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RESPIRATORY REHABILITATION IN CHILDREN WITH ACUTE RESPIRATORY INFECTION: AN INTEGRATIVE LITERATURE REVIEW

REABILITAÇÃO RESPIRATÓRIA NA CRIANÇA COM INFEÇÃO RESPIRATÓRIA AGUDA: REVISÃO INTEGRATIVA DA LITERATURA

REHABILITACIÓN RESPIRATORIA EN NIÑOS CON INFECCIÓN RESPIRATORIA AGUDA: REVISIÓN INTEGRADORA DE LA LITERATURA

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RESUMO

Introdução: As infeções respiratórias agudas constituem uma importante causa de morbilidade em crianças, particularmente em menores de cinco anos. A reabilitação respiratória tem sido utilizada para melhorar a função respiratória e apoiar a recuperação clínica. Este estudo objetiva identificar e analisar a evidência disponível sobre as intervenções de reabilitação respiratória que promovem a melhoria da função respiratória em crianças com infeção respiratória aguda.

Metodologia: Revisão integrativa da literatura baseada na questão PIO. A pesquisa foi realizada em julho de 2025 nas bases de dados da plataforma EBSCOhost®**, incluindo estudos primários publicados nos últimos dez anos.**

Resultados: Foram incluídos 10 estudos, maioritariamente ensaios clínicos randomizados, que analisaram intervenções de reabilitação respiratória em crianças com infeção respiratória aguda, em contexto de internamento e ambulatório. As intervenções incluíram técnicas modernas, convencionais e instrumentais. Globalmente, observaram-se melhorias nos resultados clínicos e funcionais, com alguns estudos a reportar redução do tempo de internamento. Foram reportados poucos efeitos adversos, geralmente ligeiros.

Discussão: Apesar dos resultados globalmente favoráveis, a evidência apresenta heterogeneidade metodológica, amostras reduzidas e variabilidade de desfechos, limitando a comparabilidade entre estudos.

Conclusão: A reabilitação respiratória pode contribuir para a melhoria da função respiratória em crianças com infeção respiratória aguda. Contudo, são necessários estudos mais robustos que sustentem recomendações clínicas consistentes.

Descritores: Infeções Respiratórias; Criança; Terapia Respiratória; Enfermagem em Reabilitação

ABSTRACT

Introduction: Acute respiratory infections are a major cause of morbidity in children, particularly those under five years of age. Respiratory rehabilitation has been used to improve respiratory function and support clinical recovery. This study aims to identify and analyze the available evidence on respiratory rehabilitation interventions that promote improved respiratory function in children with acute respiratory infection.

Methodology: Integrative literature review based on a PIO question. The search was conducted in July 2025 in EBSCOhost® databases and included primary studies published in the last ten years.

Results: Ten studies were included, mostly randomized controlled trials, analysing respiratory rehabilitation interventions in children with acute respiratory infections, in both inpatient and outpatient settings. Interventions included modern, conventional, and instrumental techniques. Overall, improvements in clinical and functional outcomes were observed, with some studies reporting reductions in length of hospital stay. Few and generally mild adverse effects were reported.

Discussion: Despite generally favourable results, the evidence shows methodological heterogeneity, small sample sizes, and variability in outcomes, limiting comparability across studies.

Conclusion: Respiratory rehabilitation may contribute to improved respiratory function in children with acute respiratory infections. However, more robust studies are needed to support consistent clinical recommendations.

Descriptors: Respiratory Tract Infections; Child; Respiratory Therapy; Rehabilitation Nursing

RESUMEN

Introducción: Las infecciones respiratorias agudas constituyen una importante causa de morbilidad en niños, especialmente en menores de cinco años. La rehabilitación respiratoria se ha utilizado para mejorar la función respiratoria y apoyar la recuperación clínica. Este estudio tiene como objetivo identificar y analizar la evidencia disponible sobre las intervenciones de rehabilitación respiratoria que promueven la mejora de la función respiratoria en niños con infección respiratoria aguda.

Metodología: Revisión integradora de la literatura basada en la pregunta PIO. La búsqueda se realizó en julio de 2025 en las bases de datos de la plataforma EBSCOhost®, incluyendo estudios primarios publicados en los últimos diez años.

Resultados: Se incluyeron 10 estudios, en su mayoría ensayos clínicos aleatorizados, que analizaron intervenciones de rehabilitación respiratoria en niños con infección respiratoria aguda, tanto en contexto hospitalario como ambulatorio. Las intervenciones incluyeron técnicas modernas, convencionales e instrumentales. En general, se observaron mejoras en los resultados clínicos y funcionales, con algunos estudios que reportaron reducción de la estancia hospitalaria. Se reportaron pocos efectos adversos, generalmente leves.

Discusión: A pesar de los resultados globalmente favorables, la evidencia presenta heterogeneidad metodológica, muestras pequeñas y variabilidad en los desenlaces, lo que limita la comparabilidad entre estudios.

Conclusión: La rehabilitación respiratoria puede contribuir a la mejora de la función respiratoria en niños con infección respiratoria aguda. Sin embargo, se necesitan estudios más robustos que respalden recomendaciones clínicas consistentes.

Descriptores: Infecciones del Sistema Respiratorio; Niño; Terapia Respiratoria; Enfermería en Rehabilitación

INTRODUCTION

Acute respiratory infections (ARIs) are infectious diseases defined as the sudden onset of one or more respiratory signs or symptoms and/or a clinical assessment that the disease is due to an infection of the upper or lower respiratory tract [1]. The most common signs and symptoms include fever, cough, runny or stuffy nose, difficulty breathing, general malaise, and odynophagia. In children, nonspecific symptoms such as diarrhoea, nausea, vomiting, and loss of appetite, often associated with viral respiratory infections, should also be considered [1,2].

