



THE EFFECT OF CHEST PHYSIOTHERAPY ON OXYGEN SATURATION AND RESPIRATORY RATE IN PEDIATRIC PNEUMONIA

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ABSTRACT

Pneumonia is a disease that infects the respiratory tract. The main complaints that often occur in pneumonia patients are shortness of breath, increased body temperature, and coughing. Apart from being a medical parameter for certain diseases, out of a total of six parameters used for the National Early Warning Score (NEWS), oxygen saturation and respiratory rate are two parameters to assess patient's condition. The purpose of the study was to explore the impact of chest physiotherapy and evaluate changes in oxygen saturation and respiratory rate in pediatric pneumonia patients. The research method in this application is application of interventions using case studies. The informative sampling method used was the purposive sampling technique. This research was conducted on July 10, 2023. This type of research is quantitative using a comparative method, where researchers will compare the results before and after the chest physiotherapy intervention. The inclusion criteria of this study are data on children aged 3–4 years. The types of data collection are interviews, actions, and documentation. The instrument used by researchers is pulse oximetry. Conclusion: There is difference in results before and after being given chest physiotherapy in children with pneumonia.

Keywords: child; chest physiotherapy; pneumonia; respiratory rate

INTRODUCTION

Every child is precious to his or her mother. There are many terrible diseases that can threaten the lives of children. One of them is respiratory disease, which is one of the leading causes of death in children under 5 years old. Children with respiratory problems often have excess mucus in their lungs. Phlegm often builds up and becomes thick, making it difficult to expel. The most common respiratory diseases suffered by children include acute respiratory infections (ARI), pneumonia, asthma, and tuberculosis. According to the report of the 22nd National Congress of the Indonesian Lung Doctors Association in 2011, lung and respiratory system health problems are one of the most important health problems in the world and one of the most important health problems in Indonesia. Pediatric nursing is childcare that focuses on family efforts and child prevention (Henny, 2020). Pneumonia is an acute disease of the lower respiratory tract that affects the lung parenchyma, including the alveoli and interstitial tissue, resulting in tissue inflammation on one or both sides of the lung. Most pneumonia is caused by viruses or bacteria. In general, the bacteria that play the most role in the occurrence of pneumonia are *Streptococcus pneumoniae*, *Haemophilus influenzae*, and *Staphylococcus aureus*, as well as the atypical bacteria *Chlamydia* and *Mycoplasma* (Mani, 2018).

Based on 2019 data, pneumonia and diarrhea are still major problems, causing 979 deaths (pneumonia) and 746 deaths (diarrhea). The increase in the number of deaths in the neonatal period reflects the decrease in mortality of children aged 1 to 59 months compared to newborns. One of the efforts made to control this disease is to increase the discovery of pneumonia in children under five. The discovery of pneumonia in children aged 1 to 59 months is usually characterized by respiratory distress. Respiratory distress is the body's compensation for an oxygen imbalance. Low oxygen concentration stimulates the central nervous system and

increases the frequency of rapid breathing. If this effort is not compensated, it can affect oxygenation status, ranging from mild to severe, and lead to an emergency (Muliasari & Indrawati, 2018).

When the human body's immunity decreases, pneumonia is easy to occur, so the human body is easily infected by the virus. Host, pathogen, and environment are risk factors for pneumonia. As far as the host is concerned, the susceptibility to viral infection is high. In addition to the cause of pneumonia, bacteria enter the respiratory tract through the inhalation process (inhaled air) or through direct transmission, namely droplets released by the patient when the patient coughs on people around him or holds and uses objects that come into contact with the patient's respiratory secretions (Anggraeni and Susilaningasih, 2022). The World Health Organization (2019) states that the diagnosis of pneumonia is based on the presence of chest aspiration or shortness of breath in children with coughs and/or shortness of breath and the presence of severe pneumonia in quiet children, which is a sign of general distress or stridor. Pneumonia is responsible for 14% of deaths in children under 5 years old, accounting for 740,180 deaths. Pneumonia is a worldwide health problem due to its high mortality rate. Pneumonia has claimed the lives of more than 80,080 children under 5 years of age worldwide, or 39 children every second. Most deaths occur in children under two years of age, with nearly 153,000 deaths occurring in the first month of life (UNICEF, 2022).

