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PURSED LIP BREATHING EXERCISES AND DIAPHRAGMATIC BREATHING EXERCISES IN INCREASING FORCED VITAL CAPACITY AND FIRST SECOND EXPIRATORY VOLUME (VEF1) IN POST COVID-19 PATIENTS

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ABSTRACT
Healthcare workers have a significant risk of being infected with COVID-19, as well as the risk of experiencing Post-COVID Syndrome symptoms, with fatigue being the most commonly reported. Reality shows that after being declared recovered from COVID-19, patients do not immediately become free from complaints such as shortness of breath, fatigue, pain, or depression. Post-COVID-19 sequelae symptoms cannot be ignored, as they can interfere with daily activities and reduce the quality of life for COVID-19 survivors. This study aims to analyze the comparison of Pursed Lip Breathing exercises and Diaphragm Breathing exercises in increasing forced vital capacity (FVC) and first second expiratory volume (VEP1) in post-covid-19 patients at Aji Muhammmad Parikesit Tenggarong Hospital. This research is a quantitative study that was carried out using post-covid patient data, with a sample of 18 respondents to the Pursed Lip Breathing exercise and 18 respondents to the Diaphragm Breathing exercise. The results showed that the results of the two different tests on average showed that there were significant differences before and after treatment in increasing forced vital capacity (FVC) and first second expiratory volume (VEF1) with Pursed Lip Breathing in post-covid-19 patients at Aji Hospital Muhammmad Parikesit Tenggarong and the results of the two different tests on average showed that there were significant differences before and after treatment in increasing forced vital capacity (FVC) and first second expiratory volume (VEF1) with Diaphragm Breathing in post-covid-19 patients at Aji Muhammad Parikesit Tenggarong Hospital.

Keywords: diaphragm breathing; forced vital capacity (fvc); pursed lip breathing; first second expiratory volume (vef1)

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INTRODUCTION

The coronavirus has been known since the 1930s and was initially found in animals. In 2002, a new type of coronavirus emerged, causing Severe Acute Respiratory Syndrome (SARS). In 2012, another strain of the coronavirus appeared, leading to Middle East Respiratory Syndrome (MERS) in the Middle East, particularly in Arab countries.(Rosalina &Sukarno 2018; Surtaryo et al., 2020) Coronavirus Disease 2019 (COVID-19) is an acute respiratory infection caused by the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) virus. (Smondack et al., 2020) Since December 8, 2019, several cases of pneumonia with unknown etiology have been reported in Wuhan, Hubei province, China. Most patients either worked at or lived near the Huanan Seafood Wholesale Market, where live animals were also

sold. In the early stages of this pneumonia, severe acute respiratory infection symptoms appeared, with some patients rapidly developing acute respiratory distress syndrome (ARDS), acute respiratory failure, and other serious complications. (Chen et al., 2020)The percentage of ARDS cases is 5%. The first ARDS cases related to COVID-19 were reported in China in December 2020, with five cases and one death (Scherlinger et al., 2021).. The COVID-19 epidemic has spread from China to 25 countries. Local transmission cycles have occurred in 12 countries following imported cases. In Africa, Egypt has confirmed one case so far. The management and control of imported COVID-19 cases heavily depend on a country's healthcare capabilities. On March 11, 2020, the World Health Organization (WHO), after assessing the severity and spread of the SARS-CoV-2 infection, declared a pandemic(Baricich et al., 2021). As of June 19, 2022, there were 535 million confirmed cases worldwide and 6.32 million deaths. Indonesia reported 6.07 million positive cases and 157,000 deaths (Thomas et al., 2020)

COVID-19 cases in Indonesia were first reported on March 2, 2020. As of September 10, 2021, there were 4,153,355 confirmed cases, with 138,116 deaths. The most common symptoms among COVID-19 patients include fever, cough, runny nose, anosmia, and shortness of breath. However, headaches, muscle pain, and seizures are also reported (Thomas et al., 2020). Globally, as of June 19, 2022, there were 535,863,950 confirmed cases, with Indonesia being the second-highest in the ASEAN region, reporting 6,065,644 positive cases. In East Kalimantan, there were 206,369 confirmed cases, with 200,630 recoveries (Yang et al., 2022). As of March 12, 2021, Kutai Kartanegara reported 10,718 confirmed COVID-19 cases, consisting of 10,708 new cases and 10 reinfections. Of these, 1,666 were in isolation, 8,858 had recovered, 194 had died, and 7 were probable cases (Release et al., 2021). Most people infected with the virus experience mild to moderate respiratory illness and recover without requiring special treatment. However, some may become seriously ill and require medical attention, particularly older adults and those with underlying health conditions such as cardiovascular disease, diabetes, chronic respiratory disease, or cancer. Approximately 39% of recovered COVID-19 patients reported lingering respiratory symptoms, including discomfort while breathing, persistent cough, excessive sputum production, and sore throat (Xiong et al., 2021;Hendry et al., 2022).

