ปัจจัยที่มีอิทธิพลต่อการป้องกันการเกิดอาการกำเริบเฉียบพลันในผู้ป่วยโรคปอดอุดกั้นเรื้อรัง
Factors Influencing Prevention of Acute Exacerbation in Patients with Chronic Obstructive Pulmonary Disease

นิพนธ์ต้นฉบับ

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Original Article

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บทคัดย่อ

วัตถุประสงค์: เพื่อศึกษาระดับพฤติกรรมป้องกันอาการกำเริบเฉียบพลัน และปัจจัยที่มีอิทธิพลต่อระดับพฤติกรรมป้องกันอาการกำเริบเฉียบพลันในผู้ป่วยโรคปอดอุดกั้นเรื้อรัง **วิธีการศึกษา:** การศึกษาแบบทดสอบความสัมพันธ์เชิงทำนายของปัจจัย ได้แก่ การรับรู้ความรุนแรงของการเกิดอาการกำเริบเฉียบพลัน การรับรู้โอกาสเสี่ยงของการกำเริบเฉียบพลัน การรับรู้สมรรถนะแห่งตนในการป้องกันอาการกำเริบ และภาวะซึมเศร้า กลุ่มตัวอย่างคือ ผู้ที่เป็นโรคปอดอุดกั้นเรื้อรังและเกิดอาการกำเริบเฉียบพลันอย่างน้อย 1 ครั้งในรอบ 1 ปี ที่ติดตามรักษาที่แผนกผู้ป่วยนอกอายุรกรรมและคลินิกโรคปอดอุดกั้นเรื้อรังของโรงพยาบาลสมุทรปราการ 108 ราย คัดเลือกโดยการสุ่มอย่างง่าย เครื่องมือที่ใช้ในการวิจัยประกอบด้วย แบบสอบถามข้อมูลทั่วไป แบบประเมินการรับรู้ความรุนแรง การรับรู้โอกาสเสี่ยง การรับรู้สมรรถนะแห่งตน ภาวะซึมเศร้า และพฤติกรรมป้องกันการเกิดอาการกำเริบเฉียบพลัน วิเคราะห์ข้อมูลด้วยสถิติพรรณนาและสถิติการวิเคราะห์ถดถอยพหุคูณ **ผลการศึกษา:** กลุ่มตัวอย่างมีคะแนนเฉลี่ยพฤติกรรมป้องกันอาการกำเริบเฉียบพลันโดยเฉลี่ยเท่ากับ 44.76 (SD = 4.81) จากทั้งหมด 60 คะแนน ปัจจัยด้านการรับรู้สมรรถนะแห่งตน การรับรู้โอกาสเสี่ยง การรับรู้ความรุนแรง และภาวะซึมเศร้า สามารถร่วมกันทำนายความแปรปรวนของพฤติกรรมป้องกันอาการกำเริบได้ร้อยละ 53 (adj. R^2 = 0.53, *P*-value < 0.001) การรับรู้สมรรถนะแห่งตนทำนายพฤติกรรมป้องกันอาการกำเริบมากที่สุด (β = 0.67, *P*-value < 0.001) ตามด้วย การรับรู้โอกาสเสี่ยง (β = 0.21, *P*-value = 0.007) **สรุป:** พฤติกรรมป้องกันอาการกำเริบเฉียบพลันในผู้ป่วยโรคปอดอุดกั้นเรื้อรังมีระดับไม่สูงมาก และทำนายได้ด้วยการรับรู้สมรรถนะแห่งตนในการป้องกันอาการกำเริบเฉียบพลันและการรับรู้โอกาสเสี่ยงของการเกิดอาการกำเริบเฉียบพลัน

คำสำคัญ: อาการกำเริบเฉียบพลัน, โรคปอดอุดกั้นเรื้อรัง, การรับรู้สมรรถนะแห่งตน, การรับรู้โอกาสเสี่ยง, พฤติกรรมป้องกัน