Children are more vulnerable to developing acute respiratory infections than adults due to the anatomical and physiological characteristics of their respiratory system [3]. In addition, acute respiratory infections in childhood are associated with environmental and social factors such as daycare attendance, exposure to tobacco smoke, dampness at home, and traffic pollution, while breastfeeding is an important protective factor [4].

Acute respiratory infections represent a major global health burden, particularly among children under five years of age, who are especially vulnerable due to the developmental characteristics of the respiratory system. Lower respiratory tract infections, particularly pneumonia, remain among the leading causes of morbidity and mortality in this population worldwide, although epidemiological estimates may vary depending on geographical context and time period [5]. In Portugal, although the numbers are significantly lower, there were four deaths of children under the age of five from pneumonia in 2021 [6].

Among ARIs, bronchiolitis and pneumonia are two of the most clinically relevant conditions in early childhood. Bronchiolitis, most commonly associated with respiratory syncytial virus (RSV), primarily affects infants and is characterized by inflammation of the bronchioles and nasal congestion, usually manifesting as coughing, wheezing, tachypnoea, fever, or chest retraction [7,8]. Although typically self-limiting, severe cases may progress to respiratory failure. Pneumonia, on the other hand, is associated with significant morbidity and is generally diagnosed based on clinical assessment, with radiological examination used when clinically indicated [9]. These conditions differ in pathophysiology and clinical course, which may influence therapeutic approaches and clinical decision-making.

According to the systematic review conducted by [10], RSV is responsible for approximately 3.6 million hospitalizations and approximately 100.000 deaths annually in children under five years of age worldwide. In Portugal, between 2015 and 2018, there were more than 26.000 hospitalizations of children under five years of age related to ARIs of the lower respiratory tract, of which approximately 9.700 had specific coding for RSV [11]. Also, in the Autonomous Region of Madeira, during the 2022–2023 epidemic season, RSV was identified in more than half of ARI cases in children, accounting for almost half of hospitalizations in children under two years of age [12].

ARIs in childhood can have a significant and lasting effect on lung development. According to a study [13], these infections are associated with measurable changes in lung function at three years of age. Children who experienced ARIs had lower forced expiratory volume and lower expiratory flow, as well as greater resistance in small-calibre airways. These effects occur because the early years of life correspond to a critical period of lung growth, and inflammation caused by respiratory viruses, such as RSV, can impair normal lung development [13].

Given the significant impact that acute respiratory infections can have on respiratory function during childhood, it is essential to adopt therapeutic strategies that promote lung recovery and prevent complications. In this context, respiratory rehabilitation emerges as a relevant intervention aimed at improving respiratory function, reducing symptoms, and supporting functional recovery. Within Rehabilitation Nursing, the Specialist Rehabilitation Nurse (SRN) plays a key role in assessing respiratory needs and implementing targeted interventions across different care settings [14].

Paediatric respiratory rehabilitation consists of a set of therapeutic interventions aimed at restoring or optimizing lung function in children with respiratory disorders. It is a process adapted to the child's age, degree of lung development, and individual characteristics. Studies show that techniques should be adjusted to the particularities of the infant respiratory system and the severity of the diseases, reinforcing the importance of individualizing care plans [9, 15].

For the purpose of this review, paediatric respiratory rehabilitation is defined as a set of non-pharmacological therapeutic interventions aimed at optimizing ventilation, promoting airway clearance, improving oxygenation, and supporting respiratory function recovery in children with respiratory conditions. Interventions primarily classified as pharmacological or supportive treatments, such as inhalation therapy alone, were considered only when integrated within a broader rehabilitation approach, in order to preserve conceptual clarity.

Paediatric respiratory rehabilitation should integrate preventive measures and therapeutic intervention, with objectives such as secretion mobilization, correction of pulmonary ventilation, improvement of oxygenation, and prevention of complications. In the context of acute respiratory infections, these interventions are particularly important, contributing to the recovery of lung function and reducing the risk of clinical worsening [9,15].

Among the main paediatric respiratory rehabilitation interventions, respiratory kinesiotherapy represents a central component, while inhalation

therapy may be used as an adjunct within broader rehabilitation protocols. Respiratory kinesitherapy is a broad approach that encompasses exercises and manoeuvres designed to improve ventilation, mobilize secretions, and train the respiratory muscles, thereby improving respiratory function [9, 16].

Based on previous literature, respiratory rehabilitation interventions can be broadly categorized into conventional techniques (manual airway clearance manoeuvres), modern techniques based on controlled respiratory flow and active participation, and instrumental techniques involving assistive devices [9,16]. The selection of these interventions should be tailored to the child's age, clinical condition, and severity of disease.

On the one hand, conventional techniques correspond to traditional manual manoeuvres, mainly aimed at mobilizing secretions, while modern techniques are based on controlling respiratory flow and encourage the child's active participation. Instrumental techniques, on the other hand, use auxiliary devices to promote ventilation and the elimination of secretions [9, 17]. Despite this diversity and the growing number of studies on respiratory rehabilitation in the paediatric setting, the evidence remains scattered and sometimes contradictory, making it difficult to define the most clinically effective interventions in children with ARIs [7, 17].

Many of the available studies focus on specific populations or contexts, using heterogeneous methodologies, which limits their general applicability in the clinical practice of the SRN [9, 15, 17, 18]. Therefore, a structured synthesis of the existing evidence is needed to clarify the effectiveness of respiratory rehabilitation interventions, identify consistent patterns across studies, highlight existing gaps in knowledge, and support clinical decision-making in paediatric rehabilitation contexts.

In this context, the following research question emerged: Which respiratory rehabilitation interventions improve respiratory function in children with acute respiratory infections?

Based on the question posed, this study aimed to identify and analyse the available evidence on respiratory rehabilitation interventions that promote improved respiratory function in children with ARIs.

METHODOLOGY

This Integrative Literature Review was guided by a research question structured according to the PIO mnemonic (Population, Intervention, Outcome) (Table 1): Which respiratory rehabilitation interventions improve respiratory function in children with acute respiratory infections?

