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# Promoting Oxygen Saturation and Relaxation Level through Pursed Lip Breathing Exercise and Progressive Muscle Relaxation in Patients with Lung Cancer

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***Abstract*---The most common symptoms in lung cancer are dyspnea and anxiety that cause restlessness on patients. This study aimed to identify the impact of PLB and PMR training program on the increase of oxygen saturation level and relaxation in patients with lung cancer. The study design was Quasi-Experiment with pre-test and post-test without control group. The inclusion criteria were patients with lung cancer who were affected by shortness of breath, admitted for at least 6 days, and provided with oxygen therapy through nasal cannula. The exclusion criteria were patient with musculoskeletal disorder, abnormal hemoglobin level, and pleural effusion. 19 participants were involved in this study. The instruments included pulse oximetry to measure oxygen saturation as well as subjective and objective monitoring form to measure relaxation level. The Faculty of Nursing of Universitas Indonesia had issued ethical clearance before the study was conducted. The results indicated a significant difference in oxygen saturation before and after PLB and PMR training program (p value < 0.05), and a significant difference in the level of relaxation before and after PLB and PMR training program (p value < 0.05). The multivariate analysis showed that age was a strong predictor of oxygen saturation. This study concluded that breathing and relaxation training program were able to promote oxygen saturation level and relaxation. Nurses are encouraged to apply this exercise for patients with lung cancer who are affected by shortness of breath. The authors suggest to apply a qualitative method by providing longer time for intervention for further study.**

***Keywords: PLB and PMR Training Program, Lung Cancer, Oxygen Saturation, Level of Relaxation***

## I. INTRODUCTION

Cancer is defined as a medical condition in which body cells have lost their regular control and mechanism which cause abnormal, rapid, and uncontrollable growth [1]. Lung cancer is the leading cause of death than any other types of cancer (claiming 1.59 million lives annually) [2]. *The American Cancer Society* stated that there were 222,520 new cases in 2010, affecting 116,750 men and 105,770 women [3].

Cancer, including lung cancer, is among chronic diseases which requires prolonged hospitalization. Lung cancer is a complex diasease with various clinical manifestations [4]. Patients with lung cancer physically suffer from chest pain, loses appetite and weight, and get affected by weakness during activities associated with shortness of breath [5]. Psychologically, lung cancer may affect patients' mental state. Patients with cancer may experience anger, anxiety, depression due to hopelessness, disturbed freedom in performing daily activities, dependency on others, and lengthy treatment sessions as well as despair. Patients with cancer may be affected by psychological issue due to several factors, including unpleasant emotional experience, physical symptoms associated with cancer and the treatment, and coping method that is used in dealing with the disease [6].

Based on the descriptions above, it can be concluded that the most frequent complaints among patients with lung cancer were breathing difficulty and anxiety leading to restlessness among them. A study by Gaguski claimed that 60% of patients with lung cancer complained about chest tightness [7]. It was estimed that 139 out of 247 participants with lung cancer (56%) experienced shortness of breath [8]. Breathing difficulty in lung cancer requires immediate treatment as it may lead to respiratory failure and death due to altered perfusion developed into arterial hypoxemia [5].

Acute phase management for shortness of breath is done by giving oxygen therapy. Prolonged oxygen therapy may result in toxicity in human body such as damage of pulmonary epithelial cells, hypoventilation, retinopathy, and atelectasis [9]. *PLB* is aimed to reduce shortness of breath, improve ventilation, increase respiratory muscles functioning, promote exercice tolerance, and provide subjective advantages including reducing anxiety and strain associated with shortness of breath. Furthermore, *PLB* may also reduce respiratory rate which promotes tidal volume and oxygen saturation instead [10].

Relaxation therapy is used to manage psychological impacts, such as anxiety, among patients with lung cancer. Relaxation is a self-management technique that is based on sympathetic and parasympathetic nerves function which reduces tense and anxiety level [11]. *Progressive Muscles Relaxation* is a simple relaxation technique by tensing and relaxing particular set of muscles at a time to produce physical relaxation. Progressive tightening and relaxing set of muscles are performed continuously in the main group [12].

