requirement for informed consent was waived because of the anonymous nature of the data. Study approval was obtained from the institutional review board at the University of Tokyo.

Subject Selection and Data

We identified subjects age ≥40 y whose diagnoses at admission were COPD and allied conditions, including bronchitis (ICD-10 codes J40–J42), emphysema (J43), and other types of COPD (J44), and who were discharged from an acute care hospital between July 1, 2010 and June 30, 2011. To avoid a pseudo-positive factor, we excluded se-

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vere patients who would probably have died before undergoing rehabilitation, such as those who required ventilator management at the time of admission, because they might affect excessively the mortality of the non-rehabilitation group.

Body mass index (BMI) was classified in 4 categories (<18.5, 18.5–24.9, 25.0–29.9, and ≥30 kg/m^2) in accordance with the World Health Organization BMI Classification.[18] The Hugh-Jones classification is a dyspnea scale that includes 5 categories: class 1, able to work, walk, and climb up and down slopes and stairs similarly to healthy persons of the same age; class 2, able to walk similarly to healthy persons of the same age but unable to climb up and down slopes and stairs like other healthy persons of the same age; class 3, unable to walk like healthy persons on level ground, but able to walk more than a mile (1.6 km) at own pace; class 4, unable to walk 50 m without resting; and class 5, shortness of breath occurs when speaking or changing clothes, and usually unable to leave home. Hospital volume was defined as the number of subjects with COPD hospitalized and was categorized into 3 tertiles (low, medium, and high), with an approximately equal number of subjects in each group. On the basis of the protocol of Quan et al,[19] each ICD-10 code of comorbidity was converted into points and totaled to calculate each subject's Charlson comorbidity index (CCI), which was categorized into 1, 2, 3, and ≥4. We also assessed in-hospital respiratory tract infections for each subject. Smoking index (pack-years) was converted to smoking status: non-smoker (smoking index = 0) and current or past smoker (smoking index ≥1).

Identification of Rehabilitation

In the health-care payment system for DPC hospitals, each subject is reimbursed for rehabilitation, and a unique procedure code for rehabilitation is recorded in the DPC database. We identified subjects who underwent rehabilitation during the hospitalization by checking this code and divided the eligible subjects into 2 groups: a usual care group and a usual care with rehabilitation group.

Statistical Analyses

With research into comparative effectiveness using retrospective observational data, treatment assignments are not random (ie, treatment selection is biased by confounding factors, including subject backgrounds). Outcomes can reflect a lack of comparability in treatment groups rather than the effects of treatment. To address this issue, we performed one-to-one propensity score matching between subjects with and without rehabilitation.[20-22] The propensity score method has previously been used to reduce potential confounding caused by unbalanced covariates. This propensity-matched analysis approach allows us to construct a randomized experiment-like situation, in which the treatment groups under investigation are comparable for observed prognostic factors. The application of propensity score matching involves estimating the propensity score, followed by matching subjects according to this score and comparing the outcomes of matched subjects. To determine the propensity score, we fitted a logistic regression model for undergoing rehabilitation as a function of age, sex, BMI, Hugh-Jones classification, CCI, smoking status (smoker or non-smoker), respiratory tract infections, and hospital volume category. The C statistic for evaluating the goodness of fit was calculated. Each subject who underwent rehabilitation was matched with a subject who did not, with the closest estimated propensity on the logit scale being within a specified range (≤.25 of the pooled SD of the estimated logits). Fisher's exact test was used to compare the proportions between the groups. We performed multivariate logistic regression analysis to analyze the effect of rehabilitation on in-hospital mortality, with adjustment for potential confounders. The threshold for significance was $P < .05$. All statistical analyses were conducted using IBM SPSS 19.0 (IBM Corporation, Armonk, New York).

