EFFECTIVENESS OF CHEST PHYSIOTHERAPY ON CHANGES IN SPO2 VALUES IN PNEUMONIA PATIENTS WITH SECRETION ACCUMULATION

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ABSTRACT

Pneumonia is a lower respiratory tract infection characterized by inflammation of the alveoli and increased secretion production, which leads to impaired gas exchange and a decrease in oxygen saturation (SpO_2). Chest physiotherapy is a non-pharmacological intervention aimed at facilitating the mobilization and elimination of secretions to improve oxygenation. Aim To analyze the effectiveness of chest physiotherapy on changes in SpO_2 levels in pneumonia patients with accumulated secretions. study employed a pre-experimental design using a one-group pretest-posttest approach. The sample consisted of 51 pneumonia patients with accumulated secretions. Data were collected by measuring SpO_2 levels before and after chest physiotherapy using a pulse oximeter. Data analysis was performed using the Wilcoxon Signed-Rank Test. The results showed that, prior to the intervention, the majority of patients experienced moderate hypoxemia (60.8%). Following chest physiotherapy, the majority of patients achieved normal SpO_2 levels (64.7%). The Wilcoxon test yielded a p-value of 0.000 ($p < 0.05$), with all respondents showing an increase in their SpO_2 levels. Conclusion and Recommendations: There is a significant difference in SpO_2 levels before and after chest physiotherapy, indicating that the intervention has a tangible effect on improving patient oxygenation. It is recommended that future research investigate the optimal frequency of chest physiotherapy sessions within a 24-hour period.

Keywords: Pneumonia, Chest Physiotherapy, Spo_2, Secretions, Oxygenation.

INTRODUCTION

Pneumonia is a leading cause of morbidity and mortality resulting from lower respiratory tract infections globally, particularly among adults with underlying comorbidities. The condition is characterized by acute inflammation of the lung tissue—triggered by bacterial, viral, or fungal infections—which leads to increased secretion production and impaired gas exchange within the alveoli. The accumulation of these secretions reduces oxygen saturation (SpO_2); if left unaddressed, this can progress to hypoxemia, respiratory failure, and even death (Robert J. Mason, 2016; Romadhon Gilang Bariq, 2025).

A sustained decline in SpO_2 can lead to hypoxemia, which carries the risk ofrespiratory muscle fatigue, impaired brain function (manifesting as restlessness or a reduced level of consciousness), cardiac dysfunction (such as arrhythmias or shock), and potentially respiratory failure or death. Furthermore, this condition increases the length of hospital stays, the need for respiratory support devices, and overall patient care costs (Romero Dapueto, 2015).

According to a comprehensive report from the latest Global Burden of Disease (GBD) Study, lower respiratory tract infections—predominantly pneumonia—

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account for approximately 2.5 million deaths globally. The highest vulnerability is observed among those at the extremes of the age spectrum: children under five years old and the elderly over 70. Globally, the incidence of this disease exceeds 1,400 cases per 100,000 children annually. Data from the Forum of International Respiratory Societies (FIRS) indicate that the burden is concentrated primarily in low- and middle-income developing countries, with Indonesia ranking 8th among the 10 nations with the highest childhood pneumonia mortality rates in the world (Sarah Sirota, 2025). An official report from the Indonesian Ministry of Health, via the Indonesian Health Survey (SKI), confirms that the prevalence of pneumonia across all age groups stands at 0.48%, with the highest prevalence—0.86%—observed among the elderly (aged 65–74 years). The Ministry's efforts to improve early detection and case registration have also led to a significant year-on-year increase in reported clinical cases. The high morbidity and economic burden of the disease are reflected in data from the Social Security Agency for Health (BPJS Kesehatan), which identifies pneumonia as the condition with the highest treatment costs in the inpatient category, with claims totaling IDR 8.7 trillion. In pneumonia patients, the clinical manifestation of accumulated secretions obstructing the airways directly leads to a decrease in oxygen saturation (SpO2), necessitating targeted non-pharmacological interventions, such as chest physiotherapy (KepMenKesRI, 2025).

