

Effectiveness of pursed lips breathing using a pinwheel on oxygenation status in children with pneumonia

Ises Reni, MKep, Rifka Putri Andayani, SpKepAn

University Mercubaktijaya, Padang, West Sumatera, Indonesia

ABSTRACT

Introduction: Pneumonia is one of the causes of child death in the world. One of the non-pharmacological therapies given to overcome the impact of pneumonia in children is Pursed Lips Breathing (PLB) exercises. PLB is given to help overcome the ineffectiveness of airway clearance in patients with pneumonia by increasing the development of the alveoli in each lung lobe so that it can induce a normal breathing pattern and the child becomes more relaxed. The purpose of this study was to determine the effectiveness of PLB using pinwheel game on oxygenation status in children with pneumonia.

Materials and Methods: This study is a quantitative study using a quasi-experimental design using a pretest and posttest approach with control group design. This study consisted of two groups, namely the intervention group given PLB blowing a pinwheel with a penguin game, while the control group was given LPS. The study was conducted at Reksodiwiryo Army Hospital Padang with 15 respondents in the intervention group and 15 in the control group. Data analysis was carried out using a pooled t-test and paired t-test.

Results: The effectiveness of PLB using a pinwheel on oxygenation status in children with pneumonia found in this study can be used as evidence-based practice in treating children with pneumonia.

Conclusion: PLB can be used as an independent nursing intervention that can be implemented in hospitals.

KEYWORDS:

Children, Games, PLB, Respiratory Rate, Oxygen Saturation

INTRODUCTION

Children with pneumonia who come to the hospital will have an impact on the child's physical and psychological well-being. Psychologically, children will feel anxious due to the impact of hospitalization that can be experienced by children because they face stressors around the hospital environment. Feelings that are often experienced by children when being treated in the hospital are feeling anxious, angry, afraid, unfamiliar environment, separated from parents, lack of information, loss of freedom and loss of independence.¹

The impact of children with pneumonia will experience oedema in the pulmonary alveoli which can provide

opportunities for organisms and cause pneumonia. The inflammatory process in the lungs occurs in the tissue and lung capacity decreases, the bronchial narrows and mucus production increases.² This condition increases the resistance of the respiratory tract and decreases the expiratory volume of breathing. This can result in hypoxemia which is a complication of pneumonia that can cause death. Hypoxemia can be prevented by monitoring and evaluating oxygen administration. To maximize breathing in children with pneumonia, breathing exercises can be done using Pursed Lips Breathing (PLB) to train the lungs to do diaphragmatic breathing. Doing PLB can increase the residual capacity of the lungs during expiration after inspiration.³ The PLB technique is used to activate the lungs, to increase alveolar pressure in each lobe of the lung so that it can increase air circulation during expiration and support improved gas exchange in the tissue. Doing PLB must be adjusted to the child's abilities.⁴

Hospitalized pneumonia patients often experience respiratory distress characterized by rapid breathing, chest retraction, nasal flaring and accompanied by stridor.⁵ Both pharmacological and non-pharmacological therapies are given to help pneumonia patients, one of the non-pharmacological therapies given is PLB exercises. PLB is given to help overcome the ineffectiveness of airway hygiene in patients with pneumonia by increasing the development of the alveoli in each lobe of the lung so that alveolar pressure increases and can help push secretions into the airway during expiration and can induce normal breathing patterns.⁶

PLB exercises can also be performed on patients with severe airway obstruction, by opposing the lips during expiration, the respiratory pressure in the chest is maintained, preventing respiratory failure and collapse, during PLB the airways are open during expiration and will increase further, reducing shortness of breath and reducing the respiratory rate.⁷ Modification of PLB using a pinwheel is effective in preschool children in reducing respiratory rate and increasing oxygen saturation in children with respiratory system problems.⁸ Breathing exercises with PLB have stages that can help induce slow breathing patterns, improve oxygen transport, help patients control breathing and also train respiratory muscles, can also increase the exchange of O₂ and CO₂ gases that occur in the blood capillaries, which is caused by inflammation of the alveoli filled with fluid that makes it difficult for the body to get oxygen so that gas exchange cannot be carried out optimally, the accumulation

This article was accepted: 01 July 2026

Corresponding Author: Ises Reni

Email: isesreni15@gmail.com

of fluid between the capillaries and alveoli increases the distance that must be traveled by oxygen and carbon dioxide.

MATERIALS AND METHODS

This type of research is quantitative with a quasi-experimental design using a pre- and post-test with control group design approach. This study consists of an intervention group and a control group. The location of the study was at the Reksodiwiry Army Hospital Padang from June to November 2023.

