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The Effect of Pursed Lip Breathing and Orthopneic Position on Increasing Peak Expiration Flow in Chronic Obstructive Pulmonary Disease Patients

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ABSTRACT

Background: Chronic Obstructive Pulmonary Disease (COPD) is a condition characterized by chronic respiratory symptoms, including shortness of breath and cough, decreased Peak Expiratory Flow (PEF), caused by airway obstruction. Interventions such as Pursed Lip Breathing and orthopnea positioning can potentially improve PEF in COPD patients. **Objective:** This study aims to analyze the effect of Pursed Lip Breathing and orthopnea position on increasing PEF in COPD patients at Kartini Karanganyar Hospital. **Methods:** This study used a quasi-experimental design with a pretest-posttest approach. The sample consisted of 64 COPD patients who were divided into two groups: the intervention group who received Pursed Lip Breathing and orthopnea position every morning for 5 minutes for 3 days, and the control group who only received the intervention according to hospital standards. PEF measurements were taken before and after the intervention using a Peak Flow Meter. **Results:** The results showed that the combination of the two interventions had a significant effect on increasing the patient's PEF indicating an improvement in respiratory function (p=0.00). **Conclusion:** Pursed Lip Breathing and orthopnea positioning are effective in improving PEF in COPD patients, so it can be recommended as part of respiratory care.

Keywords: Chronic Obstructive Pulmonary Disease, Orthopnea Position, Peak Expiratory Flow, Pursed Lip Breathing.

BACKGROUND

The Global Initiative for Chronic Obstructive Pulmonary Disease (GOLD) (2024) defines Chronic Obstructive Pulmonary Disease (COPD) as a disease characterized by chronic respiratory symptoms such as dyspnea or shortness of breath, cough, sputum production, and exacerbations. These symptoms are caused by abnormalities in the airways (chronic bronchitis) and/or alveoli (emphysema), which cause persistent and often progressive airway obstruction. Chronic airway obstruction is a hallmark of COPD, which is generally caused by a combination of chronic bronchitis and

emphysema. The inflammation that occurs in chronic bronchitis causes structural changes and narrowing of the small airways. Consequently, alveolar damage caused by this inflammatory process leads to alveolar enlargement and decreased lung recoil elasticity, resulting in inadequate airflow (Soemarwoto et al., 2021).

In COPD, the primary problem is the expiratory process, which is highly dependent on lung recoil elasticity. When COPD patients inhale, the respiratory muscles work hard to maintain atmospheric pressure, facilitating oxygen (O2) uptake in the lungs. However, during expiration, inadequate lung recoil elasticity prevents carbon dioxide (CO2) from being effectively expelled due to obstruction and air trapping (CO2 trapped in the alveoli). Consequently, COPD patients experience increased respiratory effort because the expiratory phase is longer than the inspiratory phase. Therefore, the inspiratory muscles must work harder over a prolonged period to push air into the lungs, requiring the assistance of additional muscles (Ikawati, 2022).

The primary risk factor for the development of COPD is smoking (Nielsen et al., 2024). Long-term exposure to the harmful substances in cigarette smoke causes chronic inflammation in the airways and damages lung tissue. Furthermore, air pollution from sources such as vehicle exhaust, industrial processes, or wood fuels can also damage the lungs and worsen COPD symptoms. Genetic factors also play a role in some cases, where individuals may have a genetic predisposition that makes them more susceptible to the effects of smoking or exposure to air pollution. Other factors, such as a history of frequent respiratory infections or passive exposure to secondhand smoke, can also contribute to the development of COPD (Muliase, 2023). GOLD (2020) also estimates that the prevalence of COPD will continue to increase by 2060, as the number of people smoking increases.

As the prevalence of COPD increases worldwide, the WHO reports that COPD is the third leading cause of death, accounting for 6% of deaths, or 3.23 million deaths worldwide (WHO, 2023). In Asia-Pacific countries, the prevalence of COPD is estimated at 14.5% in Australia, 4.4%-16.7% in China, and 5.6% in Indonesia (Cheng & Lin, 2021). According to the 2018 Basic Health Research (Riskesdas), the prevalence of COPD in Indonesia ranks second at 5.6%, with a mortality rate of 4.3 million patients. In Central Java alone, the prevalence of COPD patients in 2017 was recorded at 54,110 (Health Office, 2017).

