ORIGINAL RESEARCH

Factors Associated with Non-Adherence to Self-Management Among Patients with Chronic Obstructive Pulmonary Disease: A Survey Using the Delphi Technique and Analytic Hierarchy Process

Ja Yun Choi[1], Eui Jeong Ryu [ID][2]

[1]College of Nursing, Chonnam National University, Chonnam Research Institute of Nursing Science, Gwangju, Republic of Korea; [2]Department of Nursing, Dongshin University, Naju, Republic of Korea

Correspondence: Eui Jeong Ryu, Department of Nursing, Dongshin University, 34-22, Dongshin-daegil, Naju, Jeolla Province, 58245, Republic of Korea, Tel +82-10-9193-9075, Fax +82-61-225-3307, Email yeswecan9075@naver.com

Background: The relevant factors and patterns of non-adherence to self-management among patients with chronic obstructive pulmonary disease (COPD) need to be elucidated to improve self-management.

Purpose: This study was a survey to prioritize the relevance of factors associated with non-adherence to COPD self-management using the Delphi technique and analytic hierarchy process (AHP).

Patients and Methods: A total of 15 expert panels were established to determine the priority of relevant factors in a three-round Delphi survey and an AHP. To develop the preliminary conceptual framework for non-adherence to COPD self-management, findings from a systematic literature review, a qualitative study using in-depth interviews with COPD patients, and the first round of the Delphi survey were integrated. Based on the preliminary framework, the content validity ratio (CVR) was analyzed to examine the consensus among expert panels in the second and third rounds of the Delphi survey, and the relative weight was determined by pairwise comparisons between alternative factors in the AHP.

Results: In developing the preliminary conceptual framework, 8 factor categories and 53 factors were identified as relevant to non-adherence to COPD self-management. Of the 53 factors, 22 factors with a CVR of 0.49 or higher were identified in the Delphi survey. A total of 14 of the 53 factors were common to both the Delphi survey and AHP with high weights. The most notable factors were prolonged treatment, experience of treatment failure, and unknown effects of medication.

Conclusion: Through consensus decision-making by experts, 14 factors were identified as relevant factors associated with non-adherence to COPD self-management. A hierarchical and systematic framework incorporating factors associated with non-adherence to COPD self-management was developed in this study. Further research is needed to develop intervention strategies based on factors associated with non-adherence to COPD self-management.

Keywords: chronic obstructive pulmonary disease, self-management, non-adherence, Delphi technique, analytic hierarchy process

Introduction

Chronic obstructive pulmonary disease (COPD) is a common respiratory disease characterized by chronic airway inflammation and airflow limitation.[1] The Global Burden of Disease Study reported that there were 212.3 million prevalent cases of COPD globally, accounting for 3.3 million deaths and 74.4 million disability-adjusted life years (DALYs) with an age-standardized rate of 926.1 DALYs per 100,000 in 2019.[2] Furthermore, approximately $20 million was spent on outpatient treatment expenses in 2020 according to the Korea Health Insurance Review & Assessment Service.[3] As a result, COPD is the world's fifth-largest economic burden.[4] One of the most significant variables affecting

the course of the disease and the quality of life of patients with COPD is the occurrence of acute exacerbations (AEs), which increases the medical expenses of patients with COPD.[5] Patients with frequent AEs experience a noticeable decline in their ability to support themselves, as reported in a Delphi study showing that self-management behaviors were influenced by AE episodes; however, there were some differences in relevant and feasible behaviors before, during, and after AEs.[6] In turn, poor adherence to COPD self-management and a high-cost burden can be a risk factor for acute exacerbations of COPD.[7]

COPD self-management programs can help patients recognize any related signs and symptoms and manage the disease under routine and AE conditions.[8] Indeed, implementing a COPD self-management program is an effective strategy for improving the health-related quality of life of those who suffer from the disease.[9] However, only 38% of COPD patients have been found to show optimal or suboptimal adherence to COPD exacerbation action plans; thus, the level of adherence to a self-management program might determine the success of the program.[10] Various factors can predispose patients with COPD to poor adherence.