Abstract

Objective: To assess the preventive behavior of acute exacerbation (AE) of chronic obstructive pulmonary disease (COPD) and the associations with its influencing factors. **Method:** In this predictive correlational research, predictive factors were studied including perceived severity and perceived risk of COPD acute exacerbation, perceived self-efficacy of performing exacerbation preventing behavior, and depression. Study sample was 108 participants with COPD who experienced at least one acute exacerbation in the last year during regular care at the outpatient department of medicine and COPD clinic, Samutprakam hospital recruited by a simple random sampling. The questionnaire collected demographic data and assessed the perceived severity, perceived risk, perceived self-efficacy and depression. Descriptive statistics and multiple regression analysis were used to analyze the data. **Results:** Mean score of exacerbation preventing behavior was 44.76 (SD = 4.81) out of 60 points. All four factors together predicted 53% of variance of the preventing behavior (adj. R^2 = 0.53, *P*-value < 0.001). Perceived self-efficacy in preventing exacerbation was the most predictive factor (β = 0.67, *P*-value < 0.001), followed by perceived risk of the exacerbation (β = 0.21, *P*-value = 0.007). **Conclusion:** The exacerbation preventing behavior among COPD patients was not at a very high level and could be predicted by perceived self-efficacy of performing the behavior and perceived risk of the acute exacerbation.

Keywords: acute exacerbation, chronic obstructive pulmonary disease, perceived self-efficacy, perceived risk, preventive behavior

Introduction

Chronic Obstructive Pulmonary Disease (COPD) is one of the three leading causes of death worldwide.[1] In Thailand, COPD was the 8th leading cause of death in 2019.[2] In the province of Samutprakarn of Thailand, COPD-related death increased from 1,808 per 100,000 populations in 2017 to 1,928 per 100,000 populations in 2018.[3] Lung disease related death which included COPD was the second cause of death in Samutprakarn from 2019 to 2018.[3] This could be because, as one of the industry provinces in Thailand, residents of Samutprakarn have been facing air pollutions from exhaustion pipes from transportation, pollutions from industrial plants, and particulate dust/aerosol pollutants which are related to the

incidence of COPD.[4] Nationwide, as high as 54.9% of patients visiting the emergency department in Thailand were COPD patients with exacerbation.[5] This finding is consistent with the international study revealing that as high as 78% of COPD patients experienced at least one episode of exacerbation each year.[6]

The treatment of COPD aims to control or slow down the disease progression, and to prevent the risk factors for exacerbation. As the critical aspect of the COPD treatment, preventing COPD exacerbation involves smoking cessation, compliance to treatment guidelines, lung rehabilitation exercise, and flu vaccination.[7] However, a certain number of patients do not adhere to treatment plan especially exacerbation prevention. These patients also lack the knowledge about proper self-care behavior and/or motivation to perform such behavior. As a result, these patients experience more episodes of exacerbation and hospitalizations. This emphasizes the essence of motivating COPD patients to modify their behavior to better prevent exacerbations as recommended by GOLD guideline.[1] According to the Service Plan of Non-communicable Diseases (2017) of the Ministry of Public Health of Thailand, COPD is one of the diseases that the care performance indicators include the decreased exacerbation and death rates, and the increased quality of life.[8]

According to the Protection Motivation Theory[9] in association with factors affecting acute exacerbation prevention behaviors, perceived severity of acute exacerbation, perceived risk of acute exacerbation, perceived self-efficacy in preventing acute exacerbation, and depression. To modify their behaviors from risking to preventing the exacerbation, the patients with more perceived severity and risk of acute exacerbation would perceive the danger or have more fear of the acute exacerbation. Such more perceived danger or fear would prompt the patients to avoid the exacerbation. This is the process of modifying attitudes and behaviors. In addition, if the patients perceive more self-efficacy in changing, they will have more confidence in their own capability to successfully perform or carry out desirable behaviors to prevent the exacerbation. In addition, more than 50% of COPD patients have depression.[10] Depression promotes negative perception and reduces self-care and cognitive functions of COPD patients.[11] These detrimental effects could further prevent COPD patients from performing exacerbation prevention behaviors.

