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ORIGINAL RESEARCH

THE EFFECT OF BALLOON BLOWING EXERCISE ON PEAK EXPIRATORY FLOW IN COPD PATIENTS

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ABSTRACT

Chronic obstructive pulmonary disease (COPD) harms health due to progressively reversible airflow obstruction. Mortality in patients hospitalized for exacerbations with hypercapnia and acidosis is estimated at 10%. The mortality rate reaches 40% in patients who require mechanical ventilation one year after treatment and is 49% overall. The purpose of this study is to analyze the effect of Balloon Blowing Exercise on peak expiratory flow (PEF) in COPD patients. This research is a quantitative study with a pre-experimental design using a one-group pre-post test approach. The sample consisted of 30 COPD patients who met the inclusion criteria, notably not currently experiencing contagious pulmonary infections. Data collection tools included balloons, a peak flow meter to measure PEF, and SPO2 monitors for the balloon blowing breathing exercises. The results showed that the average (Mean) PEF before the Balloon Blowing Exercise intervention was 90.83 lpm, with a standard deviation of 23.271, indicating that the pre-test PEF data had some variation but largely clustered around the mean. After the Balloon Blowing Exercise (post-test), the average PEF increased to 103.53 lpm, with a standard deviation of 28.565, indicating the post-test data was similarly spread around its mean. The Wilcoxon Signed Rank Test resulted in a Sig.(2-tailed) value of 0.000 < 0.05, meaning H0 is rejected and Ha is accepted, demonstrating that Balloon Blowing Exercise significantly affects PEF in COPD patients. This exercise engages respiratory muscles, helping to strengthen them and improve breathing efficiency. By enhancing ventilation, preventing water trapping, and strengthening respiratory muscles, Balloon Blowing Exercise can reduce the work of breathing and improve PEF scores.

Keywords

Balloon Blowing Exercise, COPD, Peak Expiratory Flow

INTRODUCTION

According to WHO 2022, over the past three decades, there has been a shift in disease prevalence from communicable to non-communicable diseases (NCDs). NCDs are the leading cause of death globally, claiming approximately 41 million lives each year (Kemenkes RI, 2023). Major non-communicable diseases include hypertension, diabetes mellitus, cancer, and Chronic Obstructive Pulmonary Disease (COPD) (Kemenkes RI, 2022). Non-Communicable Diseases (NCDs) are chronic diseases that are not transmitted from person to person. The morbidity of COPD among Non-Communicable Diseases in developed and developing countries poses a high risk of death. Non-Communicable Diseases (NCDs) are chronic diseases that are not transmitted from person to person, including hypertension, diabetes mellitus, cancer, and Chronic Obstructive Pulmonary Disease (COPD) (Kemenkes RI, 2022). COPD morbidity among non-communicable diseases in developed and developing countries is a high mortality threat (Sharma et al., 2025). COPD is a major public health problem worldwide, and one of the causes of mortality and morbidity cases in both high-income and low-income countries (Shodiq, 2020). Chronic Obstructive Pulmonary Disease (COPD) is classified as a non-communicable disease that poses a global health problem, with a significant contribution to morbidity, mortality, and an increased risk of lung cancer (Cheng et al., 2021). Chronic Obstructive Pulmonary Disease (COPD) is a respiratory disease that causes limited airflow due to chronic bronchitis and emphysema. Symptoms that appear in patients with this disease include shortness of breath, coughing, wheezing, mucus production, and restricted air circulation (Camac et al., 2021). This condition is due to narrowing or obstruction of the airways, which causes difficulty in the process of expiration. As a result, patients often experience an increased breathing rate in response to unmet oxygen needs. If shortness of breath is not promptly treated, oxygen deficiency in the blood can occur, leading to hypoxemia and carbon dioxide buildup. This condition can lead to respiratory failure, which is potentially fatal, because the supply of oxygen to the brain is disrupted. If the brain does not receive oxygen within 3 to 7 minutes, brain cells will begin to die, which can eventually result in a person's death (Sanga et al., 2020). The impact of these respiratory obstructions will cause a decrease in peak expiratory flow. Peak expiratory flow is the maximum flow achieved during expiration with maximal effort from the level of maximal lung inflation (Quanjer et al., 1997).

