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Decreasing degrees of dyspnea in chronic obstructive pulmonary disease patients through combination of breathing exercises and relaxation

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ABSTRACT Shortness of breath (dyspnea) is a common symptom that accompanies patients with Chronic Obstructive Pulmonary Disease (COPD). Management of dyspnea in patients with COPD is not only using pharmacological therapy but also non-pharmacological therapy. Non-pharmacological therapy for patients with COPD covers three main aspects: breath, mind, and functional processing. Along with the development of complementary therapy in nursing science, nursing interventions that can be done at home begin to be in great demand because of their low cost and time effectiveness. One of the interventions is providing breathing exercises and relaxation for patients with COPD to reduce the dyspnea complaints, increase the strength of breathing muscles and prevent the hospital re-admission due to acute exacerbation. This study aimed to see the effectiveness of the combination of Pursed Lip Breathing (PLB) and Progressive Muscle Relaxation (PMR) on the degree of dyspnea. This quasi-experimental study was conducted with a pre and post-test design approach with 20 respondents in each group. The results showed significant differences in the degree of dyspnea after the combination of PLB and PMR ($p < 0.05$). The results from this study recommend improving the development of complementary therapy programs in nursing education and services by modifying nursing care standards with the combinations of PLB and PMR for patients with COPD.

1. Introduction

Chronic Obstructive Pulmonary Disease (COPD) contributes significantly to high morbidity and mortality rates. It represents about 6% of all causes of death worldwide, leading to the deaths of 3 million people every year.[1] In 2015, there were an estimated 3.17 million patients worldwide, with COPD making up 5% of them. This trend made COPD the fifth most prevalent disease in the world by 2020.[2,3]

Almost 90% of COPD deaths occur in Lower-Middle-Income Countries (LMICs), with Indonesia being one of the countries included in the category of high risk.[4-6] Socio-economic conditions are the main determinants in determining health status. Thus, there is a strong relationship between socio-economic conditions and the prevalence of COPD, with high rates of morbidity and mortality in LMICs.[7]

COPD has bio-psycho-social-spiritual impacts on sufferers. The main problem that patients with COPD always complain about is shortness of breath or dyspnea, which is commonly encountered in patients with lung disease.[8] Dyspnea was reported by nearly all (98%) of 833 patients with COPD in a web-based survey conducted in 17 countries. The degree of dyspnea in patients with COPD has a significant correlation with survival rates over the next 5 years.[9] The severity of dyspnea also deteriorates as COPD

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worsens, which contributes to the patient's quality of life.[10]

Managing dyspnea in patients with COPD uses not only pharmacological therapy, but also non-pharmacological therapy. There are three main aspects of non-pharmacological therapy for patients with COPD: breath, mind, and functional treatment. These three factors are beneficial in enhancing COPD patients' quality of life.[11,12] Pursed Lip Breathing (PLB) is one type of breathing exercise that can be used to reduce the symptoms of shortness of breath in patients with COPD. Relaxation techniques are another non-pharmacological treatment option for patients with COPD. Mind-body therapy is used in this technique, which targets the sympathetic and parasympathetic nervous systems. Progressive Muscle Relaxation (PMR), diaphragmatic breathing, attention-focusing exercises, and behavioral relaxation training are the four major types of relaxation.[13]

Along with the development of complementary therapy in nursing science, nursing interventions that can be done at home begin to be in great demand because of the low cost and time effectiveness. One of the interventions is providing breathing exercises and relaxation for patients with COPD to reduce the dyspnea complaints, increase the strength of breathing muscles and prevent the hospital re-admission due to acute exacerbation. This study aimed to see the effectiveness of the combination of PLB and PMR on the degree of dyspnea.[2]

2. Method

2.1 Design and participants

This quasi-experimental study was conducted in two major public hospitals in Jakarta and Bandung, from July 2019 to November 2019. A total of 40 respondents diagnosed with COPD grades I-II were chosen using consecutive sampling techniques and assigned into two intervention groups. The researchers included respondents from Bandung in the first group, and respondents from Jakarta in the second group. The approach split up the groups based on the situation and conditions in the field where the research approval from the hospital in Jakarta was given, and the procedure in the Bandung hospital was done on more than half of the target respondents.

