Original Article

JHSMR Journal of Health Science and Medical Research

Effects of a Health Educational Intervention on Knowledge and Self-Management Skills in Patients with Chronic Obstructive Pulmonary Disease: A Randomized Controlled Trial

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Received 15 October 2025 ● Revised 22 December 2025 ● Accepted 16 January 2026 ● Published online 10 September 2026

Abstract:

Objective: The study evaluated the effectiveness of a health education intervention program on disease knowledge and self-management skills in patients with COPD.

Material and Methods: A randomized controlled trial was conducted with 90 COPD outpatients. The intervention included two in-person education sessions at the outpatient clinic and three months of weekly group phone calls at home. Disease knowledge was measured using the COPD-Q, and self-management skills were assessed with standardized checklists. Paired t-tests and McNemar's tests were used to evaluate within- and between-group differences.

Results: At baseline, there were no significant differences between the groups in demographics, knowledge, or self-management skills. After three months, the intervention group showed a significant increase in knowledge scores (from 9.31±2.44 to 12.51±0.69, p-value<0.001; EI=180.9), while the control group showed only a modest increase (from 10.02±2.31 to 10.44±2.10, p-value=0.03). Correct inhaler use improved from 48.9% to 91.1% in the intervention group compared with 37.8% to 48.9% in the control group (p-value<0.001; EI=86.3). Adherence to breathing exercises increased from 60.0% to 91.1% in the intervention group versus 66.7% to 68.9% in the control group (p-value<0.01; EI=52.0).

Conclusion: Educational intervention programs carried out by nurses improved patients' knowledge and skills in using inhalers and performing breathing exercises. Therefore, nurses need to expand the program so that more patients can access this service in the future.

Keywords: chronic obstructive pulmonary disease, knowledge, patient care management, self-management

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J Health Sci Med Res
doi: 10.31584/jhsmr.20261416
www.jhsmr.org

Introduction

COPD was the third leading cause of death in 2019 worldwide, of which more than 80% occurred in low- and middle-income countries[1]. In addition to increased morbidity and mortality, COPD causes a significant socioeconomic burden in these countries due to its impact on work productivity[2,3]. Specifically, among chronic diseases, COPD is one of the diseases with the most expensive treatment costs, estimated at $49 billion in 2020, and medical costs related to COPD increase as the severity of the disease stage; accordingly, people with severe COPD often have to pay nearly 3 times more the annual costs than people with mild stage (with 18,070 USD versus 5945 USD, respectively)[4].

The consequences of COPD extend beyond direct health outcomes. Patients often experience persistent symptoms, such as dyspnea, cough, and fatigue, which lead to limitations in daily activities, reduced functional capacity, and frequent exacerbations. These not only impair physical and psychological well-being but also increase healthcare utilization and place a heavy burden on families and health systems[2,3].

Previous studies have examined interventions to support COPD patients, but many have focused on either medication adherence or respiratory rehabilitation programs, often addressing these aspects separately[5-7]. Few studies have combined strategies to simultaneously enhance both disease knowledge and self-management skills, such as correct inhaler use and breathing exercises, particularly in Vietnam. Furthermore, interventions adapted to local cultural contexts and delivered by nurses in outpatient settings remain underexplored.

In response to these gaps, we conducted a randomized controlled trial to evaluate the effectiveness of a nurse-led educational intervention based on the Theory of Planned Behavior. The program aimed to improve COPD patients' knowledge of the disease, as well as their practical skills in inhaler use and breathing exercises. By addressing these essential self-management components, our study provides evidence to support scalable, culturally relevant interventions for COPD care in Vietnam.

Theoretical background

Theory of Planned Behavior (TPB) is a model in the field of psychology and behavioral science that was developed by Ajzen to explain human behavior under "voluntary" control. Accordingly, the author relied on the assumption that action intention is the most immediate, direct determinant of behavior, and all other factors indirectly influence behavior through behavioral intention. The theory also holds that humans are rational and will make predictable decisions under clearly defined circumstances[8].

The Theory of Planned Behavior model contains 5 main constructs, including an individual's attitude toward a behavior, subjective norm, perceived behavioral control, intention, and behavior. Specifically, the attitude toward the act construct records an individual's feelings (positive or negative) about the desire to perform the behavior, and this attitude depends on the expected value and beliefs about the effects of behavioral outcomes. The construct of perceived social norms is related to the individual's perception of how other people (family and friends) feel when the individual performs that behavior, and this is influenced by the individual's beliefs about social norms. The third construct is perceived behavioral control, which refers to the perception of the ease or difficulty of performing the behavior, representing the individual's perception of whether he or she has the ability and enough resources to perform the behavior. The ability to control behavior is influenced by the perception of ability in each individual. The fourth construct is the intention, which is considered an indication of an individual's readiness to perform a certain