Therefore, management for the disease is needed, which includes pharmacological and non-pharmacological treatments, among them breathing exercises as one of the non-pharmacological methods that are still limited and not widely implemented in hospitals, particularly the Balloon Blowing Exercise. Breathing exercises, which are inexpensive and easy to perform, are considered an important element in non-pharmacological treatment for lung rehabilitation (Firdausi et al., 2021). To treat shortness of breath in COPD patients, one of the self-nursing interventions that can be performed is the balloon blowing exercise (BBE) technique. BBE is an active breathing technique aimed at increasing lung capacity and can help the intercostal muscles lift the ribs and diaphragm. Several studies on the effects of balloon blowing in smokers have found that regularly blowing balloons can improve lung function in smokers by increasing peak expiratory flow (Jun et al., 2015).

The World Health Organization (WHO) states that Chronic Obstructive Pulmonary Disease (COPD) is the third leading cause of death in the world, accounting for about 6% of the total deaths worldwide (Jun et al., 2015). As many as 3.23 million deaths occurred in 2019 with smoking as the main cause. In 2020, the Global Initiative for Chronic Obstructive Lung Disease epidemiologically estimated that by 2060, the prevalence of COPD will continue to rise due to the increasing number of smokers. The prevalence of COPD worldwide reaches 12% of the general population, with 44.16% experiencing mild obstruction, 44.22% experiencing moderate obstruction, and the rest experiencing severe obstruction. In Southeast Asia, the prevalence is 6.3%, while in Indonesia it reaches 9.2 million people or around 3.7%, with the death rate from this disease accounting for 60% of total deaths in Indonesia (Firdausi et al., 2021). In the 2018 Riskesdas, it is estimated that the prevalence of COPD in Indonesia is 3.7% or approximately 9.2 million people suffering from COPD (Kemenkes RI, 2018). In East Java, the number of people suffering from the disease is estimated to be around 8.95 million or approximately 3.6%. The prevalence in East Java, which is almost the same as the national figure, indicates that the handling and health programs related to COPD are not evenly distributed across Indonesia. Therefore, it is important to improve health programs related to COPD, both at the national and local levels, to reduce the prevalence and mortality rate from this disease. A preliminary study was conducted starting on November 6, 2024, at Sumberglagah Regional General Hospital, Mojokerto Regency, recording 1,705 patients who had been diagnosed with COPD during the year 2024, while in the last three months from October to December, 472 patients were recorded. A survey conducted on several COPD patients showed that all experienced dyspnea at various levels.

COPD is characterized by irreversible airway obstruction with persistent respiratory symptoms over the long term. In COPD patients with airway obstruction, they will experience difficulty breathing and a decrease in peak expiratory flow (PEF) (Lestari & Saraswati, 2022). Cigarette smoke irritates the airways, causing hypersecretion of mucus and inflammation. Due to the irritation, the mucus-secreting glands and goblet cells increase in number, ciliary function decreases, and more mucus is produced, resulting in narrowed and obstructed bronchioles. Further bronchial narrowing occurs as a result of fibrotic changes in the airways, leading to irreversible changes in the lungs and causing emphysema and bronchiectasis. In emphysema, several factors cause airway obstruction, including inflammation and bronchial swelling, excessive mucus production, loss of airway elastic recoil and bronchiolar collapse, as well as the redistribution of air to functional alveoli (Mukhtar, 2017). It is also known that in COPD there is an abnormality of the respiratory muscles, indicated by the tension of the respiratory muscles. The loss of lung flexibility in this disease leads to hyperinflation and airway obstruction, causing the expiratory process to be hindered. As a result, the volume of air moving in and out becomes unbalanced, leading to air trapping. Tidal volume decreases and breathing becomes shorter, resulting in alveolar hypoventilation and increased O_2 consumption. The respiratory rate increases in response to the compensatory effort of the small airways, causing characteristic shortness of breath; consequently, patients often experience an increased respiratory rate as a response to unmet oxygen demands. This condition prompts patients to find ways to manage their shortness of breath (Suharno et al., 2020). Addressing excessive sputum in hospitalized patients with COPD is an important aspect of overall COPD patient management (Westerdahl et al., 2019).