A low perceived severity of acute exacerbation has been known to be associated with poor health behaviors such as non-adherence to treatment plans, non-compliance to medications, and a lack of effective symptom management among asthma patients.[12] Perceived severity could predict the acute exacerbation of asthma and possibly COPD. In addition, perceived risk of acute exacerbation was positively correlated with rehabilitation of the lung in COPD patients.[13] Perceived self-efficacy in preventing COPD acute exacerbation was found to predict additional 4% of the variance of health preventing behaviors in Thai COPD patients.[14] However, a study in Korean COPD patients revealed that perceived self-efficacy was not associated with their self-care behaviors.[15] Depression poses a negative perception on diseases and treatments, and causes poor health behaviors.[16] Depression also has a direct, negative influence on self-management.[17] With a contradicting result, a study revealed that depression did not predict acute exacerbation of COPD.[18]

Evidence previously mentioned suggests that influences of various factors on the acute exacerbation of COPD have been conflicting. Few studies explored the prevention of COPD exacerbation. Most studies explored certain, not all elements of the COPD exacerbation preventing behaviors as recommended by the guideline of the Thoracic Society of Thailand.[7] Most importantly, no studies in the heavy industrial estate with significant air pollution, like Samutprakarn province, have been conducted. This present study aimed to determine the COPD acute exacerbation promoting behavior and its influencing factors among COP patients with the experiences of COPD acute exacerbation in Samutprakarn province. The predicting factors included perceived severity and perceived risk of COPD acute exacerbation, perceived self-efficacy of COPD acute exacerbation prevention, and depression. It was hypothesized that perceived severity and perceived risk of COPD acute exacerbation, and depression had a negative relationship, while depression had a negative relationship, with the COPD acute exacerbation preventing behavior. The findings could be useful in reducing the progression of COPD, exacerbation rate, hospitalization rate, complications, mortality rate, and the associated economic loss. Ultimately, quality of life of COPD patients could also be improved.

Methods

In this predictive correlational research, study population was patients diagnosed with COPD and at least one acute exacerbation episode within a year before the study recruitment. Study sample was those of the study population receiving regular care at the COPD clinic and out-patient department care of Samutprakarn Hospital. To be eligible, they had to be 40 – 70 years old, have good consciousness and perception on date, time, place and person, have no problems in communication in Thai language, have COPD severity stage 2 or 3 as indicated by the Thoracic Society of Thailand[7], have no disabilities which could interfere or inhibit them from their daily functions, have no co-morbidities with relapses, and have no psychiatric disorders.

The sample size was estimated using the equation of Tabachnick and co-workers[19], $N \geq 104 + m$, where N is the required sample size, and m is the independent variables. With 4 independent variables to study, a total of 108 participants were needed. Those eligible for the study were listed using the hospital number (HN) and selected by the simple random sampling method. On a given day, if an odd number was randomly selected, potential participants with odd-numbered last digit HN were recruited. On the other hand, if an even number was randomly selected, potential participants with even-numbered last digit HN were recruited.

Research instruments

The tool was a 6-section questionnaire. The first section contained 14 questions collecting demographic and clinical characteristics (7 questions each). The second section assessed perceived severity of COPD acute exacerbation. The questions were modified from the perceived asthma severity questionnaire of Muennipat and colleagues.[20] All 6 questions were positive statements with a 5-point Likert-type rating scale ranging from 1-highly disagree to 5-highly agree. With the total score of 30 points, higher scores indicated higher level of perceived severity of acute exacerbation.

The third section asked about perceived risk of acute exacerbation of COPE modified from the perceived risk of asthma exacerbation of Muennipat and colleagues.[20] All 10 questions were positive statements with a 5-point Likert-type rating scale ranging from 1-highly disagree to 5-highly agree. With the total score of 50 points, higher scores indicated higher level of perceived risk of COPD acute exacerbation.

In the fourth section, perceived self-efficacy of preventing COPD acute exacerbation was evaluated using the questions the researchers modified from the perceived self-efficacy of asthma exacerbation prevention of Pimkhot and co-workers.[21] All 12 questions were positive statements with a visual analogue scale of 0 on the left end (not at all confident) to 10 on the right end (totally confident). With the total score of 0 – 120, higher scores indicated higher level of perceived self-efficacy of preventing COPD acute exacerbation.

In the fifth section, depression was assessed using the Thai Geriatric Depression scale (TGDS-15).[22] Of the 15 questions, 5 questions were positive statements with a score of 0 for "yes" and 1 for "no"; while 10 questions were negative statements with a score of 1 for yes and 0 for no. With the total score of 15 points, scores of 0 – 4, 5 – 10 and 11 – 15 points indicate no, suggestive and definite depression, respectively.

