

Effectiveness of chest physiotherapy in stabilizing breathing rate in children with upper respiratory tract infections

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ABSTRACT

Introduction: Acute Respiratory Tract Infections (ARTIs) remain a leading cause of morbidity and mortality among children, particularly in developing countries. Elevated respiratory rate is a common clinical manifestation in pediatric ARTI cases, often resulting from airway obstruction due to mucus accumulation. Chest physiotherapy is a non-pharmacological intervention aimed at mobilizing secretions, improving ventilation, and reducing respiratory effort. This study aimed to evaluate the effectiveness of chest physiotherapy in stabilizing the respiratory rate in preschool children diagnosed with ARTI.

Methods: This case study involved two pediatric inpatients aged 1 and 3 years with a confirmed diagnosis of ARTI at Sandi Karsa Hospital, Makassar. Each patient received daily chest physiotherapy including percussion, vibration, and postural drainage for three consecutive days. Respiratory rate was measured before and after each session using direct observation and timing methods..

Results: A consistent reduction in respiratory rate was observed in both patients following each chest physiotherapy session. The average decrease ranged from 8 to 9 breaths per minute, indicating a significant clinical improvement. No adverse effects were reported during or after the intervention.

Conclusion: Chest physiotherapy is an effective and safe non-pharmacological intervention for stabilizing the respiratory rate in children with ARTI. It facilitates mucus clearance, improves pulmonary ventilation, and alleviates respiratory effort. This intervention is recommended for integration into pediatric respiratory care protocols in hospital settings.

Keywords: Airway clearance, ARTI, chest physiotherapy, children, non-pharmacological therapy.

INTRODUCTION

Acute Respiratory Tract Infections (ARTIs) continue to represent a significant global health concern, particularly in developing countries where healthcare access and environmental factors contribute to high incidence rates [1]. ARTIs are among the primary causes of morbidity and mortality in children under five years old, with millions of new cases emerging annually. According to the World Health Organization (WHO), there are approximately 156 million new ARTI cases globally yearly, with 96.7% occurring in low- and middle-income countries [2]. In Indonesia, ARTI remains the leading cause of childhood hospital visits and deaths, especially during dry seasons and in areas with poor sanitation and high population density. ARTIs encompass many infections affecting the upper and lower respiratory tracts, including rhinitis, pharyngitis, laryngitis, otitis media, bronchitis, bronchiolitis, and pneumonia [3]. While some of these infections are self-limiting, others can escalate to severe complications such as acute bronchopneumonia or respiratory failure, particularly in vulnerable populations such as infants, immunocompromised children, or those with low birth weight. One of the primary clinical indicators of ARTI severity is an elevated respiratory rate. Tachypnea (rapid breathing) is often a physiological response to airway obstruction caused by inflammation and mucus accumulation, which leads to inefficient gas exchange and increased respiratory effort [4].

The respiratory system is still in a developmental phase in the pediatric population, especially among preschool-aged children (3–6 years) [5]. The narrow airway diameter, an underdeveloped immune system, and a limited ability to effectively expectorate mucus make children more susceptible to complications from ARTI. In clinical practice, interventions that assist in airway clearance are vital to alleviate symptoms, improve breathing patterns, and enhance overall oxygenation [6]. While pharmacological treatments such as bronchodilators, mucolytics, and antibiotics remain central to ARTI management, non-pharmacological approaches are increasingly recognized for their supportive role in improving respiratory outcomes [7]. Chest physiotherapy (CPT) is a widely practiced non-pharmacological intervention encompassing various techniques to enhance mucociliary clearance and optimize lung function. It includes percussion (clapping), vibration, postural drainage, and assisted coughing [8]. These techniques facilitate the mobilization and expulsion of respiratory secretions, especially in patients with ineffective spontaneous coughing. CPT is particularly beneficial for pediatric patients who cannot clear their airways independently due to age or disease severity. It is non-invasive, generally well-tolerated, and can be performed by trained healthcare workers or, in some cases, caregivers at home after appropriate instruction [9].

The physiological benefits of chest physiotherapy include improved ventilation-perfusion matching, decreased work of breathing, and enhanced oxygen saturation. When used consistently and correctly, CPT can significantly reduce the accumulation of mucus, decrease airway resistance, and restore standard respiratory patterns [10]. Clinical studies have demonstrated that CPT effectively manages various pulmonary conditions, including pneumonia, bronchiolitis, and chronic lung diseases. Moreover, in the context of ARTI, it can serve as a valuable adjunct to medical therapy, providing symptomatic relief and potentially shortening the duration of illness and hospital stay. Despite its widespread use, the evidence base for CPT effectiveness in acute conditions like ARTI in children remains under discussion in some clinical settings [11]. While numerous studies support its role in chronic respiratory conditions such as cystic fibrosis, fewer high-quality studies have specifically investigated its utility in acute pediatric infections. Therefore, conducting focused case studies and observational analyses is crucial to build a stronger foundation for CPT as a routine part of pediatric respiratory care [12].