Pulmonary rehabilitation is a comprehensive and multidisciplinary management approach that has been proven to benefit patients with COPD. The goal of pulmonary rehabilitation is to reduce symptoms, improve functional status, enhance quality of life, and lower healthcare costs. The pulmonary rehabilitation program consists of three components: physical exercise, psychosocial support, and breathing exercises (Fretes et al., 2020). One of the important parameters in evaluating lung function in COPD patients is the peak expiratory flow (PEF), which reflects the patient's ability to exhale forcefully in a short period of time. PEF in COPD patients is generally decreased due to airway obstruction and respiratory muscle weakness (Sharma et al., 2025).

In an effort to improve the capacity and function of the respiratory muscles, various breathing exercises have been developed, one of which is the Balloon Blowing Exercise (BBE). BBE is a simple breathing exercise that involves repeatedly blowing up a balloon with the aim of strengthening the respiratory muscles, enhancing lung ventilation, and improving the efficiency of gas exchange (Kim & Lee, 2012). This exercise has been used as part of respiratory rehabilitation to improve vital capacity and PEF values, especially in patients with chronic lung disorders. The Balloon Blowing Exercise serves to strengthen the respiratory muscles and enhance control over the breathing rate. The balloon-blowing technique helps elevate the diaphragm and rib muscles, and is effective in developing the lungs to increase the ability to inhale oxygen and exhale carbon dioxide, which is useful for improving respiratory function (Kanniappan & Manivannan, 2020).

Previous studies have shown that BBE can provide positive effects on improving lung function and quality of life in COPD patients. It was found that administering BBE interventions for two weeks significantly increased PEF values and reduced shortness of breath in patients with mild to moderate COPD (Suharno et al., 2020).

However, there is still a limited number of studies specifically evaluating the effects of BBE on peak expiratory flow in COPD populations at various severity levels, especially in resource-limited areas. Therefore, this study aims to analyze the effects of Balloon Blowing Exercise on peak expiratory flow in COPD patients, as a form of non-pharmacological intervention that is easy, inexpensive, and can be performed independently.

METHOD

This study is a Pre-experimental type of research that uses a One Group Pretest-Posttest design with the provision of Balloon Blowing Exercise (BBE) intervention carried out 1x on the respondents. The instrument in evaluating lung function from this study uses the Peak Flow Meter tool which is carried out before and after the application of Balloon Blowing Exercise therapy. The population of this study was all COPD patients on the first day of treatment inpatient room at Sumberglagah Hospital, Mojokerto City. The sample in this study is 30 respondents who have been selected through a purposive sampling technique based on inclusion criteria and exclusion criteria by the researcher. The inclusion criteria in this study are COPD patients.

The data analysis technique in this study uses the Paired T-Test with the help of the SPSS program. This research has passed the ethics test and obtained ethical feasibility from the health research ethics commission of the Bina Sehat PPNI Mojokerto University with No. 04/KEP/UBS-PPNI/X/2025.

RESULTS

1. Characteristics of Respondents

Table 1. Frequency Distribution Based on Respondent Characteristics

Characteristics of Respondents	Frequency F	%
Age		
41-50	1	3,3
51-60	5	16,7
>60	24	80,0
Gender		
Male	21	70,0
Female	9	30,0
Phisical Activity		
Yes	14	46,7
No	16	53,3
Total	30	100,0

Source: Primary Data, 2025

Based on the data presented in the table, it can be described that almost all respondents are in the age group above 60 years. In terms of gender, the majority of respondents are male. Regarding physical activity, more than half of the respondents do not engage in physical activity. The total number of respondents in this study was 30 people.