The objective of this study is to analyze the effectiveness of chest physiotherapy on changes in SpO_2 levels among pneumonia patients with accumulated secretions who are receiving care at the Kaimana Regional General Hospital (RSUD Kaimana).

METHOD

This study employs a pre-experimental design, specifically a one-group pretest–posttest design, to assess the effectiveness of chest physiotherapy (the independent variable) on changes in peripheral oxygen saturation (SpO_2) levels (the dependent variable) among patients with pneumonia and retained secretions admitted to Kaimana Regional General Hospital (RSUD Kaimana). The study population consists of all patients with pneumonia and retained secretions admitted to RSUD Kaimana during the study period; this group was selected due to ventilation impairment resulting from the accumulation of secretions in the airways. The sample comprises 51 patients with pneumonia and retained secretions at RSUD Kaimana who met the following inclusion criteria: a medical diagnosis of pneumonia with retained secretions (confirmed via auscultation), age >18 years, stable hemodynamic status, an initial oxygen saturation level of <95%, and consent from the patient or their family to participate. Exclusion criteria include a history of heart disease or thoracic surgery, severe complications such as acute respiratory failure, impaired consciousness (Glasgow Coma Scale/GCS score < 13), and the use of an invasive mechanical ventilator. Consecutive sampling was used as the sampling technique. Data collection instruments included a pulse oximeter and an observation sheet. Data analysis involved both univariate and bivariate methods. Univariate analysis was used to describe patient characteristics (e.g., age, gender), SpO_2 levels before and after the chest physiotherapy intervention, and the difference in SpO_2 values. Prior to bivariate analysis, a normality test was conducted using the Shapiro-Wilk test. Bivariate analysis to determine the difference in SpO_2 levels before and after the intervention was performed using the Wilcoxon signed-rank test.

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The characteristics of the respondents describe the demographic and clinical profiles of pneumonia patients with secretion accumulation who were treated at Kaimana Regional General Hospital (RSUD Kaimana). The study included 51 adult pneumonia patients who were admitted to the hospital's wards during the study period and met the inclusion criteria. All respondents received chest physiotherapy interventions in accordance with the hospital's standard operating procedures.

Table 1. Respondent Distribution by Age

Age group	Frequency (n)	Percentage (%)
0–5 years	15	29,4
12–17 years	3	5,9
18–59 years	31	60,8
> 60 years	2	3,9
Total	51	100,0

Table 2. Respondent Distribution by Gender

Gender	Frequency (n)	Percentage (%)
Male	21	41,2
Female	30	58,8
Total	51	100,0

Table 3. Initial Patient SpO_2 Distribution Before Intervention

SpO_2 Category	Frequency (n)	Percentage (%)
< 90% (Hipoksemia berat)	5	9,8
90%–92% (Hipoksemia sedang)	31	60,8
93%–94% (Hipoksemia ringan)	9	17,6
95%–96% (Normal rendah)	6	11,8
Total	51	100,0

Table 4. Initial Patient SpO_2 Distribution after Intervention

SpO_2 Category	Frequency (n)	Percentage (%)
90%–92% (Moderate Hypoxemia)	4	7,8
93%–94% (Mild Hypoxemia)	1	2,0
95%–96% (Low-Normal)	13	25,5
≥ 97% (Normal)	33	64,7
Total	51	100,0

Table 5. SpO_2 Increase Differences in Pneumonia Patients

SpO_2 Difference Category	Frequency (n)	Percentage (%)
3–4% (Rendah)	12	23,5
5–6% (Sedang)	27	52,9
> 6% (Tinggi)	9	17,6
≥ 10% (Sangat tinggi)	3	5,9
Total	51	100,0

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Table 6. Wilcoxon Test Results for SpO_2 Values Before and After Chest Physiotherapy Intervention