## II. METHODS

This study was a quantitative study with *quasy-experimental* design with pre-test and post-test *without control group*, in which the intervention was provided for one group without comparison and its effectiveness was evaluated by comparing the post-test and pre-test scores.

The study population was all patients admitted in the inpatient unit of Persahabatan Hospital in May 2014. Study sample was patients with lung cancer who were admitted in the inpatient unit of Persahabatan Hospital. The participants were selected by employing non probability sampling technique with consecutive sampling method. There were 19 patients involved in this study. The inclusion criteria for samples were patient with lung cancer who were affected by shortness of breath, admitted for at least 6 days, provided with oxygen therapy through nasal cannula. The exclusion criteria were patient with injury and musculoskeletal disorder, cardiovascular disease, mild to severe hypertension, severe stress/ anxiety, abnormal Hb level, muscle strength < 5, and patient with hemoptysis and pleural effusion.

The study applied four main principles in the ethics of nursing research, such as beneficence, respects for human rights, and justice. The data was collected from May through May 2014 after receiving a letter of ethical review approval from Universitas Indonesia. The study instruments included pulse oxymetry to evaluate oxygen saturation and monitoring form to measure relaxation level before and after PLB and PMR exercise.

The intervention was provided in three steps. At the beginning, measurement of oxygen saturation and relaxation level was performed before the intervention. Participants were also asked to perform PLB and PMR exercise. On the first to the fifth day, participants were asked to perform PLB and PMR exercise twice a day, at 9.00 am and 2.00 pm. On the sixth day, oxygen saturation and relaxation were re-evaluated.

The data processing consisted of 4 stages including *editing, coding, processing* and *cleaning*. The data analysis incorporated a univariate analysis to identify the participants' characteristics (age, sex, height, stage of malignancy, haemoglobin level, and oxygen therapy) and a bivariate analysis to identify the difference in oxygen saturation and relaxation level prior to and following the PLB and PMR therapy. Furthermore, a multivariate analysis was applied to identify the most determinant factor affecting oxygen saturation and relaxation level.

## III. RESULT

TABLE 1. FREQUENCY DISTRIBUTION OF GENDER AND MALIGNANCY STAGING IN PARTICIPANTS WITH LUNG CANCER

| Variable | Frequency | (%) |
|---|---|---|
| Gender | | |
| Male | 15 | 78.9 |
| Female | 4 | 21.1 |
| Cancer stages | | |
| Stage I | 0 | 0 |
| Stage II | 0 | 0 |
| Stage III | 5 | 26.3 |
| Stage IV | 14 | 73.7 |

The majority of the participants in this study was male (15 participants, 78.9%) and there were only 4 females. Based on the cancer staging, 14 participants were affected by stage IV lung cancer (73.7 %) and 5 others were affected by stage III lung cancer.

TABLE 2. RESULT OF UNIVARIATE ANALYSIS ON AGE, HEIGHT, OXYGEN THERAPY, AND HEMOGLOBIN LEVEL IN PATIENTS WITH LUNG CANCER

| Variable | Mean ± SD | 95 % CI |
|---|---|---|
| Age | 49.26 ±11.57 | 43.68-54.84 |
| Height | 165.21 ±6.005 | 162.32-168.11 |
| Oxygen therapy | 3.26 ±1.24 | 2.67-3.86 |
| Hb level | 13.76 ±0.53 | 13.49 -14.01 |

The mean of the participants' age was 49.26 years old (95% CI: 43.68-54.84) with the standard deviation of 11.57 years. The mean of the participants' hemoglobin level was 13.76 g/dl (95% CI: 13.49 – 14.01) with the standard deviation of 0.53 g/dl. The mean of the participants' oxygen therapy was 3.26 L/minutes (95% CI: 2.67-3.86) with the standard deviation of 1.24 L/minute. The average height of the participants was 165.21 cm (95% CI: 162.32-168.11) with the standard deviation of 6.005 cm.