2. Peak Expiratory Flow Rate Before *Ballon Blowing Excercise*

Table 2. Frequency Distribution of Peak Expiratory Flow Before Undertaking Ballon Blowing Exercise Therapy (Pre-Test)

Variable	Mean	Min	Max	Standart Deviation
Peak Expiratory Flow Pre Test	90.83	80.0	190,0	23,271

Source: Primary Data, 2025

Based on Table 2, it can be seen that the mean (Average) PEF value before the Ballon Blowing Exercise intervention was 90.83 lpm. With a standard deviation of 23.271, it indicates that the peak expiratory flow data in the pre-test group tends to have a variation that is not too far from the average value and is mostly clustered around the mean of 90.83.

3. Peak Expiratory Flow Rate After *Ballon Blowing Excercise*

Table 3. Frequency Distribution of Peak Expiratory Flow After Undertaking Ballon Blowing Exercise Therapy (Post-Test)

Variable	Mean	Min	Max	Standart Deviation
Peak Expiratory Flow Post Test	103,53	80.0	230,0	28,565

Source: Primary Data, 2025

Based on Table 3, it can be seen that the peak expiratory flow of patients after performing the Balloon Blowing Exercise intervention (post-test) showed an average (Mean) PEF value of 103.53 lpm. With a standard deviation of 28.565, it indicates that the distribution of post-test PEF data is not too far from its mean value.

4. Effect of Ballon Blowing Excercise on Peak Expiratory Flow

Table 4. Effect of Ballon Blowing Excercise on Peak Expiratory Flow

Variable	Mean		diff	95% CI		*P Value*
	Pre	Post		Lower	Upper	
Expiratory Peak Flow	90.83	103.53	-12,7	82,14-92,87	99,52-114,20	0.000

Source: Primary Data, 2025

Table 4 presents the results of the Wilcoxon Signed Rank-Test showing a Sig.(2-tailed) value = 0.000 < 0.05, H0 is rejected and Ha is accepted, which means that there is an effect of Ballon Blowing Exercise on PEF in patients with COPD (Chronic Obstructive Pulmonary Disease). The results of the statistical test are attached.

DISCUSSION

Peak Expiratory Flow Rate Before Balloon Blowing Excercise

Table 2 presents the research results showing that the average value (mean) of PEF in COPD patients at the pre-test stage was 90.87 lpm. In this condition, the average respondents fell into the red zone category. PEFR is one of the pulmonary function parameters used to determine the presence of abnormalities in the respiratory tract; a decrease indicates that there is an obstruction in the airflow of the respiratory tract (Santosa et al., 1996). In addition, considering that the normal heart rate range (PEFR) for adult men is around 500-700 bpm, while for adult women it ranges between 380-500 bpm (Butsainah et al., 2025).

In patients with COPD, there is a narrowing or obstruction of the airways that makes it difficult for them to exhale and causing shortness of breath. If the shortness of breath is not addressed promptly, oxygen deficiency in the blood can occur, leading to hypoxemia and carbon dioxide buildup. (Sanga et al., 2020). This condition can trigger anaerobic metabolism, which can lead to respiratory muscle fatigue due to lactic acid production, thereby reducing the breathing process, which can cause a decrease in FEV (forced expiratory volume) with an increase in RV (residual volume) and FRC (functional residual capacity) (GOLD, 2025). Obstruction in the respiratory system that hinders the normal intake of air can result in decreased lung elasticity, impacting a reduction in peak expiratory flow values. (Afrian, 2023).

Therefore, this pre-test PEF data serves as an important baseline for evaluating the impact of Ballon Blowing Exercise intervention on patients' breathing patterns. The decrease in PEF values is influenced by several factors, including gender, age, height and weight, race, smoking habits, and environment (Yuniarti, 2024). Based on the previous crosstabulation results, the average PEF score of 90.83 tends to be held by those over 60 years old.

This is in line with the theory of Guyton & Hall, 2011 in (Ihwan et al., 2022), which states that the decline in PEF is related to age because as a person gets older, their lung ventilation function decreases due to reduced alveolar elasticity, thickening of the bronchial glands, and decreased lung capacity, which results in a reduction in oxygen diffusion capacity.