In the sixth section, COPD acute exacerbation preventing behavior was assessed using the questions modified from the questions on COPD exacerbation preventing behavior of Phuwilai and colleagues.[23] The 12 questions represented 4 aspects of COPD acute exacerbation preventing behaviors including smoking cessation, compliance to medication regimens prescribed, lung rehabilitation, and flu vaccination. With 8 positive and 4 negative statements, the response was a 5-point rating scale ranging from 1-not practice at all to 5-practice regularly. Scores of negative statements were reversed. With a total of 60 points, higher scores indicated higher level of COPD acute exacerbation preventing behaviors.

Study instrument quality assurance

The questionnaire was tested for content validity with five experts, specifically a physician specialized in respiratory diseases, two nurses specialized in internal medicine nursing and respiratory nursing, and two faculty members specialized in adult and geriatric nursing. The congruence to the study objectives of each item of each questionnaire was rated on a 5-point rating scale where higher points indicated higher congruence. The content validity index (CVI) for each question was calculated. In addition, the questionnaire was tested for internal consistency reliability in 30 individuals comparable to the participants.

Perceived severity of COPD acute exacerbation, perceived risk of COPD acute exacerbation, perceived self-

efficacy of COPD acute exacerbation preventing behavior, and COPD acute exacerbation preventing behavior were found to have a high content validity with CVIs of 0.96, 1.00, 1.00, and 0. 98, respectively. Perceived severity of COPD acute exacerbation, perceived risk of COPD acute exacerbation, perceived self-efficacy of COPD acute exacerbation preventing behavior, depression, and COPD acute exacerbation preventing behavior were found to have a high internal consistency reliability with Cronbach's alpha coefficients of 0.80, 0.81, 0.80, 0.86, and 0.81, respectively.

Participant protection

The study was approved by the Ethics Committee for Human Study of Burapha University (approval number: G-HS009/ 2564; approval date: May 5, 2021) and of Samutprakarn Hospital (approval number: Nq00964; approval date: April 20, 2021). The potential participants were informed about objectives, steps, risks, benefits and voluntary nature of the study. They were informed that they can withdraw from the study at any time with no consequences on the care they regularly received from the hospital. With anonymity nature of the study, no identifications of the participants were asked. Their information and answers were kept in a secured place and presented as a summary, not individual participants' data. The data were destroyed after the presentation of the study findings. Once the written informed consent was obtained, the questionnaire was given with instruction. The participants answered the self-administered questionnaire which took about 20 minutes to complete.

Data analysis

Descriptive statistics including mean with standard deviation (SD) and frequency with percentage were used to present demographic and clinical characteristics, and scores of the study factors. To examine the associations between the COPD acute exacerbation preventing behavior and its predicting factors (i.e., perceived severity and perceived risk of COPD acute exacerbation, perceived self-efficacy of COPD acute exacerbation prevention, and depression), multiple linear regression analysis was conducted. All assumptions of the multiple linear regression were met. Statistical significance of all tests was set at a type I error of 5% (or P-value < 0.05). Statistical analyses were conducted using SPSS version 27.

Results

Of the 108 participants, most of them were men (93.5%) (Table 1). They were 63 years old by average with the majority in their 61 – 70 years old (72.2%). The majority were with no job (49.1%), had spouse as caregivers (65.7%), had been diagnosed with COPD for more than 2 years to 3 years and more than 5 years to 10 years (28.8% for both durations), had stage 2 COPD (74.1%), and had co-morbid illnesses (52.8%). Most of them used short-acting beta-agonist with corticosteroid inhalers (74.1%) and oral methylxanthine medication (49.1%). The majority never had flu vaccine (44.4%). Most of them had a smoking history (95.4%). The largest proportion of the participants had smoked for 36 – 40 years (35.0%). Almost two-thirds had one acute exacerbation in the last year (62.0%). It was worth noting that among the rest (38.0%) who had 2 or more exacerbations in the last year, 37.5% of them remained smoking (Table 1).