Before beginning the study, all participants were given a thorough explanation of the technical implementation of the research, as well as the potential benefits and drawbacks they might encounter. Participants who agreed to participate in the study signed an informed consent form following the explanation. The Faculty of Nursing Universitas Indonesia and both hospitals provided ethical approval for the study.

2.2. Measures

The Modified Medical Research Council (mMRC) Dyspnea Scale was used in this study to assess pre- and post-intervention dyspnea. The mMRC Dyspnea Scale is a 5-point (0 – 4) scale based on the severity of dyspnea. For seven days, the group I was given a combination of PLB and PMR for ten minutes twice a day. Similarly, for seven days, group II received PLB for ten minutes twice a day. The severity of dyspnea was assessed before and after the intervention.

2.3. Data collection

Medical records were used to collect the patient's gender, age, length of suffering COPD, smoking habits, previous history of exposure to substance irritant, lung infection, and using pulmonary drugs, nutritional, and socio-economic status. Before beginning the study, the researchers explained the objectives and methods. All participants were fully included in the study with personal consent, were free to leave at any time, and the data collected were kept confidential, so the participants' names were not listed in the results.

2.4. Intervention

The researchers assessed the respondent's degree of dyspnea at the first meeting using the mMRC instrument Questionnaire Dyspnea Scale. Respondents and their families were given educational leaflets and explanation sheets of the self-report exercises by the researcher. The researchers demonstrated the exercises to the respondents using a video tool. Furthermore, the researchers assessed

Table 1. Correlation between respondents' characteristics and degree of dyspnea

	Variable	Group 1					Group 2				
		Degree of dyspnea		Total		p-value	Degree of dyspnea		Total		p-value
		Severe	Mild	n	Total		Severe	Mild	n	Total	
1	**Sex**										
	Male	2	16	18	90		8	8	16	80	
	Female	0	2	2	10	1.000	1	3	4	20	0.91
	Total	2	8	20	100		9	11	20	100	
2	**Smoking habits**										
	Smoking	2	16	18	90		7	9	16	80	
	Never	0	2	2	10	1.000	2	2	4	20	1.000
	Total	2	18	20	100		9	11	20	100	
3	**History of exposure to substance irritants/pollutants**										
	Ever	2	15	17	85		8	2	10	50	
	Never	0	3	3	15	1.000	1	9	10	50	0.005
	Total	2	18	20	100		9	11	20	100	
4	**History of lung infection**										
	Ever	2	11	13	65		7	9	16	80	
	Never	0	7	7	35	0.521	2	2	4	20	1.000
	Total	2	18	20	100		9	11	20	100	
5	**Comorbidities**										
	Yes	1	11	12	60		3	3	6	30	
	None	1	7	8	40	1.000	6	8	14	70	1.000
	Total	2	18	20	100		9	11	20	100	
6	**Use of pharmacological therapy**										
	Use	1	10	11	55		7	3	10	50	
	Not use	1	8	9	45	1.000	2	8	10	50	0.70
	Total	2	18	20	100		9	11	20	100	
7	**Nutritional status**										
	Poor	2	10	12	60		6	3	9	45	
	Good	0	8	8	40	0.495	3	8	11	55	0.175
	Total	2	18	20	100		9	11	20	100	
8	**Socio-economic status**										
	Low	2	16	18	90		9	9	18	90	
	High	0	2	2	10	1.000	0	2	2	10	0.479
	Total	2	18	20	100		9	11	20	100	

Fisher's Exact Test, significant p > 0.05.

the respondent's psychomotor abilities by having the respondent independently perform the exercises. As a guide for the respondents when doing the exercise, the researchers/research assistants distributed a soft copy of the video of the stages of the exercise to the respondent and the accompanying family. During the study period, the researchers/research assistants attempted to ensure that there were no other interventions involving the respondents.

For seven days, the exercises were performed for 10 minutes, twice a day (morning and evening) before the participants ate. From the second to the seventh meeting, the respondents were accompanied by the researchers and a family member or caregiver while performing the exercise procedure. Following the exercise procedure, the respondents completed a self-reporting form as evaluation material. On the last day of the study, this self-reporting form was returned to the researchers.