Recognizing the relevant factors and patterns of non-adherence of COPD patients should be considered as the initial step in understanding the behavior of self-management adherence.[11] Adherence to self-management among patients with chronic disease is a complicated behavior because many factors are linked and affected by one another.[12] Nevertheless, patients with COPD have insufficient opportunities to engage in the behavior required for self-management as demonstrated in a Birmingham COPD cohort study,[13] which found that less than 50% of patients received advice on diet/exercise, and less than 50% of current smokers were offered practical help to stop smoking in the previous year.

Several studies on factors associated with non-adherence to COPD self-management have been published. Among the factors associated with non-adherence to self-management, the ineffectiveness of medication,[14] the presence of comorbid illness, and depressed mood have been associated with drug non-adherence.[15] Additionally, non-adherence to COPD self-management has been associated with health literacy (HL), disease-related attitudes, and the degree of medication belief.[16] To understand non-adherence behavior, contrasting examples of non-adherence should be considered, including factors contributing to adherence. Factors that affect self-management adherence include patients (health beliefs, cognitive abilities, self-efficacy, comorbidities, and psychological profile), physicians (polypharmacy and side effects), and society (patient-doctor relationship, social support, and follow-up).[17] However, as it remains difficult to understand non-adherence behavior, improving the outcomes of COPD patients can be challenging. Therefore, it is necessary to systematically elucidate the factors of non-adherence in the domains of COPD self-management.[18]

The Delphi technique was originally devised to obtain the most reliable opinion consensus from a group of experts through a series of questionnaires.[19] On the other hand, the analytic hierarchy process (AHP) is used to evaluate mutually exclusive decision alternatives systematically and conclude their priorities by measuring the relative importance or preference of alternatives through a quantitative comparison.[20] The integration of the Delphi technique with the AHP has been used to obtain a quantitative consensus on healthcare policies or priorities.[21] Additionally, through a systematic and comprehensive identification of factors related to non-adherence to COPD self-management, a hierarchical and systematic conceptual framework for non-adherence to COPD self-management can be established, allowing the construction of a knowledge structure specific to non-adherence to COPD self-management.

Objectives

This study aimed to prioritize the relevance of factors associated with non-adherence to self-management among patients with COPD based on the consensus of expert panels.

Materials and Methods
Research Design

This study was a survey to prioritize the relevance of factors associated with non-adherence to COPD self-management using the Delphi technique and AHP.

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Expert Panels

A total of 15 healthcare professionals participated as expert panels in the Delphi survey and AHP between October 2022 and January 2023. Specifically, the expert panels consisted of five nurses, five nursing professors, three respiratory residents, and two respiratory medical professors. The survey was anonymous, and the participants were required to participate in all three Delphi rounds and one AHP round. The 15 experts satisfied the minimum requirement for the number of panels given that at least 10 experts are needed for the Delphi technique.[21]

Research Process

The priority of relevant factors associated with non-adherence was established through a three-round Delphi survey and an AHP using an online survey system. The three-round Delphi survey was conducted for this study as it takes two to three surveys to reach a consensus among experts and acquire consistent results.[22] In the first round of the Delphi survey, expert panels were asked open-ended questions to obtain qualitative responses regarding factor categories and factors related to non-adherence to self-management among COPD patients. Two researchers provided their qualitative responses regularly, independently listed factor categories and factors, and linked factor categories with factors of non-adherence to self-management in COPD. In instances of disagreement between two researchers, a consensus process was undertaken.

Subsequently, in the second round of the Delphi survey, expert panel members were presented with a structured questionnaire by our research team to evaluate the relevance of factors related to non-adherence. This evaluation was conducted using a 5-point Likert scale.

In the following round, the third round of the Delphi survey, group responses from the second round were shared with expert panel members. These responses were accompanied by quartile scores indicating the relevance level. The members were again asked to assess the relevance of factors related to non-adherence using the same 5-point Likert scale to achieve opinion consensus.