behavior based on attitudes toward the behavior, subjective norms, and ability to control the behavior, with each predictor weighted according to its importance regarding the behavior of interest. Finally, behavioral content captures an individual's actions in each situation toward a given goal[8]. This theory has been applied in several intervention studies, such as Sanlturk and Ayaz-Akaya (2021) on asthma patients[9], and Javaran et al. (2020) on patients with hypertension[10]. Both studies demonstrated significant improvements in skills and treatment adherence among patients with chronic diseases. Based on this evidence, the present study evaluated the effectiveness of a nurse-led educational intervention, grounded in the Theory of Planned Behavior, in improving disease knowledge and self-management skills, including correct inhaler use and breathing exercises, among patients with COPD.

Material and Methods

Study design

This randomized controlled trial was conducted from March to December 2022 with 90 participants recruited from the respiratory outpatient clinics of C-Da Nang Hospital and Da Nang Lung Hospital, Vietnam. The trial was registered in the Thai Clinical Trials Registry (TCTR20240526001) and reported in accordance with the CONSORT guidelines (https://www.consort-statement.org/).

Participants

Selection criteria included patients who were treated with inhaled medications at home in the stable phase and did not have an exacerbation requiring hospitalization for at least three months; could speak, read, and understand Vietnamese; owned and used a mobile phone frequently; and voluntarily agreed to participate in the study.

Participants were excluded if they had a history of bronchial asthma, allergic rhinitis, lung surgery, or other respiratory diseases; were experiencing a COPD exacerbation or exacerbation of co-morbidities in the past three months, or had had a change in medication in the past three months; or had a mental disorder or other serious illness.

Sample size

The sample size was calculated using the sample size formula for comparing two proportions. Accordingly, the estimated treatment adherence rate before intervention was 50%, and the expected treatment adherence rate after the intervention was 85%, with values of α=0.05 and β=0.1. Additionally, the attrition rate may be as high as 30%, with study subjects being absent and/or not cooperating for the entire 3 months. It was estimated that each group required 45 participants.

Sampling and data collection

The study was conducted as a cluster-randomized trial, with entire hospitals assigned to either the intervention or control condition. Specifically, three hospitals were numbered (01: C-Da Nang Hospital, 02: Da Nang Hospital, 03: Da Nang Lung Hospital), and two hospitals were randomly selected: C-Da Nang Hospital as the intervention site and Da Nang Lung Hospital as the control site.

Within the selected hospitals, eligible patients were considered for recruitment. In the intervention hospital, 140 outpatients were initially invited, from whom 45 participants were randomly selected using computer-generated random numbers in Microsoft Excel. In the control hospital, 150 outpatients were numbered, and 45 participants were randomly selected in the same manner. If a selected patient declined participation, another patient was randomly chosen until the required sample size was reached. Stratified randomization based on key variables, including age, gender, treatment adherence, disease severity, and degree

of airway obstruction, was applied within each hospital to ensure balance. Outcome assessors were blinded to group allocation throughout data collection and analysis.

After hospital discharge, four trained research support staff contacted all the eligible patients by telephone, explained the study purpose, procedures, potential benefits, and voluntary nature, and obtained written informed consent from those who agreed to participate. All the invited patients and their responses were documented in a secure electronic database with restricted access.

Study tools

The study used a questionnaire with 3 parts. Part 1 was a participant's demographic characteristics, developed based on the existing literature, and included seven items: age, gender, education level, employment status, smoking status, and the number of years of illness.

Part 2 was for assessing COPD patients' knowledge. This content was assessed by the Chronic Obstructive Pulmonary Disease Knowledge Questionnaire (COPD-Q) scale that was developed by Maples et al[11]. The COPD-Q includes 13 questions, of which there are 8 correct and 5 incorrect items. Each correct response was scored as 1 point, while incorrect or "I don't know" responses were scored as 0 points. The total score for the entire scale is from 0 to 13 points; accordingly, participants are considered to have knowledge when the patient achieves 10 points or more, and a total score of less than 10 points is considered deficient in knowledge about the disease[11]. This set of questions has been authorized by the author Maples to be used and translated from English to Vietnamese. After that, the research team conducted a validation and reliability test of the Vietnamese version of the questionnaire on 90 people with COPD. The test result showed that the Vietnamese version of the COPD questionnaire - Q had good content and high internal consistency. Specifically, the KR20 with pre- and post-test was 0.883 and 0.866, respectively, and the test-retest reliability at 4 weeks (r=0.996, p-value=0.000)[12].