Table 2. Degree of dyspnea before and after intervention

Degree of dyspnea	Group 1				p-value	Group 2				p-value
	Before		After			Before		After		
	n	%	n	%		n	%	n	%	
Severe	15	75	2	10		10	50	9	45	
Mild	5	25	18	90	0.000	10	50	11	55	1.000
Total	20	100	20	100		20	100	20	100	

Mc Nemar Test, significant p > 0.05.

Table 3. Difference in degree of dyspnea after intervention

Degree of dyspnea	Group 1		Group 2		p-value
	n	%	n	%	
Severe	2	10	9	45	
Mild	18	90	11	55	0.034
Total	20	100	20	100	

Chi-square test, significant $p > 0.05$.

If the respondent was allowed to leave the hospital before completing the 7-day intervention, one of the researchers made a home visit in the morning or evening, as agreed upon with the respondent, to aid and evaluate the implementation. If the researcher made a home visit in the morning, the researcher performed follow-up care in the afternoon by contacting the respondent or family via telephone or video call to ensure that the respondent had independently performed the exercises. After seven days of exercise, the researcher used the mMRC Dyspnea Scale to assess the degree of dyspnea.

2.5. Statistical analysis

The data were analyzed using SPSS version 22.0 software (IBM Corp., Armonk, NY), as well as descriptive and inferential statistical methods. The association between confounding variables and degree of dyspnea were confirmed by the Fisher's exact test and independent *t*-test. Furthermore, the statistical significance level was set at $p < 0.05$.

3. Result

As many as 85% of the respondents in this study were male; 85% of respondents are active smokers and ex-smokers; 82.5% of respondents are frequently exposed to irritants/pollutants; 57.5% of COPD respondents had a lung infection; 55% of COPD respondents had no comorbid disease; 52.5% of COPD respondents used pharmacological therapy to treat complaints of shortness of breath; 52.5% of respondents fall into the category of poor nutrition, and 90% of respondents have low income. The overall mean age of the patients was 55.55 ± 14.254 years and the mean length of suffering COPD was 2.53 ± 2.195 years.

Tables 1-3 show the bivariate analysis between the respondents' characteristic and the degree of dyspnea. Further analysis showed that most of the respondents' characteristics did not have a significant relationship with the degree of dyspnea ($p > 0.05$); except history of exposure to irritants/pollutants in the group II ($p < 0.05$).

The differences in dyspnea severity between the two intervention groups are shown in Tables 2–3. Further investigation revealed a significant difference in the degree of dyspnea in patients with COPD before and after a combination of PLB and PMR ($p < 0.05$; Table 2). In this study, however, there was no significant difference in the degree of dyspnea before and after PLB ($p < 0.05$; Table 2). The degree of dyspnea after exercise differed significantly

between the two groups, according to the results of the analysis ($p < 0.05$; Table 3).

4. Discussion

The combination of physical exercises in the form of breathing and relaxation significantly improves the patient's ability to regulate breathing patterns, which helps to reduce the severity of dyspnea. There was a significant difference in dyspnea severity between the group that received only PLB training and the group that received both PLB and PMR. The results of this study support the hypothesis that the combination of PLB and PMR has a differential effect on the severity of dyspnea in patients with COPD. In addition, the combination of PLB and PMR administered to COPD patients significantly altered their dyspnea levels.

Men and women have different phenotypes in response to cigarette smoke exposure. Males are more resistant to the emphysematous phenotype, whereas females are more vulnerable to the airway phenotype. The differences in sexual responses to disease are thought to be caused by the body's immune response based on sexual dimorphism. As a result, it is recognizable why men and women respond differently to illness.[14] Patients with COPD in this study included not only elderly people but also young adults. The youngest respondent who was diagnosed with COPD in this study was 20 years old and had a history of smoking since the age of seven. Smoking at a young age has caused a shift in this phenomenon.

This study did not find a significant relationship between duration of COPD and degree of dyspnea. The patients have not felt the severity of respiratory symptoms due to decreased lung function in COPD degree I. The clinical diagnosis of chronic bronchitis, which is one of the clinical features of COPD, is established if the patient has had a cough for at least 3 months in 2 consecutive years.[8] However, in the elderly who experience symptoms of chronic cough and often come for treatment at health facilities, it is often not detected that they have COPD.[15] This causes differences in the length of time experiencing COPD in published studies.