Generally, the PEF (Peak Expiratory Flow Rate) of COPD patients tends to decrease due to airway abnormalities. This decrease in PEF is often correlated with increased symptoms of shortness of breath, limited physical activity, and a decreased quality of life. Measuring PEF in COPD patients is important because it can be used to evaluate treatment effectiveness, monitor disease progression, and detect acute exacerbations that require immediate medical intervention. Knowing and regularly monitoring PEF can improve disease control, allow for early treatment adjustments, and prevent complications that can worsen the patient's condition. PEF monitoring also aids in the long-term management of COPD, improving patient quality of life and reducing the risk of more severe exacerbations (Emi Nurlaela, 2021).

The tool used to measure PEF is a peak flow meter with units of L/minute. Peak flow meters are portable, affordable, and easy-to-use devices. This tool helps us measure how well we can exhale air from the lungs (Ayudia et al., 2020). PEF measurement results

can be interpreted using a traffic light zone system. The green zone is when the PEF value is 80%-100% (good lung function), the yellow zone is 50%-80% indicating the onset of airway narrowing, and the red zone is ≤ 50% indicating extensive airway narrowing. The normal PEF value in adult men is 400-600 L/minute while in adult women it is 300-500 L/minute (Dewanti et al., 2024).

There are two main treatments for COPD: pharmacological and non-pharmacological. The initial pharmacological therapy recommended by GOLD (2024) is bronchodilators. Bronchodilators are the primary medication in COPD management, widening the airways and improving airflow. One type of bronchodilator is Ventolin, a beta-2 agonist bronchodilator. Using Ventolin via a nebulizer allows the medication to be inhaled directly into the lungs as a fine mist, providing a rapid and more even effect, and making it easier for patients who have difficulty using conventional inhalers. This therapy is particularly beneficial for patients who need rapid symptom relief, especially when they are experiencing severe or worsening breathing difficulties. Non-pharmacological therapies include smoking cessation, exercise/physical activity, vaccination, and pulmonary rehabilitation (Dewanti et al., 2024).

Pharmacological therapy only has symptomatic effects, so non-pharmacological therapies are needed to prevent worsening and improve COPD care (Chen et al., 2024). Recent research highlights the increasing importance of pulmonary rehabilitation as a vital non-pharmacological therapy component in the treatment of COPD (Holland et al., 2021). According to the Indonesian Pulmonary Physicians Association (PDPI) in 2023, breathing exercises are part of pulmonary rehabilitation. Furthermore, expiratory disorders in COPD patients can also be addressed through body positioning.

Pursed Lip Breathing (PLB) and orthopnea postures can increase Peak Expiratory Flow (PEF) in COPD patients (Amalia et al., 2020). Both work synergistically to improve airflow and increase respiratory efficiency. Pursed Lip Breathing (PLB) is a technique that involves inhaling through the nose and exhaling slowly through pursed lips, similar to whistling (Buranapuntalug et al., 2023). This technique is beneficial for COPD patients because it prolongs the expiratory phase, increases airway pressure during exhalation to prevent small airway collapse, and increases PEF by reducing air trapping and maintaining airway patency (Parkavi et al., 2022).

The orthopnea posture involves sitting with the body leaning forward with the arms propped on a table or two pillows in front of them (Amri, 2020). The orthopnea position aims to maximize the function of the accessory respiratory muscles, thus maximizing the inspiration and expiration processes. It can increase respiratory capacity by reducing pressure on the diaphragm, allowing the respiratory muscles to work more effectively (Ryan et al., 2023). Furthermore, this position can also reduce dyspnea (shortness of breath) and increase PEF by optimizing respiratory muscle function and lung expansion. By combining PLB and the orthopnea position, COPD patients can more effectively expel air from the lungs, reducing symptoms of shortness of breath and increasing PEF, thus optimizing the patient's respiratory function (Windartik & Soemah, 2023).

