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THE EFFECT OF MODIFIED PURSED LIPS BREATHING TROUGH PLAT ON RESPIRATORY RATE AND OXYGEN SATURATION IN CHILDREN WHIT PNEUMONIA

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Abstract

Pneumonia is the most common inflammatory lung disease in children. One of the symptoms of pneumonia is an increased respiratory rate and decreased oxygen saturation due to alveolar inflammation, which makes it difficult for the body to obtain oxygen. A non-pharmacological therapy that can be applied is tongue-blowing play based on the principles of Pursed Lips Breathing (Pursed Lips Blowing Play). This study aims to determine the effect of pursed lips blowing play on reducing respiratory rate and increasing oxygen saturation in children with pneumonia. The research design used was a Quasi-Experimental study with a pre- and post-test without a control group. The study was conducted at Pamboang Community Health Center with a sample size of 15 respondents, selected using purposive sampling. Univariate and bivariate analyses were performed using the Paired t-test and Wilcoxon test. The intervention produced measurable clinical improvement, with the mean respiratory rate decreasing from 39.80 to 35.07 breaths/min ($\Delta = -4.73$; $p = 0.001$), while the mean oxygen saturation increased from 92.80% to 95.36% ($\Delta = +2.56\%$; $p = 0.001$). These numeric improvements indicate a strong effect of modified PLB play on respiratory performance. The results showed a significant effect on changes in respiratory rate and increased oxygen saturation after tongue-blowing play, with p-values of 0.001 and 0.001, respectively. Based on these findings, pursed lips blowing play is recommended as a nursing intervention for pneumonia patients.

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INTRODUCTION

Pneumonia is an acute infection that affects lung tissue (alveoli) and is caused by bacteria, viruses, or fungi.[1] Pneumonia is the leading infectious cause of death among children worldwide.[2] The World Health Organization (WHO) reported that in 2019, pneumonia killed approximately 740,180 children under the age of five. Pneumonia affects children under five years old at a rate of around 30% in developing countries, which translates to 10–20 cases per 100 children each year, with a significant mortality rate.[3] More than 5 million children under the age of five die from pneumonia each year in developing countries.[4] Pneumonia is the leading cause of death in India, while in Indonesia is the second leading cause of death after diarrhea.[5] A common issue in caring for children with pneumonia in hospitals and other healthcare facilities is respiratory distress.[4] Signs of respiratory distress include nasal flaring, increased respiratory rate, and stridor accompanied by chest wall retraction.[6]

The basic principle of pneumonia treatment in children is to eliminate the causative microorganisms with the appropriate antibiotics and to administer antipyretics for fever management.[7] Non-pharmacological treatments include encouraging rest, providing oxygen therapy, ensuring proper hydration to thin secretions, and maintaining adequate fluid intake. Intravenous (IV) fluid therapy may be administered if the child is weak or unable to drink sufficient fluids.[6] This is because

children expend a significant amount of energy as a compensatory mechanism for breathing, which is evident in the use of accessory respiratory muscles in moderate to severe pneumonia cases.[1] This deep breathing technique is implemented to improve alveolar ventilation function, reduce the risk of atelectasis, and enhance nutrient intake. Improving dietary patterns aims to boost immunity and enhance the performance of the immune system.[8]

Pursed Lips Breathing (PLB) is a breathing exercise that focuses on prolonged exhalation to facilitate the removal of trapped air from the lungs.[9] This technique is one of the methods that can be used to reduce shortness of breath and improve lung function.[10] Treatment using PLB will be simpler and more effective if applied to children who can follow instructions.[11]

PLB therapy is administered to help address ineffective airway clearance in pneumonia patients.[9] This therapy aids in expanding the alveoli within the lung lobes, facilitating the expulsion of secretions from the respiratory tract during exhalation, and increasing alveolar pressure.[8] PLB exercises can also be performed in patients with severe airway obstruction. By puckering the lips during exhalation, intrathoracic pressure is maintained, helping to prevent respiratory failure and lung collapse.[12] During PLB, the airways remain open during exhalation, gradually improving airflow, which reduces shortness of breath and decreases respiratory rate.[9]

The PLB technique can be incorporated into play activities for children, making it easier to engage them by using the blowing principle.[13] Games that can be used include pursed lips blowing play[11], bottle-blowing activities,[12] blowing a melodica, and other similar blowing exercises.[10] The best way to use pursed lips blowing play is by applying the PLB technique, where the child inhales deeply and exhales through the mouth with pursed lips.