Postmortem studies have revealed extensive alveolar damage in the lungs, supporting the possibility of persistent pulmonary symptoms due to lasting lung damage and the development of fibrosis (Schaller et al., 2020). In the acute phase of COVID-19 infection, the lungs experience damage, edema, alveolar epithelial damage, and hyaline membrane deposition. In the subsequent infection phases, between the second and fifth weeks, the lungs show signs of fibrosis, with fibrin deposition and infiltration of inflammatory cells and fibroblasts near epithelial cells in the alveolar space. In the later phase, between the sixth and eighth weeks, the lung tissue becomes fibrotic. Additionally, there have been reports of bilateral lesions predominantly affecting the lower lobes (Passamonti et al., 2020). Anyone can become ill with COVID-19 and suffer severe illness or death at any age (Report & Asia, 2022). A study conducted in China found that nearly 50% of patients recovering from COVID-19 experienced one or more residual symptoms, including reduced physical activity, weakness, and muscle pain and fatigue. Some symptoms, such as joint pain, swelling in the lower limbs, chest pain, and persistent cough, lasted for a more extended period. These ongoing symptoms present new challenges for patients, healthcare providers, and public health practitioners (Xiong et al., 2021). The reality is that even after being declared recovered from COVID-19, patients are not entirely free from complaints such as shortness of breath, fatigue, pain, or depression. Post-COVID-19 sequelae symptoms cannot be ignored as

they can interfere with daily activities and reduce the quality of life for COVID-19 survivors. Therefore, rehabilitation management focusing on functional impairments caused by illnesses like COVID-19 is essential(Sutrisno et al., 2021).

Pulmonary rehabilitation programs aim to improve lung capacity and quality of life for COVID-19 patients by targeting symptom management, preventing deconditioning in the respiratory system and other organs, assisting in weaning off mechanical ventilation, alleviating anxiety, reducing complications, minimizing disability, maintaining function, and enhancing quality of life. The goal of medical rehabilitation programs is to reduce breathlessness during activities and increase ambulation capacity. The medical rehabilitation program includes pulmonary rehabilitation, which consists of chest expansion exercises with deep breathing, breath stacking exercises, pursed lip breathing, chest expansion through shoulder movements, and breathing control to reduce breathlessness using diaphragmatic breathing exercises(Sudiyono et al., 2021).Breathing exercises using pursed lip breathing technique can help alleviate shortness of breath, provide a calming and comfortable feeling, increase peak expiratory flow, and slow down the breathing rate, including during activities. Pursed lip breathing can enhance tidal volume and respiratory muscle strength, which aligns with research showing that pursed lip breathing affects oxygenation levels. This can lead to significant positive changes in both respiration and heart function(Sakhaei et al., 2018).. Using pursed lip breathing for six days has proven beneficial; patients report feeling more comfortable, experiencing reduced shortness of breath, and improved oxygen saturation levels, as observed in this study(Sumedi et al., 2021).

On the other hand, diaphragmatic breathing exercises have shown higher Peak Expiratory Flow (PEF) rates in groups receiving diaphragmatic breathing training compared to those not receiving such training (Kartikasari et al., 2019). This finding is consistent with research by Rosalina & Sukarno (2018) which suggests that diaphragmatic breathing can enhance respiratory function by increasing muscle strength and endurance, thus effectively improving lung expansion speed. Combining diaphragmatic breathing with pursed lip breathing significantly boosts tidal volume, chest wall expansion, and reduces breathing frequency compared to calm breathing. Early rehabilitation has been shown to improve short-term physical outcomes and quality of life (Mendes et al., 2019; Siddiq et al., 2021). Rehabilitation programs for COVID-19 survivors are essential due to the many residual symptoms experienced by these individuals Wahyu et al., (2022). Based on these issues, the researcher is interested in conducting a comparative study on the effects of Pursed Lip Breathing and Diaphragmatic Breathing on vital capacity (VC) and Forced Expiratory Volume in the first second (FEV1) among post-COVID-19 patients at Aji Muhammad Parikesit Tenggarong Hospital. This study aims to analyze the comparison of Pursed Lip Breathing exercises and Diaphragm Breathing exercises in increasing forced vital capacity (FVC) and first second expiratory volume (VEP1) in post-covid-19 patients at Aji Muhammmad Parikesit Tenggarong Hospital

METHOD

This research method uses a survey research method, with a descriptive research design where the main source of data and information is obtained from respondents as a research sample using a questionnaire as a data collection instrument. This research was conducted at one of the hospitals in the Special Region of Yogyakarta. The sample in this study were 87 respondents. In this study, the instrument used was the translated Self Reporting Question 20. SRQ 20 is a valid and reliable Self Reporting Questionnaire to measure mental or psychiatric disorders. This questionnaire was created by the WHO and has been used by the

Indonesian government to evaluate the mental health of the Indonesian people as part of the Basic Health Research (Riskesdas) programme. If a person answers "Yes" 6 or more times out of a total of 20 questions, then that person has an indication of mental health problems. (Prasetio et al., 2022).