Research conducted by Rana et al. (2022) at the Rehman Medical Institute in Peshawar found that pursed lip breathing had a positive effect on COPD patients, increasing their PEF. Another study by Agreta et al. (2023) at the Jakarta Islamic Hospital in Cempaka Putih found an increase in peak expiratory flow (PEF) values in COPD patients after

receiving pursed-lip breathing intervention every morning for 5 minutes for 3 days. Furthermore, research conducted by Akbar et al. (2020) using a systematic review method found that the orthopnea position maximizes accessory respiratory muscle function, resulting in optimal inspiration and expiration. Furthermore, research conducted by Amalia et al. (2020) found that pursed lip breathing affected increasing PEF values.

A preliminary study conducted by researchers in August 2024 at Kartini Regional Hospital in Karanganyar revealed that the primary pharmacological intervention typically used for COPD patients in the inpatient ward is a nebulizer with a bronchodilator (Ventolin), while the non-pharmacological intervention is the semi-Fowler's position. In 2023, Kartini Karanganyar Regional Hospital (RSUD Kartini Karanganyar) had 156 COPD patients, and for the last three months, from May to July, there were 59 patients registered. Furthermore, the average number of COPD patients per month was 19.

Based on the background above and the researchers' interest in providing a combined intervention of PLB with orthopnea positioning to improve PEF in COPD patients, the researchers chose the title "The Effect of Pursed Lip Breathing with Orthopnea Positioning on Increasing Peak Expiratory Flow (PEF) in Chronic Obstructive Pulmonary Disease (COPD) Patients at Kartini Karanganyar Regional Hospital."

OBJECTIVE

The general objective of this study was to determine the effect of pursed lip breathing and orthopnea position on increasing Peak Expiratory Flow (PEF) in Chronic Obstructive Pulmonary Disease (COPD) patients.

METHODS

This research is quantitative. The research method used was a pre-experimental design with a one-group pretest-posttest with a control group design. The study was conducted in the inpatient ward of Kartini Karanganyar Regional Hospital in September-October 2024. The study was conducted in two groups: the intervention group and the control group. The intervention group underwent pursed lip breathing in the orthopnea position, while the control group only received treatment according to hospital standards. The intervention of pursed lip breathing and orthopnea position breathing exercises was carried out every morning for 5 minutes for 3 days. Before and after the intervention, respondents were measured for their PEF using a peak flow meter. Then, the pre-test and post-test results were compared to determine whether there were differences in the average PEF values in each group and between groups. The population was divided into two: the target population, identified based on the research problem, and the survey population, involved in the ongoing research. In this study, the target population was COPD patients at Kartini Karanganyar Regional Hospital. The sample in this study amounted to 64 respondents consisting of 2 groups, namely 32 respondents in the intervention group and 32 respondents in the control group. The sampling technique used in this study was non-probability, namely convenience sampling or accidental sampling. The group division used a lottery, namely a coin toss. Based on the lottery, Mawar Room 1 and Mawar Room 2 were the intervention group, while Teratai Room 3 and Cempaka Room 3 were the control group. The inclusion criteria in this study were

1) Patients diagnosed with COPD with compos mentis awareness; 2) COPD patients who were undergoing inpatient treatment; 3) COPD patients receiving pharmacological therapy with nebulizer bronchodilator drugs (ventolin 2 x 1 day & oral medication); 4) COPD patients aged 26-85 years.

RESULTS

Table 1. Respondent Characteristics

Respondent Characteristics	Intervention		Control	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Age				
Early adulthood (26-45 years)	3	9,4	3	9,4
Late adulthood (46-65 years)	10	31,3	14	43,8
Seniors (66–85 years old)	19	59,4	15	46,9
Gender				
Male	23	71,9	19	59,4
Female	9	28,1	13	40,6
Total	32	100	32	100

The table 1 shows that the largest number of respondents in the intervention group were elderly (66-85 years old) with 19 respondents (59.4%) and in the control group with 15 respondents (46.9%). The results also showed that the majority of respondents in both groups, both the intervention group (23 respondents (71%)) and the control group (19 respondents (59.4%)) were male.