The novelty of this study lies in the modification of the conventional PLB technique into a play-based breathing intervention using a blowing plate, making it more suitable for pediatric patients (1). Traditional PLB is often challenging for children because it requires sustained attention, controlled exhalation, and understanding of instructions. By integrating PLB into a blowing play activity, this study introduces a child-friendly, engaging method that improves cooperation and facilitates effective respiratory muscle training (2). The relevance of this innovation is supported by the clinical phenomenon observed at the research setting in Pamboang primary health care Majene city, where pneumonia consistently ranks among the highest causes of pediatric hospitalization. In 2023, the pediatric ward recorded 10,8% pneumonia cases, with a large proportion of children presenting tachypnea and reduced oxygen saturation on admission (3). These findings highlight the urgent need for non-pharmacological, play-based respiratory interventions that can enhance treatment outcomes and support the stabilization of respiratory rate and oxygen saturation in children with pneumonia.

METHODS

The research design used in this study is Quasi-Experimental with a pre- and post-test without a control group. The population in this study consists of all pediatric patients with pneumonia in the Pamboang Community Health Center area, totaling 63 children. The sampling technique used is non-probability sampling with a purposive sampling approach. Based on the Power and Sample Size Program, the minimum required sample size is 14 children, with a 10% dropout rate (1 child), resulting in a total sample of 15 children. Primary data was obtained directly from the respondents, including patient identification information and pre- and post-intervention results. The intervention in this study was adapted from the standard PLB technique. The procedure consisted of the following steps: (1) the child was positioned in a comfortable sitting posture with relaxed shoulders; (2)

the child was instructed to inhale slowly through the nose for approximately two seconds; (3) exhalation was performed PLB for a longer duration (three to four seconds) to create mild positive airway pressure; (4) during exhalation, the child was asked to blow onto a plastic plate toy to maintain pursed lips positioning and promote prolonged expiration; (5) the breathing cycle was repeated 5–10 times per session, twice daily, for four consecutive days. This modification was designed to maintain the physiologic mechanism of PLB while increasing cooperation and engagement in pediatric patients.

The univariate data is presented descriptively in the form of frequency tables. Statistical analysis was performed using the Wilcoxon test.

RESULTS AND DISCUSSION

Based on the results in Table 1, it was found that the majority of respondents were aged 3-6 years (73.3%), most were male (60.0%), the majority of respondents with pneumonia had an underweight nutritional status (53.3%), and most had a temperature greater than 37°C.

The most common age group is 3-6 years old (73.3%), while the least common age group is 7-12 years old (26.7%). The 3-6-year age group is at risk of developing pneumonia because their immune systems are still weaker compared to those of adults.[14] For preschool children, their growth is stable. Development occurs through increased physical activity, improved skills, and the development of thinking processes.[15] Children are at higher risk for pneumonia in toddlers, influenced by anatomical differences in the respiratory tract between male and female children.[14] The highest frequency of pneumonia cases in children occurs in males (60.0%), with the remainder in females (40.0%). Male children are more susceptible to pneumonia compared to female children.[16] The respiratory tract in male children is smaller compared to female children, or there are differences in immunity between male and female children.[15]