As many as 42% of patients reported having COPD for 2-5 years or more. The length of time a patient suffers from COPD is directly proportional to the degree of obstruction suffered; thus, the longer the patient suffers from COPD, the worse the patient's quality of life will be.[16] Exacerbations of COPD, on the other hand, have the potential to worsen the patient's quality of life regardless of how long the patient has had COPD.[17]

Most previous studies have found a link between smoking and COPD. As many as 90% of patients with COPD are current or former smokers.[18] The high rate of cigarette consumption in Indonesia is closely related to the ease with which tobacco products can be obtained in public places. In addition to having easy access to cigarettes, the low selling price of cigarettes allows people with low-income to purchase them.[19]

Statistically, there was no significant relationship between the history of lung infection and the degree of dyspnea in this study. In 2019, GOLD reported that bacterial infections cause more than half of all COPD exacerbations.[8] The lack of a significant relationship between a history of pulmonary infection and the degree of dyspnea in this study could be related to how the study criteria were determined. Patients with COPD with degrees of obstruction I-II, indicating early-stage COPD, were one of the inclusion criteria in this study. As a result, the impact of lung damage has been minimal.

Metabolic disease is a significant comorbidity in COPD. This high metabolic comorbidity is due to all respondents having the same cardiometabolic risk factor, namely smoking. COPD alone can increase the risk of vascular damage by two times in patients with coronary heart disease, 3.9 times in patients with heart failure, 2.4 times in patients with arrhythmia, and 1.5 times in stroke patients.[20] Comorbidities can predict mortality in patients with COPD using the COPD Specific Comorbidity Test index, but their role as predictors of acute exacerbations in COPD is still being debated.[21] In this study, 45% of the subjects had no comorbid disease. But since 40% of respondents in this study had been diagnosed with COPD for less than a year, they did not have systemic COPD side effects.

Hanania and O'Donnell found that using bronchodilators in combination with long-term-agonist receptors significantly increased dyspnea symptoms as measured by the St. George Respiratory Questionnaire (SGRQ).[22] The Food and Drug Administration (FDA) does not recommend dual bronchodilators as a therapy to reduce dyspnea complaints based on this assessment.[22-26] This study is not in line with the research of Lee et al. on 102 patients with stable COPD taking pharmacotherapy to reduce dyspnea symptoms. Treatment response was evaluated after three months of drug use. Based on the mMRC Dyspnea Scale and COPD Assessment Test assessment (CAT), it was found that there was a decrease in the degree of dyspnea after three months of using pharmacotherapy.

Mete et al. discovered a link between high dyspnea scores and low body mass index (BMI) scores. Their study included 105 COPD inpatients using a nutritional assessment instrument with a 24-hour recall for three consecutive days.[27] Furthermore, Baig et al. discovered a significant relationship between BMI and upper arm circumference on the degree of dyspnea and severity of COPD in 138 hospitalized patients with COPD. The findings of this study did not show a relation between nutritional status and the degree of dyspnea in patients with COPD.[28] The researchers analyzed this based on the respondents' smoking habits. Patients have a tendency to continue smoking in order to control their body weight.[29] As a result, the respondent's nutritional status has no significant bearing on his or her decision to smoke.

Borné at al. conducted a study on 118,134 subjects with COPD ranging in age from 40 to 89 years in Sweden. Borné stated that there was no statistically significant relationship between socioeconomic status and the incidence of COPD in nonsmokers. Borné argued that a smoker's socioeconomic status is closely related to the risk of COPD.[30] Kanervisto et al., who also discovered a link between respiratory tract obstruction disease with low socioeconomic status, as defined by low levels of education and income.[31] Patients with COPD with low income are 2.1 times more likely to have acute COPD exacerbations.[32] Furthermore, the rate of mortality in COPD patients with low incomes is 2.5 times higher than in COPD patients with high incomes.[33] People with low socioeconomic status are more likely to engage in unhealthy behaviors such as smoking, lack of physical activity, and poor dietary intake.[34]

