The Effectiveness of COPD Management Program via Smartphone Applications on Clinical Status in Patients with Chronic Obstructive Pulmonary Disease*

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Abstract

Purpose: To study the effectiveness of COPD management program via smartphone applications on clinical status in patients with chronic obstructive pulmonary disease.

Design: A randomized controlled trial.

Methods: The participants were 60 patients with chronic obstructive pulmonary disease aged 40 years or over who visited the clinic at a tertiary level hospital in Kanchanaburi, Thailand. The participants were randomized into either the experimental group (n = 30) or the control group (n = 30) by a computer-generated random scheme. The control group received usual care, while the experimental group received both usual care and the 6-week COPD management program via LINE and calendar applications developed from the researchers based on the Information–Motivation–Behavioral Skills model. Clinical status was measured by the Clinical COPD questionnaire. Data was analyzed with descriptive statistics, independent sample t-test, and paired sample t-test.

Main findings: The result revealed that the majority of the experimental group and the control group were male, 93.3% and 83.3%, respectively. The experimental group had the mean age of 64.63 years (SD = 10.28), and the control group had the mean age of 62.70 years (SD = 10.79). There were no significant differences in the mean scores of clinical status between both groups at baseline ($p > .05$). After receiving the program, the experimental group had significantly better clinical status than before receiving the program ($p < .001$), and better than that of the control group ($p < .05$).

Conclusion and recommendations: The finding suggested that COPD management program can be used to improve patient's clinical status. Nurses should use this program to provide health education, enhance motivation, improve inhaler skills, and promote medication adherence in patients with COPD.

Keywords: chronic obstructive pulmonary disease, health status, mobile applications

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ประสิทธิผลของโปรแกรมการจัดการโรคปอดอุดกั้นเรื้อรังผ่านสมาร์ตโฟนแอปพลิเคชันต่อสถานะทางคลินิกในผู้ป่วยโรคปอดอุดกั้นเรื้อรัง*

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บทคัดย่อ

วัตถุประสงค์: เพื่อศึกษาประสิทธิผลของโปรแกรมการจัดการโรคปอดอุดกั้นเรื้อรังผ่านสมาร์ตโฟนแอปพลิเคชันต่อสถานะทางคลินิกในผู้ป่วยโรคปอดอุดกั้นเรื้อรัง

รูปแบบการวิจัย: การวิจัยเชิงทดลองแบบสุ่มและมีกลุ่มควบคุม

วิธีดำเนินการวิจัย: กลุ่มตัวอย่างเป็นผู้ป่วยโรคปอดอุดกั้นเรื้อรังอายุ 40 ปีขึ้นไป จำนวน 60 รายที่เข้ารับการรักษาที่คลินิกโรคปอดอุดกั้นเรื้อรัง โรงพยาบาลตติยภูมิแห่งหนึ่งในจังหวัดกาญจนบุรี กลุ่มตัวอย่างได้รับการสุ่มโดยใช้โปรแกรมคอมพิวเตอร์เข้ากลุ่มทดลองและกลุ่มควบคุม กลุ่มละ 30 ราย กลุ่มควบคุมได้รับการพยาบาลตามปกติ กลุ่มทดลองได้รับการพยาบาลปกติร่วมกับโปรแกรมการจัดการโรคปอดอุดกั้นเรื้อรังผ่านสมาร์ตโฟนแอปพลิเคชัน ซึ่งพัฒนาขึ้นจากกรอบแนวคิด Information–Motivation–Behavioral Skills model ระยะเวลาในการทดลอง 6 สัปดาห์ ประเมินผลสถานะทางคลินิกโดยใช้แบบสอบถามทางคลินิกโรคปอดอุดกั้นเรื้อรัง วิเคราะห์ข้อมูลโดยใช้สถิติพรรณนา การทดสอบทีแบบสองกลุ่มอิสระและแบบสองกลุ่มสัมพันธ์กัน

ผลการวิจัย: ผลการวิจัยพบว่า กลุ่มทดลองและกลุ่มควบคุม ส่วนใหญ่เป็นเพศชายร้อยละ 93.3 และร้อยละ 83.3 ตามลำดับ กลุ่มทดลองมีอายุเฉลี่ย 64.63 ปี กลุ่มควบคุมอายุเฉลี่ย 62.70 ปี ก่อนการทดลองกลุ่มทดลองและกลุ่มควบคุมมีสถานะทางคลินิกไม่แตกต่างกัน ($p > .05$) หลังการทดลองกลุ่มทดลองมีสถานะทางคลินิกดีกว่าก่อนการทดลองอย่างมีนัยสำคัญทางสถิติ ($p < .001$) และดีกว่ากลุ่มควบคุมอย่างมีนัยสำคัญทางสถิติ ($p < .05$)