In addition, based on gender, it can be concluded that patients with Pre-PEF 90.87 bpm tend to be male, found before intervention. This is supported by the table of respondent characteristics data which states that the majority of respondents are male. This is in line with the theory (Kim & Lee, 2012) In addition to having a history of smoking, men are also more frequently exposed to pollutants in the workplace (such as dust and chemicals), which can contribute to the development of COPD and worsen lung function. Long-term exposure to these risk factors leads to more severe or more progressive lung damage in men.

In addition to age and gender, based on the physical activity of the respondents, with an average PEF-Pre value of 90.87 bpm, they tend to have a pattern of physical activity that never involves exercising. This value is closer to the average of the 'never exercise' group, which has a mean of 84.06 from the previous histogram table, compared to the 'sometimes' group with a mean of 98.57. Furthermore, the data spread in the 'never' group is narrower, with a standard deviation of 7.12, so the value of 90.87 still falls within the typical range of the 'never exercise' group.

In patients with COPD, the respiratory system is already impaired, with limited airflow and air trapping, which increases the effort required to breathe even at rest. A sedentary lifestyle, such as rarely exercising or never exercising, worsens their functional capacity. One of the affected areas is the respiratory muscles, which become weak and less efficient, so individuals with a sedentary lifestyle have PEF values that are no better than those of individuals who exercise regularly. This is consistent with the research by (Lontoh, 2021) It shows a significant relationship between exercise habits and lung function. Respondents who exercise regularly have better lung function compared to those who never exercise, who are 3.42 times more at risk of having abnormal lung vital capacity. In line with this, (Suharno et al., 2020) It has also been reported that physical activity, including high-intensity exercise, has been shown to improve lung vital capacity, thereby supporting more efficient oxygen exchange.

Based on the above explanation, the researcher states that the decrease in PEF in COPD patients has an average PEF value of 90.87 lpm. This is caused by pathological mechanisms in the respiratory system, such as airway narrowing or obstruction, chronic bronchitis, emphysema, and abnormalities in the respiratory muscles, which are related to factors such as age, gender, and physical activity. This condition causes difficulty in expiration, air trapping, reduced tidal volume, alveolar hypoventilation, and increased oxygen consumption, which impacts the decrease in peak flow meter values due to the lungs' limited ability to expand optimally.

Ekspirasi Peak Expiratory Flow *Rate* After Ballon Blowing Excercise

Table 3 presents the characteristics of patients' PEF values after the Balloon Blowing Exercise intervention was applied. The data shows a mean post-intervention PEF of 103.53 lpm, with a standard deviation of 28.565.

After the Balloon Blowing Exercise intervention, the highest PEF value was 230 lpm, which is still in the yellow zone category. This post-test distribution indicates a shift in a more positive direction. The results of statistical analysis using the Wilcoxon signed-rank test proved that there is a significant effect of the Balloon Blowing Exercise on PEF values. Although there was an increase in PEF values, most respondents were still in the red and yellow zones. This indicates that the patients' lung function has not reached an optimal condition, despite improvements following the intervention.

This condition can be caused by several factors, such as the severity of the disease, the relatively short duration of exercise, and other factors like age, gender, and physical activity that affect PEF values in patients, as well as the presence of comorbidities that affect lung function. Thus, the increase in PEF values is indeed observed, but it is still not enough to bring the patient out of the risk zone (red/yellow). Although Balloon Blowing Exercise has been proven effective in providing improvement, this intervention needs to be carried out continuously and combined with other pulmonary rehabilitation strategies to achieve more optimal results.

This is in line with the research (Jun et al., 2015) which states that balloon-blowing exercises can significantly increase FEV1, FVC, and PEF values in COPD patients. Overall, it can be concluded that the average PEF value of 103.53 is more likely to be held by male respondents, aged over 60 years, and who have never engaged in physical activity.

Balloon Blowing Exercise Mechanism according to (Suharno et al., 2020) explains that this exercise involves the use of respiratory muscles, thereby helping to strengthen these muscles and improve breathing efficiency. By improving ventilation, preventing air trapping, and strengthening the respiratory muscles, the Balloon Blowing Exercise can reduce the work of breathing, which impacts the improvement of PEF values.