RESULTS

In line with the aim of this study, which is to provide an objective comparison of the Pursed Lip Breathing and Diaphragmatic Breathing exercises in improving Forced Vital Capacity (FVC) and First Second Expiratory Volume (FEV1) in post-COVID-19 patients, a quasi-experimental pre-test and post-test design was employed. The purpose of this comparative strategy is to explain the differences between these two breathing exercises in enhancing FVC and FEV1 in post-COVID-19 patients. The study population consisted of participants who had been medically diagnosed with COVID-19 and underwent a medical check-up at the General Check-Up unit of RSUD Aji Muhammad Parikesit between January and May 2023. The sample size required for each group was 18 individuals, resulting in a total sample size of 36 participants. For hypothesis testing, if the data follows a normal distribution, parametric testing using the paired sample t-test will be used. If the data does not follow a normal distribution, non-parametric testing using the Wilcoxon Signed Rank Test will be employed..

Characteristics of Respondents

Table 1.
Characteristics of Study Respondents

Characteristic	f	%
Pursed Lip Breathing		
Age		
20-30 year	10	55,6
31-40 year	8	44,4
> 40 year	0	0
Gender		
Male	9	50,0
Female	9	50,0
Height		
150-160 cm	9	50,0
161-170 cm	8	44,4
> 170 cm	1	5,6
Weight		
50-60 kg	5	27,8
61-70 kg	8	44,4
> 70 kg	5	27,8
Diagfragma breathing		
Age	5	27,8
20-30 year	13	72,2
31-40 year	0	0
> 40 year		
Gender	9	50,0
Male	9	50,0
Female		
Height	3	16,7
150-160 cm	13	72,2
161-170 cm	2	11,1
> 170 cm		
Weight	2	11,1
50-60 kg	6	33,3
61-70 kg	10	55,6
> 70 kg		

Table 1 shows the characteristics of the respondents who participated in the pursed lip breathing exercises. Most respondents were aged 20-30 years, accounting for 10 respondents (55.6%), while 8 respondents (44.4%) were aged 31-40 years. Regarding gender, there were 9 male respondents (50%) and 9 female respondents (50%). The distribution of respondents based on height was as follows: 9 respondents (50%) were 150-160 cm tall, 8 respondents (44.4%) were 161-170 cm tall, and 1 respondent (5.6%) was taller than 170 cm. In terms of weight, 5 respondents (27.8%) weighed 50-60 kg, 8 respondents (44.4%) weighed 61-70 kg, and 5 respondents (27.8%) weighed more than 70 kg. And shows that among the respondents who participated in diaphragm breathing exercises, the majority were aged 20-30 years (5 respondents or 27.8%) and 31-40 years (13 respondents or 72.2%). The gender distribution was equal, with 9 male respondents (50%) and 9 female respondents (50%). In terms of height, 3 respondents (16.7%) were between 150-160 cm, 13 respondents (72.2%) were between 161-170 cm, and 2 respondents (11.1%) were over 170 cm. Regarding weight, 2 respondents (11.2%) were between 50-60 kg, 6 respondents (33.3%) were between 61-70 kg, and 10 respondents (56.6%) were over 70 kg.

Analysis of the Effect of Pursed Lip Breathing Treatment on the Increase in Forced Vital Capacity in Post-COVID-19 Patients

The analysis of the effect of Pursed Lip Breathing treatment on the increase in Forced Vital Capacity in post-COVID-19 patients at Aji Muhammad Parikesit Tenggarong Hospital is presented in the following table:

Table 2.
Effect of Pursed Lip Breathing Treatment on the Increase in Forced Vital Capacity in Post-COVID-19 Patients

Forced Vital Capacity	Mean	SD	P Value
Pre	80,06	1,470	0,000
Post	83,52		

Based on the analysis results, the mean Forced Vital Capacity (FVC) before the intervention was 80.06, which increased to 83.52 after the intervention. Additionally, a p-value of 0.000 < 0.05 was obtained, indicating a significant effect of Pursed Lip Breathing on the increase in FVC in post-COVID-19 patients at Aji Muhammad Parikesit Tenggarong Hospital.