สรุปและข้อเสนอแนะ: โปรแกรมการจัดการโรคปอดอุดกั้นเรื้อรังผ่านสมาร์ตโฟนแอปพลิเคชันช่วยส่งเสริมให้ผู้ป่วยมีสถานะทางคลินิกที่ดีขึ้น พยาบาลควรนำโปรแกรมการจัดการโรคปอดอุดกั้นเรื้อรังผ่านสมาร์ตโฟนแอปพลิเคชันมาใช้ในการให้ความรู้ เสริมแรงจูงใจ และส่งเสริมทักษะและความสม่ำเสมอในการใช้ยาสูดในผู้ป่วยปอดอุดกั้นเรื้อรัง

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Background and Significance

Chronic obstructive pulmonary disease (COPD) is a major global health problem. The global prevalence of COPD was 251 million cases in 2016[1]. It was estimated by the World Health Organization (WHO) that COPD would be the third leading cause of death by 2030 and more than 5.4 million people would die from COPD annually by 2060[2]. However, in 2016, COPD was already the third leading cause of death worldwide[3]. In Thailand, based on the latest available data in 2013, the prevalence of COPD was about 176.77 per 100,000 populations[4]. It caused an increase of premature death from 3.8 to 4.5 per 100,000 population between 2012 and 2015[5].

COPD is a chronic inflammatory lung disease characterized by airflow limitation in the lungs. Patients normally suffer from several symptoms including dyspnea, chronic cough, and chest tightness. Although COPD patients received treatment for their symptoms, they still experienced exacerbation. Several studies revealed that COPD patients were unable to manage their symptoms and more likely to have poor health behaviors such as current smoking, poor adherence to treatment, and lack of exercise[6], which led to poor clinical status. Moreover, they still performed incorrect inhaler technique, even after receiving education and training[7]. Furthermore, the finding showed that in the real world, the level of medication adherence in COPD patients was lower than was previously recorded[8-9]. Therefore, to improve clinical status, the appropriate management in patients with COPD is needed. As there is currently no cure for COPD, the effective management such as medication adherence, regular exercise, pulmonary rehabilitation, and healthy diet are essential to delay disease progression, relieve symptoms, and improve health status in patients with COPD[2].

According to previous literature reviews, there were several interventions helping patients to improve their clinical status and the strategies used have differed across studies. Previously, most of the interventions focused on providing face-to-face education to both groups and individuals. The educational methods included passive lecture[10-11], interactive lecture, demonstrations and practice[12-13], and group discussion[14]. However, patients needed to come to the hospital in order to received health education from healthcare professionals. Recently, the quasi-experimental study evaluated the effect of inhaler demonstration and returned demonstration combined with a telephone follow up on dyspnea among COPD patients. The result revealed that the program could relieve dyspnea symptoms[15]. However, the main limitation of this method is the high cost. Nowadays, smartphones play an important role in

personal lives as well as our societies. Smartphones help people to easily access information due to a rapid advanced internet. Moreover, many functionalities of smartphones help people to communicate to anyone at any place and anytime across the world. In addition, some functions are no charge such as text message, free voice call, and video chat. In Thailand, Tippala[16] examined the effectiveness of providing information and inhaler skills via the LINE application on clinical control in patients with COPD; the patients received video clips of how to use inhaler correctly via the LINE application and recorded their videos while performing inhaler medication. Then, the patients sent the videos back to the researcher and received text feedback. Although the result showed that patients who received the program had significantly improved their clinical control, the program only focused on correct inhaler technique and did not promote medication adherence, which is an essential component in relieving COPD symptoms and improving clinical status in COPD patients. Moreover, the study did not provide real-time feedback, which could potentially solve the problem instantly rather than writing a text massage.

Therefore, the researchers developed a COPD management program to provide health education to patients with COPD via smartphones by using LINE and calendar applications. This program was based on the Information-Motivation-Behavioral Skills (IMB) model[17]. The content of program had three parts including health education, patient motivation, and practice skills. The LINE application was two-way communication tool and had many features such as free messages, free voice and video calls, and stickers. The video conference feature was used for breathing strategies and inhaler technique training. It allowed real-time feedback and patient-healthcare professional interactions. The calendar application was used to remind patients to take their medication, which could improve medication adherence in patients with COPD.

