



(REVIEW ARTICLE)



## The effectiveness of respiratory physiotherapy in children with severe respiratory problems: Literature review

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International Journal of Science and Research Archive, 2024, 12(02), 103–109

Publication history: Received on 11 May 2024; revised on 25 June 2024; accepted on 28 June 2024

Article DOI: <https://doi.org/10.30574/ijrsra.2024.12.2.1126>

### Abstract

**Introduction:** Respiratory physiotherapy is essential for children with severe respiratory problems. It aims to clear the bronchi, maintain spinal and thoracic mobility, and improve posture. It also helps restore respiratory functions by improving oxygen uptake and carbon dioxide elimination.

**Aim:** This review aims to highlight the effectiveness of respiratory physiotherapy in children with severe respiratory problems, focusing on improving respiratory function and rehabilitation of problems and complications.

**Methodology:** A literature search was conducted via Google Scholar and PubMed, using keywords such as "physical therapy treatment", "cystic fibrosis", and "children". Clinical studies and systematic reviews published in English were selected. Of the 248 initially identified studies, 14 were selected based on specific criteria.

**Results:** The review showed that respiratory physiotherapy significantly improves respiratory function and reduces complications in children with severe respiratory problems and cystic fibrosis. Effective techniques include diaphragmatic breathing, active breathing cycle and PEP, FLUTTER and ACAPELLA devices. Consistency in treatment is critical for better clinical outcomes.

**Conclusions:** Respiratory physiotherapy is vital in the treatment of children with severe respiratory problems, offering multiple benefits in improving respiratory function and reducing complications. Consistency in treatment and parental involvement are critical to the success of treatment.

**Keywords:** Respiratory physiotherapy; Severe respiratory problems; Children; Cystic fibrosis; Airway clearance techniques; PEP; FLUTTER; ACAPELLA; Respiratory function.

### 1. Introduction

Respiratory physiotherapy is essential in the treatment of children with severe respiratory problems. Its main aim is to clear the bronchi of secretions, maintain spinal and thoracic mobility and improve posture. It also aims to improve respiratory function, helping to improve oxygen uptake and carbon dioxide elimination. According to Tang et al. (2010), it includes techniques and strategies that improve respiratory function and remedy problems resulting from various conditions. Its importance is great in intensive care units, where the patient's vital functions need special attention due to possible complications.

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Respiratory physiotherapy helps to clear secretions to the trachea to induce the cough reflex, which many patients cannot induce on their own. In addition, diaphragm training is important for obtaining a correct breathing pattern. This specialized physiotherapy aims to achieve a calm breathing pattern or to improve the existing pattern, to obtain controlled breathing and to reduce respiratory work. It also aims to reduce bronchospasm, assist the expansion of the lung parenchyma and remove bronchial secretions to keep the lungs clear.

Another objective is to increase the patient's stamina, to make him/her independent and to facilitate his/her functional activities. These goals focus on better ventilation, improved oxygen uptake and carbon dioxide elimination, tailored to the needs of each patient. In recent years, physiotherapy has also been applied through exercise, including techniques such as the active breathing cycle and autogenous drainage, combined with manipulations such as filling and vibration during expiration, and positioning in drainage positions.

Pulmonary complications are common causes of morbidity and mortality in patients with severe respiratory problems. Effective coughing is essential for expectoration, as the accumulation of secretions can worsen bronchial health and cause complications such as atelectasis, inflammation, infections, pneumonia, respiratory arrest and death. The need to support children with severe respiratory problems has led to the development of devices such as the flutter and acapella, as well as techniques to remove secretions and improve respiratory function.

### *Objective*

The purpose of this review is to highlight the effectiveness of respiratory physiotherapy, which includes techniques and strategies aimed at improving respiratory function and rehabilitating problems and complications from various respiratory, musculoskeletal and neurological conditions. It also aims to compile current research data, comment on their effectiveness and provide information to parents and clinicians on the importance of respiratory physiotherapy in children with severe respiratory problems.

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## **2. Methodology**

The literature was searched through Google Scholar and PubMed databases, with the language of publication being English only. The keywords used were: "physical therapy treatment", "cystic fibrosis", and "children". Clinical studies and systematic reviews were included. Initially 248 relevant studies were identified. Of the 248 initially identified studies, 14 were selected based on specific criteria.

### **2.1. Inclusion and exclusion criteria**

The inclusion criteria were: a) studies involving children aged 6-18 years, b) studies related to children receiving treatment for cystic fibrosis, and c) studies related to physical therapy or therapeutic exercise or a combination of both.