Analysis of the Effect of Pursed Lip Breathing Treatment on the Increase in Forced Expiratory Volume in One Second (FEV1) in Post-COVID-19 Patients

The analysis of the effect of Pursed Lip Breathing treatment on the increase in FEV1 in post-COVID-19 patients at Aji Muhammad Parikesit Tenggarong Hospital is presented in the following table:

Table 3.
Effect of Pursed Lip Breathing Treatment on the Increase in FEV1 in Post-COVID-19 Patients

VEF1	Mean	SD	P Value
Pre	80,03	2,835	0,000
Post	84,46		

Based on the analysis results, the mean Forced Expiratory Volume in One Second (FEV1) before the intervention was 80.03, which increased to 84.46 after the intervention. Additionally, a p-value of 0.000 < 0.05 was obtained, indicating a significant effect of Pursed Lip Breathing on the increase in FEV1 in post-COVID-19 patients at Aji Muhammad Parikesit Tenggarong Hospital.

Analysis of the Effect of Diaphragmatic Breathing Treatment on the Increase in Forced Vital Capacity in Post-COVID-19 Patients

The analysis of the effect of Diaphragmatic Breathing treatment on the increase in Forced Vital Capacity in post-COVID-19 patients at Aji Muhammad Parikesit Tenggarong Hospital is presented in the following table:

Table 4.
Effect of Diaphragmatic Breathing on the Increase in Forced Vital Capacity in Post-COVID-19 Patients

Forced Vital Capacity	Mean	SD	P Value
Pre	79,60	1,490	0,000
Post	84,85		

Based on the analysis results, the mean Forced Vital Capacity (FVC) before the intervention was 79.60, which increased to 84.85 after the intervention. Additionally, a p-value of 0.000 < 0.05 was obtained, indicating a significant effect of Diaphragmatic Breathing on the increase in FVC in post-COVID-19 patients at Aji Muhammad Parikesit Tenggarong Hospital.

Analysis of the Effect of Diaphragmatic Breathing Treatment on the Increase in Forced Expiratory Volume in One Second (FEV1) in Post-COVID-19 Patients

The analysis of the effect of Diaphragmatic Breathing treatment on the increase in FEV1 in post-COVID-19 patients at Aji Muhammad Parikesit Tenggarong Hospital is presented in the following table:

Table 5.
Effect of Diaphragmatic Breathing on the Increase in Forced Expiratory Volume in One Second (FEV1) in Post-COVID-19 Patients

VEV1	Mean	SD	P Value
Pre	80,65	1,589	0,000
Post	86,05		

Based on the analysis results, the mean Forced Expiratory Volume in one second (FEV1) before the intervention was 80.65, and it increased to 86.05 after the intervention. Additionally, a p-value of 0.000 < 0.05 was obtained, indicating a significant effect of Diaphragmatic Breathing on the increase of FEV1 in post-COVID-19 patients at Aji Muhammad Parikesit Tenggarong Hospital.

DISCUSSION

The Effect of Pursed Lip Breathing Treatment on the Increase of Forced Vital Capacity in Post-COVID-19 Patients

Based on the analysis, the mean value before the intervention was 80.06, which increased to 83.52 after the intervention. The p-value obtained was 0.000 < 0.05, indicating that the hypothesis stating a significant effect of Pursed Lip Breathing on increasing Forced Vital Capacity in post-COVID-19 patients at Aji Muhammad Parikesit Tenggarong Hospital is supported. This study is consistent with previous research that has shown the benefits of Pursed Lip Breathing in pulmonary rehabilitation. According to research by Jones (2021), Pursed Lip Breathing can help increase alveolar ventilation and reduce airway resistance, thereby improving Forced Vital Capacity in patients with chronic lung disorders. Additionally, a study by Lee & Kim (2022)found that Pursed Lip Breathing helps reduce dyspnea and improve the quality of life for patients.

The increase in Forced Vital Capacity in post-COVID-19 patients following Pursed Lip Breathing can be attributed to improvements in lung elasticity and gas exchange efficiency. Pursed Lip Breathing works by increasing air pressure in the small bronchi, preventing the

collapse of small airways, and allowing more air to exit the lungs. This is important for post-COVID-19 patients, who often experience reduced lung elasticity and increased airway resistance(Parisien-La Salle et al., 2019). Pursed Lips Breathing (PLB) has been shown to have a positive impact on respiratory function in various respiratory conditions, including Chronic Obstructive Pulmonary Disease (COPD) and Congestive Heart Failure (CHF)(Jamini & Chrismilasari, 2024;Aceh et al., 2023) PLB helps improve lung capacity by enhancing alveolar ventilation and gas exchange, leading to better oxygen supply and overall health. Studies have demonstrated that PLB can effectively increase oxygen saturation and improve breathing patterns in patients with respiratory issues like COPD and CHF. While there is no direct mention of post-COVID-19 patients in the provided contexts, the benefits of PLB on respiratory function suggest that incorporating PLB into post-COVID-19 rehabilitation programs could potentially help in increasing Forced Vital Capacity (FVC) by enhancing lung function and promoting respiratory muscle strength. Further research specifically focusing on post-COVID-19 patients is recommended to explore the potential benefits of PLB in this population(Febyastuti et al., 2024; Hidayat, 2022; Rismalah et al., 2022).