TABLE 3. ANALYSIS RESULT OF OXYGEN SATURATION LEVEL IN PATIENTS WITH LUNG CANCER BEFORE AND AFTER THE INTERVENTION

| Variable | Mean ± SD | 95 % CI |
|---|---|---|
| $O_2$ saturation prior to intervention | 96.16 ± 1.53 | 95.42-96.90 |
| $O_2$ saturation following intervention | 98 ± 0.816 | 97.61- 98.39 |

The mean of oxygen saturation before the intervention was 96.16 % (95% CI: 95.42-96.90) with the standard deviation of 1.53%. The mean of oxygen saturation following the intervention was 98 % (95% CI: 97.61 – 98.39) with the standard deviation of 0.816%.

TABLE 4. ANALYSIS RESULT OF RELAXATION LEVEL IN PARTICIPANTS WITH LUNG CANCER BEFORE AND AFTER THE INTERVENTION

| Variable | Mean ± SD | 95 % CI |
|---|---|---|
| Relaxation level before intervention | 6.63 ± 0.597 | 6.34 – 6.92 |
| Relaxation level after intervention | 3 ± 0.471 | 2.77 – 3.23 |

The mean of relaxation level prior to the intervention was 6.63 (95% CI: 6.34 – 6.92) with the standard deviation of 0.597. The mean of relaxation level following the intervention was 3 (95% CI: 2.77 – 3.23) with the standard deviation of 0.471.

TABLE 5. MEAN DISTRIBUTION OF OXYGEN SATURATION IN PATIENTS WITH LUNG CANCER BASED ON MEASUREMENT BEFORE AND AFTER PLB AND PMR EXERCISE

| Variable | Mean | SD | SE | p value | *N* |
|---|---|---|---|---|---|
| Oxygen saturation | | | | | |
| 1. Before | 96.16 | 1.53 | 0.35 | 0.0001 | 19 |
| 2. After | 98.00 | 0.81 | 0.18 | | |

The statistical result revealed that the difference in mean of oxygen saturation level before and after the PLB and PMR exercise was 1.84 % with the standard deviation of 1.34 % and p value 0.0001. Hence, it can be concluded that there was a significant difference in oxygen saturation level between before and after PLB and PMR exercise.

TABLE 6. MEAN DISTRIBUTION OF RELAXATION LEVEL IN PARTICIPANTS WITH LUNG CANCER BASED ON MEASUREMENT BEFORE AND AFTER PLB AND PMR EXERCISE

| Variable | Mean | SD | SE | p value | *N* |
|---|---|---|---|---|---|
| Relaxation level | | | | | |
| 1. Before | 6.63 | 0.59 | 0.13 | 0.0001 | 19 |
| 2. After | 3.00 | 0.47 | 0.10 | | |

The statistical analysis revealed that the difference in mean of relaxation level prior to and following PLB and PMR exercise was 3.63 with the standard deviation of 0.59 and p value 0.0001. Hence, it can be concluded that there was a significant difference in relaxation level between before and after PLB and PMR exercise.

TABLE 7. MEAN DISTRIBUTION OF OXYGEN SATURATION LEVEL IN PARTICIPANTS WITH STAGE IV LUNG CANCER BASED ON MEASUREMENT BEFORE AND AFTER PLB AND PMR EXERCISE

| Variabel | Mean | SD | SE | p value | *N* |
|---|---|---|---|---|---|
| Oxygen saturation | | | | | |
| 1. Before | 96,14 | 1,40 | 0,37 | 0,0001 | 14 |
| 2. After | 98,07 | 0,82 | 0,22 | | |

The analysis result suggested that the difference in mean of oxygen saturation level prior to and following PLB and PMR exercise was 1.93% with the standard deviation of 0.15% and p value 0.0001. Hence, it can be concluded that there was a significant difference in oxygen saturation between before and after PLB and PMR exercise.

TABLE 8. MEAN DISTRIBUTION OF OXYGEN SATURATION LEVEL IN PARTICIPANTS WITH STAGE III LUNG CANCER BASED ON MEASUREMENT BEFORE AND AFTER PLB AND PMR EXERCISE

| Variable | Mean | SD | SE | p value | *N* |
|---|---|---|---|---|---|
| Oxygen saturation | | | | | |
| 1. Before | 96.02 | 2.04 | 0.91 | 0.078 | 5 |
| 2. After | 97.8 | 0.83 | 0.37 | | |

The analysis result revealed that the difference in mean of oxygen saturation level before and after PLB and PMR exercise was 1.78% with the standard deviation of 1.21% and p value 0.078. Hence, it can be concluded that there was a significant difference in oxygen saturation prior to and following PLB and PMR exercise. Hence, it can be concluded that there was no significant difference in oxygen saturation level between before and after PLB and PMR exercise.