Part 3 was for assessing the practical skills of COPD patients. Based on Decision 4562/QD-BYT promulgating the guidance on diagnosis and treatment of COPD from the Ministry of Health of Vietnam, 2018, for measuring the practical skills of patients, it includes two specific constructs: the practice of using inhaled drugs and the practice of breathing exercises[13]. Accordingly, the checklist for assessing the practice of using inhaled drugs will assess the patient's ability to use a metered-dose inhaler (6 steps), dry powder inhaler (6 steps), and Turbuhaler (6 steps). For each step performed correctly, the patient will receive 2 points; if performed incorrectly, the patient will receive 1 point, and 0 points if the patient does not perform it. According to the results of some previous studies, a patient's practice level is classified as passed when they do all the steps correctly and failed when they make at least 1 mistake, or do not perform all the steps[5,9]. The next construct is to evaluate the practice of breathing exercises recommended by the Global Initiative on COPD[14]. Specifically, this includes observing patients practicing pursed-lip breathing (4 steps), practicing diaphragmatic breathing (4 steps), and the frequency of practicing these techniques. For each step the patient performs correctly, the patient receives 2 points; for each step performed incorrectly, the patient receives 1 point, and for each step performed incorrectly or not performed at all, the patient receives 0 points. Some previous studies determined that patients were considered to have achieved passed when they did all the steps of the two breathing exercises correctly and performed the breathing exercises 1 time or more per day for 10-15 minutes each time, while they failed if at least 1 step was completed wrong, or they did not perform any step in either of the breathing exercises, and did not maintain daily practice[15].

Intervention

The study began with two face-to-face health education sessions for participants in the intervention group at the hospital's outpatient clinic. During the first meeting, 60 to 90 minutes, the patient was provided with knowledge about the disease, practical skills for using inhaled medications, and instructions on breathing exercises. The next meeting was conducted a week later with the same content and focused on answering participants' questions, listening to their problems, and correcting mistakes. In addition, upon completion, each patient was given and instructed to keep a medication and breathing exercise diary. The diary was collected at the end of the intervention and served as a basis for evaluating participants' practice (Table 1). The acceptability, appropriateness, and feasibility from both healthcare managers and practicing nurses were high (mean=4.31±0.11) and (mean=4.37±0.12), respectively[16].

The online home-monitoring process was conducted immediately after hospital discharge and lasted for three months. Once a week, from 8 to 9 a.m. on Wednesday, the research team divided patients into nine groups (five patients per group) and organized group phone calls via the Zalo application. Each call lasted approximately 3–5 minutes and never exceeded 10 minutes. Patients who did not join the scheduled group call were contacted individually by phone up to three times, at five-minute intervals, to maximize participation. Participants were instructed not to disclose or share call content with others. During these calls, each participant self-reported their medication use, any side effects, adherence to breathing exercises, symptoms experienced during therapy, number of weekly episodes of dyspnea, and sputum quantity and color. The research team also provided tailored health information, including strategies for managing dyspnea, reminders to practice breathing exercises, advice on smoking cessation, demonstrations of inhalation with the Sopiroball device, coughing techniques, and reminders to record daily observations in a patient diary.

Table 1 Outline of educational intervention program topics

Topics and components in the theory	Intervention contents
Topic 1: Focus on improving knowledge about COPD **Theoretical component:** Attitude towards behavior and subjective norm	– Determine the patient's level of knowledge – Determine the patient's attitude in receiving knowledge related to the disease – Determine the level of knowledge the person needs to receive support from the nurse – Analyze for patients to understand the benefits of understanding the disease in disease prevention and control.
Topic 2: Guidance on self-management methods **Theoretical component:** Perceived behavioral control	– Discuss self-management measures – Discuss the advantages and disadvantages of not practicing self-management behaviors – Determine the ability to self-implement the self-management disease methods – Discuss the difficulties of the patient when self-administering the self-management disease methods
Topic 3: – Increase the rate of correct practice of using inhaled medication – Guidelines for the COPD self-management action plan **Theory component:** Improved behavior	– Determine the perceived level of control over the use of inhaled medications – Instructing participants to strictly follow the standard steps in drug use – Encourage the participants to do the right thing, emphasizing the steps to perform the inhaler technique, avoiding mistakes they often make or miss, and increasing the level of behavioral control as much as possible – Provide video instructions on how to use inhaled medicine for patients to watch when needed – Guild patients writing medical consumption diary – Encourage patients to make their own action plan to adhere to treatment

COPD=chronic obstructive pulmonary disease

In addition, face-to-face meetings were conducted monthly for three consecutive months during routine outpatient visits. These sessions allowed researchers to address patients' difficulties and directly evaluate performance (Figure 1).