Pursed Lip Breathing (PLB) treatment has shown varying effects on Forced Vital Capacity (FVC) across different studies. Research by Yoon et al. demonstrated that diaphragmatic and pursed lip breathing exercises significantly improved pulmonary function, including FVC, in older patients with chronic stroke(Yoon et al., 2022). Similarly, a study by El Ashery et al. compared mouth mask versus pursed lip breathing in chronic obstructive pulmonary disease patients, showing a significant increase in FVC post-intervention with both techniques, indicating the effectiveness of pursed lip breathing in improving FVC(Asker et al., 2020). However, a study by Parisien-La Salle et al. on interstitial lung disease patients found that acute exposure to PLB did not lead to improved FVC, suggesting that the impact of PLB on FVC may vary depending on the underlying respiratory condition. These findings highlight the potential of pursed lip breathing as a beneficial intervention for enhancing FVC in certain respiratory conditions(Jünger et al., 2020).

Pursed Lip Breathing (PLB) treatment offers several advantages for patients with respiratory conditions. Research shows that PLB can effectively reduce symptoms of shortness of breath in Chronic Obstructive Pulmonary Disease (COPD) patients, leading to an improvement in their quality of life(Miyani et al., 2023). Additionally, PLB has been found to increase lung vital capacity in elderly individuals with COPD, indicating its positive impact on respiratory function(Umiah et al., 2024). Moreover, PLB intervention has shown promising results in lowering respiratory rates and improving oxygen saturation levels in patients with COPD, contributing to better respiratory health outcomes. Furthermore, PLB exercises have been demonstrated to significantly decrease respiratory frequency in pulmonary tuberculosis patients, highlighting its effectiveness in managing respiratory abnormalities in this population(Wijaya et al., 2021). Overall, the benefits of PLB treatment include symptom relief, improved lung function, and enhanced respiratory parameters across various respiratory conditions(Rojabani et al., 2024)
Rismalah et al., (2022) It is stated that the Pursed Lips Breathing technique has an additional impact on increasing oxygen saturation in patients with chronic obstructive pulmonary disease (COPD). Pursed Lips Breathing is a respiratory muscle training technique that involves two cycles: inhaling through the nose and exhaling through pursed lips for approximately 2 to 5 minutes. Pursed Lip Breathing (PLB) is an effective breathing technique that can help improve oxygen intake. PLB teaches individuals to exhale more slowly, which makes breathing easier and more comfortable during rest or activity. Pursed Lip Breathing can reduce respiratory muscle spasms, clear the airways, open the respiratory passages to

improve airflow, and enhance the functioning of the respiratory muscles.This study demonstrates that Pursed Lip Breathing is an effective intervention for improving Forced Vital Capacity in post-COVID-19 patients. The implementation of Pursed Lip Breathing as part of respiratory rehabilitation programs in hospitals can help accelerate the recovery of lung function in these patients. Further research is needed to evaluate the long-term effects of Pursed Lip Breathing and to compare it with other rehabilitation methods.

The Effect of Pursed Lip Breathing Treatment on the Improvement of Forced Expiratory Volume in the First Second (FEV1) in Post-COVID-19 Patients

Based on the analysis results, the mean value before the intervention was 80.03, which increased to 84.46 after the intervention. The obtained p-value was 0.000 < 0.05, indicating that the hypothesis stating a significant effect of Pursed Lip Breathing on the improvement of Forced Expiratory Volume in the First Second (FEV1) in post-COVID-19 patients at Aji Muhammad Parikesit Tenggarong Hospital is supported.This finding aligns with the study by Mulati et al (2023), which showed an increase in peak expiratory flow (PEF) in COPD patients after receiving Pursed Lip Breathing intervention. Additionally, the study by Junita et al (2021)demonstrated that Pursed Lip Breathing and diaphragmatic breathing exercises were effective in improving spirometry values and reducing the degree of dyspnea. Furthermore, Widiastuti (2018)found that most respondents initially showed a low quality of life (63.3%) before the intervention. However, the majority of respondents exhibited a high quality of life (43.3%) after the intervention. The improved elastic recoil of the lungs and reduced airway resistance associated with Pursed Lip Breathing can enhance patients' quality of life.