Table 1. Characteristics of Respondents

Characteristics	F	%
Age		
3-6 Years	11	73,3
7-12 Years	4	26,7
Total	**15**	**100**
Gender		
Male	9	60,0
Female	6	40,0
Total	**15**	**100**
Nutrition Status		
Underweight	8	53,3
Good Nutrition	6	40,0
Malnutrition	1	6,7
Total	**15**	**100**
Duration of illness		
2 Days	13	88,7
3 Days	2	13,3
Total	**15**	**100**
Temperature		
36.2	2	13.3
36.5	1	6.7
36.6	1	6.7
37.2	3	20.0
37.4	1	6.7
37.6	1	6.7
37.8	1	6.7
37.9	1	6.7
38.0	2	13.3
37.9	1	6.7
38.0	2	13.3
38.2	2	13.3
Total	**15**	**100**

Poor and inadequate nutritional status can lead to immune system disorders. Almost all mechanisms of the body's defense deteriorate in a state of malnutrition.[16] Malnutrition disrupts the physiological function of the respiratory system, which increases the risk of maximum lung ventilation. This is due to a lack of muscle mass in the chest muscles, leading to suboptimal chest expansion.[17]

Pneumonia is classified as a disease ranging from mild, non-acute conditions to life-threatening ones. Chronic diseases can affect quality of life, but frequent acute and recurrent infections can also impact the health of some

children.[1] The symptoms of pneumonia in children do not always correspond to the stage or duration of the illness.[6] The possible reasons for the discrepancy between symptoms and the duration of the illness are the child's nutritional status, the presence of comorbidities, complications, the causative bacteria, and the presence of viral co-infections.[18] Therefore, the duration of the illness does not significantly affect the oxygenation status.

Fever increases tissue oxygen demand and enhances CO2 production.4 If the fever persists, the metabolic rate remains high, causing stored proteins in the body to break down, leading to muscle weakness and loss of muscle mass, such as in the respiratory muscles and diaphragm.[17] The body attempts to adapt to the increased carbon dioxide levels by increasing the frequency and depth of breathing to eliminate the excess carbon dioxide.[16] Respiratory effort increases, and eventually signs and symptoms of hypoxemia appear.[19]

The intervention resulted in a meaningful improvement in respiratory efficiency, as indicated by a significant reduction in the mean respiratory rate from **39.80** breaths/min before the intervention to **35.07** breaths/min afterward (Δ = **–4.73** breaths/min; p = **0.001**). This numeric decline reflects a decreased respiratory workload and improved expiratory control, suggesting that modified PLB effectively enhances ventilation and reduces tachypnea in children with pneumonia.

Based on the results of the normality test, the p-values for pre-test and post-test oxygen saturation using the Shapiro-Wilk test were greater than α = 0.05. This indicates that the data are normally distributed. Therefore, the data can be analyzed using a Paired T-Test.

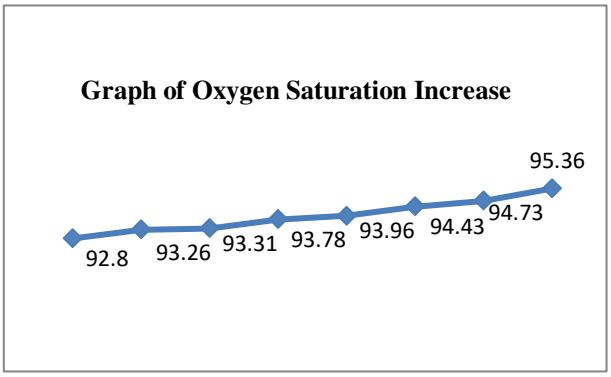
The results showed that the p-values for pre-test and post-test respiratory rates were less than α = 0.05. Therefore, it can be concluded that the data are not normally distributed, as the p-value is < α = 0.05. Therefore, the Wilcoxon test was used to analyze these data.