Objectives

1. To compare clinical status between the participants who received the COPD management program and those who received only usual care.

2. To compare clinical status of the participants in the experimental group before and after receiving the COPD management program.

Hypotheses

1. After implementing the COPD management program, the participants who received the program have better clinical status than those who received only usual care.

2. After receiving the COPD management program, the participants in the experimental group had better clinical status than before receiving the program.

Methodology

This study was a randomized controlled trial.

Population and Sample

The population of this study were patients aged 40 or over, both male and female, diagnosed with any stage of COPD. The participants were patients with COPD who followed up at the COPD clinic in a tertiary level hospital in Kanchanaburi, Thailand and met the following inclusion criteria: 1) showing incorrect use of inhaler devices at least one step; 2) having their own smartphones and ability to use basic applications such as LINE application; 3) having ability to read, write, and speak Thai language; 4) having no cognitive impairment screened by the Mini-Cog; 5) not being diagnosed with mental disorder; and 6) having no severe conditions of comorbid diseases limiting them from performing the experiment such as severe heart, liver or kidney disease, and end stage of malignant disease.

The sample size was calculated by using G-power analysis software (3.1.9.4 version). With an initial plan to use ANCOVA for the analysis, the effect size was calculated from a previous study regarding the effectiveness of telemedicine on reducing exacerbation and improving clinical status in patients with COPD[18]. The effect size (f) was calculated and equal to .44. At significance level (α) .05 and power of .85, the calculated sample size was 50. The anticipated dropout rate and missing data was 20%. Therefore, the total sample size was 60 (30 participants in each group).

In this study, three participants in the experimental group withdrew after the program started. One participant did not answer the questionnaires since the 4th week. Two participants did not answer the questionnaires or join the video conference from the 3rd week onwards. In the control group, one participant read the message but did not complete the questionnaires both the 3rd and 6th week. However, the baseline data of these participants were used in data analysis.

Research Instruments

The instruments used in this study can be divided into 3 parts as follows:

Instruments for screening

1) The Mini-Cog was used to test for cognitive impairment in patients who were aged 60 and above developed by Borson, et al.[19] and translated into Thai language by Trongsakul, et al.[20] The patients who have the score less than 3 with

abnormal clock drawing test indicate cognitive impairment.

2) The inhaler technique checklist developed by NHS Liverpool Clinical Commissioning Group[21] was used to examine patients' ability to properly administer their COPD controller medication therapies via inhaler devices. In this study, the inhaler devices included Metered dose inhaler (MDI) with and without spacer, Turbohaler, Accuhaler, Handihaler, and Respimat. The checklist assessments addressed seven steps covering the essential elements of inhaler technique, starting from preparation of the devices to delivery of the medications. Patients who performed inhaler technique incorrectly at least one step were included into this study.

Instruments for data collection

1) A General information questionnaire which consisted of the demographic data and the information related to COPD. The demographic data consisted of age, sex, marital status, educational level, occupation, monthly income, sufficiency of income, and the carer or person with whom the patient lives. The information related to COPD consisted of history of smoking, time since diagnosis of COPD, comorbidity, hospital admission due to exacerbation, and a spirometry test.

2) A COPD Knowledge Questionnaire was used to measure the patient's COPD knowledge. The original Bristol COPD Knowledge Questionnaire (BCKQ) was developed by White, et al.[22] The researchers asked and received permission from the developer to use and cut out some dimensions of the questionnaire and items due to the unrelated context and suitability for the online questionnaire. Finally, there were 8 dimensions used in this study including; breathlessness, phlegm, infections, exercise, smoking, vaccination, inhaled bronchodilators, and inhaled steroids with totally 20 items. Then, this questionnaire was translated into Thai language by using the back-translation method. The COPD knowledge questionnaire items had three options of answer: correct, incorrect, and don't know. If the participants chose a "correct" answer, they would get the score of 1. If they chose an "incorrect" or "don't know" answer, the score would be 0.

3) The Clinical COPD Questionnaire (CCQ) was developed by van Der Molen, et al.[23] to measure clinical status in COPD patients. The researchers used the Thai official translated version by the Mapi Research Trust[24]. The CCQ consisted of 10 items divided into 3 components including symptoms, functional, and mental state. The response scale was a 7-point Likert scale, where "0" was the best possible score and "6" was the worst possible score.

The sum of all items divided by 10 yielded the average score ranging from 0 to 6. The higher the score, the poorer patient's clinical status.