The population of this study were children with pneumonia who were treated at Reksodiwiry Army Hospital Padang Hospital. The sampling technique used was probability sampling with consecutive sampling technique. The inclusion criteria in this study were children aged over 3 years with a diagnosis of pneumonia and willing to be respondents, while the exclusion criteria were children with a diagnosis of pneumonia but had other complications such as muscle weakness and children with labioschisis or labiopalatoschisis. The intervention group performed PLB for 3 cycles with 10 times for 2 minutes each cycle with an inspiration to expiration ratio of 1:2. The control group received standard intervention in the hospital. This study involved 15 people for each group with a total sample of 30 children. Ethical clearance was issued by the Ethical Committee of University of Perintis Indonesia No. 552/KEPK.F1/ETIK/2023.

Data analysis used univariate and bivariate analysis. Univariate analysis in this study was used to determine respiratory rate and oxygen saturation values. Bivariate analysis was conducted to determine the effect of PLB on oxygenation status in children with pneumonia. The bivariate test used in this study was a paired t-test to determine the mean respiratory rate and oxygen saturation.

RESULTS

Based on Table I, it shows that the average respiratory rate before PLB blowing a pinwheel in the intervention group was 41.33 times/minute and in the control group 40.93 times/minute. After PLB blowing a pinwheel in the intervention group was 27.73 times/minute and in the control group 36.60 times/minute. The average oxygen saturation before PLB blow the wheel in the intervention group was 93% and in the control group 92%. After PLB blow the wheel in the intervention group was 97.07% and in the control group 94.93%.

Based on table II, it shows that there is an effect of PLB intervention using a pinwheel on the respiratory rate in children with pneumonia with a p-value < 0.001 and there is an effect of PLB intervention using a pinwheel on oxygen saturation in children with pneumonia with a p-value < 0.001 at Reksodiwiry Army Hospital Padang.

Table I: Mean respiratory rate and oxygen saturation before and after PLB blowing a pinwheel in children with pneumonia at Reksodiwiry Army Hospital Padang (n=30)

Group	Mean $\pm$ SD	CI 95%
Respiratory Rate		
Intervention		
Before	41.33 $\pm$ 7.835	36.99 – 45.67
After	27.73 $\pm$ 5.750	24.55 – 30.92
Control		
Before	40.93 $\pm$ 6.670	37.24 – 44.63
After	36.60 $\pm$ 6.379	33.07 – 40.13
Oxygen Saturation		
Intervention		
Before	93 $\pm$ 3.873	90.86 – 95.14
After	97.07 $\pm$ 2.463	95.70 – 98.43
Control		
Before	92.40 $\pm$ 3.814	90.29 – 94.51
After	94.93 $\pm$ 2.120	93.76 – 96.11

Standard deviation (SD), confidence interval (CI)

Table II: Differences in respiratory rate and oxygen saturation before and after PLB Blowing a pinwheel in children with pneumonia at Reksodiwiry Army Hospital Padang (n=30)

Variables	Intervention			p-value	Control			p-value
	Mean	SD	95%CI		Mean	SD	95%CI	
Respiratory Rate								
Before	41.33	7.835	11.021 ; 16.179	< 0.001*	40.93	6.670	3.382 ; 5.285	< 0.001*
After	27.73	5.750			36.60	6.379		
Oxygen Saturation								
Before	93	3.873	-5.014 ; -3.120	< 0.001*	92.40	3.814	-3.677 ; -1.389	< 0.001*
After	97.07	2.463			94.93	2.120		

Standard deviation (SD), confidence interval (CI) *Significant at p<0.05

DISCUSSION

Average Respiratory Rate and Oxygen Saturation Before PLB Blowing a Pinwheel in Children with Pneumonia

The results of the study showed that the average respiratory rate before PLB was performed in the intervention group was 41.33 times/minute and in the control group 40.93 times/minute. The average oxygen saturation before PLB was performed in the intervention group was 93 times/minute and in the control group 92 times/minute. This is in line with a study conducted by Arisa on the application of PLB therapy in children with pneumonia, data was obtained that the child's respiratory rate had a mean value of 37 and oxygen saturation of 93%. The respiratory rate is included in the fast category and the oxygen saturation in children is abnormal.⁹

Based on the results of respiratory rate measurements in this study, it was found that respondents with rapid breathing frequency and oxygenation status were included in the abnormal category. One of the factors that affects respiratory rate is body temperature, especially in feverish conditions. Fever will increase the need for oxygen for tissues and as a result carbon dioxide will increase. The body will try to adapt to the increase in carbon dioxide by increasing the depth and speed of breathing. In patients with pneumonia, obstruction of the upper or lower airways was found which can limit the delivery of inhaled oxygen to the alveoli.¹⁰ If the concentration of inhaled oxygen decreases, the capacity of the blood oxygen content will also decrease. This is because in patients with pneumonia there is lung inflammation which has an impact on the disruption of oxygen fulfillment.⁶