People with lower socioeconomic status are more vulnerable to disease. A person with high socioeconomic status can live a healthier lifestyle by receiving regular medical treatment and check-ups, living in a clean environment with low pollution levels, purchasing healthy and nutritious food, participating in sports groups such as Zumba or yoga, and being able to pay for smoking cessation therapy. The findings of this study revealed that there was no significant relationship between socio-economic status and the degree of dyspnea. The researchers analyzed this in terms of the respondents' smoking habits, with 85% of the respondents in this study being smokers or ex-smokers. Tobacco use has evolved into a physiological, psychological, and social dependency trait. Dependence on nicotine in cigarettes is a behavioral disorder.[29]

PLB exercises are designed to improve oxygen transport, train expiratory muscle strength, increase airway pressure during expiration, decrease airway obstruction, and prevent lung collapse. Other studies have demonstrated that PLB can temporarily reduce the sensation of dyspnea, allowing individuals to control their breathing independently and in accordance with their body's tolerance. The process of pursed lips will lengthen the duration of expiration, thus decreasing the dead space in the airway. The manipulation of breathing patterns can be advantageous for cardiovascular and respiratory control in physiological and pathological conditions. Increased venous return, for instance, can aid in maintaining stable blood pressure during rest periods in critical illness.[35]

The pursed-lip maneuver is utilized frequently in respiratory rehabilitation programs. The purpose of pursed lips is to increase respiratory efficiency and provide better control during periods of dyspnea by increasing resistance during expiration and thereby decreasing the respiratory rate. Pursed lips facilitate breathing with a longer expiration duration and reduced lung volume at the end of exhalation.[35,36] In addition, PLB increases vagal modulation, which may

be associated with a reduction in respiratory rate.[37] PLB can decrease respiratory rate and raise SpO2 levels. This breathing exercise is also recommended to reduce dyspnea symptoms, boost self-esteem, and alleviate night-time anxiety. Due to the mechanism of increased airflow during the expiration process, PLB results in a decrease in respiratory frequency.[38] While the use of accessory muscles during respiration results in an increase in tidal volume, an improvement in the exchange process, and adequate breathing, the use of accessory muscles does not affect tidal volume.[36]

The Randomized Clinical Trial (RCT) research conducted by Seyedi Chegeni et al. demonstrated that eight weeks of home-based PMR successfully reduced fatigue and improved certain components of sleep quality in COPD patients with obstructive degrees III to IV at Shohada Teaching Hospital, Iran.[39] Similarly, Volpato, Banfi, Nicolini, and Pagnini conducted an RCT study on patients with COPD at the Don Gnocchi Hospital in Milan. The research indicated that relaxation exercises have the potential to improve the functioning of the heart and lungs, as well as make people feel better and less anxious.[40]

In this study, the researchers did not conduct an inter-rater reliability test on the research assistants in the second group. Therefore, researchers cannot be certain of the perceptions held in common by the researchers and research assistants regarding PLB training. However, the research assistants recruited for this study already possess research experience, having worked in the respiratory field for more than five years and possess a Bachelor of Science in Nursing degree. Consequently, the research assistants have been generally considered acceptable enough to provide PLB training in terms of competence.

This study's findings can be used to improve COPD patients' ability to self-manage their disease and reduce the frequency of acute exacerbations. For therapy to be effective, nursing personnel who are competent in providing this combination of breathing exercises and relaxation techniques are required. This combination of exercises is applicable for both inpatient and outpatient COPD patients. The findings of this study can also be used to create a comprehensive Standard Operating Procedure that enables nurses to independently care for patients using a combination of PLB and PMR.

5. Conclusion

This study's findings show that there is a significant difference in the degree of dyspnea after performing a combination of PLB and PMR. Thus, combining PLB and PMR has an indirect effect on improving lung function, as evidenced by a reduction in dyspnea after seven days of intervention. Except for the degree of dyspnea, improvements in lung function and functional capacity in patients with COPD can also be assessed using sputum production, spirometry values, and the number of exacerbations. As a result, this study can serve as a reference and provide preliminary data for future research for patients with COPD by investigating the relationship between the combination of PLB and PMR and other indicators of disease severity.

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Conflict of interests

The authors declared no conflict of interest.

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