Development of the Preliminary Conceptual Framework for Non-Adherence to COPD Self-Management

As described in a previous study,[23] the systematic literature review flow of PRISMA guided the processes of data retrieval, selection, and extraction. Three domestic and two international databases were used to identify literature covering factors associated with non-adherence to COPD self-management from the last decade. A total of 1693 articles were screened. Two reviewers independently assessed titles and abstracts following the inclusion and exclusion criteria to initially select potential articles. A total of 45 articles were finally selected for inclusion in the analysis. Along with the systematic literature review, in-depth interviews with COPD patients were conducted through open-ended inquiries for the identification of categories and items associated with non-adherence to COPD self-management in our previous qualitative study.[24] From our qualitative study, two researchers extracted relevant factors and factor categories independently and reached a consensus. The first round of the Delphi survey using semi-structured open questions on relevant factors and factor categories related to non-adherence to COPD self-management was conducted.

The findings from the systematic literature review, in-depth interviews, and first round of the Delphi survey were integrated to develop the preliminary conceptual framework for non-adherence to COPD self-management, where factor categories and factors extracted at least once were selected.

Second Round of the Delphi Survey

After developing the preliminary conceptual framework for non-adherence to COPD self-management, factor categories and factors associated with non-adherence to COPD self-management, which were identified as relevant factors in the first step, were evaluated using a 5-point Likert scale (1 = "irrelevant" and 5 = "highly relevant") to determine the relevance level in the second round.

Third Round of the Delphi Survey and Analytic Hierarchy Process

To achieve a consensus among expert panels, the third round of the Delphi survey and the AHP were conducted based on the conceptual framework and the second round of the Delphi survey. Participants were presented with the second-round results, including the mean, standard deviation, and quartile range of the relevance level of non-adherence to COPD self-

management for each factor category and factor, in the third-round survey. The participants were asked to review the results of the second-round Delphi survey and to amend their responses accordingly, allowing them to reflect on the views of others. The AHP, which makes pairwise comparisons of the factor categories and factors, was carried out to prioritize the relative relevance of two alternative factors associated with non-adherence to COPD self-management. The AHP pairwise comparison scale ranges from 1 to 9, where a value of 1 indicates that the two elements are the same or are equally relevant. On the other hand, a value of 9 implies that one element is extremely more relevant than the other one in a pairwise matrix.[25]

Data Analysis
Delphi Survey
The mean, standard deviation, quartile range of the relevance level, and content validity ratio (CVR) were analyzed to demonstrate the consensus of the expert panels using Microsoft Excel 2016®. The CVR is calculated as (ne - N/2) / (N/2), where "ne" is the number of panels with points of 4 or higher, and N is the total number of panels. The minimum CVR for 15 experts is 0.49 according to the criteria of Lawshe.[26]

Analytic Hierarchy Process
The AHP is composed of two main steps: designing and constructing a hierarchy and numerical evaluation of the hierarchy. All factor categories or factors at the same level of the hierarchy were compared reciprocally to determine their relative weight and to prioritize them.[27]

The relative weight was analyzed using the I make it® program for pairwise comparisons. A cutoff value of 1.89% (100% / 53) for each factor was used to identify factors with high weights by the researchers. The reliability of pairwise comparisons in the AHP was evaluated using the consistency ratio (CR). A CR of more than 0.1 indicates a reasonable level of consistency; otherwise, it indicates a non-consistent response.[28]

Results
Development of the Preliminary Conceptual Framework
The data are presented according to the factor categories and factors related to non-adherence. A total of 8 factor categories and 53 factors were identified as relevant to non-adherence to COPD self-management. The factor categories associated with non-adherence to self-management included personal, socioeconomic, disease-related, functional, treatment-related, healthcare system-related, and environmental characteristics.

Second-Round Delphi Survey
In the second-round Delphi survey, 18 factors were found to be associated with non-adherence to COPD self-management with a CVR of 0.49 or higher (Table 1). The average CVR for 53 factors associated with non-adherence to COPD self-management was 0.29. The most relevant factors were smoking status (1.00), AE experience (1.00), experience of medication side effects (1.00), economic status (0.87), social support (0.87), and severity of COPD (0.87).