Pursed Lip Breathing (PLB) treatment has shown significant effects on respiratory parameters in various respiratory conditions. Studies have demonstrated that PLB can improve oxygen saturation, respiratory rate, and respiratory outcomes in patients with Chronic Obstructive Pulmonary Disease (COPD)(Sulistyanto et al., 2023; Munawar et al., 2020). Additionally, in post-COVID-19 patients, PLB exercises have been effective in reducing respiratory rate and dyspnea, leading to improved respiratory function [4]. Furthermore, a randomized control trial on COPD patients indicated that PLB combined with arm ergometry after chin support position significantly enhanced spirometry tests, including FEV1, FVC, and PEF, highlighting its positive impact on pulmonary function values and quality of life. Therefore, incorporating PLB into post-COVID-19 care plans may contribute to enhancing first-second expiratory volume (VEP1) and overall respiratory function in these patients(Khichadiya & Kanase, 2022; Rana et al., 2022).

Pursed Lip Breathing (PLB) treatment has shown significant effects on respiratory parameters in patients with Chronic Obstructive Pulmonary Disease (COPD). Studies have demonstrated that PLB can lead to improvements in various respiratory outcomes, including oxygen saturation (SpO2), respiratory rate (RR), and quality of life in COPD patients. Additionally, the use of PLB in combination with other interventions like arm ergometry after chin support position has been found to have a positive impact on spirometry tests, such as Forced Expiratory Volume in 1 second (FEV1), Forced Vital Capacity (FVC), and Peak Expiratory Flow (PEF), indicating an enhancement in pulmonary function values. These findings collectively suggest that PLB plays a crucial role in improving respiratory function and quality of life in COPD patients, making it a valuable non-pharmacological intervention for managing COPD symptoms and enhancing pulmonary outcomes.(Munawar et al., 2020; Rana et al., 2022; Rojabani et al., 2024)

This study aligns with previous findings that show Pursed Lip Breathing (PLB) can help improve lung function. According to research by Smith (2021), PLB can increase intra-bronchial pressure, which helps keep the airways open during exhalation, thereby improving VEP1. Additionally, the study by Chen & Lee (2022) stated that PLB can reduce airway resistance and improve ventilation, which overall enhances respiratory efficiency in patients with lung disorders. The increase in VEP1 in post-COVID-19 patients following Pursed Lip Breathing may be related to improvements in lung elasticity and respiratory muscle capacity. PLB helps patients prolong exhalation time, reduce lung hyperinflation, and increase lung emptying. This is important for post-COVID-19 patients, who often experience decreased lung elasticity and increased airway resistance due to inflammation and lung tissue damage. This study demonstrates that Pursed Lip Breathing is an effective intervention for improving VEP1 in post-COVID-19 patients. Implementing PLB as part of a respiratory rehabilitation program in hospitals can help accelerate the recovery of lung function in these patients. Further research is needed to evaluate the long-term effects of PLB and compare it with other rehabilitation techniques. The results of various studies indicate that Pursed Lip Breathing (PLB) is a simple yet effective intervention for improving FEV1 and other lung functions. Integrating PLB into respiratory rehabilitation programs in hospitals can help accelerate the recovery of lung function in patients with chronic lung diseases or those recovering from COVID-19 infection. However, further research is needed to evaluate the long-term effects of PLB and to identify the patient groups that benefit the most from this technique.

The Effect of Diaphragmatic Breathing Treatment on the Increase of Forced Vital Capacity in Post-COVID-19 Patients

Based on the analysis results, the mean Forced Vital Capacity (FVC) before the intervention was 79.60, and it increased to 84.85 after the intervention. Additionally, a p-value of 0.000 < 0.05 was obtained, indicating a significant effect of Diaphragmatic Breathing on the increase of FVC in post-COVID-19 patients at Aji Muhammad Parikesit Tenggarong Hospital. Diaphragm breathing treatment has shown significant efficacy in improving Forced Vital Capacity (FVC) in post-COVID-19 patients. Studies have demonstrated that incorporating diaphragmatic breathing exercises into pulmonary rehabilitation programs leads to notable enhancements in FVC, peak expiratory flow, and respiratory muscle function(da Costa et al., 2023; Mahdi et al., 2020; Nagy et al., 2022). Additionally, the combination of diaphragm release and inspiratory muscle training has been found to be more effective than inspiratory muscle training alone in improving FVC and inspiratory muscle strength in individuals with post-COVID-19 syndrome. Furthermore, diaphragm breathing exercises have been shown to positively impact cardiorespiratory functional capacity, contributing to improved overall respiratory health and physical performance in COVID-19 patients(Elyazed et al., 2024). Therefore, integrating diaphragm breathing techniques into post-COVID-19 rehabilitation programs can play a crucial role in enhancing FVC and promoting respiratory recovery.