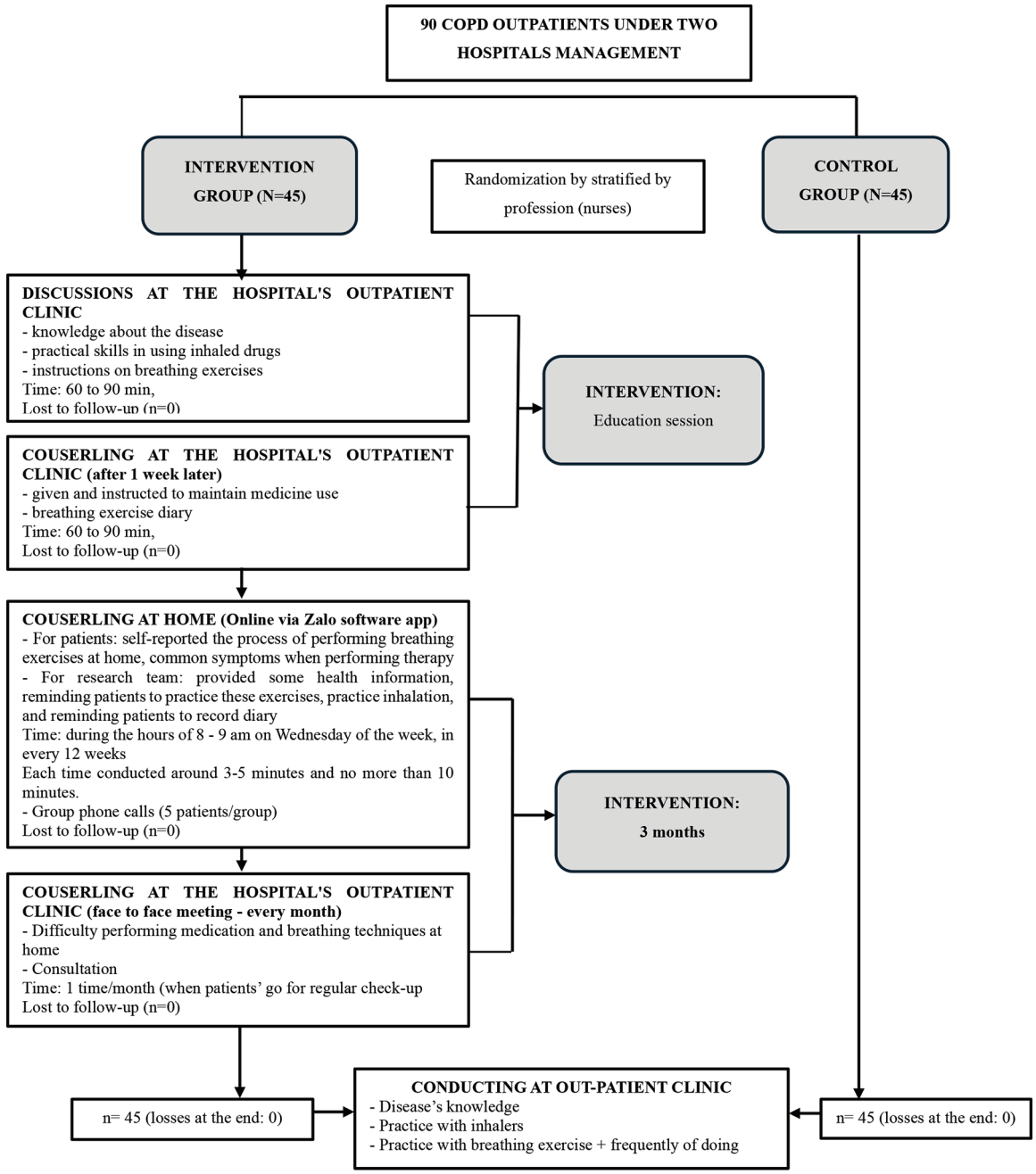

Figure 1 Study flow chart

To minimize missing data, participants were reminded regularly by phone, and data were cross-checked with patient diaries and monthly face-to-face assessments. If data from weekly calls were incomplete, the research team verified the information at the next scheduled contact. Cases with repeatedly missing or incomplete reports were documented and analyzed using the available data, with sensitivity analyses conducted to ensure the robustness of findings.

Control group (applying usual care)

Participants in the control group received the usual care provided at the outpatient clinic. This included routine medical consultations, prescription of inhaled medications as indicated, and standard advice on COPD management. No structured educational sessions, home-monitoring calls, or diaries were provided. Patients were free to seek additional information or guidance from healthcare staff as per standard practice, but no organized follow-up or reinforcement of inhaler technique and breathing exercises was offered. This standard care served as a reference to evaluate the incremental effect of the structured nurse-led educational and home-monitoring intervention.