The COPD management program

The intervention of this study was COPD management program developed by the researchers based on the IMB Model[17] and was validated by five experts including a pulmonologist, two respiratory nurses, a nursing instructor specializing in the respiratory system, and an instructor specializing in information technology. The program consisted of three parts as follows;

Information: The researchers developed the program to provide health behavior information for COPD patients by using a manual booklet, video clips, and text messages. The content in the booklet consisted of the pathophysiology of COPD, medication use, breathing strategies, exercise, exacerbation triggers and management, stress management, and nutrition. The content in the video clips were the same as the booklet but divided into several clips (approximately 4-7 minutes for each clip). The health information delivery methods were characterized in three ways, as follows: face-to-face education, LINE application, and manual booklet.

Motivation: The researcher motivated participants via face-to-face education and LINE application by encouraging them to set the goals for behavioral change such as getting more exercise and quitting smoking. Moreover, the researcher gave them the reasons to perform health behaviors including the advantages of performing good health behaviors and the negative consequences of taking risk behaviors. The researcher also gave them personal feedback about their inhaler technique. The participants who correctly performed inhaler technique would receive verbal messages such as *"You can do it"* and "*Keep up your effort"*. If the participants incorrectly performed, the researchers would provide verbal encouragement such as *"Try better next time, you can do it"*.

Skills: The participants were trained the breathing and inhaler techniques by using three methods including face-to-face education, video clips, and weekly video conference via the LINE application. In addition, medication reminders were set on the calendar application on smartphones to remind them to take their medications.

Validity and Reliability

Instrument validity

The Mini-Cog, Inhaler Technique Checklist, and CCQ are valid and widely used. Therefore, the content validity was not be performed. The content and wordings of the modified COPD knowledge questionnaire was also reviewed by three experts including a pulmonologist, a respiratory nurse, and a

nursing instructor specializing in respiratory system. After that, the researchers adjusted the instruments according to the suggestions from the experts.

Instrument reliability

The reliability of the CCQ and the COPD knowledge questionnaire were tested with 10 patients who had the similar characteristics to the sample. Cronbach's Alpha Coefficient was used to measure internal consistency of the CCQ. The reliability of this instrument was .87. Test-retest was used to determine reliability of the COPD knowledge questionnaire. Pearson correlation coefficient was used to evaluate the test-retest reliability, which was .74.

Ethical Considerations

This study was aware of the ethical issue of research on human subjects. Before collecting the data, this research study was approved by the Institutional Review Board (IRB), Faculty of Nursing, Mahidol University (COA. No.IRB-NS 2020/545.2701) and the Ethic Committee on Research Involving Human Subjects, Paholpolpayuhasena Hospital (COA. No. 2020-02).

Data Collection

After receiving permission, the principal investigator met the head nurse of the COPD clinic to explain purpose of the study and data collection processes. The nurse announced the research project at the clinic and asked for their interest in participating in the study and met with the researcher. The researcher approached the patients who were interested in the study in a waiting area and started by introducing herself. Then, the researcher would explain the research objectives, benefits and the steps of data collection. The researcher also informed the patients about their confidentiality and their right to withdraw from the study at any time. Then, the researcher provided the information sheet to request a consent form.

The researcher assessed the cognitive impairment by using the Mini-Cog in patients aged 60 years or over. No one had cognitive impairment. Then, patients demonstrated all the inhaler devices that were currently used. The one who incorrectly performed inhaler technique at least 1 step were invited to join in this study. After recruiting the participants, the researcher assessed participants' demographic data and information related to COPD by asking them to answer the questions in the general information questionnaires. The researcher also asked their permission to collect the data from their medical records. After that, the researcher asked the permission to be added as a friend in the LINE application. Then the researcher sent the CCQ and the COPD knowledge questionnaire using a link to Google Forms via the LINE application and

asked the participants to answer the questionnaires. The participants were then randomized using a computer-generated random scheme to either the experimental or the control group. The participants in both groups received usual care by healthcare professionals at the clinic. Moreover, the experimental group received the COPD management program from the researcher including heath education individually by face-to-face education, COPD manual booklet, five video clips via LINE application, and medication reminders on calendar application. The researcher made appointments with the participants in the experimental group for a weekly video conference. The experimental group received the video clips and messages at 9 A.M. every other day over 5 weeks via LINE application. At the 3rd and 6th week, the researcher sent the CCQ and the COPD knowledge questionnaire by using Google forms via the LINE application to the participants in both groups to measure their clinical status and COPD knowledge after participating the program.