Results

Subject Background

We identified 18,037 eligible subjects from 1,055 hospitals, among whom 4,592 subjects (25.5%) underwent rehabilitation. Using one-to-one propensity score matching, a total of 3,356 pairs of subjects were selected from the rehabilitation and non-rehabilitation groups (n = 6,712). The C statistic for goodness of fit was 0.624 in the propensity-matched model. The mean stay ± SD for all 18,037 subjects was 22.8 ± 47.1 d, of which the rehabilitation group was 29.2 ± 58.5 d and the non-rehabilitation group was 20.5 ± 42.3 d. Meanwhile, the mean stay for the 6,712 propensity score-matched subjects was 23.0 ± 48.9 d, of which the rehabilitation group was 27.2 ± 59.3 d and the non-rehabilitation group was 18.9 ± 35.2 d. The major causes of death in all subjects who died (n = 1,593) were respiratory failure (59.3%), pulmonary infection (23.2%), infectious focus-unknown sepsis (3.9%), heart failure (2.2%), and stroke (0.5%).

Table 1 shows the demographics of all of the subjects (N = 18,037) and the propensity score-matched subjects (n = 6,712). For all subjects, an unpaired t test showed that the mean age was lower in the rehabilitation than in the non-rehabilitation group (76.0 ± 9.1 y vs 77.0 ± 9.9 y, $P < .001$) and that the proportion of subjects with a Hugh-Jones classification ≥3 was higher in the rehabilitation

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Table 1. Demographic and Clinical Characteristics of All Subjects and the Propensity-Matched Subjects

Characteristics	All Subjects (N = 18,037)					Propensity-Matched Subjects (n = 6,712)				
	Rehabilitation Group (n = 4,592)		Non-Rehabilitation Group (n = 13,445)		P	Rehabilitation Group (n = 3,356)		Non-Rehabilitation Group (n = 3,356)		P
	n	%	n	%		n	%	n	%	
Male sex	3,844	77.9	10,471	83.7	<.001	2,806	83.6	2,828	84.3	.48
Age, y					<.001					.45
40–59	197	4.3	739	5.5		155	4.6	135	4.0	
60–69	729	15.9	2,005	14.9		553	16.5	542	16.2	
70–79	1,802	39.2	4,594	34.2		1,362	40.6	1,355	40.4	
80–89	1,678	36.5	5,120	38.1		1,166	34.7	1,219	36.3	
≥90	186	4.1	987	7.3		120	3.6	105	3.1	
Hugh-Jones classification					<.001					.49
1	261	6.2	1,165	10.4		211	6.3	211	6.3	
2	481	11.5	1,474	13.2		388	11.6	359	10.7	
3	709	17.0	1,663	14.9		596	17.8	562	16.7	
4	1,473	35.3	3,401	30.5		1,196	35.6	1,210	36.1	
5	1,254	30.0	3,461	31.0		965	28.8	1,014	30.2	
Body mass index, kg/m^2					<.001					.47
<18.5	1,813	44.9	4,451	39.4		1,471	43.8	1,504	44.8	
18.5–24.9	1,886	46.7	5,680	50.3		1,596	47.6	1,595	47.5	
25.0–29.9	277	6.9	998	8.8		238	7.1	216	6.4	
≥30	63	1.6	165	1.5		51	1.5	41	1.2	
Charlson comorbidity index					<.001					.65
1	2,067	45.0	5,990	44.6		1,522	45.4	1,555	46.3	
2	1,323	28.8	3,620	26.9		966	28.8	975	29.1	
3	751	16.4	2,236	16.6		551	16.4	533	15.9	
>4	451	9.8	1,599	11.9		317	9.4	293	8.7	
Smoking	2,783	68.1	6,640	56.8	<.001	2,343	69.8	2,343	69.8	>.99
Respiratory tract infections	1,004	21.9	3,341	24.8	<.001	672	20.0	653	19.5	.56
Hospital volume, subjects/y					<.001					.40
Low (≤21)	1,167	25.4	4,992	37.1		849	25.3	891	26.5	
Medium (22–41)	1,622	35.3	4,643	34.5		1,143	34.1	1,147	34.2	
High (≥42)	1,803	39.3	3,810	28.3		1,364	40.6	1,318	39.3	

group than in the non-rehabilitation group (82.3% vs 76.4%, $P < .001$). Smokers (68.1% vs 56.8%, $P < .001$), subjects with BMI <18.5 (44.9% vs 39.4%, $P < .001$), and high-volume hospitals (39.3% vs 28.3%, $P < .001$) were more likely to undergo rehabilitation. The use of the propensity score matching method allowed us to closely balance subjects' backgrounds between the rehabilitation and non-rehabilitation groups.