In terms of the COPD acute exacerbation preventing behavior, the overall mean score was 44.76 ± 4.81 out of 60 points (Table 2). For individual aspects of the behavior, mean scores of smoking cessation effort/behavior, compliance with medication regimens prescribed, lung rehabilitation, and annual flu vaccination were 7.03, 18.38, 16.90, and 2.42 points, respectively. For the effort or behavior of smoking cessation, a large proportion of participants reported that they did not smoke any more (79.6%); while the rest (21.4%) reported that they smoked all the time. For compliance to medications prescribed, 68.5% of the participants reported that they used the scheduled bronchodilator inhalers (or controllers) as prescribed all the time, and 71.3% took regular oral medications as prescribed all the time. For the use of rescue bronchodilator inhaler, 47.2% reported they used the rescue inhalers and rushed to the emergency room every time when needed. 55.5% of them performed proper lung rehabilitation. It was found that 50% of them avoided physical exertion with no or low effort on exercise. A high proportion of 44.4% of the participants did not have annual flu vaccination (Table 2).

Table 1 Demographic and clinical characteristics of the participants (N = 108).

Characteristics	N	%
Gender		
Men	101	93.5
Women	7	6.5
Age (years) (mean = 63 ± 5.5, min = 44, max = 70)		
44 – 50	3	2.8
51 – 60	27	25
61 - 70	78	72.2
Occupation		
No occupation	53	49.1
Small business	11	10.2
General labors	14	40.7
Caregivers		
Spouse	71	65.7
Offspring	32	29.7
Others (relatives, siblings)	5	4.6
Duration since diagnosed with COPD (years) (min = 1, max = 21)		
1 – 2	11	10.1
> 2 - 3	31	28.8
> 3 - 4	18	16.6
> 4 - 5	4	3.7
> 5 - 10	31	28.8
> 10 - 15	7	6.4
> 15 - 20	4	3.7
> 20	2	1.9
COPD severity stage		
2	80	74.1
3	28	25.9
Co-morbid illnesses		
No	51	47.2
Yes	57	52.8
Inhalers		
Short-acting beta-agonist with corticosteroid inhalers	80	74.1
Other inhalers	28	25.9
Oral medications		
Mucolytics	18	16.6
Methylxanthine	53	49.1
Mucolytic with methylxanthine	35	32.4
Other oral bronchodilators	2	1.9
Flu vaccination		
Never vaccinated	48	44.4
Vaccinated within a year	24	22.3
Vaccinated more than a year	36	33.3
Smoking history		
Never	5	4.6
Yes	103	95.4
Number of years of smoking (*n* = 103) (mean = 36 ± 4.1, min = 10, max = 50)		
< 15	2	1.9
15 - 20	2	1.9
21 – 25	9	8.7
26 – 30	18	17.5
31 – 35	18	17.5
36 – 40	36	35.0
≥ 41	18	17.5
Number of acute exacerbations in the last year (mean = 2.38 ± 0.48, min = 1, max = 3)		
1	67	62.0
2 or more*	41	38.0
Depression		
No depression	91	84.3
Suggestive depression	17	15.7

* Of these 41 participants, 37.5% of them remained smoking.

Table 2 Individual aspects of OPD acute exacerbation preventing behaviors (N = 108).

Individual aspects of the behavior	N (%) by levels of performing the behavior				
	1 (never)	2 (rarely)	3 (sometimes)	4 (most of the time)	5 (all the time)
Smoking cessation effort/behavior: mean = 7.03 ± 2.13 points.					
Actual smoking (i.e., how often the participant smoked)	86 (79.6)	0	0	0	22 (21.4)
Interaction with smokers	7 (6.5)	18 (16.7)	54 (50)	18 (16.7)	11 (10.2)
Compliance with medication regimens prescribed: mean = 18.38 ± 1.56 points.					
Scheduled bronchodilator inhalers (controllers)	0	5 (4.6)	2 (1.9)	27 (25.0)	74 (68.5)
Regular oral medications (controllers)	1 (0.9)	4 (3.7)	1 (0.9)	25 (23.2)	77 (71.3)
Rescue bronchodilator inhalers (and rush to the emergency room if not relieved)	0	0	6 (5.6)	51 (47.2)	51 (47.2)
Lung rehabilitation: mean = 16.90 ± 3.38 points.					
Proper diaphragmatic breathing*	2 (1.9)	17 (15.7)	60 (55.5)	26 (24.1)	3 (0.8)
Breathing with abdominal muscles	2 (1.9)	16 (14.8)	69 (63.9)	19 (17.5)	2 (1.9)
Exercising muscles of arms, legs and shoulders	2 (1.9)	0	62 (57.4)	19 (17.6)	25 (23.1)
Exercising 3 – 4 days/week	2 (1.9)	11 (10.2)	59 (54.6)	25 (23.1)	11 (10.2)
Avoiding physical exertion (i.e., no or low effort on exercise)	20 (18.5)	54 (50.0)	34 (31.5)	0	0
Annual flu vaccination: mean = 2.42 ± 1.43 points.					
	48 (44.4)	8 (7.4)	22 (20.4)	20 (18.5)	10 (9.3)