Based on research conducted by Sadat stated that before the application of PLB on An. A and An. M, the results of oxygen saturation measurements were 95% and 93%.³ Another study conducted by Muliasari and Indrawati regarding the application of PLB obtained results before the application with an average in the intervention group before being given PLB was 28 times/minute and a standard deviation of 6.088 and a standard error of 1.435.¹¹

Mean Respiratory Rate and Oxygen Saturation After PLB Blowing a Pinwheel in Children with Pneumonia

The results of the study showed that the average respiratory rate after PLB with a pinwheel in the intervention group was 27.73 times/minute and in the control group 36.60 times/minute. The average oxygen saturation after PLB with a pinwheel in the intervention group was 97.07% and in the control group 94.93%. The results of the study showed that after PLB with a pinwheel, the average respiratory rate was 28.17% and oxygen saturation was 97.50%. This study agrees with the study conducted by Arisa et al., which explained that after the application of PLB, it showed that the respiratory rate was included in the fast category and oxygen saturation was included in the normal category. Measurement of oxygenation status was carried out after the provision of PLB intervention using pulse oximetry to measure oxygen saturation and calculate the respiratory rate manually.¹⁰

This is in line with the research of Devia which states that PLB is a breathing exercise in the form of breathing or inspiration

through the nose for 2-3 seconds followed by slow expiration through the mouth for at least 2 inspirations (4-6 seconds) which is carried out for 30 minutes with a tolerance of 5 minutes of rest for 3 times (5 interventions, 5-minute rest interval, continued 5 minutes to 2 and 5 minutes of rest interval, then 5 minutes to 3 and rest/finish time for 5 minutes) then oxygen saturation is measured using a pulse oximeter.¹²

Another study conducted by Indrawati et. al showed that the average respiratory rate in the intervention group after being given PLB by blowing a pinwheel was 26.11 times/minute with a standard deviation of 5.487.¹¹ This is in accordance with the study conducted by Azizah et al. where the PLB action was given for 3 days, each day carried out 2 times of exercise in the morning and evening, and each exercise was done for 10 minutes.¹⁰

The application of PLB blowing a pinwheel is part of the breathing exercises needed for patients who experience disorders of the respiratory system, because PLB has a good effect on the respiratory system, including increasing ventilation, releasing air trapped in the lungs, keeping the airways open longer and reducing the work of breathing, prolonging the exhalation time which then slows down the breathing frequency, and introducing new air into the lungs, eliminating shortness of breath and increasing relaxation.

Physiologically, the PLB technique blowing a pinwheel can improve the flexibility of the chest cavity and diaphragm and train the expiratory muscles and increase airway pressure during expiration and this exercise can also induce breathing patterns, especially breathing frequency, into slow and shallow breathing and is done for 5-10 minutes in the morning.¹³

The Effect of PLB Blowing a Pinwheel on Respiratory Rate and Oxygen Saturation in Children with Pneumonia

The results of the study showed that there was an effect of PLB intervention blowing a pinwheel on the respiratory rate in children with pneumonia with a p-value < 0.001 and there was an effect of PLB intervention blowing a pinwheel on oxygen saturation in children with pneumonia with a p-value < 0.001 at Reksodiwiro Army Hospital Padang. PLB is breathing through the lips using a pinwheel toy that can help train respiratory muscles, slow expiration, prevent small airway collapse, and control the speed and depth of breathing.⁶ PLB exercises blowing a pinwheel are useful for improving ventilation and increasing the work of the abdominal and thoracic muscles.

Research conducted by Anggreini explained that the average oxygen saturation results in respondents before being given PLB intervention were 92.93% and after being given the intervention the average oxygen saturation value became 97.87%. The mean difference in oxygen saturation before and after being given PLB intervention was -4.94. These results show that the average oxygen saturation after being given the intervention was higher than before being given the intervention.¹² Another study by Arisa also explained that there was an effect of giving PLB on changes in oxygenation status in toddlers with pneumonia with a p-value < 0.001 and

there was a significant effect on children's airway clearance with a p -value < 0.001 .¹⁰

PLB is also one of the easiest techniques to reduce shortness of breath. The same study also showed that the application of PLB in children with pneumonia can significantly affect the respiratory rate and oxygen saturation. Changes in respiratory rate and oxygen saturation are not only influenced by PLB. There are several things that can affect the oxygenation status of children with pneumonia, one of which is chest physiotherapy, positioning, oxygenation therapy and collaboration in administering drugs. This can affect changes in respiratory rate and oxygen saturation in children with pneumonia. So that the PLB intervention can be used as a supporting therapy which is also an independent nursing intervention that can be implemented with other therapies according to the interventions prepared by nurses in dealing with toddlers with pneumonia.