From the above description, the researcher states that the Balloon Blowing Exercise intervention is effective as a non-pharmacological management method in increasing peak expiratory flow as an indication of reduced shortness of breath experienced by COPD patients. This is supported by previous research findings and a clear physiological mechanism explaining how this exercise improves respiratory function. However, this intervention needs to be carried out continuously and combined with other pulmonary rehabilitation strategies to achieve more optimal results. This is because the exercise alone is still not sufficient to bring patients out of the risk zone (red/yellow), as it is related to other factors affecting peak expiratory flow, as explained above.

Effect of Ballon Blowing Excercise on Peak Respiratory Flow

Table 4 presents the results of statistical analysis regarding the effect of Balloon Blowing Exercise intervention on peak expiratory flow in COPD patients. From the presented data, it can be seen that the mean Pre-PEF value was 90.83 l/min. The mean Post-PEF value increased to 103.53 l/min. The difference between the Pre and Post mean PEF values was -12.7 l/min, indicating a positive effect from the intervention. The statistical significance test yielded a P-Value of 0.000 ($p < 0.05$), proving that the Balloon Blowing Exercise has a very significant effect on increasing peak expiratory flow in COPD patients.

Based on the research conducted on COPD patients at RSUD Sumberglagah, Pacet District, Mojokerto Regency, almost all respondents were in the age group over 60 years. Although there were a number of respondents under 60 years old included in this enhancement category. Older individuals usually experience a decline in lung elasticity and respiratory muscle strength, so they feel the effects of breathing exercises such as Balloon Blowing Exercise more. This intervention can stimulate the respiratory muscles and improve breathing patterns, allowing an increase in PEF to occur. Broadly speaking, the main point lies in the concept of "room for improvement," as explained in the theories mentioned above. This does not mean that lungs that have already undergone aging have a better ability to respond to the interventions provided; rather, a worse initial condition offers a greater opportunity to see more significant improvements from the interventions given.

The analysis of the relationship between the increase in PEF after the intervention and gender cannot be conducted in depth to produce a definite conclusion. The significant dominance of male respondents in this study's sample, comprising most of the total respondents in Table 4.1, resulted in a very limited number of female respondents. This limitation in the number of female respondents hinders the study's ability to identify any significant differences in the effects of the Ballon Blowing Exercise intervention between male and female genders.

In addition to being associated with age and gender, the increase in PEF can be linked to physical activity, as field case findings indicate that the increase in PEF tends to occur in respondents with a sedentary lifestyle (never exercising). Certainly, such a phenomenon observed in the field contradicts the research theory conducted by (Boyle et al., 2010) which states that individuals who regularly exercise have significantly higher values of forced expiratory volume in 1 second (FEV1), forced vital capacity (FVC), peak expiratory flow (PEF), and maximal expiratory flow (MEF25) compared to those who never exercise. However, this study is not in line with the research conducted by Marangoz et al. in 2016, which found no significant difference in Forced Expiratory Volume in 1st Second (FEV1) and peak expiratory flow (PEF) between individuals who regularly exercise long-term and those with a sedentary lifestyle. It should be noted that the differences in research results are due to differences in respondent characteristics, the spirometer used during the study, research outcome parameters, and statistical tests employed.

Although the Ballon Blowing Exercise intervention seems relatively simple, this exercise can provide a quite substantial stimulus to trigger early adaptations where changes are more clearly noticeable. Small improvements in respiratory muscle strength and coordination in a predominantly sedentary group can significantly reduce respiratory workload, and as a result, produce a more measurable increase in PEF. On the other hand, respondents who exercise occasionally are likely to have slightly better baseline respiratory fitness before the intervention. Although the intervention still provides benefits, they may have reached a certain threshold of adaptation, so the scale of improvement observed tends to show relatively small changes. These results highlight that the Balloon Blowing Exercise can be a very effective starting point for intervention, particularly for COPD patients with very low physical activity levels, with the potential to achieve more significant improvements in respiratory function.