Table 2. Results of Paired Samples T-test Analysis on PEF Values

Group	n	Mean Pre-Test	Mean Post-Test	Difference (Δ Mean)	p Value
Intervention	32	175,63	330,63	155	0,00
Control	32	184,69	211,87	27,18	

Table 2 shows that there was a significant increase in the PEF value in COPD patients with a difference of 155, while in the control group it was only 27.18. This indicates that the increase in PEF that occurred in the intervention group was better than the control group (p=0.00) every morning for 5 minutes for 3 days. Therefore, it's meaning that there was an effect of providing pursed lip breathing and orthopnea position interventions on increasing PEF values. So, it can be concluded that there is an effect of pursed lip breathing and orthopnea position on increasing PEF based on the results of the comparison of the average increase in PEF values in the intervention group which was higher (330.63 L/minute) compared to the average PEF value in the control group (211.87 L/minute).

DISCUSSION

Respondent Characteristics

Based on the research data obtained, the majority of respondents in both groups were in the elderly age category. The degenerative theory explains the aging process as a condition in which biological function and body capabilities decline with age (Mulyady et al., 2020). This degenerative process can trigger various chronic diseases, including COPD, with a decrease in PEF (Sari & Mayasari, 2020) as one of the main clinical indicators.

PEF decline can be influenced by several factors, including bronchial smooth muscle atrophy, decreased lung elasticity, and less effective diaphragmatic muscle contraction. As per the degenerative theory, the aging process can cause structural degeneration of the bronchi, such as bronchial smooth muscle atrophy. This makes the bronchi less flexible and difficult to expand during breathing, thus impairing airflow and reducing PEF (Sharma & Goodwin, 2020).

Lung elasticity also decreases with age due to the reduced reuse of lung connective tissue. This condition makes it difficult for the lungs to stretch and return to their original shape during breathing, reducing their volume and lowering the PEF. The diaphragm, which is crucial for the respiratory process, also experiences decreased strength and efficiency with age. This exacerbates the decline in PEF because the diaphragm muscle can no longer function effectively to move the lungs (Sari & Mayasari, 2020).

This is in line with research conducted by Janssens and Verleden (2023), which showed that in elderly patients, decreased lung function significantly contributes to increased symptoms and exacerbations of COPD. Research by Morena et al. (2023) indicates that elderly individuals who experience decreased physical function due to degenerative diseases tend to have a lower quality of life. This research emphasizes the importance of interventions designed to slow the degenerative process, such as physical rehabilitation programs and social support. This shows that the prevalence of COPD is higher in people over 60 years of age than in younger age groups. COPD is also considered a condition of accelerated lung aging (Devulder, 2024).

Based on data and degenerative theory, it appears that older adults constitute the majority of COPD patients. Therefore, it is important to recognize that aging brings significant changes in lung function and overall health. Efforts to improve lung function through interventions such as breathing exercises can help improve the quality of life for patients with COPD.

The results of this study indicate that the majority of respondents in both groups were male. These results are consistent with epidemiological data showing that men have a higher risk of developing COPD than women (GOLD, 2024).

Biological theories can provide a more in-depth explanation for the gender distribution in this study, where the majority of respondents were male. First, genetic factors play a significant role in susceptibility to certain diseases, including Chronic Obstructive Pulmonary Disease (COPD). Genes related to the inflammatory response and lung metabolism may be more active or more prevalent in men, increasing their risk of

developing COPD (PDPI, 2023).

Furthermore, differences in the inflammatory response between men and women may also explain these findings. Men tend to exhibit a more aggressive inflammatory response to harmful environmental exposures, such as cigarette smoke and air pollution. This stronger inflammatory response can lead to more rapid lung damage, making men more susceptible to developing COPD than women (Putra & Artika, 2021).

Hormonal factors also contribute; testosterone, the primary male hormone, can affect lung metabolism and function in ways that increase the risk of damage from harmful environmental exposures. Conversely, estrogen in women may have a protective effect against some lung diseases. Finally, structural differences between male and female lungs can also affect respiratory health. In general, men have a larger lung capacity and a wider airway volume, so they may be exposed to more respiratory pollutants over a given period of time. All of these factors together explain why the majority of respondents in this study were male ((PDPI), 2023).