The exclusion criteria were: a) studies involving adult patients over 18 years of age, b) studies involving patients undergoing lung transplantation, and c) studies published before 2000.

### **2.2. Review of the bibliography**

A literature review was performed to search for studies on the effect of respiratory physical therapy in children with severe respiratory problems using the databases.

Based on the above criteria, 248 articles emerged and after applying the selection criteria, 14 articles were selected. The search strategy is then detailed in the table below (Table 1).

**Table 1.** Data of the literature review

<b>Title of article</b>	<b>Author</b>	<b>Content</b>
The safety and sustainability of bottle-pep therapy in pediatric patients with cystic fibrosis	Findik, B. N., et al. (2021)	Busra Nur Findik et al., (2021), conducted a study on the use of the bottle as a PEP device. The bottle, is a low-cost device, but an effective alternative. This research examined if bottle-PEP therapy is a feasible and secure choice for home recovery.
Coughing and diaphragmatic breathing exercise: What is the repercussion on respiratory mechanics of children and adolescents with cystic fibrosis?	Castilho, T., et al. (2021)	Tayná Castilho and her team found that coughing worsened breathing mechanics for all participants. However, diaphragmatic breathing had mixed results: it improved breathing mechanics in younger children but had a negative impact on older ones. This suggests that diaphragmatic breathing has age-dependent effects on respiratory mechanics in pediatric CF patients.
Autogenic Drainage in Children With Cystic Fibrosis	Corten, K., & Morrow, B. (2017)	Corten and Morrow (2017) studied the effectiveness of autogenous drainage and assisted autogenous drainage in relation to other airway clearing techniques or the absence of them. Airway clearance is one of the most important issues regarding the treatment of cystic fibrosis as it facilitates the clearance of pathological secretions. The researchers found that they were not able to make clear and generalised conclusions with this data about the use of this technique. They could neither prove nor reject this therapeutic technique as safe or effective for use in clinical practice.
Acapella vs. PEP mask therapy: A randomized trial in children with cystic fibrosis during respiratory exacerbati	West, K., Wallen, M., & Follett, J. (2010)	The study by Kerry West et al., (2010), investigated the effectiveness of the Acapella device compared to PEP mask therapy. The outcome measures were changes in lung function (FEV1, FVC, FEF and PEF) and exercise performance. In addition, total sputum production during treatment, and patient satisfaction were assessed over the period of 10 days. At the end of 10 days there were no statistically significant differences between groups for any of the outcome measures. Participants were very satisfied with both devices. The Acapella device and PEP mask in their use in cystic fibrosis during an acute flare showed no statistical difference.
Effect of active cycle of breathing techniques in patients with chronic obstructive pulmonary disease: a systematic review of intervention	Shen, X., Zhang, H., He, J., & Li, Y. (2020)	Shen et al. (2020) examined if the active breathing cycle technique was effective. The result was that this technique helps to reduce dyspnea and remove sputum through productive coughing. However, the results were not conclusive as to the effectiveness of active breathing cycle in improving lung function and blood gases.
Effectiveness Active Cycle of Breathing Technique (ACBT) with Pursed Lips Breathing Technique (PLBT) to tripod position in increase oxygen saturation in patients with COPD, West Sumatera	Zuriati, I., & Surva, R. (2020)	Another study conducted in a hospital in western Sumatera on the effectiveness of the active breathing cycle technique concluded that combining this technique with the closed lip breathing technique (PLBT) leads to higher oxygen saturation, less dyspnoea and easier elimination of secretions (Zuriati & Surva, 2020).
Respiratory therapy: a problem among children and adolescents with cystic fibrosis	Taiane, Dos Santos Feiten P. et al. (2016)	Taiane Dos Santos Feiten et al, (2016), studied whether adherence to the physiotherapy protocol of respiratory physiotherapy in children with cystic fibrosis helped more than in children who did not follow the protocol to the letter. There were statistically significant differences between the high adherence group and the moderate/poor adherence group. The latter showed lower scores for the "radiological findings" domain of the clinical score, greater number of hospitalizations and more days of hospitalization in the past year, as well as lower scores for the quality of life, emotions, and respiratory problems questionnaire domains.