It subsequently followed six stages, as described in the literature [19]: (1) identification of the research problem, (2) establishment of inclusion and exclusion criteria, (3) data extraction, (4) data analysis, (5) interpretation of results, and (6) presentation of the review. The identification of the research problem was reflected in the formulation of the research question. The establishment of inclusion and exclusion criteria guided the study selection process. Data were extracted using a structured form including study characteristics and outcome measures. Data analysis involved the categorization and synthesis of findings. The interpretation of results was developed in the discussion section, and the presentation of the review is reflected in the results section and tables.

Table 1 – PIO mnemonic

Population (P)	Children up to five years of age with acute respiratory infection
Intervention (I)	Respiratory rehabilitation interventions
Outcome (O)	Indicators of respiratory function, including peripheral oxygen saturation (SpO_2), respiratory rate, clinical severity scores, signs of respiratory effort, and length of hospital stay

Source: The Authors

The Boolean search strategy was constructed based on controlled descriptors (MeSH terms), combined using the Boolean operators AND and OR to establish relationships between the search terms and the components of the PIO mnemonic, as presented in Table 2. The table includes the main controlled descriptors (MeSH terms) used in the search strategy. Additional relevant terms and variations were also included in the search process to improve sensitivity, although only the primary descriptors are presented in the table for clarity. The descriptors within each component were combined using the operator OR, and the different components of the PIO mnemonic were combined using the operator AND.

Table 2 – Descriptors for the construction of the Boolean phrase

Mnemonic	Controlled descriptors (MeSH terms)
Population (P)	Infant, Newborn; Infant; Child, Preschool; Paediatrics; Respiratory Tract Infections; Respiratory Tract Diseases; Pneumonia; Pneumonia, Bacterial; Bronchiolitis; Bronchiolitis, Viral; Influenza, Human; Common Cold; COVID 19; SARS-CoV-2; Severe Acute Respiratory Syndrome; Respiratory Syncytial Virus, Human; Respiratory Syncytial Virus Infections
Intervention (I)	Rehabilitation; Rehabilitation Nursing; Respiratory Therapy; Breathing Exercises; Airway Management; Drainage, Postural
Outcome (O)	------

Source: The Authors

The literature search was conducted in July 2025 using databases available on the EBSCOhost® platform, via the Portuguese Order of Nurses (CINAHL®, Nursing & Allied Health Collection, Cochrane, MedicLatina and MEDLINE®). Studies were selected according to predefined inclusion and exclusion criteria (Table 3).

Table 3 – Inclusion and exclusion criteria for articles

	Inclusion criteria	Exclusion criteria
Population (P)	Children with acute respiratory infections up to the age of 5.	Children with comorbidities or pre-existing medical conditions
Intervention (I)	Studies addressing respiratory rehabilitation interventions	Studies that do not describe in detail how interventions are carried out
Outcome (O)	Studies reporting indicators of respiratory function (e.g., SpO_2, respiratory rate, clinical severity scores, signs of respiratory effort, and length of hospital stay)	------
Study type	Primary studies	Secondary studies
Time frame	Studies published in the last 10 years	Studies published outside this period
Language	Studies published in any language	------

Source: The Authors

The population was limited to children up to five years of age due to the high incidence of acute respiratory infections in early childhood, their significant epidemiological burden, and the specific anatomical and physiological characteristics of the developing respiratory system, which may influence the response to respiratory rehabilitation interventions and related clinical outcomes [3,5,13].

A ten-year time frame was applied to include the most recent and relevant evidence and to reflect current clinical practice. Only primary studies were included in the analysis. Systematic reviews identified during the search were excluded from the analysis corpus. However, their reference lists were screened to identify additional potentially relevant primary studies, which were included if

they met the predefined inclusion criteria.

The screening of studies was carried out in three phases: reading of titles, abstracts, and full texts. The process was conducted by the lead reviewer and subsequently validated by a second reviewer, with a third reviewer consulted in cases of disagreement. The studies were managed using EndNote and screened using Rayyan, according to the predefined inclusion and exclusion criteria.