Variables	Test	statistical	df	Sig.
SpO_2 before intervention	Kolmogorov-Smirnov	0,356	51	0,000
	Shapiro-Wilk	0,792	51	0,000
SpO_2 after intervention	Kolmogorov-Smirnov	0,373	51	0,000
	Shapiro-Wilk	0,631	51	0,000

Based on the research findings analyzed using the SPSS program, the Wilcoxon Signed Rank Test indicates a significant difference in SpO_2 levels before and after chest physiotherapy in pneumonia patients with secretion accumulation at Kaimana Regional General Hospital (RSUD Kaimana). The test results show a significance value of $p = 0.000$ ($p < 0.05$) with a Z-value of 6.313. All 51 respondents (100%) fell into the "positive ranks" category, meaning that every patient experienced an increase in SpO_2 levels following the chest physiotherapy intervention. No respondents showed a decrease in SpO_2 levels ("negative ranks"), nor were there any instances where values remained unchanged ("ties").

These findings align with the pathophysiology of pneumonia, which posits that inflammation of the alveoli—accompanied by increased production of mucus and exudate—fills the alveolar space, impairs pulmonary ventilation, and disrupts gas exchange, thereby leading to hypoxemia (Smeltzer, O'Connell, & Bare, 2013). This is further supported by Perry (2021), who explains that impaired airway clearance due to the accumulation of secretions is a primary cause of oxygenation disturbances, as these secretions obstruct airflow to the alveoli.

Furthermore, Hinkle (2022) states that secretions accumulating in the airways can cause airway obstruction and ventilation-perfusion mismatch, ultimately resulting in a decline in oxygen saturation. From a physiological perspective, Hall (2021) also explains that impaired oxygen diffusion—caused by the presence of fluid and exudate in the alveoli—reduces blood oxygen levels, thereby triggering hypoxemia.

The low SpO_2 levels observed in pneumonia patients prior to chest physiotherapy are not solely attributable to pulmonary inflammation caused by infection; they are also significantly influenced by an excessive accumulation of secretions that cannot be effectively expelled (Agustiansyah Ferdika, 2026). Inadequate coughing, physical weakness, and limited mobility during the course of treatment further impair the patient's ability to clear their airways independently. A delay in seeking medical attention often contributes to the severity of the clinical condition upon admission, characterized by low SpO_2 levels and a high volume of secretions. Consequently, the early identification of oxygenation impairments and the accumulation of secretions is crucial from the outset of care, ensuring that nursing interventions—including chest physiotherapy—can be administered in a timely manner tailored to the patient's specific condition.

Beyond the statistically significant differences, the effectiveness of chest physiotherapy is also clinically evident in the magnitude of the increase in SpO_2 values. As shown in Table 4.5, the majority of respondents (n=27; 52.9%) experienced a moderate increase in SpO_2 (5–6%). A total of 12 respondents (23.5%) showed a low increase (3–4%), while 9 respondents (17.6%) experienced a high increase (>6%). Furthermore, 3 respondents (5.9%) demonstrated a very high increase (≥10%). These findings indicate that chest physiotherapy not only yields statistically significant differences but also results in a clinically meaningful improvement in oxygenation for the majority of patients.

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The substantial increase in SpO_2 values reflects the success of the intervention in improving airway clearance and pulmonary ventilation. Patients who experienced moderate to very high increases in SpO_2 generally showed a significant reduction in accumulated secretions, which optimized airflow to the alveoli. This condition directly enhances oxygen diffusion into the blood and improves the pulmonary ventilation-perfusion balance (Trisusanti Eka Amelia, 2026).