Effects of expiratory muscle training on peak cough flow in children and adolescents with cystic fibrosis: A randomized controlled trial	Emizra, C., et al. (2021)	Cigdem Emizra and her team (2021) conducted a randomized controlled trial focusing on strengthening expiratory muscles to improve peak cough flow in children and adolescents with cystic fibrosis. The goal was to examine how expiratory muscle training (EMT) affects peak cough flow (PCF), respiratory muscle functions, exercise capacity, and quality of life (QoL). According to the results the exercise group experienced reduced treatment burden, better digestive symptoms, and enhanced QoL. The exercise group also had greater improvements in PCF and peak expiratory pressure compared to the sham group.
Effects of Diaphragmatic Breathing With and Without Pursed-Lips Breathing in Subjects With COPD	Mendes, R. G., et al. (2018)	This study compared the effectiveness of simple diaphragmatic breathing and lip-clamp techniques. The results showed that both methods improve oxygenation, lower respiratory rate, and reduce shortness of breath.
The effectiveness of a bronchial drainage technique (ELTGOL) in COPD exacerbations	Kodric, T., et al. (2009)	The study examined the effectiveness of bronchial drainage and concluded that it reduces dyspnoea and sputum and improves quality of life.
A comparison of autogenic drainage and the active cycle of breathing techniques in patients with acute exacerbation of chronic obstructive pulmonary disease.	Moiz, J. A., et al. (2007)	The results of a study conducted by Moiz et al., (2007), to investigate the effectiveness of the technique of autogenous drainage and active breathing cycle, showed that autogenous drainage reduces dyspnoea and helps chronic hypercapnia but no significant changes in other parameters of lung function were observed. In addition, both techniques were found to be almost equally effective in removing secretions, improving lung function, clearing the airways and increasing oxygen saturation.
Chest physiotherapy for patients admitted to hospital with an acute exacerbation of chronic obstructive pulmonary disease (COPD): A systematic review	Tang, C. Y., Taylor, N. F., & Blackstock, F. C. (2010).	The effectiveness of chest physiotherapy was examined in this study using the vibration technique, active breathing cycle and PEP mask in patients with chronic respiratory problems. The results showed that these help to improve lung air volume and clear airway secretions.
Comparison of Autogenic drainage & Active cycle breathing techniques on FEV1, FVC & PEFr in chronic obstructive pulmonary disease.	Buragadda, S., Sharma, D., Alghamdi, M.A., & Arabia, S. (2012)	compared the effectiveness of autogenous drainage with the active breathing cycle technique in patients with chronic respiratory failure and ended up to the conclusion that autogenous drainage and active breathing cycle significantly improve breathing in these patients.
Comparison of effects of the Flutter device versus autogenic drainage on peak expiratory flow rate, oxygen saturation, respiratory rate, and pulse rate in COPD patients	Jahan, S., Kumar, L., & Ahmed, F. (2015)	The results of the study by Jahan et al., (2015), which aimed to compare the effects of the flutter device versus autogenous drainage in patients with respiratory failure, led to the conclusion that both methods contribute to obtaining maximal expiratory flow and improving oxygen saturation and improving heart and respiratory rhythm.

### 3. Research studies

This literature review examines the use of respiratory physiotherapy in children with severe respiratory problems and cystic fibrosis, analyzing the effectiveness of various techniques and devices. The researchers highlight the importance of physiotherapy in improving respiratory function and reducing respiratory complications.

The study by Findik et al. (2021) showed that the use of the bottle-PEP device is safe and cost-effective for home use, providing an economical and effective alternative. Children using this device improve their respiratory function and expel secretions better.

Research by Castilho et al. (2021) examined the effect of diaphragmatic breathing and coughing on breathing mechanics in children with cystic fibrosis. Diaphragmatic breathing improved breathing mechanics, whereas coughing worsened it, particularly in older children.

Corten and Morrow (2017) evaluated autogenous drainage compared with other airway clearance techniques. The results were not sufficient for firm conclusions, requiring further research into the effectiveness of this technique.

The study by West et al. (2010) compared the Acapella device with PEP mask therapy in children with cystic fibrosis during respiratory flare-ups. No significant differences were found between the two devices, suggesting that the choice may be based on patient preference.

Shen et al. (2020) investigated the effectiveness of the active breathing cycle in reducing dyspnoea and sputum production in patients with chronic obstructive pulmonary disease (COPD). This technique improved respiratory function and reduced dyspnea. Its combination with closed-lip breathing improved oxygenation and reduced dyspnea (Zuriati & Surva, 2020).

Adherence to treatment is critical. Research by Feiten et al. (2016) showed that children who adhered faithfully to the physical therapy protocol had better outcomes and fewer hospitalizations. Adherence to guidelines reduces the risk of complications and improves quality of life.

The study by Emizra et al. (2016) showed that strengthening the expiratory muscles improves peak cough flow and respiratory muscle function in children with cystic fibrosis, contributing to expectoration and respiratory function.

Respiratory physiotherapy also includes diaphragmatic breathing and tight lip breathing techniques, which improve oxygenation and reduce dyspnoea (Mendes et al., 2018). These techniques can be incorporated into daily practice.