Baidah, Yani (2021), Globally, more than 801,000 children under the age of 5 die from pneumonia. In countries such as Nigeria (163,000) and India (128), half of the children under the age of 5 die from pneumonia. The incidence of pneumonia in developing countries is 10 times that of developed countries (0.29 vs. 0.03), and the number of pneumonia-related child deaths is 2,000 times that in developed countries. Asia, particularly the Philippines, ranked fourth in the number of pneumonia cases in 2013 (10.0%). In another Asian country, Malaysia, pneumonia mortality ranked second. There were 9,250 cases (12.0%) in 2014 (Malaysia, 2019). Ministry of Health of the Republic of Indonesia (2020), In NTT, pneumonia was the fourth cause of death after birth (29 days–11 months) with 83 cases. The Ministry of Health also reported that there were 278,261 children under the age of 5 infected with pneumonia in 2021, down 10.19% from 309,838 in the previous year (Indonesia, 2022). Indonesia is Riskesdas data shows that the number of pneumonia patients increases with age, and children and patients with weakened immune systems tend to experience unusual signs and symptoms, so pneumonia can be clearly diagnosed through chest x-rays. (Riskesdas Indonesia Data, 2018).

According to Central Java Provincial Health Center data (2022), the incidence of pneumonia in Central Java Province increased from 2018 to 2023. The incidence of pneumonia in Central Java Province was 1.6% in 2018 and increased by 0.2% to 1.8% in 2023. In 2023, the number of under-five pneumonia patients found in Central Java Province was 52,033, with 86 deaths and a case fatality rate of 0.17%. The high incidence of pneumonia in children makes this case important to study further. Children who suffer from pneumonia usually have relatively rapid breathing. Socioeconomic factors, nutritional status, parents who smoke, the number of siblings under the age of five in the home, a lack of basic health services such as immunization, a lack of awareness, and overcrowding are some of the causes. Rapid-breathing pneumonia is more common in infants, children under five, and the elderly, especially those with comorbidities such as HIV infection, measles, or malaria. If we want to reduce the amount of rapid breathing, we have to do therapy. One type of this therapy is chest physical therapy (CPH). CPH is a treatment method that aims to optimize respiratory rate and improve oxygen saturation (Nurmayanti, Waluyo, Jumaiyah, & Azzam, 2019).

In this case, oxygen saturation and respiratory rate (RR) can be a reference for the occurrence of respiratory disorders. In addition to being medical parameters for certain diseases, oxygen saturation and respiratory rate are also two of the five parameters of the National Early Warning Score (NEWS), meaning that respiration is the human body's mechanism for utilizing air exchange between atmospheres. Oxygen saturation, blood pressure when the heart pumps blood throughout the body, pulse rate, body temperature, etc. NEWS is a parametric system used by the National Health Service to assess patient deterioration and predict mortality in hospitalized or ICU patients (Perry & Potter, 2016). According to Damayanti (2019), oxygen saturation is the percentage of hemoglobin in arteries that is associated with oxygen, and normal oxygen saturation ranges from 95–100%. At low oxygen partial pressures, most of the hemoglobin is deoxygenated, which means the distribution of oxygenated blood from the arteries to the body tissues. At the same time, recording respiratory rate (RR) is one of the bases of pre-hospital, medical, and nursing assessments. RR is elevated for respiratory diseases (e.g., pneumonia, bronchiolitis, and asthma) and non-respiratory diseases (e.g., sepsis). RR is important for monitoring children receiving opioid analgesics and is an important early warning sign of clinical deterioration in patients, including children. As a result, children with these diseases are highly susceptible to infections, including pneumonia.