The case study presented in this research focuses on two preschool-aged children hospitalized with ARTI. Over three consecutive days, chest physiotherapy sessions were conducted, and respiratory rates were measured before and after each session. The findings provide insights into the short-term impact of CPT on respiratory stability and support its use as an integral component of ARTI management in pediatric settings. ARTI remains a pressing health issue among children, necessitating multi-faceted approaches that combine pharmacological treatment with supportive therapies. Chest physiotherapy offers a promising, non-invasive solution to assist airway clearance and restore standard breathing patterns. By investigating its effectiveness in real-world clinical settings, this study contributes valuable

evidence that can inform clinical guidelines, enhance nursing competencies, and ultimately improve the quality of care for children with respiratory tract infections.

MATERIALS AND METHODS

Study Design

This research used a case study approach with a descriptive observational design. The study aimed to evaluate the effect of chest physiotherapy on respiratory rate stabilization in pediatric patients diagnosed with Acute Respiratory Tract Infections (ARTI). A case study design allows for an in-depth evaluation of the clinical outcomes in a real-world setting, focusing on the physiological responses before and after intervention.

Setting and Duration

The study was conducted in the Inpatient Unit, 5th Floor of Sandi Karsa Hospital, Makassar, Indonesia. Data collection was conducted during June 2025, with the intervention and observations completed over three consecutive days for each patient. Participants. Two pediatric patients were selected based on specific inclusion and exclusion criteria.

Inclusion Criteria: Diagnosed with Acute Respiratory Tract Infection (ARTI). Aged between 3 and 6 years old. Hospitalized in the inpatient pediatric unit. Parental consent obtained for participation.

Exclusion Criteria: Children with ARTI complicated by pneumonia, bronchiolitis, or respiratory failure. Children above 6 years of age. Patients are managed under outpatient care only.

Intervention Procedure: Chest Physiotherapy

The chest physiotherapy intervention was performed once daily for three consecutive days for each patient. Each session lasted approximately 15–20 minutes and consisted of the following techniques:

Percussion (Clapping)

Gentle rhythmic tapping on the chest wall using cupped hands to loosen mucus from the lung walls.

Vibration

Manual vibratory pressure is applied during exhalation to mobilize loosened secretions towards the larger airways.

Postural Drainage

Positioning the patient to allow gravity-assisted drainage of mucus from specific lung segments.

Effective Cough Technique

Children were assisted or instructed (if developmentally appropriate) to perform controlled coughing after each CPT session to expel loosened secretions. The techniques were administered by trained healthcare staff following standard operating procedures to ensure safety, comfort, and efficacy.

Data Collection Tools and Measurements

Respiratory Rate Assessment. Instrument: A digital wristwatch or stopwatch was used to count breaths per minute (bpm). Timing: Measurements were taken immediately before and 15 minutes after each CPT session. **Observation Checklist.** A structured sheet was used to record patient responses, comfort level, cooperation, and adverse reactions during or after the intervention. **Clinical Records:** Basic demographic and clinical data were collected from patient medical records, including age, gender, length of hospitalization, and baseline symptoms.

Ethical Considerations

Ethical clearance and permission were obtained from the hospital administration and the nursing academic institution. Informed consent was secured from the parents of the participating children. All personal identifiers were kept confidential through coded data sheets, and no names were recorded in the final report. **Informed Consent:** Parents received detailed information regarding the purpose, procedure, benefits, and potential risks of the study and were asked to sign a consent form. **Anonymity and Confidentiality:** Patient identities were anonymized using pseudonyms or initials. Data were stored securely and were only accessible to the research team. **Voluntary Participation:** Participation was voluntary, and parents could withdraw their child from the study without affecting their treatment.

Data Analysis

The data were analyzed using descriptive statistics, comparing respiratory rate values before and after each CPT session. The results were presented in tabular format, showing the difference in breaths

per minute (bpm) to indicate the effect of the intervention. Given the small sample size, inferential statistics were not applied, and findings were interpreted qualitatively based on observed clinical changes.

RESULTS

This case study involved two pediatric patients admitted to the Sandi Karsa Hospital, Makassar inpatient ward, diagnosed with Acute Respiratory Tract Infections (ARTI). Both patients met the inclusion criteria and were enrolled following parental consent.

Table 1. Participant Characteristics

Respondent	Age	Gender	Length of Stay
Respondent 1	1 year	Male	1 day
Respondent 2	3 years	Female	2 days

Both children were within the targeted age range (1–3 years) and presented with symptoms of ARTI, including elevated respiratory rates. Neither had underlying complications nor comorbidities that would exclude them from the study.