In addition, PLB is one of the easiest techniques to reduce shortness of breath. This technique is an easy way to reduce the frequency of breathing so that breathing becomes more effective. This technique can help to produce a lot of air into the lungs and reduce the energy expended when breathing. PLB can also increase alveolar pressure in each lobe of the lung so that it can increase air flow during expiration. Increased air flow during expiration will evacuate secretions out of the airways. This action is one of the efforts that can increase oxygenation because it can increase ventilation, free air trapped in the lungs, reduce the work of breathing, prolong exhalation which can slow down the frequency of breathing.⁸

CONCLUSION

The application of PLB using the windmill game is effective in improving oxygenation status in children with pneumonia. PLB pinwheel in this study is an implication of the application of nursing intervention classification and is also an independent nursing action. This can be used as a follow-up plan for hospitals conducting research to be applied by nurses in the pediatric inpatient room to be applied to children with pneumonia.

ACKNOWLEDGEMENTS

We would like to express our gratitude to all respondents, parents, Mercubaktijaya University and the research team.

FUNDING

There is no funding provided for this research.

REFERENCES

1. Andayani RP. Pengaruh atraumatic care: audiovisual dengan portable DVD terhadap hospitalisasi pada anak. *Menara Ilmu*. 2019; XIII(5): 114-21.
2. Togodly A. Faktor-faktor yang berpengaruh terhadap kejadian infeksi saluran pernafasan akut (ISPA) pada balita di Puskesmas Karubaga Kabupaten Tolikara. *Jurnal Sains dan Kesehatan*. 2022; 4(4): 407-15.
3. Sadat N. Teknik pursed lips breathing dengan modifikasi meniup balon pada anak dengan gangguan sistem pernafasan. *Indonesian Journal of Health Medical* 2022; 2(3): 66.
4. Inayah N, Wilutono N. Efektivitas metode pursed lips breathing dan buteyko breathing pada posisi fowler terhadap saturasi oksigen pasien asma. *Jurnal Citra Keperawatan*. 2022; 10(2): 118-25.
5. Adawiyah R, Duarsa ABS. Faktor-faktor yang berpengaruh terhadap kejadian pneumonia pada balita di Puskesmas Susunan Kota Bandar Lampung. *Jurnal Kedokteran*. 2016; 2(1): 311-31.
6. Kyle T, Carman S. *Essentials of pediatric nursing*. Philadelphia: Wolters Kluwer Health; 2017.
7. Mukaram P, Hi Baco N, Hutahuruk M. Effect of pursed lip breathing technique on breath patterns in respiratory disorders pasien. *Jurnal Kesehatan* 2022; 6(2): 49-56.
8. Gea NYK, Nurhaeni N, Allenidekania. Blow pinwheels improve oxygen saturation of preschool children with post pneumonia in outpatient pediatric departement. *Pediatrica Medica e Chirurgica*. 2021; 43(s1): 1-5.
9. Andayani S, Badriyah UN. Pursed lips breathing therapy for ineffective respiratory patterns in pneumonia patients. *Jurnal Keperawatan Suaka Intan* 2024; 9(2): 194-201.
10. Arisa N, Azizah. Penerapan terapi pursed lips breathing terhadap status oksigenasi pada anak dengan pneumonia. *JKMC* 2023; 2(8): 142-50.
11. Virgo G, Cholisah N, Indrawati. Hubungan status gizi dengan kejadian infeksi saluran pernafasan bkut (ISPA) pada Balita di wilayah kerja Puskesmas Air Tiris. *Jurnal Ners* 2022; 6(23): 86-91.
12. Anggreini DM. Penerapan pursed lips breathing untuk perubahan saturasi oksigen pada anak dengan gangguan sistem pernafasan akibat bronkopneumonia di Rsud Dr Soekardjo Kota Tasikmalaya 2022; 02(01): 1-165.
13. Nugrahmi MA, Mariyona K. Peran orang tua dalam pendidikan seks pada anak usia 5-9 tahun di Nagari Tanjung Bungo Kecamatan Suliki Kabupaten Lima Puluh Kota. *Jurnal Ilmu Universitas Batanghari Jambi* 2021; 21(3): 1396.