TABLE 9. MEAN DISTRIBUTION OF RELAXATION LEVEL IN PARTICIPANTS WITH STAGE IV LUNG CANCER BASED ON MEASUREMENT BEFORE AND AFTER PLB AND PMR EXERCISE

| Variable | Mean | SD | SE | p value | *N* |
|---|---|---|---|---|---|
| Relaxation level | | | | | |
| 1. Before | 6.79 | 0.57 | 0.15 | 0.0001 | 14 |
| 2. After | 3.07 | 0.47 | 0.12 | | |

Analysis result showed the difference in mean of relaxation level prior to and following PLB and PMR exercise was 3.72 with standard deviation of 0.1 and p value 0.0001. Therefore, it can be concluded that there was a significant difference in relaxation level between before and after PLB and PMR exercise.

TABLE 10. MEAN DISTRIBUTION OF RELAXATION LEVEL IN PARTICIPANTS WITH STAGE III LUNG CANCER BASED ON MEASUREMENT BEFORE AND AFTER PLB AND PMR EXERCISE

| Variable | Mean | SD | SE | p value | *N* |
|---|---|---|---|---|---|
| Relaxation level | | | | | |
| 1. Before | 6.20 | 0.44 | 0.20 | 0.0001 | 5 |
| 2. After | 2.80 | 0.44 | 0.20 | | |

The statistical analysis revealed that the difference in mean of relaxation level prior to and following PLB and PMR exercise was 3.4 with the standard deviation of 0.00 and p value 0.0001. Thus, it can be concluded that there was a significant difference in relaxation level between before and after PLB and PMR exercise.

TABLE 11. RELATIONSHIP BETWEEN GENDER, CANCER STAGING AND OXYGEN SATURATION LEVEL IN PARTICIPANTS WITH LUNG CANCER

| Variable | Mean | SD | SE | p value | N |
|---|---|---|---|---|---|
| Gender | | | | | |
| Male | 98.07 | 0.88 | 0.22 | 0.50 | 19 |
| Female | 97.75 | 0.50 | 0.25 | | |
| Cancer stage | 98 | 0.81 | 0.18 | 0.0001 | 19 |

The statistical analysis revealed that the p value = 0.50, implying that there was no significant difference in oxygen saturation level between males and females following the exercise.

The analysis result revealed that the p value = 0.0001 which indicated a significant difference in mean of oxygen saturation level following the exercise based on cancer staging.

TABLE 12. CORRELATION BETWEEN AGE, HEIGHT, HEMOGLOBIN LEVEL, OXYGEN THERAPY, AND OXYGEN SATURATION LEVEL IN PARTICIPANTS WITH LUNG CANCER

| Variable | r | *p value* | N |
|---|---|---|---|
| Age | - 0.49 | 0.032 | 19 |
| Height | - 0.03 | 0.89 | 19 |
| Hemoglobin level | 0.29 | 0.22 | 19 |
| Oxygen therapy | 0.05 | 0.82 | 19 |

The statistical analysis suggested a significant correlation between age and oxygen saturation (p value = 0.032). There was no significant association between body height and oxygen saturation level (p value = 0.89). There was no significant correlation between hemoglobin level and oxygen saturation (p value = 0.22). There was no significant correlation between oxygen therapy and oxygen saturation as well (p value = 0.82).

TABLE 13. RELATIONSHIP BETWEEN GENDER, CANCER STAGING, AND RELAXATION LEVEL IN PATIENTS WITH LUNG CANCER

| Variable | Mean | SD | SE | p value | N |
|---|---|---|---|---|---|
| Gender | | | | | |
| Male | 3 | 0.37 | 0.09 | 1.00 | 19 |
| Female | 3 | 0.81 | 0.40 | | |
| Cancer stage | 3 | 0.47 | 0.10 | 0.0001 | 19 |

The analysis result revealed that the p value 0.0001 which indicated a significant difference in mean of relaxation level following the exercise based on cancer staging. The result also revealed that the p value 1.00 which implied a significant difference in mean of relaxation level between male and female participants following the exercise.