Research conducted by Adiana and Maha Putra (2023) states that the incidence of COPD is higher in men than in women, with data showing that 61.1% of COPD sufferers are male. Furthermore, in a study conducted in Malang, Indonesia, of 166 COPD patients, 112 were male and 54 were female (Djajalaksana et al., 2024). This aligns with research by Fadhilah (2024), which reported an overall COPD prevalence of 3.7% in Indonesia, with men significantly more affected due to lifestyle factors such as smoking and environmental exposure.

Based on the discussion above, it can be concluded that the majority of COPD patients in this study were male. Furthermore, a combination of biological factors such as genetics, inflammatory response, hormone production, and lung structure may explain why the majority of COPD patients are male.

Increased PEF values in COPD patients in the intervention group before and after a pursued lip breathing and orthopnea positioning

The results showed a significant increase in PEF values after the intervention. Before the intervention, the average PEF value was 175.63 L/minute, and after the intervention, it increased to 330.63 L/minute, a difference of 155 L/minute. Whereas, the results of the control group showed that 184.69 L/minute (pre-test) and 211.87 L/minutes (post-test), a difference of 27.18 L/minute. P value showed that 0.00, this indicates that both intervention methods were effective in improving patient's respiratory capacity.

One relevant theory is the theory of restoring body function through breathing stimulation and training. The intervention may include breathing techniques designed to increase lung capacity and respiratory efficiency. Pursed lip breathing involves regulating breathing by exhaling through pursed lips. The theory behind this technique is to slow the respiratory rate and increase expiratory time, thereby helping to expel trapped air in the lungs. This can reduce shortness of breath and improve gas exchange efficiency. The orthopneic position is typically achieved by sitting upright or leaning slightly forward. The theory behind this position is that it reduces pressure on the diaphragm and allows the lungs to expand better. This position allows patients to feel more comfortable while breathing, which contributes to increased airflow (Amalia et al., 2020).

This is in line with research conducted by Agreta et al. (2023) that showed a significant increase in PEF values after PLB exercises. The average PEF value before the intervention was 278.3 liters/minute, and after the intervention it increased to 290.0 liters/minute (p=0.00).

A previous relevant study by Suprayitno (2023) showed a significant increase in PEF values in the intervention group who performed PLB three times a week for four weeks (p=0.000), while the control group showed no significant change. This indicates that PLB has a positive effect on increasing PEF values in COPD patients.

PLB helps keep the airways open longer, thus improving gas exchange (Mohammed & Hanafy, 2024). PLB slows the respiratory rate and increases expiratory time, which helps reduce the accumulation of carbon dioxide in the lungs. By exhaling through pursed lips, patients can prolong the expiratory phase, allowing air trapped in the lungs to be expelled more effectively. This technique allows patients to exhale more efficiently, contributing to an increase in PEF.

The application of the orthopnea position is also supported by research by Ritianingsih et al. (2021), who found that both the high Fowler and orthopnea positions significantly increased PEF (p=0.005). However, the orthopnea position performed better than the high Fowler position, with an average PEF of 27.48% in the orthopnea position compared to 25.89% in the high Fowler position.

This is supported by research by Novitasari et al. (2024) The orthopnea position reduces pressure on the diaphragm because abdominal organs are not pressing on it, thus facilitating the expiration process. This allows the respiratory muscles to function more optimally, improving gas exchange in the lungs and reducing complaints of shortness of breath.

This is in line with research conducted by Akbar et al. (2020) that found that the orthopnea position, which involves sitting with the body leaning forward, increases lung capacity and facilitates better ventilation. This position helps reduce pressure on the diaphragm and allows the respiratory muscles to function more efficiently.

Based on the results and discussion above, it can be concluded that the combination of pursed lip breathing and the orthopnea position in COPD patients can significantly improve the quality of their respiratory function, as reflected in higher PEF values. Furthermore, this intervention also has the potential to reduce symptoms of shortness of breath, increase activity tolerance, and improve patient comfort while breathing.