Table 2. The Effect of Modified Pursed Lips Breathing Play on Oxygen Saturation in Children with Pneumonia

Variabel	N	Mean	Std	P-*Value*
Oxygen Saturation	15	-2.56267	0.90825	0.000

Based on Table 2, the change in oxygen saturation (SpO2) before and after the intervention was -2.59600% with a standard deviation of 0.90825. Further analysis shows that the average oxygen saturation after the intervention is higher compared to before the intervention, with a p-value (0.000; <α=0.05), indicating a significant effect of tongue-blowing play on oxygen saturation in children with pneumonia in the Pamboang Community Health Center area.

Figure 1. Increase in Oxygen Saturation in Children with Pneumonia in the Pamboang Community Health Center Area



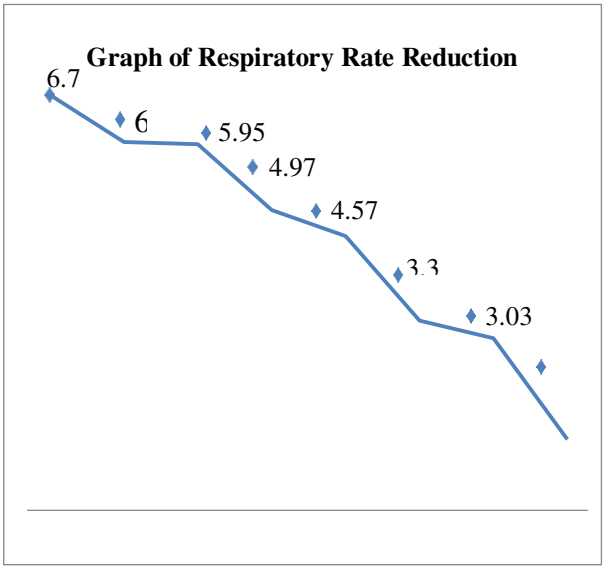
Based on Figure 1, it can be seen that the lowest average oxygen saturation is the SpO2 before intervention 1, which is 92.80%, and the value with the highest average, indicating a significant increase, is the oxygen saturation after intervention 4, which is 95.36%.

Table 3. The Effect of Modified Pursed Lips Breathing Play on Respiratory Rate Reduction in Children with Pneumonia

Variabel	N	*Mean Rank*	*p Value*
Respiratory rate	15	7,50	0,001

Based on Table 3, it shows that the mean rank is the reduction in the respiratory rate of children with pneumonia before and after, which is 7.50, while the p-value (0.001 < 0.05) indicates that there is an effect of playing tongue blowing on the reduction of respiratory rate in children with pneumonia at the Pamboang Community Health Center Area.

Figure 2. The Effect of Modified Pursed Lips Breathing Play on the Reduction of Respiratory Rate in Children with Pneumonia



Based on the graph above, it can be seen that the respiratory rate in relation to playing tongue blowing shows the highest mean value for the respiratory rate before intervention 1, which is 6.7, while the lowest mean value, indicating a significant decrease, is the respiratory rate after intervention 4, which is 1.5.

Table 4. Effect size of Modified Pursed Lips Breathing (PLB) play on oxygen saturation in children with pneumonia

outcome	N	Mean pre SPO2 (%)	Mean post SpO2 (%)	Mean change	SD of Change	p-Value	Effect size (Cohen's d)	Interpretation
Oxygen saturation	15	92.80	95.36	+2.56	0.91	0.001	2.82	Very large effect

The intervention resulted in a meaningful improvement in oxygenation status, with mean oxygen saturation increasing from **92.80%** before treatment to **95.36%** after the four-day intervention period (Δ = **+2.56%**; p = **0.001**). This rise in SpO_2 demonstrates enhanced alveolar ventilation and better gas exchange, indicating that modified PLB play supports more effective oxygen perfusion in children with pneumonia.