According to Indonesian physiotherapy competency standards (2020), chest physiotherapy (CPH) is a treatment that is very beneficial for people with respiratory diseases, both acute and chronic. In another explanation, it is said that physiotherapists optimize the quality of life by developing, maintaining, and restoring motion and function that are potentially impaired by aging, injury, disease, physical disorders, and environmental factors throughout the life cycle through manual methods, improving movement abilities, using equipment, function training, and communication. According to the physiotherapy perspective, pneumonia patients experience varying degrees of difficulties, including difficulty in expelling sputum, changes in breathing patterns, difficulty in performing daily activities due to complaints, and delays in child development. Most respiratory diseases in children with chronic respiratory diseases or neuromuscular diseases can be treated with CPH, one of the therapies that can be used (GSS et al., 2019).

Annisa (2020) says that CPH is included in the therapy used to treat most respiratory diseases in children, with the method of removing secretions or mucus from the respiratory tract indirectly. Conventional respiratory therapy (CPH) is very effective in improving ventilation in patients with impaired lung function and can be performed alone or with the help of others, such as physiotherapists, parents, or caregivers. CPH can be performed by manual vibration of the chest. Chest physical therapy techniques can be divided into conventional, modern, and instrumental categories. Modern techniques use flow variation through controlled breathing to mobilize secretions, while instrumental techniques use flow variation through breathing. For example, noninvasive ventilation can help with airway clearance and respiratory support as adjunctive therapy (Hansmann, 2017). According to GSS et al. (2019), the goal of CPH in children is to aid the clearance of tracheobronchial secretions, which decreases airway resistance, improves gas exchange, and facilitates breathing. In addition, chest physiotherapy has the potential to evacuate tracheobronchial secretions and inflammatory exudates, remove airway obstructions, reduce airway resistance, improve gas exchange, and reduce the amount of respiratory work required. One of the other goals of chest physiotherapy is to clear accumulated secretions and improve respiratory status. This means lowering airway resistance, increasing gas exchange, and easing breathing (Chaves et al., 2019).

According to Roqué and Figuls (2016), CPH removes inflammatory and tracheal secretions, eliminates airway obstruction, reduces airway resistance, improves gas exchange, and reduces breathing during labor. Two types of chest physical therapy (CPH) differ. Percussion techniques use cupped hands to touch the back or chest wall. national and international magazines, books, and articles in print and non-print versions. Secondly, we talk about vibration techniques with manual compression and vibration of the chest wall during expiration (Musniati & Badrin, 2020). The mechanical principles of physical therapy methods used in children are the same as those used in adults, but there are changes in respiratory function that require further adjustment. Age determines the method of physical-respiratory therapy. Consequently, this feature limits the use of certain CPH methods. The chest compression/CPH technique and manual cough support use manual compression of the chest during exhalation and make a pause at the end of exhalation to allow lung secretions to move, which facilitates exhalation. This technique is based on its compressive effect on the airway, which increases airflow velocity and results in better mucus transportation (Yousefnia-Darzi 2016).

Ulemadja Wedho, Tely, and Aty (2019) stated that nurses have the duty to provide nursing care to pneumonia patients with a sense of responsibility towards patients, maintain the scope of medical services, and be able to adapt to patient problems, solve patient problems easily, and provide solutions. In this situation, nurses can also apply preventive measures to patients through health education about pneumonia and directly teach patients physical breathing techniques (Nurrohimi, Arifah, and Kp, 2017). The CPH technique is a physical therapy technique that can be used in patients with cardiovascular and respiratory disorders, including pneumonia. Researchers use this method to help children breathe more comfortably and become more active every day without fear. The purpose of the study was to explore the impact of chest physiotherapy and evaluate changes in oxygen saturation and respiratory rate in pediatric pneumonia patients.