Increased Expiratory Flow Rate in COPD patients in the control group before and after hospital-standard intervention

The results showed an increase in the average Expiratory Flow Rate (PEF) in the control group receiving standard hospital intervention, namely nebulizer therapy with bronchodilator drugs (ventolin 2 x 1 day & oral medication). Before the intervention, the average PEF value was 184.69 L/minute, increasing to 211.87 L/minute after the intervention, a difference of 27.18 L/minute. Nebulizer therapy increases PEF through mechanisms consistent with respiratory physiology theory. When aerosol medication is inhaled, small particles reach the airways, helping to open bronchi narrowed by inflammation or obstruction (p=0.00) (PDPI, 2023).

In this context, several research journals can support these findings. For example, a previous study by Endiyono (2020) found that the use of nebulizers in patients with COPD increased Peak Expiratory Flow (PEF), with an average PEF after nebulizer use of 233 ± 33.7 L/minute, indicating an effect on PEF (p=0.00). Furthermore, it's worth noting that although these standard hospital interventions can also increase PEF, they may not be sufficient to address the complex respiratory challenges faced by COPD patients. Therefore, non-pharmacological interventions such as pursed lip breathing and orthopnea positioning are needed as a complement to pharmacological interventions, such as nebulizer therapy alone, to achieve optimal respiratory management in COPD patients.

The effect of pursed lip breathing and orthopnea positioning on increasing PEF values in COPD patients

The results showed that the provision of pursed lip breathing for 5 minutes during 3 days and orthopnea positioning interventions also nebulizer therapy with ventolin 2 x 1 day & oral medication was more effective in increasing PEF in COPD patients (p=0.00). This can be seen from the comparison of the results of the increase in PEF values in the intervention group of 155 L/minute compared to the control group, which was only 27.18 L/minute. This is because the intervention group, in addition to a pursed lip breathing and orthopnea positioning, also received standard hospital therapy, namely nebulizer therapy, while the control group received only nebulizer therapy.

This is supported by the theory of pulmonary ventilation, which explains that increased ventilation can be achieved by reducing airway resistance and increasing lung capacity. The combination of these three interventions optimizes ventilation conditions, thereby significantly increasing PEF. Pursed lip breathing slows the respiratory rate and creates positive airway pressure during expiration, helping reduce air trapping, increase ventilation, and improve gas exchange efficiency (Ryan et al., 2023). Sitting in an orthopnea position, i.e., slightly bent forward, reduces pressure on the diaphragm, allowing the lungs to expand more effectively. Furthermore, standard hospital interventions, such as nebulizer therapy, deliver medication in aerosol form directly to the airways, helping to open narrowed airways and reduce inflammation (Nur Imamah & Rahmawatie Ratna Budi Utami, 2022).

Research by Chen et al. (2024) supports these findings, showing that interventions involving active breathing techniques such as PLB and orthopnea positioning yield superior results in improving PEF compared to standard treatment.

Research by Yari et al., 2023, however, suggests that nebulizers are commonly used as standard treatment for COPD patients, but they do not always provide optimal results in improving lung function. Conversely, non-pharmacological interventions such as PLB and orthopnea positioning can provide better results in reducing symptoms and improving patients' quality of life.

Overall, Pursed Lip Breathing and orthopnea positioning are more effective methods in improving respiratory function than standard treatments such as nebulizers. These interventions are recommended as part of the care management of COPD patients to improve their quality of life. Furthermore, the study emphasizes the importance of patient education on effective breathing techniques, which can increase their

independence in managing symptoms and improve quality of life.

CONCLUSION

Based on the results of research conducted on 64 respondents aimed to determine the effect of Pursed Lip Breathing (PLB) and orthopnea position interventions on increasing Peak Expiratory Flow (PEF) in patients with Chronic Obstructive Pulmonary Disease (COPD), it can be concluded that the age category of respondents in this study was mostly elderly, with a higher proportion of male gender. Pursed Lip Breathing (PLB) and orthopnea position interventions significantly increased PEF values in COPD patients with an average PEF value of 155 L/minute with a p value = 0.00 which indicates a significant effect.

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