Overall score of COPD acute exacerbation preventing behavior: mean = 44.76 ± 4.81 out of 60 points

* Proper diaphragmatic breathing includes breathing in slowly through the nose, keeping the mouth closed, feeling the lungs filled with air and inflated like a balloon as the belly moves outward.

Regarding factors predicting COPD acute exacerbation preventing behavior, the mean scores of perceived severity and perceived risk of COPD acute exacerbation, perceived self-efficacy of COPD acute exacerbation prevention, and depression were 24.33, 39.88, 91.17, and 3.21 points, respectively (Table 3) . Most of the participants had no depression (84.3%), while 15.7% had suggestive depression (Table 1).

Table 3 Factors predicting COPD acute exacerbation preventing behavior (N = 108).

Factors	Possible range	Actual range	Mean	SD
Perceived severity of COPD acute exacerbation	6 - 30	20 - 29	24.33	2.06
Perceived risk of COPD acute exacerbation	10 - 50	37 - 44	39.88	1.77
perceived self-efficacy of COPD acute exacerbation prevention	0 - 120	76 - 116	91.17	8.84
Depression	0 - 15	1 - 6	3.21	1.44

All predicting factors simultaneously explained 53% of the variance of the COPD acute exacerbation preventing behavior (*adj.* R^2 = 0.53, *P*-value < 0.001). While perceived self-efficacy of COPD acute exacerbation prevention was the most significant predicting factor (β = 0.67, *P*-value < 0.001) followed by perceived risk of COPD acute exacerbation (β = 0.21, *P*-value = 0.007); perceived severity of COPD acute exacerbation and depression were not (Table 4).

Table 4 Relationships between COPD acute exacerbation preventing behavior and its predicting factors by multiple linear regression (N = 108).

Predicting factors	b	SE	β	t	P-value
Constant					
Perceived severity of COPD acute exacerbation	-0.27	0.18	-0.11	-1.5	0.13
Perceived risk of COPD acute exacerbation	0.57	0.20	0.21	2.76	0.007
perceived self-efficacy of COPD acute exacerbation prevention	0.36	0.04	0.67	8.54	< 0.001
Depression	-0.42	0.22	-0.12	-1.94	0.055

R = 0.74, R^2 = 0.55, *adj.* R^2 = 0.53, $F_{4,103}$ = 31.86, *P*-value < 0.001.

Discussions and Conclusion

In this group of patients with COPD, their score of COPD acute exacerbation preventing behavior was 44.76 out of 60 points which was slightly above the half of the possible score. This relatively low preventing behavior score cold be because most of the participants were the elderly (72.2%). Their physical functions could be deteriorated and their self-care could be limited.[24] In addition, most participants had COPD severity stage 2 and 3, had a smoking history, had been smoking for a relatively long time, and still smoked. These suggest an inadequate level of exacerbation preventing behavior.

For individual aspects of the exacerbation preventing behavior, a relatively large proportion of participants still smoked regularly (21.4% in Table 2). Since smoking cessation is the most recommended treatment modality to slow the lung deterioration down[25], reduce mortality rate, and prevent COPD acute exacerbation. Present smokers could be affected by the short, positive, relaxing effect of nicotine in the cigarette. Once the blood nicotine level drops, the positive relaxing effect subsides.[26] Those who crave for such positive, relaxing effect will continue smoking. With the damage of the lung parenchyma and alveoli caused by nicotine, gas exchange could be reduced which leads to the shortness of breath and dyspnea. In our study, as high as 41 participants had acute exacerbations at least twice in the last year. Of these 41 participants, 37.5% of them still smoked.