Data analysis

The Statistical Package for Social Sciences (SPSS, version 23.0) was used for the data analysis process. Continuous variables were calculated as means and variance, and the t-test statistical technique was applied to compare the two research variables. Categorical and hierarchical variables were calculated as percentages, while the Chi-Square statistical technique was used to compare two variables. The Paired-Samples T-Test was used for comparison of the difference between variables before and after the intervention. A comparison of percentage differences in variables before and after intervention was performed using McNemar's test, and the difference was statistically significant with a p-value<0.05. Additionally, the efficiency index (EI) was calculated by a formula (with *P1*- ratio of value before intervention; and *P2* - ratio of value after intervention):

$$EI = \frac{|p2 - p1|}{p1} 100\%$$

Results

Participant's characteristics

No patient dropped out during the 3-month intervention, with a total of 90 patients divided equally between the two groups. The intervention carried out 12 group calls with 100% patient participation. All participants were reexamined once a month. Additionally, when the intervention program ended, 100% of the subjects in our study were satisfied with the content, methods, and organization of communication.

At baseline, there were no significant differences between groups in terms of gender, education level, employment status, smoking status, and years of illness, according to the Chi-square test (p-value>0.05; Table 2). Furthermore, the Mann-Whitney U test showed that the intervention and control groups did not differ significantly in mean age (64.11 vs. 61.24; p-value=0.2).

Change in the patient's disease knowledge before and after the intervention

Before the intervention, only 35.6% of participants in the intervention group had disease knowledge, while for the control group accounted for 48.9%. After 3 months, 100% of participants in the intervention group had disease knowledge. In general, the level of change in knowledge after the intervention increased in both the intervention group and the control group, but the increase in the intervention group was nearly 9 times higher than that of the control group (EI=180.9; p-value=0.000) (Table 3).

Furthermore, after the intervention, 100% of participants knew the importance of getting a flu vaccine, quitting smoking, believed that COPD could be cured, and that they only needed to use an inhaler when they had difficulty breathing, while this rate at the beginning ranged from 66.7 to 73.3% (Table 4).

Changing the practice of participants before and after the intervention

The practice of using inhaled drugs

Before the intervention, the rate of use of inhaled drugs with a passing score was quite low (48.9%); after 3 months of intervention, the rate increased to a high ratio, with 91.1%. The results also showed that the level of change in inhaled drug use after the intervention increased, and was four times higher than in the control group (EI=86.3). The difference between before and after the intervention between the control and intervention groups was statistically significant (p-value<0.05) (Table 5).

In addition, evaluating the technique of using pMDI and Turbuhaler showed that, at the beginning, the intervention group had 38 patients using the pMDI metered dose inhaler, while the control group had 14 patients, and no one performed all 6 steps correctly. After 3 months, 38 participants of the intervention group used pMDI, and the rate of them doing all the steps correctly was 93.3%; while none of the 14 control participants practiced 6/6 steps correctly. The difference in the rate of performing all the steps correctly between both groups was significant (p-value<0.000) (Figure 2). In addition, the intervention group had 7 patients and the control group had 31 patients using the Turbuhaler before the intervention, with no one doing all 6 steps correctly. After 3 months, the rate of the 7 participants in the intervention group who did all the steps correctly of the Turbuhaler was 95.6%; while in the control group, 31 participants were using this inhaler, but no one did 6/6 steps correctly. The difference in the rate between groups was p-value<0.001 (Figure 2).

Table 2 Participant's characteristics

Group characteristics		Intervention (n=45) N, %	Control (n=45) N, %	p-value
Age		Mean; S.D.=64.11±6.48	Mean; S.D.=61.24±9.33	0.20
Gender	Male	34 (75.6)	37 (82.2)	0.44
	Female	11 (24.4)	8 (17.8)	
Education level	High school or under	6 (13.3)	5 (11.1)	0.75
	University	39 (86.7)	40 (88.9)	
Employment status	Worker	6 (13.3)	4 (8.9)	0.08
	Civil servant	3 (6.7)	17 (37.8)	
	Free business	27 (60.0)	19 (42.2)	
	Retired	9 (20.0)	5 (11.1)	
Smoking status	No	22 (48.9)	21 (46.7)	0.83
	Yes	23 (51.1)	24 (53.3)	
Number of years of illness	≤5 years	8 (17.8)	14 (31.1)	0.13
	5 to 10 years	12 (26.7)	12 (26.7)	
	>10 years	25 (55.6)	19 (42.2)	
Treatment adherence	Adherent	15 (33.3)	16 (35.6)	0.82
	Non-adherent	30 (66.7)	29 (64.4)	

S.D.=standard deviation

The practice of breathing exercise

Table 5 shows that before the intervention, the rate of practicing breathing exercise therapy in both groups was above average (60%). After the intervention, the rate of practicing breathing exercise therapy in the intervention group increased more significantly than in the control group, with 91.1% vs 68.9%. The level of change in practice of breathing exercises after the intervention increased 16 times (EI=52.0) higher than in the control group, while the difference between before and after the intervention, between the control and intervention groups was statistically significant (p-value<0.05).