Table 1 Factors Associated with Non-Adherence to COPD Self-Management in the Delphi Survey (N = 15)

Factor	Second Round			Third Round		
	Mean ± SD	CVR	Priority	Mean ± SD	CVR	Priority
Smoking status	4.47±0.52	1.00	1	4.47±0.52	1.00	1
Economic status	4.27±0.59	0.87	4	4.33±0.49	1.00	1
Social support	4.33±0.62	0.87	4	4.33±0.49	1.00	1
Severity of COPD	4.47±0.64	0.87	4	4.60±0.51	1.00	1

(*Continued*)

Table 1 (Continued).

Factor	Second Round			Third Round		
	Mean ± SD	CVR	Priority	Mean ± SD	CVR	Priority
Acute exacerbation experience	4.53±0.52	1.00	1	4.73±0.46	1.00	1
Experience of medication side effects	4.20±0.41	1.00	1	4.13±0.35	1.00	1
Education level	4.07±0.96	0.73	7	4.33±0.62	0.87	7
Social recognition of COPD	4.20±0.77	0.73	7	4.20±0.56	0.87	7
Frequency of symptoms	4.40±0.74	0.73	7	4.53±0.64	0.87	7
Activities of daily living	4.07±0.70	0.60	10	3.53±0.99	0.87	7
Unknown effects of medication	3.93±0.59	0.60	10	4.00±0.38	0.87	7
Professionalism of healthcare providers	3.73±1.03	0.60	10	3.87±0.52	0.87	7
Number of medications	4.00±0.85	0.60	10	3.67±0.82	0.87	7
Age	4.07±0.80	0.47	19	3.87±0.74	0.73	14
Disease duration	4.20±0.77	0.60	10	4.27±0.70	0.73	14
Possibility of recovery from COPD	4.07±0.88	0.60	10	4.20±0.86	0.73	14
Complexity of symptoms	4.07±0.80	0.47	19	4.20±0.68	0.73	14
Comorbidity	3.93±0.80	0.60	10	3.93±0.70	0.73	14
Quality of life	3.93±0.59	0.60	10	3.93±0.50	0.73	14
COPD knowledge	3.93±0.88	0.47	19	3.73±0.59	0.73	14
Prolonged treatment	3.80±0.68	0.60	10	4.20±0.68	0.60	21
Time to symptom relief	3.80±0.77	0.47	19	3.80±0.41	0.60	21
Medical cost	3.93±0.70	0.47	19	3.80±0.56	0.47	23
Emotional state	3.80±1.01	0.33	27	3.87±0.99	0.47	23
Beliefs about medicines	3.80±0.86	0.33	27	3.80±0.77	0.47	23
Treatment beliefs	3.87±0.83	0.47	19	3.80±0.77	0.47	23
Trust in healthcare providers	3.73±0.96	0.33	27	3.80±0.94	0.47	23
Physical activity	3.87±0.83	0.47	19	3.73±0.80	0.47	23
Complexity of treatment	3.67±0.98	0.47	19	3.73±0.70	0.47	23
COPD incidence rate	3.87±1.13	0.20	31	4.00±1.00	0.33	30
Motivation	4.00±1.07	0.20	31	4.00±1.00	0.33	30
Forgetfulness	3.47±1.13	0.20	31	3.80±0.41	0.33	30
Health literacy	3.67±0.98	0.20	31	4.20±0.56	0.33	30
Routine pulmonary rehabilitation	3.73±0.70	0.20	31	3.87±0.83	0.33	30
Experience of treatment failure	3.40±0.99	0.20	31	3.53±0.74	0.33	30
Living environment	3.73±0.59	0.33	27	3.73±0.59	0.33	30
Partnership between patients and healthcare providers	3.47±0.64	0.07	38	3.53±0.64	0.20	37
Access to medical resources	3.73±0.88	0.20	31	3.60±0.83	0.20	37
Self-efficacy	3.47±1.25	0.07	38	3.60±1.06	0.07	39
Hospital-community links	3.67±0.90	0.07	38	3.20±0.77	0.07	39
Self-management program	3.47±0.99	−0.20	43	3.40±0.83	−0.07	41
Waiting time for consultation	3.47±0.74	−0.07	42	4.27±0.59	−0.07	41
Medically-oriented care	3.53±0.92	0.07	38	3.47±0.74	−0.07	41
Occupation	3.13±1.06	−0.20	43	3.27±0.88	−0.20	44
Consultation time	3.13±0.92	−0.20	43	2.67±0.82	−0.20	44
Support of COPD	3.13±0.83	−0.20	43	3.07±0.88	−0.20	44
Social activity	3.20±0.77	−0.20	43	3.20±0.68	−0.33	47
Gender	2.93±1.22	−0.33	48	2.8±0.86	−0.47	48
Personality	2.93±1.16	−0.33	48	2.87±0.92	−0.47	48
Surroundings	3.07±1.03	−0.47	50	2.93±0.88	−0.60	50
Treatment system	2.60±0.83	−0.87	52	3.40±0.83	−0.87	51
Religion	1.93±1.03	−0.87	52	1.73±0.70	−1.00	52
Weather	2.47±1.06	−0.73	51	2.13±0.83	−1.00	52