CONCLUSIONS

Based on the result of this reseach, the researcher states that this study provides strong empirical evidence to support the implementation of Balloon Blowing Exercise as an effective non-pharmacological therapy modality in pulmonary rehabilitation programs for COPD patients in healthcare facilities.

REFERENCE

Afrian, N. N. (2023). Health Journal "Love That Renewed" Peningkatan Kapasitas Paru Dengan Metode Ballon Blowing Relaxation Pada Perokok Aktif. *Jurnal Kesehatan*, *11*(1), 139–147.

Boyle, K. L., Olinick, J., & Lewis, C. (2010). The value of blowing up a balloon. *North American Journal of Sports Physical Therapy : NAJSPT*, *5*(3), 179–188. http://www.ncbi.nlm.nih.gov/pubmed/21589673%0Ahttp://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=PMC2971640

Butsainah, D., Multazam, A., & Lubis, Z. I. (2025). *Hubungan Lama Penggunaan Dupa terhadap Nilai Arus Puncak Ekspirasi pada Masyarakat Jembrana Bali*. *5*(1), 55–62.

Camac, E. R., Voelker, H., & Criner, G. J. (2021). Impact of COPD exacerbations leading to hospitalization on general and disease-specific quality of life. *Respiratory Medicine*, *186*(June). https://doi.org/10.1016/j.rmed.2021.106526

Cheng, W., Duan, J., Zhou, A., Zhao, Y., Yi, R., Liu, Y., Deng, D., Li, X., Zeng, Y., Peng, Y., Song, Q., Lin, L., Yang, M., & Chen, P. (2021). Real-World Effectiveness of Inhalation Therapy Among Patients With Symptomatic COPD in China: A Multicenter Prospective Study. *Frontiers in Pharmacology*, *12*(September), 1–11. https://doi.org/10.3389/fphar.2021.753653

Firdausi, N. L., Artanti, K. D., & Li, C.-Y. (2021). Analysis of Risk Factors Affecting The Occurrence of Chronic Obstructive Pulmonary Disease in Indonesia. *Jurnal Berkala Epidemiologi*, *9*(1), 18. https://doi.org/10.20473/jbe.v9i12021.18-25

Fretes, F. De, Messakh, S. T., Dina, I., & Saogo, M. (2020). Analisis Efektifitas Pursed Lip Breathing dan Balloon Blowing untuk Meningkatkan Saturasi Oksigen pada Pasien COPD (Chronic Obstructive Pulmonary Disease). *Jurnal Sains Dan Kesehatan*, *3*(2), 418–421.

GOLD. (2025). *GOLD-REPORT-2026-v1.1-11Nov2025_DRAFT_WMV.pdf*.

Ihwan, A., Nugraha, A., & Negara, C. K. (2022). Ballons And Buteyko Blowing Exercises Against Peak Current Expiration Of Asthma Patients-Anhar Ihwan, Ary Nugraha, Candra Kusuma Negara Ballons And Buteyko Blowing Exercises Against Peak Current Expiration Of Asthma Patients. *Jurnal Eduhealt*, *13*(01), 204–211. http://ejournal.seaninstitute.or.id/index.php/healt

Jun, H. ju, Lim, S. W., & Kim, K. J. (2015). Comparison of the Impact of Breathing Strengthening Exercises and Balloon