METHOD

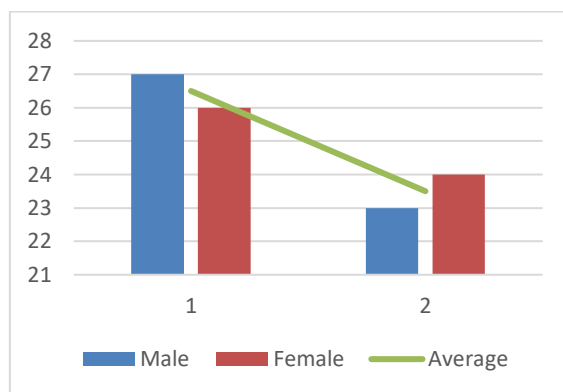
This research is a case study. The study was conducted at Indriati Hospital in Sukoharjo. Children who suffered from pneumonia were the subjects of the study that started on July 10, 2023. A total of 2 children who became respondents met certain conditions, namely having close family members, anxiety, and not having hearing or vision problems. Purposive sampling is a sampling technique used to produce an informative sampling. This quantitative research with comparative method will compare the results before and after the CPH intervention. Data collection was done in three ways: interviews, measures and records. Explanation of random checks for errors in data entry... Use statistics for descriptive and inferential purposes (IBM SPSS Stats 25 and Excel Spreadsheets 2016).

RESULTS

The results showed that both patients were male and female aged 3 and 4 years old.

The doctor diagnosed shortness of breath, the same symptom in both patients, as pneumonia. With the results presented in the graph below, the results are depicted as the ratio and average of respiration rate and oxygen saturation.

Table 1.
Before and after chest physiotherapy intervention (RR)



Based on Table 1. Based on this table, the results obtained before CPH were higher than the normal value with an average value of 26 times/minute compared to after CPH with a decrease in respiratory rate / RR, the average value before the intervention was 26.5 times/minute with the average value after the intervention was 23.5 times/minute, it can be concluded that CPH affects the respiratory frequency of male and female.

Table 2.
Before and after chest physiotherapy intervention (SPO2)

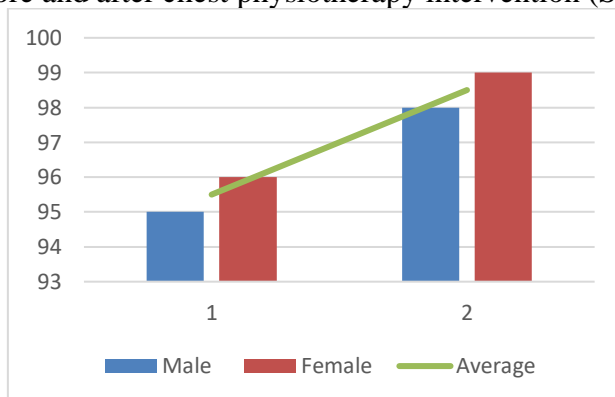


Table 2 provides an overview of boys and girls who experienced increased oxygen saturation during the chest physical therapy intervention/CPH. Before the procedure, the average oxygen saturation of both children was 95.5. Both children's saturation increased to an average of 98.5. The children is oxygen saturation (SpO2) and respiratory rate (RR) had significant changes during the intervention. In addition, the children appeared cooperative during the intervention. Parents are very important in looking after the children and providing adequate support during the treatment process.

DISCUSSION

The end result is a nursing process that is used to evaluate the success of nursing care. In the final stage, the evaluation of the patient's health status is compared with the criteria or goals that have been set. Managing oxygen administration in children must be done quickly. Clinical guidelines are not enough to diagnose childhood pneumonia in the community. Studies show that hypoxemia, which is not accurately detected through oxymetry to prevent early rescue, and the low respiratory rate of children are the causes of the deaths of many children suffering from severe pneumonia in the community. (Tarwoto & Wartolah, 2015) The results of performing

CPH on two pediatric patients showed that performing respiratory physical therapy on children suffering from pneumonia at that time was effective and in accordance with previous results from before and after CPH.