Abbreviations: COPD, chronic obstructive pulmonary disease; CVR, content validity ratio; SD, standard deviation.

Third-Round Delphi Survey and Analytic Hierarchy Process

A total of 4 factors associated with non-adherence to COPD self-management (age, complexity of symptoms, COPD knowledge, and time to symptom relief) were identified in addition to the 18 factors from the second-round Delphi survey, resulting in 22 factors, which satisfied the CVR criteria. For 53 factors associated with non-adherence to COPD self-management, the mean CVR was 0.36. The most relevant factors were smoking status (1.00), economic status (1.00), social support (1.00), severity of COPD (1.00), AE experience (1.00), and experience of medication side effects (1.00), as shown in Table 1.

The complex judgment matrix derived from calculating the geometric mean of reciprocal entries of the pairwise comparison matrices of 8 factor categories completed by the expert panels is shown in Table 2.

In the AHP, as the CRs of the factor categories and factors were more than 0.1, there was consistency in the pairwise comparisons (Table 3). The most relevant factor category was treatment-related characteristics (W = 0.22), followed by disease-related characteristics (W = 0.17) and functional characteristics (W = 0.14). Among the 53 factors associated with non-adherence, the most relevant factor was prolonged treatment (W = 3.46%), followed by experience of treatment failure (W = 3.05%), unknown effect of medication (W = 3.02%), experience of medication side effects (W = 2.55%), and self-management program (W = 2.48%) (Table 3).

Factor Categories and Factors Associated with Non-Adherence to COPD Self-Management in the Delphi Survey and Analytic Hierarchy Process

Table 4 shows the most relevant factors associated with non-adherence to COPD self-management in the Delphi survey and AHP. There were 22 factors with a CVR of 0.49 or higher in the Delphi survey and 22 factors with a weight of 1.89% (cutoff point) or higher in the AHP.

Of the 22 factors identified in each method, 14 factors were common to both methods: prolonged treatment, experience of treatment failure, unknown effect of medication, experience of medication side effects, self-management program, and time to symptom relief in the category of treatment-related characteristics; AE experience, severity of COPD, possibility of recovery from COPD, and complexity of symptoms in the category of disease-related characteristics; COPD knowledge and activities of daily living (ADL) in the category of functional characteristics; economic status in the category of socioeconomic characteristics; smoking status in the category of personal characteristics.

Discussion

This study comprehensively and systematically identified factor categories and factors associated with non-adherence to COPD self-management by integrating the Delphi technique with the AHP, which are representative methods that can help experts reach a consensus.[29] In the process of developing the preliminary conceptual framework for non-adherence to COPD self-management, 53 factors were associated with non-adherence. However, only 22 factors (around 1/3) fulfilled the CVR criteria (0.49 or higher) in the Delphi survey. Additionally, around 1/5 of the 53 factors demonstrated consistency in both the Delphi technique and AHP. These results showed that it was difficult to reach a consensus among experts on the behavior of non-adherence. Nevertheless, 14 factors were common to both the Delphi technique and AHP in terms of their relevance to non-adherence, which may be considered as key factors in non-adherence to COPD self-management. The implication of this study is the expansion of the scope of understanding non-adherence to COPD self-management by incorporating previous findings and achieving expert consensus.