TABLE 14. RELATIONSHIP BETWEEN AGE, HEIGHT, HEMOGLOBIN LEVEL, OXYGEN THERAPY, AND RELAXATION LEVEL IN PATIENTS WITH LUNG CANCER

| Variable | r | *p value* | N |
|---|---|---|---|
| Age | 0.05 | 0.83 | 19 |
| Height | 0.0001 | 1.000 | 19 |
| Hemoglobin level | 0.02 | 0.92 | 19 |
| Oxygen therapy | 0.19 | 0.43 | 19 |

The older the participant' was, the higher his or her relaxation level was. The statistical analysis revealed that there is no significant correlation between age and oxygen saturation level (p value 0.032).

TABLE 15. RESULT OF FINAL MULTIVARIATE MODELLING OF CONFOUNDING VARIABLES WITH HIGHER OXYGEN SATURATION LEVEL IN PARTICIPANTS WITH LUNG CANCER

| Variable | B | Koef B | $R^2$ | p value | p value (Uji Anova) |
|---|---|---|---|---|---|
| Age | -0.03 | 5.70 % | 0.24 | 0.03 | 0.03 |

## IV. DISCUSSION

The study revealed that the mean of oxygen saturation prior to the intervention was 96.16% and following the intervention was 98%. It indicated an increase in oxygen saturation level between before and after the intervention. Furthermore, the statistical analysis indicated that there was a significant difference in oxygen saturation level between before and after PLB and PMR exercise.

However, the result was rather different when classified based on cancer staging. On stage IV, the result was similar with the mean of oxygen saturation prior to PLB and PMR exercise, that was 96.14% and following the intervention was 98.07%.

The study analysis revealed that there was a significant difference in oxygen saturation between before and after PLB and PMR exercise. However, there was a distinct result on stage III that the mean of oxygen saturation prior to PLB and PMR exercise was 96.02% and following the intervention was 97.8%. The analysis also revealed no significant difference in oxygen saturation between before and after PLB and PMR exercise.

The combination effect of PMR and Deep Breathing resulted in a significant decrease in blood pressure after the intervention [13]. The combination between breathing management and relaxation technique was able to relieve shortness of breath in patient with lung cancer [6]. *Pursed lip breathing* is an exercise to relieve shortness of breath. *Pursed lip breathing* is aimed to control breathing pattern, improve ventilation, increase effective coughing mechanism, prevent atelectasis, improve the strength of respiratory muscles, promote relaxation, and prevent relapse and breathing difficulty [14].

*Pursed lip breathing* (PLB) is a therapy that could be applied to manage chest tightness and facilitate patient in controlling his/her own respiratory rate and depth as well as improving relaxation which allows patient to manage shortness of breath and reduce anxiety [15]. PLB improved physical functioning, reduced breathing difficulty, and controlled respiratory pattern. *Pursed lip breathing* promotes $CO_2$ exhalation through the mouth, improves pressure in obstructed airway, and increases $CO_2$ exhalation by exhaling 2 to 3 times longer than inspiration [10]. PLB was able to increase peak expiratory flow up to 47% [16].

*Pursed lip breathing* will provide maximum result in improving oxygenation if applied simultaneously with relaxation technique. Relaxation technique is aimed to reduce muscle tension and energy expenditure which, in turn, promotes work of breathing and lower anxiety due to breathing difficulty.

In patients with lung cancer, inflammation and destruction affect airway or bronchus and alveoli which increase sputum production, mucus plug, airway obstruction and atelectasis [9]. Increased respiratory rate in

patient with lung cancer may lead to exhaustion of diaphragm muscles. Lung hyperinflation usually affects patient in with chronic lung disease and cause mechanical exchaustion of inspiration muscles [15].

PLB may assist patients with lung cancer in maintaining respiration which makes them more relaxed. *Pursed lip breathing* facilitates patients in controlling their own respiratory rate and depth as well as improves relaxation which allows patients to manage shortness of breath and reduce anxiety [15].

Moreover, it was revealed that the mean of relaxation level prior to the intervention was 6.63 and after the intervention was 3 (on a scale from 0 to 10). It showed an increase in the relaxation level perceived by the participants between before and after the intervention.