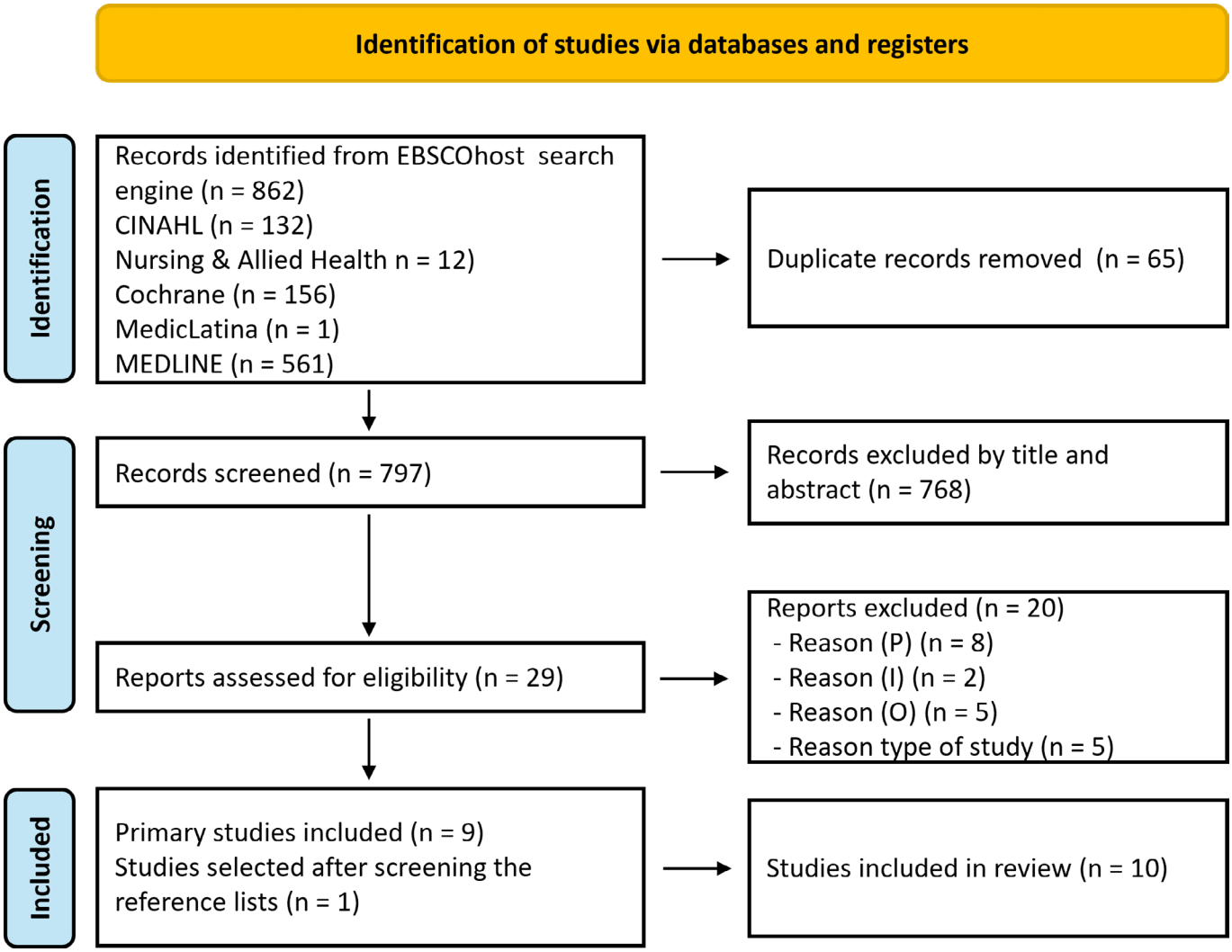
Ethical considerations: As this is an integrative literature review that does not involve direct participation of human subjects, approval by a Research Ethics Committee was not required.

RESULTS

A total of 862 studies were initially identified from the five databases, as described in the PRISMA flowchart (Figure 1). After excluding 65 duplicate articles, 797 remained for screening. Of these, 767 were excluded based on the title and abstract, leaving 29 for full-text reading. After applying the eligibility criteria, 20 studies were excluded.

Additionally, the reference lists of the identified systematic reviews were screened to identify potentially relevant studies, resulting in the inclusion of one additional primary study. In total, 10 studies were included in this review, as shown in the PRISMA flowchart (Figure 1).

Figure 1 – PRISMA flowchart – Research and study selection process. Source: The Authors, adapted [20]



Data extraction was performed using a structured grid containing: authors and year, title, country, type of study, population, description of the intervention, indicators for assessing respiratory function and outcome, and main conclusions.

The analysis of the studies was conducted using a descriptive and categorical approach, focusing on the effects of interventions on respiratory function and the identification of possible adverse effects.

Of the ten included studies, most were randomized controlled trials, with only one observational study. The studies were published between 2015 and 2023.

The included studies were conducted in different geographical contexts and clinical settings, including both hospitalization and outpatient care environments, with a predominance of hospital-based studies.

In total, the ten studies analysed included 760 children aged between zero and five years, with infants being the most frequently investigated age group.

A range of respiratory rehabilitation interventions was identified across the included studies, with outcomes primarily related to changes in respiratory function indicators.

Table 4 summarizes the main characteristics of the included studies, including population, intervention, clinical context, and outcomes, facilitating comparison across studies.

Table 4 – Results

Modern Respiratory Rehabilitation Techniques									
Study	**Condition**	***n***	**Age**	**Context**	**Intervention**	**Duration**	**Outcomes**	**Main Findings**	**Adverse Effects**
Pinto *et al.*, 2021 [23]	Bronchiolitis	45	≤ 24 months	Outpatient	PSE-based protocol (incl. RRC and PC) vs No respiratory rehabilitation	20 min/session, 1×/day for 5 consecutive days and 3 alternate days	KRS Score; RR and Retractions	↓KRS score; RR and retractions vs control	No adverse effects
Conesa-Segura *et al.*, 2019 [25]	Bronchiolitis	71	1 – 24 months	Hospital	PSE-based protocol (incl. RRC, PC and Aspiration) vs Aspiration	15 min/session, 1×/day during hospitalization	ABSS scale and SpO_2	↓ABSS score vs control; Similar SpO_2	No adverse effects
González-Bellido *et al.*, 2021 [21]	Bronchiolitis	91	0 – 12 months	Outpatient	High-Frequency Chest Compression (HFCC) vs PSE + PC	Single session: 15 min (HFCC) vs 20 min (PSE + PC)	Wang score; SpO_2; HR; RR and Amount of secretions	↓Wang score; Similar SpO_2, HR, and RR; Lower secretion clearance compared to HFCC	Infrequent and transient