Physiologically, the observed differences and the magnitude of the increase in SpO_2 values before and after the intervention occur because chest physiotherapy improves airway clearance mechanisms. The mobilization of secretions—achieved through techniques such as percussion, vibration, effective breathing exercises, controlled coughing, and the use of nebulization—helps dislodge secretions adhering to the bronchial walls, moving them from the distal to the proximal airways, where they can be more easily expelled (Wardiyah Aryanti, 2022). A reduction in secretions obstructing the airways lowers airflow resistance, enhances alveolar ventilation, and improves the balance between pulmonary ventilation and perfusion; consequently, the gas exchange process becomes more optimal, and SpO_2 levels increase significantly (Smeltzer, Suzanne C., Brenda G. Bare, 2013).

These findings align with the view expressed by Perry (2021), who states that impaired airway clearance due to secretions is a primary cause of oxygenation disturbances; therefore, respiratory interventions focused on clearing the airways can enhance alveolar ventilation and improve gas exchange. Furthermore, Hall (2021) explains that hypoxemia in pneumonia occurs due to inflammation of the alveoli and the accumulation of exudate, which hinders oxygen diffusion. Consequently, improving ventilation by eliminating secretions directly contributes to an increase in oxygen saturation.

The results regarding the improvement in SpO_2 levels in this study are also supported by previous research. Dian Prihatiyani and Rani Risdiana reported that chest physiotherapy can increase oxygen saturation levels in toddlers with pneumonia, with the average oxygen saturation rising to 97.43% following the intervention (Prihatiyani, 2025). A study by Dhea Amelia Putri et al. noted that, following chest physiotherapy, the subjects' oxygen saturation levels increased to 96% (Putri, 2026).

The significant difference and improvement in SpO_2 levels observed before and after the chest physiotherapy intervention are influenced not only by the specific physiotherapy techniques employed but also by the consistency with which the procedures are carried out, adherence to established protocols, and the patient's cooperation in performing effective coughing following the intervention. The combination of chest physiotherapy with concurrent medical therapies—such as the administration of oxygen and antibiotics—plays a crucial role in facilitating successful improvements in oxygenation (Agustiansyah, 2026). Thus, when chest physiotherapy is implemented in a planned, consistent manner and tailored to the individual patient's condition, it can yield optimal results in improving the respiratory status of patients with pneumonia characterized by the accumulation of secretions. Research by Dian Prihatiyani and Rani Risdiana (2025) indicates that chest physiotherapy, when applied selectively and on an individualized basis, remains effective in improving oxygenation and the respiratory status of patients with pneumonia (Prihatiyani & Risdiana, 2025).

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The success of chest physiotherapy in this study demonstrates that a respiratory nursing approach tailored to the patient's specific condition—individualized care—is more effective than the uniform application of interventions. Consistent implementation, procedural accuracy, and patient cooperation in performing effective coughing techniques are crucial factors that contribute to the success of chest physiotherapy (Sari, 2025). Furthermore, combining chest physiotherapy with medical interventions—such as oxygen administration, antibiotics, bronchodilators, and nebulization—plays a role in accelerating the improvement of respiratory status. Therefore, chest physiotherapy should be integrated into comprehensive respiratory nursing care, with careful consideration given to the indications, contraindications, and individual patient tolerance.

CONCLUSIONS AND RECOMMENDATIONS

The results of this study indicate a significant difference in SpO_2 levels before and after chest physiotherapy in pneumonia patients with secretion accumulation at Kaimana Regional General Hospital (RSUD Kaimana). The Wilcoxon test yielded a significance value of $p = 0.000$ ($p < 0.05$) with a Z-score of 6.313. Furthermore, all respondents (51 individuals / 100%) fell into the "positive ranks" category, meaning that every patient experienced an increase in SpO_2 levels following the chest physiotherapy intervention. Chest physiotherapy has been shown to be effective in improving SpO_2 levels in pneumonia patients with secretion accumulation. This effectiveness is evidenced by the rise in SpO_2 levels across all respondents, an increase in the number of patients reaching the normal oxygenation category post-intervention, and an improvement in respiratory status accompanying the enhanced oxygenation. It is recommended that future researchers investigate the optimal frequency of chest physiotherapy sessions within a 24-hour period.