In the factor category of treatment-related characteristics, prolonged treatment, experience of treatment failure, unknown effect of medication, experience of medication side effects, self-management program, and time to symptom relief were factors common to both methods in this study. All factors except for self-management program were related to treatment outcomes. The Prompt Initiation of Maintenance Therapy Study reinforces the need for timely COPD patient-clinician communication regarding increased symptoms and follow-up visits within days after an AE visit to ensure that therapy is appropriately and promptly modified.[30] Therefore, healthcare providers should actively control symptoms and closely communicate with COPD patients to avoid the occurrence of negative events or outcomes such as

Table 2 Complex Judgment Matrix of Pairwise Comparison Matrices in the Analytic Hierarchy Process (N = 15)

	Personal Characteristics	Socioeconomic Characteristics	Disease-Related Characteristics	Psychological Characteristics	Functional Characteristics	Treatment-related Characteristics	Healthcare System-Related Characteristics	Environmental Characteristics
Personal characteristics	1							
Socioeconomic characteristics	0.57	1						
Disease-related characteristics	0.36	0.41	1					
Psychological characteristics	0.55	0.69	1.17	1.00				
Functional characteristics	0.43	0.54	1.35	0.92	1.00			
Treatment-related characteristics	0.34	0.44	0.76	0.66	0.63	1.00		
Healthcare system-related characteristics	0.75	0.79	1.18	0.89	1.16	1.96	1.00	
Environmental characteristics	0.95	1.47	2.64	2.07	2.12	4.02	1.81	1.00

Table 3 Factors Associated with Non-Adherence to COPD Self-Management in the Analytic Hierarchy Process (N = 15)

Factor Category	Weight (W)	Priority	Consistency Ratio (CR)*	Factor	Within Category		Within Factor	
					Weight (W)	Priority	Weight (W%)	Priority
Treatment-related characteristics	0.22	1	0.006	Prolonged treatment	0.04	1	3.46	2
				Experience of treatment failure	0.03	2	3.05	3
				Unknown effects of medication	0.03	2	3.02	4
				Experience of medication side effects	0.03	2	2.55	10
				Self-management program	0.03	2	2.48	13
				Time to symptom relief	0.02	6	2.17	18
				Complexity of treatment	0.02	6	1.98	20
				Number of medication	0.02	6	1.84	24
				Professionalism of healthcare providers	0.01	9	1.27	42
Disease-related characteristics	0.17	2	0.007	Acute exacerbation experience	0.04	1	4.16	1
				Severity of COPD	0.03	2	3.00	5
				Possibility of recovery from COPD	0.02	3	2.13	19
				Complexity of symptoms	0.02	3	1.94	22
				COPD incidence rate	0.02	3	1.64	27
				Comorbidity	0.02	3	1.62	29
				Frequency of symptoms	0.02	3	1.52	34
				Disease duration	0.01	8	1.27	42
Functional characteristics	0.14	3	0.003	Routine pulmonary rehabilitation	0.03	1	2.73	7
				Physical activity	0.03	1	2.61	9
				Health literacy	0.03	1	2.55	10
				COPD knowledge	0.03	1	2.54	12
				Activities of daily living	0.02	5	2.20	17
				Forgetfulness	0.02	5	1.56	33
Psychological characteristics	0.13	4	0.004	Self-efficacy	0.02	1	1.85	23
				Beliefs about medicines	0.02	1	1.84	24
				Quality of life	0.02	1	1.67	26
				Treatment beliefs	0.02	1	1.64	27
				Trust in healthcare providers	0.02	1	1.46	36
				Emotional state	0.01	6	1.07	46
				Confidence	0.01	6	1.04	47
				Personality	0.01	6	0.85	51