Before Getting CPH

Physiotherapists play a role in the treatment of pneumonia. Physiotherapy therapy for children with pneumonia aims to reduce pain, tightness, and spasm of respiratory support muscles and improve chest mobility. methods or actions to remove phlegm, either independently or together, so that phlegm does not stagnate and cause obstruction to breathing (Aryayuni, 2015). In this case, in boys before CPH, the results showed tachypnea of 27 breaths per minute and low oxygen saturation of 95%. Whereas in girls before undergoing CPH, the results showed tachypnea of 26 breaths per minute and low oxygen saturation of 96%. Symptoms that appear for the first time before the CPH technique is performed in children with pneumonia are restlessness, difficulty breathing, breathing through the nostrils, sometimes accompanied by diarrhea, and ineffective airways (Hidayat, 2021). According to another PPNI theory (2017), the main symptoms and signs that appear are ineffective coughing or an inability to cough, excessive spitting, and additional respiratory sounds. Mild symptoms and signs include difficulty breathing, difficulty speaking, agitation, cyanosis, and changes in breathing and breathing patterns. Based on this hypothesis, the results of the intervention on 2 children showed a change in the chest physiotherapy intervention, meaning that there was an effect of chest physiotherapy.

After Getting CPH

The results of thoracic physiotherapy showed that both patients had ineffective airway clearance. Signs included decreased dyspnea, an increased respiratory rate, reduced additional breath sounds, a heart rate within normal limits, and increased oxygen saturation. For the boy An.B., chest physiotherapy was not one of the effective therapies; medication and oxygen therapy were better; respiratory rate increased to 23 times per minute; there were no additional breath sounds; and oxygen saturation increased to 98%. In a girl with the An. A, after receiving physical therapy in the chest/CPH area, her respiratory frequency improved to 24 times per minute, there were no more breath sounds, and oxygen saturation increased to 99%. These results are the same as those from other studies showing that chest physiotherapy can mobilize tracheobronchial secretions based on clinical parameters such as respiratory frequency and oxygen saturation (Abdelbasset, W., & Elnegamy, 2015). According to Ngastiyah et al. (2022), it is also explained that chest physiotherapy is a therapy that can be applied to patients with acute and chronic respiratory diseases. The techniques used are postural drainage, percussion, and vibration, which aim to maintain and restore respiratory function and help clear phlegm in the lungs. bronchi and increase the movement and flow of the phlegm so that it can facilitate the passage of the respiratory tract.

Comparison of Effects Before and After Getting CPH

The application of chest physiotherapy before and after the results showed that chest physiotherapy could affect the pulse rate, breathing, oxygen saturation, and less effective airway clearance in both patients. In both patients, before chest physical therapy, similar results were obtained, namely tachypnea, ronki breath sounds, and low oxygen saturation. This study is similar to research conducted by Syafiati and Nurhayati with the research title "Application of Chest Physiotherapy in Overcoming Ineffective Airway Clearance in Toddler-Age Pneumonia Children (3-6 Years)" and obtained significant results before and after being given chest physiotherapy. This study showed changes in respiratory frequency, reduced additional breath sounds, and an increase in SpO₂ (Alya Syafiati & Nurhayati, 2021) The second

additional breath sound of the child before chest physiotherapy is heard, namely ronchi in all lung lobes, is quite decreased. Chest physiotherapy can mobilize tracheobronchial secretions based on clinical parameters such as respiratory frequency and oxygen saturation (Abdelbasset, W., & Elnegamy, 2015). According to Rigustia et al. (2019), boys are a risk factor for pneumonia morbidity. This is due to the smaller diameter of the respiratory tract of boys compared to girls or differences in endurance between boys and girls. Another similar study explained that chest physical therapy (CPH) affects oxygen saturation. Another study from Brazil also found that patients who underwent chest physical therapy had improved oxygen saturation.