It has been known that smoking is related to COPD acute exacerbation and hospitalization significantly.[5] In addition, many participants still interacted with smoker 3 – 4 days a week which had them exposed to the cigarette harm as the second-hand smokers. Like the harm of smoking, second-hand smoking causes reduced lung function especially in COPD patients which already have reduced lung function. In the long term, health defects among second-hand smokers are similar to the smokers.[27] COPD patients with second-hand smoking are therefore more likely to experience acute exacerbation and hospitalization.

For medication use compliance, 68.5% of the participants used the regular bronchodilator inhalers regularly. This finding is consistent with a previous study revealing that 74% of COPD patients used controller inhaler medications regularly.[28] We also found that 71.3% of the participant took oral medications regularly. Our findings of the compliance to regular medications for COPD control could be considered relatively low which could contribute to a poor control and exacerbation. However, correct steps of inhalation which are also essential for effective treatment were not determined in our study. Since 62% of the participants experienced one exacerbation episode in the last year, the participants could have a low concern about the consequence of a low medication compliance. This is consistent with a study showing that the experience of acute exacerbation affected inhaler medication compliance.[29] Patients experiencing more numbers of episode or more severe episodes are more likely to be alerted, concerned or even feared. With such concern over the threat of exacerbation, the patients' attitude is modified and behaviors are changed for the better prevention of acute exacerbation. The compliance on COPD medications, i.e., regular scheduled administrations with correct techniques, could slow down the progression and prevent the exacerbation.[30]

For lung rehabilitation, it is encouraged since it could alleviate shortness of breath, improve exercise capability and tolerance, promote quality of life, and reduce acute exacerbation.[31] Most participants reported breathing with abdominal muscles sometimes (63.9%). However, only 55.5% breathed with proper diaphragmatic breathing sometimes which is includes breathing in slowly through the nose, keeping the mouth closed, feeling the lungs filled with air and

inflated like a balloon as the belly moves outward. The participants exercised muscles of arms, legs and shoulders sometimes (57.4%) and exercised 3 – 4 days/week sometimes (54.6%). This indicates a relatively low level of physical exertion.

The low level of lung rehabilitation exercise reported in our study could be due to a large proportion of the elderly participants. With physical deterioration and co-morbidities, their exercise could be limited. In addition, COPD patients might think that they could prevent the exacerbation by the regular bronchodilator inhaler and to relieve the acute exacerbation by the rescue bronchodilator inhaler. They might also think that exercise could cause exhaustion and trigger acute exacerbation. It could also be that the participants lacked knowledge and understanding about proper self-care to prevent acute exacerbation. As a result, lack of proper self-care could lead to a low level of exercise and rehabilitation among COPD patients.[32]

For the annual flu vaccination, only 22.3% of the participants were vaccinated within the last year and 33.3% were vaccinated but longer than one year. This could be because most participants did not know that they should be vaccinated and/or perceived that they had to pay out-of-pocket for the flu vaccine. The annual flu vaccination is recommended for all COPD patients. It reduces flu infections and the exacerbation of COPD. A previous study showed that the risk of acute exacerbation increased by 27.79 times among COPD patients with no flu vaccination.[33] It was also found in a study that 65.2% of COPD patients with no flu vaccination experienced respiratory failure while only 34.8% of those with flue vaccination did so.[34] A low flu vaccination rate in our study could also be due to a lack of campaigns to promote the understanding about flu vaccination among these COPD patients.

For the factors predicting the COPD acute exacerbation preventing behavior, only perceived self-efficacy of COPD acute exacerbation prevention and perceived risk of COPD acute exacerbation were significant predictors (β = 0.67, P-value < 0.001, and β = 0.21, P-value = 0.007, respectively); while perceived severity of COPD acute exacerbation and depression were not. However, these 4 predictors together explained a relatively large portion of variance of the prevention behavior (53%).

Perceived self-efficacy, as a prominent predictor of various health behaviors, could be a significant predictor of COPD acute exacerbation promoting behavior. Self-efficacy refers to the confidence to perform preventing behavior to prevent the exacerbation. In our study, the mean score of self-efficacy was 91.17 out of 120 points which was relatively high. Individuals with high self-efficacy are motivated to perform the healthy behavior. When the individuals face problems, self-efficacy as a mediator could prompt them to modify their behavior to achieve the desirable health state. Our finding is consistent with a previous study revealing that self-efficacy was related and able to predict an additional 4% of variance of health-promoting behaviors.[14] The confidence of carrying out the prevention behavior absolutely drives the actual COPD acute exacerbation preventing behavior.