Healthcare system related characteristics	0.12	5	0.005	Support of COPD	0.02	1	1.96	21
				Medically oriented care	0.02	1	1.59	30
				Consultation time	0.02	1	1.58	31
				Treatment system	0.02	1	1.57	32
				Partnership between patients and healthcare providers	0.02	1	1.47	35
				Hospital-community links	0.02	1	1.46	36
				Access to medical resources	0.01	7	1.31	41
				Waiting time for consultation	0.01	7	0.99	49
Socioeconomic characteristics	0.1	6	0.002	Economic status	0.03	1	2.69	8
				Medical cost	0.02	2	2.41	14
				Social support	0.01	4	1.33	39
				Social recognition of COPD	0.01	4	1.33	39
				Social activity	0.01	4	1.25	44
Personal characteristics	0.07	7	0.011	Smoking status	0.02	1	2.29	15
				Education level	0.01	2	1.37	38
				Age	0.01	2	1.001	48
				Occupation	0.01	2	0.97	50
				Gender	0.01	2	0.64	52
				Religion	0.00	6	0.37	53
Environmental characteristics	0.06	8	0.002	Living environment	0.03	1	2.88	6
				Surroundings	0.02	2	2.21	16
				Weather	0.01	3	1.23	45

Note: *Consistency ratio for each factor ranges from 0.01 to 0.46.

Table 4 Priority of Relevant Factors Associated with Non-Adherence to COPD Self-Management in the Delphi Survey and Analytic Hierarchy Process (N =15)

Delphi Survey			Analytic Hierarchy Process		
Factor	Third CVR	Priority	Factor	Weight (%)	Priority
Smoking status*	1.00	1	Acute exacerbation experience*	4.16	1
Acute exacerbation experience*	1.00	1	Prolonged treatment*	3.46	2
Prolonged treatment*	1.00	1	Experience of treatment failure*	3.05	3
Economic status*	1.00	1	Unknown effects of medication*	3.02	4
Social support	1.00	1	Severity of COPD*	3.00	5
Severity of COPD*	1.00	1	Living environment	2.88	6
Education level	0.87	7	Routine pulmonary rehabilitation	2.73	7
Social recognition of COPD	0.87	7	Economic status*	2.69	8
Frequency of symptoms	0.87	7	Physical activity	2.61	9
Activities of daily living*	0.87	7	Health literacy	2.55	10
Experience of treatment failure*	0.87	7	Experience of medication side effects*	2.55	10
Unknown effects of medication*	0.87	7	COPD knowledge*	2.54	12
Self-management program*	0.87	7	Self-management program*	2.48	13
Disease duration	0.73	14	Medical cost	2.41	14
Possibility of recovery from COPD*	0.73	14	Smoking status*	2.29	15
Comorbidity	0.73	14	Surroundings	2.21	16
Quality of life	0.73	14	Activities of daily living*	2.20	17
Age	0.73	14	Time to symptom relief*	2.17	18
Complexity of symptoms*	0.73	14	Possibility of recovery from COPD*	2.13	19
COPD knowledge*	0.73	14	Complexity of treatment	1.98	20
Time to symptom relief*	0.60	21	Support of COPD	1.96	21
Experience of medication side effects*	0.60	21	Complexity of symptoms*	1.94	22

Note: *Factors common to both the Delphi survey and analytic hierarchy process.
Abbreviations: COPD, chronic obstructive pulmonary disease; CVR, content validity ratio.

adverse drug reactions and prolonged treatment. With a greater improvement in COPD treatment outcomes, adherence to COPD self-management may be increased.

Patients with COPD have been observed to discontinue treatment after experiencing a temporary improvement in symptoms following treatment with inhalers or medications.[31] Therefore, patients should have opportunities to participate in COPD self-management education programs; however, these opportunities are insufficient.[32] Specifically, when patients lack COPD-related knowledge,[33] they would require more information on COPD.[34] Appointments typically fall within the range of 9.8 to 13.2 minutes in the United States.[35] Moreover, in the Korean medical environment, patients consult their physicians for 6.2 minutes on average in outpatient clinics.[36] However, appointments shorter than 15 minutes can strain physician-patient relationships, adversely affecting care quality and limiting patient engagement in health management.[37] Consequently, it is essential to develop programs that encourage continuous self-management among patients to overcome challenges within the healthcare environment, such as short consultation times.