According to Marni (2022), the results showed that chest physical therapy, although simple, was very effective in improving hemodynamic status and oxygen saturation. Chest physiotherapy can make significant changes to airway clearance, so the application of chest physiotherapy is effective in improving airway clearance (Ngastiyah et al., 2022). According to Amin et al. (2018), there was a difference in the patient's respiratory frequency per minute between before and after therapy, while for shortness of breath, the patient experienced a significant decrease between before and after treatment, concluding that it can increase the respiratory rate per minute and reduce breathing difficulties. In addition, the results are also in accordance with the results of previous studies, as they found in their study that post-percussion auscultation therapy during CPH resulted in improved audible breath sounds due to better air intake and oxygenation (Abdelbasset & Elnegamy, 2015). The CPH techniques used in this study do not include all the techniques available for children with pneumonia. There are many variations in the application of specific chest physiotherapy techniques, both in literature and practice, but these techniques can be used individually or in combination (Snijders 2015).

In this treatment, chest physiotherapy is considered an attractive therapeutic tool that can be used after a thorough assessment of each patient's abilities, needs, and comorbidities. The diverse and interesting techniques of CPH have many advantages and are easy to implement in the community. The results of this study are similar to those of Selviyana, who said that this chest physiotherapy intervention has a great opportunity to be applied in clinics and communities, especially in Indonesia. The many advantages of this method support this (Selviyana, 2020). In addition to the CPH methods mentioned above, passive smokers should also have a supportive environment, such as cigarette smoke, if they or their family members smoke. This is because passive smokers are more susceptible to health problems due to their combined exposure to secondhand smoke from active smokers and the smoke exhaled by active smokers. More than seven thousand chemicals are found in the smoke inhaled by second-hand smokers. In addition, the smoke content can increase the risk of various diseases, including cancer and lung disorders. As a result, passive and active smokers are at almost the same risk (Centers for Disease Control and Prevention, 2020)

Respiratory drive is controlled by airways, lung and respiratory muscle information from sensory receptors as well as central and peripheral chemo receptors. Contraction and relaxation of the respiratory muscles is controlled by GOT (glutamic oxaloacetic transaminase), which is susceptible to muscle stretch (active or passive), as a result of which there is a firing discharge of the muscle spindle, which gives this signal to CNS via Alpha and Gamma motor neurons directly responsible for initiating muscle contraction. Chest expansion is decrease due to decreased mobility of the chest wall and lung compliance. Intercostal stretching can increase chest wall elevation and thus enhance expansion to improve intra- thoracic volume of the lung which leads to an improvement in percentage flow rate. This can lead to increase ventilator ability such as tidal volume, minute ventilation, and oxygen status, thus increasing chest

expansion, hyperinflation, and air trapping. This result corresponded to the previous study in that the average of oxygen saturation in toddlers improved after chest physiotherapy. Another similar study explained that chest physiotherapy affected oxygen saturation. Another study in Brazil also revealed that patients who underwent chest physiotherapy experienced an increase in oxygen saturation. A case study with two respondents found that chest physiotherapy improved airway hygiene in pneumonia patients. This suggests that chest physiotherapy is very effective for improving SpO₂ and breath frequency.

CONCLUSION

After performing nursing actions in the pediatric inpatient room at Indriati General Hospital Solo Baru, the author learned to use chest physiotherapy effectively in pediatric pneumonia patients. The results of the case study showed that the child with pneumonia was able to resolve dyspnea and clear the airway with fifteen minutes of CPH technique/chest physiotherapy treatment. Oxygen saturation increased and respiratory rate decreased as a result of this treatment, which returned both to normal levels. Chest physiotherapy can be recommended in pneumonia patients with inadequate airway and dyspnea. For best results, these procedures should be performed before the patient eats and before bedtime and should also be performed by experienced nurses, staff, or medical personnel in a clean and healthy environment.

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