Table 5. Effect size of modified Pursed Lips Breathing (PLB) play on respiratory rate in children with pneumonia

outcome	N	Mean pre SPO2 (%)	Mean post	Mean change	p-Value	Effect size (Cohen's d)	Interpretation
Respiratory rate	15	39.80	35.07	-4.73	0.001	1.58	Very large effect

The statistical test results using the Wilcoxon test showed a p-value of 0.001, which is less than 0.05, meaning there is an effect of playing tongue blowing on the reduction of respiratory rate in children with pneumonia in the Puskesmas Pamboang area. Based on the results shown in Figure 1, the respiratory rate measurement before intervention 1 showed the highest value at 6.7, while the lowest value was the respiratory rate after intervention 4, with a value of 1.5. This indicates a significant reduction in respiratory rate from the first (initial) to the eighth (final) measurement. The Wilcoxon test results show a p-value of 0.001 < 0.05, meaning there is an effect of playing tongue blowing on the reduction of respiratory rate in children with pneumonia.

It is clearly seen in the graph of respiratory rate reduction after the tongue-blowing intervention. The respiratory rate before intervention 1 shows the highest value, serving as the baseline for measuring changes in respiratory rate reduction. After intervention 1, a reduction in the respiratory rate was observed, indicating the effect of playing tongue blowing in effectively addressing the respiratory rate issue in children with pneumonia. Moving on to the respiratory rate before intervention 2, a further reduction was noted from the previous measurement, meaning that playing

tongue blowing continues to have a positive impact on addressing respiratory rate issues. The respiratory rate after intervention 4 proves that the conclusion of the study shows a significant effect of tongue-blowing intervention on reducing the respiratory rate in children with pneumonia.

Administering the tongue-blowing game is effective in regulating respiratory rate and breathing patterns, reducing air trapping, improving alveolar ventilation for better gas exchange, without increasing respiratory effort, and coordinating and regulating the breathing rate to make breathing more effective and reduce shortness of breath. Breathing exercises using the pursed lips technique involve two mechanisms: strong inhalation and forceful, prolonged exhalation.[8] Forceful and prolonged exhalation during pursed lips breathing can reduce respiratory resistance and accelerate the intake or exhalation of air. Forced and prolonged expiration can speed up both inhalation and exhalation, thus preventing air sacs in the alveol.[9]

Breathing exercises are performed to improve breathing coordination, from rapid and shallow breathing to deep and slow breathing.[12] This exercise technique includes diaphragmatic breathing and pursed lips breathing to improve ventilation and synchronize the work of the abdominal and chest muscles. Pursed lips breathing also improves breathing patterns, increases tidal volume, and reduces shortness of breath. Pursed-lips breathing enhances respiratory muscle function, ventilation, and oxygenation.[9]

The study found that the pursed lips breathing technique can increase the expansion of the alveoli in all lobes and also raise the pressure within them.[12] The cilia in the airways are activated by the high pressure in the alveoli and lobes, causing secretions to flow out of the airways and creating a more efficient airway. The reduction in airway resistance and the improvement in ventilation due to secretion clearance from the airways alter the perfusion and diffusion of oxygen to the tissues. Physiologically, the pursed lips breathing technique can enhance the flexibility of the chest cavity and diaphragm, as well as train the expiratory muscles, increasing airway pressure during expiration. This exercise can also induce a breathing pattern, especially slowing down the respiratory rate, and it should be performed regularly. Pursed lips breathing, when performed by blowing into a melodica, has an effect on reducing shortness of breath, anxiety, and improving quality of life.[10] Pursed lips breathing is a breathing technique that is done calmly and relaxed to slow down the expiratory process and help expel trapped air from the airways. With this technique, the exhaled air is resisted by the two lips, creating a more positive pressure in the oral cavity.[10] This positive pressure spreads throughout the narrowed airways, helping them stay open. Opening the airways allows air to flow out of the constricted passages and slightly reduces the effort of the respiratory muscles, thereby alleviating shortness of breath.

CONCLUSION

From the results of this study, it is concluded that the average respiratory rate decreased after the intervention was conducted. Likewise, the oxygen saturation increased after the intervention with the breath technique using the pursed lips blowing toys.

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