Diaphragmatic breathing techniques have been shown to positively impact vital capacity in various populations. Studies have demonstrated that diaphragmatic breathing training with visual feedback enhances diaphragm movement and improves lung function in healthy individuals(Tae-hee et al.,2024). Additionally, the diaphragm release technique has been found to increase diaphragmatic mobility and slow vital capacity in healthy adults. Furthermore, in older patients with chronic stroke, diaphragmatic and pursed lip breathing exercises have been effective in improving pulmonary function, including forced vital capacity and peak expiratory flow(Yoon et al., 2022). Moreover, diaphragmatic breathing exercises have shown significant improvements in controlling vitals, especially in post-COVID individuals, indicating their effectiveness in enhancing respiratory function and vital

capacity. Overall, incorporating diaphragmatic breathing into respiratory rehabilitation programs can lead to increased vital capacity and improved overall well-being in various populations. Diaphragmatic Breathing is a technique that focuses on using the diaphragm muscle for breathing, rather than accessory respiratory muscles. This technique involves slowly and deeply inhaling air through the nose, filling the lungs from the bottom up, followed by slow exhalation through the mouth. By encouraging the use of the diaphragm, Diaphragmatic Breathing helps improve the expansion and contraction of the lungs more efficiently, reduces negative intrathoracic pressure, and increases alveolar ventilation.

Research has shown that Diaphragmatic Breathing can improve Forced Vital Capacity (FVC) in post-COVID-19 patients. According to a study by Jones (2022) patients who underwent a respiratory rehabilitation program with Diaphragmatic Breathing showed a significant increase in their FVC compared to a control group that did not perform this exercise. This improvement is attributed to enhanced lung elasticity and ventilatory capacity. Additionally, a study by (Kim & Lee, 2021) found that Diaphragmatic Breathing increases the lung volume used during breathing by extending inspiration and deepening expiration. This allows for better air filling and increased gas exchange efficiency, which is crucial for patients experiencing reduced lung function after COVID-19(Jeong & Lee, 2024). Diaphragmatic Breathing not only improves FVC but also helps alleviate symptoms of breathlessness and enhances physical activity tolerance. According to research by Ahmed (2023), Diaphragmatic Breathing can also reduce anxiety and improve the quality of life in patients with respiratory disorders. This is because the breathing technique helps calm the nervous system, reduce stress levels, and improve overall body oxygenation. The advantages of using a diaphragm in breathing treatment devices include improved airflow control and distribution, leading to more efficient therapy delivery to patients. Devices with diaphragms can regulate the flow of air, ensuring a consistent and optimal supply of purified air to the patient's respiratory system. Additionally, the use of a diaphragm can enhance the effectiveness of air recirculation systems, air purification filters, ultraviolet ray sterilizers, and plasma electrostimulators present in the treatment device, ultimately improving the overall therapeutic outcomes for patients. Moreover, diaphragm-based systems can contribute to maintaining a stable and controlled airflow, which is crucial for ensuring the proper functioning of the breathing treatment device and maximizing its therapeutic benefits for patients(Hamasaki, 2020)

Diaphragmatic Breathing is an effective intervention for improving FVC and other lung functions in post-COVID-19 patients. Implementing Diaphragmatic Breathing in hospital respiratory rehabilitation programs can accelerate patient recovery and improve their quality of life. However, further research is needed to understand the long-term effects of Diaphragmatic Breathing and to develop optimal exercise protocols for patients with varying degrees of lung disease severity.

The Effect of Diaphragmatic Breathing Treatment on the Increase of Forced Expiratory Volume in One Second (FEV1) in Post-COVID-19 Patients

Based on the analysis results, the mean FEV1 before the intervention was 80.65, and it increased to 86.05 after the intervention was given. Additionally, a p-value of $0.000 < 0.05$ was obtained, indicating a significant effect of Diaphragmatic Breathing on the increase of FEV1 in post-COVID-19 patients at Aji Muhammad Parikesit Tenggarong Hospital.This finding is supported by research conducted by Nikmah et al., (2014)., which showed that Diaphragmatic Breathing exercises led to an increase in FEV1, with a pre-intervention average of 66.66±6.43 and a post-intervention average of 67.06±5.32. Further support comes from Ajul et al., (2020), who found a significant difference in peak expiratory flow values

before and after combining progressive muscle relaxation and diaphragmatic breathing exercises (p-value 0.00 <0.05). Another study by Nohantara & Putriyani (2023) on Indonesian Navy personnel in Denpasar, Bali, showed that Diaphragmatic Breathing exercises increased the lung capacity of taekwondo athletes. The measured lung capacity increased by 18.79%, from 1650.00 to 1960.00. Diaphragmatic Breathing has proven effective in increasing FEV1 in post-COVID-19 patients, supporting the recovery of lung function and overall quality of life.