Data Analysis

For data analysis, the data was analyzed with the Statistical Package for Social Sciences (SPSS) software. The level of significance was set at .05. Descriptive statistics were used to analyze the demographic data of participant's characteristics and dependent variable. Fisher's Exact Test were used to compare categorical variables between the control and the experimental group. Initially, ANCOVA was planned to be used in the analysis with baseline knowledge and inhaler technique as covariates since they might have an influence on clinical status[2]. However, the assumption of ANCOVA was not met; thus, independent sample t-test and Mann Whitney-U test were applied instead to examine the significant differences of the mean scores of clinical status, COPD knowledge, and inhaler technique at baseline and at the 6th week between the experimental and the control groups. A paired sample t-test was used to compare the mean scores of clinical status and COPD knowledge within the control and experimental group between the baseline and at the 6th week. Assumptions for statistical use was tested before the analysis.

Findings

Most participants were male (93.33% in the experimental and 83.33% in the control group). The age of the participants in both groups were in the range of 45 to 82 years old with a mean age of 64.63±10.28 years in the experimental group, and a mean age of 62.70±10.79 years in the control group. Most of them were previously smokers for 30 to 40 years in both groups. FEV1 of the participants in both groups were in the range of 31% to 100%;

and 60% in the experimental and 50% in the control group had mild COPD. At the baseline, there were no significant differences between the experimental and the control groups in terms of participant demographics and information related to COPD ($p > .05$), as shown in Table 1.

Table 1 Comparison of participant demographics and health information related to COPD between the experimental and the control groups

Demographics	Experiment (n = 30)		Control (n = 30)		p-value
	n (%)	X (SD)	n (%)	X (SD)	
Gender					.424[1]
Male	28 (93.3)		25 (83.3)		
Female	2 (6.7)		5 (16.7)		
Age (year)		64.63 (10.28)		62.70 (10.79)	.666[1]
40-50	3 (10.0)		6 (20.0)		
51-60	8 (26.7)		7 (23.7)		
>60	19 (63.3)		17 (56.3)		
Smoking					1.000[1]
No	4 (13.3)		3 (10.0)		
Past smoker	24 (80.0)		25 (83.3)		
Current smoker	2 (6.7)		2 (6.7)		
FEV1 (% predicted)		78.20 (19.01)		73.17 (18.03)	.620[1]
≥ 80% (Mild)	18 (60.0)		15 (50.0)		
50-79% (Moderate)	9 (30.0)		13 (13.3)		
30-49% (Severe)	3 (10.0)		2 (6.7)		
Duration of illness		5.47 (4.50)		4.90 (3.19)	1.000[1]
1-5 years	19 (60.0)		19 (63.3)		
6-10 years	9 (30.0)		10 (33.3)		
>10 years	2 (10.0)		1 (33.3)		

[1] Fisher's Exact Test

As seen in Table 2, the baseline mean scores of inhaler technique between two groups were compared by using Mann-Whitney U test. The results showed that there was no significant difference in the mean scores of inhaler technique between the experimental and the control group at baseline ($p > .05$). For COPD knowledge, there were significant differences in baseline COPD knowledge between two groups ($p = .02$, $t = -2.39$).

Table 2 Comparison of the mean scores of inhaler technique and COPD knowledge between the experimental and the control group at baseline

Study variable	$\bar{X}$	SD	Statistic	p-value
Inhaler technique				
Experimental	4.23	0.74	- .84[1]	.40
Control	4.14	0.50		
COPD knowledge				
Experimental	10.73	2.16	-2.39[2]	.02
Control	9.53	1.70		

[1] z, Mann-Whitney U test; [2] t, independent sample t-test

When comparing the mean scores of clinical status at baseline between the two groups by using independent sample t-test, the results showed that at baseline there were no significant differences ($p = .109$, $t = -1.63$) whereas, at the 6th week, the experimental group had statistically significant better clinical status than those in the control group ($p = .019$, $t = 2.13$), as shown in Table 3.

Table 3 Comparison of the mean scores of clinical status between the experimental and the control groups at baseline and at 6th week

Clinical status	Experimental gr. (n = 30)		Control gr. (n = 30)		t	p-value
	$\bar{X}$	SD	$\bar{X}$	SD		
At base line	1.31	0.72	1.05	0.48	-1.63	.109
At 6th week	.83	0.52	1.16	0.62	2.13	.019

When comparing the mean scores of clinical status within each group at baseline and the 6th week, the mean scores of clinical status in the experimental group at the 6th week was significantly lower than the mean score at baseline ($p < .001$, $t = 6.91$), while there was no significant improvement within the control group ($p > .05$) as shown in Table 4.