Blowing Training on the Pulmonary Function of Elderly Smokers. *Journal of International Academy of Physical Therapy Research*, *6*(2), 878–883. https://doi.org/10.5854/jiaptr.2015.10.30.878
Kanniappan, V., & Manivannan, V. (2020). Efficacy of Balloon Blowing Exercise on Peak Expiratory Flow Rate in Young Adult Smokers. *Journal of Lifestyle Medicine*, *10*(2), 116–120. https://doi.org/10.15280/jlm.2020.10.2.116
Kemenkes RI. (2018). Hasil Riset Kesehatan Dasar Tahun 2018. *Kementrian Kesehatan RI*, *53*(9), 1689–1699.
Kemenkes RI. (2022). *Hari Paru-Paru Obstruktif*.
Kemenkes RI. (2023). Ditjen P2P Laporan Kinerja Semester I Tahun 2023. *Kemenkes RI*, 1–134.
Kim, J. S., & Lee, Y. S. (2012). Effects of a balloon-blowing exercise on lung function of young adult smokers. *Journal of Physical Therapy Science*, *24*(6), 531–534. https://doi.org/10.1589/jpts.24.531
Lestari, N. K. Y., & Saraswati, N. L. G. I. (2022). Pengaruh Yoga Pranayama terhadap Kualitas Hidup Penderita PPOK di Rumah Sakit Sanjiwani Gianyar. *Malahayati Nursing Journal*, *4*(12), 3335–3346. https://doi.org/10.33024/mnj.v4i12.7924
Lontoh, S. O. (2021). *MAHASISWA FAKULTAS KEDOKTERAN UNIVERSITAS mahasiswa dengan kriteria inklusi adalah mahasiswa / mahasiswi Fakultas Kedokteran Universitas Tarumanagara bersedia berpartisipasi sebagai subjek penelitian dan menandatangani informed consent . Kriteria eksklusi penelitian saat pemeriksaan fungsi paru sedang mengalami infeksi pengambilan subjek menggunakan judgment sampling . Data primer berdasarkan kebiasaan mendapatkan data tambahan karekteristik responden seperti jenis kelamin , umur . Variabel bebas*. *1*(2), 147–154.
Mukhtar, H. (2017). *Pengaruh penambahan active cycle of breathing technique pada latihan endurance terhadap peningkatan kualitas hidup pada penderita PPOK*. 1–23.
Quanjer, P. H., Lebowitz, M. D., Gregg, I., Miller, M. R., & Pedersen, O. F. (1997). Peak expiratory flow: Conclusions and recommendations of a Working Party of the European Respiratory Society. *European Respiratory Journal, Supplement*, *11*(1), 2–8.
Sanga, L., Purba, L., & Harefa, N. (2020). Pengaruh Kandungan Oksigen Udara Sekolah Terhadap Konsentrasi Belajar Siswa. *Jurnal EduMatSains*, *4*(2), 169–182.
Santosa, S., Purwito, J., & Widjaja, J. T. (1996). *Perbandingan Nilai Arus Puncak Ekspirasi Antara Perokok dan Bukan Perokok*. 59–70.
Sharma, M., Joshi, S., Banjade, P., Ghamande, S. A., & Surani, S. (2025). Global Initiative for Chronic Obstructive Lung Disease (GOLD) 2023 Guidelines Reviewed. *The Open Respiratory Medicine Journal*, *18*(1), 1–7. https://doi.org/10.2174/0118743064279064231227070344
Shodiq. (2020). Intervensi Keperawatan Dalamupaya Peningkatan Keefektifan Pola Nafas Pada Pasien Dengan Ppok. *PENGARUH PENGGUNAAN PASTA LABU KUNING (Cucurbita Moschata) UNTUK SUBSTITUSI TEPUNG TERIGU DENGAN PENAMBAHAN TEPUNG ANGKAK DALAM PEMBUATAN MIE KERING*, *3*, 274–282.
Suharno, M. D., Sudiana, I. K., Dian, N. K., Bakar, A., Amin, M., Sukartini, T., & Winoto, A. (2020). The Effectiveness of Ballon Blowing Exercise on Increasing Expiratory Forced Volume Value in 1 Second (FEV1) and Oxygen Saturation among COPD patients. *International Journal of Nursing and Health Services (IJNHS)*, *3*(4), 513–519. http://ijnhs.net/index.php/ijnhs/homehttp://doi.org.10.35654/ijnhs.v3i3.229
Westerdahl, E., Osadnik, C., & Emtner, M.

(2019). Airway clearance techniques for patients with acute exacerbations of chronic obstructive pulmonary disease: Physical therapy practice in Sweden. *Chronic Respiratory Disease*, *16*. https://doi.org/10.1177/1479973119855868

Yuniarti, E. V. (2024). *Active Cycle of Breathing Technique (ACBT) against peak expiratory flow in COPD Patient*. *8*(3), 463–472.