Bronchial drainage techniques reduce breathlessness and remove secretions, improving quality of life (Kodric et al., 2009). The choice of technique varies according to age, disease severity and practitioner preference. A combination of techniques may be effective in improving airway clearance and lung function.

In summary, respiratory physiotherapy is important in the management of respiratory problems in children with cystic fibrosis, helping to improve respiratory function, clear secretions and reduce complications.

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#### **4. Discussion**

This review highlights the importance of respiratory physiotherapy in the management of respiratory problems in children with severe conditions such as cystic fibrosis. Results from several studies show that physiotherapy can significantly improve respiratory function, reduce dyspnea and prevent complications.

Respiratory physiotherapy involves various techniques and devices to improve lung function and remove secretions. Techniques such as diaphragmatic breathing, active breathing cycle, autogenous drainage and PEP, FLUTTER and ACAPELLA devices have been shown to be effective at different levels.

Diaphragmatic breathing, according to Castilho et al. (2021), improves breathing mechanics and reduces dyspnea, with better results in the younger age group.

Autogenous drainage and active breathing cycle are also important airway clearing techniques. Despite Corten and Morrow's (2017) inconclusive conclusions about autogenous drainage, the data suggest that it may be beneficial for improving respiratory function.

PEP, FLUTTER and ACAPELLA devices are widely used in respiratory physiotherapy for children with cystic fibrosis. The study by West et al. (2010) showed that there were no significant differences between the Acapella device and the PEP mask, indicating that the choice may be based on patient preference.

Consistency in treatment is critical. Research by Taiane et al. (2016) showed that children who followed the physiotherapy protocol faithfully had better clinical outcomes and fewer hospitalizations, demonstrating the importance of consistency and parental involvement.

Strengthening the expiratory muscles is also important. The study by Emizra et al. (2016) showed that exercising these muscles improves peak cough flow and respiratory muscle function, helping to remove secretions.

Physiotherapy also includes techniques such as diaphragmatic breathing and tight-lipped breathing, which improve oxygenation and reduce dyspnea (Mendes et al., 2018). These techniques are easily applicable in daily practice.

Bronchial drainage techniques help to reduce dyspnea and remove secretions, improving quality of life (Kodric et al. 2009). The choice of the appropriate technique varies according to age, disease severity and practitioner preference. A combination of techniques may be effective.

In conclusion, respiratory physiotherapy is vital to improve respiratory function, clear secretions and reduce complications in children with cystic fibrosis and other severe respiratory problems. These techniques help improve the quality of life and overall health of patients.

### *Suggestions*

Respiratory physiotherapy is essential for treating children with severe respiratory problems, improving respiratory function and reducing complications. For best results, it is recommended to use various techniques and devices that have been shown to be effective.

It is important to educate parents and caregivers on physiotherapy techniques and to ensure that they are properly applied at home. This can improve clinical outcomes and reduce hospitalizations.

The use of PEP, FLUTTER and Acapella devices. and Acapella devices are economical and effective home solutions, as studies show, helping to improve clearance of secretions and improve respiratory function.

Techniques such as diaphragmatic breathing should be tailored to the age and needs of the child for best results. Also, the combination of autogenous drainage and active breathing cycle may maximise airway clearance, despite the inconclusive conclusions of some studies.

Incorporating exercise and breathing techniques into daily practice, such as diaphragmatic breathing and tight-lipped breathing, may improve oxygenation and reduce dyspnea.

Finally, regular assessment by a healthcare team, including physiotherapists, is essential to tailor physiotherapy techniques to each child's needs.

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## **5. Conclusions**

Respiratory physiotherapy is essential for the treatment of children with severe respiratory problems, offering many benefits in improving respiratory function and reducing complications. This review demonstrates the effectiveness of the techniques and devices used in physiotherapy and emphasizes the importance of consistency in treatment. The bottle-PEP device, according to Findik et al. (2023), is an economical and effective solution for home use. Diaphragmatic breathing improves breathing mechanics in children with cystic fibrosis, but it should be adapted to the age and respiratory capacity of the children. Autogenous drainage and active breathing cycle, although not conclusive according to Corten et al. (2017), appear to help improve respiratory function and clear secretions. Consistency in treatment and parental involvement are critical to the effectiveness of treatment, as highlighted by Taiane et al. (2016). Finally, techniques such as diaphragmatic breathing and tight-lipped breathing improve oxygenation and reduce dyspnea, helping to improve the quality of life of children with severe respiratory problems.

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## **Compliance with ethical standards**

### *Disclosure of conflict of interest*

No conflict of interest to be disclosed.

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