Mortality in the Propensity-Matched Group

Table 2 shows the odds ratio (OR) of in-hospital mortality in the propensity-matched groups. In the treatment of COPD, rehabilitation had a positive effect in reducing in-hospital mortality by 20% (OR = 0.80, 95% CI 0.65–1.00, $P = .045$). Other factors associated with in-hospital mortality were sex (OR = 0.53, 95% CI 0.37–0.76, $P = .001$ for males compared with females), BMI (OR = 2.28, 95% CI 1.81–2.86, $P < .001$ for BMI <18.5 and OR = 0.34, 95% CI 0.14–0.85, $P = .02$ for BMI 25.0–29.9 compared with the normal BMI 18.5–24.9 group), Hugh-Jones classification (OR = 2.55, 95% CI 1.02–6.38, $P = .045$ for class 4 group and OR = 10.02, 95% CI 4.07–24.69, $P < .001$ for class 5 group compared with class 1 group), CCI (OR = 1.96, 95% CI 1.46–2.64, $P < .001$ for CCI 3 and OR = 2.57, 95% CI 1.85–3.57, $P < .001$ for CCI ≥4 compared with the CCI = 1 group), respiratory tract infection (OR = 1.66, 95% CI 1.31–2.10, $P < .001$) for the respiratory tract infection group compared with the non-respiratory tract infection group). Subjects in high-volume hospitals had a lower risk of in-hospital mortality than those in low-volume hospitals (OR = 0.73, 95% CI 0.56–0.95, $P = .02$). Regarding age, there was a nonsignificant tendency for increased risk of

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Table 2. Odds Ratio of In-Hospital Mortality in the Propensity-Matched Group

Factors	Odds Ratio	95% CI	*P*
Rehabilitation			
No	Reference		
Yes	0.80	0.65–1.00	.045
Sex			
Male	Reference		
Female	0.53	0.37–0.76	.001
Age, y			
40–59	Reference		
60–69	0.64	0.27–1.52	.31
70–79	1.38	0.62–3.04	.42
80–89	2.16	0.98–4.74	.056
≥90	2.44	0.99–5.98	.052
Hugh-Jones classification			
1	Reference		
2	0.83	0.27–2.58	.75
3	1.84	0.7–4.83	.21
4	2.55	1.02–6.38	.045
5	10.02	4.07–24.69	<.001
Body mass index, kg/m^2			
<18.5	2.28	1.81–2.86	<.001
18.5–24.9	Reference		
25.0–29.9	0.34	0.14–0.85	.02
≥30	1.00	0.3–3.31	>.99
Charlson comorbidity index			
1	Reference		
2	1.21	0.93–1.58	.16
3	1.96	1.46–2.64	<.001
≥4	2.57	1.85–3.57	<.001
Respiratory tract infection			
No	Reference		
Yes	1.66	1.31–2.10	<.001
Hospital volume, subjects/y			
Low (≤21)	Reference		
Medium (22–41)	0.81	0.62–1.05	.11
High (≥42)	0.73	0.56–0.95	.02

n = 6,712.

in-hospital mortality with advancing age: OR = 2.16 in the group age 80–89 y (*P* = .056) and OR = 2.44 in the ≥90-y group (*P* = .052) compared with the group age 40–59 y.

Table 3 shows the subgroup analyses when comparing in-hospital mortality between the subjects with and without rehabilitation stratified by the BMI categories. The rehabilitation group had a lower in-hospital mortality in the pre-obese subgroup (BMI 25.0–29.9) than the non-rehabilitation group (*P* = .02). Although not significant, the rehabilitation group had relatively low in-hospital mortality in the underweight subgroup (BMI <18.5, *P* = .062).

Table 4 shows the subgroup analyses when comparing in-hospital mortality between the subjects with and without rehabilitation stratified by Hugh-Jones classification. Although not significant, the rehabilitation group showed relatively low in-hospital mortality compared with the non-rehabilitation group in the Hugh-Jones class 5 subgroup (*P* = .066).