Van Ginderdeuren *et al.*, 2017 [22]	Bronchiolitis	93	≤ 24 months	Hospital	*Bouncing* vs AAD and *Bouncing* vs IPV and *Bouncing*	20min/session, 1x/day during hospitalization	Length of Stay; Wang score; SpO_2 and HR	↓Wang score and shorter length of stay vs Bouncing; Similar SpO_2 and HR; comparable to IPV	No adverse effects
Corten *et al.*, 2018 [29]	Pneumonia	29	1 – 60 months	Hospital	AAD-based protocol (incl. PC and Aspiration) vs PC and Aspiration	10-30min/ session, 2x/day for 5 days	RR; SpO_2; HR and Length of Stay	↓RR and shorter length of stay vs control; Similar SpO_2 and HR	No adverse effects
Evenou *et al.*, 2017 [24]	Bronchiolitis	160	≤ 24 months	Outpatient	AEF	1x/day 2 consecutive days	Wang score	Wang score	Infrequent
Conventional Respiratory Rehabilitation Techniques									
Study	**Condition**	***n***	**Age**	**Context**	**Intervention**	**Duration**	**Outcomes**	**Main Findings**	**Adverse Effects**
Pinto *et al.*, 2017 [26]	ARI	23	0 – 36 months	Hospital	Vibrocompression, Diaphragmatic Proprioception and Accessory Muscle Techniques	15 min/session, 1–2×/day for 2 consecutive days	SAB RR; SpO_2; HR and Pulmonary Auscultation	↓SAB score, similar RR and SpO_2; improved pulmonary auscultation; HR	Not reported
Abdelbasset & Elnegamy, 2015 [28]	Pneumonia	50	29 days to 5 years	Hospital	Postural Drainage, Chest Compression, Percussion, Vibration and PC	20 min/session, 3×/day during hospitalization	RR; SpO_2 and Clinical Recovery Time	↓ RR and faster clinical recovery vs control; Similar SpO_2	Not reported
Qiaohua *et al.*, 2023 [30]	Bronchiolitis	98	1 – 12 months	Hospital	Percussion and Vibration vs Mechanical Vibration Drainage	10 min/session, 1×/day during hospitalization	Length of Stay; Time until the disappearance of adventitious sounds and Overall Clinical Efficacy	Shorter length of stay and faster symptom resolution; Greater clinical efficacy compared to mechanical vibration drainage	Not reported

Instrumental Respiratory Rehabilitation Techniques									
Study	**Condition**	***n***	**Age**	**Context**	**Intervention**	**Duration**	**Outcomes**	**Main Findings**	**Adverse Effects**
González-Bellido *et al.*, 2021 [21]	Bronchiolitis	91	0 – 12 months	Outpatient	High-Frequency Chest Compression (HFCC) vs PSE + PC	A single 15 min/ session vs A single 20/min/ session	Wang score; SpO_2; HR; RR and Amount of secretions	↓ Wang score Similar SpO_2, HR, and RR; Greater secretion clearance compared to PSE	Infrequent and transient
Van Ginderdeuren *et al.*, 2017 [22]	Bronchiolitis	93	≤ 24 months	Hospital	*Bouncing* vs AAD and *Bouncing* vs IPV and *Bouncing*	20min/session, 1x/day during hospitalization	Length of Stay; Wang score; SpO_2 and HR	↓ Wang score and shorter length of stay vs Bouncing; Similar SpO_2 and HR; Similar to AAD	No adverse effects
Qiaohua *et al.*, 2023 [30]	Bronchiolitis	98	1 – 12 months	Hospital	Percussion and Vibration vs Mechanical Vibration Drainage	10 min/session, 1×/day during hospitalization	Length of Stay; Time until the disappearance of adventitious sounds and Overall Clinical Efficacy	Longer length of stay and slower symptom resolution; lower clinical efficacy compared to conventional techniques	Not reported
Other Respiratory Rehabilitation Interventions									
Study	**Condition**	***n***	**Age**	**Context**	**Intervention**	**Duration**	**Outcomes**	**Main Findings**	**Adverse Effects**
Gomes *et al.*, 2016 [27]	Bronchiolitis	100	0 – 12 months	Hospital	RRC vs Aspiration	3×/day for 1 day	RR; SpO_2; HR; Wood Scale and Signs of respiratory distress	Similar RR, SpO_2, and Wood score; Clinical improvement in both groups	Infrequent

Source: The Authors

Abbreviations: RR - Respiratory Rate; HR - Heart Rate; SpO_2 - Peripheral Oxygen Saturation; ABSS - Acute Bronchiolitis Severity Score; KRS - Kristjansson Respiratory Score; SAB - Silverman–Andersen Bulletin; PC - Provoked Cough; PSE - Prolonged Slow Exhalation; RRC - Rhinopharyngeal Retrograde Clearance; AAD - Assisted Autogenic Drainage; HFCC - High-Frequency Chest Compression; IPV - Intrapulmonary Percussive Ventilation; AEF - Acceleration of Expiratory Flow.

DISCUSSION

This Integrative Literature Review identified that several respiratory rehabilitation interventions are associated with improvements in respiratory function in children with ARIs. The techniques analysed included conventional, modern, and instrumental approaches, often combined to enhance clinical effects. The effects observed varied according to the clinical condition, particularly between bronchiolitis and pneumonia, as well as the care setting.

The categorization of interventions into conventional, modern, and instrumental techniques is based on their underlying mechanisms and mode of application, although these distinctions are not always clearly defined in the literature.

MODERN RESPIRATORY REHABILITATION TECHNIQUES

Prolonged Slow Exhalation (PSE), combined with Rhinopharyngeal Retrograde Clearance (RRC) and Provoked Cough (PC), was associated with reductions in clinical scores (Acute Bronchiolitis Severity Scale, ABSS, and Kristjansson Respiratory Score, KRS), as well as reducing signs of respiratory effort (namely retractions) and respiratory rate (RR) in children with bronchiolitis [23, 25]. These interventions were generally well tolerated, with no adverse effects reported in the included studies, in both inpatient and outpatient settings.

PSE, in combination with PC, was used as a technique for comparison with High-Frequency Chest Compression (HFCC) in children with bronchiolitis [21]. Although both were associated with clinical improvement, the group that received HFCC mobilized a greater volume of secretions, suggesting a potential advantage in secretion clearance.

Similar results were observed by other authors [15, 31], who found that PSE, alone or in combination with other techniques, particularly RRC, may contribute to improvements in respiratory function parameters, with few reported adverse effects.