The result is similar when the data are classified based on cancer staging. On stage IV, it was revealed that the mean of relaxation level before PLB and PMR exercise was 6.79 and after the exercise was 3.07. Therefore, it can be concluded that there was a significant difference in relaxation level between before and after PLB and PMR exercise (p value < 0.05). It was also revealed on stage III that the mean of relaxation level before PLB and PMR exercise was 6.20 and after the exercise was 2.80. Hence, it can be concluded that there was a significant difference in relaxation level between before and after PLB and PMR exercise (p value < 0.05).

PMR exercise is a nursing intervention that is used to manage or reduce cancer-related symptoms. PMR is able to reduce anxiety and stress level in patients with prostate malignancy (p value < 0.001) [17]. PMR exercise is able to improve an individual's capacity to manage various stressful circumstances and increase self-control [18].

Moreover, PMR was effective in reducing anxiety level in patients with respiratory problem who underwent rehabilitation program [19]. Progressive muscle relaxation therapy was effective in reducing anxiety among post-hysterectomy patients [20]. Nursing intervention to manage patients with lung cancer experiencing breathlessness through combination of breathing management and relaxation technique was done for 8 weeks. The study shows that most participants who had poor prognosis and dyspnea as its particular symptom demonstrated an increase in life expectancy for more than 6 months. Therefore, it can be concluded that PMR therapy is able to reduce anxiety level and promote relaxation. Thus, this therapy can be provided for patients affected by anxiety, inlcuding those with lung cancer [6].

Multivariate analysis of oxygen saturation level indicates that age is the most determinant variable affecting oxygen saturation level in patients with lung cancer among other confounding variables. The result is explainable since one's lung ventilation decreases as the age advances; it is primarily due to loss of elasticity of thoracic wall, increasing the anteroposterior chest diameter, collapse of osteoporotic vertebral which results in kyphosis, calcification of cartilage costae, declining efficiency of respiratory muscles, increasing lung rigidity and lower surface area of alveoli. Increased rigidity or loss of lung recoil causes an increase in residual volume and decrease in lung vital capacity. The loss of alevoli elasticity, thickening of bronchial glands, decline in lung capacity, and increasing dead space occur throughout aging process. These increases certainly reduce oxygen diffusing capacity. Moreover, the older someone is, the higher his ventilation-perfusion ratio is. This condition contributes to dyspnea during activities and lowers the volume of inhaled and exhaled air which is irreversible [15].

The multivariate analysis of relaxation level shows no confounding variable that affects relaxation level in patients with lung cancer who were affected by dyspnea after PLB and PMR therapy. It is indicated by p value < 0.25 for each confounding factor.

## V. CONCLUSION AND RECOMMENDATION

The mean of the participants' age was 49.26 years old. The majority of them were males (78.9 %) who suffered from stage IV lung cancer (73.7 %), and the average body height was 165.21 cm. Most participants were provided with oxygen therapy 3.26 L/minute and they had hemoglobin level of 13.76 g/dl.

The mean of the participants' oxygen saturation level prior to the intervention was 96.16% and after the intervention was 98%. The mean of the participants' relaxation level before the intervention was 6.63 and after the intervention was 3.

*PLB* and *PMR* exercise was able to significantly promote oxygen saturation level (p value 0.0001). The exercise was also able to significantly improve relaxation level (p value 0.0001)

Based on the cancer staging (stadium IV), *PLB* and *PMR* exercise was able to significantly increase oxygen saturation level (p value 0.0001) while the exercise was not able to significantly increase oxygen saturation level among participants with stage III lung cancer (p value 0.078). Based on the cancer staging (stadium IV), *PLB* and *PMR* exercise was able to significantly promote relaxation level (p value 0.0001) as well as those with stage III cancer (p value 0.0001)

The only confounding factor contributing to the change in oxygen saturation level was age, however there were not any confounding factors which affected relaxation level.

Further study is expected to be conducted with qualitative approach in order to identify effectiveness of PLB and PMR exercise in increasing oxygen saturation and relaxation level among patients with lung cancer and shortness of breath. Moreover, the therapy should be provided in longer duration and Cohort design.

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