Discussion

We examined whether rehabilitation had a positive effect on patient in-hospital mortality in the treatment of COPD. The results showed that rehabilitation does indeed contribute to a reduction of in-hospital mortality. These findings underscore the importance of adopting rehabilitation as part of the treatment of COPD.

Based on the existing evidence,[23] pharmacologic treatment is routinely performed for patients with COPD. Meanwhile, non-pharmacologic treatments, including rehabilitation, have not yet been widely adopted despite its recommendations by the ACCP/AACVPR and GOLD guidelines. According to the European Respiratory Society (ERS) COPD Audit performed in 13 European countries, 30% of the patients with COPD received rehabilitation.[24] In this study, we found out that only 25.5% of patients in Japan underwent rehabilitation.

Although the guidelines present concrete evidence of the effectiveness of rehabilitation in improving functional outcomes in patients with COPD, its mortality-reducing effect remained uncertain. The GOLD guidelines evaluate rehabilitation in COPD as level B evidence, and the ACCP/AACVPR guidelines indicate that it does not necessarily have an effect on the survival rate, but its evidence was insufficient; therefore, the accumulation of more research data was needed. Over the past years, several studies on the mortality-reducing effect of rehabilitation for patients with COPD have been reported.[11-14] The Cochrane review by Puhan et al,[11] 3 studies involving 110 subjects (30–40 subjects each), concluded that treatment with rehabilitation led to a reduction in the odds of death (OR = 0.28, 95% CI 0.10–0.84). Using a large sample size, the present study demonstrates that rehabilitation reduced in-hospital mortality.

Examining the factors determining the prognosis of COPD is also an important matter. Smoking is the most fully studied risk factor for COPD, and other studies pertaining to age, sex, BMI and comorbidities have also been conducted in the past. Age is often mentioned as a risk factor for COPD. In terms of sex, most recent studies have shown that the prevalence of COPD and the mortality rate were higher in men than in women. However, previous reports have also shown that in developed countries, the prevalence of COPD showed virtually no difference between the sexes,[25] which was believed to reflect changes in smoking patterns. Fatigue, underweight, and loss of appetite have often been found in patients with severe

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Table 3. Subgroup Analyses Comparing In-Hospital Mortality Between the Subjects With and Without Rehabilitation Stratified by Body Mass Index Categories

Body mass index, kg/m^2	Rehabilitation Group			Non-Rehabilitation Group			P
	Total (n = 3,356), n	Death (n = 177)		Total (n = 3,356), n	Death (n = 222)		
		n	%		n	%	
<18.5	1,471	116	7.9	1,504	148	9.8	.062
18.5–24.9	1,596	59	3.7	1,595	68	4.3	.41
25.0–29.9	238	0	0.0	216	5	2.3	.02
≥30	51	2	3.9	41	1	2.4	>.99

Table 4. Subgroup Analyses Comparing In-Hospital Mortality Between the Subjects With and Without Rehabilitation Stratified by the Hugh-Jones Classification

Hugh-Jones classification	Rehabilitation Group			Non-Rehabilitation Group			P
	Total (n = 3,356), n	Death (n = 177)		Total (n = 3,356), n	Death (n = 222)		
		n	%		n	%	
1	211	4	1.9	211	1	0.5	.37
2	388	5	1.3	359	3	0.8	.72
3	596	12	2.0	562	16	2.8	.44
4	1,196	39	3.3	1,210	50	4.1	.28
5	965	117	12.1	1,014	152	15.0	.066

COPD.[26] A report on a previous study of the BMI and the prognosis of COPD during hospitalization has shown that the underweight group had the highest rate of hospital mortality associated with exacerbations of COPD and that the mortality rate was lowest in the pre-obese group.[27] Regarding comorbidities, there is an increasing awareness that most patients with COPD have comorbidities, and that they have a considerable impact on the quality of life and survival rate.[28]