Assisted Autogenic Drainage (AAD) has been evaluated in different studies [22, 29]. When combined with PC and aspiration, it was associated with reductions in RR and length of hospital stay in children with pneumonia [29]. In the study that combined AAD, Bouncing and PC in one of the experimental groups, shorter hospital stays and improved Wang clinical scores were observed compared to the group that used only Bouncing, with no significant differences in peripheral oxygen saturation (SpO_2) and heart rate (HR) in children with pneumonia [22]. Overall, when integrated with other approaches, AAD was also associated with improvements in clinical recovery, with good tolerance and no adverse effects [22,29].

Regarding Acceleration of Expiratory Flow (AEF) [24], the study showed improvements in clinical symptoms of bronchiolitis, as assessed by the Wang score, with few reports of adverse effects.

The results obtained in this Integrative Literature Review, which suggest potential clinical benefits of modern techniques, are consistent with findings from other studies [32], indicating that these approaches may contribute to improvements in the management of bronchiolitis symptoms.

CONVENTIONAL RESPIRATORY REHABILITATION TECHNIQUES

Conventional techniques, such as vibration, percussion, postural drainage, and diaphragmatic proprioception, were associated with improvements in some clinical parameters. The combination of these manual techniques resulted in improved RR, SpO_2, and clinical recovery time in children hospitalized with pneumonia [28]. Similarly, the combination of percussion, vibration, and aspiration was more effective than Mechanical Vibration Drainage alone, with shorter hospital stays and faster disappearance of adventitious sounds in children with bronchiolitis [30]. In the study that used an intervention protocol that included vibrocompressions, diaphragmatic proprioception, and action on the accessory respiratory muscles in children with ARIs, progressive improvement was observed in the Silverman-Andersen Bulletin (BSA) score and pulmonary auscultation, although there were no significant changes in RR and SpO_2 [26]. It should be noted that, in these studies, information on the occurrence of adverse effects was unclear or absent.

Despite these results, a study reveals that in children with bronchiolitis, conventional respiratory rehabilitation, namely postural drainage associated with percussion and vibration techniques, did not show clear benefits and, in some cases, was associated with adverse effects, so its use in this age group is not generally recommended [15]. This highlights the importance of considering the clinical condition when selecting interventions.

In the context of pneumonia, other authors have demonstrated improvements in SpO_2 values following conventional respiratory rehabilitation. However, in the same study, there was no evidence of significant improvement in RR after its implementation [9].

INSTRUMENTAL RESPIRATORY REHABILITATION TECHNIQUES

Instrumental techniques appear in three studies, all conducted with children with bronchiolitis, and are used alone or in combination with other techniques [21, 22, 30]. The application of HFCC, compared to PSE associated with PC, was associated with greater secretion mobilization and reductions in Wang score, with similar improvements in SpO_2, RR, and HR levels, in addition to good tolerance and no relevant adverse effects [21]. Intrapulmonary Percussive Ventilation (IPV) was associated with favourable clinical outcomes, especially when combined with Bouncing and PC, with no adverse effects reported. However, the results were comparable to those of the group receiving AAD, with no evidence of clear superiority [22].

VED, used alone, was less effective, as the authors pointed out that this technique was associated with longer hospital stays and lower efficacy when compared to the combined manual approach. In this study, there was no explicit mention of the presence or absence of adverse effects, making it difficult to assess safety [30].

The prescription of instrumental techniques applied to children with bronchiolitis varies according to the severity of the disease and the characteristics of the child [32]. Current evidence on instrumental techniques remains limited and heterogeneous.

OTHER RESPIRATORY REHABILITATION INTERVENTIONS

Aspiration was a widely used technique as a complementary or control intervention. When compared with RRC, both showed similar results in the parameters of RR, SpO_2, and Wood score. However, RRC was associated with lower respiratory effort and fewer adverse effects, suggesting greater comfort and safety in children with bronchiolitis [27].

When comparing RRC with nasal aspiration, this non-invasive technique demonstrated an immediate reduction in severity scores and presented few adverse events and complications in infants with moderate acute bronchiolitis [15].

SAFETY IN THE IMPLEMENTATION OF INTERVENTIONS AND LIMITATIONS

Overall, most studies did not report significant adverse effects. In the few cases in which they occurred, episodes of epistaxis, vomiting, petechiae, and tachycardia were noted, considered mild and transient, with no relevant clinical impact [21, 24, 27]. These findings suggest a generally favourable safety profile for respiratory rehabilitation techniques when correctly applied in children with ARIs.

Modern techniques such as PSE, AAD, AEF, and instruments such as IPV and HFCC have shown good tolerance. However, the lack of clear data in some studies, especially those that used conventional techniques, limits the complete assessment of the safety profile [26, 28, 30]. Thus, the available data suggest an overall favourable safety profile, although monitoring for adverse effects should be systematically reported in future studies.

In contrast to the results of this Integrative Literature Review, international guidelines tend to recommend a more restrictive use of respiratory rehabilitation techniques in bronchiolitis, due to insufficient and inconsistent evidence, and do not support their routine application [33, 34, 35].

The main limitations identified in the available evidence include heterogeneity of intervention protocols and outcome measures, small sample sizes, and short follow-up periods.

With regard to the methods used, there was considerable heterogeneity in the interventions, protocols, and clinical indicators used, which makes direct comparisons and the development of uniform recommendations difficult. Most studies involved small samples and short-term follow-up, making it impossible to assess sustained effects in the medium and long term. Another point is the concomitant use of respiratory rehabilitation techniques with clinical measures such as oxygen therapy, medication, and aspiration, which may have influenced the results.

In addition, the studies used different clinical assessment instruments, applied in various ways, compromising the uniformity of the data. Few studies described blinded assessments or detailed randomization and allocation procedures, which increases the risk of bias and weakens the robustness of the results.

This review also presents limitations. The restriction to a 10-year publication period, the use of a limited number of databases, and potential constraints in the search strategy may have limited the comprehensiveness of the evidence identified. In addition, study selection procedures may have introduced selection bias.