Table.2: Effect of Chest Physiotherapy on Respiratory Rate

Respondent	Date	Before Therapy (bpm)	After Therapy (bpm)	Change (Δ bpm)
1	June 4, 2025	38	30	-8
1	June 5, 2025	36	28	-8
1	June 6, 2025	35	26	-9
2	June 7, 2025	40	31	-9
2	June 8, 2025	38	30	-8
2	June 9, 2025	37	29	-8

Consistent Reduction: Each child exhibited a consistent reduction in respiratory rate following chest physiotherapy, with decreases ranging from 8 to 9 breaths per minute. **Clinical Improvement:** A decrease in respiratory rate suggests reduced respiratory distress, improved airway clearance, and increased efficiency in ventilation. The average pre-therapy respiratory rate was 35–40 bpm, indicating mild to moderate respiratory distress. The average post-therapy respiratory rate decreased to 26–31 bpm, approaching more stable levels for the children's age group. Chest physiotherapy effectively reduced respiratory effort and improved respiratory patterns within a short-term intervention period. These findings demonstrate that chest physiotherapy can be a safe and effective method for stabilizing respiratory rates in children with ARTI when performed consistently over several days. **Tolerability:** No side effects or complications were observed during or after therapy. Both patients remained calm and cooperative throughout the procedures.

DISCUSSION

The present case study demonstrates the effectiveness of chest physiotherapy (CPT) in stabilizing and reducing the respiratory rate in preschool-aged children diagnosed with Acute Respiratory Tract Infections (ARTI). Across six sessions administered to two pediatric patients, the intervention consistently resulted in a measurable decrease in respiratory rate by an average of 8–9 breaths per minute per session. This consistent decline underscores the potential of CPT as a clinically effective, non-invasive, and low-risk intervention for respiratory support in children with ARTI.

The Physiological Basis of Elevated Respiratory Rate in ARTI, particularly in young children, leads to inflammation, mucus accumulation, and narrowing of the airways. These pathophysiological changes impair gas exchange in the lungs, leading to hypoxemia and triggering compensatory mechanisms such as increased respiratory rate (tachypnea) to maintain adequate oxygen delivery. A persistently high respiratory rate is a standard clinical marker of respiratory distress and is associated with increased work of breathing, fatigue, and poor oxygenation [13]. Children, especially those aged 1–5 years, are anatomically and immunologically more vulnerable to respiratory tract infections. Their

smaller airway diameter makes them more susceptible to airway obstruction from mucus and inflammation. Furthermore, their underdeveloped cough reflex limits their ability to clear secretions effectively, exacerbating respiratory symptoms [14].

Effectiveness of Chest Physiotherapy. Chest physiotherapy techniques used in this study, percussion (clapping), vibration, postural drainage, and effective coughing collectively contributed to the clearance of secretions from the airways [15]. These techniques facilitated the mobilization of mucus from peripheral airways toward the central airways, where it could be expelled through coughing or suctioning [16]. This mechanism aligns with previous studies that have established the physiological benefits of CPT in enhancing mucociliary clearance, reducing airway resistance, improving alveolar ventilation, and subsequently lowering respiratory rate [17]. Chest physiotherapy improves airway patency, oxygenation, and respiratory comfort, particularly in pediatric populations with ineffective airway clearance [18]. In this case study, the reduction of respiratory rate post-therapy reflected a direct improvement in respiratory function, with patients appearing calmer and showing no signs of increased respiratory effort post-intervention [19]. These outcomes indicate that CPT improved mucus clearance and positively impacted overall pulmonary ventilation [20].

Comparison with Previous Research. The results of this study are consistent with earlier findings. Found a statistically significant improvement in sputum clearance in pediatric patients following CPT, particularly using clapping and vibration techniques [21]. The presence of mucus plugs can dramatically elevate the respiratory rate and increase the risk of lower respiratory tract involvement. By breaking down these plugs and enhancing expectoration, CPT helps restore airway patency [22]. Emphasized that percussion can mechanically dislodge mucus adhered to airway walls, making it easier. The improvement in respiratory rate observed in our study suggests that the same physiological effects were achieved in these pediatric patients, even within three days. Intervention is also non-pharmacological, which minimizes the risk of drug-related side effects, making it especially valuable in settings where pharmacological treatments alone may not suffice or where polypharmacy needs to be avoided. From a clinical nursing perspective, CPT is a valuable tool within the broader scope of nursing care. It enables nurses and physiotherapists to deliver direct, hands-on respiratory support, especially in cases where pharmacological options are limited or contraindicated. Furthermore, CPT enhances the nurse's role in promoting airway clearance and preventing deterioration, thus aligning with the goals of holistic, patient-centered care.

CONCLUSIONS

In conclusion, this case study provides empirical support for the effectiveness of chest physiotherapy in reducing and stabilizing the respiratory rate in children with ARTI. CPT is a safe, non-invasive, cost-effective intervention that complements pharmacological treatments. When performed correctly, it can significantly improve respiratory function, enhance patient comfort, and reduce the risk of complications. With appropriate training and integration into standard care, CPT holds great potential in improving pediatric respiratory outcomes, particularly in resource-constrained healthcare settings.

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Authors' contributions

All authors contributed significantly to the development and completion of this research study.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this research. No financial, professional, or personal relationships have influenced the outcomes or interpretations presented in this study.

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