In comparison with the previous studies, the present study also shows a relationship between in-hospital mortality and risk factors, including age, sex, BMI, severity of dyspnea, and comorbidities. Underweight subjects had a higher mortality, and most notably a lower mortality rate was found in the pre-obese group, which was similar to the results of previous studies. Regarding the severity of dyspnea, a higher mortality rate was found in subjects categorized as class 4 or higher in the Hugh-Jones classification. With respect to comorbidities, our results showed that subjects with a CCI of ≥3 had an elevated mortality rate, which supports the finding that the number of comorbidities has a considerable impact on the survival rate of patients with COPD. There are other symptoms, such as depression and anxiety, that are not included in the CCI. Previous reports have found that these comorbidities have a high prevalence in patients with COPD and increase the mortality rate.[29-31] Management of these conditions should also be part of the treatment.

We performed stratified analyses based on BMI of the effect of rehabilitation on reducing the mortality rate. These analyses are the strengths and important differences in relation to other studies. The result showed that in the pre-obese subgroup, whose BMI by itself is a factor that positively contributes to reducing mortality, rehabilitation interventions led to a further decrease in the in-hospital mortality rate. Based on these results, rehabilitation is recommended for pre-obese patients with COPD. The GOLD guidelines also emphasize the fact that being underweight or overweight is a poor prognostic factor for COPD, and nutrition therapy is an important component of the program in rehabilitation. A previous study suggests that nutritional therapy alone is not a sufficient strategy, and increased calorie intake is best accompanied by rehabilitation, even helping patients without severe nutritional depletion.[32] Therefore, combining the treatment with nutrition therapy and preventing patients from losing weight is a subject that deserves greater attention in treating COPD.

Several limitations of our study should be noted. First, we extracted a subjective measure of dyspnea as the Hugh-Jones classification from an existing database; however, there were no available data on the stages of COPD and the values of pulmonary function tests. Second, the results of propensity score matching in this study are generalizable only among the patients in the range of propensity scores included in the paired analysis; they may not be applicable to patients who are out of this range. Propensity

score methods can reduce bias in causal estimates due to observed differences between treatment groups; however, they are still subject to biases from unobserved variables, such as, in the present study, those not included in the DPC data: laboratory data, physiological data, and radiographic image data. Third, the present study consists of various types of rehabilitation programs, ranging from simple physical rehabilitation to comprehensive rehabilitation, which are not differentiated in the DPC data; therefore, details on rehabilitation programs are not identified. Fourth, the mean stay was 29.2 d for subjects who underwent rehabilitation during hospitalization. The GOLD guideline recommends 6 weeks as the minimum length of an effective rehabilitation program; however, because our study is based on an existing database that does not include details on rehabilitation programs, interpretation of the meaning of the stay cannot be determined. It must also be noted that the studies referenced in the GOLD guideline predominantly focus on out-patient rehabilitation, not in-patient.[33-35] Meanwhile, other studies have reported the effectiveness of in-patient rehabilitation for a period of <6 weeks.[36-38] Other limitations include the following: the data do not include whether subjects underwent rehabilitation before and/or after hospitalization; recorded diagnoses in administrative databases are less well validated than those in planned prospective cohorts or registries; the lack of data on post-discharge status precludes an evaluation of long-term outcomes; and the smoking index in the DPC data does not specify the current smoking status.

Conclusions

Although existing guidelines for COPD have noted the need to accumulate more research data on a mortality-reducing effect of pulmonary rehabilitation in patients with COPD, this large nationwide cohort study showed that rehabilitation treatment is essential for patients with COPD in improving their survival rate. These findings underscore the importance of non-pharmacologic treatments, such as rehabilitation, in providing an effective mortality-reducing treatment for COPD. Meanwhile, the burden imposed by COPD on the health-care system is large. It is important to promote an interest in research related to this highly morbid disorder so as to raise awareness of the financial burden and to improve the prevention, treatment, and management of COPD through collaboration among people involved in all aspects of health care and health policy. This study examined the effects of rehabilitation on hospitalized subjects with COPD on the basis of DPC data. It is important, however, that rehabilitation be conducted not only during hospitalization but also be continued in the long term, including at-home care as a follow-up. This study provides further evidence related to the use of rehabilitation in the treatment of COPD.

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