Moreover, 48.9% of patients in the intervention group did not practice breathing exercises during the day at the beginning. After 3 months, 15.6% practiced breathing exercises more than 5 times/day, EI=132.8. The level of change in practicing breathing exercise therapy from 3 to 5 times a day after intervention increased 706 times higher than in the control group, while the difference between before and after the intervention, between the control and the intervention group was statistically significant (p-value<0.05).

Table 3 Changing knowledge of participants before and after the intervention

Group outcomes	Control			Intervention (n=45)			
	Pretest (n=45) N (%)	Posttest (n=45) N (%)	EI (%)	Pretest (n=45) N (%)	Posttest (n=45) N (%)	EI (%)	p-value
Knowledgeable	22 (48.9)	28 (62.2)	27.2	16 (35.6)	45 (100)	180.9	
Lack of knowledge	23 (51.1)	17 (37.8)	-	29 (64.4)	0	-	0.000
p-value	0.03			0.000			

EI=efficiency index

Table 4 Disease knowledge of the intervention group before and after the intervention

No.	Contents	Intervention group	
		Before (%)	After (%)
1	Pneumonia vaccination is recommended.	75.6	91.1
2	Using Oxygen at home can help you live longer	84.4	93.3
3	Medicines prevent the disease from getting worse	62.2	97.8
4	COPD is a preventable disease	77.8	95.6
5	Stop inhaled medication when symptoms improve	46.7	86.7
6	Coughing is a common symptom and will not go away	77.8	93.3
7	Stopping smoking will prevent the disease from getting worse	66.7	100
8	Smoking or cigarette smoke is the main cause	75.6	95.6
9	Shortness of breath is a symptom	82.2	97.8
10	Inhaled medications can be used at any time	68.9	97.8
11	You should get a flu shot every year.	73.3	100
12	Inhaled medications should only be used when breathing is difficult	73.3	100
13	COPD can be cured	68.9	100

Table 5 Changing the practical skills of participants before and after the intervention

Group outcomes	Control (n=45)			Intervention (n=45) N (%)			
	Pretest (n=45) N (%)	Posttest (n=45) N (%)	EI (%)	Pretest (n=45) N (%)	Posttest (n=45) N (%)	EI (%)	p-value
Practice of using inhaled drugs							
Passed	17 (37.8)	22 (48.9)	29.4	23 (48.9)	41 (91.1)	86.3	0.000
Failed	28 (62.2)	23 (51.1)	–	22 (51.1)	4 (8.9)		
p-value	0.25			0.000			
Practice of breathing exercises							
Passed	30 (66.7)	31 (68.9)	3.3	27 (60)	41 (91.1)	52	0.008
Failed	15 (33.3)	14 (31.1)	–	18 (40)	4 (8.9)		
p-value	0.09			0.000			
Frequency of practicing breathing exercises							
>5 times	0	0	0	3 (6.7)	7 (15.6)	132.8	0.000
3–5 times	7 (15.6)	1 (2.2)	–	2 (4.4)	16 (35.6)	706	
1–3 times	19 (42.2)	22 (48.9)	15.8	18 (40)	11 (24.4)	–	
Never	19 (42.2)	22 (48.9)	15.8	22 (48.9)	11 (24.4)	–	
p-value	0.48			0.000			