In the factor category of disease-related characteristics, AE experience, severity of COPD, possibility of recovery from COPD, and complexity of symptoms were common to both methods in this study. When symptoms worsen, they can affect ADL, making it difficult for patients to satisfy their self-care needs and focus on self-management.[38] In addition, when the disease is complicated and the possibility of recovery is low, COPD patients can experience burnout due to physical and emotional burdens, making self-management difficult.[33] As a result, strategies to reduce the disease burden on COPD patients are required. According to previous studies, it is necessary to reinforce positive attitudes toward COPD, support other priorities such as hobbies, and highlight successful cases of disease adaptation for COPD patients.[39]

In the factor category of functional characteristics, COPD knowledge and ADL were common to both methods in this study. COPD patients with poor HL lack knowledge of COPD, resulting in reduced adherence to self-management.[40] To

increase the patients' COPD knowledge, personalized education materials could be offered according to the patients' HL level.[41] In addition, patients with low HL have been reported to have more difficulty in performing their ADL.[42] The low ADL performance of COPD patients may be attributed to their struggles in daily life, such as sitting up, going to the toilet, taking a shower, and walking a short distance.[43] Patients with COPD should participate in respiratory rehabilitation exercises to maintain ADL.[44] Mobile applications for respiratory exercise involving all four extremities developed based on the severity of COPD symptoms may be one of the strategies to support COPD self-management; however, the limited digital literacy of COPD patients might be a considerable issue.[45]

In the factor category of socioeconomic characteristics, economic status was a factor common to both methods in this study. COPD poses a significant economic burden on COPD patients and their families in the United States and Korea.[46] As prescription drugs can account for almost half of the total treatment cost, patients may have trouble with medication adherence due to the high cost of medications.[34,47] Therefore, it is crucial to increase awareness about COPD, prevent COPD patients from experiencing AEs, and detect COPD symptoms in the early stages in order to reduce the COPD economic burden.[48]

In the factor category of personal characteristics, smoking status was common to the Delphi survey and AHP. Smoking cessation is the most important therapeutic intervention in all stages of COPD because it is the only intervention that slows disease progression and improves respiratory symptoms.[49] Although patients are aware that smoking is the cause of COPD, they may have difficulty quitting.[31] However, a cohort study reported that more than 50% of current smokers did not receive information to stop smoking.[13] Therefore, smokers of any severity should be enrolled in an intensive smoking cessation program that includes regular and long-term follow-up. This will help them achieve abstinence from smoking and avoid relapses.[50]

This study has some limitations in generalization. Although this study was based on research involving different countries or various COPD patient populations through a systematic review, the relevance of certain factors may have been underestimated as the outcomes were obtained from a single-country, single-center study. Therefore, an in-depth follow-up study on factors with low relevance is required. In addition, the group of expert panels might be lacking in terms of diversity as they work in one institution and consist of professionals in the medical and nursing fields.

Conclusion

The most relevant factors associated with non-adherence to COPD self-management were identified through consensus decision-making by expert panels using the Delphi technique and AHP. A total of 14 factors were prioritized according to their relevance to non-adherence to COPD self-management in both methods. Based on the findings of this study, a hierarchical and systematic conceptual framework for non-adherence to COPD self-management was developed. In the future, appropriate intervention strategies should be developed for high-risk patients with smoking habits, severe COPD, complex treatments, and lower knowledge levels based on the factors associated with non-adherence to COPD self-management.

Ethics Approval and Informed Consent

The study was approved by the Institutional Review Board of Chonnam Hospital prior to data collection (CNUH-2022-232).

Consent for Publication

We have identified information likely to be published and confirmed that those who provided consent for publication have reviewed the content intended for release.

Disclosure

The authors report no conflicts of interest in this work.

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