Table 4 Comparison of the mean scores of clinical status between baseline and the 6th week within each group

Clinical status	Experimental gr. (n = 30)		Control gr. (n = 30)		t	p-value
	$\bar{X}$	SD	$\bar{X}$	SD		
At base line	1.31	0.72	1.05	0.48	-1.63	.109
At 6th week	.83	0.52	1.16	0.62	2.13	.019

Discussion

From the findings, the clinical status at the 6th week in the experimental group ($\bar{X} = .83$, SD = 0.52) was significantly better than those in the control group. As revealed, the experimental group received both usual care by healthcare professionals at the COPD clinic and the COPD management program based on the IMB model by the researchers consisting of providing information, reinforcing motivation, and practicing health behavioral skills. In terms of information, the participants in the experimental group received information by various methods including face-to-face education, manual booklet, video clips, and text messages. The effect of this provided information would add up face-to-face education in usual care with comprehensive content in manual booklet, which was designed to be attractive with colorful pictures and easy to understand. The participants in the experimental group could read along and ask the researcher if they had any questions. In addition, the researcher uploaded the educational video clips and summarized text messages as well as taught the participants to open in the LINE application. These materials were provided to participants in case they forgot or wanted to review the content. Thus, they could watch the video clips and read text messages in their LINE.

In terms of motivation, the personal motivation was used to adjust participants' attitudes toward health behavior changes by verbal persuasion and feedback via face-to-face conversation, video conference, LINE stickers, and text messages. In addition, each video clip had

verbal motivation for enhancing positive attitude about performing good health behaviors. The positive attitudes would be reinforced by persuading the participants to set their goals such as getting more exercise and quitting smoking. The researcher also provided positive feedback about their inhaler technique by giving compliments via video conference and sending LINE stickers. These personal motivations might enhance participants' confidence in correctly performing inhaler technique and breathing strategies.

Finally, the participants were trained in health behavior skills such as inhaler technique and breathing strategies via face-to-face education and weekly video conference via the LINE application. On the first day of the study, the participants in both groups received training in these skills in a group from a pharmacologist and a physical therapist at the COPD clinic. Then, the participants in the experimental group would receive individual training and feedback from the researcher. Later on a weekly basis, the researcher trained the participants in the experimental group in these skills via video conference in LINE application for 5 weeks. Additionally, the researcher provided real time feedback in inhaler technique and breathing strategies. The participants also discussed issues about their disease management. In addition, as adherence to medication was an essential skill for health promotion in COPD patients to prevent exacerbation[2], the participants were reminded to take the medication via calendar application on their smartphones to increase medication adherence.

The study findings were consistent with a randomized controlled trial (RCT) of Tippala[16] who used the IMB model in developing the program via the LINE application on clinical control in patients with COPD. The result presented that patients who received the program had significantly improved their clinical control when compared to the ones who did not ($p < .05$). Also, Polhan, Wattanakitkrileart and Pongthavornkamol[25] studied the effect of education and inhaler skills program through the LINE application based on the IMB model. The finding revealed that the program significantly improved asthma control among 64 asthmatic patients ($p < .05$). Moreover, Alwashmi and colleagues[26] conducted a systematic review and meta-analysis to explore the effect of smartphone interventions on reducing exacerbation in patients with COPD. The study demonstrated that smartphones are useful in reducing the frequency of COPD exacerbations.

Overall, the results of this study provided evidence that the COPD management program

had a significant effect on improving clinical status in patients with COPD. However, the improved clinical status in the experimental group might not only be caused by the effect of the intervention offered but also the effect of COPD knowledge prior to the intervention phase. As we could not use statistics to control the confounding effect of COPD knowledge, the interpretation of the effect of our program should be cautious with the concern of such confounding effect.

Limitations

The COPD management program can only be implemented with COPD patients who have smartphones and internet availability which might limit the generalizability of the results.

Conclusion and Recommendations

From the findings, it could be concluded that COPD management program could improve clinical status in COPD patients. Nurses should use this program to provide health education, enhance motivation, improve inhaler skills, and promote medication adherence, which can lead to better clinical status in patients with COPD. Future research should follow up the long-term effect of the program in order to evaluate the sustainability at the 3rd, 6th, and 12th month intervals. Moreover, there should be a study related to the development of the COPD management program in applications which can be installed on a smartphone. In addition, there should be a study to test the effectiveness and feasibility of this application.

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