EI=efficiency index

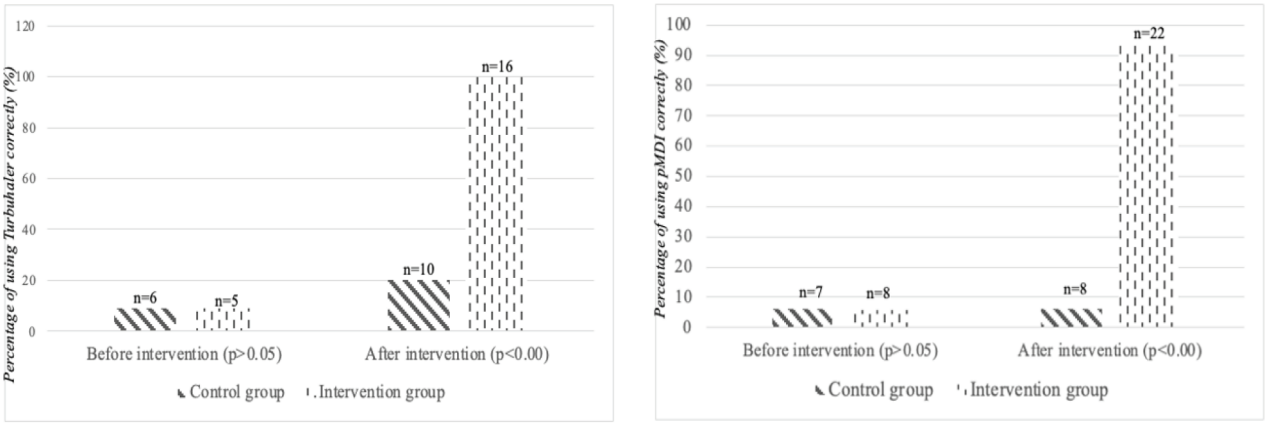

Figure 2 Use inhaler drugs correctly

Discussion

In our study, after the intervention, COPD knowledge in the intervention group increased to 100% compared to 35.6% before the intervention (p-value=0.000), and it was higher than in the control group. Compared with previous studies, our study has similarities in research results[17,18]. This result shows that the direct educational intervention for patients at the outpatient clinic has contributed to improving patient knowledge about the disease, together with the participation of family members in the counseling session, partly enhancing family support for patients in the care process, while reducing the dependence on medical staff who could be more proactive in practicing healthcare. For chronic diseases that require long-term treatment, this is also an important benefit because it helps strengthen the patient's self-care capacity and manage their health more sustainably. Although the level of change in knowledge about the disease varies due to different intervention times, in different areas, and on different subjects, all demonstrated that the intervention's effectiveness is very positive[17,18].

The use of inhaled drugs plays an important role in the treatment of COPD because the drug is delivered directly into the airways; thus, high local concentrations can be achieved with a reduced risk of side effects. Regular use of inhalers, even when there are no symptoms of the disease, is one of the mandatory requirements for preventing and treating acute attacks[14]. Our research results on inhaled drug use after 3 months of intervention increased to 84.4% compared to 51.1% before the intervention, EI=65.2. In general, this level of change increased in both groups, but in the intervention group, the EI index increased by nearly 50%, and this increase was much higher than in the control group (p-value<0.05). In addition, at the beginning, the practice rate of using inhaled drugs was quite low (35.6%), and almost all patients were not proficient in the important steps when using pMDI and Turbuhaler. This can be explained by the fact that from 2020 to the time of the study, the COVID-19 epidemic was complicated, so most COPD patients had to be transferred to commune health stations, interrupting health consultations for patients. By 2023, although hospitals reopened for people with COPD, fear of the epidemic made a large number of patients hesitant to attend regular check-ups. Furthermore, health consultationshad not yet been reimplemented[19].

For practice using inhalers, the rate of practice in the intervention group increased significantly (91.1%). Specifically, the rate of correct use of the 6/6 steps for pMDI was 100%; for Turbuhaler, it was 76%. The difference between groups was statistically significant (with p-value= 0.000). Our research results were similar to many previous studies[15,20]. More specifically, after the intervention, patients were provided with a video link instructing them how to use inhalers; they could watch it whenever they needed it, and their family members also could learn and better understand how to support them effectively, thereby reducing patients' dependence on the medical staff. In addition, the method of communication through the Zalo chat group application on smartphones could help patients update and share information related to the disease with people who have the same disease, through which they can learn about disease care, and share knowledge to motivate them to treat the disease at home with peace of mind.

When looking specifically at the type of inhalation device used, we found that most patients preferred to use the pMDI over the Turbuhaler, and errors while using the pMDI were lower than the Turbuhaler. Specifically, the rate of patients using pMDI was 28%, and Turbuhaler was 31% at the beginning, while after 3 months of intervention, the rate of patients using pMDI increased to 100%, and Turbuhaler to 76%. Regarding the technique of using the pMDI, many studies have shown that up to 60% of people with COPD inhale too quickly, and not surprisingly, these were also common errors in our research. To overcome the problem, patients participating in our study were counseled

and instructed on another supporting device to use, which is a spacer chamber. The use of a spacer has been shown to improve the effectiveness of inhalation through the MDI device, especially for patients who have difficulty using the MDI alone[14].

Regarding the practice of breathing exercises, at the beginning, nearly 50% of research participants did not practice breathing therapy, of which only 60% practiced correct breathing techniques. During the intervention program, participants were provided with knowledge about the importance of practicing breathing exercises and the need to maintain regular breathing exercises to improve respiratory function, guide the correct practice, and monitor the daily diary of the investigator through weekly group calls and monthly follow-up visits. After 3 months of the intervention, the results showed that the rate of practicing breathing exercise therapy in the intervention group increased (91.1%). EI increased 16 times (EI=52.0) and was higher than in the control group. At the same time, the practice frequency with 3-5 times/day or more than 5 times/day was also increased. Specifically, EI in the intervention group exercising more than 5 times a day increased 132 times (EI=132.8), and in the group exercising 3-5 times a day, it increased 706 times (EI=706). The difference between before and after the intervention, between the control and the intervention groups, was statistically significant (p-value<0.05). Our research results were similar to some previous studies[17,18,20] because the rehabilitation of respiratory function through practicing breathing exercise therapy is extremely necessary for people with COPD to help them improve their disease self-management capacity. Our findings reinforce these benefits and suggest that integrating breathing exercises into routine outpatient care is both feasible and effective. Importantly, the combination of regular follow-up, family involvement, and peer encouragement through Zalo groups appeared to foster patient motivation and long-term adherence.