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REFERENCES

Agustiansyah Ferdika, S. (2026). Efektivitas fisioterapi dada terhadap tingkat SpO_2 dan RR pada anak dengan pneumonia di RSUD Dr. H. Abdul Moeloek Bandar Lampung tahun 2026. Health Research Journal of Indonesia, 4(5), 1863–1869.

Alghamdi, A. (2022). Effect of chest physiotherapy on oxygen saturation in patients with pneumonia: A clinical observation. Journal of Pulmonary & Respiratory Medicine, 12(4), 215–219.

Hall, J. E. (2021). Guyton and Hall textbook of medical physiology (14th ed.). Elsevier.

Hinkle, J. L., & Cheever, K. H. (2022). Brunner & Suddarth's textbook of medical-surgical nursing (15th ed.). Wolters Kluwer.

Kementerian Kesehatan Republik Indonesia. (2023). Profil kesehatan Indonesia tahun 2022. Kementerian Kesehatan RI.

Kementerian Kesehatan Republik Indonesia. (2025). Pedoman nasional pelayanan klinis tata laksana pneumonia pada dewasa. Kementerian Kesehatan RI.

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Perry, A. G., Potter, P. A., & Ostendorf, W. R. (2021). Fundamentals of nursing (11th ed.). Elsevier.

Prihatiyani, D., & R. R. (2025). Pengaruh fisioterapi dada terhadap peningkatan saturasi oksigen pada pasien anak balita dengan pneumonia di ruang PICU RSKD Duren Sawit. Jurnal Ners, 10(2), 4101–4106.

Putri, D. A., & H. (2026). Implementasi fisioterapi dada terhadap saturasi oksigen pasien penyakit paru obstruksi kronik (PPOK). Jurnal Cendekia, 6(2).

Mason, R. J. (2016). Murray and Nadel's textbook of respiratory medicine (6th ed.). Elsevier.

Romadhon, G. B., & A. G. S. (2025). Pemenuhan kebutuhan oksigen pada anak dengan pneumonia melalui terapi nebulisasi. Scientific Journal of Nursing, 2(1), 18–23.

Romero, D., Dapueto, B., & G. J. (2015). Pathophysiological basis of acute respiratory failure on non-invasive mechanical ventilation. The Open Respiratory Medicine Journal, 9, 9–97.

Sirota, S. (2025). Global burden of lower respiratory infections and aetiologies, 1990–2023: A systematic analysis for the Global Burden of Disease Study 2023. The Lancet Infectious Diseases, 26(4), 343–361.

Sari, I. D. K., & N. Y. T. (2025). Analisis asuhan keperawatan melalui intervensi fisioterapi dada (clapping) pada anak dengan diagnosis medis bronkopneumonia. Jurnal Penelitian Perawat Profesional, 7(3), 771–776.

Smeltzer, S. C. O., Bare, B. G., & Hinkle, J. L. (2013). Brunner & Suddarth's textbook of medical-surgical nursing (12th ed.). Lippincott Williams & Wilkins.

Trisusanti, E. A., & P. M. M. Z. (2026). Pengaruh suction pada pasien post-op craniectomy yang terpasang ventilator terhadap saturasi oksigen di ICU RSKD Dadi. Corona: Jurnal Ilmu Kesehatan Umum, Psikologi, Keperawatan dan Kebidanan, 4(1), 146–159.

Wardiyah, A., & W. (2022). Implementasi fisioterapi dada untuk pasien dengan masalah bersihan jalan napas di Desa Mulyojati, Kota Metro. Jurnal Kreativitas Pengabdian kepada Masyarakat (PKM), 5(8), 2348–2362.

World Health Organization. (2023). Pneumonia. https://www.who.int/westernpacific/health-topics/detail/pneumonia (Diakses 4 Juli 2025)

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