Perceived risk of COPD acute exacerbation was found to be a moderate-to-high level with a mean score of 39.88 out of 50 points, and positively related with the prevention behavior in our study. The more the patients perceive the risk of acute exacerbation, the more likely they will perform the exacerbation preventing behavior. The patients estimate how much the risk of the exacerbation they are facing. This perceived risk is also considered the belief. If the patients believe that they are in a high risk of threat or danger toward their health or well-being, the importance or significance of preventing or reducing the threat or danger is realized. As a result, the patients are motivated to perform the preventing behavior. Our finding is consistent with a study reporting that health belief was associated with lung rehabilitation among COPD patients.[35] It is also consistent with another previous study showing that with the self-management program to enhance perceived risk of asthma exacerbation, the score of self-management for asthma was improved with statistical significance.[36] With a higher perception on risk of the acute exacerbation, the patients are more likely to perform the prevention behavior.

For factors not associated with the prevention behavior, i.e., perceived severity of COPD acute exacerbation and depression, certain arguments could be as follows. Perceived severity of acute exacerbation was found to be at a moderate-to-high level with a mean score of 24.33 out of 30 points in our study. Perceived severity is how much the patients believe their acute exacerbation, as the threat or danger, will affect their lives physically, psychologically, socially and economically. Perceived severity as an information input could cause fear or concern which could motivate the patients to modify their prevention behavior to avoid and/or avert such

threat or danger. No association between perceived severity and the acute exacerbation preventing behavior could be due to a low incident of exacerbation (once in the last year) among most patients (62%). The majority also had no co-morbid illnesses (47.2%). With these circumstances, even with a moderate-to-high level of perceived severity, the concern that the exacerbation could be life-threatening might not be high enough to motivate the actual prevention behavior. Our finding is consistent with a previous study showing that perceived severity could not predict the cardiovascular disease preventing behavior among employees of public universities in Bangkok.[37]

For depression, it was found to be at a very low level with a mean score of 3.21 out of 15 points, and not related with acute exacerbation preventing behavior. Based on the mean score, 84.3% of the participants were categorized as not depressed. Most patients were able to perform activities of daily living. Most of them (95.4%) had caregivers which were their spouse and offspring to help in most activities. These caregivers could also offer social and emotional support which allow the patients not to feel too dependent or emotionally deviated to feel depressed. With such no or low level of depression, no association with the actual exacerbation preventing behavior was found in our study. The finding is consistent with a previous study showing depression did not predict acute exacerbation of COPD patients.[18]

In preventing COPD acute exacerbations, our findings could be useful in developing programs to promote perceived self-efficacy of performing the exacerbation preventing behavior and perceived risk of the exacerbation. For example, programs that allow sharing experience of those who had proper self-care and succeeded in preventing the exacerbation could empower other COPD patients for modifying their preventive behavior. In addition, more knowledge and understanding on inhaler compliance, lung rehabilitation, and flu vaccination should be encouraged and regularly monitored. Lung rehabilitation tailored to individual patients' health status and context should be provided. Flu vaccination should be more readily available, promoted and encouraged into communities with co-operations with the sub-district health promoting hospitals. Since most COPD patients are the elderly, caregivers should be brought into the self-care and management. Healthcare setting administrators should also provide more resource for promoting advanced knowledge and skills of the nurse for COPD exacerbation

preventing care. Specifically, regular training for every 1 to 3 months should be scheduled.

The study had certain limitations. Since it was a cross-sectional study, only a snapshot of the associations between the study variables was captured. Studies with a longer follow-up duration and/or with patients with and without acute exacerbation should be conducted. Our study was conducted in a hospital, generalization to other settings could be limited. More studies in other settings with air pollution should be conducted.

In conclusion, perceived self-efficacy of performing COPD acute exacerbation preventing behavior and perceived risk of acute exacerbation were significant positive predictors of the exacerbation preventing behavior among Thai COPD patients in a province with a heavy air pollution.

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