Importantly, although our study demonstrated significant improvements in knowledge, correct inhaler use, and adherence to breathing exercises after the 3-month intervention, this relatively short follow-up period may limit the ability to determine whether these behavioral changes are sustained over the long term. COPD is a chronic condition, and maintaining self-management behaviors typically requires ongoing reinforcement and support. Therefore, future studies with longer follow-up periods are needed to assess the durability of these effects and to evaluate whether the improvements observed at 3 months translate into lasting clinical benefits.

Finally, our findings demonstrate that a nurse-led educational intervention significantly improved disease knowledge, inhaler technique, and adherence to breathing exercises among COPD outpatients. These results confirm the effectiveness of structured education in enhancing patients' self-management skills. Similar positive effects of educational programs have been documented in previous studies, which demonstrated increased adherence, reduced exacerbations, and improved overall health outcomes[17,18,20]. While the positive impact of educational interventions on patients' knowledge and skills has been well established in the literature, the originality of our study lies in the way it adapts these approaches to the Vietnamese context. By incorporating cultural and contextual elements, our intervention offers additional insights into how such programs can be tailored to resource-limited health systems. Specifically, family members were actively engaged in counseling sessions, reflecting their central role in healthcare decision-making in Vietnam. This involvement not only reinforced patients' learning but also created a supportive home environment that facilitated the adoption of self-care behaviors. In addition, the use of Zalo, a widely popular communication platform in Vietnam, for weekly follow-up calls enhanced accessibility and fostered peer support among patients. These culturally relevant

strategies differentiate our study from international research and demonstrate the feasibility of scalable nurse-led interventions in outpatient settings.

Taken together, these findings indicate that structured, culturally adapted, and nurse-led educational programs can strengthen patient empowerment and support sustainable self-management in COPD. Such strategies may be particularly relevant for low- and middle-income countries, where resource limitations demand cost-effective and scalable interventions.

Limitations

This study has several limitations. First, it was conducted shortly after the COVID-19 epidemic, and patients' apprehension about hospital visits posed challenges for recruitment and intervention sessions, although thorough counseling and safety measures ensured participants' confidence. Second, the intervention and follow-up lasted only 3 months, which may limit conclusions about long-term sustainability; future studies with longer follow-up are needed. Third, the cluster-randomized design included only two hospitals, restricting the ability to account for within-cluster correlation and potentially reflecting hospital-level characteristics rather than solely the intervention effect. Finally, while the study demonstrated improvements in knowledge and self-management skills, it did not assess clinical outcomes, quality of life, or long-term behavior change. The trial focused on the immediate effects of a nurse-led educational intervention, and future research should examine its long-term clinical impact.

Conclusion

This nurse-led educational intervention focusing on counseling and practical training proved effective in improving COPD outpatients' knowledge, inhaler technique, and practice of breathing exercises. Compared with usual care, the intervention demonstrated the feasibility and value of integrating structured educational programs into the outpatient management of COPD. These findings underscore the critical role of nurses in empowering patients for better self-management and highlight the potential for scaling such culturally adapted interventions in resource-limited settings. Future studies with longer follow-up and validated quality-of-life instruments are recommended to examine whether these improvements translate into broader health and quality-of-life benefits.

Authors' contribution

Conceptualization: Nguyen Thi Thu Trieu.

Data curation, Formal Analysis, Validation, and Writing – original draft: Nguyen Thi Yen Hoai, Nguyen Thi Thu Trieu, Phan Thi An Dung.

Writing – review & editing: Nguyen Thi Yen Hoai, Nguyen Thi Thu Trieu, Phan Thi An Dung.

Ethical considerations

The study was approved by the Protocol Approval Council and the Medical Ethics Council of Nam Dinh University of Nursing, Decision No. 1681/GCN-HDDD dated August 2, 2021. All research participants were provided a detailed explanation regarding the purpose of the study. All agreed to voluntarily participate. Participants were informed that they have the right to withdraw from the study at any time when they feel uncomfortable or unable to continue, and this experiment does not involve any form of inducement or coercion. Also, the study does not carry risks that would require any kind of compensation. After completing the intervention study, all participants in the control group were given a health consultation session and distributed the same content as that in the intervention group.

Acknowledgement

We would like to express our sincere thanks to the study participants for their enthusiastic cooperation. This study is part of a doctoral thesis: to study the status and effectiveness of interventions to improve treatment adherence in patients with COPD at medical facilities in Da Nang City.

Conflict of interest

There are no conflicts of interest in this study.

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