These limitations reinforce the need for randomized controlled clinical trials with rigorous methodological design, representative samples, and adequate control of the clinical variables involved. In this sense, studies are essential to validate the effectiveness of each intervention, provide a basis for safe practice guidelines, and generate consistent clinical recommendations adapted to the paediatric context.

Overall, the analysis of the studies included in this Integrative Literature Review suggests that respiratory rehabilitation interventions may contribute to improvements in respiratory function in children with ARIs. Improvements were observed in clinical scores obtained using the assessment tools, as well as in respiratory effort and physiological parameters, although the magnitude and consistency of these effects varied.

Thus, when properly indicated and applied, these techniques may represent useful resources in paediatric clinical practice, although further research is essential to consolidate their role in care protocols for children with ARIs.

CONCLUSION

This Integrative Literature Review suggests that various conventional, modern and instrumental respiratory rehabilitation techniques may contribute to improvements in respiratory function in children with ARIs. Among these, modern techniques such as PSE, AAD, RRC, and AEF, as well as PC as a complementary technique, have been associated with improvements, particularly in bronchiolitis, while generally presenting a favourable safety profile. Conventional techniques appear to have greater relevance in the context of pneumonia, whereas instrumental techniques, although promising, still require further research to better define their clinical applicability.

Despite the methodological heterogeneity of the included studies, the findings indicate that respiratory rehabilitation interventions may be associated with improvements in clinical severity, physiological parameters and, in some cases, length of hospital stay. However, the lack of standardization of protocols and the methodological limitations observed reinforce the need for more robust clinical trials, with representative samples and longitudinal follow-up, to consolidate the available evidence and support clinical practice on a consistent scientific basis.

It can therefore be concluded that the careful integration of respiratory rehabilitation techniques, tailored to the type and severity of ARI, may represent a useful approach to support functional recovery and quality of life in children, while also representing a relevant area for intervention and research in Rehabilitation Nursing.

BIBLIOGRAPHICAL REFERENCES

1. Public Health Scotland. Guidance for the public health management of acute respiratory infections (ARI) in community, social and residential care settings: guidance for health protection teams (HPTs) [Internet]. 2024. [cited 2025 Jul 11]. Available from: https://publichealthscotland.scot
2. Centers for Disease Control and Prevention. Glossary of Influenza (Flu) Terms [Internet]. 2024. [cited 2025 Jul 11]. Available from: https://www.cdc.gov/flu/glossary
3. Panetti B, Bucci I, Di Ludovico A, Pellegrino GM, Di Filippo P, Di Pillo S, et al. Acute respiratory failure in children: a clinical update on diagnosis. *Children*. 2024;11(10):1232. doi:10.3390/children11101232
4. Ruffles T, Inglis SK, Memon A, Seddon P, Basu K, Bremner SA, et al. Environmental risk factors for respiratory infection and wheeze in young children: a multicentre birth cohort study. *Pediatr Pulmonol*. 2024;59(1):19–30. doi:10.1002/ppul.26664
5. United Nations Inter-Agency Group for Child Mortality Estimation. Levels and trends in child mortality [Internet]. New York: UNICEF; 2025 Mar 24. [cited 2025 Jul 11]. Available from: https://data.unicef.org
6. UNICEF. Pneumonia [Internet]. 2024 Nov. [cited 2025 Jul 25]. Available from: https://data.unicef.org/topic/child-health/pneumonia
7. World Health Organization. ICD-11 for Mortality and Morbidity Statistics [Internet]. 2025. [cited 2025 Jul 25]. Available from: https://icd.who.int
8. Justice NA, Le JK. Bronchiolitis. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023. [cited 2025 Jul 25]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK441959
9. Chaves GS, Freitas DA, Santino TA, Nogueira PAM, Fregonezi GA, Mendonça KM. Chest physiotherapy for pneumonia in children. *Cochrane Database Syst Rev*. 2019;1:CD010277. doi:10.1002/14651858.CD010277.pub3
10. Li Y, Wang X, Blau DM, Caballero MT, Feikin DR, Gill CJ, et al. Global, regional, and national disease burden estimates of acute lower respiratory infections due to respiratory syncytial virus in children younger than 5 years in 2019: a systematic analysis. *Lancet*. 2022;399(10340):2047–64. doi:10.1016/S0140-6736(22)00478-0
11. Bandeira T, Carmo M, Lopes H, Gomes C, Martins M, Guzman C, et al. Burden and severity of children's hospitalizations by respiratory syncytial virus in Portugal, 2015–2018. *Influenza Other Respir Viruses*. 2023;17(1):e13066. doi:10.1111/irv.13066
12. Direção Regional da Saúde. *Circular normativa n.º 1797/2023: Imunoprofilaxia com nirsevimab para a prevenção da infeção pelo vírus sincicial respiratório em crianças – época 2023–2024* [Internet]. Funchal: Governo Regional da Madeira; 2023 Oct. [cited 2025 Jul 04]. Available from: https://www.madeira.gov.pt
13. Kumar P, Mukherjee A, Randev S, Medigeshi GR, Jat KR, Kapil A, et al. Effect of acute respiratory infections in infancy on pulmonary function test at 3 years of age: a prospective birth cohort study. *BMJ Open Respir Res*. 2020;7(1):e000436. doi:10.1136/bmjresp-2019-000436
14. Ordem dos Enfermeiros, Conselho de Enfermagem; Mesa do Colégio de Enfermagem de Reabilitação. *Guia orientador de boa prática: reabilitação respiratória* [Internet]. Lisboa: Ordem dos Enfermeiros; 2018. [cited 2025 Jul 04]. Available from: https://www.ordemenfermeiros.pt
15. Roqué-Figuls M, Giné-Garriga M, Granados Rugeles C, Perrotta C, Vilaró J. Chest physiotherapy for acute bronchiolitis in paediatric patients between 0 and 24 months old. *Cochrane Database Syst Rev*. 2023;4:CD004873. doi:10.1002/14651858.CD004873.pub6
16. Videira-Amaral JM. *Tratado de clínica pediátrica*. 3.ª ed. Lisboa: Círculo Médico; 2022.
17. Esteban-Gavilán CB, Rico-Mena P, Güeita-Rodríguez J, Navarro-López V, Escudero-Romero R. Respiratory physiotherapy interventions in paediatric population with atelectasis: a systematic review. *Children*. 2024;11(11):1364. doi:10.3390/children11111364
18. Abreu V, Castro S, Sousa D, Julião E, Sousa JL. Impacto da fisioterapia nos diferentes tipos de bronquiolite, pacientes e locais de atendimento: revisão sistemática. *Fisioter Pesqui*. 2021;28(4):464–82. doi:10.1590/1809-2950/21019428042021