Diaphragmatic Breathing (DB) involves slowly and deeply inhaling air through the nose, using the diaphragm muscle, followed by slow exhalation through the mouth. This technique helps reduce the use of accessory respiratory muscles and encourages more effective ventilation in the lower parts of the lungs. DB can enhance lung expansion, improve lung tissue elasticity, and reduce airway resistance, all of which contribute to increased Forced Expiratory Volume in one second (FEV1). Diaphragmatic breathing (DB) treatment has shown significant benefits in post-COVID-19 patients, particularly in improving pulmonary function. Studies have demonstrated that incorporating DB into the standard care of post-COVID-19 patients leads to enhanced clinical improvement, as evidenced by increased first-second expiratory volume (VEP1)(Elyazed et al., 2024). Additionally, pulmonary rehabilitation (PR) programs, which often include DB techniques, have been found to significantly improve peak expiratory flow, forced vital capacity (FVC), forced expiratory volume in the first second (FEV1), and the ratio between FEV1/FVC in post-COVID-19 patients(Costa et al., 2023). Furthermore, research has shown that incentive spirometry, a related therapy to DB, has led to a notable increase in pulmonary function test values, including improvements in forced expiratory volume in the first second (FEV1), forced vital capacity (FVC), and FEV1/FVC ratio in post-COVID-19 pneumonia patients These findings collectively highlight the positive impact of DB treatment on enhancing VEP1 and overall pulmonary function in individuals recovering from COVID-19(Suharti et al., 2022).

Several studies have demonstrated that DB is effective in improving FEV1 in patients with chronic lung diseases, including those recovering from COVID-19. According to a study by Smith (2022) patients who participated in a respiratory rehabilitation program that included DB showed a significant increase in their FEV1 compared to a control group that did not perform these exercises. This study suggests that DB helps reduce airway obstruction and enhances lung emptying capacity, which is crucial in post-COVID-19 recovery. Enhancing forced expiratory volume in one second (FEV1) is crucial in managing obstructive airways diseases like asthma and COPD. Studies have shown that inhaled corticosteroid therapy can lead to significant improvements in FEV1, with factors like baseline PC20, total IgE levels, and smoking habits influencing the immediate response to treatment (Howe et al., 2020). Additionally, high-frequency chest wall oscillations (HFCWO) have been utilized to increase airflow velocities and clear mucus from the lungs, aiding in improving respiratory function. Furthermore, addressing underlying genetic factors like alpha-1 antitrypsin deficiency, a common genetic cause of COPD, is essential in managing the disease effectively [5]. Therefore, treatments that target FEV1 enhancement through various approaches, including corticosteroid therapy and airway clearance systems, play a vital role in improving respiratory function and quality of life in patients with obstructive airways diseases(Kostikas et al., 2019).

Another study by Chen & Zhang (2021) found that DB improves vital capacity and ventilatory function in patients with pulmonary fibrosis, a condition often observed in post-COVID-19 patients. DB helps reduce intrathoracic pressure and allows for more effective

exhalation, increasing FEV1 and alleviating symptoms of breathlessness. In addition to improving FEV1, DB also benefits by reducing anxiety, enhancing physical activity capacity, and improving overall quality of life. Ahmed (2023),indicated that this breathing technique can reduce stress and enhance body oxygenation, which is crucial for the holistic recovery of post-COVID-19 patients. Diaphragmatic Breathing is an effective intervention for increasing FEV1 and other lung functions in post-COVID-19 patients. Implementing DB in hospital respiratory rehabilitation programs can accelerate patient recovery and improve their quality of life. Nonetheless, further research is needed to understand the long-term effects of DB and to develop optimal exercise protocols for patients with varying degrees of lung disease severity.

CONCLUSION

The study conducted at Aji Muhammad Parikesit Regional General Hospital in Tenggarong found that Pursed Lip Breathing Exercises and Diaphragmatic Breathing Exercises have positive effects on improving Forced Vital Capacity (FVC) and First Second Expiratory Volume (VEP1) in post-Covid-19 patients. These methods are effective in alleviating shortness of breath and increasing oxygen saturation. Patients who participated in these exercises showed significant improvements in FVC and VEP1, contributing to overall respiratory function improvement. Diaphragmatic Breathing Exercises help strengthen respiratory muscles and enhance breathing efficiency. The study results indicated that patients practicing diaphragmatic breathing also experienced significant improvements in FVC and VEP1, as well as greater comfort during daily activities. Overall, both exercise methods can be utilized as part of a rehabilitation program for post-Covid-19 patients at Aji Muhammad Parikesit Regional General Hospital in Tenggarong. A rehabilitation program that incorporates these two techniques can help enhance lung function, reduce residual symptoms, and improve patients' quality of life.

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