19. Souza MT, Silva MD, Carvalho R. Revisão integrativa: o que é e como fazer. Einstein (São Paulo). 2010;8(1 Pt 1):102-6. doi.org/10.1590/S1679-45082010RW1134
20. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. 2021;372:n71. doi:10.1136/bmj.n71
21. González-Bellido V, Velaz-Baza V, Blanco-Moncada E, Jimeno Esteo MC, Cuenca-Zaldívar JN, Colombo-Marro A, et al. Immediate effects and safety of high-frequency chest wall compression compared to airway clearance techniques in non-hospitalized infants with acute viral bronchiolitis. *Respir Care*. 2021;66(3):425–33. doi:10.4187/respcare.08177
22. Van Ginderdeuren F, Vandenplas Y, Deneyer M, Vanlaethem S, Buyl R, Kerckhofs E. Effectiveness of airway clearance techniques in children hospitalized with acute bronchiolitis. *Pediatr Pulmonol*. 2017;52(2):225–31. doi:10.1002/ppul.23495
23. Pinto FR, Alexandrino AS, Correia-Costa L, Azevedo I. Ambulatory chest physiotherapy in mild-to-moderate acute bronchiolitis in children under two years of age: a randomized controlled trial. *Hong Kong Physiother J*. 2021;41(2):99–108. doi:10.1142/S1013702521500098
24. Evenou D, Sebban S, Fausser C, Girard D. Évaluation de l'effet de la kinésithérapie respiratoire avec augmentation du flux expiratoire dans la prise en charge de la première bronchiolite du nourrisson en ville. *Kinésithérapie Rev*. 2017;17(187):3–8. doi:10.1016/j.kine.2017.04.003
25. Conesa-Segura E, Reyes-Dominguez SB, Ríos-Díaz J, Ruiz-Pacheco MÁ, Palazón-Carpe C, Sánchez-Solís M. Prolonged slow expiration technique improves recovery from acute bronchiolitis in infants: FIBARRIX randomized controlled trial. *Clin Rehabil*. 2019;33(3):504–15. doi:10.1177/0269215518809815
26. Pinto BF, Araújo PQ, Amaral JDF. Atuação da fisioterapia no esforço respiratório em crianças hospitalizadas com infeção respiratória aguda: um estudo comparativo. *Fisioter Bras*. 2017;18(2):140–47. doi:10.33233/fb.v18i2.791
27. Gomes GR, Calvete FP, Rosito GF, Donadio MV. Rhinopharyngeal retrograde clearance induces less respiratory effort and fewer adverse effects in comparison with nasopharyngeal aspiration in infants with acute viral bronchiolitis. *Respir Care*. 2016;61(12):1613–19. doi:10.4187/respcare.04685
28. Abdelbasset WKM, Elnegamy TEH. Effect of chest physical therapy on pediatrics hospitalized with pneumonia. *Int J Health Rehabil Sci*. 2015;4(4):219–26. doi:10.5455/ijhrs.000000095
29. Corten L, Jelsma J, Human A, Rahim S, Morrow BM. Assisted autogenic drainage in infants and young children hospitalized with uncomplicated pneumonia: a pilot study. *Physiother Res Int*. 2018;23(1):1690. doi:10.1002/pri.1690
30. Qiaohua Y, Xiaoyu L, Fengqiong J, Yun Q, Xiaoli T. Optimal schemes of assisted sputum excretion in infants with bronchiolitis: a comparative study. *Chin Nurs Res*. 2023;37(24):4538–41. doi:10.12102/j.issn.1009-6493.2023.24.034
31. Mai P, Fushen. Prolonged slow expiration and prone position intervention in children: a literature review. *J Keperawatan Soedirman*. 2021;16(2):66–75. doi:10.20884/1.jks.2021.16.2.1532
32. Carvajal-Tello N, Segura-Ordoñez A, Grisales-Jaramillo V, Rayo-Salazar LI, Hernandez-Peñuela KJ, Estela-Zape JL. Effectiveness of manual bronchial clearance techniques in the treatment of bronchiolitis. *Life*. 2024;14(12):1675. doi:10.3390/life14121675
33. Manti S, Staiano A, Orfeo L, Midulla F, Marseglia GL, Ghizzi C, et al. Update – 2022 Italian guidelines on the management of bronchiolitis in infants. *Ital J Pediatr*. 2023;49:19. doi:10.1186/s13052-022-01392-6
34. National Institute for Health and Care Excellence. *Bronchiolitis in children: diagnosis and management (NICE guideline NG9)* [Internet]. London: NICE; 2021 Aug 9. [cited 2025 Jul 25]. Available from: https://www.nice.org.uk
35. UCSF Northern California Pediatric Hospital Medicine Consortium. *Consensus clinical guidelines for inpatient management of viral bronchiolitis* [Internet]. San Francisco: University of California San Francisco; 2024. [cited 2025 Jul 25]. Available from: https://medconnection.ucsfbenioffchildrens.org

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